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DIVERSITY AND DISTRIBUTION OF SEA ANEMONES IN INDIA WITH SPECIAL REFERENCE TO ANDAMAN AND NICOBAR ISLANDS

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INTRODUCTION

Sea anemones are brightly coloured, classified under the phylum Cnidaria, inhabit coastal waters throughout the world, but are particularly abundant in tropical oceans. They are distributed in intertidal to deep oceans and live attached with rocks, sea floor, shells and some forms burrow in the mud or sand. They are radial symmetric with columnar body have a single body opening, mouth which is surrounded by tentacles. However, body shape of the sea anemones is often related to the habitat in which they live. Sea anemones are solitary polyps and are considerably larger and heavier than the polyps of hydrozoans (Barnes, 1982). There are over 1000 species of sea anemones reported worldwide. The size is usually about 2.5-10 cm across, but few grow up to 1.8 meter across. They are carnivorous, prey upon small fishes, sea urchins, shrimps, crabs, worms with their nematocysts. Anemones of some species are capable of absorbing nutrients directly from seawater through their tissues, and that may be another source of nutrition for these animals as well (Fautin and Allen, 1992). Predators of sea anemone are very few animals which include nudibranchs, fishes, sea stars and snails. Scattered record on temperate sea anemones surviving many decades in commercial aquaria, and the life span of small sea anemone is calculated based on actuarial tables to be over 300 years (Fautin and Allen, 1992). They reproduce both sexually by external fertilization followed by the development of planktonic planula larva and settled down as single polyp, and asexually by budding, binary fission and pedal laceration.

Though the sea anemone encompasses order Actiniaria, Corallimorpharia and Ptychodactiaria, however due to wide distribution, and sheer numbers, especially in the intertidal region, the actiniarian sea anemones are received more attention for their potential uses in drugs and pharmaceuticals as well as sentinel organisms for ecological monitoring of estuarine and marine environment (Ross, 1967) and also played a role in the marine aquarium trade. Sea anemones are susceptible to overexploitation due to their long life spans, slower relative growth rates, and lower reproductive rates. Despite these facts, global trade in marine ornamentals is a rapidly expanding industry involving numerous countries around the world. In early 1980s, the import value of marine fish and invertebrates for the aquarium trade was estimated to be US $24-40 million annually (Wood, 1985) and it increased to US $ 200-330 million annually (Chapmen *et al*., 1997; Forum Secretariat, 1999; Larkin and Degner, 2001).

Studies on sea anemones gained attention across the world following Verrill's (1928) monograph 'Hawaiian shallow water Anthozoa' in which 21 sea anemone species described. Dunn (1974a) redescribed the species *Macranthea cookie* described by Verrill (1928) in Hawaii

and synonymized with *Radianthus papillosa*, first described by Kwietniewski (1898) as *Stichodactis papillosa* from Ambon. Another species *Anthopleurua nigrescens* was also redescribed by Dunn (1974b), originally described as *Tealiopsis nigrescens* by Verrill (1928). Dunn (1974c) identified *Actiniogeton sesere* from Hawaii which was earlier described from Torres Strait (Haddon and Shackleton, 1893). Dunn (1978) described a new species *Anthopleura handi* which is an internally brooding intertidal actinian from Malacca Strait, Malaysia. Fifteen species of sea anemones including 3 new species from two orders**,** Actiniaria and Ptychodactiaria (1 species) were reported by Dunn (1983) from Antarctic and sub-Antarctic areas. A new species of Acontiate sea anemone *Acontiophorum niveum* collected from Mission Bay, California was described by Fautin *et al*. (1987). Fautin (1988) identified 22 species of Actiniarian and Corallimorpharian sea anemones from the waters less than 30m depth at Madang Province. Further**,** Fautin *et al.* (1989) studied the systematic of genus *Metridium* and described the new species *Metridium giganteum* from west coast of North America. Distribution, abundance and adaptations of Actiniarian sea anemones *Bunodosoma cangicum* Correa in Belem and Preslercravo, 1973; *Actinia bermudensis* (Mc Murrich, 1889); and *Anthopleura krebsi* Duchassaing and Michelotti, 1860 were assessed in intertidal beach rock in Carneiros beach, Pernambuco, Brazil and their density was 1.1 to 24.5 ind/m^2 (Gomes *et al*., 1998). Daly and Fautin (2004) described a new endemic species, *Anthopleura mariscali* from the intertidal zone of the islands of Galapagos Archipelago. Fautin *et al*. (2009) documented 16 species of sea anemones belong to the families Actiniidae, Actinodendridae, Aiptasiidae, Boloceroididae, Diadumenidae, Stichodactylidae and Thalassianthidae including a cosmopolitan invasive species *Diadumene lineata* in Singapore. Most of the species under these families are widespread in Indo-Pacific tropics as common intertidal and shallow subtidal sea anemones in Singapore. Another new species *Anthopleura buddemeieri* described from Fiji and Papua New Guinea occurred in the intertidal zone and the taxonomical remarks on *Anthopleura asiatia* and *Gyaractis sesere* were also given from the same locality (Fautin, 2005). Fautin *et al.* (2007) reported the first inventory of eight species of actiniarians represented by families Actiniidae, Actinostolidae, Aiptasiidae, Hormathiidae and Isophellidae from Galapagos Islands. Again**,** Fautin *et al.* (2008) documented 19 species of sea anemones from the Moreton Bay, eastern Australia based primary on specimens observed and collected during the Moreton Bay International Marine Biological Workshop in February 2005. Investigations on sea anemones of Panama coast resulted with 26 species, of which 14 species belonging to the order Actiniaria found in Pacific coast of Panama, while 11 species recorded from Caribbean coast of Panama and one species *Calliactis polypus* found to be new record to Panama (Garese *et al*., 2009). Recently fourteen species of sea anemones of the orders Actiniaria and Corallimorpharia were observed greater than the depth of 1000 meters in the waters of the northeastern Pacific Ocean (Eash-Loucks and Fautin, 2012). Acuna *et al*., (2013) has updated the inventory of sea anemones of Costa Rica to 16 species with the addition of 8 new records identified from Caribbean and Pacific coasts of Costa Rica and compared with the occurrence of 26 species of sea anemone in Panama. The study concluded that except *Anthopleura elegantissima, Anthopleura nigrescens, Nemanthus californicus Alicia mirabilis, Lebrunia coralligens* and *Phialoba steinbecki* all other species are common to both the countries.

As evinced by scant literature, though India having 7600 km long coastline, studies on sea anemones in Indian waters are very limited, except the studies made by Annandale (1907 & 1915), Panikkar (1936, 1937a-c, & 1939) and Parulekar (1966, 1967, 1968, 1969a, b & 1971). However**,** these studies have discontinuously been

investigated and are better known through new species and new genera, rather than the magnitude and diversity of the fauna itself (Parulekar, 1990). Parulekar (1990) has enumerated 40 species of sea anemones belonging to 33 genera under 17 families from India, of which 13 species were reported for the first time. Out of 40 species, 24 species inhabits in marine, 13 species in estuarine, while 3 species are common to both the habitats. The actiniarian sea anemone fauna of India is so far known from few places viz. West Bengal (Port Canning), Orissa (Chilka lake), Tamil Nadu (Adyar backwaters and Gulf of Mannar), Kerala (Cochin backwaters and Ashtamudi lake), Gujarat (Gulf of Kachchh), Maharashtra (Mumbai, Malvan), Goa, northern Karnataka and Andaman and Nicobar Islands. Probably since from the description of two new species *Edwardsia jonessi* Seshaiya and Cutress, 1969 from Porto Novo and *Paracondylactis sagarensis* Battacharya, 1979 in India, no species has been added in the sea anemone list of India. The studies on sea anemones of Andaman and Nicobar Islands are *terra incognita* except few reports. The Indian sea anemones were listed by Parulekar (1990) includes *Anthoplerua panikkarii*, *Bunodactis nicobarica* and *Parabunodactis inflexibilis* from Andaman and Nicobar Islands. Madhu and Madhu (2007) reported the occurrence of 10 species of sea anemones at 14 sites from Andamans. The present study provides the illustrated data on the diversity and distribution of sea anemones in Andaman and Nicobar Islands with their diagnostic features and also compilation of the known occurrence of sea anemones around Indian seas with existing literatures.

MATERIAL AND METHODS

Surveys on the occurrence of sea anemones along the fringing reefs of North Andaman, Middle Andaman, South Andaman, Richiès Archipelago, Mahatma Gandhi Marine National Park (MGMNP), Little Andaman and Nicobar regions in Andaman and Nicobar Islands (Fig.1) were conducted during 2009-2012 from intertidal to the subtidal region up to the depth of 40 meters while undertaking coral reef monitoring studies under the project of National Coral Reef Research Institute sponsored by Ministry of Environment and Forests, Government of India. The specimens of different species were observed and studied in subtidal areas by snorkeling and at greater depth with SCUBA devices. Underwater photographs of all the observed sea anemones were made by the digital cameras with underwater housing. The collected specimens were narcotized with magnesium chloride to expand their polyps and tentacles before preserving them in 80% ethyl alcohol. The coordinates of the study area were collected using GARMIN 12 Channel GPS.

Species Identification

Sea anemone colour pattern can be important for field identification, but colour itself, being highly variable in most actinian sea anemones, is of little diagnostic value. Symbiotic algae may affect anemone colour, either by imparting their own golden brown colour, or by stimulating the animal to produce a pigment that protects the algae against excessive sunlight (Fautin and Allen, 1992). The external characters of the sea anemones were observed in the field itself and for some specimens the species confirmation was made by studying anatomy under a stereo-zoom microscope in the laboratory. The species level identification of all the species were made following the published literatures and monographs (Fautin and Allen, 1992; Gomes *et al*., 1998; Fautin *et al*., 2009; Eash-Loucks and Fautin, 2012).

Statistical applications

The species diversity of sea anemones was calculated according to the Shanon-Weiner formula.

$$H' = -\sum Pi \log_e Pi$$

Where Pi = proportion of the *i*th species in the collection and H'= Diversity of a theoretically infinite population.

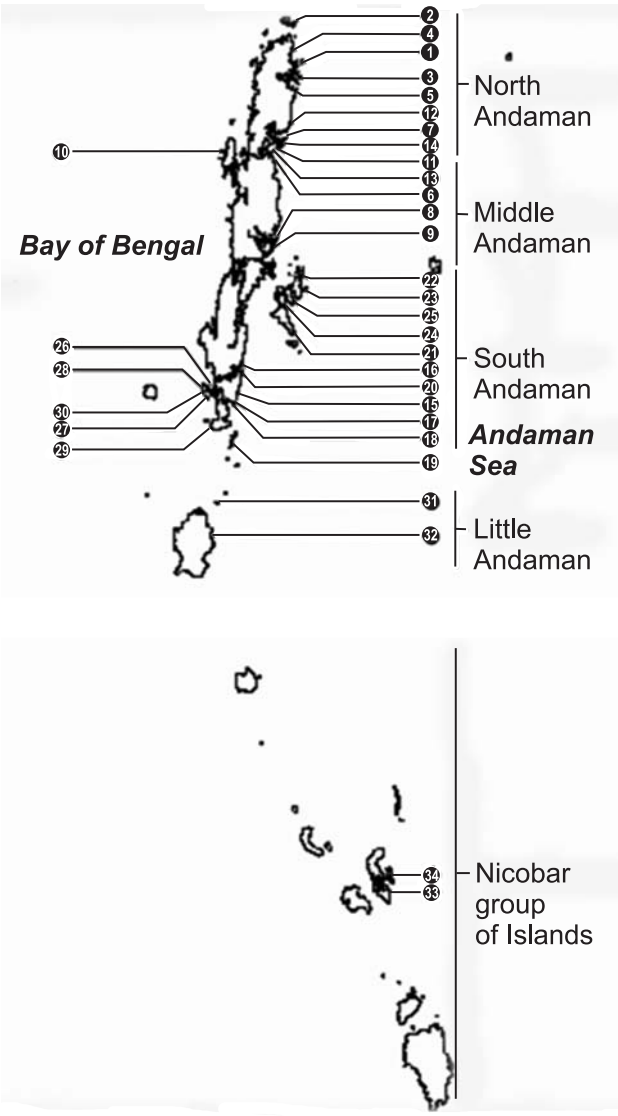

Fig. 1. Map showing study sites in Andaman and Nicobar Islands.

[1-Diglipur, 2-East Island, 3-Ross & Smith Island, 4-Kalipur beach, 5-Twin Island, 6-Mayabunder, 7-Sound Island, 8-Long Island, 9-Guitar Island, 10-Interview Island, 11-Carlew Island, 12-Oliver Island, 13-Avis Island, 14-Rail Island, 15-Burmanallah, 16-North Bay, 17-Pongibalu, 18-Chidiyatapu, 19-Cinque Island, 20-Sinclair's Bay, 21-Havelock Island, 22-South Button Island, 23-Inglis Island, 24-Peel Island, 25-Henry Lawrence Island, 26-Grub Island, 27-Boat Island, 28-Jolly Buoy Island, 29-Rutland Island, 30-Tarmugli Island, 31-South Brother Island, 32-Dugong creek, 33-Nancowry, 34-Trinket Island]

Similarity Index was calculated using the formula.

$$QS= (2C/A + B)$$

Where, *A* and *B* are the species numbers in samples A and B respectively and *C* is the number of species shared by the two samples.

RESULTS

Diversity of Sea anemones in Andaman and Nicobar Islands

The present study revealed 15 species of Actiniarian sea anemones belonging to 11 genera and 8 families along the areas surveyed in 6 regions of Andaman and Nicobar Islands (Table 1). Of which, five species *viz. Actinodendron glomeratum* Hadden, 1898; *Calliactis miriam* Hadden and Shackleton 1893; *Anthopleura handi* Dunn, 1978; *Phymanthus buitendijki* Pax, 1924; *Telmatactis decora* (Hemprich and Ehrenberg in Ehrenberg, 1834) are new records to India. The diversity of sea anemones found to be maximum in South Andaman and it was represented by 9 species under 8 genera and 5 families with H' value of 0.98, whereas, minimum density was reported at both Little Andaman and Nicobar, where 4 species under 3 genera and 3 families with H' value of 0.55. Among the species found, *Cryptodendrum adhaesivum* and *Heteractis magnifica* were the only species found in all the regions. The *Entacmaea quadricolor* and *Heteractis crispa* were distributed in most of the regions**,** except Nicobar and South Andaman respectively. Nine species were found restricted to one particular region of the study area (Table 1), which are *Actinodendron glomeratum* in Ritchie's Archipelago (Havelock and South Button Islands); *Boloceroides mcmurrichi* in Nicobar (Nancowry Islands); *Calliactis miriam, Anthopleura handi, Phymanthus buitendijki* and *Telmatactis decora* in South Andaman (Burmanallah, Pongibalu, North Bay and Chidyatapu), *Macrodactyla doreensis* in Middle Andaman (Mayabunder and Avis Island); *Stichodactyla gigantea* in MGMNP (Jolly Buoy and Tarmugli Islands); *Stichodactyla merternsii* in North Andaman (Diglipur and Ross & Smith Islands). The occurrence of *H. magnifica* was found in hundreds at a depth of 20m in Nancowry Islands. The density and distribution of other species were sporadic in nature.

Table 1. Diversity and Distribution of sea anemones in Andaman and Nicobar Islands

Sl. No.	Order/Family/Genus/Species	North Andaman	Middle Andaman	South Andaman	Ritchie's Archipelago	MGMNP	Little Andaman	Nicobar
	Order: Actiniaria Family: Actinodendronidae Hadden, 1898 Genus: *Actinodendron* de Blainville, 1830							
1.	*Actinodendron glomeratum* Hadden, 1898*				xxi, xxii			
	Family: Boloceroidae Carlgren, 1924 Genus: *Boloceroides* Carlgren, 1899							
2.	*Boloceroides mcmurrichi* (Kwietniewski, 1898)							xxxiii
	Family: Hormathiidae Carlgren, 1932 Genus: *Calliactis* Verrill,1869							
3.	*Calliactis miriam* Hadden and Shackleton, 1893*			xv				
	Family: Thalassianthidae Milne Edwards, 1857 Genus: *Cryptodendrum* Klunzinger, 1877							
4.	*Cryptodendrum adhaesivum* Milne Edwards, 1857	i, ii, iii, iv	vi, vii, viii, ix	xvi, xvii, xviii, xix	xxi	xxvi, xvii	xxxi	xxxiii
	Family: Actiniidae Rafinesque, 1815 Genus: *Entacmaea* Ehrenberg, 1834							
5.	*Entacmaea quadricolor* (Rueppel and Leuckar, 1828)	i, ii, v	vi, ix, x, xi, xii	xvi, xvii, xviii, xix	xxi	xxvi, xxvii, xxviii, xxix	xxxii	
	Genus: *Macrodactyla* Haddon, 1898							
6.	*Macrodactyla doreensis* (Quoy and Gaimard, 1833)		vi, xiii					
	Genus: *Anthopleura* Duchassaing de Fonbressin & Michelotti, 1860							
7.	*Anthopleura handi* Dunn, 1978*			xiv, xvii, xviii				
	Family: Stichodactylidae Andres, 1863 Genus: *Heteractis* Milne Edwards, 1857							
8.	*Heteractis aurora* (Quoy and Gaimard, 1833)			xvii		xxix		
9.	*Heteractis crispa* (Hemprich and Ehrenberg in Ehrenberg, 1834)	i,v	vi, xiv		xxi, xxiii, xxiv, xxv	xxix	xxxi	xxxiii
10.	*Heteractis magnifica* (Quoy and Gaimard, 1833)	i ,ii, iii, v.	vi, vii, x, xi, xii, xiii,	xvi, xvii, xviii, xix	xxi	xxviii, xxvi, xxvii, xxix	xxxii	xxxiii, xxxiv

Table 1. contd.

Sl. No.	Order/Family/Genus/Species	North Andaman	Middle Andaman	South Andaman	Ritchie's Archipelago	MGMNP	Little Andaman	Nicobar
	Genus: *Stichodactyla* Brandt, 1835							
11.	*Stichodactyla gigantea* (Forskal, 1775)					xxviii, xxx		
12.	*Sitchodactyla haddoni* (Saville-Kent, 1893)	i, iii.	vi, vii	xvi, xx		xxix		
13.	*Stichodactyla merternsii* (Brandt, 1835)	i, iii.						
	Family: Phymanthidae Andress, 1833 Genus: *Phymanthus* Milne Edwards, 1857							
14.	*Phymanthus buitendijki* Pax, 1924*			xvi, xvii				
	Family: Isophellidae Stephenson, 1935 Genus: *Telmatactis* Gravier, 1916							
15.	*Telmatactis decora* (Hemprich and Ehrenberg in Ehrenberg, 1834)*			xviii				
	Number of species	6	6	9	5	7	4	4
	Number of genera	4	5	8	4	4	3	3
	Number of families	3	3	5	4	4	3	3
	Species Diversity (H')	0.72	0.76	0.98	0.65	0.80	0.55	0.55

MGMNP- Mahatma Gandhi Marine National Park; * New record to Indian waters.

[i-Diglipur, ii-East Island , iii-Ross & Smith Island, iv-Kalipur beach, v-Twin Island, vi-Mayabunder, vii-Sound Island, viii-Long Island, ix-Guitar Island, x-Interview Island, xi-Carlew Island, xii-Oliver Island, xiii-Avis Island, xiv-Rail Island, xv-Burmanallah, xvi-North Bay, xvii-Pongibalu, xviii-Chidiyatapu, xix-Cinque Island, xx-Sinclair's Bay, xxi-Havelock Island, xxii-South Button Island, xxiii-Inglis Island, xxiv-Peel Island, xxv-Henry Lawrence Island, xxvi-Grub Island, xxvii-Boat Island, xxviii-Jolly Buoy Island, xxix-Rutland Island, xxx-Tarmugli Island, xxxi-South Brother Island, xxxii-Dugong creek, xxxiii-Nancowry, xxxiv-Trinket Island].

Distribution of Sea anemones in India

Table 2 depicts the updated list of Actiniarian sea anemones in India with the existing reports of Parulekar (1990) and Madhu and Madhu (2007). The present paper provides the detailed distribution of 54 species of sea anemones belonging to 40 genera and 20 families in India. Sea anemones of Lakshadweep waters are not included in this list as no published reports available from this archipelago. Among the species reported, a maximum of 32 species belonging to 29 genera and 17 families found distributed in west coast of India, while 19 species under 16 genera and 11 families distributed in east coast of India and 19 species, out of 13 genera and 8 families were observed in Andaman and Nicobar Islands. *Metridium senile* and *Stichodactyla gigantea* were the only species distributed in both west and east coasts of Indian peninsula as well as Andaman and Nicobar Islands. It is fascinating to note that except these two species, other 16 species of sea anemones are restricted to Andaman and Nicobar Islands as they were not found in east and west coasts of India, however, *Anthopleura panikkari* reported from west coast as well as South Andaman. Furthermore, 11 species such as *Cirbrinopsis robertii*, *Paracondylactis sinensis*, *Boloceractis gopalayi*, *Diadumense schilleriana*, *Edwardsia tinctrix*, *Pelecoetes exul*, *Phytocoetes gangeticus*, *Stephensonactis ornata*, *Metapeachia tropica*, *Nevadne glauca* and *Phymanthus loligo* distributed in both east and west coasts of India (Table 2). The species diversity (H') of sea anemones in India varied from 1.53 at Andaman and Nicobar Islands to 2.20 at west coast of India.

Table 2. Diversity and Distribution of sea anemones in India

(Data compiled from Parulekar, 1989; Madhu and Madhu, 2007; and the present study of ZSI)

Sl. No.	Order/Family/Genus/Species	West Coast	East Coast	Andaman and Nicobar Islands
	Order: Actiniaria Family: Acontiophoriidae,Carlgren 1938 Genus: *Acontiophorum* Carlgren, 1938			
1.	*Acontiophorum bombayensis* Parulekar, 1968	Mumbai, Malvan and Karwar		
	Family: Actiniidae Rafinesque, 1815 Genus: *Actinogeton* Carlgren, 1938			
2.	*Gyractis sesere* (Haddon & Shackleton, 1893)	Mumbai (Cuffe Parade)		
	Genus: *Entacmaea* Ehrenberg, 1834			
3.	*Entacmaea quadricolor* (Rueppel and Leuckar, 1828)			North, Middle, South and Little Andaman, Ritchie's Archipelago and MGNP
	Genus: *Anemonia* Risso, 1826			
4.	*Anemonia indica* Parulekar, 1968	Gulf of Kachchh, Maharastra, Goa and North Karnataka		
	Genus: *Anthopleura* Duchassaing de Fonbressin and Michelotti, 1860			
5.	*Anthopleura asiatica* Uchida and Muramatsu, 1958	Mumbai, Malavan and Anjidiv Island		
6.	*Anthopleura midori* Uchida and Muramatsu, 1958	Maharashtra, Goa, and North Karnataka		
7.	*Anthopleura pacifica* Uchida and Muramatsu, 1958	Mumbai, Malvan and Goa		
8.	*Anthopleura panikkarii* Parulekar, 1969	Maharashtra, Goa, North Karnataka and Kerala (Vizhinjam)		South Andaman (Port Blair)
9.	*Anthopleura handi* Dunn, 1978			South Andaman
	Genus: *Bunodactis* Verrill, 1869			
10.	*Bunodactis nicobarica* Carlgren, 1928			Andaman Sea

Table 2. contd.

Sl. No.	Order/Family/Genus/Species	West Coast	East Coast	Andaman and Nicobar Islands
	Genus: *Bunodosoma* Verrill, 1899			
11.	*Bunodosoma granulifera* Leseur, 1917	Mumbai		
	Genus: *Cribrinopsis* Carlgren, 1921			
12.	*Cribrinopsis robertii* Parulekar, 1971	Maharashtra and Goa	Mandapam and Tuticorin	
13.	*Cribrinopsis* sp.	Mumbai		
	Genus: *Glyphoperidium* Roule, 1909			
14.	*Glyphoperidium bursa* Roule, 1909	Off Southwest coast		
	Genus: *Glyphostylum* Roule, 1909			
15.	*Glyphostylum calyx* Roule, 1909	Off southwest coast and Lakshadweep Sea		
	Genus: *Parabunodactis* Carlgren, 1928			
16.	*Parabunodactis inflexibilis* Carlgren, 1928			Andaman Sea
	Genus: *Paracondylactis* Carlgren, 1928			
17.	*Paracondylactis sinensis* Carlgren, 1934	Bombay and Gujarat (Sikka)	Gangetic delta	
18.	*Paracondylactis sagarensis* Bhattacharya, 1979		Sagar Island, Sunderbans	
	Genus: *Macrodactyla* Haddon, 1898			
19.	*Macrodactyla doreensis* (Quoy & Gaimard, 1833)			Middle Andaman
	Family: Actinodendronidae Haddon, 1898 Genus: *Actinodendron* de Blainville, 1830			
20.	*Actinodendron glomeratum* Haddon, 1898			Ritchie's Archipelago
	Family: Actinostoiidae Carlgren, 1938 Genus: *Bathydactylus* Carlgren, 1928			
21.	*Bathydactylus valdiviae* Carlgren, 1928	Off west coast		
	Family: Aiptasiidae Carlgren, 1924 Genus: *Aiptasia* Gosse, 1858			
22.	*Aiptasia* sp.	Mumbai		
	Genus: *Neoaiptasia* Parulekar, 1969			
23.	*Neoaiptasia commensali* Parulekar, 1969	Padmagad		

Table 2. contd.

Sl. No.	Order/Family/Genus/Species	West Coast	East Coast	Andaman and Nicobar Islands
	Family: Aiptasiomorphidae (Stephenson, 1920) Genus: *Haliplanella* Hand, 1956			
24.	*Haliplanella lineata* (Verrill, 1870)	Gulf of Kachchh, Mumbai, Central and southwest coast		
	Family: Aliciidae (Duerden, 1897) Genus: *Alicia* Johnson, 1861			
25.	*Alicia sansibarensis* Carlgren, 1900	Central and southwest coast		
	Family: Boloceroidae Carlgren, 1924 Genus: *Boloceractis* Panikkar, 1937			
26.	*Boloceractis gopalayi* Panikkar, 1937	Cochin backwaters and Asthamudi Lake	Chennai	
	Genus: *Boloceroides* Carlgren, 1899			
27.	*Boloceroides mcmurrichi* Kwiteriewski, 1898	Central west-coast		
	Genus: *Bunodeopsis* Andres, 1881			
28.	*Bunodeopsis* sp.		Chennai	
	Family: Diadumeneidae (Stephenson, 1920) Genus: *Diadumene* Stephenson, 1920			
29.	*Diadumene schilleriana* Stoliczka, 1863	West coast in general	Tuticorin, Mandapam, Chandipur and Digha	
	Family: Edwardsiidae Andres, 1880 Genus: *Edwardsia* Quatrefages, 1842			
30.	*Edwardsia jonesii* Seshaiya & Curtress, 1969		Port Novo (Tamil Nadu)	
31.	*Edwardsia tinctrix* Annandale, 1915	Mumbai, Malvan and Goa	Chennai, Chilka Lake	
	Family: Halcampidae Andreas, 1883 Genus: *Halcampa* Gosse, 1858			
32.	*Halcampa capensis* Carlgren, 1938	Northwest coast		
	Genus: *Mena* Stephenson, 1920			
33.	*Mena limnicola* Annandlae, 1915		Chilka Lake and Balramghadi (Odisha)	

Table 2. contd.

Sl. No.	Order/Family/Genus/Species	West Coast	East Coast	Andaman and Nicobar Islands
	Family: Haliactiidae Carlgren, 1949 Genus: *Pelocoetes* Annandale, 1915			
34.	*Pelocoetes exul* (Annandlae, 1915)	Gulf of Cambay, Mumbai, Malvan, Goa estuaries, and Cochin backwaters	Chennai and Gangetic delta	
35.	*Pelocoetes minima* Panikkar, 1939		Chennai and Sagar Island	
	Genus: *Phytocoetes* Annandale, 1915			
36.	*Phytocoetes gangeticus* Annandale, 1915	West coast in general	East coast in general	
	Genus: *Phytocoetopsis* Panikkar 1936			
37.	*Phytocoetopsis ramunni* Panikkar, 1936		Chennai	
	Genus: *Stephensonactis* Panikkar, 1936			
38.	*Stephensonactis ornata* Panikkar, 1936	West coast in general	East coast in general	
	Family: Haloclavidae Verrill, 1899 Genus: *Metapeachia* Carlgren, 1943			
39.	*Metapeachia tropica* Panikkar, 1938	Mumbai, Malvan and Goa	Kurusadai Island in Gulf of Mannar	
	Family: Hormathiidae Carlgren, 1932 Genus: *Calliactis* Verrill, 1869			
40.	*Calliactis miriam* Haddon & Shackleton, 1893			South Andaman
	Genus: *Paraphellia* Haddon, 1889			
41.	*Paraphellia sanzoi* Colabresi, 1926	Gulf of Kachchh		
	Family: Isophelliidae Stephenson, 1935 Genus: *Telmatactis* Gravier, 1916			
42.	*Telmatactis decora* (Hemprich and Ehrenberg in Ehrenberg, 1834)			South Andaman
	Family: Metridiidae (Carlgren 1893) Genus: *Metridium* de Blainville, 1824			
43.	*Metridium senile* (Linnaeus, 1761)	West coast in general	East coast in general	South Andaman (Port Blair)
	Family: Nevadneidae, Carlgren 1925 Genus: *Nevadne* Stephenson, 1922			
44.	*Nevadne glauca* Annandale 1915	Goa estuaries	Chilka Lake	

Table 2. contd.

Sl. No.	Order/Family/Genus/Species	West Coast	East Coast	Andaman and Nicobar Islands
	Family: Phymanthidae Andres, 1883 Genus: *Phymanthus* Milne Edwards, 1857			
45.	*Phymanthus buitendijki* Pax, 1924			South Andaman
46.	*Phymanthus loligo* Hand E Ehrenberg 1834	Gulf of Kachchh	Gulf of Mannar	
	Family: Stichodactylidae Andres, 1883 Genus: *Heteractis* Milne Edwards, 1857			
47.	*Heteractis aurora* (Quoy and Gaimard, 1833)			South Andaman and MGMNP
48.	*Heteractis crispa* (Hemprich & Ehrenberg in Ehrenberg, 1834)			North, Middle and Little Andaman, MGMNP, Ritchie's Archipelago and Nicobar
49.	*Heteractis magnifica* (Quoy and Gaimard, 1833)			North, Middle, South and Little Andaman, MGMNP, Ritchie's Archipelago and Nicobar
50.	*Heteractis malu* (Haddon & Shackleton, 1893)			South, Middle, and North Andaman
	Genus: *Stichodactyla* Brandt, 1835			
51.	*Stichodactyla gigantea* (Forskål, 1775)	Gulf of Kachchh	Gulf of Mannar	MGMNP
52.	*Stichodactyla haddoni* (Saville-Kent, 1893)			North, Middle and South Andaman, and MGMNP
53.	*Stichodactyla mertensii* (Brandt, 1835)			North Andaman
	Family: Thalassianthidae Milne Edwards, 1857 Genus: *Cryptodendrum* Klunzinger, 1877			
54.	*Cryptodendrum adhaesivum* Milne Edwards, 1857			South, Middle, and North Andaman
	Number of species	**32**	**19**	**19**
	Number of genera	**29**	**16**	**13**
	Number of families	**17**	**11**	**8**
	Species Diversity (H')	**2.20**	**1.62**	**1.53**

Similarity Index

The data calculated for species similarity index on the distributional pattern of sea anemones in Andaman and Nicobar Islands and the other region of India are given in Tables 3 and 4. In Andaman and Nicobar Islands, the maximum similarity of species (0.89) was observed between Ritchie's Archipelago & Little Andaman, while minimum (0.43) was found between South Andaman & MGMNP. However, in Indian coast, it showed 0.51 as maximum between West & East coasts and minimum (0.11) between East coast & Andaman and Nicobar Islands. The index clearly indicated that no definite degree of sea anemones distribution in Indian seas as it found occurred sporadically.

Table 3. Similarity Index of Sea anemones distribution in Andaman and Nicobar Islands

	North Andaman	**Middle Andaman**	**South Andaman**	**Ritchie's Archipelago**	**MGMNP**	**Little Andaman**	**Nicobar Islands**
North Andaman		0.83	0.53	0.73	0.62	0.80	0.60
Middle Andaman			0.53	0.73	0.77	0.80	0.60
South Andaman				0.43	0.50	0.62	0.46
Ritchie's Archipelago					0.67	0.89	0.67
MGMNP						0.73	0.55
Little Andaman							0.75
Nicobar Islands							

Table 4. Similarity Index of Sea anemones distribution in India

	West Coast	**East Coast**	**A&N Islands**
West Coast		0.51	0.12
East Coast			0.11
A&N Islands			

Morphology of Sea anemones

In general, sea anemones are cylindrical in shape. The lower end of the animal has a pedal disc which will help for the firm attachment with solid substratum especially rock, dead coral and often buried in sediment. Middle of the upper end is the mouth and the hollow tentacles arising from the oral disc surround it. The tentacles number may be few to hundreds and arranged in circlets which is the distinguished characters for species identification. Normally tentacles are short or long, thin or thick, pointed of blunt and globular or tree like. The cylindrical column of the sea anemones is tapered towards the pedal end and the oral disc is greater in diameter. The column of the animals may be patterned as splotches of colours or longitudinal stripes. Presence or absences of verrucae and an arrangement of tentacles are the characters defining the genera (Fautin and Allen, 1992). Thus, all species in a particular genus do (e.g. *Stichodactyla*) or do not (e.g. *Entacmaea*) have verrucae. There may be one tentacle per space between mesenteries or more than one tentacle between each two mesenteries. Members of the Actiniidae have one tentacle per space while Stichodactylidae and Thalassianthidae can have so many tentacles because up to several, radially arrayed rows of tentacles arise from alternate spaces (the endocoels), whereas only one tentacle arises from other spaces (exocoels). The single tentacle is positioned at the extreme margin of the oral disc. This arrangement may be obvious**,** when the animals are well extended (Fautin and Allen, 1992). Though the occurrence of 19 species of sea anemones reported, the morphological features of 15 species recorded during the present study are illustrated herewith for field identification of live specimens.

Phylum CNIDARIA

Class ANTHOZOA

Order ACTINIARIA

Family ACTINIIDAE Rafinesque, 1815

Genus ***Anthopleura*** Duchassaing de Fonbressin & Michelotti, 1860

1. ***Anthopleura handi*** Dunn, 1978 (Fig. 2)

Fig. 2. *Anthoplerua handi*

1978. *Anthopleura handi* Dunn (Original description)

Diagnostic characters: Oral disc is small; tentacles are moderately long and tapered at the tip. Verrucae is not prominent to which pieces of shell and gravels adhere at the distal part. Oral disc is dark brown in colour, mouth raised on the cone. Tentacles are transparent with prominent irregular lines (spots) can be seen on upper side and they are broad at the base and tapered at the tip. Column is white in colour, firmly attached with substratum.

Distribution: India: Andaman and Nicobar Islands: Pongibalu (Lat. 11º 31. 030'N, Long. 92º 39.159'E), Chidiyatapu (Lat. 11º 29. 460'N, Long. 92º 42.530'E) and Burmanallah (Lat. 11º 33. 468'N, Long. 92º 43.873'E). *Elsewhere*: Singapore, Malaysia, Australia and New Zealand.

Depth: 2-3m

Remarks: Mostly attached on manmade structures i.e. seawall and jetty. The occurrence of *Anthopleura handi* Dunn, 1978 in Andaman and Nicobar Islands is a new distributional record to Indian waters.

Genus ***Entacmaea*** Ehrenberg, 1834

2. ***Entacmaea quadricolor*** (Rüppell & Leuckart, 1828) Fig. 3

1828. *Actinia quadricolor* Leuckart in Rüppell & Leuckart, (Original description)

1981. *Entacmaea quadricolor* Dunn.

Diagnostic characters: Pedal disc is well devloved, usually narrower than oral disc. Column is 500mm long, flared, without verrucae, typically rich brown but may be greenish or reddish. The tentacles are 100mm long, cylindrical, bulbous, usually with a pear-shape or smooth and tapered all over the surface of the oral disc; inner tentacles 2-3 times longer than marginal; most of the tentacles forms near to margin; typically brown with greenish cast and pink or purple tip; tentacle usually with bulb at or somewhat below tip may have white equator. Tentacles without bulbs are blunt-ended a white ring where equator would form. Bulb seems to be related to presence of fish. Oral disc is flat; brown, greenish or pink in colour with radial white stripes around the mouth. Animal commonly attached deeply in crevice or hole**,** so that only emergent tentacles visible.

Distribution: India: Andaman and Nicobar Islands: Havelock Is. (Lat. 12º 00. 005'N, Long. 92º 56.808'E), Interview Is. (Lat. 12º 59. 125'N, Long. 92º 42.981'E), Carlew Is. (Lat. 12º 56. 084'N, Long. 92º 53.378'E), Oliver Is.(Lat. 12º59.585'N, Long. 092º58.154'E), East Is.(Lat. 13°38.172'N, Long. 93°02.572'E), Twins Is.(Lat. 13°25.671'N, Long. 93°05.938'E), Long Is.(Lat.

12˚21.749'N, Long. 93˚55.410'E), Guitar Is.(Lat. 12˚21.136'N, Long. 92˚55.218'E), North Bay (Lat. 11º 42. 068'N, Long. 92º 45.116'E), Pongibalu (Lat. 11º 31. 030' N, Long. 92º 39.159'E), Jolly Buoy Is. (Lat. 11º 30. 251'N, Long. 92º 32.591'E), Rutland Is. (Lat. 11º 25. 504'N, Long. 92º 40.301'E), Grub Is.(Lat. 11º 35. 391'N, Long. 92º 35.637'E), Boat Is.(Lat. 11° 30.464'N, Long. 92° 33.242'E), Chidiyatapu (Lat. 11º 29. 460'N, Long. 92º 42.530'E), Cinque Is.(Lat. 11º 18.660'N, Long. 092º 42.570'E), Dugong creek in Little Andaman (Lat. 10º 48. 385'N, Long. 92º 64.000'E). *Elsewhere*: Micronesia and Melanesia to East Africa and the Red Sea and from Australia to Japan.

Depth: 1-25m

Fig. 3. *Entacmaea quadricolor* (Rüppell & Leuckart, 1828)

Remarks: Found in reef environments; pedal end attached in crevices of rock or corals; hence the animal could be seen**,** when the tentacles expanded. *Entacmaea quadricolor* is a host for anemone fishes *Amphiprion bicinctus, A. clarkii, A. ephippium, A. frenatus, A. melanopus* and *Premnas biaculeatus* in Andaman and Nicobar Islands.

Genus ***Macrodactyla*** Haddon, 1898

3. ***Macrodactyla doreensis*** (Quoy & Gaimard, 1833) Fig. 4

1830. *Actinia doreensis* de Blainville.

1833. *Actinia doreensis* Quoy & Gaimard, (Original description).

1857. *Paractis doreensis* Milne Edwards.

1883. *Cereactis doreensis* Andres.

1893. *Condylactis gelam* Haddon & Shackleton, (Original description)

1898. *Aulactinia gelam* Haddon.

1949. *Anthopleura gelam* Carlgren.

1972. *Radianthus gelam* Allen.

1972. *Macrodactyla gelam* Mariscal.

1973. *Radianthus gelam* Allen.

1976. *Radianthus malu* Moyer

1981. *Macrodactyl adoreensis* Dunn.

1987. *Heteractis gelam* Cutress & Arneson

2001. *Antheopsis gelam* Uchida &Soyama.

Diagnostic characters: Pedal disc distinct, circular and narrower than oral disc, buried in sand or muddy substrate. The colour is brown to orange, have distinctive white spots on their foot. The anemone has a tube shaped soft squishy body. Column with adhesive verrucae distally, without marginal spherule, up to 150mm long, distal end broadly flared; lower part dull orange to brilliant red, upper part brownish with non-adhesive, prominent white circular to eye shaped verrucae in longitudinal rows. Tentacles few (around 100-200 in numbers), sparse, 175 mm long, tapering to slender tip, some with corkscrew form. Each pointed tentacles grey with pink or mauve tip, may have longitudinal white streak. Tentacles are more concentrated at the margin of oral disc, few tentacles scattered on oral disc closer to mouth. Oral disc is on central, lipped mouth; sometimes on an elevated cone, widely flared, 500mm diameter with radial white lines that may extend onto tentacles.

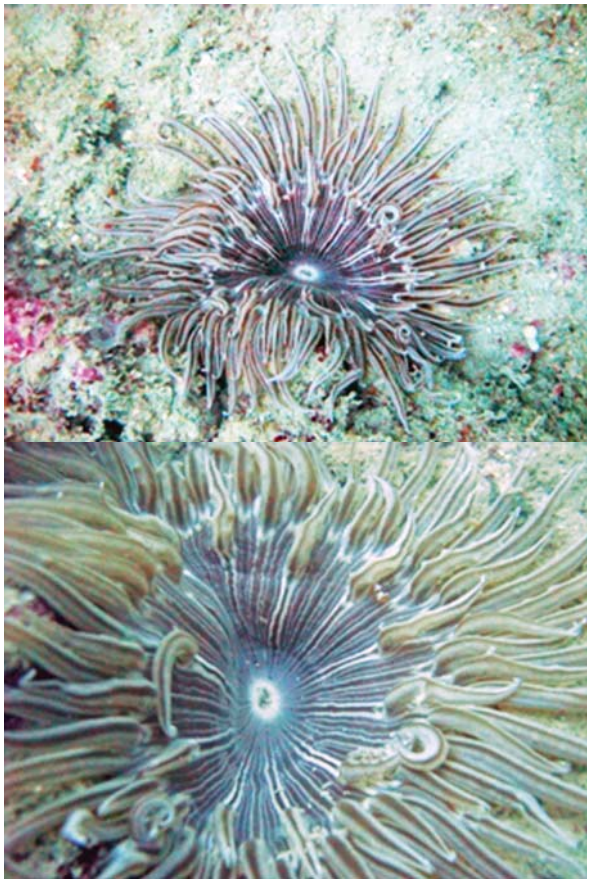

Fig. 4. *Macrodactyla doreensis* (Quoy & Gaimard, 1833)

Distribution: India: Andaman and Nicobar Islands: Avis Island (Lat. 12º 56. 210'N, Long. 92º 33.066'E). *Elsewhere*: Japan south to New Guinea and northern Australia.

Depth: 9-11m

Remarks: Found in deep waters, buried in sediments. *Macrodactyla doreensis* is a host for anemone fishes *Amphiprion chrysogaster*, *A. clarkii*, *A. perideraion* and *A. polymnus* in Andaman and Nicobar Islands.

Family ACTINODENDRONIDAE Haddon, 1898

Genus ***Actinodendron*** de Blainville, 1830

4. ***Actinodendron glomeratum*** Haddon, 1898 (Fig. 5)

Diagnostic characters: The tentacles are branched, long with a leaf shaped or feather-like appearance with each tentacle having a space in between, cream in colour, thick at base with grayish to green in colour. Pedal column that buried in rubble or sand, but only the oral disc and the tentacles are visible. Oral disc projects inward, circular, filled with dark spots. Each tentacle has a cluster of vesicles that look like a cauliflower.

Distribution: India: A&N Islands: South Button Is. (Lat. 12º 13. 467'N, Long. 92º 01.334'E) *Elsewhere*: Fiji, Marshall Islands and Australia.

Depth: 15-23m

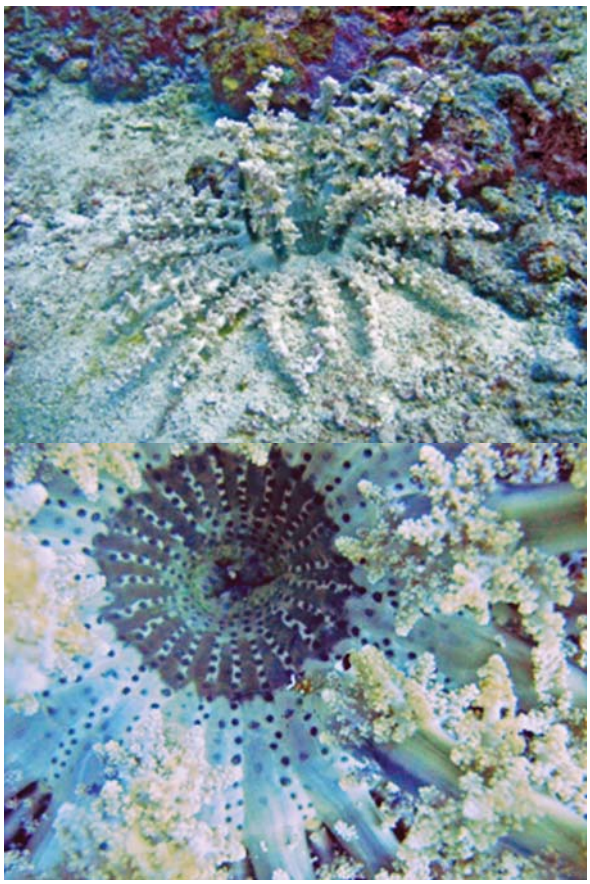

Fig. 5. *Actinodendron glomeratum* Haddon, 1898

Remarks: Look more like colonies of soft corals, buried in sand. *Actinodendron glomeratum* from Andaman and Nicobar Islands is a first record to Indian waters.

Family BOLOCEROIDAE Carlgren, 1924

Genus ***Boloceroides*** Carlgren, 1899

5. ***Boloceroides mcmurrichi*** Kwiteriewski, 1898 (Fig. 6)

Diagnostic characters: Column smooth, thin-

walled, semi- transparent, about to very small in length. Tentacles are thick at the base, tapering to slender tips, transparent with white or cream transverse stripes; tentacles number variable (usually around 400). Inner tentacles are much longer than marginal ones. The tentacles hide the small oral disc and the mouth which is on a cone. Some have a white band on the oral disc across the mouth. Sometimes, two of the tentacles near the mouth are prominently lighter. Pedal disc is present but**,** weakly adherent.

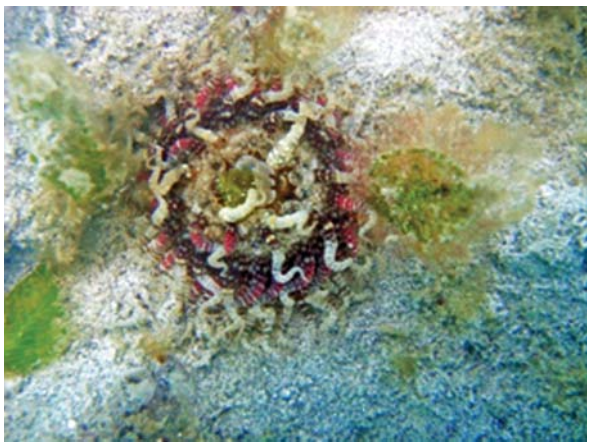

Fig. 6. *Boloceroides mcmurrichi* Kwiteriewski, 1898

Distribution: India: Central West-Coast of India, and Andaman and Nicobar Islands: Nancowry Is. (Lat. 08º 02. 151'N, Long. 93º 33.182'E). *Elsewhere*: Indonesia, Hawaiian Islands and Red Sea.

Depth: 6-8m

Remarks: Mostly found in sandy and sea grass environments, often confused with sea grasses.

Family HORMATHIIDAE Carlgren, 1932

Genus ***Calliactis*** Verrill, 1869

6. ***Calliactis miriam*** Haddon & Shackleton, 1893 (Fig. 7)

Diagnostic characters: Pedal disc is well developed, the body column smooth, without verrucae, 10-15 mm long, brightly coloured; usually purple in colour; middle part of column with white spot and white lines are radiated towards distal column. Oral disc is flat and circular. Tentacles are small, sturdy and transparent.

Fig. 7. *Calliactis miriam* Haddon & Shackleton, 1893

Distribution: India: Andaman and Nicobar Islands: Burmanallah (Lat. 11º 33. 468'N, Long. 92º 43.873'E). *Elsewhere*: Micronesia, Panama, Philippines and America.

Depth: Intertidal

Remarks: Attached on gastropod shell (hermit crab); may be more than one anemone in a shell.

Family: ISOPHELLIIDAE Stephenson, 1935

Genus ***Telmatactis*** Gravier, 1916

7. ***Telmatactis decora*** (Hemprich and Ehrenberg in Ehrenberg, 1834) Fig. 8

Diagnostic characters: Oral disc is very small, mouth present on the cone and cone occupies 2/3 of oral disc. There are two types of tentacles in this species, big tentacles arranged near to cone and the small ones occurred in outer. All the tentacles are thick, blunt tips forming bulbs, from the base to middle of the tentacles are white in colour, remaining parts are coloured with irregular brown stripes, base of the tentacles are brownish grey in colour. Column is long, prominent verrucae and brown in colour.

Distribution: India: Andaman and Nicobar Islands: Chidiyatapu (Lat. 11º 29. 460'N, Long. 92º 42.530'E). *Elsewhere*: Maldives and Seychelles.

Depth: 0-6m

Fig. 8. *Telmatactis decora* (Hemprich and Ehrenberg in Ehrenberg, 1834)

Remarks: Usually found on rocks and dead corals. *Telmatactis decora* from Andaman and Nicobar Islands is a new record to Indian waters.

Family PHYMANTHIDAE Andres, 1883

Genus ***Phymanthus*** Milne Edwards, 1857

8. ***Phymanthus buitendijki*** Pax, 1924 (Fig. 9)

Diagnostic characters: Column is smooth, inconspicuous verrucae and bluish grey in colour. Oral disc is dark greenish blue, mouth located on the cone in most of the animals, oral disc covered with sediments. Tentacles are arranged in 2 or 3 orders at periphery of the oral disc. Tentacles are long, tapered tips, small flower like projections attached right to the tentacles, arranged alternatively, highly branched and brightly coloured. Purple lines between oral disc and tentacle tip. Most of the tentacles are curved inward which looks like fishing hook.

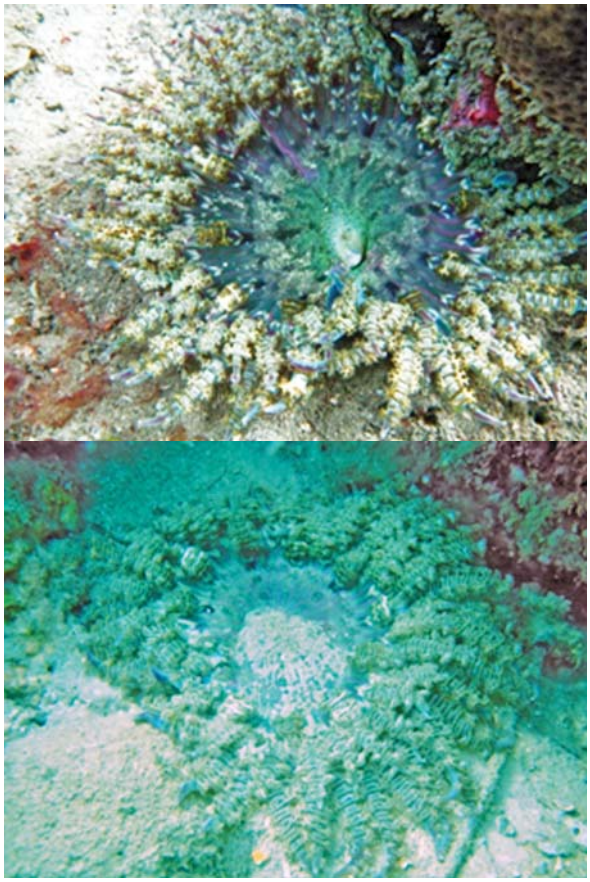

Fig. 9. *Phymanthus buitendijki* Pax, 1924

Distribution: India: Andaman and Nicobar Islands: North Bay (Lat. 11º 42. 068'N, Long. 92º 45.116'E) and Pongibalu (Lat. 11º 31. 030'N, Long. 92º 39.159'E). *Elsewhere*: Indonesia.

Depth: 0-2m

Remarks: *Phymanthus buitendijki* is a new record to India through Andaman and Nicobar Islands.

Family STICHODACTYLIDAE Andres, 1883

Genus ***Heteractis*** Milne Edwards, 1857

9. *Heteractis aurora* (Quoy and Gaimard, 1833) Fig. 10

1972. *Radianthus koseirensis* (Mariscal 1970)

1976. *Radianthus simplex* (Allen 1972, Moyer)

1975. *Bartholomea* sp. (Uchida)

Diagnostic characters: The sticky foot at the pedal end adheres to various surface; upper column lighter in colour with adhesive verrucae, whereas

lower column mottled or solid orange or red in colour. Tentacles are up to 50mm long, sticky with white spots which enlarge into bead-like swellings; tapered to point that may be magenta in colour. These swelling run entire length of tentacles forming as 'strings of bead' like appearance. The tentacles can be brown, tan, various shades of green, purple with white markings, arising from oral disc of the similar colour; inner tentacles much longer than marginal ones. Oral disc is broad, up-to 250mm or possibly more, spread flat or slightly undulating at surface of sediment. The tentacles are relatively sparse; and larger portion of the oral disc is exposed. The disc has often white radiating lines continued onto tentacles.

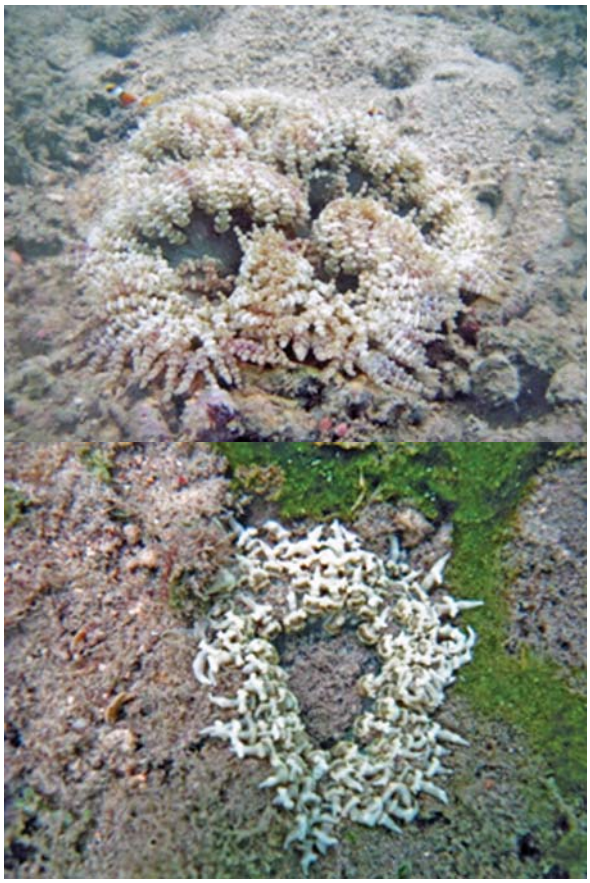

Fig. 10. *Heteractis aurora* (Quoy and Gaimard, 1833)

Distribution: India: Andaman and Nicobar Islands: Pongibalu (Lat. 11º 31. 030'N, Long. 92º 39.159'E) and Rutland Is. (Lat. 11º 25. 504'N, Long. 92º 40.301'E). *Elsewhere*: Micronesia and Melanesia to East Africa and the Red Sea, Australia and Ryukyu Island.

Depth: 2-6m

Remarks: Found in sandy environments. *Heteractis aurora* is a host to anemone fishes such as *Amphiprion bicintus*, *A. chrysogaster* and *A. frenatus* in Andaman and Nicobar Islands.

10. ***Heteractis crispa*** (Hemprich & Ehrenberg in Ehrenberg, 1834) Fig. 11

Fig. 11. *Heteractis crispa* (Hemprich & Ehrenberg in Ehrenberg, 1834)

1834. *Actinia (Entacmaea) crispa* Hemprich & Ehrenberg in Ehrenberg, (Original description)

1846. *Actinia poumatensis* Couthouy in Dana, (Original description)

1893. *Radianthus kukenthali* Haddon & Shackleton, (Original description)

1896. *Discosoma macrodactylum* Kwietniewski, (Original description)

Diagnostic characters: The sticky foot at the base of pedal column adheres to various substrata. Column is grey in colour, leathery in texture, flared at oral end, prominent adhesive verrucae with raised rim; lower part rarely mottled with

yellow, buried in sediment and the oral disc lies at surface of sediment. Tentacles up to 45 mm long, typically intertwined, numerous in number (around 800), tapered at tip , sometimes blue or mauve tip. Oral disc flat, 500 mm long, usually brownish violet or grey, rarely bright green, mouth is elongated.

Distribution: India: Andaman and Nicobar Islands: Inglis Is. (Lat. 12º 08. 639'N, Long. 93º 06.786'E), Peel Is. (Lat. 12º 03.315'N, Long. 92º 59.929'E), Henry Lawrence Is. (Lat. 12º 05. 000'N, Long. 93º 06.312'E), Rail Is. (Lat. 12º 56. 860'N, Long. 92º 54.620'E), Twin Is. (Lat. 13°25.671'N, Long. 93°05.938' E), Rutland Is. (Lat. 11º 25. 504'N, Long. 92º 40.301'E), South brother Is. (Lat. 10º 55. 830'N, Long. 92º 07.023'E), and Kardeep of Nancowry Is. (Lat. 08º 02. 151'N, Long. 93º 33.182'E). *Elsewhere*: French Polynesia, Micronesia and Melanesia to the Red Sea, Australia and Japan.

Depth: 5-15m

Remarks: Found in reef environment; attached to dead corals and rocks. *Heteractis crispa* is a host for anemone fishes *Amphiprion bicintus, A. ephippium, A. melanopus, A. percula, A. perideraion, A. polymnus* and *A. sandaracinos* in Andaman and Nicobar Islands.

11. ***Heteractis magnifica*** (Quoy and Gaimard, 1833) Fig. 12

1830. *Actinia magnifica* de Blainville.
1833. *Actinia magnifica* Quoy & Gaimard.
1857. *Corynactis magnifica* Milne Edwards.
1883. *Roplactics magnifica* Andres.
1898. *Helianthopsis ritteri* Kwietniewski.
1900. *Helianthopsis mabrucki* Carlgren, (Original description)
1922. *Radianthus mabrucki* Stephenson.
1922. *Antheopsis ritteri* Stephenson.
1930. *Anemone* sp. Verwey.
1949. *Radianthus ritteri* Carlgren.
1972. *Radianthus paumotensis* Friese.
1978. *Radianthus malu* Allen.
1981. *Heteractis magnifica* Dunn.
1987. *Heteractis ritteri* Cutress & Arneson.

Fig. 12. *Heteractis magnifica* (Quoy and Gaimard, 1833)

Diagnostic characters: Sticky foot at the base of pedal column that adhere to various surface such as coral boulder, foot is larger than column, fully exposed. Column cylindrical, with distal verrucae, intensely coloured (commonly avocado green, blue, red, white, chestnut brown and magenta). The tentacles all over the surface of the oral disc, moderately long tentacles (to 75mm long), finger shaped that topped with spherical or bulb shaped tips which are lighter and usually colored an iridescent yellowish green. Oral disc flat with 1m diameter, gently undulating, tend to be brown, but can be green, yellow or white and mouth in the centre of the oral disc; may be raised in the cone.

Distribution: India: Andaman and Nicobar Islands: Havelock Is. (Lat. 12º00.005'N, Long. 92º 56.808'E), Interview Is. (Lat. 12º 59.125'N, Long. 92º 42.981'E) Carlew Is. (Lat. 12º 56.084'N, Long. 92º 53.378'E), Avis Is.(Lat. 12º 56. 210'N, Long. 92º 33.066'E), Rail Is. (Lat. 12º 56.860'N, Long. 92º 54.620'E), Sound Is. (Lat. 12º 56. 084'N, Long. 92º 57.345'E), Oliver Is. (Lat. 12º59.585'N, Long. 092º58.154'E), East Is. (Lat. 13°38.172'N, Long. 93°02.572'E), Ross & Smith Is. (Lat.13º 18.406'N, Long. 93º 04.207'E), Twin Is. (Lat. 13°25.671'N, Long. 93°05.938'E), Long Is. (Lat. 12˚21.749'N, Long. 93˚55.410'E), Guitar Is. (Lat. 12˚21.136'N, Long. 92˚55.218'E), North Bay (Lat. 11º 42. 068'N, Long. 92º 45. 116'E), Pongibalu (Lat. 11º 31.030'N, Long. 92º 39.159'E), Jolly Buoy Is. (Lat. 11º 30. 251'N, Long. 92º32.591'E), Rutland Is.(Lat. 11º 25. 504'N, Long. 92º 40.301'E), Grub Is. (Lat. 11º 35. 391'N, Long. 92º 35.637'E), Boat Is. (Lat. 11° 30.464'N, Long. 92° 33.242'E), Chidiyatapu (Lat. 11º 29. 460'N, Long. 92º 42.530'E), Cinque Is. (Lat. 11º 18.660'N, Long. 092º 42.570'E), Dugong Creek in Little Andaman (Lat. 10º 48. 385'N, Long. 92º 64.000'E) and Trinket Is. (Lat. 08º 02. 806'N, Long. 93º 34.556'E). *Elsewhere*: French Polynesia to East Africa and Australia to the Ryukyu Island.

Depth: 0-18m

Remarks: Often found associated with *Heteractis crispa* and found in rocky environments. *H. magnifica* is a host to anemone fishes *Amphiprion akallopisos, A. bicinctus, A. chrysogaster, A. clarkii, A. ephippium, A. frenatus, A. melanopus, A. ocellaris, A. percula, A. perideraion, A. sandaracinos* and *Premnas biaculeatus* in Andaman and Nicobar Islands.

Genus ***Stichodactyla*** Brandt, 1835

12. ***Stichodactyla gigantea*** (Forskål, 1775)
Fig. 13

Fig. 13: *Stichodactyla gigantean* (Forskål, 1775)

1948. *Discosoma giganteum* (Gohar; Schlichter 1968)

1969. *Stoichactis kenti* (Mariscal, 1970, 1972; Allen 1972, 1973, 1978; Uchida *et al*., 1975)

Diagnostic characters: Oral disc is thick, wide, smooth, highly folded and bare around the cone; mouth is grey in colour. Tentacles are numerous, small, sturdy, evenly distributed, extremely sticky, tip slightly tapered. Column usually brown, sometimes purple in colour, attached to hard substratum.

Distribution: India: Gulf of Kachchh, Gulf of Mannar, and Andaman and Nicobar Islands: Jolly Buoy Is. (Lat. 11º 30. 251'N, Long. 92º 32.591'E) and Tarmugli Is. (Lat. 11º 33. 261'N, Long. 92º 36.809'E). *Elsewhere*: Micronesia to the Red Sea, and Australia to the Ryukyu Island.

Depth: 0-10m

Remarks: Often found in shallow water and animals may expose during low tide. *Stichodactyla gigantea* is a host to anemone fishes *Amphiprion akallopisos, A. bicinctus, A. clarkii, A. ocellaris, A. percula* and *A. perideraion* in Andaman and Nicobar Islands.

13. ***Stichodactyla haddoni*** (Saville-Kent, 1893)
Fig. 14

Fig. 14. *Stichodactyla haddoni* (Saville-Kent, 1893)

1893. *Discosoma haddoni* Saville-Kent.

1924. *Stoichactis ambonensis* Pax.

1981. *Stichodactyla haddoni* Dunn.

Diagnostic characters: Oral disc is flat, broad, deeply folded with numerous short tentacles which are highly robust at periphery of disc. Tentacles are grey in colour and adhesive, no tentacles around the mouth, upper side of the oral disc is pale orange and the column is brown in colour.

Distribution: India: Andaman and Nicobar Islands: North Bay (Lat. 11º 42.068'N, Long. 92º 45.116'E), Grub Is. (Lat. 11º 35.391'N, Long. 92º 35.637'E), Sinclair's Bay (Lat. 11°40.057' N, Long. 92°44.587' E), Sound Is.(Lat. 12º 56. 084'N, Long. 92º 57.345'E), Rutland Is.(Lat. 11º 25. 504'N, Long. 92º 40.301'E) and Ross & Smith Is. (Lat.13º 18. 406'N, Long. 93º 04.207'E). *Elsewhere*: Fiji Islands to Mauritius, and Australia to the Ryukyu Island.

Depth: 2-11m

Remarks: It is very similar to *Stichodactyla mertensii*, found in sandy environments. *Stichodactyla haddoni* is a host to anemone fishes *Amphiprion chrysogaster, A. clarkii, A. frenatus, A. polymnus* and *A. sebae* in Andaman and Nicobar Islands.

14. ***Stichodactyla mertensii*** (Brandt, 1835)
Fig. 15

Fig. 15: *Stichodactyla mertensii* (Brandt, 1835)

1970. *Stoichactis giganteum* (Mariscal, Allen and Mariscal 1971, Allen 1972, 1973, 1975)

Diagnostic characters: Oral disc are flared, thick, slightly undulated, pale in colour. Tentacles are in two types, short tentacles evenly distributed on the oral disc, which is greenish orange in colour and the long ones are pale or white in colour, which are radially arranged from center of the

oral disc to periphery at even distance. All the tentacles are bubble in shape.

Distribution: India: Andaman and Nicobar Islands: Ross & Smith Is. (Lat. 13º 18. 406'N, Long. 93º 04.207'E). *Elsewhere*: Micronesia and Melanesia to East Africa, and Australia to the Ryukyu Island.

Depth: 6-9m

Remarks: Symbiotic fishes may be melanistic. Found in clear water, attached inside the crevices. *Stichodactyla mertensii* is a host to *Amphiprion akallopisos, A. merensii, A. chrysagaster, A. clarkii, A. ocellaris* and *A. sandaracinos* in Andaman and Nicobar Islands.

Family: THALASSIANTHIDAE Milne Edwards, 1857

Genus ***Cryptodendrum*** Klunzinger, 1877

15. ***Cryptodendrum adhaesivum*** Milne Edwards, 1857 (Fig. 16)

Fig. 16: *Cryptodendrum adhaesivum* Milne Edwards, 1857

1877. *Cryptodendrum adhasivum* Klunzinger, (Original description)

1973. *Stoichactis digitata* Doumenc, (Original description)

Diagnostic characters: The pedal column with sticky foot at the bottom adheres to various surfaces. The body column is brightly coloured; generally smooth with tiny verrucae of the same colour or slightly darker. The pedal column has lines and spots on it. The tentacles on the oral disc are short, tiny and tightly packed. Two different forms of dense sticky tentacles up to 5mm in length; in centre a narrow stalk with five and more short branches at end, whereas at very extreme margin, spherical tentacles with fewer branches. Tentacles of the two forms are blue and grey in colour. The mouth is small, about 1 cm in diameter at the centre of the oral disc. It is usually a contrasting colour to the disc; colour like yellow, white green, or violet.

Distribution: India: Andaman and Nicobar Islands: Havelock Is. (Lat. 12º00.005'N, Long. 92º56.808'E), Sound Is. (Lat. 12º56.084'N, Long. 92º 57.345'E), East Is. (Lat. 13°38.172'N, Long. 93°02.572'E), Ross & Smith Is. (Lat.13º 18.406'N, Long. 93º04.207'E), Kalipur beach (Lat. 13°13.286'N, Long. 93°02.560'E), Long Is. (Lat. 12˚21.749'N, Long. 93˚55.410'E), Guitar Is. (Lat. 12˚21.136'N, Long. 92˚55.218'E), North Bay (Lat. 11º42.068'N, Long. 92º45.116'E), Pongibalu (Lat. 11º 31. 030'N, Long. 92º 39.159'E), Grub Is. (Lat. 11º 35. 391'N, Long. 92º 35.637'E), Boat Is. (Lat. 11° 30.464'N, Long. 92° 33.242'E), Chidiyatapu (Lat. 11º29.460'N, Long. 92º42.530'E), Rutland Is. (Lat. 11º25.504'N, Long. 92º40.301'E) South brother Is. (Lat. 10º55. 830'N, Long. 92º 07.023'E) and Nancowry (Lat. 08º02.151'N, Long. 93º33. 182'E). *Elsewhere*: Australia to southern Japan and Polynesia, Micronesia, and Melanesia westward to Thailand, Maldives, and the Red Sea.

Depth: 1-20m

Remarks: Mostly found in shallow water crevices.

DISCUSSION

The present study described 15 species of Actiniarian sea anemones from Andaman and Nicobar Islands out of 19 species recorded as evinced by earlier literatures. The sea anemone fauna of these islands contribute 35.19% of a total of 54 species reported from India. The occurrence of sea anemones identified in the present study was from intertidal region to the maximum depth of 40 m in the reef area. Though nearly 1000 species of sea anemones reported from world waters, only 10 species are host to anemone fishes (Fautin and Allen, 1992). All the 10 host species are found to be occurred in Andaman and Nicobar Islands, of which except *Heteractis malu*, 9 species were observed during the study. 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, corals bivalve and gastropod molluscs barnacles, hermit crabs, cirripedes, polychaete worms, crabs and fishes. These host anemones normally exist only in shallow water, no deeper than 50m because within the cells of an anemone's tentacles and oral disc, live microscopic, single-celled dinoflagellates called zooxanthellae which require sunlight for photosynthesis (Fautin and Allen, 1992).

Out of the 19 species of sea anemones reported in Andaman and Nicobar Islands, only 3 species found in peninsular coast of mainland India, while 16 species were restricted to these islands only. However, among these 16 species 9 species such as *Anthopleura handi, Boloceroides mcmurrichi, Cryptodendrum adhaesivum, Entacmaea quadricolor, Heteractis crispa, Heteractis magnifica, Macrodactyla doreensis, Stichodactyla haddoni* and *Stichodactyla gigantea* are shared with their distribution in Singapore waters as reported by Fautin *et al.* (2009). Five species *viz., Actinodendron glomeratum, Calliactis miriam, Anthopleura handi, Phymanthus buitendijki* and *Telmatactis decora* were reported from Andaman and Nicobar Islands through this study, which are new record to India, however, no endemism of these anemones could be found in these islands. Earlier, *Actinodendron glomeratum* is known from Fiji, Marshall Islands and Australia; *Calliactis miriam* reported from Marshal Island and Australia; *Anthopleura handi* found in Singapore, Malaysia, Australia and New Zealand; *Phymanthus buitendijki* reported at Indonesia; while *Telmatactis decora* was reported from Maldives and Seychelles.

Reporting of 54 species of sea anemones in Indian waters is quite high, when compared with their records in other tropical and subtropical regions such as 16 species from Singapore (Fautin *et al*., 2009), 16 species from Costa Rica (Acuna *et al*., 2013), 26 species from Panama (Garese *et al*., 2009), 14 species from Abyssal plain (> 1000 m depth) of northwestern Pacific Ocean (Eash-Loucks and Fautin, 2012), 15 species from Antarctic and sub-Antarctic waters (Dunn, 1983), 8 species from Galapagos Islands (Fautin *et al.*, 2007), 22 species from Madang Province (Fautin, 1988) and 21 species from Hawaii (Dunn, 1974). Sea anemones reported from India represent diverse ecosystems like fringing mangroves, estuaries, coastal lagoons, rocky foreshores, sandy and muddy intertidal area, continental and oceanic islands, neritic and oceanic waters up to abyssal depths (Parulekar, 1990). Distribution of sea anemones in west coast of India represents 32 species in different ecosystems such as rocky, muddy, mangrove, estuarine, sandy etc., whereas in Andaman and Nicobar Islands itself, the diversity of sea anemones was little high in the coral reef area of South Andaman (9 species). Sea anemones are subjected to environmental factors that influence or determine their distribution, such as the type of substrate and competiveness for it. The tidal fluctuation is also important because it influences food availability, gametes and larval dispersion and some adaptation is required to resist or avoid wave and current action (Wainwright and Koehi, 1976).

It is recommended that, considering the significance on aquarium trade, medicinal properties, potential of absorbing carbons etc. more

research effort on sea anemones is prerequisite not only in Andaman and Nicobar Islands but also east and west coasts of India and Lakshadweep in order to evolve comprehensive inventory of sea anemones as it plays an integral part of marine biodiversity and ecosystem services.

SUMMARY

Fifteen species of sea anemones were recorded during 2009-12 in the intertidal and sub-tidal regions of Andaman and Nicobar Islands. Of which, five species *viz.*, *Actinodendron glomeratum* Hadden, 1898; *Calliactis miriam* Hadden and Shackleton 1893; *Anthopleura handi* Dunn, 1978; *Phymanthus buitendijki* Pax, 1924; *Telmatactis decora* (Hemprich and Ehrenberg in Ehrenberg, 1834) are new record to India. Besides, diversity and distribution status of 54 species belonging to 40 genera and 20 families of sea anemones reported in Indian waters is given in the paper. Diagnostic characters of all 15 species of sea anemones identified from Andaman and Nicobar Islands during the study are also provided.

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REFERENCES

Acuna, F.H., A. Garese, A.C. Excoffon and J. Cortes, 2013. New records of sea anemones (Cnidaria: Anthozoa) from Cost Rica. *Revista de Biologia Marina y Oceanografia,* **48**(1): 177-184.

Barnes, R.D., 1982. Invertebrate Zoology, Holt-Saunders International Editions, Saunders College, Philadelphia, p.1089.

Annandale, N., 1907. The fauna of barackish ponds at Port Canning, Lower Bengal. P.1. *Rec. Indian Mus.,* **1**(4): 45-74.

Annandale, N., 1915. Fauna of the Chilka lake. The Coelenterates. *Mem. Indian Mus.,* **5**: 21-55

Chapman, F.A., S.A., Fitz-Coy, E.M. Thunberg and C.M. Adams, 1997. United States of America trade in ornamental fish. *J. World Aquacult. Soc.*, **28**: 1-10.

Daly, M. and D.G. Fautin, 2004. *Anthopleura mariscali*, a new species of sea anemone (Cnidaria: Anthozoa: Actiniaria) from the Galapagos Islands. *Zootaxa,* **416**: 1-8.

Dunn, D.F., 1974a. *Radianthus papillosa* (Coelenterata, Actiniaria) rediscribed from Hawaii. *Pacific Sci.,* **28**(2): 171-179.

Dunn, D.F., 1974b. Redescription of *Anthpleura nigrescens* (Coelenterata, Actiniaria) from Hawaii. *Pacific Sci.*, **28**(4): 377-382.

Dunn, D.F., 1974c. *Actiniogeton sesere* (Coelenterata, Actiniaria) in Hawaii. *Pacific Sci.*, **28**(2): 181-188.

Dunn, D.F., 1978. *Anthopleura handi* n. sp. (Coelenterata, Actiniaria), and internally brooding intertidal sea anemone from Malaysia. *The Wasmann J. Biol.*, **35**(1): 54-64.

Dunn, D.F., 1983. Some Antarctic and sub-Antarctic sea anemones (Coelenterata: Ptychodactiaria and Actiniaria). Biology of the Antarctic Seas XIV, Antarctic Research Series Vol. 39 (Ed. Louis S. Kornicker), American Geophysical Union, 2000 Florida Avenue, N.W., Washington D.C., p. 1-67.

Eash-Loucks, W.E. and D.G. Fautin, 2012. Taxonomy and distribution of sea anemones (Cnidaria: Actiniaria and Corallimorpharia) from deep water of the northeastern Pacific. *Zootaxa*, **3375**: 1-80.

Fautin, D.G., 1988. Sea anemones (Atiniaria and Corallimorpharia) of Madang Province. *Science in New Guinea,* **14**(1): 22-29.

Fautin, D.G., 1989. Systematics of sea anemones belonging to genus *Metridium* (Coelenterata: Actiniaria), with a description of *M. giganteum* new species. *The Wasmann J. Biol.,* **47**(1-3): 77-85.

Fautin, D.G., 2005. Three species of intertidal sea anemones (Anthozoa: Actiniaria) from the Tropical Pacific: Description of *Anthopleura buddemeieri* n. sp. with remarks on *Anthopleura asiatia* and *Gyractis sesere*. *Pacific Sci.,* **59**(3): 379-391.

Fautin, D.G. and G.R. Allen, 1992. Field guide to anemone fishes and other host sea anemones. Western Australian Museum, Perth, WA6000 Australia, 67p.

Fautin, D.G., R.A. Eppard and R.W. Mead, 1987. *Acontiophorum niveum* (Cnidaria, Anthozoa), a new species of Acontiate sea anemone with descriptions of Actinian families Mimetridiidae and Ramireziidae. *The Wasmann J. Biol.,* **45**(1-2): 26-33.

Fautin, D.G., A.L. Crowther and C.C. Wallace, 2008. Sea anemones (Cnidaria: Anthozoa: Actiniaria) of Moreton Bay. *Mem. Queensland Mus., Nature,* **54**(1): 35-64.

Fautin, D.G., S.H. Tan and R. Tan, 2009. Sea anemones (Cnidaria: Actiniaria) of Singapore: Abundant and well-known shallow-water species. *Raffles Bull. Zool.,* **22**: 121-143.

Fautin, D.G., C.P. Hickman Fr., M. Daly and T. Molodtsova, 2007. Shallow-water sea anemones (Cnidaria: Anthozoa: Actiniaria) and tune anemones (Cnidaria: Anthozoa: Cerianthaira) of the Galapagos Islands. *Pacific Sci.,* **61**(4): 549-573.

Forum Secretariat, 1999. Marine ornamentals trade quality and sustainability for the Pacific Region. South Pacific Forum Secretariat Trade and Investment Division, Sua, Fiji.

Garese, A., H.M. Guzman and F.H. Acuna, 2009. Sea anemones (Cnidaria: Actiniaria and Corallimorpharia) from Panama. *Revista de Biologia Marina y Oceanografia,* **44**(3): 791-802.

Gomes, P.B., M.J. Belem and E. Schlenz, 1998. Distribution, abundance and adaptations of three species of Actiniidae (Cnidaria, Actiniaria) on an intertidal beach rock in Carneriros beach, Pernambuco, Brazil. *Miscel-lania Zoologica,* **21**(1): 65-72.

Haddon, A.C. and A.M. Shackleton, 1893. Description of some new species of Actiniaria from Torres Straits. *Sci. Proc. R. Dublin Soc.,* **8**: 116-131.

Kwietniewski, C.R., 1898. Actiniaria von Ambon und Thursday Island. Pages 385-430 *in* R. Semon, Ed. Zoologischc Forschungsreisen in Australien und dem Malayischen Archipel. Vol. **5**. Verlag von Gustav Fisher, Jena.

Larkin, S.L. and R.L. Degner, 2001. The US wholesale market for marine ornamentals. *Aquarium Sci. Conserv.,* **3**: 13-24.

Madhu, R. and K. Madhu, 2007. Occurrence of anemone fishes and host sea anemones in Andaman and Nicobar Islands. *J. Mar. Biol. Ass. India,* **49**(2): 118-126.

Panikkar, N.K., 1936. The structure, bionomics and systematic position of two new brackish water Actiniaria from Madras. *Proc. Zool. Soc. London,* **106**: 39-52.

Panikkar, N.K., 1937a. A study of the actinian, *Phytocoetes gangeticus. Zool. Jahb. Abt. Anat.*, **3**: 62-71.

Panikkar, N.K., 1937b. The morphology and systematic relationship of a new boloceroidean from brackish water near Madras. *Proc. Indian Acad. Sci.*, **5**(2): 33-41.

Panikkar, N.K., 1937c. Notes on Nevadne galuca. *Rec. Indian Mus.*, XXXIX, P.IV.

Panikkar, N.K., 1939. Studies on the brackish water anemone *Pelocoetes exul*, Annandale and on a new marine species from Madras. *Proc. Zool. Soc. London*, **108**: 4-7.

Parulekar, A., 1967. Two new species of sea anemones (Actiniaria) from Maharashtra. *J. Bombay Nat. Hist. Soc.*, **64**(3): 524-529.

Parulekar, A., 1968. Sea anemones (Actiniaria) of Bombay. *J. Bombay Nat. Hist. Soc.* **65**(1): 138-147.

Parulekar, A., 1969a. *Neoaiptasia commensali* gen et sp nov: An actiniarian commensal of hermit crab. *J. Bombay Nat. Hist. Soc*, **66**(1): 57-62.

Parulekar, A., 1969b. On a new species of sea anemone from Maharashtra, India. *J. Bombay Nat. Hist. Soc.*, **66**(3): 590-595.

Parulekar, A., 1971. A new sea anemone, *Cribrinopsis robertii* (Endomyaria: Actiniidae) from Maharashtra and Goa coast. *J. Bombay Nat. Hist. Soc.*, **68**(1): 291-295.

Parulekar, A., 1990. Actiniarian sea anemone fauna of India. In: Marine Bio fouling and Power Plants (Eds. K.V.K. Niltil and V.P. Venegopalan) P. 218-228.

Ross, D.M., 1967. Behavioural and ecological relationships between sea anemones and other invertebrates. *Oceanogr. Mar. Biol. Ann. Rev.*, **5**: 291-316.

Verrill, A.F., 1928. Hawaiian shallow water Anthozoa. *Bull. Bishop Mus.*, Honolulu, 49, 30pp.

Wainwright, S.A. and M.A.R. Koehi, 1976. The nature of flow and reaction of benthic Cnidaria to it. In: *Coelenterate Ecology and Behaviour*: 5-21 (G.O. Mackid, Ed.). Plenum Press, New York.

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