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Comprehensive diversity study with few new records of sea anemones along the Saurashtra coast, Gujarat

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Abstract
Cnidarians have high ecological importance because they associate with a vast variety of faunal species and often represented by high species diversity in reefs. Sea anemones are among the most diverse and successful members of the (Phylum: Cnidaria, Class: Anthozoan) subclass Hexacorallia, occupying benthic marine habitats across all depths and latitudes. Many species of sea anemones inhabit rocky shores, especially where there is tide pools in which remain submerged during low tide. The aim of this study was to present diversity and status of the Sea anemone from intertidal area of the Saurashtra coast. The Saurashtra coast which is the Northern part of Indian coastline is characterized by rocky, muddy and sandy intertidal zones harbouring rich and varied fauna which occupies a total stretch of 985 km. For the present study, some sampling sites along the Saurashtra coastline viz., Okha, Shivrajpur (Kachhighadi), Mithapur, Sutrapada, Vadodra-Jhala were selected. There were total 15 species of sea anemones belongs to 5 families and 10 genera were recorded from these selected sites.

Keywords: Sea anemones, Intertidal area, Saurashtra coast, Rocky shore

1. Introduction
The intertidal zone refers to the area of the foreshore and seabed which exposed to the air at low tide and submerged during high tide in marine environment. Intertidal zone have the greatest biodiversity of any coastal habitat as they provide shelter from various abiotic and biotic stress and protection from larger predators [1]. Cnidarians inhabit such intertidal regime subject to the varieties of environmental stresses as they are directly connected with the surroundings [2]. They have high ecological importance because they associate with a wide variety of faunal species and often represented by high species diversity in reefs [3]. Despite their great ecological importance, Sea anemone fauna is poorly known from the Saurashtra coast. Sea anemones are among the most diverse and successful members of the Phylum: Cnidaria, Class: Anthozoa, Subclass: Hexacorallia, occupying benthic marine habitats across all depths and latitudes.

Information on Indian sea anemone were made available from the earlier documentation of Annandale (1915) [4], Panikkar (1936, 1937a-c & 1939) [5-9] and Parulekar (1967, 1968, 1969a, b & 1971) [10-14]. Parulekar (1990) [15] has enumerated 40 species of sea anemones belonging to 33 genera of which 13 species were reported for the first time from India along with their ecological features. However, Madhu and Madhu (2007) [16], Raghunathan *et al*. (2014) [17] and Choudhury *et al* (2015) [18] gave more recent review of Indian benthic fauna from Andaman and Nicobar Island. The sea anemone of Gujarat is still insufficiently studied. There is some handful of papers available from Gujarat: Parulekar (1990) [15] documented *Boloceroides mcmurrichi, Anemonia indicus, Paracondylac indicus, Stoichactis giganteum, Phymanthus loligo, Paraphellia sanzoi and Metridium senile* from the Gulf of Kachchh. However, Hartog and Vennam (1993) [19] had described the Actiniarians like *Bundosoma goanensis, Synantheopsis parulekari* and *Stichodactyla haddoni* from the Okha Coast of Saurashtra. Hence the present study has been carried out as a part of preliminary survey for sea anemone diversity along the intertidal zone of Saurashtra coast of Gujarat.

2. Material and Methods

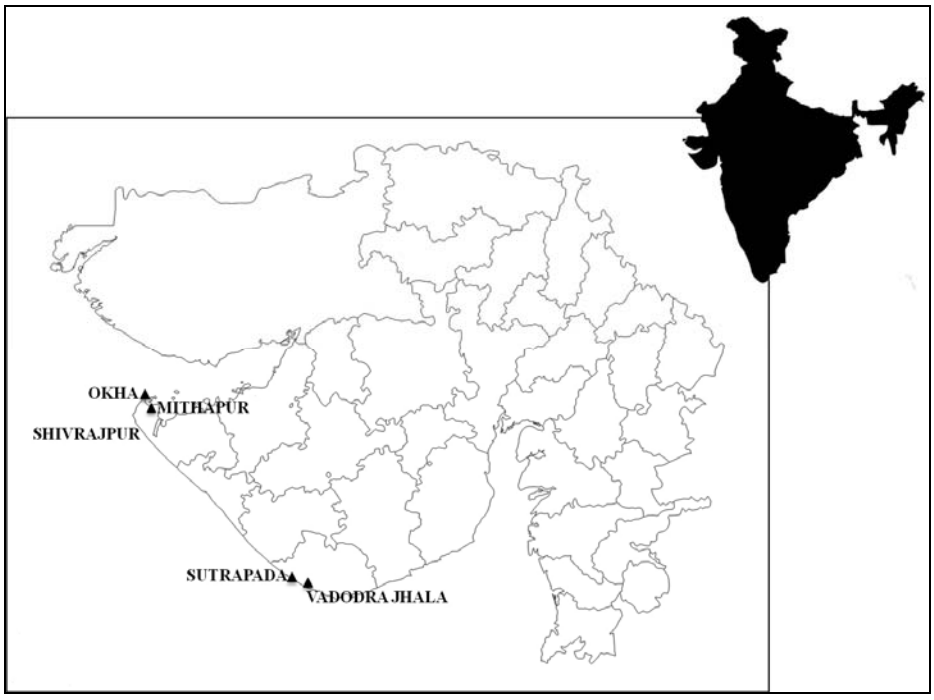

Fig 1: Map of the Gujarat coast showing selected sites

2.1 Study sites: The present study was carried out at five different sites (Fig.1) namely Okha (22° 47' 89.32" N, 69° 07' 62.56" E), Shivrajpur (Kachhighadi) (22° 34' 79.72"N, 68° 95' 63.20"E), Mithapur (22° 29' 32.84"N, 68° 94' 02.09" E), Sutrapada (20° 80' 9.735" N, 70° 53' 0.865" E) and Vadodra-Jhala (20° 78' 16.60"N, 70° 59' 00.83"E) situated along the Saurashtra coast. The habitat characteristics of the intertidal area are diverse in terms of exposure and geomorphology.

2.2 Sampling: Sea anemone diversity was preliminary observed and photographed in situ during the site survey of Saurashtra coast.

2.3 Identification: The identification of sea anemone at genus and species level was based on the study of external characters like Mouth, oral disk, tentacles with their arrangement, column, pedal disk and colouration. The identification of species was carried out using morphological characteristics key following available literature : White (2002) [20]; Lajeunesse and Trench (2000) [21] ; Pearse and Francis (2000) [22] ; Fautin (1988, 2009) [23, 24]; Oscar *et al*. (2005) [25]; Sanamyan *et al* (2013) [26] ; Cowles (2005) [27]; Hartog and Vennam (1993) [19], Raghunathan *et al* (2014) [17], G. Fariman *et al* (2015) [28].

3. Result and discussion

The present study summaries the 15 species of Actiniarian belonging to 5 family and 10 genera along the intertidal zone of Saurashtra coast, Gujarat. Of which 13 species apart from *Stichodactyla haddoni* (Saville-Kent, 1893) and *Heteractis crispa* (Ehrenberg, 1834) are first time reported from Gujarat. Herein, morphological features of 15 species recorded during the present study and their site wise distribution (Table: 1) are illustrated for field identification of live specimens.

Table 1: Geographical distribution of sea anemones along the selected sites of Saurashtra

No.	Species ID	Sutrapada	Vadodra jhala	Okha	Shivrajpur	Mithapur
1	*Anthopleura elegantissima*		+			
2	*Anthopleura sola*	+	+			
3	*Anthopleura dixoniana*	+	+			
4	*Actinia equina*	+	+			
5	*Macrodactyla dorensis*	+				
6	*Anemonia viridis*				+	
7	*Urticina clandestina*		+			
8	*Stichodactyla haddoni*			+		+
9	*Stichodactyla tapetum*			+		
10	*Heteractis crispa*			+		
11	*Heteractis magnifica*			+		
12	*Aiptasia pulchella*			+	+	
13	*Aiptasia diaphana*				+	
14	*Cryptodendrum adhaesivum*			+		
15	*Phymanthus buitendijki*			+		

The present study summaries the 15 species of Actiniarian belonging to 5 family and 10 genera along the intertidal zone of Saurashtra coast, Gujarat. Of which 13 species apart from *Stichodactyla haddoni* (Saville-Kent, 1893) and *Heteractis crispa* (Ehrenberg, 1834) are first time reported from Gujarat. Herein, morphological features of 15 species recorded during the present study and their site wise distribution (Table: 1) are illustrated for field identification of live specimens.

Family: Actinidae (Rafinesque, 1815)
***Genus: Anthopleura* (Fonbressin & Michelotti, 1860)**
1. *Anthopleura elegantissima* (Brandt, 1835) (Fig: 2A)
Habitat: This anemone prefers to live in semi protected areas near the outer coast.

Description: Commonly found either in dense populations or solitary, on rocks and boulders between high and low-tide lines. Column is pale grey-green to white and covered with vertical rows of adhesive verrucae. Numerous, thick and pointed tentacles are variously coloured mainly white, grey and light brown with olive green tips that is visible as a central ring when the tentacles are retracted around the oral disk. Oral disc has radiating stripes with olive green colour. Catch tentacles are heavily armed with stinging cells which intended for fighting other anemones [29].

Remark: *Anthopleura elegantissima* is a new record to India through Gujarat Coast.

2. *Anthopleura sola* (Pearse & Francis, 2000) (Fig:2 B)
Habitat: It lives in the lower intertidal zone of rocky habitat, often in the shelter of cracks and Crevices.

Description: In the low tide it is often concealed by shell fragments and other particles that adhere to it. These Solitary anemones are larger; averaging 6.5 cm across the oral disc. *Anthopleura sola* has olive to bright green short tentacles with pink or lavender tips having white bands or stripes. There are radiating lines and other patterns on the oral disc. The column is green to white having rounded verrucae arranged in the vertical rows.
Remark: *Anthopleura sola* is a new record to India through Gujarat Coast.

3. *Anthopleura dixoniana* (Haddon & Shackleton, 1893) (Fig:2 C)
Habitat: Mostly found in holes of rocks and stones of rocky shore.

Description: These species found on upper intertidal zone, but not in aggregating pattern like many other *Anthopleura spp*. They have acrorhagus on oral site with yellow or white marginal projection. Oral disk is flat and light brown or yellowish in colour. They have yellowish spot with white patches scattered between mouth and tentacles base which form checkerboard disc pattern [24]. Tentacles have white spots or bands along the length.

Remark: *Anthopleura dixoniana* may be confused with *Anthopleura handi* and *Anthopleura nigrescens. A. handi* is dull grey green in colour including verrucae while *A. dixoniana* is lighter in colour. This is a new record to India through Gujarat Coast.

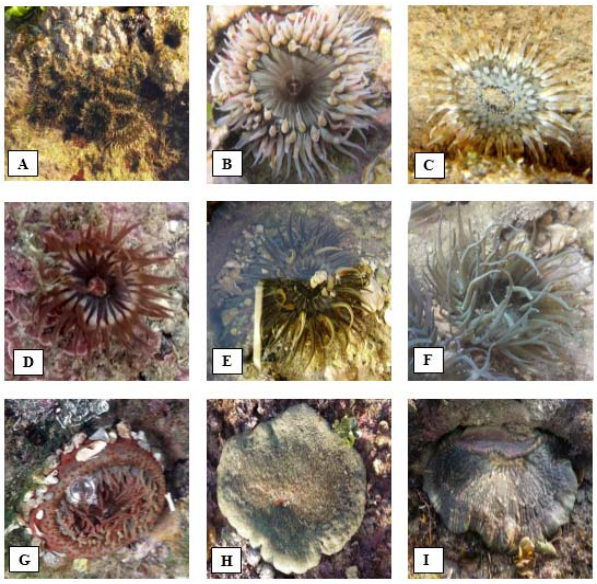

Fig 2: (A) Aggregation form of *Anthopleura elegantissima* (B) *Anthopleura sola* (C) *Anthopleura dixoniana* (D) *Actinia equina* (E) *Macrodactyla doreensis* (F) *Anemonia viridis* (G) *Urticina clandenstina* (H) Expanded oral disk of *Stichodactyla haddoni* (I) *Stichodactyla tapetum*

Genus: *Actinia* (Linnaeus, 1767)
4. *Actinia equina* (Linnaeus, 1758) (Fig:52(D))
Habitat: These anemones inhabit shaded vertical rock walls and tide pools, usually in groups in the lower littoral zone and sheltered areas.

Description: They are soft and having no skeletal elements. Column has wide base of 5-6 cm in diameter. Base formed like a sucker with which it fixes itself to the ground or rock. Tentacles are pointed, smooth and arranged in circles around the oral disk.

Remark: Anemones observed in different colours like red, orange and brown. This is a new record to India through Gujarat coast.

Genus: *Macrodactyla* (Haddon, 1898)
5. *Macrodactyla doreensis* (Quoy & Gaimard, 1833) (Fig:2 E)
Habitat: It mostly buried in sand sediment.

Description: Distal end of column is broadly flared with adhesive verrucae. Upper part of column is brownish with non-adhesive, prominent white circular to eye shaped verrucae arranged in longitudinal manner. Tentacles are sparsh and arranged in corkscrew form [30]. Each pointed tentacles grey or dull green may have white stripes. Strip pattern is throughout the oral disc, tentacle and tentacle free area.

Remark: This species was previously recorded from middle Andaman region.We are reporting this species for the first time from Gujarat.

Genus: *Anemonia* (Risso, 1826)
6. *Anemonia viridis* (Forsskal, 1775) (Fig:2(F))
Habitat: Mostly attached to the bottom of shallow intertidal pools.

Description: They are distinguish by the long flowing tentacles and will usually found in green colors. With up to over 200 sticky tentacles, the anemone grows to 20 cm across and 8 cm tall. The tentacles are lined with venomous stinging cells called cnidocysts. Tentacles rarely withdraw into column. The colour of column is brownish or grayish. The Column is smooth, with a row of inconspicuous warts on the rim of the parapet.

Remark: This species was previously recorded from Maharastra, Goa and North Karnataka and Gulf of Kachchh. Even though well reported from various parts of the western coast of India this species is not recorded in literature thus, it is our first observation and report from the Saurashtra coast.

Genus: *Urticina* (Ehrenberg, 1834)
7. *Urticina clandenstina* (Sanamyan, 2013) (Fig:2(G))
Habitat: Mostly observed from the low intertidal and shallow sub tidal zone.

Description: Anemone is large with the oral disk having an extended crown of tentacles attaining up to 8 cm. Column is cylindrical with circular pedal disk having numerous adhesive verrucae which are present over the whole of its surface. Verrucae are of same colour as of the column and observed with crowded gravels and broken shells [31]. Tentacle in the middle and at the base has a whitish coloured transverse band, encircling it completely from oral and lateral sides only. The bases of the tentacles are outlined by short thin radial lines. The background colour of its oral disk varies from bright to dull red, grey and olive green.

Family: Stichodactylidae (Andres, 1883)
Genus: *Stichodactyla* (Brandt, 1835)
8. *Stichodactyla haddoni* (Saville-Kent, 1893) (Fig:2(H))
Habitat: Commonly inhabits the soft sandy bottoms of the intertidal area. They are also found among small rocky or coral substrates in shallow waters.

Description: The rows of small and non-adhesive verrucae are arranged along the entire length of column having the same colour as the column. Anemone has two distinct types of sticky tentacles: Exocoelic tentacles are white, pointed and long ones at the edge of the oral disc emerging in a radial alignment. Endocoelic tentacles are shorter tentacles on the entire part of oral disc with equal length. Usually the coloration of endocoelic tentacles is entire part of oral disc with equal length. Usually the coloration of endocoelic tentacles is cream and light or dark brown with white streaks on the oral disc. Average size of yellowish to orange oral disc is 250-500 mm when it is extended.

Remark: This species was previously recorded from North, Middle and South Andaman and Gulf of Mannar. From Gujarat it was recorded from Kathiawar Peninsular- Okha, Dwarka and Mithapur.

9. *Stichodactyla tapetum* (Hemprich &Ehrenberg, 1834) (Fig:2 I)
Habitat: Found on rocky and sandy substratum.

Description: The average diameter of the oral disc is approximately 80–100 mm. Oral disc is flat and bulbous. The expanded oral disc is broader than the pedal disc. Pedal disc and column are red to dark pink with narrow white strips. Coloration of tentacles on oral disc is brown or cream with opaque pink tips. Tentacles arrayed in clear radial-oriented groups from mouth to margin having bare space between, with in a wedge. Tentacles so tightly packed together that may be polygonal in outline, like kernels of maize.

Remark: Distribution of this species was recorded from Indian Ocean. We report for the first time from the Gujarat Coast.

Genus: *Heteractis* (Milne Edwards, 1857)
10. *Heteractis crispa* (Ehrenberg, 1834) (Fig:2 J)
Habitat: Found in rock cervices and sandy bottom with only the oral disc and tentacles visible.

Description: The column is generally light brown to white with large, prominent and adhesive bumpy verrucae. The pedal column having sticky foots are much larger than the column in comparison to other anemones. Tentacles are long and brownish grey having purple mauve tips. Tentacles are present on all over the surface of oral disc, giving it a mop appearance. Oral disc is usually brownish violet, grey rarely bright green having white stripes.

Remark: This species was previously recorded from Andaman and Nicobar Islands.
From Gujarat it was recorded from Gulf of Kachchh - Pirotan Island, Dwarka, Veraval and Diu [32].

11. *Heteractis magnifica* (Quoy and Gaimard, 1833) (Fig:2 k)
Habitat: Mostly attached to hard substrata.

Description: This anemone attracts attention due to its intensely column colour (Commonly Red, Blue, Green, Yellow and Magenta) with distal verrucae. Oral disc is undulating and flat having mouth in the center. Tentacles are moderately long and are all over the surface of oral disc.

Remarks: This species was previously recorded from Andaman, Ritchie's Archipelago and Nicobar and Mandapam - Southeast coast of India. (Subramanian et. *al,* 2011) We report this for the first time from the Gujarat Coast.

Family: Aiptasiidae (Carlgren, 1924)
Genus: *Aiptasia* (Gosse, 1858)
12. *Aiptasia pulchella* (Carlgren, 1943) (Fig:2(L))
Habitat: *Aiptasia pulchella* has solitary polyps which favour littoral shaded habitats, including intertidal rocky and sub littoral regions.

Description: They can grow about 3 cm in diameter and 10 cm tall depending on the species. Oral disc has a mouth in the center and bordered by the tentacles. Tentacles are tons of long stinging tentacles positioned in narrow rings on the outer margin of the oral disc. These anemones produce genetically identical individuals through pedal laceration to spread quickly and enable vertical transmission of their symbionts.

Remarks: *Aiptasia sp*. Recorded from the Mumbai [15]. We reported first time from the Gujarat coast.

13. *Aiptasia diaphana* (Rapp, 1829) (Fig:2 M)
Habitat: found in shallow intertidal rocky shoreline attached to rubble, dead corals and other hard substrate.

Description: Anemone is somewhat translucent and generally occurs in brownish to greenish colour. *Aiptasia diaphana* are quite small, only reaching about 3 cm tall. This anemone will rapidly retract its tentacles, becoming a very small ball, and it will retract into its hole or crevice. Field populations of this species can form a dense carpet on substratum [34].

Remark: *Aiptasia diaphana* is a new record to India through Gujarat Coast.

Family: Thalassianthidae (Milne Edwards, 1857)
Genus: *Cryptodendrum* (Klunzinger, 1877)
14. *Cryptodendrum adhaesivum* (Milne Edwards, 1857) (Fig:2 N)
Habitat: it is usually well hidden in crevices or under large dead corals.

Description: Oral disk is thick and velvety round. Anemone appears swollen and looks like a hem. Mouth is about 1 cm in diameter on center of the oral disk. Tentacles on oral disk are short and tiny. Tentacles morphology: Marginal tentacles having fewer branches whereas central tentacles having five branches (reassembling a hand). Pedal disk has sticky foot at the bottom which adheres to the substrates.

Remark: This species was previously recorded from South, Middle and North Andaman. *Cryptodendrum adhaesivm* is a new record from Gujarat coast.

Family*:* Phymanthidae (Andres, 1883)
Genus*:* *Phymanthus* (Milne Edwards, 1857)
15. *Phymanthus buitendijki* (Pax, 1924) (Fig:2 O)
Habitat: Mostly found buried in sand substratum of littoral zone.

Description: Column is smooth, inconspicuous verrucae and 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 colored. Most of the tentacles are curved which looks like fishing hook.

Remark: This species is previously recorded from South Andaman region. *Phymanthus buitendijki* is the first report from Gujarat.

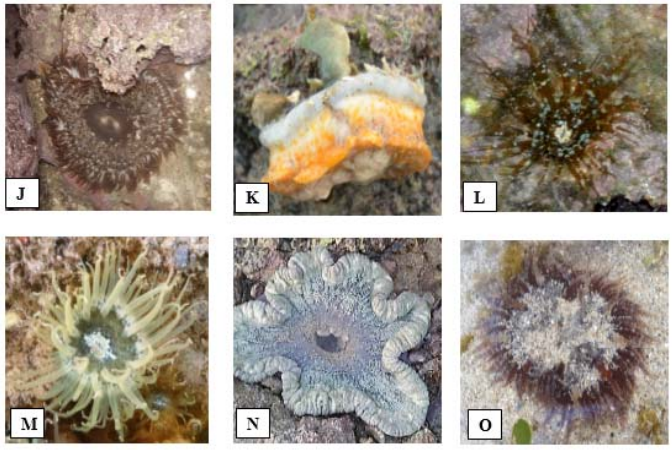

Fig 2: (J) *Heteractis crispa* (K) Retracted *Heteractis magnifica* observed with column (L) *Aiptasia pulchella* (M) *Aiptasia diaphana* (N) *Cryptodendrum adhaesivum* (O) *Phymanthus buitendijki*

The topography of the Okha, Mithapur and Shivrajpur is predominately rocky with sand deposition. Among all the sites intertidal zone of Okha is found to be having highest diversity of species belongs to Stichodactylidae family as they lived attached firmly to the substrate by its pedal disk with the column buried in sandy substrate. Rocky Intertidal zone of Sutrapada and Vadodara-Jhala supports the rich diversity of Actinidae family as these sites having large number of tide pools with very few sand patches. The distribution of other species was sporadic in nature.

4. Conclusion

Here we report the diversity of sea anemones along the Saurashtra coast, Gujarat as preliminary observation. Such documentation is not available hence this effort was carried out. However, sea anemone favours the distinct substrate specificity and habitat preference their diversity is different along the Saurashtra coast. Specific set of morphologic features distinctly separates them to lead to species confirmation. Along the Saurashtra coast in diverse habitat a total of 15 species recorded by now. Of which 13 species are new records to Gujarat. This species level identification also needs confirmation through some anatomical features and molecular characteristics that is presently ongoing activity of our research group. A unique observation is made that there are various attachments to biologic or other objectives and burrowing in bottom deposits to sea anemones.

5. Acknowledgement

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RESEARCH ARTICLE

FIRST EVIDENCE OF AGGREGATING SEA ANEMONE, *ANTHOPLEURA ELEGANTISSIMA* (BRANDT, 1835) FROM THE SAURASHTRA COAST, GUJARAT

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ABSTRACT

This communication reports the first documentation of the Actiniarian, *Anthopleura elegantissima* (Brand, 1835) which was found at mid littoral zone of Vadodra jhala, Saurashtra coast of Gujarat. Till date there are no records available on this species and its aggregation form in Indian waters. Interestingly, this species of anemone *Anthopleura elegantissima* known particularly for its aggressiveness, also display acrorhagi on contact with members of the same or other species.

INTRODUCTION

The exclusively solitary presence of sea anemone in their respective habitats is well established and has been understood in major reference works (Francis, 1988; Shick, 1991). However, anemones also form large colonies which are tightly packed together and are known as aggregating or colonial form of anemones. *Anthopleura elegantissima* is the member of most widely distributed and largest family, Actiniidae (Ford, 1964). It is described as occurring in two forms, solitary and aggregating which may be found in somewhat different microhabitat (Francis, 1979). Aggregating form of anemone is commonly found in exposed position on open rock surfaces in the mid littoral zone as it is more tolerant to wave action, desiccation and temperature extremes. Distribution pattern for such zooxanthellae hosted anemone has been recorded from west coast of Canada (Bates *et al.,* 2010). While the biogeography (LaJeunesse and Trench, 2000) and aggressions (Ayre and Grosberg, 1995) were studied from California. No such records were found in the literature in Indian context.

MATERIALS AND METHODS

Survey was carried out at Saurashtra coast of Gujarat, in order to investigate and documentation of Anthozoan diversity. The organisms were photographed in situ using digital camera before collection and the images were used to characterize external morphological characters. Specimens of the organisms were collected and preserved using proper techniques for further studies. Geo-locations were noted down using in built GPS device in the camera.

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RESULTS AND DISCUSSION

Systematics

Phylum: Cnidaria
Class: Anthozoa
Order: Actiniaria (Haeckel, 1896)
Family: Actinidae (Rafinesque, 1815)
Genus: *Anthopleura* (Fonbressin & Michelotti, 1860)
Species: *Anthopleura elegantissima* (Brandt, 1835)

During the survey of Anthozoan diversity, we have observed aggregating sea anemone, *Anthopleura elegantissima* (Brand, 1935) at the coast of Vadodra Jhala (Latitude: 20°48' 47.55"N, Longitude: 70°31' 14.37"E), Gir Somnath district, Gujarat (Fig.1). Individuals of aggregating form were observed less than 3.5cm across the oral disk (Fig. 2(A)). Inter-clonal interactions among sessile and clonal anemones, often involves aggression, which entrails the deployment of specialized structures (e.g., acrorhagi, catch tentacles) that are heavily

Fig. 1. Map of surveyed intertidal area of Vadodra Jhala coast

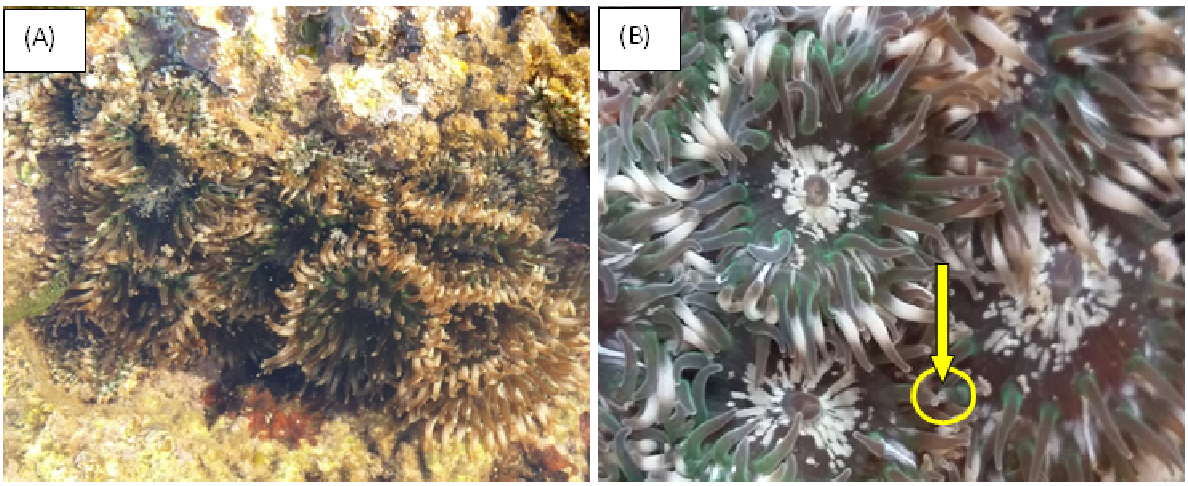

Fig. 2(A) Aggregating form of *Anthopleura elegantissima* (B) inflated acrorhagus

armed with batteries of penetrant, toxic nematocyst (Ford, 1964). This species has a ring of white knobs, called acrorhagia, just outside their ring of tentacles. The acrorhagia are loaded with stinging cells and are used for fighting other anemones. (Fig: 2(B)). Oral disc is olive green in colour with radiating stripes. Column is pale grey-green to white and twice as long as width when completely extended. It is covered with vertical rows of adhesive tubercles called verrucae. Tentacles are variously coloured mainly with grey and white while the tips are of olive green colour which are visible as a central ring when the tentacles are retracted, and the tentacles which are numerous, thick and pointed are arranged in 5 rings around the oral disk. Along the exposed rocky shores of the coast, the sea anemones form dense clonal aggregations in the mid littoral zone. *A. elegantissima* lives on the rocky substratum; thus local topography and other physical features of the habitat proximally constrain the size, shape and continuity of aggregations.

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Short Communication

Surveillance of Gravel Attached Sea Anemone

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Abstract

Sea anemone, Urticina cledenstina (Order: Actiniaria, Family: Actinidae, Genus: Urticina) is commonly found in the mid littoral zone at Vadodara-jhalaof the Saurashtra coast, Gujarat. Its presence in shallow tide pools in the intertidal zone makes them at risk to various environmental stresses during both low and high tide. The purpose of the present study is to provide evidence of the adaptive strategy of Utricina cledenstina for the survival against the environmental stresses. The adherence of the gravel and shell to the external surface of the organism is the survival peculiarity for imitating surrounding habitat. This facilitates the camouflage.

Keywords: Sea anemone, camouflage, intertidal zone.

Introduction

Anthozoans inhabit intertidal regime subject to the varieties of abiotic and biotic stresses as they are directly connected with the surroundings[1,2]. In nature, attachment of gravel and shell particles to the body walls of intertidal Anthozoans is a common phenomenon. During low tide these anemones retract their tentacles and continue to fold in it, closing until it appears to be nothing more than a protuberance of sand and tiny shells.The apparent camouflage strategies of sea anemone may beneficial to avoiding recognition by potential predators and other environmental stresses through reassembling other species or object in its environment[3].

Anthozoans found at nearly all the marine environment demonstrate various types of strategic adaptations for their survival[4]. One of such adaptation is symbiosis.Nature and role of symbiotic association between sea anemones and gastropods have been documented[5].Such is also reported from Narara reef of Saurashtra coast, here the stationary anemone living as an epibiont life on the shell of the gastropod and gets a 'mobile home' allowing it greater exposure to food by movement of gastropod[6].

However in present report, sedentary sea anemone represents another type of adaptation for its survival. Distinct adaptation strategy of a sea anemone was observed at coastal region of Vadodara Jhala village of Saurashtra Coast, Gujarat. It was observed that *Urticina cledenstina*[7] (Order: Actiniaria, Family: Actinidae, Genus: Urticina) found attached empty gastropods shells and gravel which thus showing both camouflage and as a deterrent to possible predators. The assemblage of such sea anemone was observed in the mid littoral zone (latitude: 20˚ 48' 51.042" N, longitude: 70˚31' 97.356" E) comprise of several tide pools anatomising with each other forming big network of aquatic regime as well as open rocks. In the supra littoral zone i.e. having lesser tide pools, such anemone zone is not marked. This may be attributed to substratum as well as water quality. The role of the tide pool is to be studied further for better understanding of the distribution pattern and habitat preferences of these animals.

From sporty observation, gravel and shell attached to the outer surface of the body having adhesive projection, known as verrucae; which have been implicated in the attachment of gravel and shell particles to the body wall[8]enhancing their camouflage[9] and protection against predation[10]. The gravel found stuck to their body is thought to protect the animal and its algal symbionts by providing shade fromdirectly sunlight exposure of to the tissue[11]. The simplest mechanism by which the attached gravel results in reduction of the rate of evaporative water loss is that the gravel reduces the surface area available for transpiration of water vapour[8]. The attached gravel and shells could also be dispersing wave action as the tide ebbs and flows each day.

Conclusion

Many intertidal organisms represent various adaptation strategies, one of such camouflage mechanism observed in sea anemone at Saurashtra coast of Gujarat. It involves protection against predation, exposure to sunlight and other environmental stress. This is the preliminary study which accounts behavioural study of anemone. Such example strengthens knowledge of adaptations of animals in local area.Further study on behavioural mechanism and species conformation is required hence, in progress.

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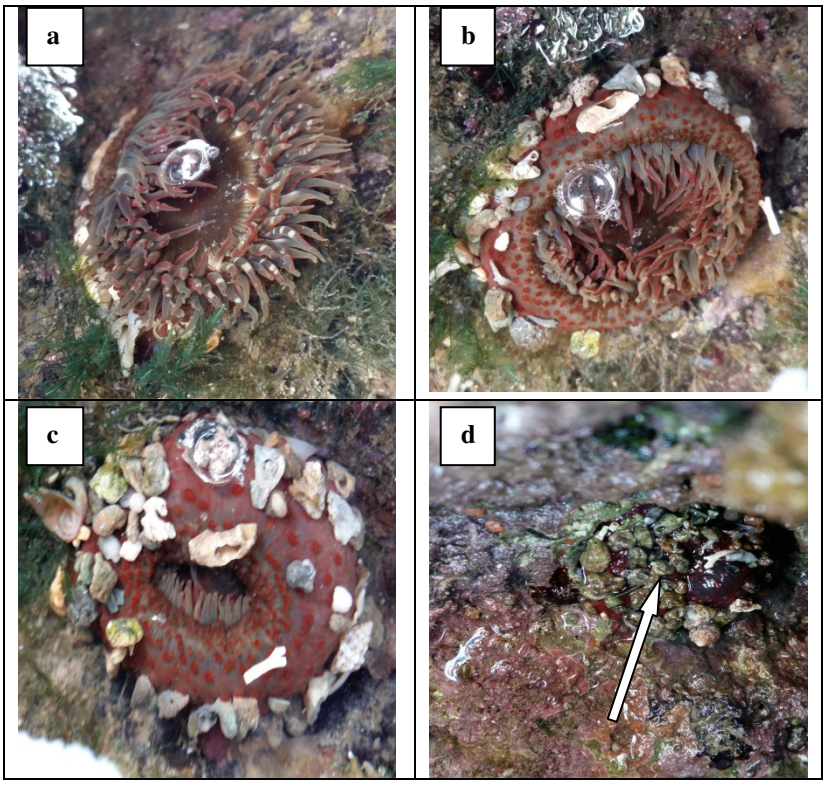

Figure-1

(a) Animal in submergence. Sea anemone having flat and circular oral disk with brick red to bright red column, Tentacles are bright to dull red and olive green with thin red radial line; (b) and (c) The retracted tentacles, showing characteristic warts (verrucae) and adherent gravel and shell; (d) The Sea anemone showing camouflage mechanism with rarely visible column

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