Journal of Entomology and Zoology Studies

Available online at www.entomoljournal.com

E-ISSN: 2320-7078
P-ISSN: 2349-6800
JEZS 2019; 7(4): 410-416

Received: 13-05-2019
Accepted: 15-06-2019

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Some important sightings of marine fauna in Southern Gulf of Kachchh, Gujarat, India

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Abstract
Coral reef ecosystem is higher in productivity in terms of diverse fauna, providing food and shelter to various marine organisms. Several marine organisms existing are being under threat due to coral bleaching and climate change during recent years. Gujarat, located on west coast of India is the northern most coral reef in the country. Southern Gulf of Kachchh comprises of total 42 islands in the Gulf of Gujarat. The present paper gives a report on six species and two genera not reported so far from the Southern Gulf of Kachchh. Some of these species are new to the region of Gujarat and Mainland India. These species were encountered in the intertidal pools in the Marine National Park, Jamnagar, Gujarat India during field surveys carried out while studying biodiversity of southern Gulf of Kachchh with reference to coral bleaching and climate change.

Keywords: Gulf of kachchh, *Bolinopsis spp.*, *Aequorea forskalea*, *Stichodactyla tapteum*, *Heteractis magnifica*, *Phymanthus spp.*

1. Introduction
Of the four major coral reefs of India the one in Marine National Park (Southern gulf of Kachchh, Jamnagar, Gujarat) is assumed to be comparatively less threatened by Global Warming and Climate Change (Annonymous, 2018, Unpublished data) [2] as it has been facing high temperatures, high salinity, higher turbidity and higher tidal fluctuations over the centuries. We have reported 10 new records from the area (Mirza *et al*., 2017, Padate *et al*., 2018) [21, 23]. Here, we report few more records from the same study area. This reef in the Gulf of Kachchh is the northern most reef of India, with an abundantly rich diversity of marine fauna (Kunte *et al*., 2003; Venkataraman *et al*., 2003) [19, 33]. The vast area of the gulf is covered with sandy, muddy and rocky shores along the coastline providing ideal habitats for these diversified species.
The fauna and flora of this open gateway are likely to be exposed to the pollution caused by the movement of large commercial ships heading towards the Kandla Port, as well as several petroleum-based industries.
The century old reef-based biodiversity research in the Gulf of Kachchh started under the authorship of Hornell (1909) [17] still remains incomplete as more and more new species are being reported in the area. Two volumes of his work published for the state of Baroda ruled by HH Maharaja Sir Sayajirao Gaekwad III is one of the finest descriptions of the coral reef fauna of Okhamandal (now known as Poshitra cluster). Hornell described some of the important groups of the reef diversity such as Hydroids, Polyzoans, Nudibranchs and Poriferans. In recent years, Kundu (2001) [18] has described the intertidal macro fauna of the Narara and Sikka intertidal areas, Dave (2011) [8] has conducted an ecological assessment of Narara reef, while Parasharya (2012) [25] has studied corals and some associate fauna in Marine National Park and Sanctuary, Gujarat in details. During the same period GEER Foundation, Gandhinagar, Gujarat, India, also conducted surveys as well as worked on coral implantation in the area (Pandey *et al*., 2010) [24]. The Gulf of Kachchh because of its unique characteristics has been explored under several other studies too, (See Sreenath 2014; Chandra *et al*., 2016) [30, 7]. Our group has also worked in this region to study the biodiversity with reference to coral bleaching/climate change. Under the present study, we report some interesting rare species, which have been encountered by us during our survey and not reported so far in the Gulf of Kachchh, the State of Gujarat and Mainland India.

2. Materials and Methods

The species encountered during the island visits were photographed with a Nikon Coolpix AW120 camera. They were identified with the keys and field guides available.

Study site:

The Gulf of Kachchh (Fig. 1) on the western side is 71 km wide and connected to the Arabian Sea. It narrows down to less than 6 km on the east at Navlakhi, forming a unique system with one of the highest tidal fluctuations in the world (Anonymous, 2002). The report is based on visits to three islands in the Southern Gulf of Kachchh (GoK).

These islands are:

Pirotan Island (Fig. 2): The island is located 12 km away from the coastline and lies between 22°24.4'N - 22°27.5'N and 69°35.3'E - 69°39.4'E. It is very well known for its rich biodiversity. It has vegetation of *Avicennia* spp., *Rhizophora* spp., *Ceriops* spp. and few trees of *Aegiceros* spp. that are the major contributors to the vegetation of the island. The island comprises of a sandy beach and a rich coral reef on the northern side.

Goose submerged reef (Fig. 3): This island is located 6 km away from the coastline and lies at 22° 28.6'N - 22° 30.6'N and 69° 47.0'E 69° 50.4'E. It remains submerged during high tides and opens during the low. Since the island remains submerged, mangroves are not present. While some regions of the reef are covered with sandy and muddy parts.

Kalumbhar Island (Fig. 4): This island is located 4 km away from the Vadinar jetty and lies between 22° 24.4'N 22° 27.5'N and 69° 35.3'E 69° 39.4'E. This island is the largest among all islands in the GoK. Kalumbhar has a dense vegetation of mangroves, in an area of 602 hectares that is dominated by *Avicennia* spp. along with *Ceriops* spp. and *Salvadora* spp. occupying small patches. The island has a sandy beach.

3. Results

During the survey in the GoK with muddy, rocky and sandy shores which are exposed during the low tides, six species and two genera encountered on the three islands were found to be new to the study area, for Gujarat and for mainland India. These include two species of jellyfish (family Bolinopsidaae and Aequoreidae) four species of sea anemones (family Stichodactylidae, Phymanthidae and Sagartiidae), one species of crabs (family Inachidae), and one species of polychaete worm (family Sabellidae). For genara *Bolinopsis* and *Phymanthus* species could not be identified. The details of all the total 8 species is as follow.

a. *Bolinopsis* spp. (L. Agassiz, 1860) (Fig. 5)

It is an oblong comb jellyfish belonging to the order Lobata of family Bolinopsidae. Its body is similar in outline to that a chicken egg in both size and shape, i.e., with one end somewhat larger and more rounded than the other; almost colourless and transparent. It has two lobes at the larger end, capable of expanding like scoops, or often held curled in, giving the animal an egg-like shape. Its body is extremely soft and breaks apart easily (Gerschwin *et al*., 2010) [15]. Bolinopsis spp. is known to occur in the Northern Atlantic, its range extending from the Arctic to the Mediterranean Sea in the east and the Gulf of Maine in the west. It also occurs in the Pacific Northwest from the Bering Sea to California (Mathieson *et al*., 2014) [20]. It is reported at the Pakistan coast (Shahnawaz *et al*., 2015) [29], which is a few hundred kilometres from the GoK.

b. *Aequorea forskalea* (Peron & Lesueur, 1810) (Fig. 6)

This jellyfish belongs to the order Leptomedusae. The tentacles and their basal bulbs have a typical appearance of species, being elongated, conical, with very slight lateral extensions (Gurlek *et al*., 2013) [16]. It is common in North Western Europe, from where its distribution extends southwards along the West Coast of Africa, at least as far as in the Gulf of Guinea. It is also common in the Mediterranean and on the East Coast of North America. It has been recorded from the Indian Ocean (Gurlek *et al*., 2013) [16].

c. *Stichodactyla tapetum* (Hemprich & Ehrenberg in Ehrenberg, 1834) (Fig. 7)

It is known as mini Carpet Anemone of the order Actiniraria, mainly found from Japan to Australia, the Indian Ocean to New Caledonia and the Red Sea (Fautin, 1981; Fautin, *et al*., 2008) [11, 13], Singapore (Fautin *et al*., 2009) [14] and the Southeastern Coast of Iran (Fariman *et al*., 2015) [10]. Its base is round, regular and flared beyond the lower column. It has the same colour as column. On its tentacles, greenish and brownish radial stripes are present with yellowish flecks. Its column length is typically about one half pedal disc in diameter, but may be taller. Its tentacles are very short; bulbous; densely packed and may be arrayed in all directions on the entire disc. Its densely packed tentacles may be rectangular in shape or resemble kernels of the maize crop (Fautin, 1981) [11]. Sreenath (2014) [30] has reported this species from the Gulf of Kachchh as other faunal diversity but the location is not given. Shah *et al* (2017) [28] have recorded this species recently from nearby area of Okha, outside the mouth of Gulf. However, no other records of this species in Gujarat are known.

d. *Heteractis magnifica* (Quoy & Gaimard, 1833) (Fig. 8)

It is a magnificent sea anemone, also known as the Ritteri anemone. It is a native of the Indo-Pacific area. This magnificent sea anemone is widespread throughout the tropical and subtropical waters of the Indo-Pacific area, from the Eastern Coasts of Africa, Red Sea included, to Polynesia and from the South Japan to Australia (Arvedlund *et al*., 1996) [5] and New-Caledonia (Fautin, 2007) [12]. Individuals found are pillar like with solid columns, which are generally pink in colour. Its distal verruca present in the column is of the same colour. The oral disc of this anemone is flat and brownish or gently undulated. These are covered by moderately long tentacles, which are blunt or slightly inflated towards the end. The tip of their tentacle is usually bright in colour than the rest of the body. Its mouth is raised on a cone and the area around it is yellow in many individuals (Fautin *et al*., 2009) [14]. Raghunathan *et al* (2014) [26] have reported this species from the Andaman and Nicobar Islands, while Santhosh *et al* (2016) [27] have reported this species as the 'Host anemone fish" in the tidal pools of the same area. Shah *et al* (2017) [28] report this species from Okha and Shivarajpur reefs.

e. *Phymanthus* spp. (Milne Edwards & Haine, 1851) (Fig. 9)

This is a genus of the order Actiniaria. Its column is smooth and bluish grey in colour with inconspicuous verrucae. It has characteristic marginal tentacles with peculiar side branches. Its oral disc is dark greenish blue with the mouth located on the cone, and covered with sediments in most of the animals. Small darker warts, arranged in short radial series on its disk,

are actually the discal tentacles. Its tentacles are long with tapered tips and small flower like projections attached on them. These are arranged alternately, highly branched and brightly coloured. Purple lines are present between its oral disc and the tentacle tip. Most of the tentacles are curved inward which look like a fishing hook (Raghunathan *et al*., 2014; Actiniaria, 2017) [26]. This species is distributed along Indonesia and the genus has been reported from the Andaman and Nicobar Islands by these authors, but it still remains new to the Western Coast of India.

f. *Sagartia ornata* (Holdsworth, 1855) (Fig. 10)

It is a species of the order Actiniaria, its oral disc is internally brownish and externally greenish, with creamy radial stripes. Its tentacles have the same colour as oral disc, but with white spots; while few tentacles are completely white. Its column has a pale pink cast, usually turning dark greenish towards the margin. In preserved specimens, the column is creamy, but the green colour persists distally (Acuna *et al*., 2004) [1]. Acuna *et al* (2004) [1] describes that in most individuals the oral disc is typically flat; with a slit-like appearance in place of the mouth. Its actinopharynx is shallowly furrowed longitudinally and usually cream in colour. Its numerous tentacles, up to 200 in number, are arranged in 4–5 cycles, the internal being longer than the external, and the last two cycles considerably smaller than the others. Its column is cylindrical, with adhesive suckers in the upper part, sometimes with exogenous material attached. Its pedal disc is adherent and smaller than the oral disc. The known distribution of this species extends from Iceland and Scandinavia, to the Mediterranean, and Africa (Acuna *et al*., 2004) [1]. Hornell (1909) [17] has reported the existence of the genus in the Okhamandal report, Gujarat. However, the species was not identified and hence our observation remains new to the area.

g. *Sabellastarte magnifica* (Shaw, 1800) (Fig. 11)

This species belongs to the order Sabellida. The distribution includes Aruba, Bonaire, Caribbean Sea, Gulf of Mexico and Jamaica (eol.org 2017) [38]. It is a large bodied species 70-142 mm long with 53-69 mm long branchial crown. Each side of the crown base is involuted ventrally to form a circle. Its outer surface of radioles is dark with pale longitudinal lines (Tovar *et al*., 2006) [31]. Radiolar tips are short and blunt. The lateral margins of its collar are transverse to the axis of the body and well above the junction between its crown and thorax. Dorsal margins are equally high, with notches above collar pockets, defining well-developed dorsal lappets, with rounded margins. It has thoracic inter-ramal eyespots. Its first segment is somewhat longer than the following segments and its thoracic tori is long, extending towards ventral shields. Its pygidium is rounded (Tovar *et al*., 2006) [31]. This species has been reported only in the form of photograph by Apte (2012) [4] but its distribution in India is not mentioned.

h. *Camposcia retusa* (Latreille, 1829) (Fig. 12)

This species is from the order Decapoda and belongs to the family Inachidae. It is commonly known as the Spider Decorator crab, a species of marine crustacean in the family Inachidae. The Spider Decorator crab is widespread throughout the tropical waters of the Indo-West Pacific area, including the Red Sea (eol.org 2017) [38]. Its carapace is pyriform and dorsally smooth, and Chelipeds are shorter than any of the ambulatory legs (Naderloo *et al*., 2015) [22]. Dev Roy, 2012 reported this species from the Andaman and Nicobar Islands and Beleem *et al* (2017) [6] from the muddy shore of Sikka at GOK.

4. Discussion

We have referred to the written records of the various marine fauna in India (Hornell 1909) [17] and each species listed here, on the Internet. On the basis of our study of records and references related to the above mentioned species, there is no mention of the distribution of six species encountered in the inter tidal zone in the GoK, while 2 species are recorded from Gujarat Coast. However, none of these species are recorded from other parts Mainland India. We, therefore, record the distribution of Jellyfish *Bolinopsis* spp. as a new report from the West Coast of India. There are four species of sea anemones reported, out of which *Stichodactyla tapetum* has been reported by Sreenath in 2014. However, its distinct locality is not reported. On the basis of the present survey, we record it from two islands Pirotan and Kalumbhar. *Sagartia ornata* is new to the region, though previously the genus was shown to be present at Okha (Hornell, 1909) [17]. *Heteractis magnifica* has been reported from the Andaman and Nicobar Islands (Raghunathan *et al*., 2014) [26] and in Gujarat outside GoK (Shah *et al*., 2017) [28] so far it has not been reported from GoK; hence this is a new report from Goose reef, the GoK. *Phymanthus* spp. also has been reported from the Andaman and Nicobar Islands (Raghunathan *et al*., 2014) [26] but is new to the Coast of Gujarat. One species of polychaete worm *Sabellastarte magnifica* is found to be new to the West Coast of India. However, it is reported from the book, Field Guide to Marine Life of India by Apte in 2012, but the location is not described. One crustacean *Camposcia retusa* is found in the Pirotan Island. This has been reported from the Andaman and Nicobar Islands by Dev Roy (2012) [19], not reported by Trivedi (2015) [32] from the Gujarat coast while Beleem *et al* (2018) [6] have reported the presence of the same from the muddy shores of Sikka.

The GoK is connected to the open Arabian Sea and has some distinct features. As a result of which the tidal fluctuations in the region are high. The Arabian Sea has unique currents, which may direct species towards the east and later towards the Gulf. In addition, Kandla, one of the busiest ports of India is situated at the eastern end of the GoK, whereas its Southern Coast is a host to several petroleum and other related industries. Consequently, heavy movement of vessels occurs in the GoK region. The occurrence of larvae of the species listed in the ballast water cannot be ruled out. Hence, it is possible that either due to ocean currents, tidal fluctuations or heavy ship movements, these species have drawn towards the gulf and found a suitable habitat for their survival. However, the number of individuals recorded for each species is single.

Fig 1: The Gulf of Kachchh, Gujarat

Fig 2: Pirotan Island

Fig 3: Goose submerged reef

Fig 4: Kalumbhar Island

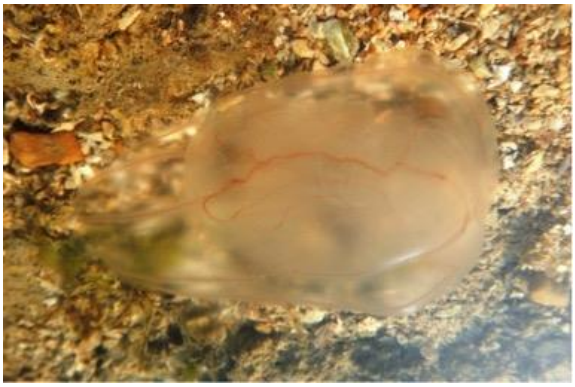

Fig 5: *Bolinopsis* spp.

Fig 6: *Aequorea forskalea*

Fig 7: *Stichodactyla tapetum*

Fig 8: *Heteractis magnifica*

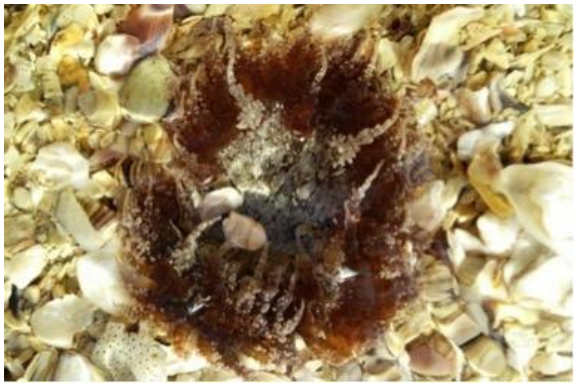

Fig 9: *Phymanthus* spp.

Fig 10: *Sagartia ornata*

Fig 11: *Sabellastarte magnifica*

Fig 12: *Camposcia retusa*

5. Conclusion

The southern part of the Gulf of Kachchh, for long, has been a region rich in biodiversity, especially in terms of marine fauna. Due to its association to the open sea, its distinct pattern of currents and its tidal fluctuations, new species tend to gather here, not only from different parts of the Arabian Sea, but also the world. Based on our efforts of field survey for more two years, the reported species are found to be new to the locality, which makes the area rich in terms of biodiversity. It may be noted that the species reported by us during our field visits have been distinctly found and have had no appearance in any survey conducted in the past.

6. Funding

The funding for the present study has been received from the Ministry of Earth Sciences, New Delhi for a project entitled "Study of biodiversity of Southern Gulf of Kachchh with reference to coral bleaching/climate change" under the network project "Marine coastal ecology of west coast of India" Ref. No. MoES/16/06/2013-RDEAS.

7. Acknowledgements

The Authors are thankful to the Ministry of Earth Sciences, Government of India, New Delhi for funding the Project under which the work was carried out. We are also thankful to PCCF Gandhinagar. Permission for the study was taken from PCCF Wildlife Gandhinagar, Gujarat, India vide Ref. No. WLP/28/C/126-27/2015-16. We are also thankful to Gujarat Biodiversity Board for granting us permission to study the biodiversity of the area vide Ref. No. GBB/form-1/T-3b/1630/2105-16 and CCF Jamnagar, for his permission, inputs and healthy discussions from time to time. We are also thankful to our local field assistant Irfanbhai to accompany us during the visits, Dr. C. Raghunathan from the Zoological Survey of India, Port Blair and Gunjan Soni for helping in crustacean identification.

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