

FIRST REPORT OF ENDEMIC TAIWANESE CARYOPHYLLID CORAL *POLYCYATHUS CHAISHANENSIS* FROM INDIAN WATERS

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AHERMATYPIC CORALS
CARYOPHYLLIIDAE
AZOOXANTHELLATE
NEW RECORD
ANDAMAN AND NICOBAR ISLANDS

ABSTRACT. – Ahermatypic corals are mostly distributed in the greater depth region in comparison with shallow areas while inter-tidal zones are representing very limited species diversity. The family Caryophylliidae harbors the maximum species of ahermatypic corals including a maximum of azooxanthellate corals also. *Polycyathus chaishanensis* Lin, Kitahara, Tachikawa, Keshavmurthy & Chen, 2012 is an endemic zooxanthellate caryophylliid coral of inter-tidal habitats of Taiwan. This present paper deals with a new distributional record of *P. chaishanensis* from a tidal pool of Andaman and Nicobar Islands as a new addition to Indian waters.

INTRODUCTION

Andaman and Nicobar Islands are representing enriched coral reef ecosystems as fringing reefs from the coastal areas of these islands while a barrier reef is also reported before a century in the western coastal areas in the Bay of Bengal region (Venkataraman *et al.* 2003). Most of the coral reef habitats of this archipelago are restricted to the shallow water region. Due to the availability and proximity, most of the studies were attributed to the reef-building corals while limited studies were made on the ahermatypic corals which remain as a lesser-known group in the Indian context (Mondal *et al.* 2012, 2014, 2017). As per the global perspective, azooxanthellate corals are sharing more than 45 % of scleractinian species (Cairns 2016) whereas only less than 10 % of azooxanthellate corals have been known among the Indian scleractinians species database. Among the azooxanthellate corals of the world, the family Caryophylliidae is contributing the maximum species diversity including 10 % of species with zooxanthellate and apo-zooxanthellate characteristics (Reyes *et al.* 2009). *Polycyathus* is one of the 44 genera under the family Caryophylliidae with a total of 20 species of ahermatypic corals including 18 species of azooxanthellate corals and two zooxanthellate coral species (Wijsman-Best 1970, Kuo *et al.* 2020, Kitahara & Cairns 2021, WoRMS 2022). The present paper deals with one species of *Polycyathus* from Indian waters as a new distributional record while this species is thought to be endemic to Taiwan only (Kuo *et al.* 2019).

MATERIALS AND METHOD

Study site: Sampling of the specimens were carried out at Interview Island, Neil Island, South Reef Island, and Paget Island of Andaman and Nicobar Islands from 2015 to 2019 (Fig. 1).

Survey and sampling: Thorough observations were made around the four islands entirely during the survey period. Inter-tidal studies were carried out comprehensively to record the scleractinian corals from coastal areas during the low-tide time. The colonies of the specimen were sampled by hand-picking method with the help of a hammer and chisel from the tidal pools of the inter-tidal region. The colonies were found attached to a dead reef.

Sample processing and cleaning: The collected sample was kept in freshwater for natural bleaching and removal of soft tissue parts and kept for one week. After that, the entire colony was washed thoroughly with running tap water to clean the algal part and other debris. The cleaned sample was kept under sunlight for drying for seven days.

Sample analysis and identification: Morphometric analysis of the skeleton structure of the scleractinian coral colonies was carried out under a stereo-zoom microscope (Leica M 205 A DFC 500). The consultation was made with the earlier reported species under the genus *Polycyathus* from the Indian Ocean and the Pacific Ocean by Alcock (1893), Duncan (1876, 1889), Klunzinger (1879), Durham & Barnard (1952), Wijsman-Best (1970), Wells (1982), Verheij & Best (1987), Cairns (1995, 2000), Lin *et al.* (2012) and Kitahara & Cairns (2021) for species identification.

Registration of the voucher sample: On completion of the study, the specimens were deposited at National Zoological Collections in Zoological Survey of India, Port Blair, which can be used as voucher specimens for future studies as well as references.

RESULTS

Based on the present study, one species of caryophylliid coral was recorded from the Bay of Bengal and

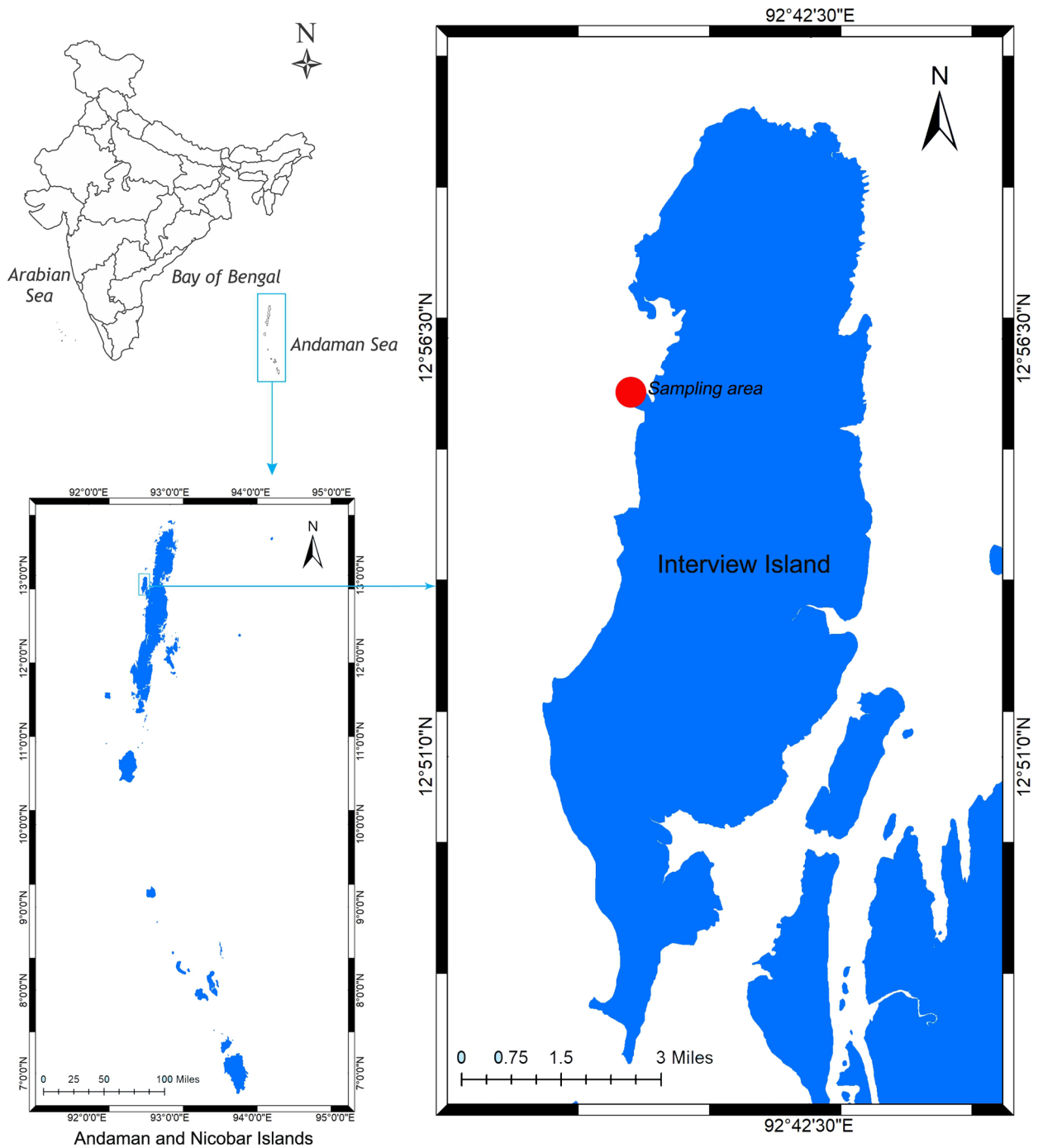


Fig. 1. – Study area for samples ZSI/ANRC/M/25250, 25346, 25587.

the Andaman Sea coastal area of Andaman and Nicobar Islands, India. The details of the species are described below.

Systematics

Phylum CNIDARIA Hatschek, 1888
 Class ANTHOZOA Ehrenberg, 1834
 Order SCLERACTINIA Bourne, 1900

Family CARYOPHYLLIIDAE Dana, 1846
 Genus *Polycyathus* Duncan, 1876
 Species *Polycyathus chaishanensis* Lin, Kitahara, Tachikawa, Keshavmurthy & Chen, 2012

Material examined

Interview Island, three colonies (GPS coordinates: Lat.: 12°50.509'N & Long.: 92°42.151'E) (Fig. 1), Anda-

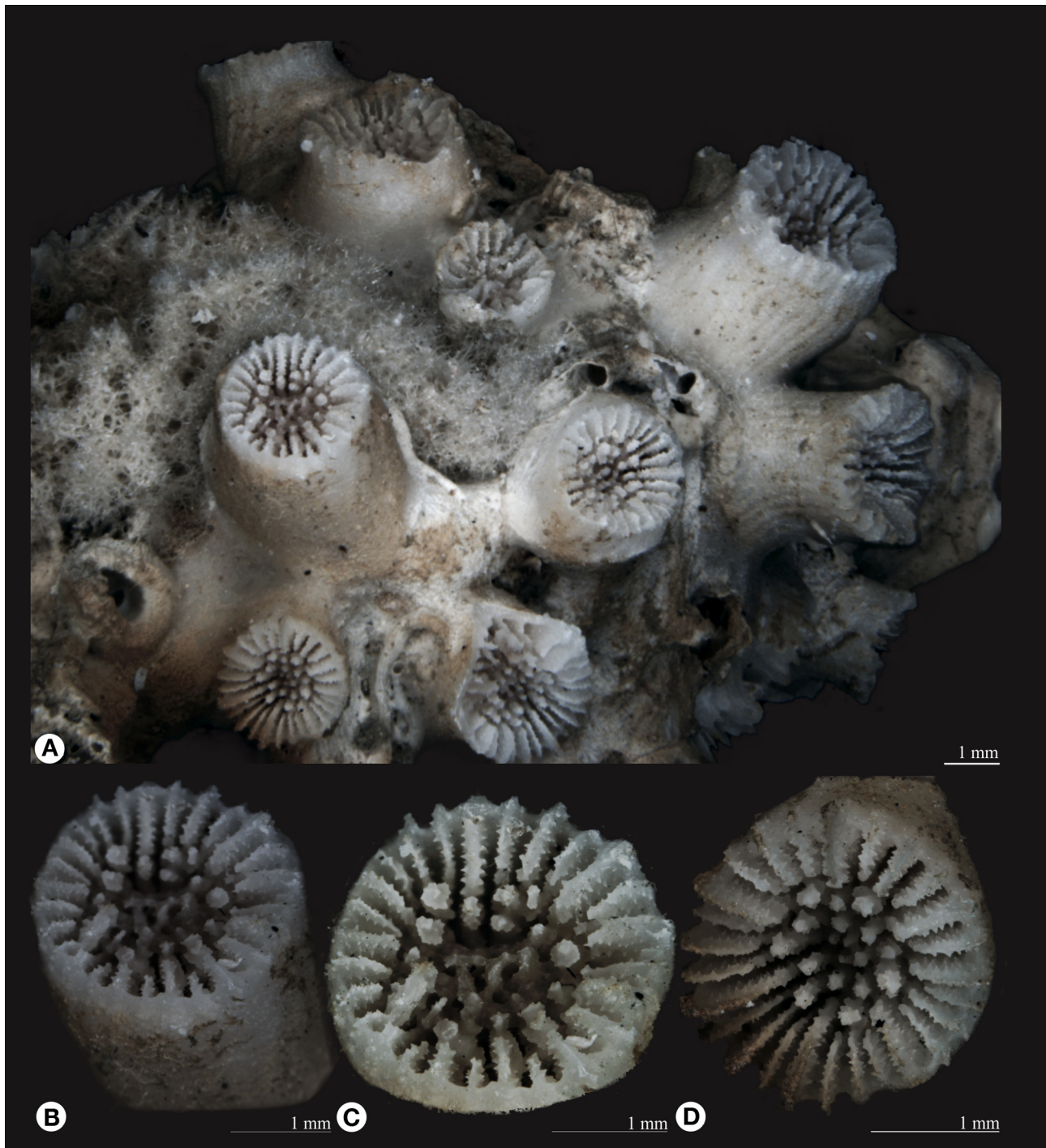


Fig. 2. – *Polycyathus chaishanensis* Lin, Kitahara, Tachikawa, Keshavmurthy & Chen, 2012. **A:** Colony and costal arrangement; **B:** Corallite structure and deep fossa; **C:** Septal arrangement, septal granules and columella; **D:** Septal arrangement ($S_1 \geq S_2 > S_3 > S_4$), pali and fossa.

man and Nicobar Islands; Date of collection: 22.ix.2019; Collection made from: Tidal pool of inter-tidal region; Depth: 0.8 m; Substratum: Dead reef, CCA and coastal rocks; Regn. No.: ZSI/ANRC/M/25250, 25346, 25587. Other specimens sampled, identified and registered: Neil Island (GPS coordinates: Lat.: $11^{\circ}50.792'N$ & Long.: $93^{\circ}03.697'E$), Date of Collection: 18.viii.2015, Regn.

No.: ZSI/ANRC/M/25259; South Reef Island (GPS coordinates: Lat.: $12^{\circ}46.104'N$ & Long.: $92^{\circ}39.233'E$), Date of collection: 21.ix.2019, Regn. No. ZSI/ANRC/M/25272; Paget Island (GPS coordinates: Lat.: $12^{\circ}25.264'N$ & Long.: $92^{\circ}49.200'E$), Date of collection: 19.xi.2017, Regn. No.: ZSI/ANRC/M/25356.

Description

The colonies are encrusting. Corallites are round-shaped, cylindrical and reptoid (Fig. 2A-D). Corallites are usually sharing the same coenosteum and ascending nearly in perpendicular ways. The examined colony contains a total of 14 corallites. The greater corallite diameter of the largest corallite is 3.62 mm × 3.31 mm with a height of 3.79 mm while the Mean corallite diameter is 2.67 ± 0.12 (SE) × 2.59 ± 0.11 (SE) and Mean corallite height-2.66 ± 0.12 (SE). Equal-sized and prominent costae are visible with small granules. The coloration of the columella as well as the theca is white while some brown pigmentation is also visible in some corallites. A total of four hexameric septal cycles are recorded with the incomplete fourth one (S1 ≥ S2 > S3 > S4) while a maximum of 29 septa are documented (Fig. 2D). Septal walls are dentate with small sharp granules (Fig. 2C, D). First-order septa are straight and comparatively thicker than second-order septa. Second-order septa are also seen as long as first-order septa for some times otherwise those fall short in length of first-order septa. Third-order septa are comparatively thinner while the length is near about two-thirds of second-order septa (Fig. 2D). Pali are well developed with pointed granular structure (Fig. 2C, D). Sometimes pali and features of the columellar structures look alike (Fig. 2C). The columella is organized with irregularly orientated slender shaped rods, which give the columella papillose-like structure (Fig. 2C). Fossa is relatively deep (Fig. 2D).

Type specimen details

Holotype specimen: Collected from Chaishan, Kaohsiung, Taiwan; deposited at the National Museum of Natural Science, Taichung, Taiwan (Voucher specimen No.: NMNS-6309-01).

Distribution

This species is endemic to Taiwan (Lin *et al.* 2012, Liou *et al.* 2017, Kuo *et al.* 2019) while distribution in Indonesia is doubtful (Hoeksema & Arrigoni 2020). This present report is the range extension from inter-tidal regions of Andaman and Nicobar Islands, India.

Remarks

The recording of *Polycyathus chaishanensis* Lin *et al.*, 2012 is only available from Taiwan (Lin *et al.* 2012, Kuo *et al.* 2019). In 2012, some specimens of live corals under various genera including the specimen of *P. chaishanensis* were inspected by the customs at Schiphol Airport (The Netherlands) and it was found that the specimens were imported from Indonesia (Hoeksema & Arrigoni 2020). As there is no proper scientific data on the collection

locality of the said specimens, the locality *i.e.*, Indonesia, remains a doubtful area of distribution for *P. chaishanensis* (Hoeksema & Arrigoni 2020).

A total of 20 extant and valid species under the genus *Polycyathus* are described till now within the depth range of 0-441 m including a maximum of 11 species from Pacific Oceanic habitats, followed by five species from the Indian Ocean, three species from the Atlantic Ocean and one species from the Mediterranean Sea (WoRMS 2022) (Table I). Altogether four species such as *Polycyathus andamanensis* Alcock, 1893, *P. chaishanensis* Lin, Kitahara, Tachikawa, Keshavmurthy & Chen, 2012, *P. fuscomarginatus* Klunzinger, 1879 and *P. verrilli* Duncan, 1889 are recorded till now from Indian waters while Andaman and Nicobar Islands harbor three species such as *Polycyathus andamanensis* Alcock, 1893, *P. verrilli* Duncan, 1889 and the present report. Apart from *Polycyathus chaishanensis* and *P. fulvus* represented symbiotic algae while all the 18 species are azooxanthellate (Wijsman-Best 1970, Kuo *et al.* 2020, Kitahara & Cairns 2021).

DISCUSSION

Among the scleractinian corals, the family Caryophylliidae shares substantially 307 valid and extant species of the Holocene period including 20 species under the genus *Polycyathus*. *P. chaishanensis* Lin, Kitahara, Tachikawa, Keshavmurthy & Chen, 2012 is known to be shallow water representative under the zooxanthellate scleractinian corals and has only been reported from Taiwan. The comparison of the anatomical structure of the holotype specimen along with the present defines the organizational resemblance like GCD of the largest corallite of the present study is 3.62 mm × 3.31 mm with a height of 3.79 mm whereas the holotype specimen is 3.62 mm × 3.31 mm with 4 mm of height. It is also noted that the presence of maximum of 29 septa in the present specimen's corallites substantially justifies the availability of 34 septa in larger corallites with a maximum limit of 3.7 mm (GCD) as mentioned by Lin *et al.* (2012). It was initially noted in 1990 from the tide pool of the inter-tidal area (Kuo *et al.* 2019). During the earlier studies, it was found that the occurrence of the colonies of *P. chaishanensis* is mostly found in the rocky intertidal region along with the tidal pools, crustose coralline algal (CCA). The present study also indicates the distributional occurrence of this species from the inter-tidal regions, especially in the tidal pools. Based on the distributional ranges and habitat preferences of this species, it is estimated that the *P. chaishanensis* has a greater scale of adaptive capacity as the inter-tidal zones are facing maximum threats either naturally by tidal variation, heat stress, exposure to UV lights, cyclonic intervention or anthropogenically due to coastal developmental works, pollution, etc. (Kuo *et al.*

Table I – Global distribution of species under the genus *Polycyathus* including Indian records

Sl No	Species	Distribution	Depth range	Indian waters	Ecological class	Remarks
1	<i>P. andamanensis</i> Alcock, 1893	Indian Ocean	Unknown	Andaman & Nicobar Islands (Alcock, 1893)	azooxanthellate	
2	<i>P. atlanticus</i> Duncan, 1876	Atlantic Ocean	Unknown		azooxanthellate	
3	<i>P. chaishanensis</i> Lin, Kitahara, Tachikawa, Keshavmurthy & Chen, 2012	Pacific Ocean	1-3 m	Andaman & Nicobar Islands – (Present report)	zooxanthellate	New record to Indian waters
4	<i>P. crosnieri</i> Kitahara & Cairns, 2021	Pacific Ocean	236-650 m		azooxanthellate	
5	<i>P. difficilis</i> Duncan, 1889	Indian Ocean	Unknown		azooxanthellate	
6	<i>P. fulvus</i> Wijsman-Best, 1970	Pacific Ocean	30-50 m		zooxanthellate	
7	<i>P. furanaensis</i> Verheij & Best, 1987	Pacific Ocean	6-52 m		azooxanthellate	
8	<i>P. fuscomarginatus</i> Klunzinger, 1879	Indian Ocean	Unknown	Chennai (Venkataraman 2007)	azooxanthellate	
9	<i>P. hodgsoni</i> Verheij & Best, 1987	Pacific Ocean	0-35 m		azooxanthellate	
10	<i>P. hondaensis</i> Durham & Barnard, 1952	Pacific Ocean	55-64 m		azooxanthellate	
11	<i>P. isabela</i> Wells, 1982	Pacific Ocean	14-23 m		azooxanthellate	
12	<i>P. marigondoni</i> Verheij & Best, 1987	Pacific Ocean	35 m		azooxanthellate	
13	<i>P. mayae</i> Cairns, 2000	Atlantic Ocean	137-309 m		azooxanthellate	
14	<i>P. muelleriae</i> Abel, 1959	Mediterranean Sea	10-32 m		azooxanthellate	
15	<i>P. norfolkensis</i> Cairns, 1995	Pacific Ocean	10-20 m		azooxanthellate	
16	<i>P. octoplus</i> Cairns, 1999	Pacific Ocean	90-441 m		azooxanthellate	
17	<i>P. palifera</i> Verrill, 1870	Pacific Ocean	Reef depth		azooxanthellate	
18	<i>P. persicus</i> Duncan, 1876	Indian Ocean	Shallow		azooxanthellate	
19	<i>P. senegalensis</i> Chevalier, 1966	Atlantic Ocean	12-143 m		azooxanthellate	
20	<i>P. verrilli</i> Duncan, 1889	Indian Ocean	Unknown	Andaman & Nicobar Islands and Gulf of Mannar (Venkataraman 2006); Gulf of Kachchh (Satyanarayana & Ramakrishna 2009); Malvan (ZSI 2017)	azooxanthellate	

2019). The higher level of resilience and adaptation capability can be seen due to the presence of stress-tolerance symbiotic algae *i.e.*, *Cladocopium* (C1) which has the excellent capacity for supplying effective nutrient translocation to the host coral species along with the nitrogen acclimatization and translocation of carbon (Baker *et al.* 2013, Kuo *et al.* 2020). During the present report, the colony was recorded from the tidal pool of the inter-tidal region, which often faces a greater range of heat stress due to diurnal tidal amplitude with the exposure to UV radiation in Andaman and Nicobar Islands. It is estimated that the presence of symbiotic algae in *P. chaishanensis* help for the sustainability and resilience against the stressed condition of inter-tidal habitats in Andaman

and Nicobar Islands. The colonies reported from Andaman and Nicobar Islands used to face only natural threats while no major anthropogenic threats are reported till now from those sampling areas except for very limited fishing activities.

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