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Description of a zooxanthellate scleractinian coral (*Blastomussa angulares* sp. nov.) from Lakshadweep, India

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ABSTRACT

One species zooxanthellate scleractinian coral i.e. *Blastomussa angulares* sp. nov. is described from Lakshadweep atoll for the first time based on the morphometric characteristics. The significant characters which differentiate this presently described species from previously known species are shape of angular corallites, length of the corallite diameter, number of septa and their cycles, highly exsert septa, structure of columella and septa like extra projection from the basal plate. *Blastomussa angulares* sp. nov. represents close structural affinities with *B. loyae* Head, 1978 which is briefly narrated here to establish the presently designated species.

KEYWORDS

Zooxanthellate, *Blastomussa*, Lakshadweep, Angular corallites.

Introduction

The genus *Blastomussa* was previously categorized under the family Mussidae Ortmann, 1890 while the recent classification and systematic arrangement emphasizes a considerable amount of doubt for this previous rank of hierarchy based on the molecular as well as microstructural studies along with revisionary works and presently tiered this genus as accepted one while the distal genetically derived relationship with the species under the family Plerogyridae Rowlett, 2020 (the genus was also categorized under Family Lobophylliidae Dai & Horng, 2009) which were previously known as Mussidae corals from Indo-Pacific realm¹⁻⁷. The genus *Blastomussa* represents five valid and extant species viz. *B. merleti* (Wells, 1961), *B. wellsi* Wijsman-Best, 1973, *B. loyae* Head, 1978, *B. omanensis* (Sheppard & Sheppard, 1991) and *B. vivida* Benzoni, Arrigoni & Hoeksema 2014 which are exclusively Indo-Pacific in distributional alignment⁵. A comprehensive study made by Kleemann and Baal⁸ emphasized on the species validity of *B. loyae* whereas they narrated the detailed chronological taxonomic status of other species under said genus where physical variances, the disparity in growth forms of the colony as well as calice, surface structure, etc. were considered for species re-establishments. The previous studies reported two species among these five species such as *B. merleti* and *B. wellsi* from Indian waters^{9&10} especially from Andaman and Nicobar Islands while no documentation was made from Lakshadweep water till now. This present paper deals with the description of a new species of zooxanthellate scleractinian coral under the genus *Blastomussa* from Lakshadweep waters. The detailed morphological attributes are defined here along with the comparative structural analysis with closely related species.

Materials and Methods

Inclusive surveys were carried out to investigate the scleractinian species of Lakshadweep from October 2019 to February 2020 within the depth limit of 40 m by employing SCUBA diving and the specimen was sampled for detailed taxonomic studies by the handpicking method. *In-situ* photographic digitization was made with the help of a Canon 1x Mark II camera along with housing. The sample was kept in fresh water at room temperature for one week for the dilution of the algal parts then carefully cleaned to remove all the algal parts by running tap water and dried under sunlight. *Ex-situ* studies were carried out under a Leica stereo zoom microscope (M 205 A) to compare the morphological characteristics while digitization was made by an attached DFC 500 camera. Morphological characteristics of all the five previously described species under the genus *Blastomussa* were compared in conjunction with the available literature of Wells¹¹, Wijsman-Best¹², Head¹³, Sheppard and Sheppard¹⁴, Veron¹⁵, and Benzoni et al.⁵. On completion of the morphometric analysis, the specimen was deposited as National Zoological Collections in Zoological Survey of India, Port Blair.

Results

One new species of scleractinian coral under the *Blastomussa* is described here. The details of the species are cited below.

Systematics:

Phylum CNIDARIA Hatschek, 1888

Class ANTHOZOA Ehrenberg, 1834

Subclass HEXACORALLIA Haeckel, 1896

Order SCLERACTINIA Bourne, 1900

Family PLEROGYRIDAE Rowlett, 2020

Genus *Blastomussa* Wells, 1968

Blastomussa angulares sp. nov.

Material examined:

Holotype- One portion of the colony (24.90cm ×16.87cm); *Location*- Bangaram Island (Lat.: 10°57'54.2935"N & Long.: 72°17'30.3399"E) of Lakshadweep (Figure 1), India; *Depth*- 35 m; *Date of collection*: 24.ii.2020; *Regn. No.*-ZSI/ANRC/M- (Figure 2a).

Diagnostic description:

The colony is encrusting (Figure 2a). Corallites are with strong angular structures and pentagonal while the developmental pattern is sub-crioid to plocoid (Figs. 2b&c). The largest diameter of the corallites ranges between 6-10 mm. Mostly two order of septa is visible and while 3rd order may be seen sometimes ($S_1 \geq S_2 > S_3$) (Figure 2c). Second-order septa are not showing structural symmetry and even can be seen as incomplete (Figure 2c). The first-order septa ($S_1=6$) are mostly equal in length and usually reach the columella whereas second-order septa ($S_2 \leq 6$) are 2/3 in thickness in comparison with first-order septa and extensively irregular to reach columella (Figs. 2b&c). The third order septa ($S_3 \sim 2$) very thin, narrow, and incomplete if present and does not reach columella (Figure 2c). The distal arrangement of the septa creates a deep hollow or gap in between inter septa space (Figs. 2b&c). Septa are highly exserted (Figure 2d). The height of exsert septal region is ranged between 2.4 to 2.9 mm for the first order septa and 0.6 to 1.8 mm for secondary septa from the colony surface (Figure 2e). The exsert septal availability can be seen as a spiny appearance for the colony while the polar view of the exsert septa is comparatively thick and the side view is fan alike with a smooth margin (Figure 2e). Small triangular-shaped granular spines are arranged in radiating manner on the septal side which is prominent on the exsert septal region (Figure 2e). One separate septum like structure is projecting from the basal disc of some of the corallites (Figs. 2b&c). Columella is solid, narrow and pointed (Figures 2a-c).

In-situ observation:

The color of the live colony is violet to blue color while the septal margins are green and columella is brown to deep green. Mantle of the corallites are giving bold leathery appearance to the corallite (Figures 3a&b).

Etymology:

The species name is *angulares* (Latin *angulares* = angular) after the corallites shape. The primarily defining structure of the corallites of presently described species is strongly angular and pentagonal which clearly make differentiation with all the other five valid and extant species.

Closely related species:

This species is closely related to *Blastomussa loyae* Head, 1978. But the size of the corallite shape and diameter, septal number and structure as well as the columella is representing differentiation with *B. loyae* (Table 1).

Zoogeographical range:

This species is only reported from Bangaram Island of Lakshadweep, India.

Discussion

Among the described five species under the genus *Blastomussa*, two categorizations can be drawn based on the corallite diameter such as corals within the diameter 8mm (*B. loyae*, *B. merleti* and *B. omanensis*) while the others with the diameter of more than 9mm (*B. wellsii* and *B. vivida*)⁵ while the presently described species share the corallite diameter within the range of 6 to 10 mm whereas the presence of smooth septal characterization considers this new species i.e. *Blastomussa angulares* among the second cluster. This currently described species characterize some closely related morphometry with *B. loyae* while some features showed remarkable differences to establish this one as new species. In *B. angulares* sp. nov. the corallites are angular with a diameter of 6 to 10mm while circular to oval corallites with 4 to 8mm of diameter are seen among *B. loyae*. The only S1 of *B. angulares* sp. nov. is with complete structure and cycle among the three orders while *B. loyae* showed only S3 as incomplete. The septa are extensively exsert with the height of 2.4 to 2.9 mm for S1 and 0.6 to 1.8 mm for S2 in *B. angulares* whereas the mean height of the exsert septa of *B. loyae* is near about 1-2 mm. The descriptions, studies, and comparative analysis made by Wells^{11&16}, Wijsman-Best¹², Head¹³, Veron and Pichon¹⁷, Scheer and Pillai¹⁸, Sheppard^{19&20}, Veron¹⁵, Sheppard and Sheppard¹⁴, Klemann and Baal⁸, Benzoni et al.⁵ on the five extant species under the genus *Blastomussa* do not show adequate characteristic similarities with the existing valid species. Based on the critical scrutiny on morphological features, this present species *Blastomussa angulares* is described as a new species to science

while molecular studies can be considered as the defining factor for the validation of this species in near future. The description of a new species from Lakshadweep atoll intensely suggests favorable biogenic habitat for the survival and development of scleractinian corals which is required to be investigated in extensive ways for improvement of proper conservatory measures through the sustainable means.

Declarations

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Competing interests

The authors declare that they have no competing interests.

Author Contributions

Both the authors contributed equally for the preparation of the manuscript, field data collection and data analysis.

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Table 1: Comparative studies of closely related *Blastomussa* sp.

Sl. No.	Features	<i>Blastomussa angulares</i> sp. nov.	<i>Blastomussa loyae</i> Head, 1978
1.	Corallite organization	Sub-crioid to plocoid	Pseudo-crioid and crioid (Benzoni <i>et al.</i> , 2014)
2.	Corallite shape	Strongly angular and pentagonal	Circular to oval ⁵
3.	Corallite diameter	6-10 mm.	4-8 mm (Benzoni <i>et al.</i> , 2014)
4.	Septal cycle	3 cycles (S_1 complete, S_2 & S_3 incomplete); ($S_1 \geq S_2 > S_3$)	3 cycles (S_1 & S_2 complete, & S_3 incomplete) ^{5&13}
5.	Height of exsert septa from colony surface	$S_1 = 2.4$ to 2.9 mm; $S_2 = 0.6$ to 1.8 mm	~ 1 mm ($S_1 > S_2$ in height) ¹³ ; ~ 2 mm ⁸
6.	Septal margin	Smooth	Predominantly smooth; two to four typically mussoid teeth may be seen ¹³
7.	Columella	Solid, narrow and pointed	Sometimes fused at the base ¹³
8.	Septa like extra projection from basal plate	Sometime present	Not visible
9.	Depth range	35 m	5 to 27 m ¹³
10.	Occurrence	Lakshadweep	Red Sea to Gulf of Tadjoura ⁵

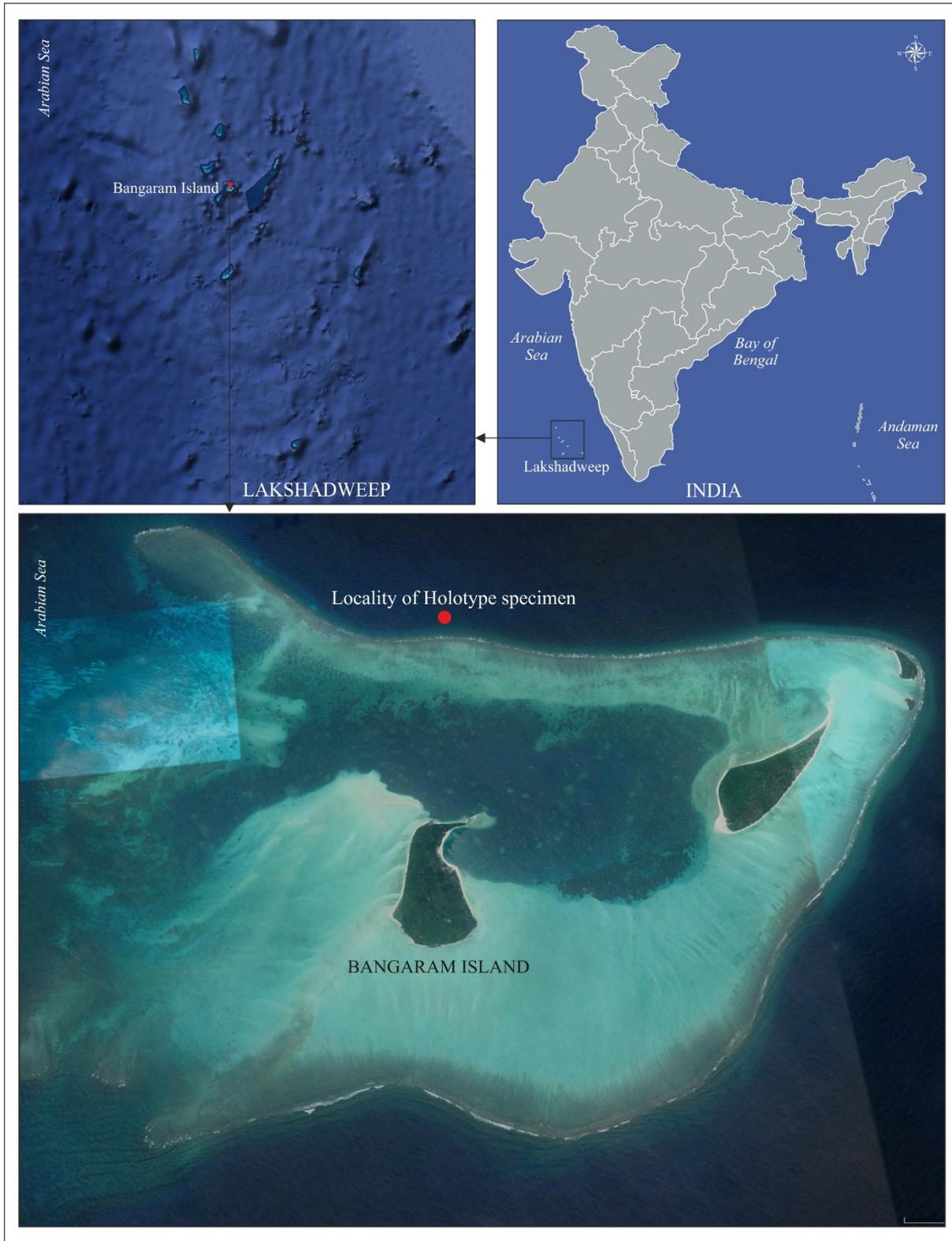


Figure 1: Locality of the Holotype specimen- *Blastomussa angulares* sp. nov.

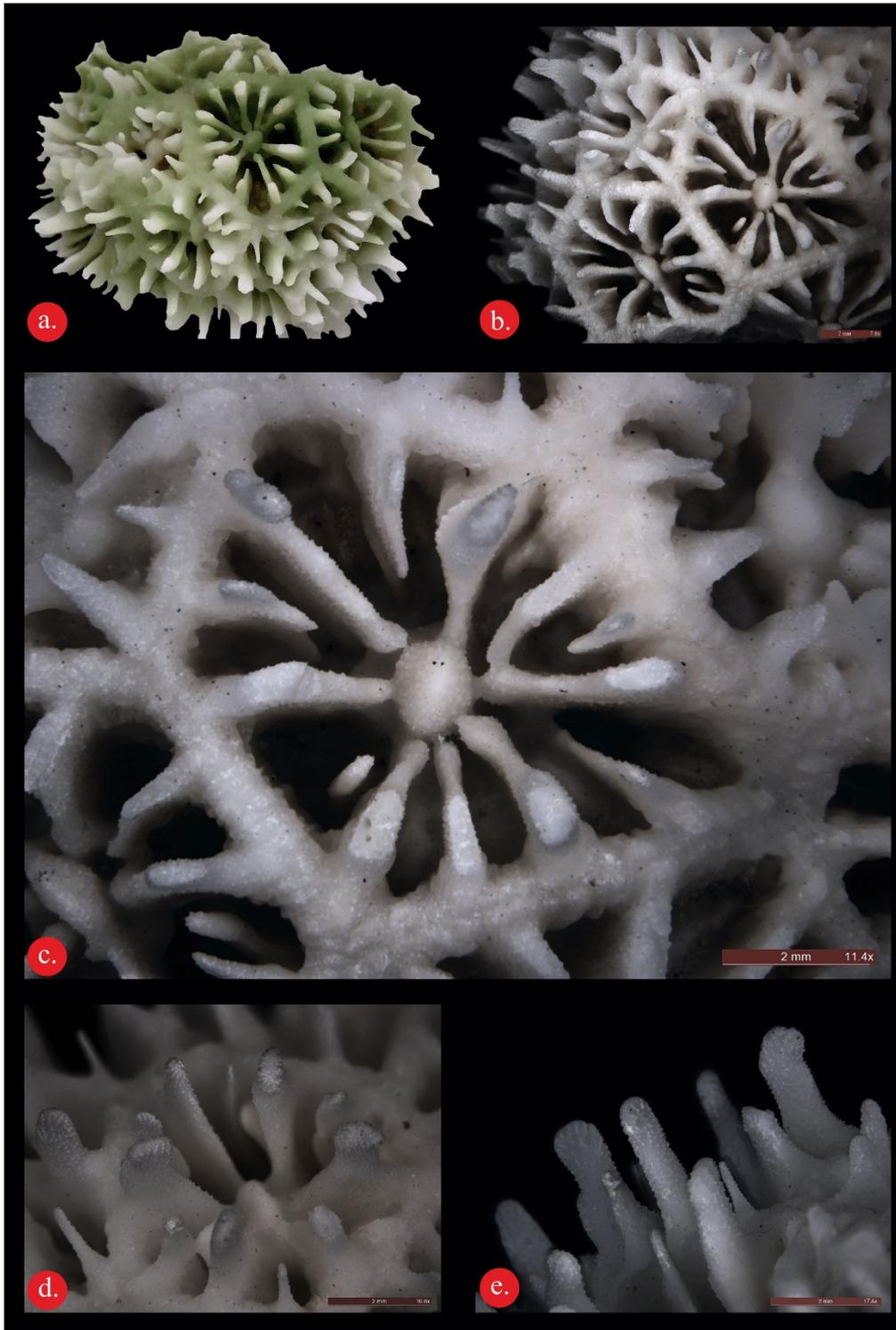


Figure 2: *Blastomussa angulares* sp. nov.; a. Portion of the colony (Holotype specimen); b. Strong angular structures of the corallites; c. Angular structure of the corallites, septal arrangement, 3 cycles of septa (S_1 complete, S_2 & S_3 incomplete), ($S_1 \geq S_2 > S_3$), septa like structural projecting from the basal disc, solid, narrow and pointed collumela; d. Highly exsert septa; e. Septal height, $S_1 = 2.4$ to 2.9 mm; $S_2 = 0.6$ to 1.8 mm from the colony surface; small triangular shaped granular spines with radiating arrangement on septal sides

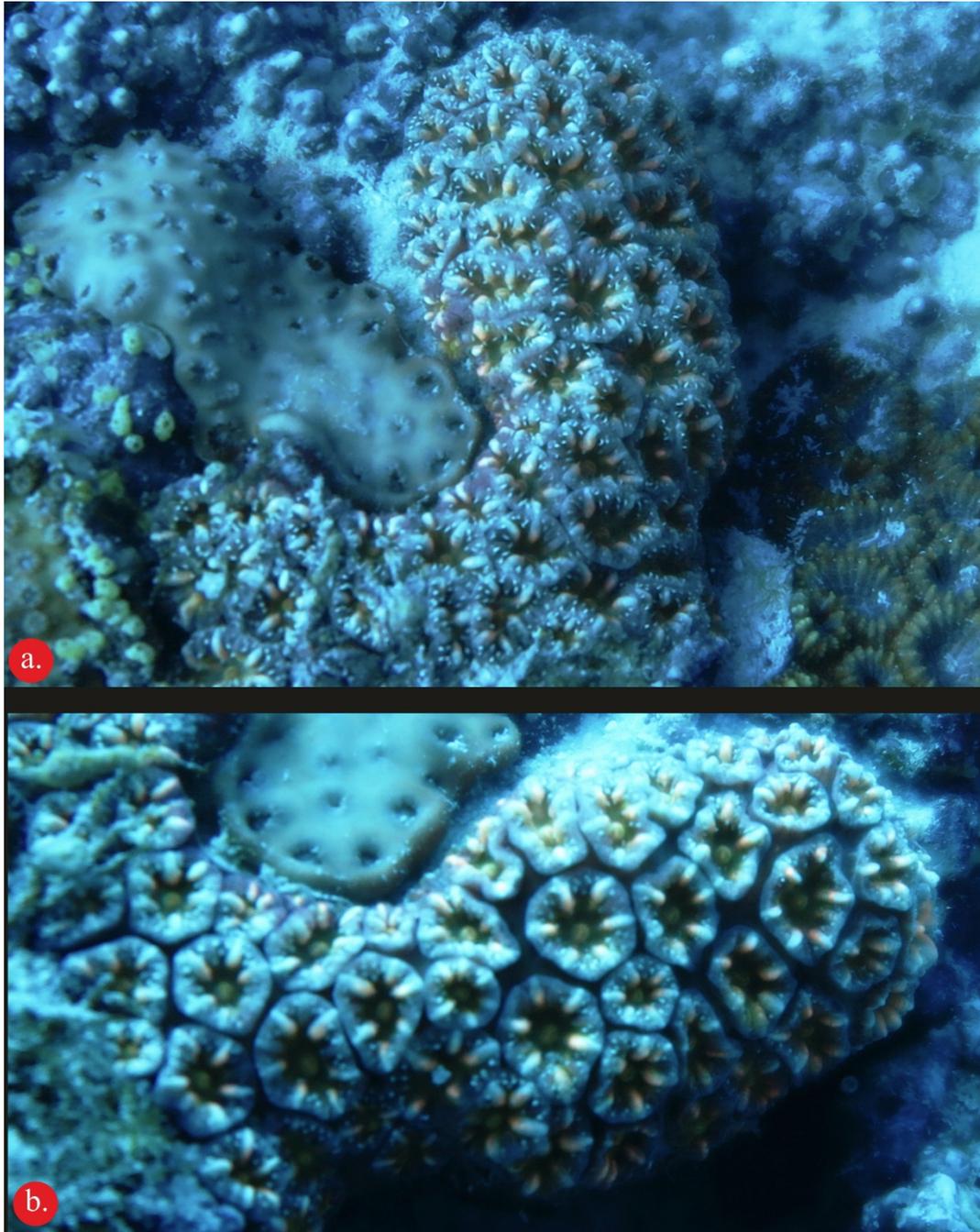


Figure 3: *Blastomussa angulares* sp. nov.; a&b. *In-situ* images of the live colony with violet to blue colour corallites, green septal margin, brown to deep green columella; leathery appearance of corallites

Figures

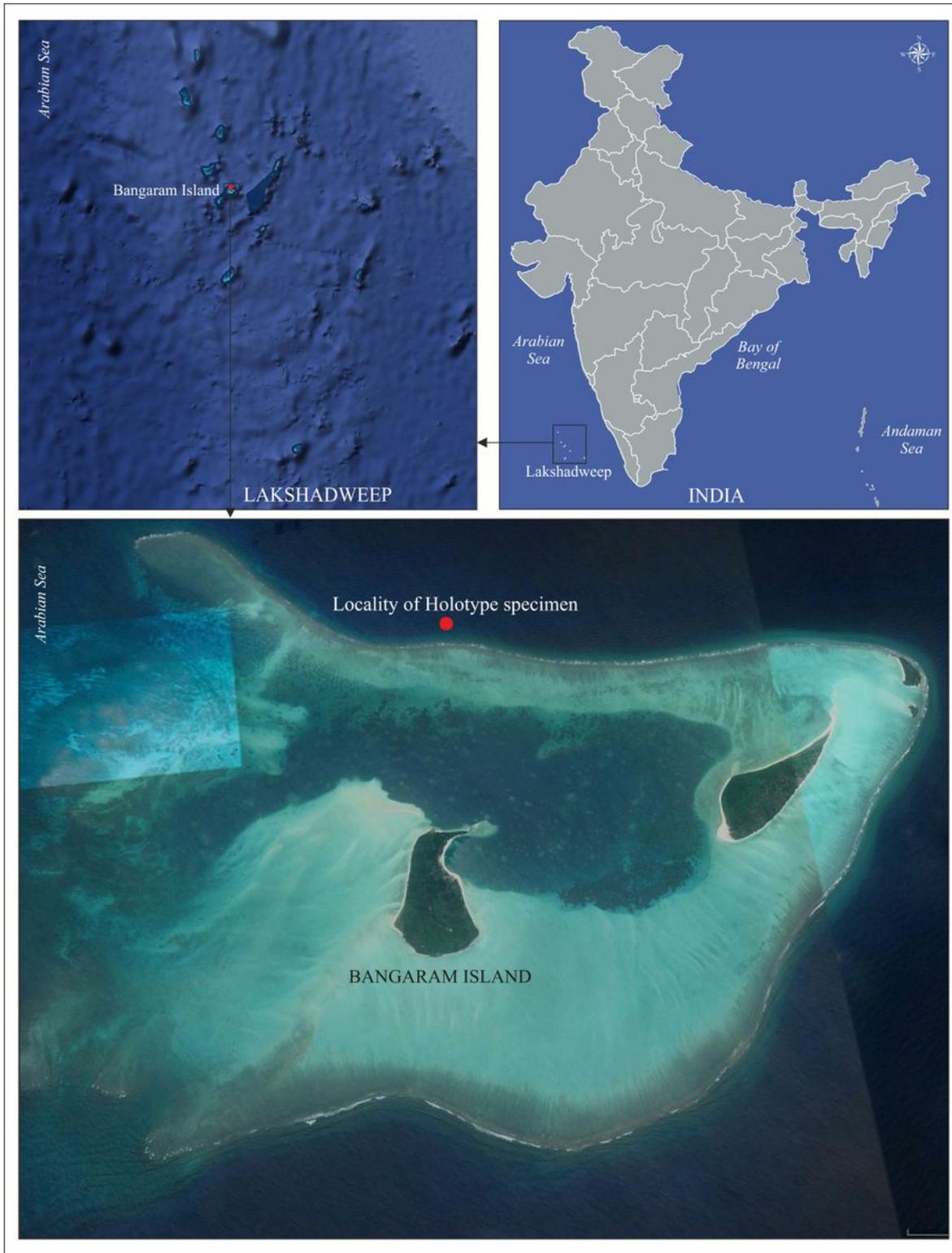


Figure 1

Locality of the Holotype specimen- *Blastomussa angulares* sp. nov. Note: The designations employed and the presentation of the material on this map do not imply the expression of any opinion whatsoever on the part of Research Square concerning the legal status of any country, territory, city or area or of its

authorities, or concerning the delimitation of its frontiers or boundaries. This map has been provided by the authors.

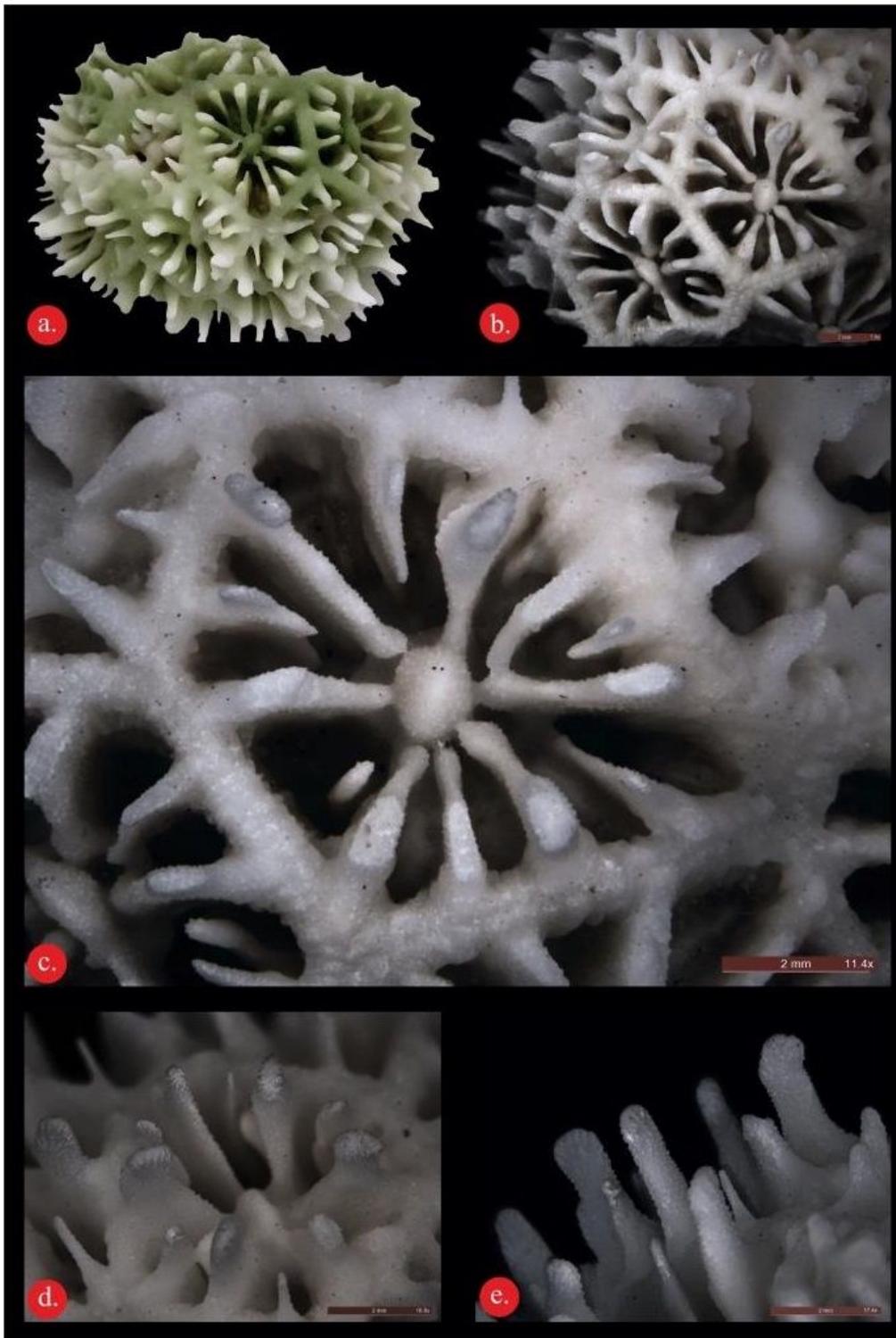


Figure 2

Blastomussa angulares sp. nov.; a. Portion of the colony (Holotype specimen); b. Strong angular structures of the corallites; c. Angular structure of the corallites, septal arrangement, 3 cycles of septa (S1 complete, S2 & S3 incomplete), ($S1 \geq S2 > S3$), septa like structural projecting from the basal disc, solid,

narrow and pointed collumela; d. Highly exsert septa; e. Septal height, S1= 2.4 to 2.9 mm; S2=0.6 to 1.8 mm from the colony surface; small triangular shaped granular spines with radiating arrangement on septal sides

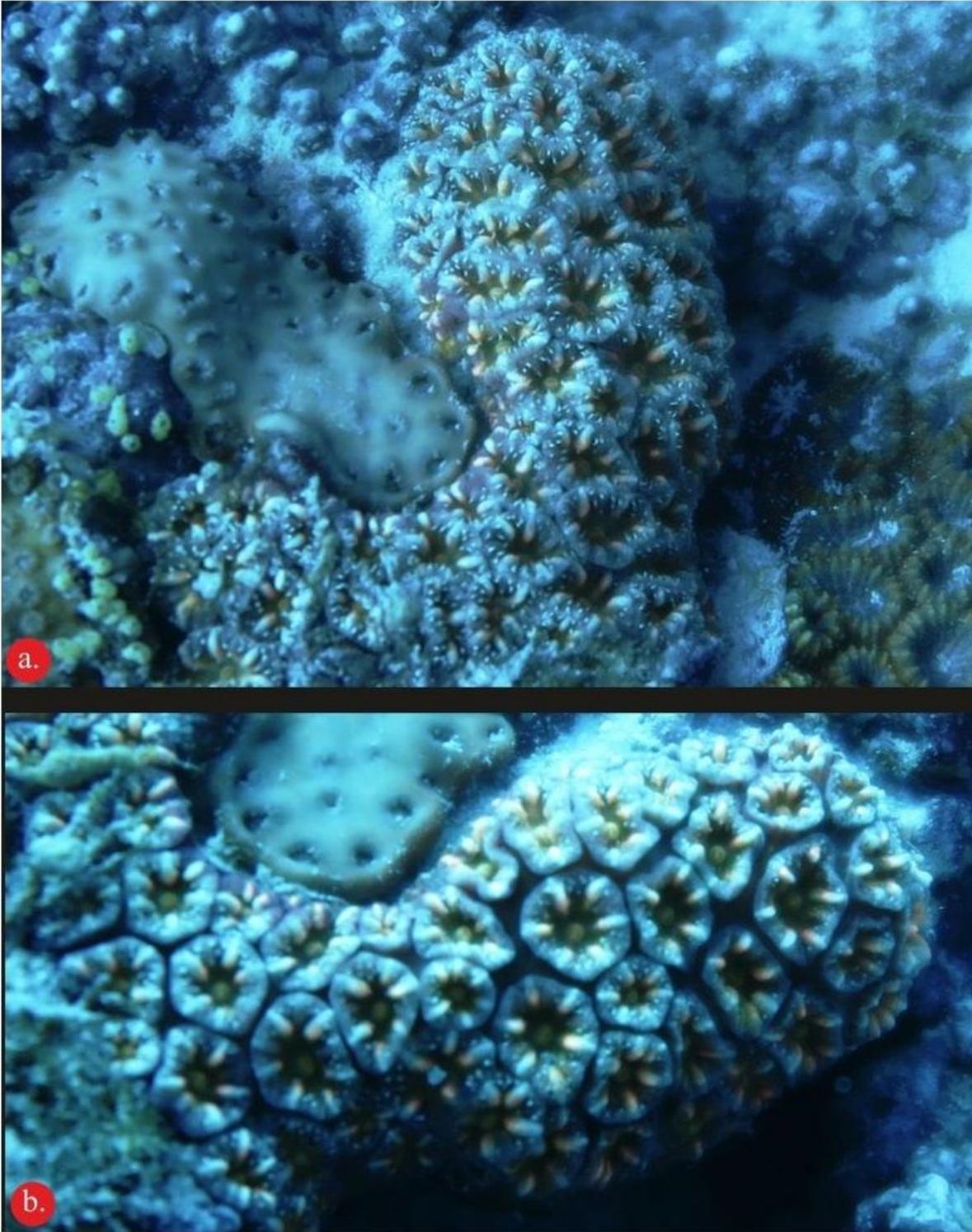


Figure 3

Blastomussa angulares sp. nov.; a&b. In-situ images of the live colony with violet to blue colour corallites, green septal margin, brown to deep green columella; leathery appearance of corallites