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Range extension of a soft coral, *Sarcophyton spinospiculatum* Alderslade & Shirwaiker, 1991 (Cnidaria: Octocorallia) in the Andaman and Nicobar Islands, India

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Abstract

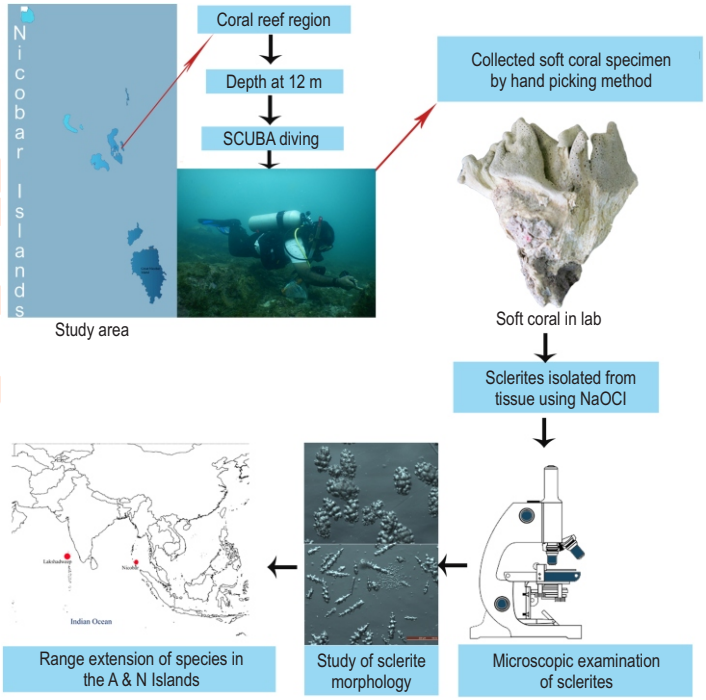
Aim: This study aimed to investigate the range of the soft coral *Sarcophyton spinospiculatum* Alderslade and Shirwaiker, 1991, from Lakshadweep in the West Coast of India to the reefs of the Andaman and Nicobar Islands in the East, significantly extending the known range of this species.

Methodology: Specimen was collected from coral reef region of Kardip (08°02.3160' N; 93°33.1601' E), Nicobar Group of islands through SCUBA diving at depths upto 12 m. Sclerites were extracted with 5% sodium hypochlorite and examined under a microscope for taxonomic identification.

Results: The species characterized by mushroom shaped colony, capitulum and stalk exterior contained club shaped sclerites (0.08 to 0.31 mm), capitulum interior sclerites were slender spindles upto 0.49 mm, with spine-like warts arranged in whorls and the stalk interior predominantly had oval sclerites (0.17–0.30 mm) with low warts. These distinctive sclerites characteristics serve as diagnostic features for identifying the species.

Interpretation: This study contributes to the relatively underexplored field of octocoral research in the Nicobar Islands. These islands represent an important yet overlooked region within Indo-Pacific benthic ecosystems, which are critical to the overall health of coral reef habitats.

Key words: Andaman Sea, Marine biodiversity, Polyps, Sclerites, Western Indo-Pacific



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Introduction

Soft corals, classified under the Class Octocorallia, phylum Cnidaria, represent one of the most important sessile, benthic organisms in coral reef ecosystem (McFadden *et al.,* 2022). Their defining characters include polyps with eight tentacles, eight mesenteries (internal partitions that help with digestion), and a siphonoglyph, a ciliated structure involved in water circulation (Hickson, 1895; Menzel *et al.,* 2015). These polyps aggregate into large colonies, which are distinguished by their flexible and soft appearance, unlike hard corals, which have rigid calcium carbonate skeletons (Fabricius and Alderslade, 2001). Tiny calcium carbonate particles, sclerites form the structural support of the colony. These sclerites not only lend the soft coral its leathery texture but also play a significant role in maintaining the integrity of both individual polyps and the colony as a whole (Sammarco *et al.,* 1987; Van Alstyne *et al.,* 1994; Fabricius and Alderslade, 2001). According to studies, sclerites provide structural support to soft coral colonies, while their secondary metabolites such as sesquiterpenes, diterpenes and cembranoids possess anti-predatory properties (Changyun *et al.,* 2008; Hoang *et al.,* 2022). These compounds help deter herbivores and other potential predators, thereby enhancing colony protection (Van Alstyne *et al.,* 1994; O'Neal and Pawlik, 2002). This defence mechanism makes them particularly resilient in environments with high predation pressure.

Octocorals are particularly remarkable for their ecological versatility. Their ability to adapt to a broad range of environmental conditions, like varying water currents, depths and light levels, allows them to thrive in a variety of marine habitats. This adaptability has enabled soft corals to colonize everything from sunlit, shallow reef areas to the dimmer, deeper sections of the ocean (Poulos *et al.,* 2013). Their distribution patterns are dynamic, with shifts in community composition observed across tropical to temperate gradients, and distinct assemblages recorded in regions such as the West Philippine Sea and the Tropical Eastern Pacific (Lalas *et al.,* 2022; Abad *et al.,* 2022; Otis *et al.,* 2024; McFadden *et al.,* 2025). These patterns highlight the need for continued biodiversity assessments, especially in underexplored areas like the Central Indian Ocean.

The genus *Sarcophyton* sp. are distinguished with other congeneric genera by dimorphic polyps, which include retractile siphonozooids and autozooids that retract only when disturbed or contract in undisturbed conditions (Lesson, 1834). Because of their massive developmental growth, the colony often assumes a large, mushroom-like appearance, consisting of a smooth, wide disc or capitulum, supported by a stalk, and is commonly referred to as "toadstool corals" (Aratake *et al.,* 2012; Fabricius and Alderslade, 2001; Rajendra *et al.,* 2023). The shape of the colonies vary by their growth stage; younger ones often resemble mushrooms, while mature colonies are more lobed and folded like a toadstool. Certain species continue to maintain this toadstool form for their entire life. The structural variation of sclerites in various parts of the colony on the capitulum surface and stalk are mostly small clubs, with some short rods and spindles. Internally, sclerites are spindle- or barrel-shaped, with wart-like structures, and are stouter in the stalk than in the polyparium (Verseveldt, 1982). The colour of *Sarcophyton* colonies vary among species and even within individuals of same species, influenced by the presence of photosynthetic microalgae called zooxanthellae and geographical factors (Fabricius and Alderslade, 2001). However, the preserved specimen's morphology and colour will strongly transform in various colours due to lack of associated microalgae. In 1982, Verseveldt revised the genus *Sarcophyton,* and recognized 35 species. The current number of this genus has increased to 51 species (McFadden *et al.,* 2025).

Species of this genus are found in the Central-West Pacific, the Indian Ocean, and the Red Sea (Fabricius and Alderslade, 2001). The present study extends the known distribution of *Sarcophyton spinospiculatum* to the Andaman and Nicobar Islands, marking only the second record of this species since its original description from Lakshadweep. This record supports evidence of range extensions and distributional shifts in Indo-Pacific octocorals, likely influenced by environmental factors and limited regional sampling.

Materials and Methods

Soft coral specimen were collected from the coral reef regions of the Kardip, Nancowry group of islands, Nicobar Islands (08°02.3160' N; 93°33.1601' E) (Fig. 1:a-c). Sampling was conducted in subtidal habitats through SCUBA diving at depths of upto 12 m and the collected specimen was preserved in 70% ethanol (Benayahu *et al.,* 2004). On preservation the specimen turned darker, almost brownish. The specimen was photographed using Cannon Power Shot G15. A fine layer of soft tissue was carefully dissected from both the external (surface) and internal regions of the capitulum and stalk of the coral specimen using sterilized blade to extract sclerites.

The tissue extraction ensured the inclusion of sclerites from different morphological zones within the colony. The excised tissues were then transferred into a clean small glass boiling tube. A few drops of 5% sodium hypochlorite solution was added and kept for 10 to 15 min to dissolve tissue (Janes and Wah, 2007).

The extracted sclerites were then examined under a stereo-zoom microscope (LEICA M 205A DFC 500) for taxonomic identification. Identification was based on colony morphology, distance between autozooids and siphonozooids, presence of siphonozooids between autozooids, and structure and measurements of sclerites from both the exterior and interior regions of the capitulum and stalk. Taxonomic identification followed the criteria outlined by Alderslade and Shirwaiker (1991), and species classification followed to McFadden *et al.* (2022). The validity of species names was verified through cross-referencing with the World Register of Marine Species (McFadden *et al.,* 2025). Map of sampling location was made by using QGIS software (version 3.34.12) (Fig. 1: abc).

Results and Discussion

Systematics: Phylum Cnidaria Hatschek, 1888; Subphylum Anthozoa Ehrenberg, 1834; Class Octocorallia Haeckel, 1866; Order Malacalcyonacea McFadden, van Ofwegen & Quattrini, 2022; Family Sarcophytidae Gray, 1869; Genus *Sarcophyton* Lesson, 1834; Type material *Sarcophyton lobulatum* Lesson, 1834=*Sarcophyton ehrenbergi* von Marenzeller, 1886.

***Sarcophyton spinospiculatum* Alderslade and Shirwaiker, 1991.**

Material examined: Kardip, Kamorta Island, Nicobar (08°02.3160' N; 93°33.1601' E), coral reef edge, at a depth of 10 m, on 19.xii.2015 (Fig. 1 d, e).

Description

Colony shape: The examined specimen was a small portion of the colony, small stalk and polyparium curved and tightly folded (Fig. 1 d, e).

Polyps: The capitulum contained dimorphic polyps that were expanded and clearly visible. The distance between the centres of two autozooids at the peripheral region of the capitulum was 1.0 to 1.5 mm, and three to four siphonozooids were present. The distance between the centres of the autozooid and siphonozooid was 0.3 to 0.4 mm, between autozooid and siphonozooid 0.3 to 0.4 m and between two siphonozooids, 0.2 to 0.4 mm.

Sclerites: The capitulum's surface layer comprised club-shaped sclerites ranging in length 0.08 to 0.31 mm (Fig. 2:a). The most of club shaped sclerites ranged from 0.08 to 0.20 mm, and the longer sclerites were cone shaped, up to 0.31 mm in length. The heads of the clubs ranged from a blunt dome form to a narrower rounded tip, decorated with extremely tiny knobs and ridges. The handles contained several whorls or irregularly distributed, huge, more or less spherical warts coated in tiny grains and prominent longitudinal ridges. Internally the capitulum comprised thin spindles upto 0.49 mm long, with high pointed warts that resembled spines organized in whorls, spiny structures on the surface of the sclerite body, and some were branching (Fig. 2:b). The surface of stalk contained club shaped sclerites measuring 0.08 to 0.19 mm in length, smaller sclerites were stout club shaped with bigger upper head portion and small lower handle portion (Fig. 3a). The warts were often divided into two whorls and included granules and ridges similar to capitulum sclerites. The heads of the clubs was generally somewhat larger than the cluster of warts at the other end of the handle. The stalk interior

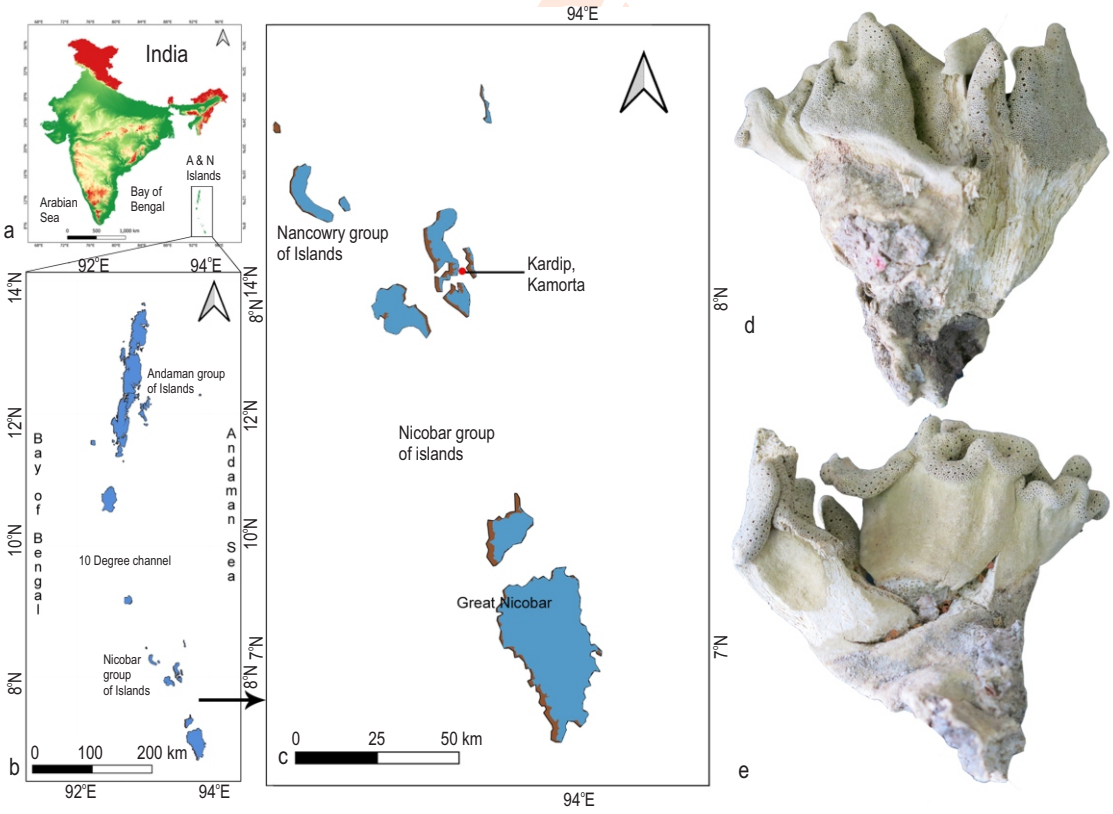

Fig. 1: (a) Map of India showing Andaman and Nicobar Islands; (b) Map of Andaman and Nicobar Islands, (c) Map showing the study area of sampling location, Kardip, Nancowry group of islands; (d) Small portion of the coral specimen showing folded capitulum; (e) side view of the coral colony.

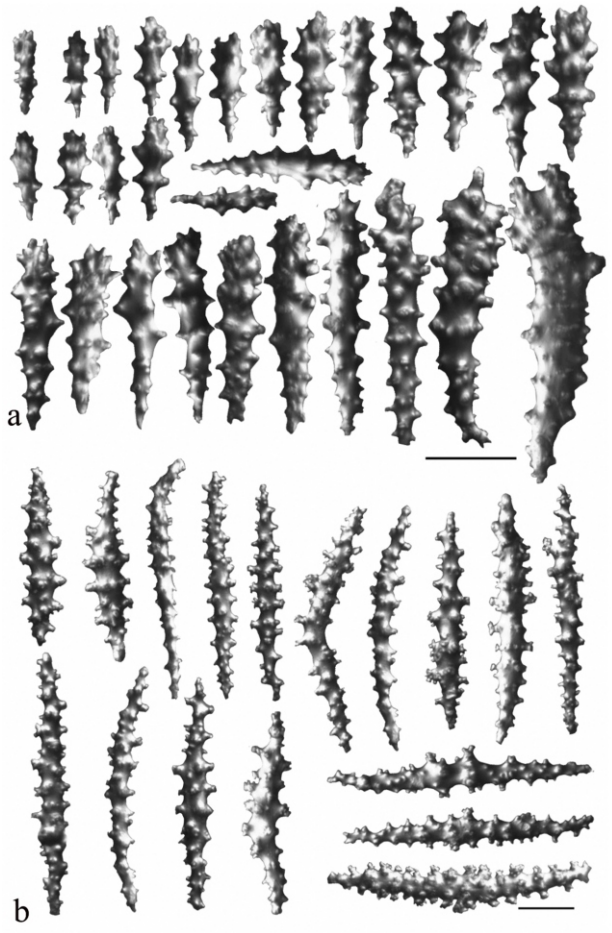

Fig. 2: Sclerites of *Sarcophyton spinospiculatum* Alderslade & Shirwaiker, 1991 (a. sclerites of capitulum exterior; b. sclerites of capiutulum interior) (scale bar=100 µm).

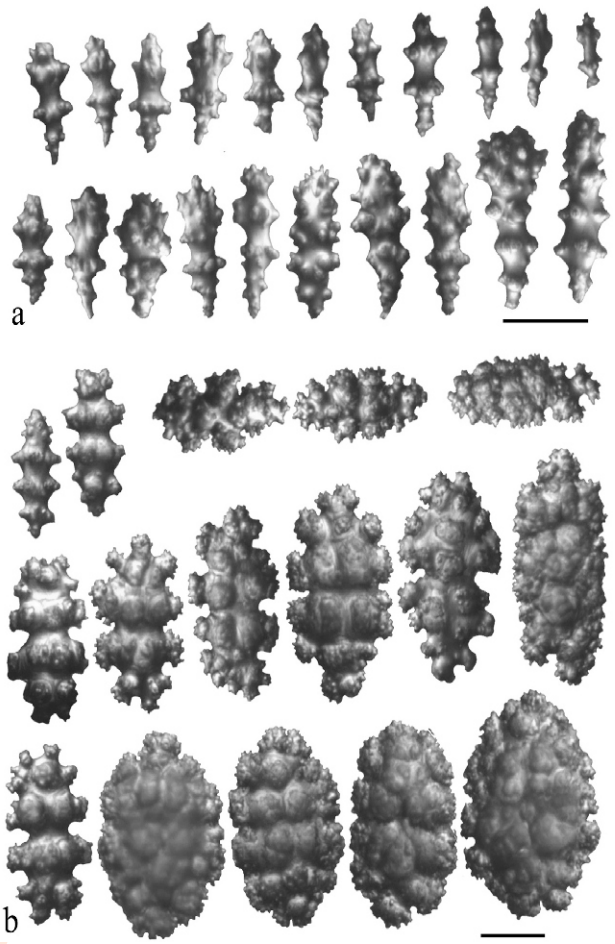

Fig. 3: Sclerites of *Sarcophyton spinospiculatum* Alderslade & Shirwaiker, 1991 (a. sclerites of stalk exterior; b. sclerites of stalk interior) (scale bar=100 µm).

sclerites were generally oval, with two whorls of low warts measuring 0.17 - 0.30 mm in length (Fig. 3b). A few sclerites possessed thorny warts and exhibited a slightly slenderer form than typical oval shape, measuring up to 0.26 mm in length. Few sclerites were round in shape and covered with thorny warts.

Colour: The colony appeared brown with white polyps when alive, and changed to dark brown after preservation.

Habitat: The specimen were found on dead coral.

Distribution: Lakshadweep (type locality) (Alderslade and Shirwaiker, 1991); Andaman and Nicobar Islands (present study). Octocorals are a diverse and significant component of benthic ecosystems in Indo-Pacific coral reefs, encompassing a wide range of marine fauna, including those found in the Andaman and Nicobar Islands. They are well distributed globally and represent a key component of reef ecosystems, particularly in the Indo-Pacific region (Fabricius and Alderslade, 2001). While several surveys have been conducted in the Andaman and Nicobar Islands, octocoral research in this region remains relatively underexplored. Notable contributions to octocoral research in the Andaman and Nicobar Islands include studies by Thomson and Simpson (1909), Jayasree *et al.* (1994, 1996), Kumar *et al.* (2012, 2014 a,b, 2015, 2018 a,b,c), Rajendra and Raghunathan (2016, 2022, 2024), Rajendra *et al.* (2017, 2023), Rajendra and Sivaperuman (2022).

The species *Sarcophyton spinospiculatum* was described by Alderslade and Shirwaiker (1991) from the Kavarati Islands (10º35'N; 72º36'E) in the Laccadive Archipelago (now the Lakshadweep) at a depth of 5-7 m. There are no further records of this species found in India or elsewhere. The present specimen was collected from the Nancowry group of islands, Nicobar Islands. The colony and sclerite morphology of this specimen matches the original description. However, a slight variation in the size of the interior sclerites was observed: sclerites in the present specimen reached a length of 0.49 mm whereas those described

by Alderslade and Shirwaiker (1991) were 0.34 mm. Aside from this, all other morphological features were consistent. This species share some similarities in the structure of its interior sclerites with congeneric species such as *Sarcophyton ehrenbergi* von Marenzeller, 1886, *Sarcophyton crassocaule* Moser, 1919 and *Sarcophyton trocheliophorum* von Marenzeller, 1886, which are commonly distributed in the Andaman and Nicobar Archipelago. Though, the overall sclerites structure of *S. spinospiculatum* does not fully align with any of these species.

Specifically, *S. ehrenbergi* and *S. spinospiculatum* share similarities in the capitulum interior, particularly in the presence of spiny, branched (thorn-like) structures on the sclerites (Rajendra *et al.,* 2023). However, differences were observed in the sclerites of the stalk. The stalk interior of *S. ehrenbergi* contains wider, wartier spindle-shaped sclerites, whereas *S. spinospiculatum* features smaller, oval shaped sclerites with less prominent, lower warts. Similarly, there were shared characteristics in the stalk interior sclerites, between *S. spinospiculatum* and *S. crassocaule,* however, notable differences existed in their capitulum exterior, interior, and stalk exterior sclerites.

The stalk exterior of *S. spinospiculatum* had oval-shaped sclerites, ranging 0.17 to 0.30 mm, with two whorls of low warts, some of which were thorny and slender in shape. In contrast, *S. crassocaule* features capstan, barrel, or oval-shaped sclerites, measuring 0.15 to 0.22 mm, along with spindles exhibited two to four zones of irregularly placed warts, some with smaller processes at the ends (Rajendra *et al.,* 2023). Thus, *S. spinospiculatum* is characterized by simpler, oval-shaped sclerites with low and thorny warts, while *S. crassocaule* shows variety of sclerite shapes, including capstan and barrel forms, with more irregular wart arrangements.

Both *Sarcophyton trocheliophorum* and *Sarcophyton spinospiculatum* share similarities in their overall morphology, particularly in the presence of club-shaped sclerites on the surface of the capitulum and stalk, though they differ significantly in the structure and characteristics of their sclerites. Capitulum interior of *S. trocheliophorum* featured simple spindles without spiny ornamentation measuring upto 0.52 mm whereas *S. spinospiculatum* exhibited spindles with more complex, branched, and spine-like warts arranged in whorls up to 0.49 mm in size. Stalk interior sclerites of *S. trocheliophorum* had larger, more robust sclerites with a distinct waist and thicker spiny warts, size ranging 0.30 to 0.44 mm, while *S. spinospiculatum* featured smaller, more delicately shaped sclerites with two whorls of low warts and occasional thorny wart (up to 0.30).

The present species was collected from Kardip in the Nancowry Group of islands in the Nicobar region. This study contributes to the limited octocoral research in the Nicobar Islands, a vital yet often overlooked part of the Indo-Pacific benthic ecosystems. Therefore, intence taxonomic and ecological studies in this region is needed inorder to discover new species and occurrences, but also to reveal more about the biology of Octocorals from these islands.

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Authors' contribution: S. Rajendra: Conceptualizaion, field data collection and analysis, original drafting of manuscript; **C. Raghunathan:** Conceptualization, supervision, writing and editing.

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