

Studies on species of *Halimeda* from Lakshadweep

M. SUNDARARAJAN¹, M. RAJENDRAN², N. KALIAPERUMAL³ AND S. KALIMUTHU⁴

¹ Department of Botany, Arignar Anna Govt. Arts College, Namakkal, India

² Govt. Higher Secondary School, Yethapur, Salem District, India

^{3, 4} Regional Centre of Central Marine Fisheries Research Institute,
Marine Fisheries - 623 520, India

ABSTRACT

Four Species of *Halimeda* viz. *H. incrassata*, *H. opuntia*, *H. simulans* and *H. taenicola* collected from Lakshadweep islands are described in detail.

Introduction

Calcareous algae are an integral part of the coral reef ecosystem and they contribute to a great extent to the building up of the coral rocks. These algae belong to various taxonomic groups. *Halimeda* is one of the most common calcareous marine algae in tropical waters. Krishnamurthy and Joshi (1970) listed 6 species of *Halimeda* from Indian coast. They are *Halimeda discoidea* Decaisne, *H. gracilis* Harvey ex J. Agardh, *H. macroloba* Decaisne, *H. opuntia* (Linnaeus) Lamouroux, *H. papyracea* Zanardini and *H. tuna* (Ellis & Solander) Lamouroux. Krishnamurthy and Jayagopal (1995) reported *H. gracilis*, *H. macroloba*, *H. opuntia* and *H. tuna* from the Galaxea reef at Krusadai Island. Sundararajan *et. al.* (1996) described *H. distorta* (Yamada) Hillis collected from Pamban area, in addition to *H. discoidea* Decaisne, *H. macroloba* Decaisne and *H. tuna* (Ellis & Solander) Lamouroux.

In a report on the survey of marine algal resources of Lakshadweep, Subbaramaiah *et. al.* (1979) reported the occurrence of *Halimeda gracilis* from the lagoons of Agathi, Ameni, Kadamath, Chetlat Kiltan, Androth, Kalpeni and Minicoy islands. Kaliaperumal *et. al.* (1989) have reported the occurrence of *H. gracilis* from all islands of Lakshadweep and *H. incrassata* at Kalpeni Island, *H. macroloba* at Kalpeni and Androth islands and *H. opuntia f. opuntia (typica)* at Kalpeni and Kavaratti islands. In the present study, some *Halimeda* species collected from Lakshadweep were examined in detail and 4 species, *H. incrassata* (Ellis) Lamouroux, *H. opuntia* (Linnaeus) Lamouroux, *H. simulans* Howe and *H. taenicola* WR Taylor (Plate I) are described. Of these, only *H. opuntia* (Linnaeus) Lamouroux has been recorded previously from India.

Materials and Methods

Specimens of *Halimeda* were collected from the Lakshadweep islands during the period January to March 1987 by

N. Kaliaperumal and S. Kalimuthu. The materials were washed thoroughly in seawater and preserved in 5% formalin. The external morphology of each species was studied. For studying the internal anatomy, segments of the thallus were decalcified by soaking them in Perenyi's fluid (Sundararajan *et. al.*, 1996). After complete decalcification, segments were separated, repeatedly washed in fresh water and then placed in a drop of 10% glycerine in the middle of a slide. The material was carefully teased out so as to expose the coenocytic filaments. Few semipermanent slides were prepared from the lower mature region and nodal regions.

Microscopic observations were made on dimensions of the medullary filaments, their mode of branching, the extent of cortex, number of layers of utricles and number of peripheral utricles borne upon an inner utricle. The behaviour of the medullary filaments at the node was also studied. The filaments of the node exhibit different types of fusion among themselves. Camera-lucida drawings of these structures were made. The identification of the species was made using the monograph on *Halimeda* by Hillis (1959).

Halimeda incrassata (Ellis) Lamouroux

The specimens collected from Kalpeni island were examined. The plants grow to about 20 cm in height, branching mostly trichotomously, dichotomy being noticed occasionally. When the branching is dichotomous, the three branches originate respectively from the three lobes of a lower segment. One of the important characters to be observed is the complanate nature of branching i.e. the branches occur in a single plane. The segments in the upper half of the thallus are moderately calcified.

The segments in the lower region of the thallus are cylindrical and about 5 mm in height. Majority of the other segments are

broadly fusiform viz. broader in the middle with either end being narrower, thereby presenting a somewhat moniliform appearance. The margin of the segment is invariably trilobed, occasionally undulate. The length of the segment varies from 3-4 mm, the breadth from 1.5-6 mm. The thickness of the segments is up to 1 mm.

Anatomically, there is a central medulla surrounded by a cortex. The medulla comprises vertically running coenocytic filaments, 93.5 to 131 μm in diameter. These filaments branch mostly trichotomously. From the medullary filaments many cortical filaments arise laterally which constitute the cortex. The cortical filaments are made up of 3 to 4 layers of utricles. The innermost utricle is not inflated but elongated, measuring 374 μm in height. The secondary utricle bears on its apex 2 peripheral utricles. In surface view the peripheral utricles present an angular appearance with a diameter ranging from 37 to 56 μm (Fig. 1). At the nodal region all the medullary filaments are adherent in the middle. The above description largely conforms to that by Hillis (1959).

Halimeda opuntia (Linnaeus) Lamouroux

The specimens examined were collected from Androth island. The plant grows to a height of 30 cm. It branches sparsely, dichotomously and trichotomously. The segments are smaller and highly variable. Some are cylindrical, some cuneate and some reniform. Some are ribbed. The length of the segment ranges from 3-5 mm and the breadth 2-6 mm. The margin of the segment is entire or predominantly trilobed, The thickness of the segment is nearly 1 mm. Some of the segments are oriented slightly in different directions so that they look distorted.

The vertical medullary filaments are mostly trichotomously branched with a diameter of 18.7-37.4 μm . Lateral cortical

filaments arise from the medullary filaments. In the cortical filaments there are 3 to 4 layers of utricles. The secondary utricle is elongated (131 μm) and bears 3 to 6 peripheral utricles at its tip which are rounded in surface view measuring 28 - 37.4 μm in diameter (Fig. 2). After decalcification, the peripheral utricles remain separated. At the nodal region the medullary filaments fuse in pairs to a longer distance, thereby showing an extended fusion. The description given above is in agreement with that of Hillis (1959).

Halimeda simulans Howe

The specimens examined were collected from Androth island. The plant grows to about 10 cm in height attached to substratum by means of a holdfast which is slightly flattened. The thallus is moderately calcified but the density of calcification is comparatively higher in the lower segments. The predominant mode of branching is trichotomous. Though the plant exhibits fairly dense branching, the branches are complanate in a single plane.

The segments, small or big, do not show much variability in shape unlike in other species. In the specimen, the lowermost few segments are narrowly cylindrical and about 2 mm long. Other segments are reniform or subcuneate. They measure 1-3 mm in length and 2-5 mm in breadth. The margin is entire or trilobed, some segments are ribbed.

As far as the anatomy is concerned, the thallus has a central medulla surrounded by a cortex. The medulla is composed of vertically running medullary filaments. The medullary filaments are largely trichotomously branched. They measure 56-112 μm in diameter. From these medullary filaments arise lateral cortical filaments. The innermost utricle is elongated (336 μm) and does not show any structural variation. The innermost utricle bears about

3 secondary utricles (93.5 μm in height) bearing two peripheral utricles. The peripheral utricles present an angular appearance in surface view with a diameter ranging from 56.1 to 74.8 μm (Fig. 3). At the nodal region all the medullary filaments remain united communicating with each other through pores. The description of this species is in agreement with that of Hillis (1959).

Halimeda taenicola W. R. Taylor

The specimens collected from Androth island were examined. The plants grow erect to a height of 7 cm attached to stones by means of a holdfast which is irregularly cylindrical and about 1 cm in height. In the upper half, the plant branches densely, sometimes about five branches arising from a single middle segment. Further branching is mostly dichotomous, trichotomy being occasional. While the lower segments are heavily calcified, the intensity of calcification decreases towards the upper segments. The lower 2 or 3 segments are cylindrical or subcuneate, while the other segments are trapezoidal. The uppermost 1 or 2 segments are comparatively much smaller and cylindrical or cuneate in appearance. The length of the segments vary from 4 mm to 10 mm and the breadth from 2 mm to 10 mm.

Anatomically there is a central medulla composed of vertically running medullary filaments from which arise lateral cortical filaments. Medullary filaments branch both dichotomously and trichotomously. The diameter of the medullary filament ranges from 37.4 μm to 112.2 μm . Cortical filaments are made of 2 to 3 layers of utricles. The innermost utricles is much larger measuring 280.5 μm in length and 149.6 μm in breadth. The secondary utricle bears 2 to 4 peripheral utricles. After decalcification peripheral utricles remain adherent without any separation. They are angular in surface view (Fig. 4).

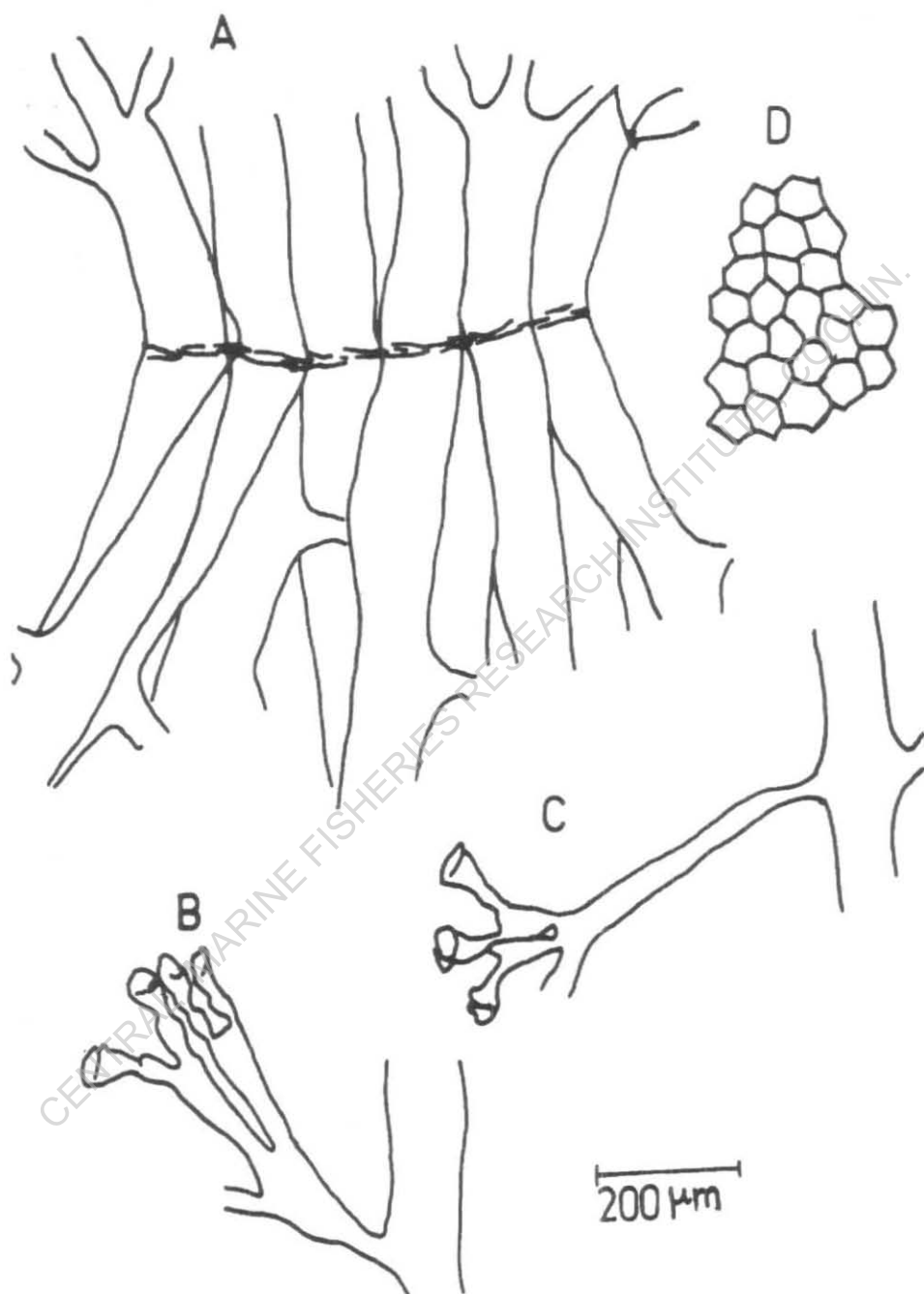


Fig. 1. *Halimeda incrassata* A. Union of all the medullary filaments in the nodal region; B - C. Cortical filament with peripheral uticles; D. Surface view of the peripheral uticles.

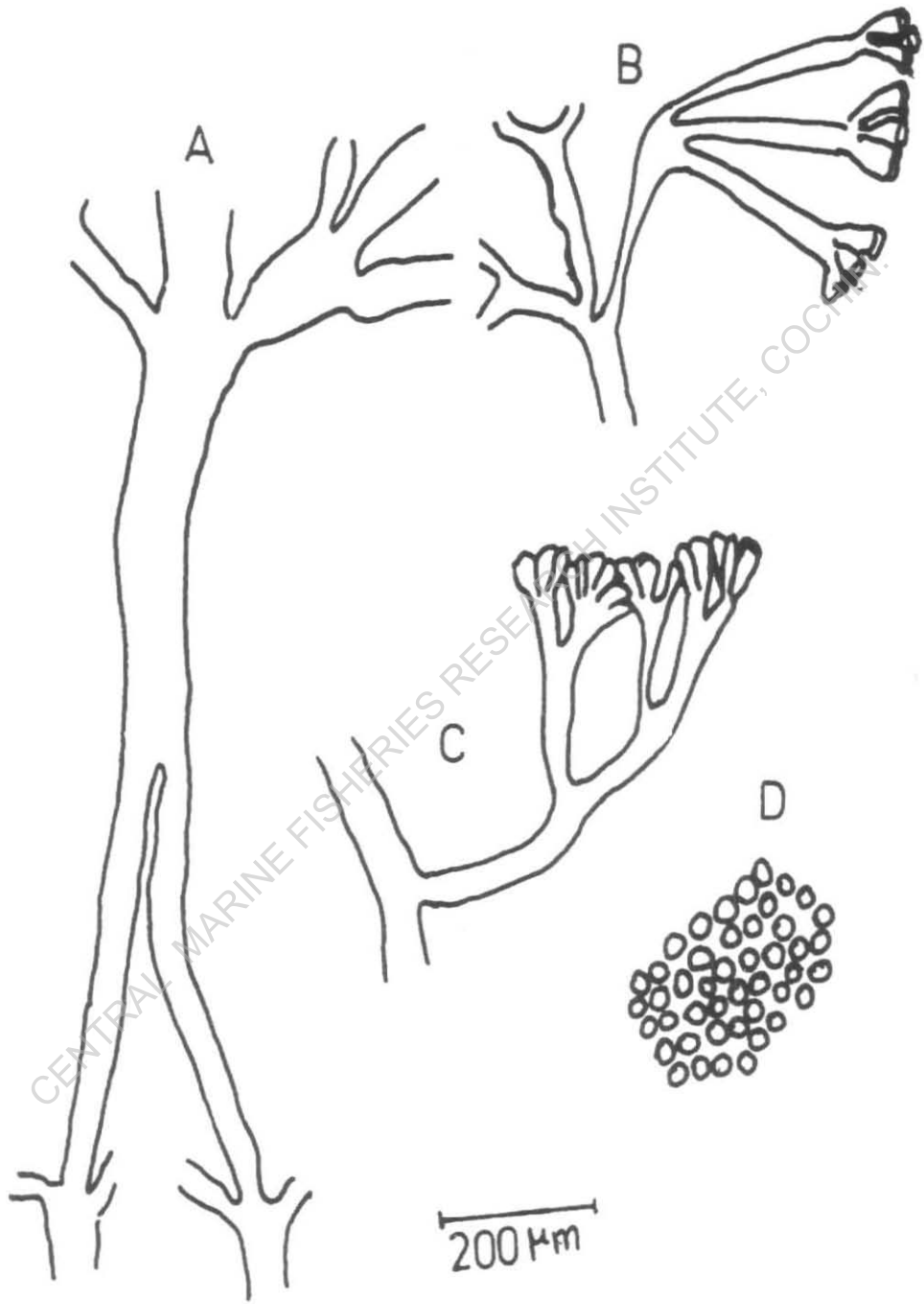


Fig. 2. *Halimeda opuntia* A. Medullary filaments showing 'Extended fusion'; B - C. Medullary filament showing a lateral filament with peripheral utricles; D. Surface view of peripheral utricles.

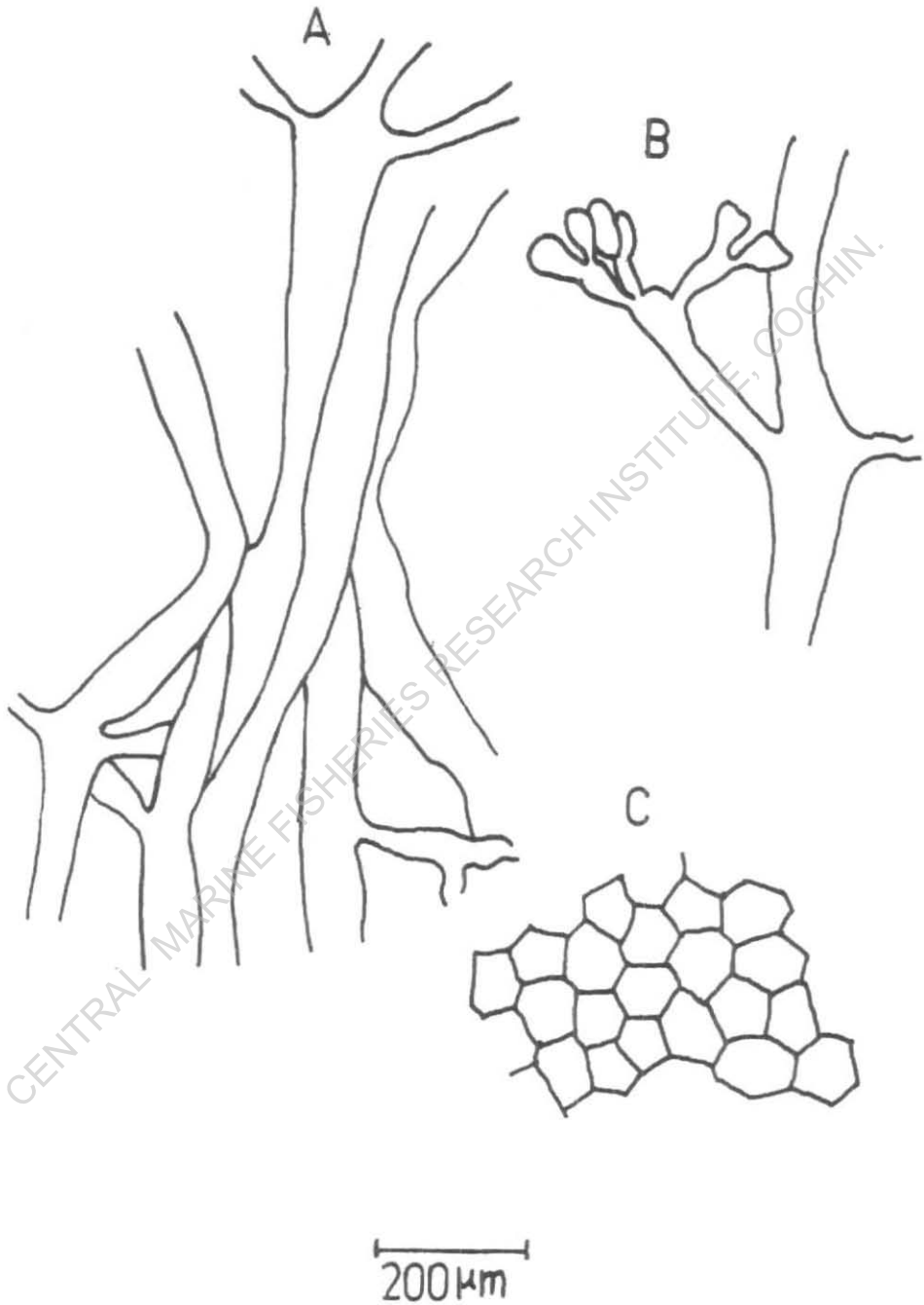


Fig. 3. *Halimeda simulans* A. Union of all the medullary filaments in the nodal region; B. Cortical filament ending with peripheral utricle; C. Surface view of peripheral utricles.

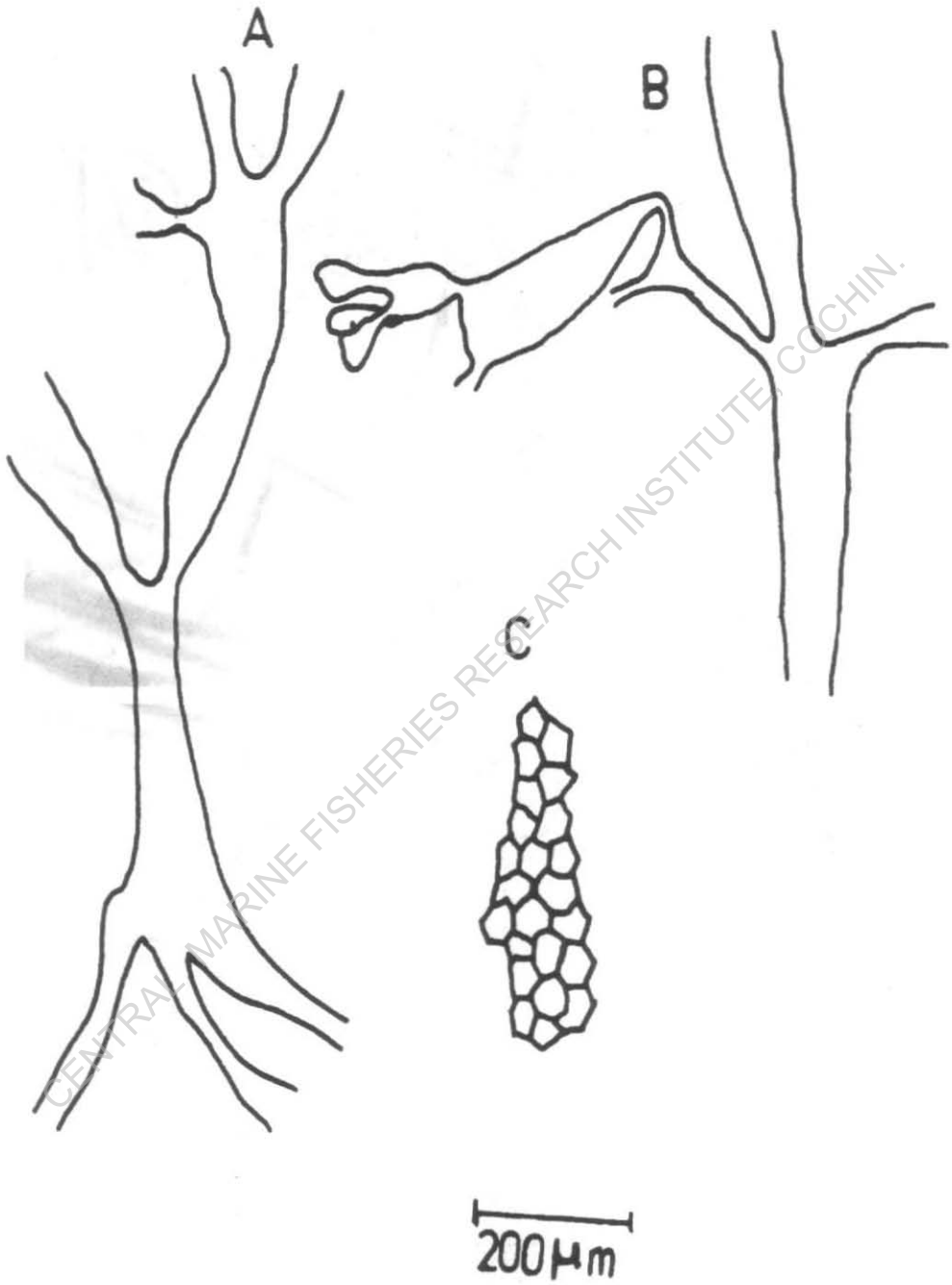


Fig. 4. *Halimeda taenicola* A. Medullary filaments showing 'Extended fusion'; B. Medullary filament showing a lateral filament with peripheral utricles; C. Surface view of peripheral utricles.

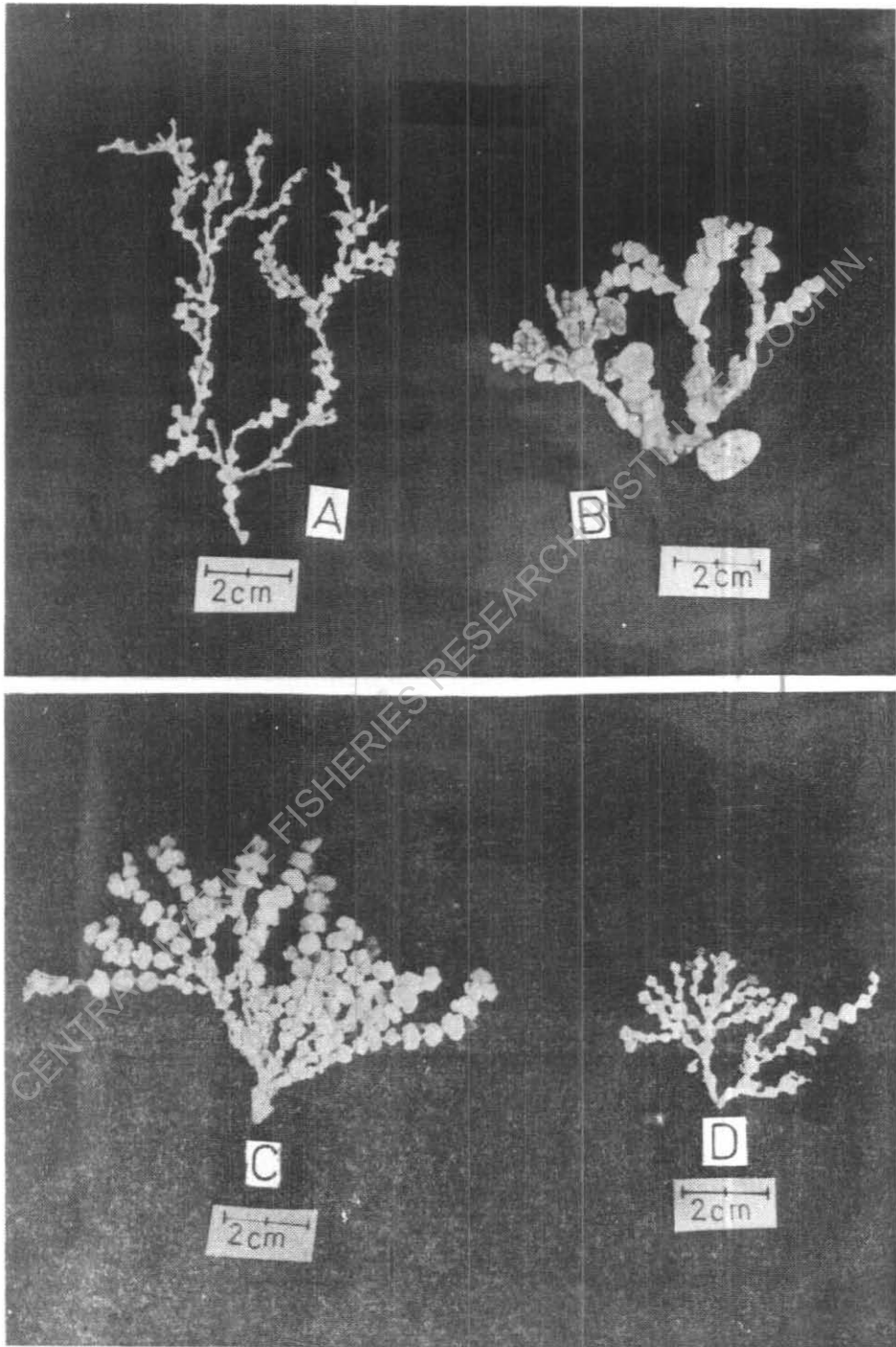


Plate I. (A) *Halimeda opuntia* (B) *H. taenicola* (C) *H. simulans* (D) *H. incrassata*

The diameter ranges from 37 μm to 56 μm . At the nodal region, three filaments fuse together for a long distance before branching. Thus they exhibit an extended type of fusion.

Acknowledgement

The authors are thankful to Prof. V. Krishnamurthy, Director, Krishnamurthy Institute of Algology, Chennai for confirming the identification and for valuable suggestions.

Literature cited

Hillis, L. W. 1959. A review of the genus *Halimeda* (Order Siphonales). Publ. Inst. Mar. Sci. Univ., Texas.

- Kaliaperumal, N., P. Kaladharan and S. Kalimuthu 1989. Seaweed and seagrass resources. CMFRI Bull., 43 : 167 - 175.
- Krishnamurthy, V. and H. V. Joshi 1970. A check list of Indian marine algae. CSMCRI, Bhavanagar, 36 pp.
- Krishnamurthy, V. and K. Jayagopal 1995. Calcareous algae of the Galaxea Reef, Krusadai Island, Tamilandu. Seaweed Res. Utiln., 17 (1 & 2) 117 - 121.
- Subbaramaiah, K., K. Ramarao and M.R.P.Nair 1979. Report on the survey of marine algal resources of Lakshadweep for 1977-79. CSMCRI, Bhavnagar 39 pp.
- Sundararajan, M., C.Selvaraju and V. Krishnamurthy 1996. On some species of *Halimeda* Lamouroux from Indian waters. Seaweed Res. Utiln., 18 (1 & 2) : 21 - 32.