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The genus *Catenella* Zanardini in Kalegauk Island, Myanmar

Thet Htwe Aung
Assistant Lecturer, Marine Science Department, Mawlamyine University, Myanmar

Abstract
The genus *Catenella* collected from the different stations along the Kalegauk Island from August 2017 to January 2018 had been revised. Specimens were identified as *Catenella caespitosa* (Withering) Irvine in Parke & Dixon, *Catenella nipae* Zanardini and *Catenella impudica* (Montagne) J. Agardh with their morphological characters. Among them, *Catenella caespitosa* (Withering) Irvine in Parke & Dixon (= *Catenella opuntia* (Goodenough & Woodward) Greville) were new record for marine algae resources of Myanmar. The descriptive keys to the species of these algae were also provided. The distributional ranges of each species found along the coastal areas of the Kalegauk Island, the three Coastal Regions of Myanmar and worldwide regions of the oceans were recorded. Moreover, their potential uses and habitats were provided.

Keywords: morphology, Kalegauk Island, distribution ranges, new record, *Catenella caespitosa*

1. Introduction
The species of the genus *Catenella* Zanardini belong to the family Calycanthaceae under the order Gelidiales are widely distributed in the estuaries of coastal regions, especially in tropical, subtropical and temperate waters throughout the world. Before the present study, there were 2 species which have been taxonomically accepted in Myanmar. In the present study, one species could be designated as the first record of Myanmar with the taxonomic evidences.

Catenella spp., locally known as "Kyaukpwint" has been utilized as traditional sea vegetable in Myanmar [1]. Plants grow on rocks and pneumatophores in upper tidal zone, always exposed at low tide. They are used as carrangeenan, fodder, fish meal, human food and manure, salad [2, 3]. Kalegauk Island is composed of the four large villages which are Apor Seik Village, Auk Seik Village, Alè Seik Village and Pashyu Chaung Village (fig.1). It is strange that Kyunn Pyet is separated from the main island and it is far away from the settlement of local people. Therefore, it appears to be free from the impacts of human beings. The coastal areas of the Kalegauk Island are generally covered by mangrove forests rather than rocky shores. Nowaday, Kalegauk Island has been declared as the island to be constructed deep sea port.

In the present study, an attempt had been made to know the diversity of the genus *Catenella* in Kalegauk Island, the morphological and taxonomic features of *Catenella* found along the coast of the Kalegauk Island located in the northern part of Andaman Sea facing the Bay of Bengal of the Indian Ocean.

2. Materials and methods
2.1 Study areas
Kalegauk Island is located in the northern part of the Andaman Sea, in the Bay of Bangal maily composed of four villages, viz., Apor Seik Village, Auk Seik Village, Alè Seik Village and Pashyu Chaung Village. Other common places are Chaytoryar Pagoda and Kyunn Pyet or Cavendish Island. Apor Seik Village is situated at the upper edge of the island (Lat. 15° 35′ N, Long. 97° 38′ E). Pashyu Chaung Village is situated between the Apor Seik and Alè Seik Villages (Lat. 15° 34′ N, Long. 97° 39′ E). Chaytoryar Pagoda is situated between the Alè Seik Village and Pashyu Chaung Village (Lat. 15° 33′ N, Long. 97° 39′ E). Alè Seik Village is situated between the Apor Seik Village and Auk Seik Village (Lat. 15° 32′ N, Long. 97° 39′ E). Auk Seik Village is situated at the lower edge of the island (Lat. 15° 30′ N, Long. 97° 39′ E). Kyunn Pyet is situated on the opposite site of Auk Seik (Lat. 15° 29′ N, Long. 97° 39′ E) (fig. 1). In the study areas, salinity range and temperature regimes seawater were 26-27 ‰ and 29° C to 31° C, respectively.

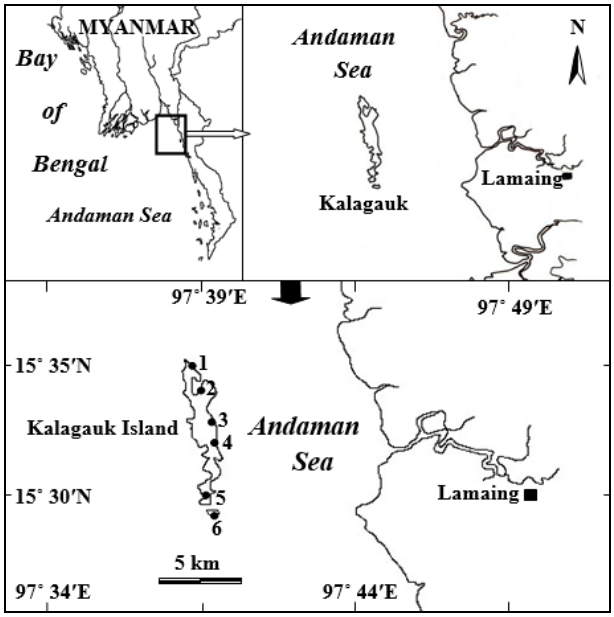

Fig 1

2.2 Procedures for taxonomic studies

Marine algae were collected in the forms of drift and live specimens growing in the high tide line, intertidal and shallow subtidal areas from Apor Seik, Pashyu Chaung, Chaytoryar Pagoda, Alè Seik, Auk Seik and Kyunn Pyet from August 2017 to January 2018. The site location, topography, associated flora and fauna and other related parameters of Kalegauk Island were recorded. In the field, all the adhering materials such as sand particles and other debris as well as epiphytes were removed from the samples with the help of painting brush before preservation. The seaweed samples preserved 4% formaldehyde with seawater. All the bags and containers were labeled with date, time of collection, locality and transport to the laboratory of Marine Science Department for further analysis.

In the laboratory, color and morphological differences between different species and taxonomic characters firstly studied and then the collected seaweeds had been identified with emphasis on the external and internal morphologies of vegetative and reproductive features. For internal details studies of the thalli, cross section (c.s) were obtained by free hand with shaving blades, then stained in Aniline Blue (0.5 g water soluble aniline blue in 100 ml distilled water and 5 ml conc. Acetic acid) and mounted in glycerine. Vegetative and reproductive structures of the plants were studied under the Olympus compound microscope and Kaneko Yushima dissecting microscope. Microscopic measurements were recorded in micrometer (µm) using the ocular meter.

All seaweed slides and herbarium sheets were deposited at the Herbarium of Department of Marine Science, Mawlamyine University, Mawlamyine, Myanmar (MMB). Photographs of external and internal morphological structures of the materials were taken with a Canon IXUS 210 digital camera and by processing Adobe Photoshop 7.0. This study basically followed the classification system of Guiry and Guiry [4]. Local distribution of each species was prepared by using herbarium specimens examined and potential uses of these algae were recorded from the literature available [3, 5, 6, 7].

3. Result

Phylum: Rhodophyta
Class: Florideophyceae
Order: Gelidiales
Family: Calycanthaceae
Genus: *Catenella* Greville
Species: **(i)** *Catenella caespitosa* (Withering) Irvine in Parke & Dixon
(ii) *C. nipae* Zanardini
(iii) *C. impudica* (Montagne) J. Agardh

Key to the species of Catenella from Kalegauk Island

1a. Branches 2-9 segments, dichotomous or second, often emits from the midportion of the thallus and not distinctly bloated…….....*Catenella caespitosa*
1b. Branches 1-3 segments, dichotomous or trichotomous, emits from the joint and distinctly bloated…….2
2a. Plants stout, swollen…….…….....*C. nipae*
2b. Plants complanate-expanded, terete, cylindrical…….....
.....*C. impudica*

***Catenella caespitosa* (Withering) Irvine in Parke & Dixon (Figs. 2-7)**

References: *Catenella caespitosa* (Withering) L.M. Irvine in M. Parke & P.S. Dixon 976; 590 [8]. Taxonomic synonyms: *Catenella opuntia* (Goodenough & Woodward) Greville: Anand and Chauhuri 1943: 46-47, fig.32 [12]; Segawa 1956: 85, fig. 404 [9]; Kyilin 1956: 85, fig. 404 [10]; Arasaki 1964: 98, fig. 350 [11]; Cordero 1977: 163, figs. 168-169 [13]; Fortes and Trono 1979: 59 [14]; Guiry and Guiry 2018 [4].

Type locality: "Side Rocks, Anglesey", Wales (Silva, Basson & Moe 1996: 280) [4].
Type: OXF (Dixon & Irvine 1977: 190) [4].

Description: Plants very small, grow together with *Bostrychia*, red to violent in color and attached by means of haptera located at the narrowings of the thallus. Branches 2-9 segments, dichotomous or secund, often emits from the midportion of the thallus and not distinctly bloated. In surface view cells irregularly rounded, 3-4 µm in diameter and segments 500-1250 µm long and 200-375 µm wide. In cross section cells composed of 2 or 4 layers of cortical cells, 3-4 µm in diameter, medullary cells network in shape, 6-8 µm long, 5 pericentral cells, 15-20 µm in diameter and one central cell, 20-24 µm in diameter.

Specimens examined: Kalegauk Island (Kyunn Pyet) (Thet Htwe Aung, 29.xiii.2017, MMB 111042- 111044).

Distribution

(i) Local distribution- Rakhine Coastal Region - No data, Ayeyarwady Delta and Gulf of Mottama (Martaban) Coastal Region - Kalegauk Island., Tanintharyi Coastal Region - No data.
(ii) World distribution: Ireland: Mayo.Europe: Ireland, Spain, Turkey (Europe). South America: Chil, Falkland Is, Galápagos Is, Tierra del Fuego. Africa: Morocco. Asia: Japan. South-east Asia: Indonesia. Australia and New Zealand: New Zealand [4].

Ecological notes: Plants grow on rocks with *Bostrychia* in upper intertidal zone, always exposed at low tide.

Potential uses: This species is used as salad.

***Catenella nipae* Zanardini (Figs. 8-14)**

References: *Catenella nipae* Zanardini 1872: 143-145; Zaneveld 1955: 29 [15]; Post 1963: 116 [16]; Kyaw Soe and Kyi Win 1977: 129, figs 120A1-2 [17]; Lewmanomont and Ogawa 1995: 97[18]; Silva, Basson and Moe 1996: 128 [19]; Islam 1998: 107 [20]; Reine and Trono 2002: 110-111 [21]; Phang 2006: 193 [22]; Pham *et al.* 2011: 12 [23], Satpati, Barman and Pal 2012: 46, pl.1, fig. E, pl.2, fig. F [24]; Guiry and Guiry 2018 [4].

Type locality: Sarawak, Indonesia (Silva, Basson & Moe 1996: 281) [4].

Type: Sarawak, Borneo; holotype (?) in Herb. Zanardini, Museo Civico di Storia Naturale, Venice[4]

Description: Plants stout, 2-3 cm high, swollen, erect and pink in color and attached by means of haptera located at the narrowing parts of the thallus. Branches 1-3 segments, dichotomous or trichotomous and emits from the joint, distinctly bloated. In surface view cells small, irregularly rounded, 3-4 µm in diameter. In cross section, cortex cell elongated, 20-28 µm long and 8-12 µm wide. Medullary cells with longitudinal filaments, more or less rounded, 8-16 µm in diameter.

Specimens examined: Kalegauk Island (Apor Seik) (Thet Htwe Aung, 28.ix.2017, MMB 11715), Kalegauk Island (Auk Seik) (Thet Htwe Aung, 28.ix.2017, MMB 11724), Kalegauk Island (Alè Seik) (Thet Htwe Aung, 28.ix.2017, MMB 11725), Kalegauk Island (Pashyu Chaung) (Thet Htwe Aung, 28.ix.2017, MMB 111045), Kalegauk Island (Kyunn Pye Kalagoke Island) (Thet Htwe Aung, 28.ix.2017, MMB 111046), Kalegauk Island (Chaytoryar Pagoda) (Thet Htwe Aung, 28.ix.2017, MMB 111047).

Distribution

(i) Local distribution - Rakhine Coastal Regions - No data; Ayeyarwady Delta and Gulf of Mottama (Martaban) Coastal Region - Kyaikkhami, Setse, Yathae Taung, Kalegauk Island., Tanintharyi Coastal Region - No data[5]

(ii) World distribution: Africa: South Africa, Tanzania, South-west Asia: Bangladesh, India, Asia: China, Japan, South-east Asia: Indonesia, Malaysia, Myanmar (Burma), Philippines, Singapore, Vietnam, Australia and New Zealand: New South Wales, New Zealand, Queensland, Victoria [4].

Ecological notes: Plants grow on rocks and pneumatophores in upper tidal zone, always exposed at low tide.

Potential uses: *Catenella nipae* Zanardini is used as carrangeenan, fodder, fish meal, human food and manure, salad [2, 7].

***Catenella impudica* (Montagne) J. Agardh (Figs. 15-21)**

References: *Catenella impudica* (Montagne) J. Agardh 1852: 701-702 [26]; Taylor 1945: 226 [25]; Zaneveld 1955: 28 [15]; Post 1963: 114 [16]; Kyaw Soe and Kyi Win 1977: 130, fig. 231 [17]; Silva, Basson, Moe 1996: 281 [19]; Islam 1998: 107 [20]; Phang 2006 [22]: 193; Pham *et al.* 2011:12 [23], Guiry and Guiry 2018 [4].

Type locality: Cayenne, French Guiana (Silva, Basson & Moe 1996: 281) [4].

Type: Unknown [4].

Description: Plants complanate-expanded, erect, 3-4 cm high, cylindrical, terete and attached by means of hapter located at the narrowing parts of the thallus. Branches 1-3 segments, ditrichotomous and emits from the joint, distinctly bloated. Discoidal holdfasts formed at the terminal end of segments. In surface view cells small, irregularly rounded, 4-12 µm in the diameter. In cross section cortex cells elongated, 20-28 µm long and 12-16 µm wide. Medullary cells with longitudinal filaments, more or less rounded, 8-16 µm in diameter. Tetraspores zonately divided, scattered or aggregated in encircling sori below the surface of the cortex of terminal segments, 60-92 µm long and 23-40 µm broad.

Specimens examined: Kalegauk Island (Apor Seik) (Thet Htwe Aung, 28.ix2017, MMB 11717), Kalegauk Island (Auk Seik) (Thet Htwe Aung, 28.ix2017, MMB 11718), Kalegauk Island (Alè Seik) (Thet Htwe Aung, 28.ix2017, MMB 11720), Kalegauk Island (Pashyu Chaung) (Thet Htwe Aung, 28.ix2017, MMB 111048), Kalegauk Island (Kyunn Pyet) (Thet Htwe Aung, 28.ix2017, MMB 111049), Kalegauk Island (Chaytoryar Pagoda) (Thet Htwe Aung, 28.ix.2017, MMB 111050).

Distribution

(i) Local distribution.- Rakhine Coastal Regions - No data; Ayeyarwady Delta and Gulf of Mottama (Martaban) Coastal Region - Kyaikkhami, Setse, Yathae Taung, Kalegauk Island; Tanintharyi Coastal Region - No data [5].

(ii) World distribution: Central America: Costa Rica, El Salvador, Caribbean Is: Caribbean, Cuba, Hispaniola, Lesser Antilles, Surinam, Western Atlantic: Trop. & Subtrop. W. Atlantic, South America: Brazil, Colombia, Guyana, Venezuela, Africa: Cameroon, Côte, Gambia, Mauritius, Senegal, South-west Asia: Bangladesh, India, Asia: China, Japan, South-east Asia: Indonesia, Myanmar (Burma), Philippines, Singapore, Vietnam [4].

Ecological notes: Plants grow on rocks and pneumatophores in upper tidal zone, always exposed at low tide.

Potential uses: *Catenella impudica* (Montagne) J. Agardh is used as carrangeenan, fodder, fish meal, human food and manure, salad [2, 7].

4. Discussion

Tin Aung Moe *et al*. [27] had firstly observed the seaweeds found around the Kalegauk Island in 1971. The natural habit of *Catenella nipae* Zanardini and it's productivity on natural and artificial substratum had been studied by Kyi Shwe 1974 [28]. Moreover, Aung Myint 1980 [29] studied the life history of *Catenella nipae* Zanardini in laboratory culture.

In this study, the three species of *Catenella* could be recorded from the different stations, Apor Seik Village, Auk Seik Village, Alè Seik Village, Pashyu Chaung Village, Chaytoryar Pagoda and Kyunn Pyet, along the Kalegauk Island from Augest 2017 to January 2018 (fig.1). They are *Catenella caespitosa* (Withering) Irvine in Parke & Dixon, *Catenella nipae* Zanardini and *C. impudica* (Montagne) J. Agardh. Although *Catenella nipae* Zanardini has been described in the previous reports of Kalegauk Island by Kyaw Soe and Kyi Win 1977 [17], *Catenella caespitosa* (Withering) Irvine in Parke & Dixon and *C. impudica* (Montagne) J. Agardh were the first record of Kalegauk Island. In addition to, *Catenella caespitosa* (Withering) Irvine in Parke & Dixon has not been recorded yet before this study. Therefore, it could be the first record of Myanmar.

Catenella nipae Zanardini and *C. impudica* (Montagne) J.Agardh were found all over Kalegauk Island. On the other hand, *Catenella caespitosa* (Withering) Irvine in Parke & Dixon were only found in Kyunn Pyet. This can be because Kyunn Pyet is separated from the main island and any

household does not settle there so it seems like free from the impacts of human being.

Catenella spp. commonly grow on rocks and pneumatophores in upper tidal zone, always exposed at low tide and they are more abundant within the mangrove forests. In Kalegauk Island, it can be seen that *Catenella nipae* Zanardini and *C. impudica* (Montagne) J.Agardh are blooming at the basal part of the mangrove trees during the rainy season and the early winter. However, *Catenella caespitosa* (Withering) Irvine in Parke & Dixon could be found just growing on rocks.

Besides, *Catenella nipae* Zanardini and *Catenella impudica* (Montagne) J. Agardh are swollen in the view, as opposed to *Catenella caespitosa* (Withering) Irvine in Parke & Dixon which is flat. The main characteristics are that in *Catenella caespitosa* (Withering) Irvine in Parke & Dixon, their branches are two to nine segments, dichotomous and often emits from the midportion of the thallus and they are not distinctly bloated. On the other hand, in *Catenella nipae* Zanardini and *C. impudica* (Montagne) J.Agardh, their branches are one to two segments, dichotomous or trichotomous and emits from the joint and distinctly bloated.

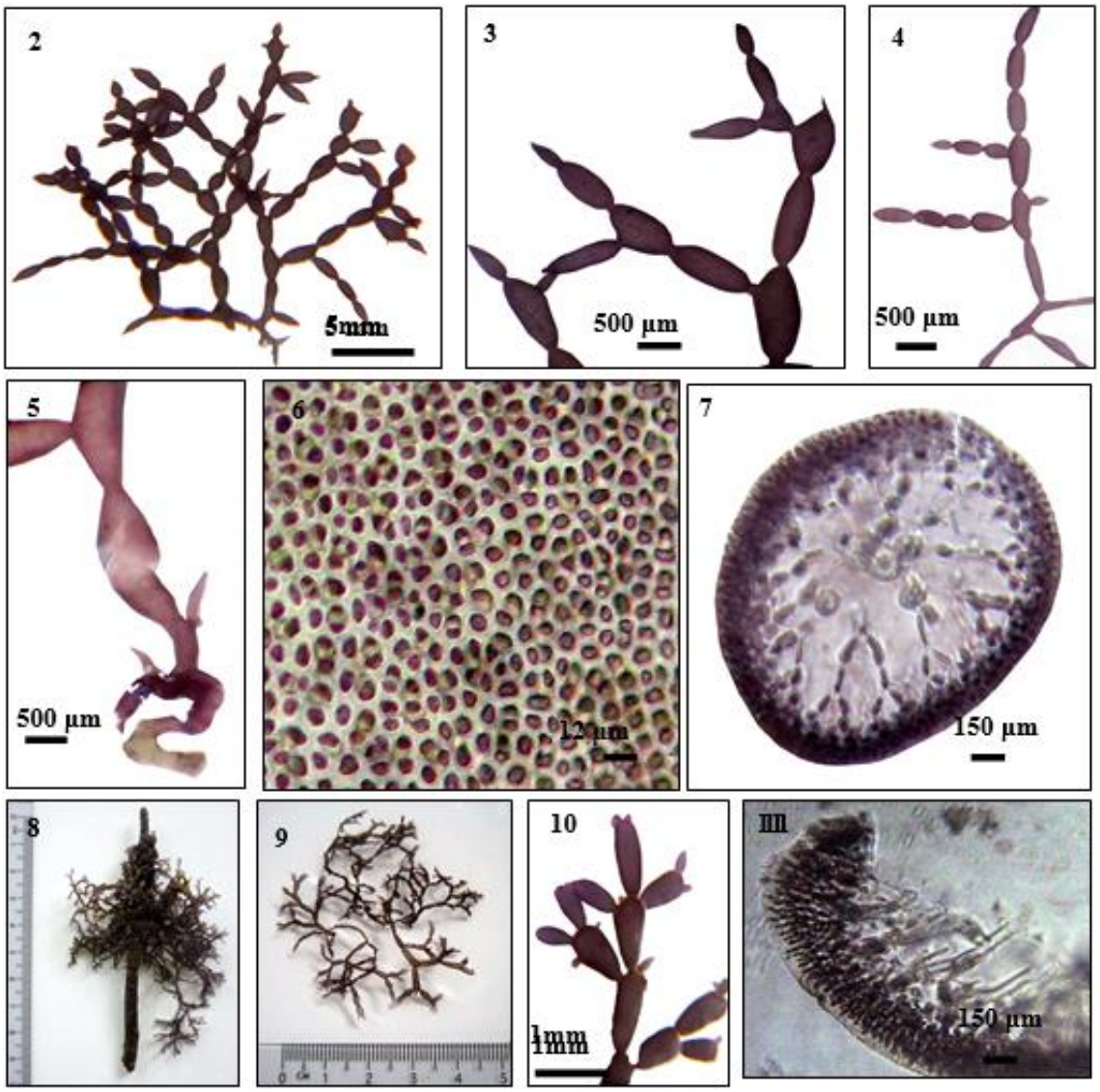

Fig 2-11: 2) Habit of *Catenella caespitosa* (Withering) Irvine; 3) Branch system of *C. caespitosa* (Withering) Irvine; 4) Segments of *C. caespitosa* (Withering) Irvine; 5) Rhizoidal holdfast of *C. caespitosa* (Withering) Irvine; 6) Surface view of *C. caespitosa* (Withering) Irvine; 7) Cross section of *C. caespitosa* (Withering) Irvine; 8) Pneumatophores of *Catenella nipae* Zanardinii; 9) Habit of *C. nipae* Zanardinii; 10) Branch system of *C. nipae*

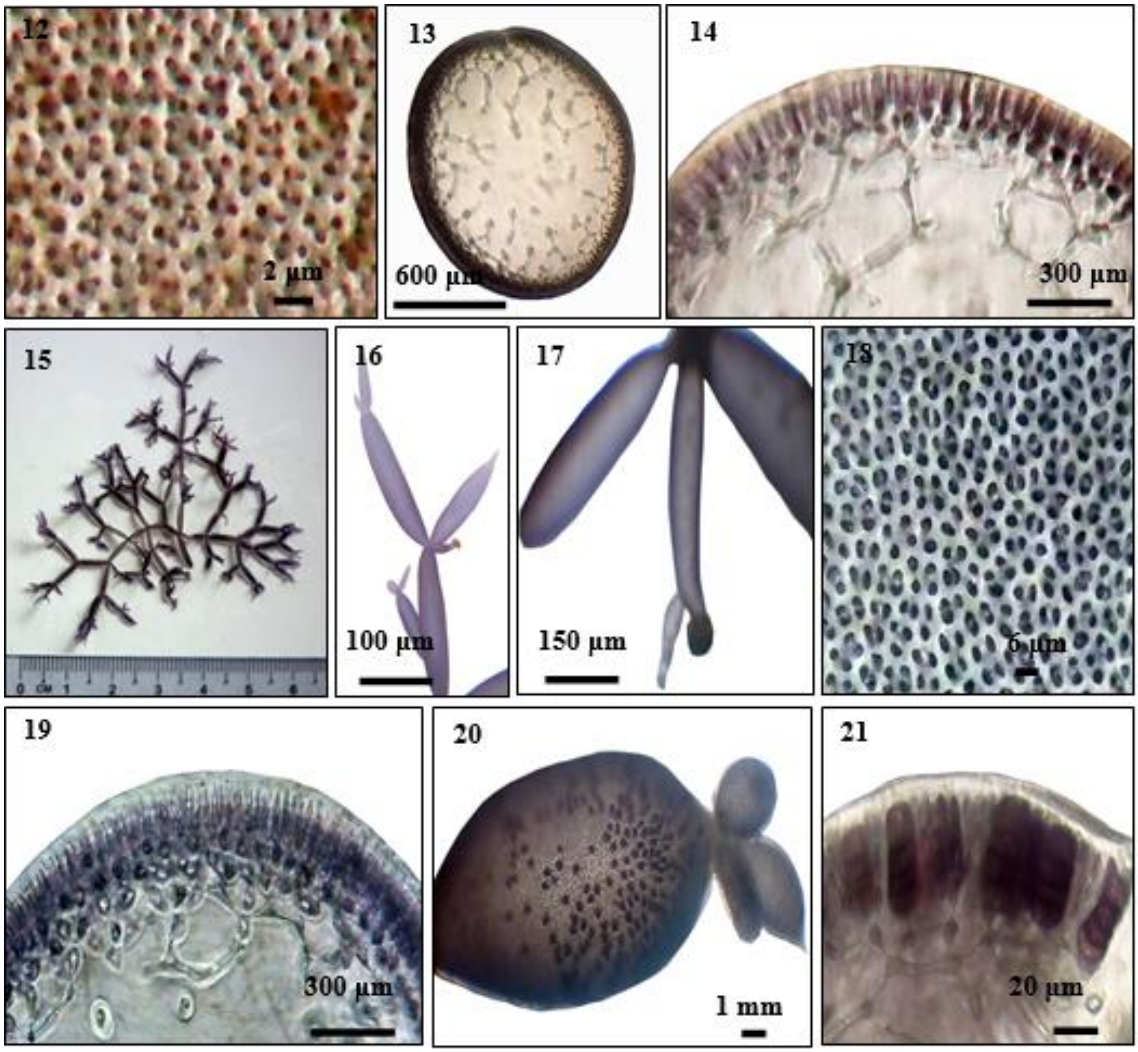

Fig 12-21: 12) Surface view of *Catenella nipae* Zanardinii; 13) Cross section of *C. nipae* Zanardinii; 14) Cortex cells and medullary cells of *C. nipae* Zanardinii; 15) Habit of *Catenella impudica* (Montagne) J.Agardh; 16) Segments of *C. impudica* (Montagne) J.Agardh; 17) Discoid holdfast of *C. impudica* (Montagne) J.Agardh; 18) Surface view of *C. impudica* (Montagne) J.Agardh; 19) Cross section of *C. impudica* (Montagne) J.Agardh; 20) Tetrasporangia of *C. impudica* (Montagne) J.Agardh; and 21) Tetrasporangia of *C. impudica* (Montagne) J.Agardh.

5. Conclusion

In relation with the present study, the genus *Catenella* grow on rocks and pneumatophores in upper tidal zone, always exposed at low tide. Moreover, it can be concluded their distinguishing characters among the species are mainly their branch systems and their segments. Furthermore, Kyunn Pyet or Cavendish Island in which there can be some unrecorded algae because *C. caespitosa* (Withering) Irvine in Parke & Dixon, new record of the present study was collected only there.

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7. References

1. Soe-Htun U, Mu Mu Aye, Ni Ni Win. Horizontal distribution of marine algae along the coastal areas of Kamake, Tawkapo and Saibala of Bilugyun I. Seminar on the resources, technology and socio-economics of Bilugyun I. Mon State in commemoration of the new millennium, 1999, 1-26.
2. Soe-Htun UHla Tint, San Tha Tun, Le Le Win, Mu Mu Aye, Ni Ni Win, Aye Mon Sein. A review on the seaweed researches in Myanmar. Technical Report, 1997a, 1-27.
3. Soe-Htun U. Distribution and potential uses of marine algae found along the Coastal Regions of Myanmar. Department of Marine Science. Mawlamyine University. Technical Report, 2005, 1-5.
4. Guiry MD, Guiry GM. AlgaeBase. World-wide electronic publication, National University of Ireland, Galway, 2018. http://www.algaebase.org.
5. Soe-Htun U, Mu Mu Aye, Soe Pa Pa Kyaw, Mya Kyawt Wai, Yin Yin Htay, Thida Nyut, *et al*. Distribution and potential uses of marine algae found along the Coastal Regions of Myanmar. Department of Marine Science,

Mawlamyine University. Technical Report, 2007, 1-190.
6. Soe-Htun U, Mya Kyawt Wai, Thida Nyunt, Soe Pa Pa Kyaw, Yin Yin Htay, Mu Mu Aye. Checklist, distribution and potential utilization of marine algae of Myanmar II: Rhodophyta (Red algae). Journal of Myanmar Academy of Arts and Science. 2009; 7(5):279-305.
7. Soe-Htun U, San Tha Tun, Aye Mon Sein, Ni Ni Win. A summary report on the seaweeds and seagrasses of the Myeik (Mergui) Archipelago. Tech. Rep, 1997b, 1-7.
8. Irvine LM. Appendix II. In M. Pake and P.S.Dixon, checklist of British marine algae-third revision. Journal of the Marine Biological Association of the United Kingdom. 1976; 56:590.
9. Segawa S. Coloured illustration of the seaweeds of Japan. 8th printing 1996. Hoikusha publishing Co. 1956, 196pp.
10. Kylin H. Die Chlorophyceae Der Schwedischen Westkuste. Lunds Univ. Arsskrift N. F. Avd. 2. Bd. 1949; 45(4):79.
11. Arasaki S. How to know the seaweeds of Japan and its vicinity fully illustrated in colours. Hokuryukan, 1964, 217.
12. Anand RL, Chaudhuri H. Marine algae from Karachi part II Rhodophyceae. Published by the University of the Pan Jab, Lahore, 1943, 176.
13. Cordero Jr PA. Studies on Philippines marine red algae. Special. Publ. Seto Marine Biol. Lab., Series IV. Contr. Seto Mar. Biol. Lab. 1977; 632(258):28.
14. Fortes MD, Trono GC. Jr. Marine algal microphytes new to the Philippines. J Biol. 1979; 8(1):51-68.
15. Zaneveld JS. The economic marine algae of the tropical region of south and east Asia and their utilization. Spec. Publ. IPFC. 1955; 3:55.
16. Post E. Zur Verbreitung and Okologic der Bostrychia-Caloglossa- Association. Int. Revue ges. Hydrobiol. 1963, 47-152pp.
17. Kyaw Soe, Kyi Win. Seaweeds for utilization University Translation and Publications Department, Yangon. 1977; 168(2):1-502. Fig. 32-299 (in Myanmar).
18. Lewmanomont K, Ogawa H. Common seaweeds and seagrasses of Thailand. Fac. Fish, Kasetsart Univ. 1995, 163.
19. Silva PC, Basson PW, Moe RL. Catalogue of the benthic algae of the benthic marine algae of the Indian Ocean. University of California Publications in Botany, 1996, 140-786.
20. Islam AKM. Nurul. The Seaweed Resources of Bangladesh. In: Critchley, A.T and Ohno, M. (Eds), Seaweed resources of the world. Kanakawa International Fisheries Training Center, Japan International Cooperation Agency (JICA), 1998, 106-109.
21. Reine WFP VAN, Trono GC. Jr. Plant resources of South-East Asia. Cryptograms: Algae. Prosea foundation, Bogor, Indonesia. 2002; 15(1):1-318.
22. Phang SM. Seaweed resources in Malaysia: Current status and future prospects. Aquatic Ecosystem Health & Mangement. 2006; 9(2):185-202.
23. Pham MN, Tan HTW, Mitrovic S, Yeo HHT. A checklist of the algae of Singapore, 2nd Edition. Raffles Museum of Biodiversity Research, National University of Singapore, Singapore, 2011, 99pp.
24. Satpati GG, Barman N, Pal R. Morphotaxonomic account of some common seaweed from Indian Sundarbans mangrove forest and inner I. area. J. Agal Biomass Utln. 2012; 3(4):45-51.
25. Taylor WR. Pacific marine algae of the Hancock expeditions to the Galapagos I. The University of Southern California Press. 1945; 12:528-100.
26. Agardh JG. Species genera et ordines algarum… Volumen secundum algas florideas complectens [Lund]. XII +1291pp. [Part 1, pp. [1]. XII+ [1] 336+337-351 (Addend and Index) (1851); part 2, fasc. 1, pp. 337-504 (1852); part 2, fasc. 2, pp.505-700+701-720 (Addenda and Index) (1852); part 3, fasc. 1, pp.701-786 (1852); part 3, fasc. 2, pp. 787-1291 (1139-1158 omitted) (1863)]Anand, R.L and Chaudhuri, H. 1943. Marine algae from Karachi part II Rhodophyceae. Published by the University of the Pan Jab, Lahore. 176.
27. Tin Aung Moe Ko, Aung Khin Myint, Ko Chit Aye, Soe Lwin U. Research on Myanmar Seaweeds 19: A study on some of the seaweeds found around the Kalagauk I., Mawlamyine Destrict. 1971; 1(32):1-51.
28. Kyi Shwe. A study on the habit and field culture of *Catenella nipae* Zanardini. Unpublished MSc Thesis. Department of Marine Science, Mawlamyine University, 1974.
29. Aung Mytint. The culture of *Catenella nipae* Zanardini under laboratory conditions. 1980. Unpublished M.Sc. Thesis. Department of Marine Biology, Moulmein College, 1872.