



Asian Journal of Research in Botany

1(1): 32-46, 2018; Article no.AJRIB.45182

Catalogue of the Marine Red Algae of Kalegauk Island

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Authors' contributions

This work was carried out in collaboration between both authors. Both authors read and approved the final manuscript.

Article Information

DOI: 10.9734/AJRIB/2018/45182

Editor(s):

(1) Dr. Hon H. Ho, Professor, Department of Biology, State University of New York, New Paltz, USA.

Reviewers:

(1) Leonel Pereira, University of Coimbra, Portugal.

(2) Ravish Choudhary, Indian Agricultural Research Institute, India.

Complete Peer review History: <http://www.sciencedomain.org/review-history/27174>

Short Research Article

Received 29th August 2018
Accepted 3rd November 2018
Published 12th November 2018

ABSTRACT

Aims: The present study was to discover the diversity and distribution of marine red algae from Kalegauk Island, in the northern parts of the Andaman Sea.

Study Design: The taxonomy of red algae in Kalegauk Island was studied and references, ecological notes and potential uses of each species were also described.

Place and Duration of Study: The samples were collected from the different stations along the Kalegauk Island from August 2016 to January 2017.

Methodology: Based on the external morphology and internal structures, the samples were identified under the Olympus compound microscope and Kaneko Yushima dissecting microscope. Microscopic measurements were recorded in micrometre (μm) using the ocular meter. The taxonomic keys of each species were used from the available references.

Results: A total of 27 species of 12 genera in *Rhodophyta* were identified. They are *Gelidium arenarium* Kylin., *Ahnfeltiopsis* sp., *Peyssonnelia rubra* (Greville) J. Agardh, *Peyssonnelia* sp., *Catenella caespitosa* (Withering) Irvine in Parke & Dixon, *Catenella nipae* Zanardini., *C. impudica* (Montagne) J. Agardh, *Hypnea pannosa* J. Agardh, *Gracilariopsis longissima* (S.G. Gmelin) Steentoft, L.M. Irvine & Farnham., *Ceramium* sp., *Caloglossa bengalensis* (Martens) King,

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Caloglossa sp., *C. adhaerens* King & Puttock, *C. lepreurii* (Montagne) Martens, *C. continua* (Okamura) King & Puttock, *Laurencia* sp., *Polysiphonia Atlantica* Kapraun & Norris, *P. subtilissima* Montagne, *P. howei* Hollenberg, *Polysiphonia* sp 1., *Polysiphonia* sp 2., *Herposiphonia tenella* (C. Agardh) Ambronn, *Bostrychia radican* (Montagne) Montagne, *B. calliptera* (Montagne) Montagne, *Bostrychia* sp., *B. tenella* (Lamouroux) J.Agardh and *B. binderi* (Lamouroux) J.Agardh. Among them, almost all species were firstly reported for the diversity of marine red algae of Kalegauk Island with the exception of *Gelidium arenarium* Kylin, *Catenella nipae* Zanardini, *Gracilaria verrucosa* (Hudson) Papenfuss, described in the previous reports [1]. Moreover, *Catenella caespitosa* (Withering) Irvine in Parke & Dixon (= *Catenella opuntia* (Goodenough & Woodward) Greville), *Polysiphonia atlantica* Kapraun & Norris (= *P. macrocarpa* Harvey) and *P. howei* Hollenberg (= *P. rhizoidea* Menez) were new records for the diversity of marine red algae of Myanmar.

Conclusion: Currently Kalegauk Island is crucial for recording its natural resources due to the plan of a deep sea port. The present study could provide information to evaluate the impacts of deep sea-port in the future.

Keywords: *Rhodophyta*; Kalegauk; *Polysiphonia atlantica* and *Polysiphonia howei*; new records.

1. INTRODUCTION

Red seaweeds can grow in deeper ocean waters than other algae because they have phycoerythrin which can absorb blue light to enhance the process of photosynthesis. Sometimes, it is possible to find red algae 200 meters deep. Red algae can be found in all latitudes, but they are usually more dominant in temperate and tropic zones rather than in frigid zones. In addition, a group of red algae called the coralline seaweeds that can deposit calcium carbonate in their cell walls, forming pink skeletons or paint-like crust on coastal rocks are encountered along all the coastal areas of the world oceans. Many kinds of products such as food, feed, pharmaceuticals and fertilizer can be extracted from marine benthic algae [2].

Kalegauk Island is the island in Ye township, Mon state, Myanmar. It is located in the northern part of the Andaman Sea, 8.25 km from the coast of Mon. The island has a long shape with a length of over 10 km and a width of 1.6 km in its widest area and there is a small Cavendish island 0.5 km off the southern point of Kalegauk Island. In addition, Chaytoryar Pagoda is also one of the most famous places in Kalegauk Island. The coastal areas of the Kalegauk Island are generally covered by mangrove forests rather than rocky shores. Nowadays, Kalegauk Island has been declared as the island for the future deep sea port.

The main objective of this study was to know the diversity and distribution of marine red algae from Kalegauk Island.

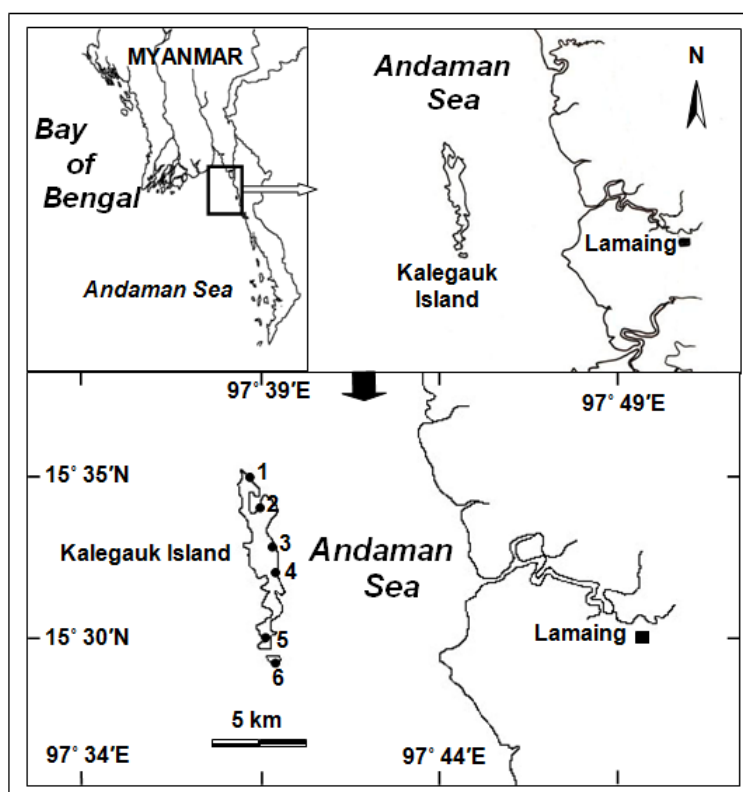
2. MATERIALS AND METHODS

2.1 Study Area

Kalegauk Island is located in the northern part of the Andaman Sea, in the Bay of Bengal mainly 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. 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). In the study areas, salinity range and temperature regimes of seawater were 26-27‰ and 29°C to 31°C, respectively (Map. 1).

2.2 Taxonomic Study

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 2016 to January 2017. The site location, topography, associated flora and fauna and other related parameters of Kalegauk Island were



Map. 1. Showing the specimens collection sites of the marine benthic algae of Kalegauk Island in the northern part of the Andaman Sea. 1. Apor Seik. 2. Pashyu Chaung. 3. Chaytoryar Pagoda. 4. Alè Seik. 5. Auk Seik. 6. Kyunn Pyet or Cavendish Island

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 were preserved in 4% formaldehyde with seawater. All the bags and containers were labeled with the date, time of collection, locality and transported to the laboratory of Marine Science Department for further analysis.

In the laboratory, the collected seaweeds were identified based on taxonomic characters

including colour and morphological differences between different genus and species. For internal studies of the thalli and reproductive structures, cross sections were obtained manually 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 10% on glass slides. The glass slides were then studied under the Olympus compound microscope and Kaneko Yushima dissecting microscope. Microscopic measurements were recorded in micrometre (μm) using the ocular meter.

3. RESULTS AND DISCUSSION

Classification of the marine benthic algae [3]

Phylum: *Rhodophyta*

Class: Florideophyceae

Order: Gelidiales

Family: Gelidiaceae

Genus: ***Gelidium* Lamouroux**

Species: ***Gelidium arenarium* Kylin**

Order: Gigartinales

Family: Phylloporaceae

Genus: ***Ahnfeltiopsis* Silva & Decew**

- Species: **Ahnfeltiopsis** sp.
Order: Peyssonneliales (Gigartinales)
Family: Peyssonneliaceae
Genus: **Peyssonnelia** Decaisne
Species: (i) **Peyssonnelia rubra** (Greville) J. Agardh
(ii) **P. sp.**
Family: Caulacanthaceae
Genus: **Catenella** Greville
Species: (i) **Catenella caespitosa** (Withering) Irvine in Parke & Dixon
(ii) **C. nipae** Zarnardini
(iii) **C. impudica** (Montagne) J. Agardh
Family: Cystocoloniaceae
Genus: **Hypnea** Lamouroux
Species: **H. pannosa** J. Agardh
Order: Gracilariales
Family: Gracilariaceae
Genus: **Gracilaria** Greville
Species: **Gracilaria verucosa** (Hudson) Papenfuss
Order: Ceramiales
Family: Ceramiaceae
Genus: **Ceramium** Roth Lyngbye
Species: **Ceramium** sp.
Family: Delesseriaceae
Genus: **Caloglossa** (Harvey) Martens
Species: (i) **Caloglossa bengalensis** (Martens) King and Puttock
(ii) **C. sp.**
(iii) **C. adhaerens** King & Puttock
(iv) **C. leprieurii** (Montagne) Martens
(v) **C. continua** (Okamura) King & Puttock
Family: Rhodomelaceae
Genus: **Laurencia** Lamouroux
Species: **Laurencia** sp.
Genus: **Polysiphonia** Greville
Species: (i) **Polysiphonia atlantica** Kapraun & Norris
(ii) **P. subtilissima** Montagne
(iii) **P. howei** Hollenberg in Taylor
(iv) **P. sp. 1**
(v) **P. sp. 2**
Genus: **Herposiphonia** Nägeli
Species: **Herposiphonia tenella** (C. Agardh) Ambronn
Genus: **Bostrychia** Montagne
Species: (i) **Bostrychia radicans** (Montagne) Montagne
(ii) **B. calliptera** (Montagne) Montagne
(iii) **B. sp.**
(iv) **B. tenella** (Lamouroux) J. Agardh
(v) **B. binderi** (Lamouroux) J. Agardh

An account of the marine red algal flora of Kalegawk Island is given.

Gelidium arenarium Kylin (Figs. 1-3)

References. - *Gelidium arenarium* Kylin: 135, fig. 86 [4]; Kyaw Soe and Kyi Win: 105, fig 182 [1]; Soe-Htun et al.: 293 [5]; Guiry and Guiry [3].

Type locality. - Isipingo Beach, near Durban, South Africa[3]

Type. - Unknown.

Ecological notes. - Plants grow on stones in the intertidal zone.

Potential Uses. - *Gelidium arenarium* Kylin is used for fodder, fish meal, manure and drugs [5].

Ahnfeltiopsis sp. (Figs. 4-6)

Type locality. - Unknown.

Type. - Unknown.

Ecological notes. - Plants grow on mangrove roots of the intertidal zone.

Potential Uses. - *Ahnfeltiopsis sp.* is used as human food, fodder and Carrageenan [6]

***Peyssonnelia rubra* (Greville) J. Agardh (Figs. 7-9)**

References. - *Peyssonnelia rubra* (Greville) J. Agardh; 502 [7]; Taylor: 168 [8]; Durairatnam: 52 [9]; Taylor: 371 [10]; Chapman 1971: 168 [11]; Abbott and Hollenberg 1976: 371 [12]; Cordero: 78, pl.XIIIC, fig.56 [13]; Yoshida, Nakajima and Nakata: 153 [14]; Lewmanomont and Ogawa: 13416; Silva, Basson and Moe: 214 [15], Guiry and Guiry [3].

Type locality. - Ionianis, Greece (Athanasiadis 1996: 70) [3]

Type. - Unknown.

Ecological notes. - Plants, common in most subtidal habitats, grow on dead coral, rubble and other hard surfaces.

Potential uses. - *Peyssonnelia rubra* (Greville) J. Agardh is used as fodder and manure [6]

***Peyssonnelia sp.* (Figs. 10-11)**

Type locality. - Unknown.

Type. - Unknown.

Ecological notes. - Plants, common in most subtidal habitats, grow on dead coral, rubble and other hard surfaces.

Potential Uses. - This species is used as fodder and manure [6]

***Catenella caespitosa* (Withering) Irvine in Parke & Dixon (Figs. 12-14)**

References. - *Catenella caespitosa* (Withering) L.M.Irvine in M. Parke & P.S. Dixon 976; 590 [16]. Taxonomic synonyms: *Catenella opuntia* (Goodenough & Woodward) Greville: Segawa 1956: 85, fig. 404 [17]; Kyilin 1956: 85 [4], fig. 404; Arasaki 1964: 98, fig. 350 [18]; Cordero 1977: 163, figs. 168-169 [13]; Fortes and Trono 1979: 59 [19]; Guiry and Guiry 2018 [3].

Type locality. - "Side Rocks, Anglesey", Wales (Silva, Basson & Moe 1996: 280) (Guiry and Guiry 2014).

Type. - OXF (Dixon & Irvine 1977: 190) [3]

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

Potential Uses. - This species is used as salad.

***Catenella nipae* Zarnardini (Figs. 15-17)**

References. - *Catenella nipae* Zarnardini 1872: 143-145; Zaneveld 1955: 29 [20]; Post 1963: 116 [21]; Kyaw Soe and Kyi Win 1977: 129, figs 120A1-2 [1]; Lewmanomont and Ogawa 1995: 97 [22]; Silva, Basson and Moe 1996: 128 [15]; Islam 1998: 107 [23]; Reine and Trono 2002: 110-111 [24]; Phang 2006: 193 [25]; Soe-Htun et al. 2009: 295 [5]; Pham et al. 2011: 12 [26]; Guiry and Guiry 2018 [3].

Type locality. - Sarawak, Indonesia (Silva, Basson & Moe 1996: 281) [3]

Type. - Sarawak, Borneo; holotype(?) in Herb. Zarnardini, Museo Civico di Storia Naturale, Venice (Guiry and Guiry 2014).

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

Potential Uses. - *Catenella nipae* Zarnardini is used as carrageenan, fodder, fish meal, human food and manure, salad [6]

***Catenella impudica* (Montagne) J. Agardh (Figs. 18-20)**

References. - *Catenella impudica* (Montagne) J. Agardh 1852: 701-702 [7]; Taylor 1945: 226 [8]; Zaneveld 1955: 28 [20]; Post 1963: 114 [21]; Taylor 1967: 462 [10]; Kyaw Soe and Kyi Win 1977: 130, fig.231 [1]; Silva, Basson, Moe 1996: 281 [15]; Islam 1998: 107 [23]; Phang 2006 [25]: 193; Soe-Htun et al. 2009: 295 [5]; Pham et al. 2011:12 [26], Guiry and Guiry 2018 [3].

Type locality. - Cayenne, French Guiana (Silva, Basson & Moe 1996: 281) [3]

Type. - Unknown [3]

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

Potential Uses. - *Catenella impudica* (Montagne) J. Agardh is used as carrageenan, fodder, fish meal, human food and manure, salad [6]

***Hypnea pannosa* J. Agardh (Figs. 21-22)**

References. - *Hypnea pannosa* J. Agard 1847: 14 [7]; Dawson 1944: 291 [27]; Taylor 1945: 227 [8]; Durairatnam 1945: 56-57, pl.XV, fig.9 [9]; Dawson 1961: 236, pl.35, figs. 4-5 [28]; Womersley and Bailey 1970: 319 [29]; Chapman 1971: 169 [30]; Yoshida, Nakajima and Nakata 1985: 259 [14]; Lewis and Norris 1987: 20 [31];

Lewmanomont and Ogawa 1995: 97 [22]; Yamagishi 1995: 145-147, figs. 22-25 [32]; Silva, Basson and Moe 1996 [15]: 304; Phang 2006: 193 [25]; Soe-Htun 2009: 296 [5]; Coppejans et al. 2010:196, figs. 15E, 32A, 36C, 122A [2], B; Pham et al. 2011: 28 [26]; Guiry and Guiry 2018 [3].

Type locality. - St Augustin" (Oaxaca), Mexico (South 2004: 138) [3]

Type. - Liebmann; LD Herb. alg. Agardh, 33892 (Dawson 1961: 237) [3]

Ecological notes. - Plants occur in tide pools and grow on mangrove trees in the intertidal zone.

Potential Uses. - *Hypnea pannosa* J.Agardh is used as carrageenan, fodder, fish meal, human food and manure, salad [6]

***Gracilariopsis longissima* (S.G. Gmelin) Steentoft, L.M. Irvine & Farnham (Figs. 23-25)**

References. - *Gracilaria verrucosa* (Hudson) Papenfuss: 1950: 195; Dawson 1961: 214, pl. 20 [27]; Duraiaratnam 1961: 61, pl.XIV, fig. 7 [9]; Taylor 1967: 441, pl.56, fig. 2 [10]; Chapman 1971: 169 [11]; Abbott and Hollenberg 1976: 500 [12]; Cordero 1977: 135 [13]; Kyaw Soe and Kyaw Win 1977: 134, fig. 237A1-2 [1]; Yoshida, Nakajima and Nakata 1985: 259 [14]; Lewis and Norris 1987: 20 [31]; Silva, Basson and Moe 1996: 178; Reine and Trono 2002: 193-194 [24]; Phang 2006: 192 [25]; Soe-Htun et al. 2009: 297 [5]; Guiry and Guiry 2018 [3].

Type locality. - Unknown.

Type. - Unknown.

Ecological notes. - Plants grow in muds under the mangrove trees in the subtidal zone.

Potential Uses. - *Gracilaria verrucosa* is used as fodder, fish meal, human food, manure and for agar extraction [6]

***Ceramium* sp. (Figs. 26-28)**

Type locality. - Unknown.

Type. - Unknown.

Ecological notes. - Plants grow on a stone in the intertidal zone.

Potential Uses. - *Ceramium* sp. is used as fodder and drugs (Soe-Htun 2010).

***Caloglossa bengalensis* (Martens) King & Puttock (Figs. 29-30)**

References. - *Caloglossa bengalensis* (G.Martens) R.J.King & Puttock: 1994: 102 [33].

Taxonomic synonym: *Caloglossa adnata* (Zarnardini) De Toni: Zaneveld 1955: 2721; Post 1963: 99 [21]; Fortes and Trono 1979: 6120; Tanaka and Chihara 1985: 42-43 [34]; Islam 1998: 107 [23]; Guiry and Guiry 2018 [3].

Type locality. - Sarawak, Malaysia (Silva, Basson & Moe 1996: 450) [3]

Type. - Unknown.

Ecological notes. - Plants form dense tufts on pneumatophore of mangrove trees.

Potential Uses. - *Caloglossa bengalensis* (G.Martens) R.J.King & Puttock is used as food.

***Caloglossa* sp. (Figs. 31-32)**

Type locality. - Unknown.

Type. - Unknown.

Ecological notes. - Plants grow on mangrove trees in the intertidal zone.

Potential Uses. - The uses of this species are unknown.

***Caloglossa adhaerens* King & Puttock (Figs. 33-34)**

References. - *Caloglossa adhaerens* R.J.King & Puttock 1994: 103-106 [33]; Kamiya, Zuccarello and West 2003: 480, fig.2 [35]; West, Zuccarello and Kamiya 2001: figs. 1-18 [36]; Guiry and Guiry 2018 [3].

Type locality. - Ballina, New South Wales, Australia (Silva, Basson & Moe 1996: 449) [3]

Type. - UNSW 15020 [3]

Ecological notes. - Plants grow on mangrove trees in the intertidal zone.

Potential Uses. - The uses of this species are unknown.

***Caloglossa leprieurii* (Montagne) Martens (Figs. 35-36)**

References. - *Caloglossa leprieurii* (Montagne) G. Martens 1869: 234 [37]; Taylor 1945: 275 [8]; Kyaw Soe and Kyi Win; 1977: 149, fig. 26 [1]; Kamiya et al. 1998: 363-365, figs 2-3 [35]; Zenke White 1999: 370; West, Zuccarella and Kamiya 2001: 184-187, figs. 1-18 [36]; Soe-Htun 2005: 5; Soe-Htun et al. 2007: 15 [6]; Soe-Htun 2009: 300 [5]; Guiry and Guiry 2018 [3].

Type locality. - Sinnamary, NW of Cayenne, French Guiana [3]

Type. - Leprieur; 20 November 1841; PC [3]

Ecological notes. - Plants grow on mangrove trees in the intertidal zone.

Potential Uses. - *Caloglossa leprieurii* (Montagne) G. Martens is used as fodder, fish meal, human food and manure.

***Caloglossa continua* (Okamura) King & Puttock (Figs. 37-38)**

References. - *Caloglossa continua* (Okamura) R.J.King & Puttock 1994:115-118 [33]; Kamiya, Zuccarello and West 2003: 483-485, fig.11 [35]; Guiry and Guiry 2018 [3]. Taxonomic synonym: *Caloglossa leprieurii* var. *continua* Okamura 1903; 129 [38].

Type locality. - River mouth of Ko-yahagi-gawa, Mikawa, Japan [3]

Type. - Unknown.

Ecological notes. - Plants grow on mangrove trees in the intertidal zone.

Potential Uses. - The uses of this species are unknown.

***Laurencia* sp. (Figs. 39-40)**

Type locality. - Unknown.

Type. - Unknown.

Ecological notes. - Plants occur on a rock in the subtidal zone.

Potential Uses. - *Laurencia* sp. is used for agar extraction and human food [6]

***Polysiphonia Atlantica* Kapraun & Norris (Figs. 41-42)**

References. - *Polysiphonia Atlantica* Kapraun & J.N.Norris 1982: 226. Taxonomic synonym: *Polysiphonia macrocarpa* Harvey 1836: 206-207; Cribb 1956: 136, pl.3, fig.1-8; Taylor 1967: 578; Yoon 1984: 33-34, pl. 4A-D, figs. 6-7; Guiry and Guiry 2013.

Type locality. - "Portstewart [Co. Antrim]; Miltown Malbay [Co. Clare], Ireland" (Guiry and Guiry 2014).

Types: TCD (Guiry and Guiry 2014).

Ecological notes. - Plants occur on mangrove trees in the subtidal zone.

Potential Uses. - The uses of this species are unknown.

***Polysiphonia subtilissima* Montagne (Figs. 43-44)**

References. - *Polysiphonia subtilissima* Montagne 1840: 199 [39]; Menez 1964: 211-213, figs. 6D-G [40]; Taylor 1967: 575 [10]; Cordero 1977: 226, figs. 250-251 [13]; Yoon 1984: 26-28, pl.3, figs. 4-5 [41]; Yoshida, Nakajima and Nakata 1985: 60; 1990: 26814; Guiry and Guiry 20181.

Type locality. - Cayenne, French Guiana¹

Type. - Herb. Montagne, PC1

Ecological notes. - Plants occur on mangrove trees in the subtidal zone.

Potential Uses. - *Polysiphonia subtilissima* Montagne is used as fodder, drugs and for agar extraction⁵

***Polysiphonia howei* Hollenberg in Taylor (Figs. 45-46)**

References. - *Polysiphonia howei* Hollenberg in W.R. Taylor 1945: 302-3058. Taxonomic synonym: *Polysiphonia rhizoidal* Menez 1964: 217, figs. 5A-H40; Guiry and Guiry 20181.

Type locality. - Whale Cay, Berryl., Bahamas¹

Type. - M.A. Howe; 29 January 1905; NY Howe 34781

Ecological notes. - Plants occur on mangrove trees in the subtidal zone.

Potential Uses. - The uses of this species are unknown.

***Polysiphonia* sp. 1 (Figs. 47-48)**

Type locality. - Unknown.

Type. - Unknown.

Ecological notes. - Plants grow on rocks and sometimes epiphytic on mangrove trees.

Potential Uses. - *Polysiphonia* sp. 1 is used as fodder, drugs, fish meals, organic fertilizers (Soe-Htun et al. 2007).

***Polysiphonia* sp. 2 (Figs. 49-50)**

Type locality. - Unknown.

Type. - Unknown.

Ecological notes. - Plants grow on rocks and sometimes epiphytic on mangrove trees.

Potential Uses. - *Polysiphonia* sp. 2 is used as fodder, drugs, fish meals, organic fertilizers (Soe-Htun et al. 2007).

***Herposiphonia tenella* (C.Agardh) Ambronn (Figs. 51-53)**

References. - *Herposiphonia tenella* (C.Agardh) Ambronn 1880: 197 [42]; Dawson 1944: 334 [27]; Taylor 1945: 305 [8]; Kylin 1956: 477, figs 379A-C [4]; Segawa 1956: 118, fig. 573 [17]; Durairatnam 1961: 152-153, pl.18, fig.3 [9]; Taylor 1967: 604, pl. 72, fig.129; Abbott and Hollenberg 1976: 718 [12]; Kyaw Soe and Kyi Win 1977: 157, fig. 284 [1]; Guiry and Guiry 2018 [3].

Type locality. - Sicily [3]

Type. - Unknown [3]

Ecological notes. - Plants grow epiphytic on mangrove trees of the upper intertidal zone.

Potential Uses. - The uses of this species are unknown.

***Bostrychia radicans* (Montagne) Montagne (Figs. 54-56)**

References. - *Bostrychia radicans* (Montagne) Montagne 1842: 661 [39]; Taylor 1945: 306 [8]; Zaneveld 1955: 27 [20]; Dawson 1963: 419, pl.136(11), fig.3 [43]; Taylor 1967: 595 [10]; Chapman 1971: 170; Fortes and Trono 1979: 65 [19]; Yoshida, Nakajima and Nakata 1990: 149; 1995:149 [14]; Silva, Basson and Moe 1996: 474 [15]; Islam 1998: 107 [23]; Reine and Trono 2002: 105-106 [24]; Pham et al. 2011: 10 [26]; Guiry and Guiry 2018 [3].

Type. - Unknown.

Type locality. - Near Cayenne, French Guiana (Silva, Basson & Moe 1996: 74) [3]

Ecological notes. - Plants grow on the pneumatophores and barks of mangrove trees.

Potential Uses. - The uses of this species are unknown.

***Bostrychia calliptera* (Montagne) Montagne (Figs. 57-58)**

References. - *Bostrychia calliptera* (Montagne) Montagne 1842: 661 [39]. Taxonomic synonym: *Bostrychia pinnata* J.Tanaka & Chihara 1984: 122-125, figs. 4-5 [44]; Yoshida, Nakajima and Nakata 1990: 304; 1995: 149 [14]; Guiry and Guiry 2018 [3].

Type locality. - Cayenne, French Guiana [3]

Type. - Unknown (Guiry and Guiry 2014).

Ecological notes. - Plants grow on the pneumatophores and barks of mangrove trees.

Potential Uses. - The uses of this species are unknown.

***Bostrychia* sp. (Figs. 59-60)**

Type locality. - Unknown.

Type. - Unknown.

Ecological notes. - Plants grow on rocks and sometimes epiphytic on mangrove trees.

Potential Uses. - The uses of this species are unknown.

***Bostrychia tenella* (Lamouroux) J. Agardh (Figs. 61-63)**

References. - *Bostrychia tenella* (J.V Lamouroux) J. Agardh 1863: 869-871 [7]; May 1953: 59 [45]; Segawa 1956: 120, fig. 585 [17]; Taylor 1967: 599 [10]; Cordero 1977: 195, figs.

210 [13]; Tanaka and Chihara 1984: 118-120, figs.1-5 [44]; Yoshida, Nakajima and Nakata 1990: 304; 1995 [14]: 149; Guiry and Guiry 2018 [3].

Type locality. - Port Natal (Durban), South Africa (Silva, Basson & Moe 1996: 476) [3]

Type. - TCD [3]

Ecological notes. - Plants grow on the pneumatophores and barks of mangrove trees.

Potential Uses. - *Bostrychia tenella* (J.V Lamouroux) J. Agardh can be used as fodder, manure, fish meal and organic fertilizer.

***Bostrychia binderi* Harvey (Figs. 63-65)**

References. - *Bostrychia binderi* Harvey 1849: 68 [46]; Taylor 1945: 306 [8]; 1967: 598, pl. 74, Fig.1; 1972: 598-599 [10]; Womersley and Bailey 1970: 335 [29]; Cordero 1977: 193, fig. 206,208-209 [13]; Tanaka and Chihara 1984: 120-122, fig. 3 [44]; Silva, Basson and Moe 1996: 476 [15]; Phang 2006: 195; Soe-Htun et al. 2009: 303 [5]; Guiry and Guiry 2018 [3].

Type locality. - Port Natal (Durban), South Africa (Silva, Basson & Moe 1996: 476) [3]

Type. - TCD [3]

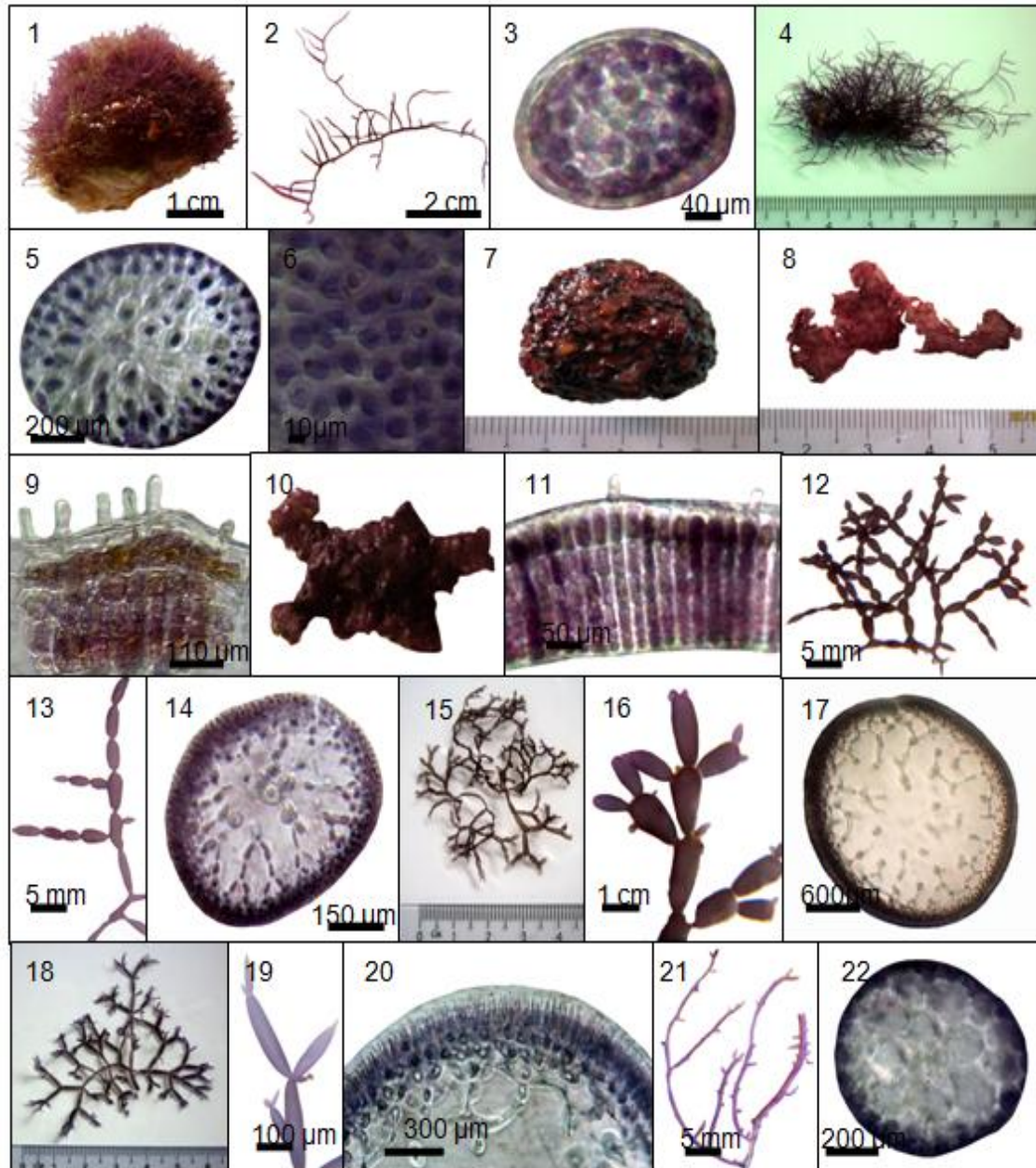
Ecological notes. - Plants grow on the pneumatophores and barks of mangrove trees.

Potential Uses. - *Bostrychia binderi* Harvey is used as fodder, fish meal, manure and organic fertilizer.

In the present study, salinity range and temperature regimes seawater were 26-27‰ and 29°C to 31°C respectively, in the study areas. The coastal areas of the Kalegauk Island are generally covered by mangrove forests rather than rocky shores. Tin Aung Moe et al. [47]. firstly observed the seaweeds found around the Kalegauk Island in 1971. After that, some marine algae of Kalegauk Island had been described as a small part of their algal flora study in Myanmar by Kyaw Soe and Kyi Win [1] in 1977. Since 1977, there was no record and study about the marine algae in Kalegauk Island.

Compared with the present study in which the total 27 species of 12 genera in *Rhodophyta* could be recorded, almost all species were new records for the diversity of Kalegauk Island with the exception of *Gelidium arenarium* Kylin, *Catenella nipae* Zanardini and *Gracilariopsis longissima* (S.G. Gmelin) Steentoft, L.M. Irvine & Farnham which were described in the previous reports of Kalegauk Island by Kyaw Soe and Kyi Win [1].

Moreover, *Catenella caespitosa* (Withering) Irvine in Parke & Dixon (= *Catenella opuntia* (Goodenough & Woodward) Greville), *Polysiphonia Atlantica* Kapraun & Norris (= *P. macrocarpa* Harvey) and *P. howei* Hollenberg (= *P. rhizoidal* Menez) were firstly recorded for the diversity of marine red algae of Myanmar after Soe-Htun et al. [5].



Figs. 1-22. 1) Habit of *Gelidium arenarium* Kylin; 2) Erect filaments of *G. arenarium* Kylin; 3) Cross section of *G. arenarium* Kylin; 4) Habit of *Ahnfeltiopsis* sp.; 5) Cross section of *Ahnfeltiopsis* sp; 6) Surface view of *Ahnfeltiopsis* sp; 7-8) Habit of *Peyssonnelia rubra* (Greville) J.Agardh; 9) Cross section of *P. rubra*; 10) Habit of *Peyssonnelia* sp; 11) cross section of *P. sp*; 12) Habit of *Catenella caespitosa* (Withering) Irvine; 13) Segments of *C. caespitosa* (Withering) Irvine; 14) Cross section of *C. caespitosa* (Withering) Irvine; 15) Habit of *C. nipae* Zarnardinii; and 16) Branch system of *C. nipae* Zarnardinii; 17) Cross section of *C. nipae* Zarnardinii; 18) Habit of *Catenella impudica* (Montagne) J.Agardh; 19) Segments of *C. impudica* (Montagne) J.Agardh; 20) Cross section of *C. impudica* (Montagne) J.Agardh; 21) Habit of *Hypnea pannosa* J.Agard; 22) Cross section of *H. pannosa* J.Agardh

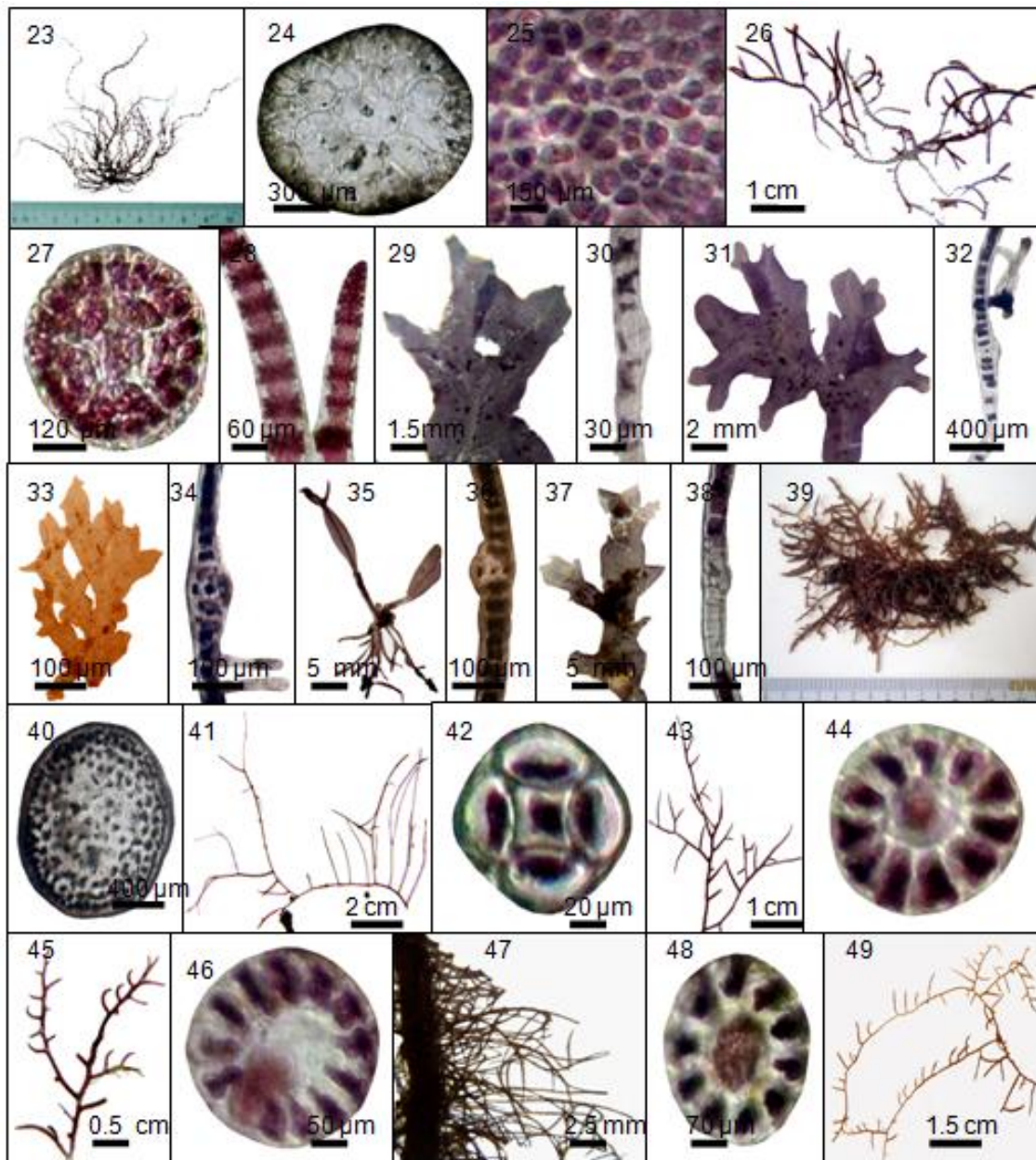
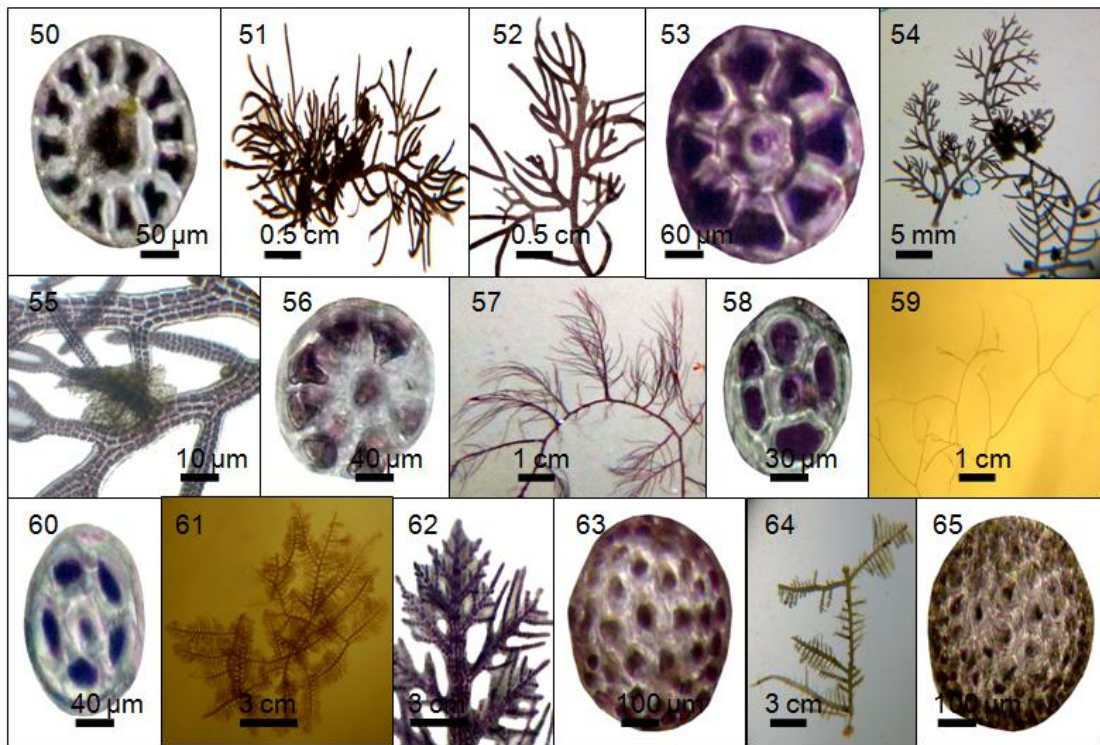


Fig. 23-49. 23) Habit of *Gracilariopsis longissima* (S.G. Gmelin) Steentoft, L.M. Irvine & Farnham; 24) Cross section of *Gracilariopsis longissima* (S.G. Gmelin) Steentoft, L.M. Irvine & Farnham; 25) Surface view of of *Gracilariopsis longissima* (S.G. Gmelin) Steentoft, L.M. Irvine & Farnham; 26) Habit of *Ceramium* sp; 27) Cross section of internodes; 28) Middle portion of *Ceramium* sp; 29) Habit of *Caloglossa bengalensis* (Martens) King and Puttock; 30) Cross section of *C. bengalensis* (Martens) King and Puttock; 31) Habit of *Caloglossa* sp; 32) Cross section of *Caloglossa* sp; 33) Habit of *Caloglossa adhaerens* King and Puttock; : 34) Cross section of *C. adhaerens* King and Puttock; 35) Habit of *Caloglossa leprieurii* (Montagne) Martens; 36) Cross section of *C. leprieurii* (Montagne) Martens; 37) Habit of *Caloglossa continua* (Okamura) King and Puttock; 38) Cross section of *C. continua* (Okamura) King and Puttock; 39) Habit of *Laurencia* sp; 40) Cross section of *Laurencia* sp; 41) Habit of *Polysiphonia atlantica* Kapraun and Norris; 42) Cross section of *P. atlantica* Kapraun and Norris; 43) Habit of *P. subtilissima* Montagne; 44) cross section of *P. subtilissima*; 45) Habit of *Polysiphonia howei* Hollenberg; 46) Cross section of *P. howei* Hollenberg; 47) Habit of *Polysiphonia* sp.1; 48) Cross section of *Polysiphonia* sp. 1; 49) Habit of *Polysiphonia* sp. 2



Figs. 50- 65. 50) Cross section of *Polysiphonia* sp. 2; 51) Habit of *Herposiphonia tenella* (C.Agardh) Ambronn; 52) Surface view of *H. tenella* (C.Agardh) Ambronn; 53) Cross section of *H. tenella* (C.Agardh) Ambronn; 54) Habit of *Bostrychia radican* (Montagne) Montagne; 55) Surface view of *Bostrychia radican* (Montagne) Montagne; 56) Cross section of *B. radican* (Montagne) Montagne; 57) Habit of *B. callioptera* (Montagne) Montagne; 58) Cross section of *B. callioptera* (Montagne) Montagne; 59) Habit of *Bostrychia* sp; 60) Cross section of *Bostrychia* sp; 61) Habit of *B. tenella* (Lamouroux) J. Agardh; 62) Apical portion of *B. tenella* (Lamouroux) J. Agardh; 63) Cross section of *B. tenella* (Lamouroux) J. Agardh; 64) Habit of *B. binderi* (Lamouroux) J. Agardh; 65) Cross section of *B. binderi* (Lamouroux) J. Agardh

Table 1 shows a comparison on the compositions of the species diversity of marine red algae encountered along the Kalegauk Island. *Gelidium arenarium* Kylin was found in Apor Seik, Kyunn Pyet and Chaytoryar Pagoda. *Ahnfeltiopsis* sp. was rarely found in Apor Seik and Pashyu Chaung. *Peyssonnelia rubra* (Greville) J.Agardh, *P. sp.*, *Catenella nipae* Zarnardini and *C. impudica* (Montagne) J.Agardh were found any places in Kalegauk Island. But *Catenella caespitosa* (Withering) Irvine in Parke & Dixon were only found in Kyunn Pyet. *Hypnea pannosa* J. Agardh was rarely found in Apor Seik and Pashyu Chaung.

Gracilariopsis longissima (S.G. Gmelin) Steentoft, L.M. Irvine & Farnham were commonly found in the pools under the mangrove trees of Apor Seik and Alè Seik. *Ceramiun* sp. is more common on stones than on mangrove trees of Apor Seik, Pashyu Chaung and Chaytoryar

Pagoda. *Caloglossa leprieurii* (Montagne) Martens, *Caloglossa* sp. and *C. continua* (Okamura) King and Puttock were found in Apor Seik, Auk Seik and Pashyu Chaung. *Laurencia* sp. is also the most dominant species of Kalegauk Island. So, it can be seen everywhere of the Kalegauk Island. *Polysiphonia subtilissima* Montagne, *P. atlantica* Kapraun and Norris, *P. howei* Hollenberg, *Polysiphonia*. sp 1 and *Polysiphonia*. sp 2 were found in Apor Seik, Kyunn Pyet and Chaytoryar Pagoda. *Herposiphonia tenella* (C. Agardh) Ambronn was found on mangrove trees of Apor Seik and Pashyu Chaung. *Bostrychia tenella* (Lamouroux) Agardh and *Bostrychia binderi* (Lamouroux) Agardh were found in Apor Seik, Auk Seik, Pashyu Chaung, Chaytoryar Pagoda and Kyunn Pyet. *Bostrychia callioptera* (Montagne) Montagne, *B. radican* (Lamouroux) Agardh and *Bostrychia*. sp were only found in Apor Seik, Alè Seik and Pashyu Chaung.

Table 1. A comparison of the compositions of the species diversity of marine red algal flora encountered along the coast of Kalegauk Island

Species	Present record (2016-2017)						Previous record*
	Apor Seik	Pashyu Chaung	Chaytor-yar Pagoda	Alè seik	Auk Seik	Kyunn Pyet	
1. <i>Gelidium arenarium</i> Kylin	+	-	+	-	-	+	+
2. <i>Ahnfeltiopsis</i> sp.	+	+	-	-	-	-	-
3. <i>Peyssonnelia rubra</i> (Greville) J. Agardh	+	+	+	+	+	+	-
4. <i>Peyssonnelia</i> . sp	+	+	+	+	+	+	-
5. <i>Catenella caespitosa</i> (Withering) Irvine in Parke & Dixon	-	-	-	-	-	+	-
6. <i>C. nipae</i> Zanardini	+	+	+	+	+	+	+
7. <i>C. impudica</i> (Montagne) J. Agardh	+	+	+	+	+	+	-
8. <i>Hypnea pannosa</i> J. Agardh	+	+	-	-	-	-	-
9. <i>Gracilariopsis longissima</i> (S.G. Gmelin) Steentoft, L.M. Irvine & Farnham	+	-	-	+	-	-	+
10. <i>Ceramium</i> sp.	+	-	-	-	-	-	-
11. <i>Caloglossa bengalensis</i> (Martens) King and Puttock	+	+	+	+	+	+	-
12. <i>Caloglossa</i> . sp.	+	+	-	-	+	-	-
13. <i>C. adhaerens</i> King and Puttock	+	+	+	+	+	+	-
14. <i>Caloglossa leprieurii</i> (Montagne) Martens	+	+	-	-	+	-	-
15. <i>C.continua</i> (Okamura) King and Puttock	+	+	-	-	+	-	-
16. <i>Laurencia</i> sp.	+	+	+	+	+	+	-
17. <i>Polysiphonia atlantica</i> Kapraun and Norris	+	-	+	-	-	+	-
18. <i>P. subtilissima</i> Montagne	+	-	+	-	-	+	-
19. <i>P. howei</i> Hollenberg	+	-	+	-	-	+	-
20. <i>Polysiphonia</i> . sp 1	+	-	+	-	-	+	-
21. <i>Polysiphonia</i> . sp 2	+	-	+	-	-	+	-
22. <i>Herposiphonia tenella</i> (C. Agardh) Ambronn	+	+	-	-	-	-	-
23. <i>Bostrychia radican</i> (Montagne) Montagne	+	+	-	+	-	-	-
24. <i>B. calliptera</i> (Montagne) Montagne	+	+	-	+	-	-	-
25. <i>Bostrychia</i> . sp	+	+	-	+	-	-	-
26. <i>B. tenella</i> (Lamouroux) J. Agardh	+	+	+	-	+	+	-
27. <i>B. binderi</i> (Lamouroux) J. Agardh	+	+	+	-	+	+	-
Subtotal	26	12	11	18	16	15	3

Symbols: + = Presence; - = Absence; * **Source:** Kyaw Soe and Kyi Win [1]

In short, a total of 26 species in *Rhodophyta* had been observed in Apor Seik while a total of 12 species in *Rhodophyta* had been found in Auk Seik. Moreover, a total of 11 species in *Rhodophyta* had been observed in Alè Seik. Likewise, a total of 18 species in *Rhodophyta*

had been observed in Pashyu Chaung. On the other hand, a total of 16 species in *Rhodophyta* had been encountered in Kyunn Pyet whereas a total of 15 species in *Rhodophyta* had been encountered in Chaytoryar Pagoda. Among them, only three species of *Rhodophyta* have

been recorded in Kalegauk Island by the previous study.

4. CONCLUSION

Apor Seik represented the most abundant flora of seaweeds as compared with other places such as Chaytoryar Pagoda and Kyunn Pyet due to the abundance of mangrove forest. *Catenella caespitosa* (Withering) Irvine was only found in Kyunn Pyet of the Kalegauk Island. It may be because there was no household and less population there. Thus, it is possible that there would be still other unrecorded seaweed in the Kalegauk Island.

ACKNOWLEDGEMENTS

I am deeply grateful to my dearest parents, U Kyin Aung and Daw Myint Myint San for their kind moral and financial supports to reach the goal of this work.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

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