The genus *Jania* J.V.Lamouroux (Corallinales, Rhodophyta) from Myanmar

**Abstract**

A taxonomic study on the articulated coralline algae collected from the three coastal zones of Myanmar: Tanintharyi coastal zone, Deltaic coastal zone and Rakhine coastal zone, and lodged in the Herbarium of Department of Marine Science had been carried out based on the morphological, reproductive and anatomical structures. A total of 6 species of the genus, *Jania* J. V.Lamouroux representing to the tribe Janiae and subfamily Corallinoideae under order Corallinales had been identified as *J. spectabilis* (Harvey ex Grunow) JH Kim, Guiry & HG Choi, *J. ungulata* (Yendo) Yendo, *J. rubens* (Linnaeus) J.V. Lamouroux, *J. verrucosa* Lamouroux, *J. capillacea* Harvey and *J. adhaerens* J.V.Lamouroux. *J. spectabilis* had marginal conceptacles while the remaining five species of *Jania* possessed axial conceptacles originated in medullary meristems. The detailed descriptions of each species were provided. Moreover, keys for species identification and some distinctive characteristics used as taxonomic criteria were also provided. Furthermore, the distributions of each species along both the coastal zones of Myanmar and the world oceans were presented.

**Keywords:** corallinales, genicula, *jania*, myanmar, rhodophyta, taxonom

**Introduction**

In division Rhodophyta, coralline algae belong to the family Corallinaceae under the order Corallinales. The coralline algae can be divided into two forms, the articulated (geniculate) corallines and the non-articulated (non-geniculate) corallines. Generally, the plants of the articulated corallines are branched by calcified segments called intergenicula which are separated from one another by unclassified nodes or genicula. Non-geniculate corallines are crustose and may occur on rock, coral skeletons, shells, other algae or seagrasses. Many coralline crusts produce knobby protuberances ranging from a millimeter to several centimeters high. The coralline algae are very important in the global carbon cycle, as well as the stability of coral reefs and provide habitat, refuge and grazing areas for numerous fish and invertebrate species.\(^1\)

Corallinaceae was the only one family of the order Corallinales and composed of four subfamilies, namely Metagoniophoraceae, Corallinoideae, Lithophyloideae (Amphiroideae Genus Johansen)\(^2\) and Mastophoroideae.\(^3,4\) Of these subfamilies, articulated coralline algae were assigned to the Metagoniophoraceae, Lithophyloideae and Corallinoideae. The genus *Jania* is one of the thirteen genera of subfamily Corallinoideae and also one of the three genera of tribe Janiae (comprising *Jania*, Haliptilon and Cheilosporum) separated from the tribe Corallinae.\(^5\) The genus *Jania* was characterized by having cylindrical intergenicula and branches dichotomous throughout, with marginal and axial conceptacles and comprised 48 species currently accepted taxonomically and distributed throughout the tropical, subtropical, and warm temperate areas.\(^6\)

In Myanmar, Martins\(^7\) recorded *J. adhaerens*, *J. fastigiata* from Pegu, Diamond I. and South Andaman Is. Kyi Win\(^8\) listed *J. rubens*, *J. nipponica*, *J. radiata*, *J. adhaerens* and *J. sp.* Moreover, Kyaw Soe and Kyi Win\(^9\) reported *J. rubens*, *J. nipponica*, *J. radiata*, and *J. sp.* Soe-Htun\(^10\) reported the occurrence of *J. longiarthra*, *J. rubens* and *Cheilosporum spectabile* (=*J. spectabilis*) in Rakhine and Tanintharyi coastal zones. Soe-Htun et al.,\(^11\) reported *J. radiata* from the Gwa coastal zones, Rakhine State. Soe-Htun et al.,\(^12\) accounted the 3 species of *Jania* such as *J. spectabilis*, *J. pumila* and *J. radiata* along the coastal zones of Myanmar. Mya Kyawt Wai\(^13\) studied the articulated coralline algae belonging to subfamily Corallinae along the coastal zones of Myanmar. She had been identified the 6 species of *Jania*: *J. spectabilis* (=*J. spectabilis*), *J. ungulata*, *J. rubens*, *J. verrucosa*, *J. capillacea* and *J. adhaerens*. In the present study, species of the genus *Jania* collected from the coastal zones of Myanmar have been identified as six species of *Jania*, namely *J. spectabilis*, *J. ungulata*, *J. rubens*, *J. verrucosa*, *J. capillacea* Harvey and *J. adhaerens*.

The objectives of this study are: 1) to revise the taxonomy of the species of *Jania* based on the morphology of vegetative and reproductive structures; 2) to know the distribution of each species along the coastal zones of Myanmar and the world oceans.

**Materials and methods**

Specimens of articulated coralline algae collected from coastal zones of Myanmar were studied. The collections were dried and preserved in 5% formaldehyde-seawater and some were prepared for herbarium specimens. These vouchered specimens were deposited in the Herbarium of Department of Marine Science, Mawlamyine University (MMB), Mawlamyine. Moreover, other specimens deposited in the Herbarium of Department of Marine Science, Mawlamyine University, were also studied. Susa fixative (HgCl, 4.5g; trichloroacetic acid, 2.0g; glacial acetic acid, 4.0ml; formalin, 20.0ml; water, 76.0ml, after Johansen\(^14\)) was used for decalcification of specimens and branches were fixed in that solution for 24h and sectioned by razor blade and stained in Ehrlich’s hematoxylin. Sectioned specimens were measured under the dissecting and compound microscopes. This taxonomic study followed the classification system of Johansen\(^2\), Silva and Johansen\(^11\), Womersely and Johansen\(^11,16\), Aguirre et al.,\(^1\) Bittner et al.,\(^17\) Guiry\(^18\). The local
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The distributional range of each taxon was arranged from the specimens examined in the Department of Marine Science, Mawlamyine University and worldwide distribution of these algae was also recorded from the literature.

Results

Classification system of the genus Jania

Phylum: Rhodophyta
Class: Rhodophyceae
Order: Corallinales Silva & Johansen
Family: Corallinaceae Lamouroux

Subfamily: Corallinoideae (Areschoug) Foslie
Genus: Jania Lamouroux
Species: J. spectabilis (Harvey ex Grunow) J.H.Kim, Guiry & H.-G.Choi
J. ungulata (Yendo) Yendo
J. rubens (Linnaeus) J.V.Lamouroux
J. verrucosa Lamouroux
J. capillacea Harvey
J. adhaerens J.V.Lamouroux

Key to the species of Jania from Myanmar

1a. Thalli with marginal conceptacles ................................................................. J. spectabilis
1b. Thalli with axial conceptacles ........................................................................ 2

2a. Intergenicula tips compressed, ungulate ........................................................... J. ungulata
2b. Intergenicula tips not compressed .................................................................... 3

3a. Intergenicula cymoid branched ........................................................................ J. rubens
3b. Intergenicula dichotomous branched ................................................................. 4

4a. Thalli robust, stiff, 7 cm high ........................................................................... J. verrucosa
4b. Thalli capillary, less than 3 cm high ................................................................. 5

5a. Intergenicula 40-100 μm in diameter ................................................................. J. capillacea
5b. Intergenicula 100-200 μm in diameter ............................................................... J. adhaerens

a. *Jania spectabilis* (Figures 1-11)


Figures 2-11 The external and internal structures of *Jania spectabilis*; (2) Habit; (3) Rounded tip of branches; (4) Thallus showing dichotomous branching; (5-6) Intergenicula with conceptacles formed marginally; (7) Surface view, showing cortical cells; (8) Longitudinal section showing uni-tiered geniculum; (9) Longitudinal section of intergenicula showing lateral fusion among cells (arrow); (10) Decalcified intergeniculum with conceptacles; (11) Tetrasporangial conceptacle.

DOI: 10.15406/jamb.2018.07.00212
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**Type locality.** Coleva, Tonga

**Description:** Thalli forming a clump, pink in color, 1.6-2.2 cm high, attached to the substratum by a discoid holdfast; intergenicula compressed with prominent midrib; terminal segments acute at the tip; branching regularly dichotomous, lateral branches common at the lower parts; cortical cells ovate, 5-13 µm broad in surface view; genicula, 80-100 µm long, 190-200 µm in diameter, consisting of 1 tier of medullary cells; compressed intergenicula, 440-550 µm long and 0.5-2 mm in diameter, composed of 5-6 tiers of medullary cells, consisting of 1-3 layers of cortical cells; interlaced intergenicular filaments forming as equal length tiers, 30-45 µm long, 8-10 µm in diameter, with lateral fusion; conceptacles embedded at the both sides of intergenicular margin; uniporate tetrasporangial conceptacles 210-470 µm in height, 250-300 µm in diameter; tetrasporangia 15-20 µm long, 10-13 µm in diameter. Sexual plants are not encountered in this study.

**Ecological notes.** Plants grow at the subtidal zone.

**Specimens examined.** Taninthayi coastal zone: Lampi I. (People’s Pearl and Fish Association (PPFC), 27.i.1971; MMB 01041, 01460-010461). Deltaic coastal zone: No data. Rakhine coastal zone: No data.

**Local distribution.** Taninthayi coastal zone: Lampi I.; Deltaic coastal zone: No data; Rakhine coastal zone: No data.

**World distribution.** Atlantic Ocean- No data; Indian Ocean- Seychelles, Laccadive Is., India, Sri Lanka, Myanmar (Present study); Indo-Pacific Region- Vietnam, Philippines; Pacific Ocean- Micronesia, Papua


*b. Jania ungulata* (Figures 12-21)

**Syntype localities:** Various, all in Japan.

**Description:** Plants erect, pink in colour, 0.5-1 cm tall, attached to the host plant by a disc-like holdfast; forming in tufts; repeatedly dichotomous, subcomplanate and corymbose branching, with wide angles of 60-70°; intergenicula cylindrical at the lower and compressed at the upper; the terminal intergenicula broad, and clearly compressed, slightly cordate at the margin; cortical cells ovate, 8-15 µm broad in surface view; genicula formed at or above the forks, at the base of each branch and frequently elsewhere as well, 20-50 µm in height and 50-100 µm in diameter, with 1 tier of medullary cells; intergenicula, cylindrical to compressed, 350-500 µm long and 110-260 µm in diameter, composed of 4-6 to several tiers of medullary cells, consisting 1-2 cortical layer; medullary filaments of the intergenicula, 20-48 µm high and 5-13 µm in diameter, with lateral fusion; the conceptacles, urn-shaped, formed at the tips of branches, up to 200 µm high and 130-160 µm in diameter.

**Ecological notes.** Plants grow on rocks at the middle intertidal zone.

**Specimens examined.** Taninthayi coastal zone- Nyaw Byin (Soe-Htun, 11.i.2001; MMB 10419); Kampani (Mya Kyawt Wai, 29.xix.2011; MMB 13092-13094); Ngwe Saung (Mya Kyawt Wai, 27.ii.2010; MMB 10423); Pashyu Gyaing (Mya Kyawt Wai, 16.xi.2009; MMB 13127); Phoe Kalar I.
The genus Jania J.V.Lamouroux (Corallinales, Rhodophyta) from Myanmar


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The external and internal structures of Jania rubens (Linnaeus) Lamouroux; (22) Habit; (23) Thallus showing dichotomous branching and cymoid clusters of conceptacles; (24) Longitudinal section of intergeniculum; (25) Longitudinal section of intergeniculum showing apex of an intergeniculum with apical meristem and without cover cells; (26) Longitudinal section of geniculum; (27) Uni-tiered geniculum; (28) Longitudinal section of intergeniculum showing tiers of medullary cells; (29) Longitudinal section of intergeniculum showing cortex with a single layer of epithallium cells (arrow); (30) Tiers of medullary filaments; (31) Lateral fusions (arrows) among cells; and (32-33) Mature tetrasporangia.

Type locality. Europe. 22

Description. Plants erect, densely tufted, sometimes forming extended cushions, rose-red in color, 0.8-1.6cm high, 1-1.5cm in diameter, attached to the substratum by a minute calcareous disc, consisting of narrow angles, dichotomous and cymoid branches, occasionally four branches formed at a genicula; intergenicula cylindrical and acute or obtuse at tip, 0.7-1.4mm in length and 125-150µm in diameter at the upper; lower intergenicula of the plants somewhat cask-shaped, often about 0.4-1.2mm in length and 175-250 µm in diameter; several branches formed at a geniculum and sometimes intervening at the points of branching; cortical cells ovate, 10-15µm broad in surface view; genicula formed at or above the forks, at the base of each branch and frequently elsewhere as well, 35-120µm in length and 80-100µm in diameter, with 1 tier of medullary cells; intergenicula branch-bearing segments broadened to 240-300µm diameter at the top; composed of 6-8 tiers of medullary cells, consisting 1-2 cortical layers; medullary filaments of the intergenicula, 43-70µm high and 8-10µm in diameter, with lateral fusion; conceptacles at first terminal, vasiform, and antenniferous, and tend to be borne in chains in a cymoid manner, eventually intercalarly below a fork, with a median protruding ostiole; tetrasporangial conceptacles, 280-360µm high and 240-380µm in diameter; tetrasporangia about 75-150µm long, 15-30µm in diameter. Sexual plants are not encountered in this study.

Ecological notes. Plants grow on rocks at the middle intertidal zone.

Specimens examined. Tanintharyi coastal zone- Nyaw Byin, Kampani, Mway Taung; Deltaic coastal zone- No data; Rakhine Coastal Region- Mawtin Point, Kyar Kan, Pashyu Gyaing, Ngwe Saung, Phoe Kalar I., Makyee, Mazin, Kyauk La Yaine Gyaing.

World distribution: Atlantic Ocean- Costa Rica; Indian Ocean- Seychelles, Tanzania, Maldives, Bangladesh, Myanmar (Present study); Indo-Pacific Region- Thailand, Vietnam, Philippines; Pacific Ocean- Taiwan, Korea, Japan, Federated States of Micronesia, Papua New Guinea, Queensland, Fiji, Galápagos Islands, Ecuador. 21

c. Jania rubens (Figures 22-33)
The genus *Jania* J.V.Lamouroux (Corallinales, Rhodophyta) from Myanmar

Local distribution: Tanintharyi coastal zone- Kampani; Deltaic coastal zone- No data; Rakhine coastal zone- Leik I., Mawtin Point, Kyar Kan.

World distribution. Atlantic Ocean- Uruguay, Brazil, Tobago, Lesser Antilles, Venezuela, Caribbean, Jamaica, Belize, Cuba, Florida, North Carolina, Bahamas, Puerto Rico, Barbados, Bermuda, Azores, Ireland, Britain, Norway, Sweden, Netherlands, France, Portugal, Spain, Italy, Adriatic, Greece, Turkey, Israel, Libya, Tunisia, Sardinia, Algeria, Balearic Islands, Morocco, Canary Islands, Mauritania, Cape Verde Islands, Senegal, Gambia, Ghana, Nigeria, Cameroon, Ascension; Indian Ocean- South Africa, Réunion, Mauritius, Madagascar, Comoros, Tanzania, Kenya, Somalia, Sudan, Egypt, Israel (Asia), Saudi Arabia, Bahrain, Iran, Pakistan, India, Myanmar (Present study), Andaman Is.; Indo-Pacific Region- Indonesia, Malaysia, Vietnam, Philippines; Pacific Ocean- Korea, Japan, Marshall Island, Federated States of Micronesia, Solomon Islands, Northern Territory, Queensland, Fiji, Colombia, Chile, California.

*d. Jania verrucosa* (Figures 34-46)

**Figures 34-46** The external and internal structures of *Jania verrucosa*: (34) Habit; (35) Thallus showing dichotomous branching; (36) Intergenicula with conceptacles; (37) Longitudinal section of intergeniculum; (38) Longitudinal section of intergeniculum showing apical cells; (39) Longitudinal section of geniculum; (40) Uni-tiered geniculum; (41) Surface view, showing cortical cells; (42-45) Longitudinal section of intergenicula: (42-43) Intergeniculum composed of medullary cells; (44) Lateral fusions (arrows) among cells; (45) Mature intergeniculum with two layers of cortical cells; and (46) Longitudinal section of conceptacle.

Type locality. Amérique Méridionale.20

Description. Plants erect, forming clumps up to 7cm high, and 2cm in diameter, dull pink in colour, with stiff and densely tufted branches, growing on the rock by a discoidal holdfast; dichotomous, sometimes corymbosely branched, with narrow angles of 45-60°; intergenicula-terete, shorter at the lower part of the plant, with occasional several adventitious lateral branches at below; tips of branches pale; cortical cells rounded to oblong, 7.5-10μm broad in surface view; genicula formed at the forks, on the intergenicula and at the base of each branch, 40-150μm in length and 50-140μm in diameter, composed of a single tier of medullary cells, 5-10μm in diameter; intergenicula,
The genus Jania J.V.Lamouroux (Corallinales, Rhodophyta) from Myanmar

300-450μm long and more or less uniform in diameter throughout, 120-150μm in diameter at the upper part and 300-370μm long and up to 200μm in diameter at the lower part, composed of interwoven medullary cells forming 6-10 tires, consisting 1-3 layers of cortical cells; medullary filaments of the intergenicula with lateral fusion, 30-70μm in length and 8-10μm in diameter; tetrasporangial conceptacles not abundant, 200-400μm in length and 200-260μm in diameter, forming at the terminal segments, with bi- or tri-antenniferous; mature tetraspores 50-100μm long and 40-90μm broad.

Ecological notes. Plants are epilithic, occurring in shallow pools or on rocks at the middle intertidal zone.

Specimens examined. Tanintharyi coastal zone- No data. Deltaic coastal zone- No data. Rakhine coastal zone- Phoe Kalar I. (Mya Kyawt Wai, 5.ii.2012; MMB 13106-13108); Ngapali (San Tha Tun, 17.iii.1987; MMB 06856); Mazin (Nyan Wai Tun, 30.iv.1984; MMB 02969).

Local distribution. Tanintharyi coastal zone- No data; Deltaic coastal zone- No data; Rakhine coastal zone- Phoe Kalar I., Ngapali, Mazin.

World distribution. Atlantic Ocean- Cape Verde Islands, Mauritania, Sierra Leone, Liberia, Côte d’Ivoire, Ghana Belize, Nigeria, Angola; Indian Ocean- South Africa, Mauritius, Sri Lanka, Myanmar (Present study); Indo-Pacific Region- Singapore; Pacific Ocean- Queensland, New South Wales, New Zealand, Tasmania, Victoria, South Australia, Western Australia, Hawaiian Islands, Mexico.

e. Jania capillacea (Figures 47-58)

Figures 47-58 The external and internal structures of Jania capillacea: (47) Habit; (48) The accessory attachment discs; (49) Longitudinal sections of intergeniculum; (50) Longitudinal sections of intergeniculum showing apex of an intergeniculum with apical meristem and without cover cells; (51) A branch with initials of dichotomous; (52) Thallus showing dichotomous branching; (53) Longitudinal section showing uni-tiered geniculum; (54) Geniculum formed at the tip of intergeniculum; (55) Genicular filaments; (56) Surface view, showing cortical cells; (57) Longitudinal section of intergenicula showing tiers of medullary cells; and (58) Lateral fusion (arrow) among cells.

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Type locality. Bahia Honda, Florida, U.S.A.22

Description. Thalli minute, capillary, epiphytic, pink, 5-8mm high, attached to the host plant by a disc-like holdfast; branching regularly dichotomous with wide angles of 60°-100°; the branches sometimes recurved, composed of 1-3 segments or intergenicula between dichotomies; apices blunt; small disc-like attachments often found on branches; cortical cells ovate to obovate, 5-10µm broad in surface view; propagulae with antenna-like branches formed at the upper part of the plants; genicula formed at the fork and along the branches, 20-80μm in height and 40-70µm in diameter, consisting 1 tier of medullar cells; intergenicula, cylindrical, 100-900µm long and 40-100µm in diameter, composed of interwoven medullar cells forming about 10-20 tires, consisting 1-2 cortical layers; medullary filaments of the intergenicula, 28-75µm high and 5-10µm in diameter with lateral fusion; conceptacles were not found; asexual reproduction by attachment discs from any one of the three limbs produced from triangular propagulae.

Ecological notes. Plants are epiphytic on shells and algae at the intertidal zone.

Specimens examined. Tanintharyi coastal zone- St. Luke’s I. (Yin Yin Htay, 5.iv.2013; MMB 13137-13139); Lampi I. (Tint Swe, 4.i.2008; MMB 10454); High I. (Yin Yin Htay, 12.xi.2008; MMB 10455); Wa Maw (Yin Yin Htay, 18.iv.2009; MMB 10451); Nyaw Byin (Soe-Htun, 11.i.2002; MMB 10452); Mway Taung (Soe-Htun, 6.iv.2001; MMB 10453). Deltaic coastal zone- No data. Rakhi-ne coastal zone- Mawtin Point (Soe-Htun, 6.iv.2001; MMB 10447); Mya Kyawt Wai, 25.ii.2010; MMB 10448-10450); Ngwe Saung (Mya Kyawt Wai, 27.ii.2010; MMB 10456); Makye (Mu Mu Aye, 4.x.2006; MMB 10446); Maw Shwe Gyaing (Soe-Htun, 7.x.2002; MMB 10445); Sin Phyu Gyaing (Soe-Htun, 8.iv.2004; MMB 10444); Moe Gyo Pyit Gyaing (Soe-Htun, 7.iv.2004; MMB 10443); Mazin (Soe-Htun, 4.iv.2004; MMB 10442).


World distribution. Atlantic Ocean- Brazil, Lesser Antilles, Caribbean, Panama, Costa Rica, Belize, Jamaica, Cuba, Texas, Florida, North Carolina, Virginia, Bahamas, Hispaniola, Barbados, Virgin Islands, Bermuda, Madeira, Canary Islands, Mauritania, Cape Verde Islands, Ghana, Gabon, Ascension; Indian Ocean- South Africa, Réunion, Mauritius, Seychelles, Tanzania, Kenya, Yemen, Pakistan, India, Laccadive Islands, Maldives; Myanmar (Present study); Indo-Pacific Region- Malaysia, Vietnam, Philippines; Pacific Ocean- Japan, Marshall Island, Federated States of Micronesia, Solomon Islands, Fiji, Islas Revillagigedo, Mexico, Galápagos Islands, Colombia, Ecuador.6

f. Jania adhaerens (Figures 59-70)

Figures 59-70 The external and internal structures of Jania adhaerens; (59) Habit; (60) A branch with antenniferous axial conceptacles in chain; (61) The accessory attachment discs (arrow); (62) Surface view, showing cortical cells; (63) Longitudinal sections of intergeniculum showing apex of an intergeniculum with apical meristem and without cover cells; (64) Longitudinal section showing uni-tiered geniculum; (65) Genicular filaments; (66-69) Longitudinal section of intergenicula: (66-67) Intergenicula with several tiers of medullary filaments; (68) Lateral fusions (arrows) among medullary cells; (69) Mature intergeniculum with cortical cells (arrow); and (70) Longitudinal section of mature tetrasporangial conceptacle.

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Type locality. Mediterranean.22

Description. Plants erect, capillary, pink in colour, 1-2 cm high, attached to substratum by a disc-like holdfast; forming dense tufts; branching dichotomous with some irregular, wide-angled (30°-70°), the lower branches cylindrical, often arcuate; disc-like attachments found on the lower branches; intergenicula bearing branches slightly dilated and refuse at the upper end; apices of branch conical, acute; cortical cells oblong, 5-15 μm broad in surface view; genicula formed at the forks and at the base of each branch, 40-50 μm in height and 70-100 μm in diameter, composed of single tier of medullar cells; intergenicula, cylindrical, short, 100-400 μm long and 100-200 μm in diameter at the lower part and 100-1500 μm long and up to 200 μm in diameter at the upper part, composed of interwoven medullar cells forming about 3-6 tiers, 43-70 μm high and 8-10 μm in diameter, consisting 1-3 cortical layers; medullar filaments of the intergenicula with lateral fusion; the conceptacles vasiiform, found at or near the ends of the ultimate branches, bearing 2 hornlike projections, which develop into branches and often in time for additional conceptacles; conceptacles, 280-360 μm high and 240-380 μm in diameter.

Ecological notes. Plants grow as epiphytes on the other algae at the intertidal zone.


Local distribution: Tanintharyi coastal zone- Kampani; Deltaic coastal zone- No data; Rakhine coastal zone- Mawtin Point, Ngwe Saung, Sin Phyu Gyaing.

World distribution. Atlantic Ocean- Brazil, Lesser Antilles, Venezuela, Jamaica, Belize, Cuba, Florida, North Carolina, Bahamas, Puerto Rico, Barbados, Isla Guadalupe, Virgin Islands, Bermuda, Azores, Spain, Balearic Islands, Corsica, Italy, Greece, Israel, Tunisia, Algeria, Morocco, Mauritania, Senegal, Gambia, Sierra Leone, Liberia, Ghana, Cameroon; Indian Ocean- South Africa, Réunion, Mauritius, Madagascar, Seychelles, Tanzania, Kenya, Ethiopia, Egypt, Iran, Pakistan, India, Laccadive Islands, Bangladesh, Myanmar (Present study), Andaman Islands; Indo-Pacific Region- Indonesia, Malaysia, Thailand, Vietnam, Philippines; Pacific Ocean- Taiwan, China, Korea, Japan, Federated States of Micronesia, Papua New Guinea, Queensland, Fiji, Hawaiian Islands, California, Colombia, Ecuador.6

Discussion

In segregating the genera of articulated corallines, the conceptacles position of each genus, the terminal (axial) position of conceptacles in Corallina and Jania and their lateral position in Amphiroa, has been generally used by Decaisne since 1842.2 Not only reproductive characters but also vegetative characters such as shape of medullar filaments, type of branching, are important in the classification of articulated coralline algae. Some vegetative structures used in the identification of species are presented in Table 1.

Table 1 A comparison of species of Jania characterized by distinctive characteristics used as taxonomic criteria

<table>
<thead>
<tr>
<th>Species</th>
<th>Frond</th>
<th>Genicula</th>
<th>Intergenicula</th>
<th>Arrangement of medullary cells</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Maximum length</td>
<td>Habit</td>
<td>No. of tiers of medullary cells</td>
<td>Length</td>
</tr>
<tr>
<td>J. spectabilis</td>
<td>1.6-2.2 cm</td>
<td>clump</td>
<td>1 tier</td>
<td>440-550 μm</td>
</tr>
<tr>
<td>J. ungulata</td>
<td>0.5-1 cm</td>
<td>tufts</td>
<td>1 tier</td>
<td>350-500μm</td>
</tr>
<tr>
<td>J. rubens</td>
<td>0.8-1.6 cm</td>
<td>erect, densely tufted</td>
<td>1 tier</td>
<td>0.7-1.4 mm at the upper, 0.4-1.2 mm at the lower</td>
</tr>
<tr>
<td>J. verrucosa</td>
<td>up to 7 cm</td>
<td>erect, forming clumps</td>
<td>a single tier</td>
<td>300-450μm</td>
</tr>
<tr>
<td>J. capillacea</td>
<td>5-8 mm</td>
<td>epiphytic</td>
<td>1 tier</td>
<td>100-900μm</td>
</tr>
<tr>
<td>J. adhaerens</td>
<td>1-2 cm</td>
<td>erect, dense tufts</td>
<td>single tier</td>
<td>100-1500 μm</td>
</tr>
</tbody>
</table>

The species identification of articulated coralline algae was carried out based on shape of intergenicula; presence of midrib at the segments; branching type, type of genicula; number of tiers formed at the genicula; shape, composition and arrangement of (short and long) tiers of medullary cells in intergenicula; presence or absence of secondary pit-connections and lateral fusions at medullary filaments of the intergenicula; and position of conceptacles.

### Table 2: The distributional range of Jania spp. along the coastal zones of Myanmar

<table>
<thead>
<tr>
<th>Sr. No.</th>
<th>Species</th>
<th>TCZ From</th>
<th>To</th>
<th>DCZ From</th>
<th>To</th>
<th>RCZ From</th>
<th>To</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td><em>J. spectabilis</em></td>
<td>Lampi I.</td>
<td>10°58′ N, Long. 98° 08′ E</td>
<td>No data</td>
<td>No data</td>
<td>No data</td>
<td>No data</td>
</tr>
<tr>
<td>2.</td>
<td><em>J. ungulata</em></td>
<td>Nyaw Byin</td>
<td>13°40′ N, Long. 98° 08′ E</td>
<td>Mway Taung</td>
<td>Lat. 14°, 27′ N, Long. 98° 00′ E</td>
<td>No data</td>
<td>No data</td>
</tr>
<tr>
<td>3.</td>
<td><em>J. rubens</em></td>
<td>Kampani</td>
<td>14°02′ N, Long. 98° 04′ E</td>
<td>No data</td>
<td>No data</td>
<td>No data</td>
<td>No data</td>
</tr>
<tr>
<td>4.</td>
<td><em>J. verrucosa</em></td>
<td>No data</td>
<td>No data</td>
<td>No data</td>
<td>No data</td>
<td>No data</td>
<td>No data</td>
</tr>
<tr>
<td>5.</td>
<td><em>J. capillacea</em></td>
<td>St. Luke’s I.</td>
<td>10°58′ N, Long. 98° 15′ E</td>
<td>Mway Taung</td>
<td>Lat. 14°, 27′ N, Long. 98° 00′ E</td>
<td>No data</td>
<td>No data</td>
</tr>
<tr>
<td>6.</td>
<td><em>J. adhaerens</em></td>
<td>Kampani</td>
<td>14°02′ N, Long. 98° 04′ E</td>
<td>No data</td>
<td>No data</td>
<td>No data</td>
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</tr>
</tbody>
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**Abbreviations:** TCZ, The Tanintharyi coastal zone; DCZ, The deltaic coastal zone; RCZ, The Rakhine coastal zone.

*J. spectabilis* was firstly described as *Cheilosporum spectabile* by Harvey ex Grunow in 1874.20 Based on nuclear SSU rDNA sequences and anatomical data, some species of the genera *Cheilosporum*, *Haliptilon*, and *Jania* had been combined into a single genus, *Jania*, including *Cheilosporum spectabile* Harvey ex Grunow by Kim et al.21 So, *Jania spectabilis* (Harvey ex Grunow) Kim, Guiry & Choi is currently accepted name of *Cheilosporum spectabile* Harvey ex Grunow. Generally, *J. spectabilis* can be distinguished by dichotomous branching, flattened and wing-like intergenicula with prominent midrib and marginal conceptacles embedded on the both sides of wings. The morphology of this species differs from *J. cultrata* and *J. sagittata* in position of conceptacles, tip of branches and shape of intergenicula. The two conceptacles form on each side of intergeniculum in *J. cultrata* whereas only one conceptacle occurs on each side of intergeniculum in *J. spectabilis*.24 In addition, intergenicular lengths of *J. sagittata* (435-665 (-750)µm) are longer than those of *J. spectabilis* (440-550)µm.24 Moreover, both sides of intergenicula found in *J. sagittata* are more sagittate than those of *J. spectabilis*.24

*J. spectabilis* of the Samoa showed dichotomous branches commonly found from the mid to the upper parts and adventitious branches were found at the lower parts.25 The tip of the trilobe segments were rounded in Samoa species. Species of Myanmar agree well with those species in having branching dichotomous and adventitious branches and differ from those species in having acute tip. Jha et al.26 also reported that *J. spectabilis* from India were markedly flattened with prominent midrib and wings on both sides. The solitary or paired conceptacles and acute tip of segments were found in Indian species. Acute tip can also be found at the intergenicula in the species of Myanmar but solitary conceptacles cannot be observed. In Myanmar, Soe-Htun10 firstly reported *J. spectabilis* (as *Cheilosporum spectabile*) from Rakhine coastal zone. Soe-Htun et al.,12 accounted *J. spectabilis* from Tanintharyi coastal zone. In present study, this species is recorded only from Lampi I. (Lat. 10°58′ N, Long. 98°08′ E) according to herbaria housed in Marine Science Department, Mawlamyine University. It is distributed throughout the tropical Regions of the Pacific Ocean, Indian Ocean, and Indo-Pacific Region.

*J. ungulata* can be distinguished from other species by the compressed and unglute tip of segments and subcomplanate and closely corymbose branching at the upper part of plant. In 1902, Yendo described *Jania ungulata* and *J. ungulata f. brevior* as new species of the genus *Corallina* from Japan. According to his description of these species, the habit of *Jania ungulata* was similar to the habit of *Corallina adhaerens* in forming a large mass of spongy network. *J. ungulata*
The genus Jania J.V.Lamouroux (Corallinales, Rhodophyta) from Myanmar and New Zealand, namely was firstly described as by from Japan such as slender plants are cylindrical and dichotomous, with several adventitious from China as had a branch with 8-11 tiers of medullary cells and subtropical areas of all of the oceans. Long. 94° 17′ E) to Kyar Kan (Lat. 15°59′N, Long. 94°13′ E) along the mid intertidal region along the Kampani (Lat 14°02′ N, Long 98°04′ E) to Kyauk La Yaine Gyaing of the intergenicula are different and intergenicula type of branching in this species. In 1945, Taylor suggested the similar points of branching but some branches formed along the intergenicula. branches formed at a geniculum and sometimes intervening at the upper and ultimate branches are club-shaped whereas lower branches connected as if strung with one or two appendages. cylindrical and club-shaped; terminal conceptacles are solitary or of Lamouroux, as a lectotype species of the genus Lamouroux proposed the intergenicula with broader upper ends. Linnaeus because of having dichotomous branched and cylindrical intergenicula with broader upper ends. Lamouroux proposed the genus Jania and firstly mentioned which was regarded as a lectotype species of the genus Jania. According to description of Lamouroux, J. rubens has dichotomous intergenicula which are cylindrical and club-shaped; terminal conceptacles are solitary or connected as if strung with one or two appendages.

In the present study, J. rubens can be recognized by its erect and corymbose branches, club-shaped terminal branches, and cymoid clusters of conceptacles. The branches of J. rubens are cylindrical at the upper and ultimate branches are club-shaped whereas lower branches are subcylindrical to cask-shaped. The branching type of this species is dichotomous forming cymoid manner. Sometimes, several branches formed at a geniculum and sometimes intervening at the points of branching but some branches formed along the intergenicula. Likewise, Taylor (1967) described several species of this species intervening at the points of branching. He also described the corymbose type of branching in this species. In 1945, Taylor suggested the similar habits of J. mexicana and J. rubens but the proportion and diameters of the intergenicula are different and intergenicula of J. mexicana was much more slender than that of J. rubens. In Myanmar, Kyaw Soe and Kyi Win firstly described J. rubens from Rakhine and Tanintharyi coastal zones. These species are growing epilithically on the rocks at mid intertidal region along the Kampani (Lat 14°02′ N, Long 98°04′ E) along the Tanintharyi coastal zone and Leik I. (Lat. 15° 51′ N, Long. 94° 17′ E) to Kyar Kan (Lat. 15°59′N, Long. 94°13′ E) along the Rakhine coastal zone. J. rubens is distributed throughout the tropical and subtropical areas of all of the oceans.

Although Lamouroux firstly described J. verrucosa, J. pedunculata and J. crassa were also firstly described in 1821, the latter two are currently recorded as synonyms of the former. Kützing identified J. verrucosa under the name of Corallina natatalensis, and C. pedunculata and illustrated the habit, warty intergenicula and branching pattern of these species. It was found that J. pedunculata had a branch with 8-11 tiers of medullary cells per intergeniculum in his illustrations. In this study, the original nomenclature by Lamouroux is retained.

Dawson identified specimens of J. verrucosa from Mexico as J. natatalensis and discussed that this species was similar with J. mexicana in habit but J. verrucosa was distinctly larger in all respects and had irregularly elongate intergenicula. Tseng identified this species from China as J. crassa and he described that plants from China are dull grey-pink in colour and turfed on rocks. Intergenicula of those plants are cylindrical and dichotomous, with several adventitious branchlets. Likewise, the plants of Myanmar are dull pink in colour and are composed of stiff and densely tufted branches. Dichotomous branchings with narrow angle are observed throughout the plants. Tips of the intergenicula are pale in colour. The several adventitious lateral branches are occasionally observed at below the intergenicula.

The thalli of J. verrucosa are more robust than that of the other species of Jania observed in Myanmar. Medullary cells of the intergenicula and genicula are larger than those of the other species of Jania in the present study. The warty like epiphytic plants are mostly found on the middle and lower part of intergenicula. Axial conceptacles with two-three antennae occur on the terminal part of the branches. This species can found epilithically growing on the rocks and in shallow tide pools at the mid intertidal zone of Phoe Kalari Is., Chaungtha coastal areas.

Womersley and Johansen also described that J. verrucosa from Southern Australia was light to medium red-brown, fading to grey-white in colour and the branches were densely tufted and fastigiated. Farr et al., also described the two other names which had been used for J. verrucosa in New Zealand, namely J. crassa and J. novae-zealandiae. Pale tip are observed in New Zealand’s species as well as species of Myanmar. Rosas-Alquicira et al., reported that the current name of both J. crassa and J. natatalensis was J. verrucosa but they proposed that taxonomic status of these species were needed to be confirmed by comparative studies of both types. This species are scarcely growing on the rocks at mid intertidal region of Phoe Kalar I. (Lat. 16°57′ N, Long. 94°26′ E) and Mazin (Lat. 18°26′N, Long. 94°18′E) at the Rakhine coastal zone. Jania verrucosa is distributed throughout the tropical and subtropical areas of all of the oceans.

The attachments discs can be found at the basal part in both J. capillacea and J. adhaerens. However, the former can be distinguished from the latter by smaller diameter of segments (40-100 μm) and presence of triangular propagulae at the upper part of plant. Dawson described that propagulae formed at the upper part of the plant has antenna-like branches at the upper corners. Attachment discs occur on one of those branches and regenerate a new plant from discs. Rosas-Alquicira et al., discussed that J. capillacea was regarded as current name but status and disposition of this species was uncertain because the type was not studied in a modern context. J. capillacea is distributed from St. Luke’s I. (Lat. 10°10′N, Long. 98°15′ E) to Mway Taung (Lat. 14°27′ N, Long. 98°00′ E) along the Tanintharyi coastal zones and, Mawin Point (Lat. 15°57′N, Long. 94°14′E) to Mazin (Lat. 18°26′ N, Long. 94°18′E) on the Rakhine coastal zones of Myanmar, except the deltaic coastal zone. It is widely distributed throughout the tropical and subtropical Regions of the Atlantic, Indian and Pacific Oceans, and Indo-Pacific Region.

Yendo described J. adhaerens from Japan such as slender capillary intergenicula, irregularly decussate dichotomous branches with slightly attenuated at ultimate and formed fastening discs at their ends. He discussed that many species of Jania e.g. Jania capillacea, J. micrarthrodia f. antennina, J. micrarthrodia f. tenissima, J. tenella, J. norae-zelandiae and J. ungulata, were closely related to J. adhaerens from the warmer part of the Atlantic and the Pacific Ocean. He pointed out that the relative size of the intergenicula was essential for distinguishing character. In 1953, Dawson discussed that the description of J. adhaerens given by Yendo was similar or equal to J. decussato-dichotoma and to several other species. He also discussed that identification of Jania decussato-dichotoma and other species may be confused with J. adhaerens because of absence of an adequate
The genus *Jania* J.V.Lamouroux (Corallinales, Rhodophyta) from Myanmar. Proceedings of the 36

**Acknowledgements**

I wish to express my sincere thanks to Dr. Aung Myat Kyaw Sein, Rector of Mawlamine University, Dr. Mie Mie Sein and Dr. San San Aye, Pro-Rectors of Mawlamine University for their permission to carry out this research work. I would like to express my gratitude to Dr. San Tha Tun, Professor and Head of Department of Marine Science, Mawlamyine University, for his valuable guidance and for providing the administrative facilities. Thanks are due to U Soe-Htun, Professor and Head (Retired), Department of Marine Science, for his guidance during this research work. Thanks are also due to all my respected teachers and colleagues for their encouragement. Finally, my infinite thanks are attributable to my beloved parents for their kind support made to reach the goal of this work.

**Conflict of Interest**

None.

**References**

The genus Jania J.V.Lamouroux (Corallinales, Rhodophyta) from Myanmar