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The Morphology of genus *Gelidium* Lamouroux (Gelidiales, Rhodophyta) from Kyaikkhami and Setse Coastal Areas, Myanmar

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ABSTRACT

The genus Gelidium Lamouroux, collected from Kyaikkhami and Setse coastal areas, was identified as Gelidium arenarium Kylin, Gelidium crinale (Hare ex Turner) Gaillon and Gelidium crinale var. perpusillum piccone & Grunow based on the external and internal morphologies of the vegetative and reproductive structures of each taxon. A comparison of main characteristics of three species of Gelidium was described. The distribution of each species along the three Coastal Regions of Myanmar was presented. Some ecological notes and potential uses of these species were briefly described.

Keywords: *Gelidiales, Gelidium arenarium, Gelidium crinale and Gelidium crinale var perpusillum, Myanmar, Rhodophyta, taxonomy.*

INTRODUCTION

The division Rhodophyta composed of two classes: the Bangiophyceae and Florideophyceae[1]. The class Florideophyceae consists of 12 orders such as Acrochaetiales, Bonnemaisoniales, Nemaliales, Corallinales, Halymeniales, Cryptonemiales, Nemastomatales. Gigartinales, Ceramiales, Gracilariales, Rhodymeniales and Gelidiales. The order Gelidiales comprises of two families; Gelidiaceae and Gelidiellaceae.

The genus comprises eight species of *Gelidium* have been reported for the coast of China, and five additional species have been described for the coast of Taiwan[2]. The taxonomic studies of *Gelidium* and *Pterocladia*, many descriptions of the species have been based on external morphology only[3]. Santelices (1991a, b) studied on the structure of cystocarps and detected intrageneric heterogenity within *Pterocladia* and *Gelidium* that 32 species of Gelidiales[4]. Thirteen species of *Gelidium* were included in the Chinese flora with a key and information on distribution[5, 6].

The Gelidiales show an alternation of isomorphic generations, although there is a great disparity in the proportion of sporophyte and gametophyte plants. The sexual plants are dioecious and distinguishable only when fertile. The plants are of moderate size, firm, cartilaginous consistency, of uniaxial construction, and of monopodial branching. The carpogonial filaments are single-celled and deeply embedded in the cortex of very young thallus parts. The gonimoblast develops directly form a multinucleate fusion cell formed from the carpogonium alone or as a result of the fusion of the carpogonium and certain neighbouring cells[7].

In Myanmar, Kyi Win[8] listed four species of the genus *Gelidium* such as *Gelidium pusillum* (Stackhouse) Le Jolis, *G. heteroplatos Boerys, G. corneum* (Huds) Lamouroux and *G. arenarium* Kylin. Moreover, Kyaw Soe and Kyi Win[9] reported *Gelidium pusillum* (Stackhous) Le Jolis, *G. heteroplatos* Boergs., *G. corneum* (Huds) Lamouroux and *Gelidium arenarium* Kylin. Soe-Htun[10] reported the occurence of *Gelidium pusillum* (Stackhouse) Le Jolis in Rakhine and Tanintharyi Coastal Regions.

The objectives of this study are 1) to identify the genus *Gelidium* based on the morphology of vegetative and reproductive structure, and 2) to know the distribution of each species along the three coastal regions of Myanmar and the world oceans.

MATERIALS AND METHODS

The present study was carried out three species of the genus *Gelidium, G. arenarium* Kylin, *G. crinale* (Hare & Turner) Gaillon and *G. crinale* var. *perpusillum* Piccone & Grunow were collected from Setse

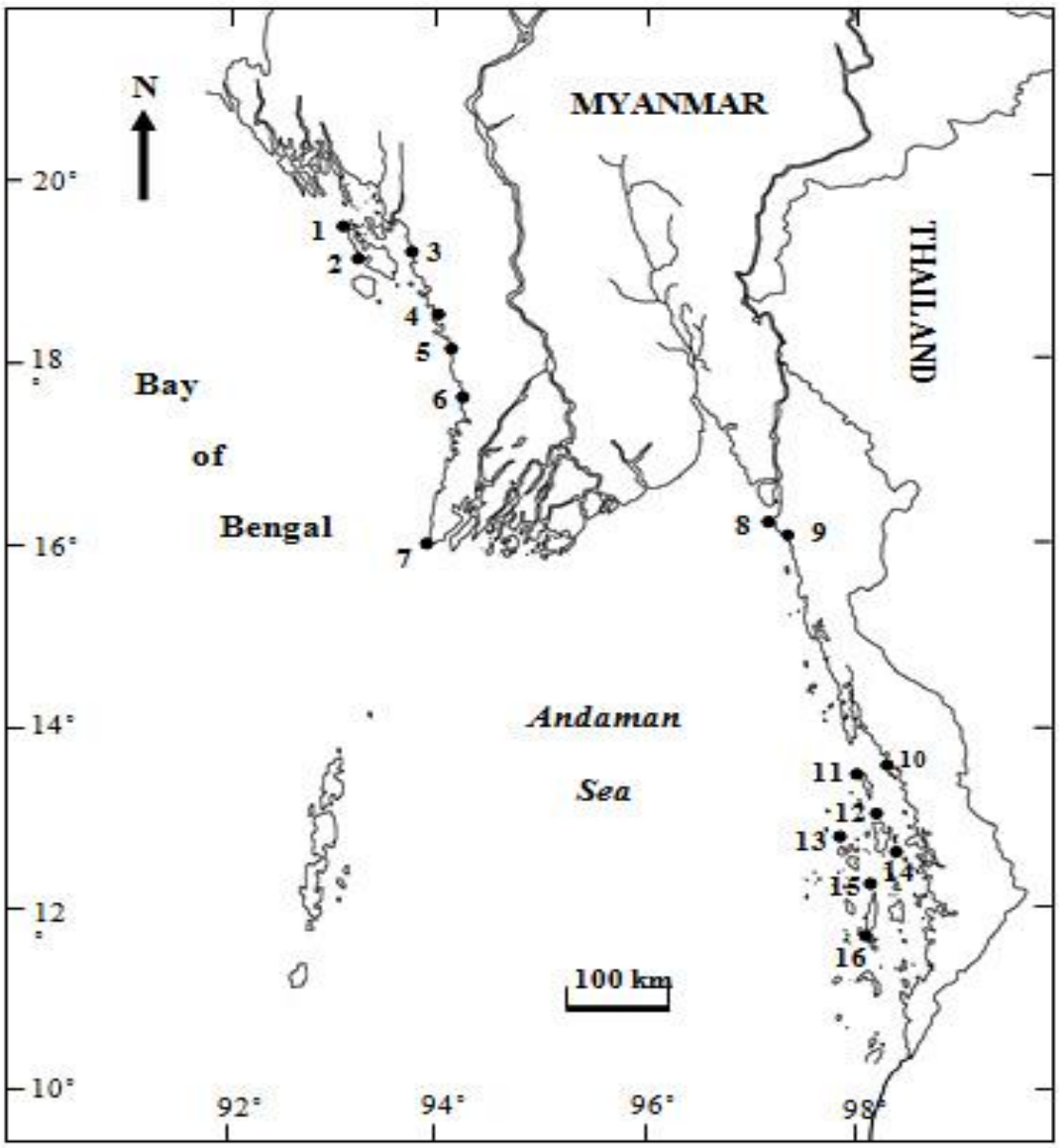

Figure1. *Map showing the distribution sites of species Gelidium along the three coastal zones of Myanmar. 1. Kyauk Phyu, 2. Kyauk La Yaine Gyaing, 3. Maw Shwe Gyaing, 4. Ngapali, 5. Shwe Ya Gyaing, 6. Gwa Aw, 7. Maw Tin Point, 8. Kyaikkhami, 9. Setse, 10. Zeaphyu Thaung, 11. Kalagoke I, 12. Thamila I, 13. Maungmagan,14. Sanhlann, 15. Kennedy I, 16. Kisseraing I.*

(Lat. 15° 52' N, Long. 97° 35' E) and Kyaikkhami (Lat. 16° 05' N, Long. 97° 34' E) coastal areas, Mon State during the period from June 2011 to February 2012. Some fresh specimens were fixed and preserved in 5% formaldehyde-seawater and some were prepared for herbarium sheets. Liquid-preserved and living specimens were used for detailed investigations on habit of plants, the external and internal morphologies of vegetative and reproductive structures, and associated algae. All herbarium sheets and liquid preserved specimens were deposited in the Herbarium of Department of Marine Science, Mawlamyine University, Myanmar (MMB).

The whole plants and sections were prepared by hand using double edged razor blades. Vegetative structure such as thallus corticated, branching system, and formation of rhizoids and reproductive structure such as tetrasporangia were studied under disecting and compound microscopes and photographed with a Sony (CS3 digital camera), processing with Adobe Photoshop 7.0. Sizes of these structures were measured under the compound microscope using on ocular meter. This taxonomic study followed the classification system of Dawson[11], Womersely[12], Silva, Menez and Moe[13] and Guiry and Guiry[14]. The local and worldwide distributional range of these algae was also recorded from the literature available.

RESULTS

Classification System of the Genus *Gelidium*

Phylum : Rhodophyta

Class : Florideophyceae

Order : Gelidiales

Family : Gelidiaceae

Genus : G*elidium* Lamouroux

Species

- *G. arenarium* Kylin
- *G. crinale* (Hare ex Turner) Gaillon
- *G. crinale* var. *perpusillum* Piccone & Grunow

Key To The Species Of *Gelidium* From Kyaikkhami And Setse Coastal Areas

- Plant less than 1cm height, erect axes subcylindrical…….....*G. arenarium*
- Plant 3-7 mm height, erect axes cylindrical…….....2
- Branched, apical portion dichotomous…….....*G. crinale*
- Unbranched, apical portion simple…….....*G. crinale* var. *perpusillum*

GELIDIUM ARENARIUM (Figure 2 A-F)

References

Kyaw Soe and Kyi Win 1977: 105, fig. 182; Xia *et al*. 2002: 186, figs. 4-6; Tseng and Wang 2002: 186, figs. 4-6; Soe-Htun *et al.* 2009 a, figs. 23-24,Guiry and Guiry 2012.

Type Locality

Isipingo Beach, near Durban, South Africa (as cited in Guiry 2008, Guiry and Guiry 2012)

Type Unknown

Description : Vegetative Structure

Plants are small, 1-4 mm high, purple red in color, composed of creeping stem. Erect axes are membranous, cylindrical to compressed, 250 µm in diameter, attached to the substratum by rhizoidal holdfast; prostrate axes cylindrical, 120 µm in diameter. In surface view, cortical cells are irregularly rounded, 10-20 µm in diameter. In cross section, the cortical cells are rounded or ovate in shape, 2-3 µm in diameter. The medullary cells are ovate or oblong in shape. A small number of colourless rhizines are found in the meudullary areas.

Reproductive Structure

In the present study, reproductive structures have not been found.

Specimens Examined

Kyaikkhami (La Pyae Phyo Aung, 22.viii.2010; MMB 10600; Moe Moe Aung, 22.viii.2010; MMB 10601; Thein Htaik Aung, 22.viii.2010; MMB 10602; Tin Htut Aung, 22.viii.2010; MMB 10603; Sai Thet Nay Min, 22.viii.2010; MMB 10604; Vegetative); Kyaikkhami (Phu Pwint Zin, 7.i.2012; MMB 11548: Vegetative).

Local Distribution

Rakhine Coastal Region: Kyauk Phyu, Ngapali, Gwa Aw, Shwe Ya Gyaing, Maw Shwe Gyaing, Maw tin Point, Kyauk La Yaine Gyaing; Ayeyarwady Delta and Gulf of Martaban Coastal Region: Kyaikkhami; Tanintharyi Coastal Region – Zeaphyu thaung, Kalagoke 1., Sanhlann, Maungmagan, Thamila I., Kennedy I., Kisseraing I. (Kyaw Soe and Kyi Win 1977, Soe-Htun *et al.* 2007, 2009 a, b).

World Distribution

Atlantic Ocean: Brazil, Florida, Bermuda, Mexico, Cuba, Jamaica, Lesser Antilles, Ireland, Britain, Greece, Portugal, Spain, Adriatic, Turkey, France, Italy, Mauritania, Gambia, Morocco, Senegal, Seirrra Leone, Liberia, Ghana, Gabon; Indian Ocean: Ethiopia, Reunion, Mauritius, Seycheles, Mdagascar, Kenya, South Africa, Diego Garcia Atoll, Egypt, Kuwait, Iran, India, Maldives, Myanmar (Soe-Htun *et al.* 2009b); Africa: Kenya, South Africa Asia: China (Guiry and Guiry 2012).

Potential Uses

Gelidium arenarium Kylin can be used as fodder, fishmeal and manure (Soe-Htun 2005).

Ecological Notes

This species is commonly found attached to rocky substratum at intertidal zone and on the pneumatophores of mangroves, growing together with *Polysiphonia subtilissima* and *Gelidium crinale*.

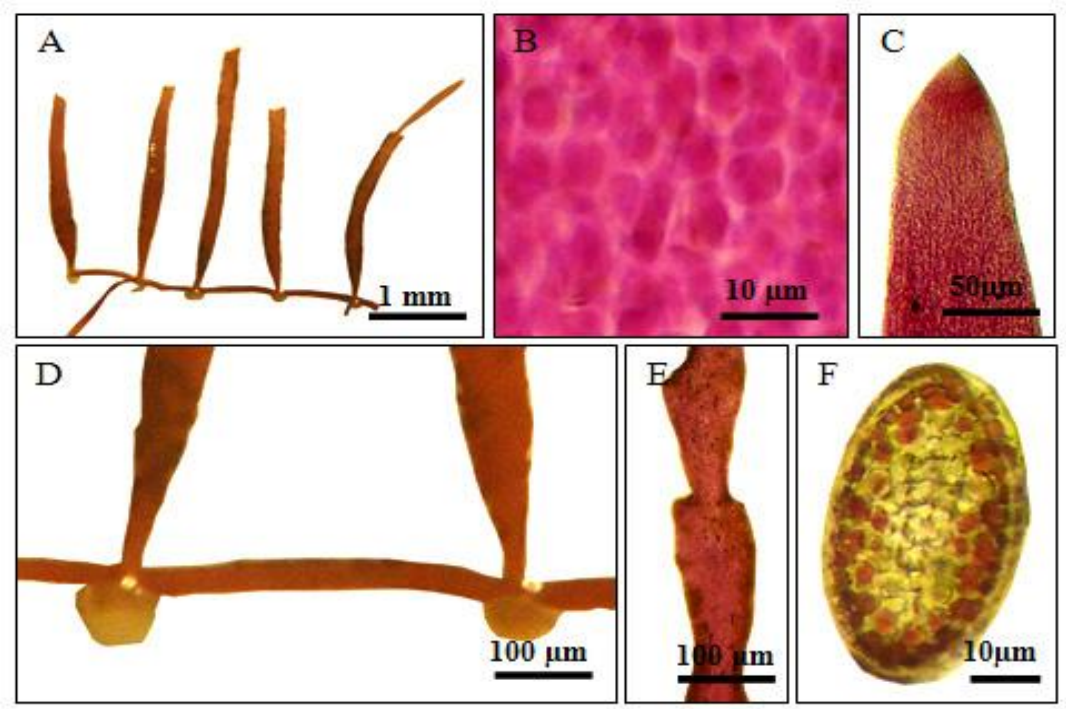

Figure2. *A-F. Morphology and anatomy of Gelidum arenarium Kylin. A. Vegetative plant; B. Surface view of cells; C. Apical portion of thallus; D. Prostrate branch with erect axis; E. New blade regenerate from truncate thallus; F. Cross section of thallus.*

GELIDIUM CRINALE

(Hare ex Turner) Gaillon (Figure 3 A-L)

References

Dawson 1944: 254-260; Shen and Fan 1950: 17; Taylor 1957: 231-232, figs. 1-3; pl. 40, fig. 3; pl. 41, fig. 5; Taylor 1960: 355; Santelices and Stewart 1985: 12, 19, fig. 11; Santelices 1988: 96-97, fig. 5; Zhang and Xia 1988: 111, fig. 3; Lee 1994: 70-71, figs. 5-8; Womersely 1994: 133, fig. 39 A-D; Lee and Kim 1995: 164-165, fig. 5; Tseng and Wang 2002:187, figs. 7-8, 78; Reine and Trono 2002: 165, fig. 9.

Synonym (S)

Fuccus crinalis Hare ex Turner 1815

Fucus crinalis Turner (1811-1819)

Capilaria crinalis (Hare ex Turner) Stackhouse 1816

Gelidium corneum var. crinale (Turner) Greville 1830

Acrocarpus crinalis (Turner) Kutzing 1984

Gelidium sipinescens (Kutzing) Trevisan 1845

Gelidium spinescens (Kutzing) Zanardini 1847. (as cited in Guiry 2010, Guiry and Guiry 2012).

Type Locality

England; Northern Ireland (Silva, Meñez and Moe 1987)

Type Unknown

Description: Vegetative Structure

Plants are dark-red in color, forming wiry composed of cylindrical prostrate axes, usually growing on rocky of intertidal zone and the pneumatophores of mangroves, attached to the substratum by massive rihizoidal holdfast. Erect axes are cylindrical below, subcylindrical above, acute at the ends, irregularly alternate or dichotomous branched, 250µm in diameter, attached by rhizoidal filaments. Cortical cells are irregularly rounded in surface view. In cross section, erect axis consists of medulla and cortex cells. The cortex has three rows of pigmented cells, 7-12 µm in diameter. The medullary cells are ovate or oblong in shape.

Reproductive Structure

Tetrasporangial sori are the spatulate, lanceolate, or irregularly shaped terminal branchlets. Tetrasporangia are ovoid or irregularly rounded in cross section, 10-30µm in diameter. Cystocarps are not seen.

Specimens Examined

Kyaikkhami (La Pyae Phyo Aung, 22.viii.2010; MMB 10586; Moe Moe Aung, 22.viii.2010; MMB 10587, 10591, 10594; Thein Htaik Aung, 22.viii.2010; MMB 10588, 10593; Tin Htut Aung, 22.viii.2010; MMB 10589; Sai Thet Nay

Min, 22.viii.2010; MMB 10590, 10592, 10605: Vegetative; Kyaikkhami (Phu Pwint Zin, 8.vii.2011; MMB 11515, 11517, 11520, 11523, 11528, 11535, 11545, 11549: Vegetative; 12.viii.2010; MMB 11530-11531, 11542-11544: Vegetative; 3.ix.2011; MMB 11516, 11522, 11527, 11540: Vegetative; 12.xii.2011; MMB 11529, 11525, 11532-11533, 11538: Vegetative; 7.i.2012; MMB 11510-11511, 11513-11514, 11524, 11526, 1136, 11539, 11546: Vegetative).

Local Distribution

Rakhine Coastal Region: No data; Ayeyawady Delta and Gulf of Martaban Coastal Region: Kyaikkhami; Tanintharyi Coastal Region: No data.

World Distribution

Ireland: Antrim, Wexford; Europe: Adriatic, Balearic Islands, Britain, Bulgaria, Corsica, France, Greece, Italy, Portugal, Romania, Spain, Turkey. Atlantic Islands: Bermuda; Canary Islands, Madeira, Salvage Islands. North America: Floria, Maine, Massachusetts, Mexico, North Carolian, Texas, Virginia. Caribbean Islands: Barbados, Cuba, Hispaniola, Jamaica, Lesser Antilles, Trinidad, Trinidad & Tobago. Africa: Angola, Egypt, Eritrea, Sudan, Ethiopia, Gabon, Gambia, Ghana, Liberia, Sao Tomè & Principe, Sierra Leone, Kenya, Mauritius, South Africa, Morocco, Senegal, Tunisia, Western Sahar. Indian Ocean Islands: Diego Garcia Atoll, Maldives, Reunion, Seychelles; South-west Asia: India; South-west Asia: India, Iran, Kuwait, Israel, Turkey (Asia); Asia: China, Japan, Korea, Taiwan; South-east Asia: Indonesia, Philippines, Vietnam; Australai and New Zealand: Australia, Lord Howe Island, New South Wales, Queensland, South Australia, Victoria, Western Australia. Pacific Island: Federated States of Micronesia, Fiji, Hawaiian Islands, Mariana Islands, Samon Archipelago; Antarctic and the Subantarctic Islands: Antarctica (as cited in Guiry and Guiry 2012).

Ecological Notes

Plants grow on the rocks of the interitdal zone and on the pneumatophores of mangroves. *Gelidium arenarium* and *Polysiphonia subtilissima* are associated algae of this species.

Potential Uses

Gelidium crinale (Hare ex Turner) Gaillon is utilized for agar production mostly in mixture with other raw materials (Levring 1969).

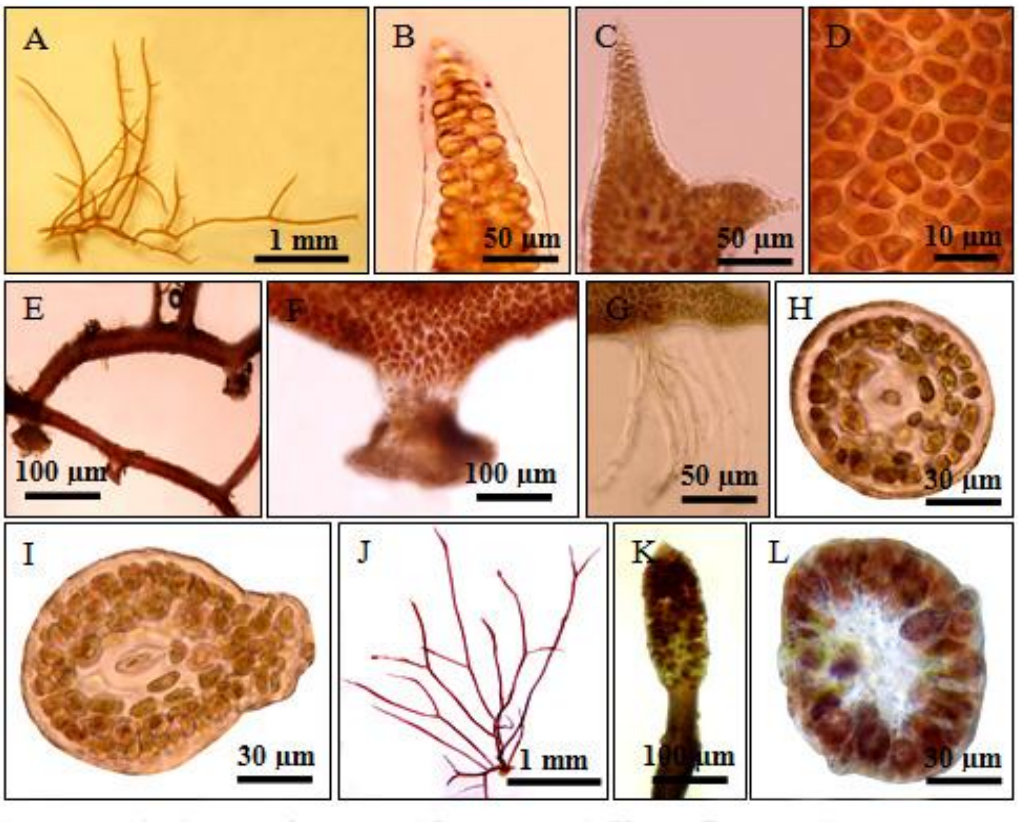

Figure3. *A-L.Morphology and anatomy of Gelidium crinale (Hare ex Turner) Gaillon: A. Vegetative plant; B-C. Apical cell; D. Surface view of cells; E. Prostrate; F-G. Rhizoidal holdfast; H-I. Transverse section of thallus; J. Tetrasporangial plant; K. Tetrasporangial stichidium; L. A transverse section of stichidium.*

Gelidium Crinale Var *Perpusillum*

Piccone & Grunow (Figure 4 A-G)

Reference

Dawson 1954: 421, fig. 31 e-f; Papenfuss 1968: 74; Buggeln and Tsuda 1969: 13; Cordero 1977: 72-73, fig. 49, pl. 25c; Aleem 1978: 91; Silva, Menez and Moe 1987: 26; Silva, Basson and Moe 1996; 138: Guiry and Guiry 2012.

Type Locality

Massawa, Eritrea, Ethiopia (Silva, Basson & Moe 1996: 138) (as cited in Guiry and Guiry 2012)

Type Unknown

Description: Vegetative Structure

Plants are small, 2-3 mm in high, red in colour, growing on the pneumatophores of mangroves and rocky at intertidal zone, erect branches are cylindrical, 80-150 µm broad, but often in curved and entangled, arise from creeping axes and acute at the ends. In surface view, cortical cells are irregulary arranged, polygonal in shape with rounded angles, to 4 µm broad. In cross section, the cortex has two to three layers of pigmented cells and the smaller form ovate or oblong in shape, 7-10 µm in diameter. The medullary cells are ovate or oblong in shape 7-12 µm in diameter. A small number of rhizines are formed in the medullary cells, 2-3 µm in diameter.

Reproductive Structure

Tetrasporangia stichidia, 200-550µm in length and 80-110µm in width.

Specimens Examined

Setsè (La Pyae Phyo Aung, 22.viii. 2010; MMB 10595; Moe Moe Aung, 22.viii.2010; MMB 10596; Thein Htaik Aung, 22.viii.2010; MMB 10597; Tin Htut Aung, 22.viii.2010; MMB 10598; Sai Thet Nay Min, 22.viii.2010; MMB 10599: Vegetative); Setse (Mya Kyawt Wai, 22.viii.2011; MMB 11547: Vegetative); Phu Pwint Zin, 7.i.2012; MMB 11512, 11529, 11534, 11541: Vegetative).

Local Distribution

Rakhine Coastal Region: No data; Ayeyawady Delta and Gulf of Martaban Coastal

Region: Setsè; Tanintharyi Coastal Region: No data.

World Distribution

Africa: Ethiopia; Indian Ocean Islands: Diego Garcia Atoll, South-east Asia: Indonesia, Phillippines. Australia and New Zealand: Queensland; Pacific Islands: Fiji (Guiry and Guiry 2012).

Ecological Note

This species is commonly attached to rocky substrate in intertidal zones. Vegetative or reproductive plants may be found in July to February. This species associate with *Polysiphonia* sp.

Potential Uses

The utilization of this species is unknown.

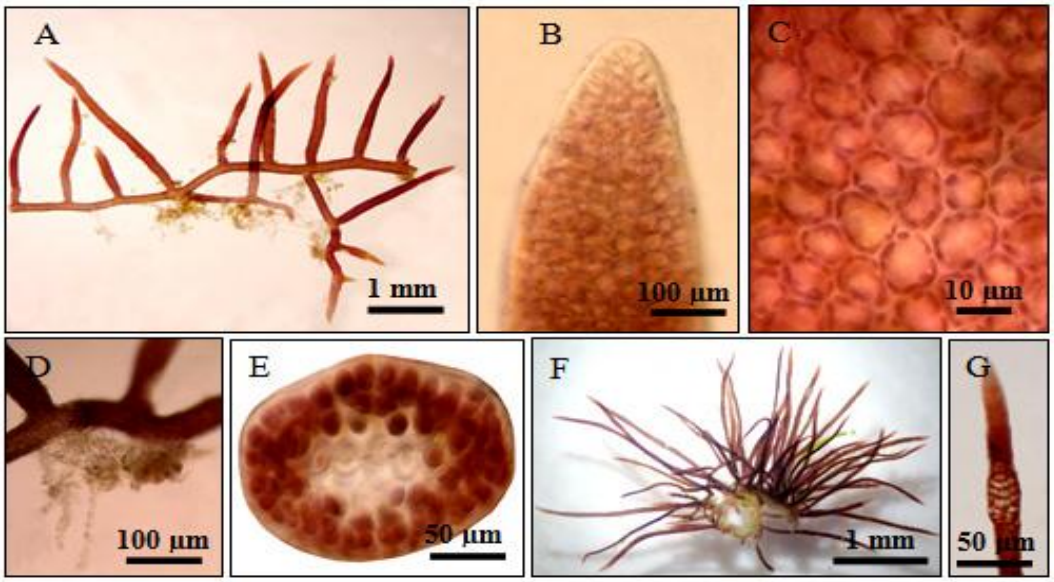

Figure4. *A-G. Morphology and anatomy of Gelidium crinale var. perpusillum Piccone & Grunow: A. Vegetative plant; B. Apical portion of plant; C. Surface view of cells; D. Rhizoidal holdfast; E. A transverse section of a thallus with rhizines; F. Tetrasporangial plant; G. A tetrasporangial stichidium.*

DISCUSSION

Santelices and Stewart[15] discussed the two genera of *Gelidium* and *Pterocladia* are the most diverse and easily confused on the basis of exteral morphology in the family Gelidiaceae and most species of two genera are similar in size and shape of sori. They also described that the most useful vegetative characters for separation of within these two genera such as branching patterns, axis dimension shape of the branchlets bearing the sori and number an arrangement of internal rhizoids, observed in transections of axes, could distinguish genera or species. Santelices[16] have suggested that two vegetative characters are useful: species of *Gelidium* have slightly apical cells in acute apices whereas the broad apices of *Pteroclaida* have apical cell in shallow apical notch. They also described cortical cells in surface view are rounded, irregular arrangement near the base of axes, slightly elongate in two species.

Moreover, Guiry[17] described the basic characters used in the identification on some genera of the order *Gelidiales.* According to his descriptions, presence of rhizines at the medulla, having bilocular cystocarp and being conical or brush-like holdfast are distinguished characters of the genus *Gelidum.* Taylor[18] described vegetative structure of *Gelidium* such as erect axis laterally branched, the branches firm, cylindrical or flattened the branches each developed from an apical cell, slender thick-walled filaments rhizines present in the axis. In present study, species of the *Gelidium* were identified

Table1. *A comparison of the main characteristics of each species of Gelidium from Kyaikkhami and Setse Coastal Areas.*

Species	Size of plants	Area	Branching	No. of layers of cortical cells	Fertile portions	Rhizoidal filament	Tetraspore
G. *arenarium* Kylin	1-4 mm	Membranes, sub cylindrical to compressed above	Some erect branch curved at the aprical part	Two to three	-	Scatter in the medulla areas	-
G. *crinale* (Hare ex Tumer) Gaillon	0.8-2 Cm	Cylindrical below, Sub cylindrical above	Irregularly alternate, sparsely dichotomo us and acute at the ends	Three	At the end of erect branches	Abundantly located in the medulla areas	Irregularly ovoid, 10-30µm in diameter
G. *crinale* var. *perpusillum* piccone & Grunow	2-3 mm	Cylindrical below, subcylindrical above	Unbranched at the upper parts and blunt or pointed at apex	Two to three	Near at the end of erect branches	Formed in the medulla areas	Ovoid or lanceolate

Table2. *The distributional range of Gelidium spp. along the coastal zones of Myanmar*

Sr. No	Species	TCZ		DCZ		RCZ	
		From	To	From	To	From	To
1	G. *arenarium* Kylin	Kisseraing I. Lat. 11° 40’ N, Long. 98° 28’E	Zeaphyu ThaungLat. 15° 20’N, Long. 97° 50’E	Kyaikhami Lat. 16° 05’N, Long. 97° 34’E	No data	Mawtin Point Lat, 15° 57’N, Long. 94° 14’E	Kyauk phyu Lat. 19° 05’N, Long. 93° 31’E
2	G. *crinale* (Hare ex Tumer) Gaillon	No data	No data	Kyaikhami Lat. 16° 05’N, Long. 97° 34’E	No data	No data	No data
3	G. *crinale* var. *perpusillum*	No data	No data	Sets Lat. 15° 52’N, Long. 97° 35’E	No data	No data	No data

Abbreviations: *TCZ= The Taninthayi Coastal Zone; DCZ= The Deltaic Coastal Zone; RCZ= The Rakhine Coastal Zone*

based on vegetative characters such as shape of axes, type of holdfast, consisting of colourless rhizines at the medulla, and reproductive structure viz., shape of tetrasporangia stichidia, arrangement of tetrasporangia.

Larger plants up to 2 cm high, is found in *Gelidium crinale* whereas the small sizes of the plants can be observed in *G. arenarium*, 1-4 mm high, and *G. crinale* var. *perpusilum*, 2-3 mm high. In *G. arenarium* Kylin, membranous subcylindrical to compressed and irregularly branched erect axes arise from creeping branches. The cortices are composed of two to three layers of cells. The prostrate branches are cylindrical. In *G. crinale* var. *perpusillum*, growing on the pneumatophores, attached a small disc-like with cylindrical creeping branches, branched acute at the apical portions. The small amount of colourless rhizoidal filament occurs at the medulla of *G. arenarium* and *G. crinale* var. *perpusillum*. Plant of *G. crinale* (Hare ex Turner) Gaillon, main axis composed of three layers of cortical cells, polygonal cortex of apical cell in surface view. The colourless rhizines are abundant in the medulla. In addition the comparison of the main characteristics of *G.arenarium* Kylin, *G.crinale* (Hare ex Turner) Gaillon and *G.crinale* var. *perpusillum* Piccone & Grunow were shown in Table 1.

Although Lee[19] described the erect axes of *G. crinale* from Korea which were cylindrical and without branches below, unusually branched erect axes at the lower part of the plants were found in present study. In addition, the cortex of the *G. crinale* from Korea were composed of five layers of cells while the cortex of *G. crinale* showed three layers of cells in this study. Lee and Kim[20] discussed the *G. crinale* and *G. pusillum*, erect thalli, the lower fronds of without branches, and mainly cylindrical fronds.However, differences between the two species in internal structures. They reported *G. pusillum* and *Gelidium crinale* is widely from Kwangyang Bay on the southern coast.

In *G. crinale*, the abundance of rhizines at the medulla agrees well with the description of Dawson[21]. Rodriguez and Santelices [22] described the two species of *Gelidium* from the coast of central Chile, differences in apical portions of *Gelidium* and *Pterocladia*. They also discussed the position of the initial apical cell with respect to the cortical cells and shape, type of division, position of the initial cells of lateral branches and cortical cells. The small amount of rhizines occurs at the medulla of *G. crinale* var. *perpusillum* in the present study.

The plants of *G. crinale* and *G. crinale* var. *perpusillum* examined in this study showed the tetrasporangial stichidia form on ultimate branches in two species. The plant of the *G. arenarium* examined in this study showed only the vegetative characters. In Myanmar Kyi Win[8] listed the genus *Gelidium* such as *G. arenarium.* Hlaing Hlaing Htoon[23] reported the marine algae from Setsè Coastal Areas and described the two species of *Gelidium* such as *G. pusillum* (Stackhouse) Le Jolis and *G. sp*. 1. Soe-Htun *et al.*[24] reported the *G. arenarium* Kylin distribute the three Coastal Regions of Myanmar.

Reine and Trono[25] discussed the *Gelidium* are distributed worldwide and are even found in cold temperate areas a far apart as the Falklands and south-western Norway. They also described *G. crinale* is found in all tropical and subtropical waters including those around Thailand, Malaysia, Vietnam, Philippines and Indonesia. *G. arenarium* is distributed along the western parts of Indian and Pacific Oceans. *G. cinale* var. *perpusillum* mainly distributes in Indo-Pacific Region, western coast of Indian and Pacific Oceans. In addition, *G. arenarium* distributes from China, the northern limit of distribution to South Africa the southern limit of distribution along the tropical and subtropical regions. Moreover, *G. crinale* var. *perpusillum* distributes from Ethiopia as the northern limit to New Zealand as the southern limit in the tropical and subtropical regions.

In local distribution, *G. arenarium* occurs along the 3 Coastal Regions of Myanmar and *G. crinale* and *G. crinale* var. *perpusillum* are found only along the Ayeyawady Delta and Gulf of Martaban Coastal Region. Figure 1 and Table 2 show the distribution of *G.arenarium* Kylin, *G.crinale* (Hare ex Turner) Gaillon and *G.crinale* var. *perpusillum* Piccone & Grunow along Myanmar coastal regions. The present study revealed that the species of *G.arenarium* Kylin distributes in the Rakhine Coastal Region, the Ayeyarwady Delta and Gulf of Martaban Coastal Region and Tanintharyi Coastal Region. The species of *G.crinale* (Hare ex Turner) Gaillon distributes only in the Ayeyarwady Delta and Gulf of Martaban Coastal Region, from Kyaikkhami (Lat. 16° 05'N and Long. 97° 34'E). The species of *G.crinale* var. *perpusillum* Piccone & Grunow distributes only in the

Ayeyarwady Delta and Gulf of Martaban Coastal Region, from Setsè (Lat. 15° 52' N and Long 97° 35' E).

In the present study, *G. arenarium* Kylin is widely distributed in tropical and temperate coasts of Atlantic Ocean, Indian Ocean, and Pacific Ocean. The distribution range of *G. arenarium* Kylin is from Iran as the northernmost recorded limit in the Atlantic Ocean. In general, this species mainly dominates in the Atlantic Ocean. *G. crinale* (Hare ex Turner) Gaillon is widely distributed in tropical and temperate coast of Atlantic Ocean, Indian Ocean, and pacific Ocean.The distribution range of *G. crinale* (Hare ex Turner) Gaillon is from Europe as the northernmost recorded limit in the Atlantic Ocean to New Zealand as the southernmost recorded limit in the Pacific Ocean. In general this species mainly dominates in the Pacific Ocean. Moreover, *G. crinale* var. *perpusillum* Piccone& Grunow is widely distributed in tropical and subtropical coast of Atlantic Ocean, Indian Ocean and Pacific Ocean. The distribution range of *G. crinale* var. *perpusillum* Piccone & Grunow is from Myanmar as the northernmost recorded limit in the Indian Ocean to the New Zealand as the southernmost recorded limit in the Pacific Ocean.

CONCLUSION

A total of three species of *Gelidum* such as *G. arenarium* Kylin, *G. crinale* (Hare ex Turner) Gaillon and *G. crinale* var. *perpusillum* Piccone and Grunow were identified from Kyaikkhami (Lat 16° 05′ N, Long 97° 34′ E) and Setse (Lat 15° 52′ N, Long. 97° 35′ E) coastal areas of Mon State. All of these species belong to the genus *Gelidium*, belonging of the family of *Gelidiaceae*, under the order of *Gelidiales*.

Gelidium arenarium Kylin identified by small size of plants, erect axes arising from creeping parts, membranous, subcylindrical to compressed axes, some branches are curved at the apical parts. The later two species of *G. crinale* (Hare ex Turner) Gaillon and *G. crinale* var. *perpusillum* Piccone & Grunow had cylindrical to subcylindrical erect axes arising from creeping parts. The plants of *G. crinale* (Hare ex Turner) Gaillon were up to 2 cm high, prostrate axes forming wiry composed of cylindrical, consist the massive rhizodal holdfast. Erect branches irregularly alternate and sparse dichotomous branching.

The plant of *G. crinale* var. *perpusillum* Piccone & Grunow were up to 3 mm high. Erects axes are the same of *G.crinale* (Hare ex Turner). Erect axes are unbranched at the upper parts and disc-like organ with cylindrical creeping branched fibres. Tetrasporangial stichidia placed at the apical portion of the plant branches. *G crinale* (Hare ex Turner) Gaillon of tetrasporangial stichidia replaced near the apical parts of the branches.

In summary, *G. arenarium* Kylin distributed along the Rakhine Coastal Region: Kyauk Phyu, Ngapali, Gwa Aw, Shwe Ya Gyaing, Mawtin Point; Kyauk La Yaine Gyaing; Ayeyarwady Delta and Gulf of Martaban Coastal Region: Kyaikkhami, Tanintharyi Coastal Region: - Zeaphyuthaung, Kalagoke I., Sanhalann, Maungmagan, Thamila I. Kannedy I., Kisseraing I. *G. crinale* (Hare ex Turner) Gaillon and *G. crinale* var. *perpusillum* Piccone & Grunow were distributed only in the Ayeyarwady Delta and Gulf of Martaban Coastal Region.

Gelidium arenarium Kylin was distributed Africa, South Africa and Asia. *Gelidum crinale* (Hare ex Turner) was recorded Ireland; Europe; Atlantic Islands. North America; Caribbean Islands; Western Atlantic, South America; Africa; Indian Ocean Islands; South-west Asia, Asia, South-east Asia, Australia and New Zealand and Pacific Islands. *G. crinale* var. *perpusillum* are distributed in Indian Ocean Islands; South-east Asia; Australia and New Zealand; Pacific Islands except Atlantic Ocean.

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