

The Morphology and Distribution of *Halymenia durvillei* Bory de Saint-Vincent (Halymeniales, Rhodophyta) from Myanmar

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ABSTRACT

The genus *Halymenia* collected from three coastal zones of Myanmar: Tanintharyi coastal zone, Ayeyawady Deltaic coastal zone and Rakhine coastal zone, and lodged in the herbarium of the Department of Marine Science, Mawlamyine University, has been identified as *Halymenia durvillei* Bory de Saint-Vincent, based on the external and internal morphologies of the vegetative and reproductive structures. The species of *H. durvillei* Bory de Saint-Vincent was encountered in the Rakhine and Tanintharyi coastal zones whereas not found in the Ayeyawady Delta and the Gulf of Mottama (Martaban) coastal zone. The photogeographical distribution range of *H. durvillei* Bory de Saint-Vincent is mostly dominates in India, Pacific Oceans and Indo-Pacific regions. But *H. durvillei* are rarely found in the Atlantic Ocean. Moreover, some ecological notes and potential uses of this species were briefly described.

Keywords: Halymeniales, *Halymenia durvillei*, Myanmar, Rhodophyta, morphology.

INTRODUCTION

The first description of the genus *Halymenia* was established by C. Agardh in 1817. Traditionally *Halymenia* has been classified in the family Halymeniaceae, one of several families belonging to the large order Cryptonemiales. And then the order of Cryptonemiales was transferred to the Halymeniales¹.

The red algal genus *Halymenia* C. Agardh, comprising 69 currently accepted species, is one of the largest genera in terms of species within the family Halymeniaceae^{2,3}. It is mostly distributed in tropical and subtropical regions^{4,5}. The genus is mainly characterized by a lubricous texture, a lax medulla with predominantly anticlinally oriented filaments connecting cortex to cortex, the presence of refractive ganglionic cells, and somewhat flattened and expanded auxillary cell ampullae with branched secondary filaments^{6,7,8,9,10,11}.

Halymenia durvillei is one of the commonest *Halymenia* species found along the Southeastern Asian Coasts. This alga was first described by Bory de Saint-Vincent (1828) from New Zreland, Papua New Guinea and has been reported from various locates around the Pacific

and the Indian Oceans¹². *H. durvillei* is characterized by its comparatively dark red color, robust blades with non gelatinous texture, toothed margin besides repeatedly branched blades¹³. Recently, based on the study of the type material and many other plants of *Halymenia durvillei* from the Philippines, De Smedt et al.² reported that the type material of *H. microcarpa* and *H. venusta* had no differences that warrant recognition on the species level, and concluded that they are both conspecific with *H. durvillei*.

In Myanmar, Kyaw Soe and Kyi Win¹⁴ described 9 species of genus *Halymenia*; *Halymenia durvillei* Bory. Var. *Ceylonia* (Kutz) Wever, *Halymenia dilatata* Zanardini, *Halymenia latifolia* (or) *Grateloupia elliptica* Holmes, *Halymenia harveyana* J. Agardh (*H. floresia* Agardh), *Halymenia porphyroides* Boerg (*Callymenia harveyana* J. Ag.), *Halymenia acuminata* (Holmes) Agardh, *Halymenia* sp. I, sp. II, sp. III. Mya Kyawt Wai et al.¹⁵ reported marine algae of Mazin coastal area, Thandwe Township, Rakhine state and enumerated *H. durvillei*. And then Soe-Htun et al.¹⁶ recorded *H. durvillei* and *H. dilatata* from Gwa Aw, Rakhine coastal area. Subsequently, Khit Latt Dwe¹⁷ had also listed *H. durvillei* from

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Magyi, Rakhine coastal area. In this study, *H. durvillei* occurred in the distribution range of the Rakhine coastal area and Tanintharyi coastal area.

The objectives of this study are: 1) to know detailed morphological of vegetative and reproductive structures used for identification in the taxonomy, 2) to study potential used and some ecological features and 3) the distribution ranges of this species growing along both the three coastal zones of Myanmar and the coastal areas of the world.

MATERIALS AND METHODS

The algae of the genus *Halymenia* C. Agardh 1817 were collected from coastal zone of Myanmar, and deposited in the herbarium of Department of Marine Science, Mawlamyine University, Myanmar (MMB). The fresh specimens were preserved in 4% formaldehyde-seawater and mounted on the herbarium sheets. From this herbarium and liquid-preserved specimens were used for detailed investigations emphasized on the vegetative of external, internal structures and reproductive features. For anatomical studies, small portions of specimen dissected from the herbarium were prepared for microscopic observations. This study of taxonomic followed the classification system used by Silva Menez and Moe¹⁸; Lewmonomont and Ogawa¹⁹; Abbott²⁰; De Smedt et al.²; Kawaguchi²¹ and Guiry and Guiry²². Photogeographical distribution and potential uses of this species were recorded from the literature available.

RESULTS

Classification System of the Genus *Halymenia*

Phylum : Rhodophyta
Class : Florideophyceae
Order : Halymeniales G. W. Saunders & G. T. Kraft
Family : Halymeniaceae Bory
Genus : *Halymenia* C. Agardh
Species : *H. durvillei* Bory de Saint-Vincent

Description of *Halymenia durvillei* Bory de Saint-Vincent

Halymenia durvillei (Figures 2-23)

References. Cordero 1977: 111, fig. 86, pl. XVII; Kyaw Soe & Kyi Win 1977: 116, fig. 202; Silva Menez and Moe 1987: 30; Lewmanomont and Ogawa 1995: 121; Abbott 1999: 165, figs. 1-4; De Smedt et al. 2001: 297, figs. 1-6; Shigeo Kawaguchi 2006: 201- 208, figs. 1-29; Coppejans et al. 2009: 192, figs. 38C, 39D, 41D, 161; Soe-Htun et al. 2009: 186; Mya Kyaw Wai et al. 2009: 10, fig. 22; Khit Latt Dwe 2014: 108-110, figs. 93-94; Guiry and Guiry 2017.

Synonyms: No synonyms

Type locality. New Ireland, Papua New Guinea²²

Type. *Halymenia floresii* (Clemente) C. Agardh²²

Description. Vegetative structure:

External features: Thallus epilithic, erect, up to 11 cm long, 4 cm wide; dark pink to red in colour; branched up to 7 orders; central axis if present flattened and blade-like erect blades are repeatedly subdichotomously branched, gradually tapering towards the tips and stipe 7 mm long. Branching is profuse and irregular, mostly occurring marginally, with secondary axes arising as proliferations on the surface of the primary axes. Numerous short lateral branchlets are formed from the margins of the branches. The branches and the branchlets are beset with spine-like proliferations along the margins and on the surfaces; *H. durvillei* has a very smooth and soft feel, contorted texture or supple cartilaginous structure and very slippery to the touch.

Internal features: Cell in surface view scutate or ellipsoidal and about 8 µm in diameter. In transverse section, the cortex 50-70 µm thick with 6-7 cells forming; an outer cortex 4-5 cell layers and an inner cortex 2-3 cell layers; outer cortex cells subspherical to elongated, 8-13 µm long (like rabbit ears) in cross section; inner cortical cells rounded to stellate, 11-16 µm in diameter, polygonal to stellate cells connected to each other by secondary pit-connections; medulla greater than 200 µm thick, medullary filaments are mainly running periclinally or obliquely from cortex to cortex; refractive ganglionic cells relatively abundant, irregularly shaped, arms branched and connected with each other under the inner cortex, about 6 arms.

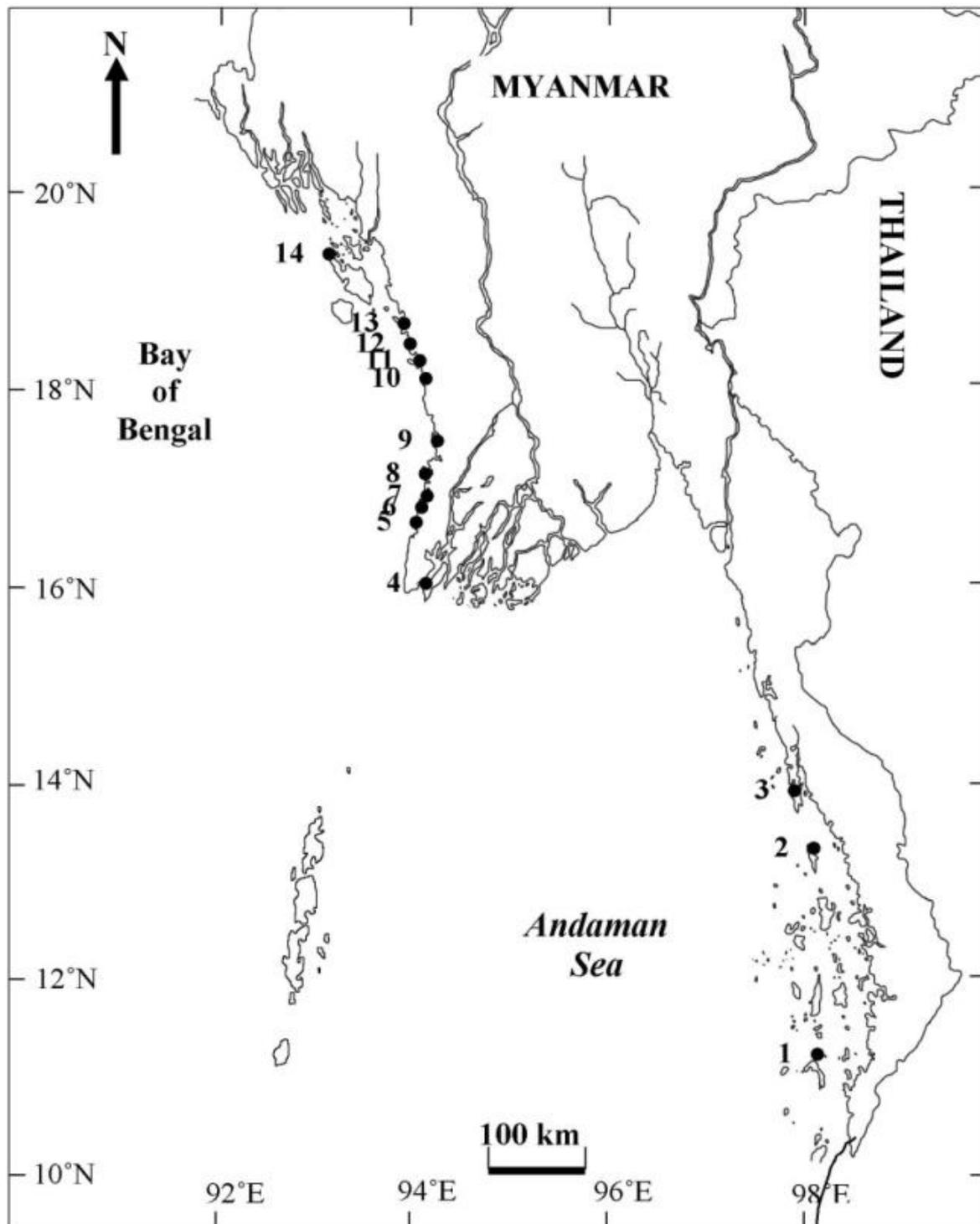


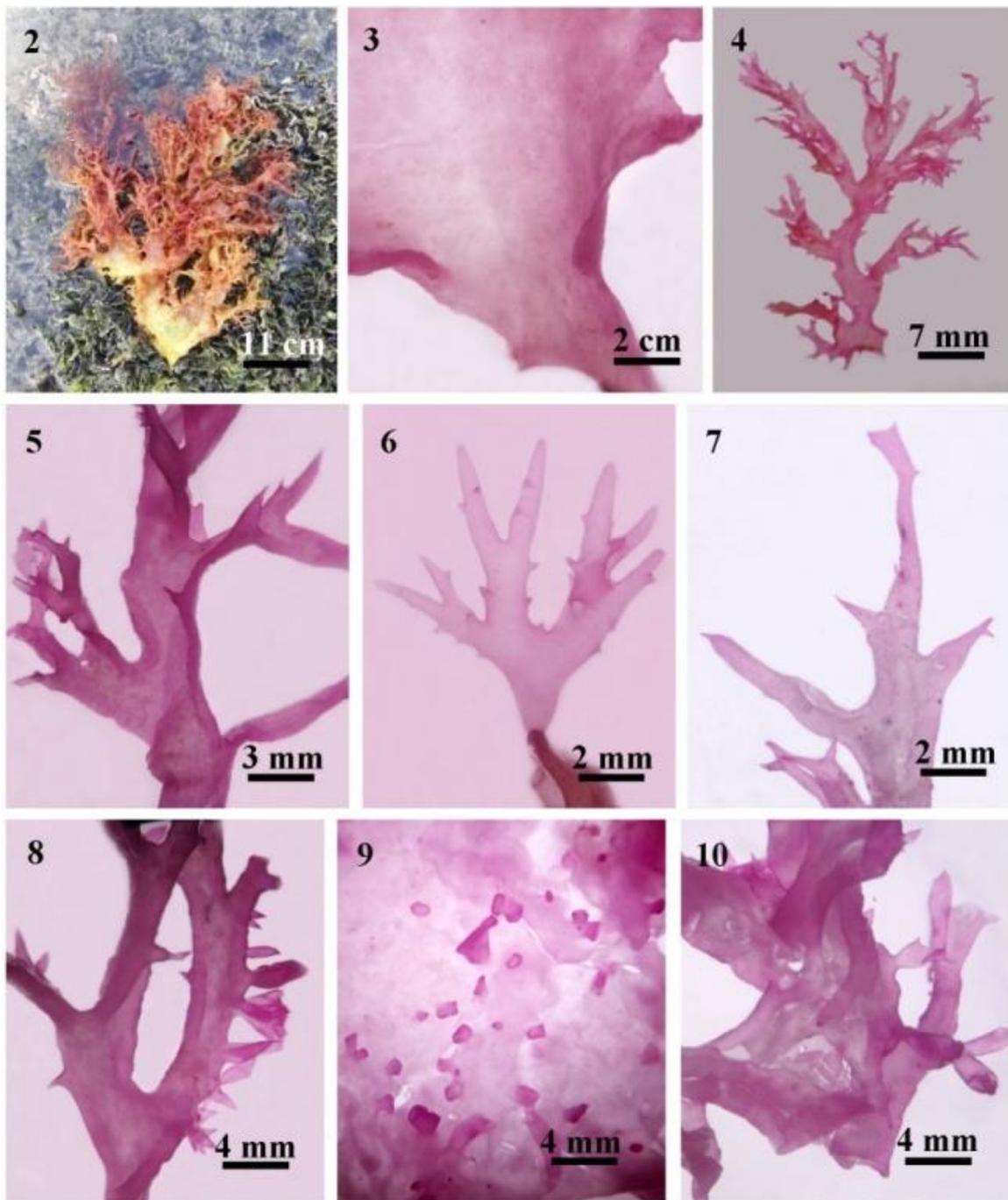
Figure 1. Map showing the collection sites of *Halymenia durvillei* Bory de Saint-Vincent (according to herbarium and liquid specimens) along the coastal zones of Myanmar. 1. High I., 2. Mali I., 3. Wa Maw, 4. Leik I., 5. Phoe Kalar I., 6. Chaungtha, 7. Magyi, 8. Wetthey, 9. Gwa, 10. Maungshwelay Gyaing, 11. Gyeik Taw, 12. Ngapali, 13. Mazin, 14. Kyauk Phyu.

Reproductive structure. Tetrasporangia are cut off from the cortical cells in the third or fourth layer from the surface. Tetrasporophytes tend to have more orders of branches. Mature tetrasporangia are broadly ellipsoidal in shape, 18 μm long and 13 μm wide, cruciately or decussately divided. Auxillary cells are formed in the bottom of cup-shaped ampullae branched

to the third order. Early post-fertilization events were not clarified, but connecting filaments in contact with auxiliary cells were frequently observed. Gametophyte and spermatangia plants are not occurred.

Ecological notes. Plants grow at the lower intertidal zone.

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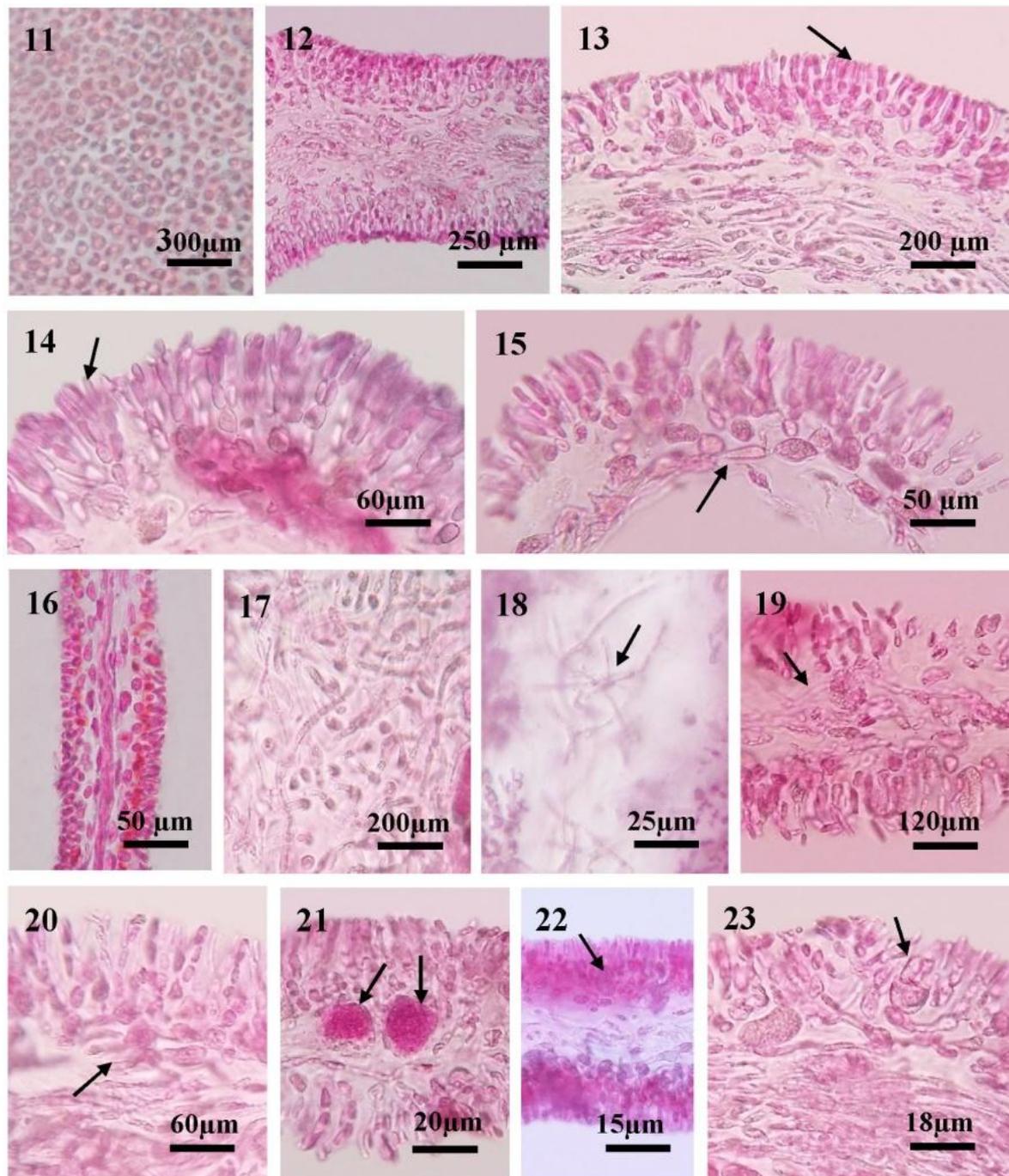


Figures 2-10. The external and internal structures of *Halymenia durvillei* Bory de Saint-Vincent (Liquid specimen). 2) Habit of tetrasporophyte plant; 3) Flattened and bladelike erect blade of a plant; 4) Part of a plant; 5) Thallus showing repeatedly subdichotomous branching; 6) One of a small branch; 7) Apical portion of a plant gradually tapering towards the tips; 8) Lateral pinnate branchlets; 9) Short spines on the surface; 10) Contorted texture or supple cartilaginous structure.

Specimens examined. Rakhine coastal zone - Leik I. (Botany Department, Mawlamyine University, 23.iv.1969; MMB 07401), Phoekalar I. (Ni Ni Win, 1.iv.1996; MMB 03159; Htun Naing Win, 1.iv.1996; MMB 03226), Chaung Tha (San San Win, 1.iv.1996; MMB 03230), Magyi (Khit Latt Dwe, 28.ii.2014; MSP0665, MSP 0666), Wethey (Myo Nanda Htut, 4.iv.1996; MMB 03253; Ni Ni Win, 3.iv.1996; MMB 03257, MMB 07443,

MMB 03254, MMB 07404, MMB 07402, MMB 07403, MMB 03419, MMB 07442, MMB 03437; Kyaw Than, 3.iv.1996; MMB 03321; Aung Cho Oo, 3.iv.1996; MMB 03110; Soe Min Aung, 3.iv.1996; MMB 03105; Thuya Tun, 3.iv.1996; MMB 03238, MMB 03241; Mya Han Aye, 3.iv.1996; MMB 07427; Mya Phone Wynn, 3.iv.1996; MMB 07476; Kyaw Htun Lin, 3.iv.1996; MMB 03271; Thandar

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Figures 11-23. The external and internal structures of *Halymenia durvillei* Bory de Saint-Vincent (Liquid specimen). 11) Surface view of a branch; 12) Transverse section of thallus; 13) Cross section shows arrangement of cortical cells (arrow); 14) Highly elongated of the outermost cortical cells (like-rabbit ear) (arrow); 15) the inner cortex layer with polygonal to stellate cells connected to each other by secondary pit-connections (arrow); 16) Longitudinal section of a branch; 17) Cross-section showing predominant periclinally or obliquely arrangement of medullary filaments from cortex to cortex; 18) Refractive ganglionic cells irregularly shaped, arms branched (arrow); 19) Incoming connecting filament attached to auxillary cell (arrow); 20) Auxillary cell-ampullae with involucreal auxillary cell-filaments (arrow); 21) Gland cell in the cortex (arrow); 22) Tetrasporangia cut off from the cortical cells in the third or fourth layer from the surface (arrow); 23) Ellipsoidal in shape of mature tetrasporangia (arrow).

Hlaing, 3.iv.1996; MMB 03116; Mie Mie Tun, 3.iv.1996; MMB 03315; Than Aung, 3.iv.1996; MMB 07430; Hsan Htoon, 4.iv.1996; MMB 03150; Soe Myo Set, 4.iv.1996; MMB 07399; San Nyunt Tun, 4.iv.1996; MMB 07432),

Maung Shwe Lay Gyaing (Dr. Min Thein, 8.v.1979; MMB 07438; S.T 45, 27.v.1980; MMB 07412; Soe Htun, 27.i.1983; MMB 07405, MMB 07406, MMB 07450, MMB 07452,

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Table 1. A comparison of main characteristics of *Halymenia durvillei* Bory de Saint-Vincent growing in different localities.

<i>Halymenia durvillei</i> Bory de Saint-Vincent			
Characters	Myanmar	Philippine ²	Western Pacific ²⁰
I: Vegetative Structures:			
(i) External structures			
Blade shape	Branched	Branched	Branched
Orders of branching	Up to 7 orders	Up to 7 orders	3 to 4 orders
Texture	supple cartilaginous structure	Cartilaginous and mucilaginous	-
Margin	Dentate and lacinate	Dentate and lacinate	-
Spines or leaflets on margin	Present	Present	-
Maculae on surface	Present	Present	-
Spines on surface	Abundant	Abundant	Rarely
Axis shape	Tapering toward the apex	Tapering toward the apex	Abruptly at apices
Axis width (mm)	> 15	15-20	-
Colour	Pink to dark	Dark pink	-
Stipe shape	Unbranched	Unbranched	-
Surface	Smooth	Smooth	Slippery
Stipe size (mm long)	7	5	-
(ii) Internal structures			
Shape of cells in outer cortex	subspherical to elongated	Elongated	Elongated
Shape of cells in inner cortex	rounded to stellate	Elongated parallel	-
Thickness of cortex (µm)	50-70	70-150	60-80
Number of cells in cortex	6-7	4-7	4-6
Medulla thickness	150	248-494	-
Refractive ganglionic cells	Present	Abundant	Present
Arms	6	6-7	4-6
II. Reproductive Structures:			
Tetrasporangia size (µm)	18l/13w	17l/14w	20l/8w
Carpospore size (µm)	No Data	12	250-270w
Spermatangia (µm)	No Data	No Data	No Data

MMB 07458, MMB 07459, MMB 07463, MMB 07464, MMB 07468, MMB 07471, MMB 07472, MMB 07473, MMB 07474, MMB 07475, MMB 07454, MMB 07451, MMB 07456, MMB 07400; ST, KL & KM, 27.i.1983; MMB 07439, MMB 07447, MMB 07453, MMB 07457, MMB 07466, MMB 07470, MMB 07482; Soe Htun & Ko Lay, 27.i.1983; MMB 07462; Win Maw, 6.iv.2004; MMB 07480), Gwa (U.A.M, 28.x.1970; MMB 07460), Gyeik Taw (KKL, 18.iv.1967; MMB 07414, MMB 07416, MMB 07418, MMB 07419, MMB 07433, MMB 07435), Ngapali (U.A.M, 14.iv.1969; MMB 07434, MMB 07444, MMB 0767; Botany Department, Mawlamyine University, 14.iv.1969; MMB 07445; Botany

Department, Mawlamyine University, 20.iv.1970; MMB 07429, MMB 07413, MMB 07477; Dr. Kyaw Soe, 16.v.1970; MMB 07479; U.A.M, 25.x.1970; MMB 07425; U.A.M, 18.iii.1973; MMB 07455; Botany Department, Mawlamyine University, 18.iii.1973; MMB 07408, MMB 07424, MMB 07428; Aung Myint, 28.iii.1977; MMB 07478; Aung Myint, 28.i.1977; MMB 07481), Mazin (Clister Min, 29.iii.1967; MMB 07448; Tin Win, 30.iv.1984; MMB 02732; San Tha Tun, 18.iii.1987; MMB 07398), Kyauk Phyu (Botany Department, Mawlamyine University, 29.x. 1970; MMB 07417; Phyu Tun Aung, 22.ii.1975; MMB 07420; L.L.W, 25.ii.1987; MMB

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Table 2. The distributional range of *Halymenia durvillei* Bory de Saint- Vincent collected along the three coastal zones of Myanmar.

Sr. No.	Species	RCZ		ACZ		TCZ	
		From	To	From	To	From	To
1.	<i>Halymenia durvillei</i> Bory de Saint-Vincent	Leik Island Lat. 15° 51' N and Long. 94° 17' E	Kyauk Phyu Lat. 19° 43' N and Long. 93° 55' E	No data	No data	High Island Lat. 11° 01' N and Long. 98° 17' E	Wa Maw Lat. 13° 35' N and Long. 98° 08' E

Abbreviations: RCZ= Rakhine Coastal Zone; ACZ= Ayeyawady Coastal Zone; TCZ= Tanintharyi Coastal Zone.

07449); Ayeyawady Delta and Gulf of Martaban coastal zone - No data; Tanintharyi coastal zone - High I. (Botany Department, Mawlamyine University, 7.ii.1972; MMB 07446), Mali I. (Soe Htun, 18.i.2002; MMB 07387, MMB 07389, MMB 07390, MMB 07391, MMB 07393, MMB 07394, MMB 07397; 19.i.2002; MMB 07386, MMB 07392), Wa Maw (Htet Htar Hlaing, drift, 26.ii.2017; MMB 111917, 111918, 111919).

Local distribution. Rakhine coastal zone- Leik I., Phoe Kalar I., Chaungtha, Magyi, Wettthey, Maungshwelay Gyaing, Gwa, Gyeik Taw, Ngapali, Mazin, Kyauk Phyu; Ayeyawady Delta and Gulf of Martaban coastal zone- No Data; Tanintharyi coastal zone- High I., Mali I., Wa Maw.

World distribution. Atlantic Ocean- Africa: Kenya, South Africa, Tanzania, Yemen; Indian Ocean- India, Sri Lanka, Myanmar (Present study), Andaman Islands; Pacific Ocean- American Samoa, Republic of Palau, Taiwan, South China Sea, Mariana Islands, Federated States of Micronesia, Papua New Guinea, Guam, Solomon Islands, Samoa, Central Polynesia, Western Australia, Queensland, Fiji, Samoan Archipelago, Western Pacific; Indo-pacific Region- Indonesia, Singapore, Malaysia, Thailand, Philippine, Japan²².

Potential Uses. *Halymenia durvillei* can be used as human foods, fish meal, manure, drugs, fodder, organic fertilizer, alginates, agar and carrageenan¹⁶. *Halymenia durvillei*' red or violet-red color is due to the accessory pigment phycoerythrin, used as a natural coloring in cosmetics, pharmaceuticals and food (USAID, STRIDE).

DISCUSSION

The first study addressing the diversity of *Halymenia* using gene sequence data (rbcL; Kawaguchi et al.²¹) confirmed the conclusions from De Smedt et al.². The analyses of Kawaguchi et al.²¹ included specimens from Indonesia, Japan, Malaysia and Thailand that, based on morphological features, would be classified as *H. durvillei* sensu De Smedt et al.². *H. durvillei* Bory de Saint-Vincent, is sometimes very variable (branching pattern, blade width or degree of dentation) and confusing the classification system of its morphology because no special differences were found in their vegetative and reproductive structures.

Normally, the characteristics of the *Halymenia durvillei* Bory de Saint-Vincent are erect blade, subdichotomously branched, lateral branchlets and short spines from the margins or on the surface. The blade consists of a comparatively dense medulla and a compact cortex; the medullary filaments are mainly running vertically or obliquely from cortex to cortex. In Myanmar specimens of *H. durvillei* are thallus epilithic, erect, up to 11 cm long, 4 cm wide; dark pink to red in colour; branched up to 7 orders; central axis if present flattened and blade-like erect blades are repeatedly subdichotomously branched, gradually tapering towards the tips and stipe 7 mm long.

Branching is profuse and irregular, mostly occurring marginally, with secondary axes arising as proliferations on the surface of the primary axes. Numerous short lateral branchlets are formed from the margins of the branches. The branches and the branchlets are beset with spine-like proliferations along the margins and on the surfaces. *H. durvillei* has a very smooth and soft feel, contorted texture or supple cartilaginous structure and very slippery to the touch.

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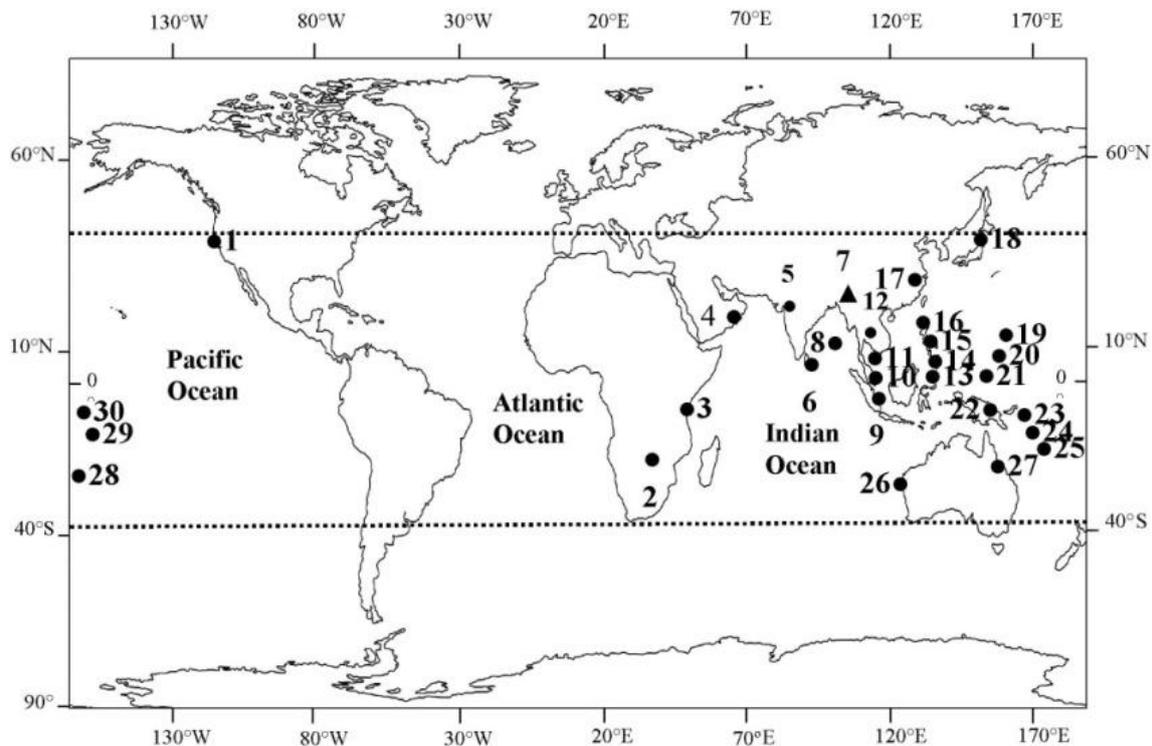


Figure 24. Map showing the worldwide distribution of *Halymenia durvillei* Bory de Saint-Vincent: 1. American Samoa, 2. South Africa, 3. Tanzania, 4. Yemen, 5. India, 6. Srilanka, 7. Myanmar (Present study), 8. Andaman Islands, 9. Indonesia, 10. Singapore, 11. Malaysia, 12. Thailand, 13. Philippines, 14. Republic of Palau, 15. Kenya, 16. Taiwan, 17. South China Sea, 18. Japan, 19. Mariana Islands, 20. Federated States of Micronesia, 21. Papua New Guinea, 22. Guam, 23. Solomon Islands, 24. Somoa, 25. Central Polynesia, 26. Western Australia, 27. Queensland, 28. Fiji, 29. Samoan Archipelago. 30. Western Pacific²².

Symbols; ▲ Present study; ● Data from the literature; -----Northernmost and Southernmost recorded limits.

The description of De Smedt et al.² specifics the presence of a high branching pattern (up to seventh order) and a thick cortex (50-100 μm) for *H. durvillei*; these characteristics are shared with the specimens in the present study branching up to seventh order and 50-70 μm cortex thickness. The branched plants of *Halymenia durvillei* collected from Wa Maw showed that the branching varied greatly from plants having a percurrent axis with pinnately or distichously arranged laterals to those with repeatedly dichotomously or subdichotomously branched blades. On the contrary, no special differences were found in their vegetative and reproductive features. This fact suggests that these plants may all belong to a single species and that the wide external variations found among them be growth forms in different environmental conditions.

Additionally, Kawaguchi et al.²¹ reported that the morphological and molecular phylogenetic studies of *H. durvillei* from Indo-Pacific. The cortex consists of an outer layer of 3 or 4 rounded cells tightly packed in vertical rows and an inner layer of 3 or 4 larger, polygonal to

stellate cells connected to each other by secondary pit-connections (measured from Japan, Philippine, Malaysia, Thailand and Indonesia). Since all previously and newly sequenced specimens share the same thickness of the cortex and characteristics of secondary pit-connection of *H. durvillei* in the present study. And then in this study, he clarified the range of morphological variations of *Halymenia durvillei* and its taxonomic relationships with the allied taxa.

In the present study, mature tetrasporangia are broadly ellipsoidal in shape, 18 μm long and 13 μm wide. According to De Smedt et al.² the tetrasporangia are decussately divided, 17 μm long and 14 μm wide so that the comparison of the present study are nearly overlapped of the tetrasporangia shape. The Western Pacific specimens by Isabella A. Abbott²⁰ described the blade bearing dense third- and fourth-order branches, outer cortex 2-celled, the outermost part 2-3 cells thick and without conspicuous stellate filaments joining to outer medullary filaments. Tetrasporangia were about 20 μm long and 8 μm wide. There is a little

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differentiates occurring between the present study and in this result paper. The analysis to establish diagnostic characteristics for morphological identification many of the measurements and features were studied by only one species and compared with the specimens of other countries such as Myanmar, Philippine and Western Pacific (Table 1).

In the study of the genus from the Philippines, however, De Smedt et al.² reduced *H. ceylanica*, *H. durvillei* var. *denudata* Weber-van Bosse, *H. durvillei* var. *edentata* Weber-van Bosse, *H. formosa*, *H. microcarpa* and *H. venusta* to synonyms of *H. durvillei*, based on comparisons of type material and vegetative and reproductive morphology. Their broad morphological species concept resulted in any tropical Indo-Pacific *Halymenia* specimens with a branched thallus and a margin and surface with branchlets and / or spines being referred to *H. durvillei*.

In the distributional range of the Rakhine coastal zone and the Tanintharyi coastal zone, *Halymenia durvillei* Bory de Saint-Vincent was occurred from Lampi Island (lat. 10° 57' N, long 98° 09' E) to Toung Pyo (lat. 21° 13' N, long 92° 15' E). Moreover, this species tend to move upwards at their northern limit of Alethankyaw (lat. 20° 50' N, long 92° 20' E) beyond Mazin coastal areas from Pine Tree Island (lat. 10° 20' N, long 98° 15' E), as recorded by Mya Kyawt Wai et al.¹⁵. Among the previously records of Soe-Htun²³ described this species from High I. (lat. 11° 01' N, long 98° 17' E) of the Tanintharyi coastal zone to Kyauk Phyu (lat. 19° 26' N, long 93° 33' E) of the Rakhine coastal zone.

In the present study, table 2 gives the distribution range of the species of *H. durvillei* Bory de Saint-Vincent distributes in the Rakhine coastal zone, from Leik Island (Lat. 15° 51' N and Long. 94° 17' E) to Kyauk Phyu (Lat. 19° 43' N and Long. 93° 55' E) and in the Tanintharyi coastal zone, from High Island (Lat. 11° 01' N and Long. 98° 17' E) to Wa Naw (Lat. 13° 35' N and Long. 98° 08' E). The genus of *Halymenia* was not found in Ayeyawady Delta and Gulf of Martaban coastal zone.

According to the herbarium specimens, *H. durvillei* were also dominated in Wethey, Ngapali and Maung Shwe Lay Gyaing from Rakhine coastal zone. In January to April, at that time the species of *H. durvillei* are more abundant species than the other months. With respect to the world distribution, this species are

encountered throughout warm temperate and tropical regions of the Atlantic, Indian, Pacific Ocean and Indo-Pacific regions. In general, *H. durvillei* is common in Indo-Pacific regions, including ASEAN countries of Philippine, Malaysia, Indonesia and Thailand including Myanmar.

Halymenia, a genus of red algae (Halymeniales), has been used as food in many countries. Anywhere that people like vegetable salads, or naturally thickened soups, *Halymenia* can be sold either fresh or dried. In Hawaii, Hawaiians love to eat *Halymenia* raw, especially with raw fish; Japanese and Koreans treat these plants “namasu style”; and others rehydrate dried pieces, adding the pieces to fresh salads or to “cream style” soup (without the calorie-rich cream). *Halymenia* species have a ready market in the United States and Japan. This *Halymenia* species is favoured as edible seaweed by several ethnic groups in Hawaii. It may have potential for domestication, especially if spores could be seeded onto coral rubble and outplanted into appropriate local habitats^{24,25}.

CONCLUSION

The order Halymeniales belonging to two families Halymeniaceae and Tsengiaceae was found in the world. But only one family of Halymeniaceae was found in Myanmar. Firstly, the taxonomic study of genus *Halymenia* collected from the three coastal zones of Myanmar was described. Detailed descriptions of *Halymenia durvillei* were studied in this result. Moreover, the distributions of this species along the three coastal zones of Myanmar and world were recorded based on the information from specimens examined and available literature. *H. durvillei* occurs along the Rakhine and Tanintharyi coastal zones and not occurs in Ayeyawady Delta and the Gulf of Martaban coastal zones. So, *H. durvillei* grow the lower intertidal zone and this species are widely distributed throughout the warm temperate and tropical Regions of the Atlantic, Indian, Pacific Oceans and Indo-Pacific regions. In ecological point of view, marine red algal beds support as natural habitats as well as feeding, spawning and nursery grounds for economically important marine living resources such as shrimps, clams, oysters and fishes. In Myanmar, the conservation of natural beds of marine red algae is still necessary to be worked out for the sustainable development of other marine living resources in the future.

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