

Studies on the Bryophyte Flora of Vanuatu. 6. Anthocerotae

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The Anthocerotae are widely distributed in the world and have also been recorded from the South Pacific islands including New Caledonia and Fiji, where many interesting species of the Anthocerotae occurred. There have been, however, no records of the Anthocerotae from Vanuatu, a group of islands sandwiched in between Fiji and New Caledonia. It is thus interesting to know the species distributed in Vanuatu from the phytogeographical point of view. Recently I had a chance to examine 23 specimens of the Anthocerotae collected in Vanuatu by Dr. M. Higuchi in 1996 and by Mr. K. Sugimura in 1997, and found nine species among them. They contain *Anthoceros* (two species), *Phaeoceros* (one species), *Megaceros* (one species) and *Dendroceros* (five species), all of which are classified in the family Anthocerotaceae.

The following are the enumeration of species found in Vanuatu with some brief taxonomic and phytogeographic notes.

Key to the genera of the Anthocerotaceae in Vanuatu

1. Capsules with stomata, antheridia more than one per cavity, elaters without spiral thickenings2
 2. Thalli cavernous, antheridial jackets with four tiers of cells, spores dark brown to black
.....*Anthoceros*
 2. Thalli solid, antheridial jackets with irregularly arranged, small cells, spores yellow
.....*Phaeoceros*
1. Capsules without stomata, antheridium one per cavity, elaters with spiral thickenings.....3
 3. Thalli not differentiated into costa and lamina, gametophytic cells mostly with more than one chloroplasts, spores unicellular at maturity*Megaceros*
 3. Thalli differentiated into costa and lamina, gametophytic cells with a single large chloroplast, spores multicellular at maturity*Dendroceros*

Anthoceros L. emend Prosk., Bull. Torrey Bot. Club 78: 346 (1951).

The genus *Anthoceros* is divided into two subgenera *Anthoceros* and *Folioceros* (Hasegawa 1994), the latter of which is mainly distributed in tropical to subtropical regions of Asia and the South Pacific islands. Two species of *Anthoceros* found in Vanuatu belong to the subgenus *Folioceros*.

Key to the species of *Anthoceros*

1. Thalli with numerous spherical gemmae on margins and dorsal surfaces*A. appendiculatus*
1. Thalli without gemmae*A. fuciformis*

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1. *Anthoceros appendiculatus* Steph., Engl. Bot. Jahrb. 23: 315 (1896).

Specimen examined. Espiritu Santo Isl., 1st Camp - 2nd Camp, along Pialapa River, 160 m alt., on rock, Oct. 15, 1997 (Sugimura 1480).

Distribution. Samoa, Fiji, New Caledonia, New Guinea, Seram, Java and Sumatra (Hasegawa 1986a, 1986b). New to Vanuatu.

Notes. *Anthoceros appendiculatus* has been often confused with *Anthoceros glandulosus* Lehm & Lindenb. Indeed, Piippo (1993) reduced it under the synonymy of the latter. Through detailed comparative studies of type specimens of both species, however, I confirmed that *A. glandulosus* was a species distributed in East Himalayas and was quite different from *A. appendiculatus*.

2. *Anthoceros fuciformis* Mont., Ann. Sci. Nat. Ser. 2, 20: 296 (1843).

Specimen examined. Espiritu Santo Isl., Mt. Tabwemasana, 1000 m alt., 15°21'S, 166°44'E, on soil, Nov. 6, 1996 (Higuchi 31517, admixed with *Phaeoceros* sp.).

Distribution. Japan, Taiwan, southern China, widely distributed in Southeast Asia and the South Pacific islands, Réunion and Africa (Hasegawa 1993, 1995). New to Vanuatu.

Notes. *Anthoceros fuciformis* is widely distributed in Paleotropical regions and is one of the commonest species of the hornworts there. The species is distinguished from other species of the subgenus *Folioceros* by strap-shaped thalli whose margins are rather regularly dissected into rectangular lobes, absence of gemmae, globose spores whose surfaces lack distinct triradiate marks and are densely covered with papilla-like small outgrowths.

Phaeoceros Prosk., Bull. Torrey Bot. Club 78: 346 (1951).

A single species of *Phaeoceros* which is closely related to *P. carolinianus* (Michaux) Prosk., a species recorded from all over the world, was found in Vanuatu.

3. *Phaeoceros* sp.

Specimens examined. Espiritu Santo Isl., Mt. Tabwemasana, 1000 m alt., 15°21'S, 166°44'E, on soil, Nov. 8, 1996 (Higuchi 31790), Nov. 6, 1996 (Higuchi 31517, admixed with *Anthoceros fuciformis*).

Notes. The present hornwort surely belongs to the *Phaeoceros carolinianus* complex, which is defined by the following characteristics: 1) the monoecious plant, 2) the absence of tubers on the ventral side of thalli, 3) the smooth dorsal surface of thalli, 4) the long, slender capsules which are, at maturity, bivalved with adhering tip and twisted, and 5) the medium-sized spores whose surfaces are simply papillate to spinulate. This species complex shows a wide range of variations in the pattern of surface ornamentation of spores, and many species have been described based on the difference of this spore feature. The validity of these species is, however, open to debatable question, although Hassel de Menéndez (1989) recognized many species which were distinguished by the difference in details of surface ornamentation of spores. This Vanuatu species of *Phaeoceros* has spores whose proximal surfaces are minutely papillate throughout, and is different from the type material of *P. carolinianus* whose proximal surfaces of spores are sparsely papillate only in the central part of each triangular face (peripheral areas are smooth). I refrain from giving a certain species name to this *Phaeoceros* sp., because the taxonomic significance of such difference in spore features still remains ambiguous.

Megaceros D.H.Campb., Ann. Bot. 21: 484 (1907).

A single species of *Megaceros*, *M. flagellaris* (Mitt.) Steph. occurs in the South Pacific regions. It is one of the commonest species of the Anthocerotae there, and was also found in Vanuatu in this study.

4. Megaceros flagellaris (Mitt.) Steph., Spec. Hep. 5: 951 (1916).

Specimens examined. Espiritu Santo Isl., Mt. Vutimele (40 km north of Mt. Tabwemasana), 1100 m alt., 15°00'S, 166°40'E, Nov. 22, 1996 (Higuchi 32080), on decaying log, Nov. 24, 1996 (Higuchi 32214), on trunk of tree fern (Higuchi 32225); Mt. Tabwemasana, 1000 m alt., on boulder, Nov. 8, 1996 (Higuchi 31817, 31821), Nov. 6, 1996 (Higuchi 31567), 1400 m alt., 15°21'S, 166°44'E, on rotten log, Nov. 7, 1996 (Higuchi 31623); 2nd Camp - Mt. Vutimena, steep slope, Oct. 18, 1997 (Sugimura 1663); Butmas, lower montane forest, 560 m alt., on humus, Oct. 23, 1997 (Sugimura 1732).

Distribution. Japan, Taiwan, southern China, widely distributed in Southeast Asia and the South Pacific islands including Tahiti, Samoa, New Caledonia and Hawaii (Hasegawa 1983), New Zealand (Campbell 1984) and Africa (Hasegawa 1995). New to Vanuatu.

Notes. *Megaceros flagellaris* is widely distributed in Paleotropical regions and shows a wide range of variations in various characters, especially in thallus form. Based on the variations of thallus form, it may be subdivided into several infra-specific taxa, but the distinction between them is not always clear, because there are various intermediate forms between them.

Dendroceros Nees in Gott. *et al.*, Syn. Hep.: 579 (1846).

The region from Tropical Asia to the South Pacific islands is one of the places where the most rich flora of *Dendroceros* exists. From Vanuatu five species were recognized in this study.

Key to the species of *Dendroceros*

1. Thallus-costae cavernous.....2
 2. Thallu-laminae finely reticulate due to scattered large perforations, spores small, 50–60 μm long.....*D. cavernosus*
 2. Thallus-laminae not reticulate, spores large, 65–85 μm long.....*D. difficilis*
1. Thallus-costae solid.....3
 3. Epidermal cells of capsules large, 25–35 μm wide, nodulose thick-walled.....*D. aff. granulatus*
 3. Epidermal cells of capsules small, less than 20 μm wide, longitudinally thick-walled.....4
 4. Thalli pinnately branched, laminae extremely crispate, covering wholly over costae, capsules long (to more than 2.5 cm long), spores large (usually more than 70 μm long).....*D. acutilobus*
 4. Thalli subdichotomously branched, laminae moderately crispate (dorsally inflate and sometimes covering over costae), capsules short (less than 1.5 cm long), spores small (usually less than 55 μm long).....*D. validus*

5. Dendroceros cavernosus J.Haseg., J. Hattori Bot. Lab. 47: 306 (1980).

Specimens examined. Espiritu Santo Isl., Mt. Tabwemasana, 1000 m alt., 15°21'S, 166°44'E, on trunk of tree fern, Nov. 8, 1996 (Higuchi 31787), on boulder (Higuchi 31786), on trunk, Nov. 6, 1996 (Higuchi 31524, 31533); Butmas, lower montane forest, 570 m alt., on trunk, Oct. 23, 1997 (Sugimura 1724).

Distribution. Samoa, Fiji, New Caledonia, New Guinea, Bismark Archipelago, Seram, Java and

Borneo (Hasegawa 1986b, Piippo 1993). New to Vanuatu.

Notes. *Dendroceros cavernosus* is one of the commonest species of *Dendroceros* in the South Pacific islands and tropical Asia. The species is closely related to *Dendroceros subdifficilis* S.Hatt. described from New Guinea. They have the following characteristics in common: (1) thallus-costae are cavernous, (2) thallus-laminae are very delicate and lacy, and (3) large perforations are scattered on laminae to form fine reticulations. They are, however, different in that the latter is an epiphyllous small plant (thalli are less than 1.4 mm wide) and has small spores (40-50 μm long vs. 45-60 μm long in *D. cavernosus*).

6. *Dendroceros difficilis* Steph., Spec. Hep. 5: 1009 (1917).

Specimen examined. Espiritu Santo Isl., Mt. Tabwemasana, 1700 m alt., 15°21'S, 166°44'E, on trunk, Nov. 7, 1996 (Higuchi 31645).

Distribution. Philippines, Java and New Guinea (Hasegawa 1980, Piippo 1993). New to Vanuatu.

Notes. The present species is distinguished from *Dendroceros cavernosus*, another Vanuatu species of *Dendroceros* with cavernous costae by that (1) thallus-laminae are neither delicate nor finely reticulate, (2) epidermal cells of capsules have fairly large lumens, and (3) spores are larger (usually more than 80 μm long).

7. *Dendroceros* aff. *granulatus* Mitt. in Seemann, Flora Vitiensis: 419 (1873).

Specimen examined. Espiritu Santo Isl., Mt. Vutimele (40 km north of Mt. Tabwemasana), 1200 m alt., 15°00'S, 166°40'E, on trunk, Nov. 23, 1996 (Higuchi 32100, admixed with *Dendroceros acutilobus*).

Notes. This hornwort is characterized by solid costae and nodulose thick-walled epidermal cells of capsules, and belongs to Stephani's (1917) taxonomic group "Costa solida, cuticula capsulae nodulose incrassate". Four species belonging to this group, *D. borbonicus*, *D. japonicus*, *D. granulatus*, *D. tahitensis*, occur in Asia and the Pacific islands (Hasegawa 1981, 1982). Among them, *D. granulatus* so far known only from Samoa is most closely related to this hornwort, but is different in that the latter has smaller spores (55-75 μm) and epidermal cells of capsules in which nodulose thickenings of walls are not so conspicuous. Further comparative studies based on ample materials are required to clarify the taxonomic status of this hornwort.

8. *Dendroceros acutilobus* Steph., Sitzungb. Naturf. Ges. Leipzig 36: 18 (1909).

Specimens examined. Espiritu Santo Isl., Mt. Vutimele (40 km north of Mt. Tabwemasana), 1200 m alt., 15°00'S, 166°40'E, on trunk, Nov. 23, 1996 (Higuchi 32100, admixed with *Dendroceros* aff. *granulatus*); Mt. Tabwemasana, 1000 m alt., 15°21'S, 166°44'E, Nov. 9, 1996 (Higuchi 31841, 31875).

Distribution. Java, New Guinea, Ambon, Seram and Samoa (Hasegawa 1986a). New to Vanuatu.

Notes. The present species is easily distinguished from any other species by its characteristic thallus form including conspicuously pinnately branched thalli and extremely crispate laminae which cover wholly over the costae. It seems to be a common species widely distributed in the South Pacific islands.

9. *Dendroceros validus* Steph., Spec. Hep. 5: 1016 (1917).

Specimen examined. Espiritu Santo Isl., 2nd Camp - 1st Camp, along Pialapa River, 400 m alt., on rotten logs, Oct. 19, 1997 (Sugimura 1687).

Distribution. Sumatra and New Zealand (Hasegawa 1980, Campbell 1986). New to Vanuatu.

Notes. The present species is characterized by moderately cripate thallus-laminae, rather short

capsules, trabeculately thick-walled epidermal cells of capsules with fairly large lumens and small to medium-size spores, and is distinguished from other species with solid costae and trabeculately thick-walled epidermal cells of capsules by the combination of these characteristics.

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Summary

A single family, four genera and nine species of the Anthocerotae are recorded for the first time from Vanuatu. A brief distributional and taxonomical note is given to each species. Taxonomy of the *Phaeoceros carolinianus* complex is discussed based on spore characters of *Phaeoceros* sp. found in Vanuatu.

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