

THE GENUS *NOWELLIA* (CEPHALOZIACEAE: MARCHANTIOPHYTA) IN INDIA

D.K. SINGH, SHUVADEEP MAJUMDAR¹ AND SUDIPA DAS²

Botanical Survey of India, CGO Complex, 3rd MSO Building, Block F (5th Floor)
Salt Lake Sector I, Kolkata - 700 064. E-mail: singh_drk@rediffmail.com

¹Botanical Survey of India, Central National Herbarium, Howrah - 711 103

²Department of Life Science and Bioinformatics, Assam University, Silchar - 788 011

ABSTRACT

The liverwort genus *Nowellia* Mitt. [*N. curvifolia* (Dicks.) Mitt.] is described from Arunachal Pradesh, India. This constitutes the first record of the genus in Indian Bryoflora.

Keywords: *Nowellia*, India, New record

INTRODUCTION

The genus *Nowellia* Mitt. is represented by 10 species in the world, viz., *N. aciliata* (P.C. Chen & P.C. Wu) Mizut. from China and Japan; *N. borneensis* (De Not.) Schiffn. from Indonesia, New Guinea and Philippines; *N. curvifolia* (Dicks.) Mitt. from Asia, Africa, North and South America, Europe and Australia; *N. dominicensis* Steph. from Dominica and the Dominican Republic; *N. evansii* Grolle from Costa Rica, Guatemala, Honduras, Jamaica and Venezuela; *N. langii* Pearson from Indonesia, Malaysia, New Caledonia, Thailand and Australia; *N. pusilla* Grolle from Indonesia; *N. reedii* H. Rob. from Costa Rica; *N. wrightii* (Gottsche & Spruce) Steph. from Cuba and *N. yunckeri* Fulford from Honduras (Grolle, 1968; Robinson, 1970; Gradstein & Hekking, 1989; Schuster, 2002; Schäfer-Verwimp, 2010). A member of the family Cephaloziaceae, the genus is characterised by usually deeply purplish plants; bilobed leaves with long, pincer-like lobes and a very constricted, transverse insertion; ventral margin of leaf inflexed to form highly distinctive water-sac; leaf cells devoid of oil-bodies; monandrous male bracts; deeply 3-plicate perianth; inner-most bracts closely clasping the perianth keels; presence of bracteole and areolate spores.

In India, Chopra (1938) for the first time described *N. orientalis* Chopra from Darjeeling, West Bengal in the Eastern Himalaya. Few years later, Pandé and Srivastava (1942) described another species, *N. indica* Pandé & T.N. Srivast. from near Girgaon in Kumaon Hills, Uttarakhand in Western Himalaya. However, these species are in fact referable to *Delavayella serrata* Steph. belonging to a distinct family of its own (Schuster, 1961; Crandall-Stotler & al., 2009).

During the course of studies on the Hepaticae and Anthocerotae of Eastern Himalaya, the authors came across the populations of *N. curvifolia*, the type of the genus, from West Siang and Lower Dibang Valley districts of Arunachal Pradesh. The same has been described and illustrated to facilitate its easy identification. This constitutes the first record of its occurrence in Indian bryoflora.

DESCRIPTION

Nowellia curvifolia (Dicks.) Mitt. in Godm. Nat. Hist. Azores 321. 1870. *Jungermannia curvifolia* Dicks., Pl. Crypt. Brit., Fasc. 2: 15. 1790. (Figs. 1-25)

Plants olive green to brownish green or purplish when fresh, brownish red in herbarium. Shoot up to 30 mm long, 1.0 - 1.2mm wide, occasionally, irregularly branched; branches up to 8mm long, branching ventral intercalary or lateral, *Frullania*-type; stoloniform branches not seen. Stem oval in outline in transverse section, (100.0-) 138.6 - 170.0 × (90.0-) 101.0 - 119.0µm, 5 - 8 cells across the diameter; cortical cells in 8 - 9 vertical rows, sub quadrate-polygonal, 22.2 - 68.7 × 6.1 - 38.4µm, slightly thick-walled, conspicuously bigger than medullary cells, hyaline or opaque with pale brown-purplish tinge; medullary cells in 9-17 vertical rows, sub quadrate- polygonal, 7.1 - 22.2 × 5.0 - 15.2µm, thin-walled. Leaves transversely inserted, loosely imbricate-

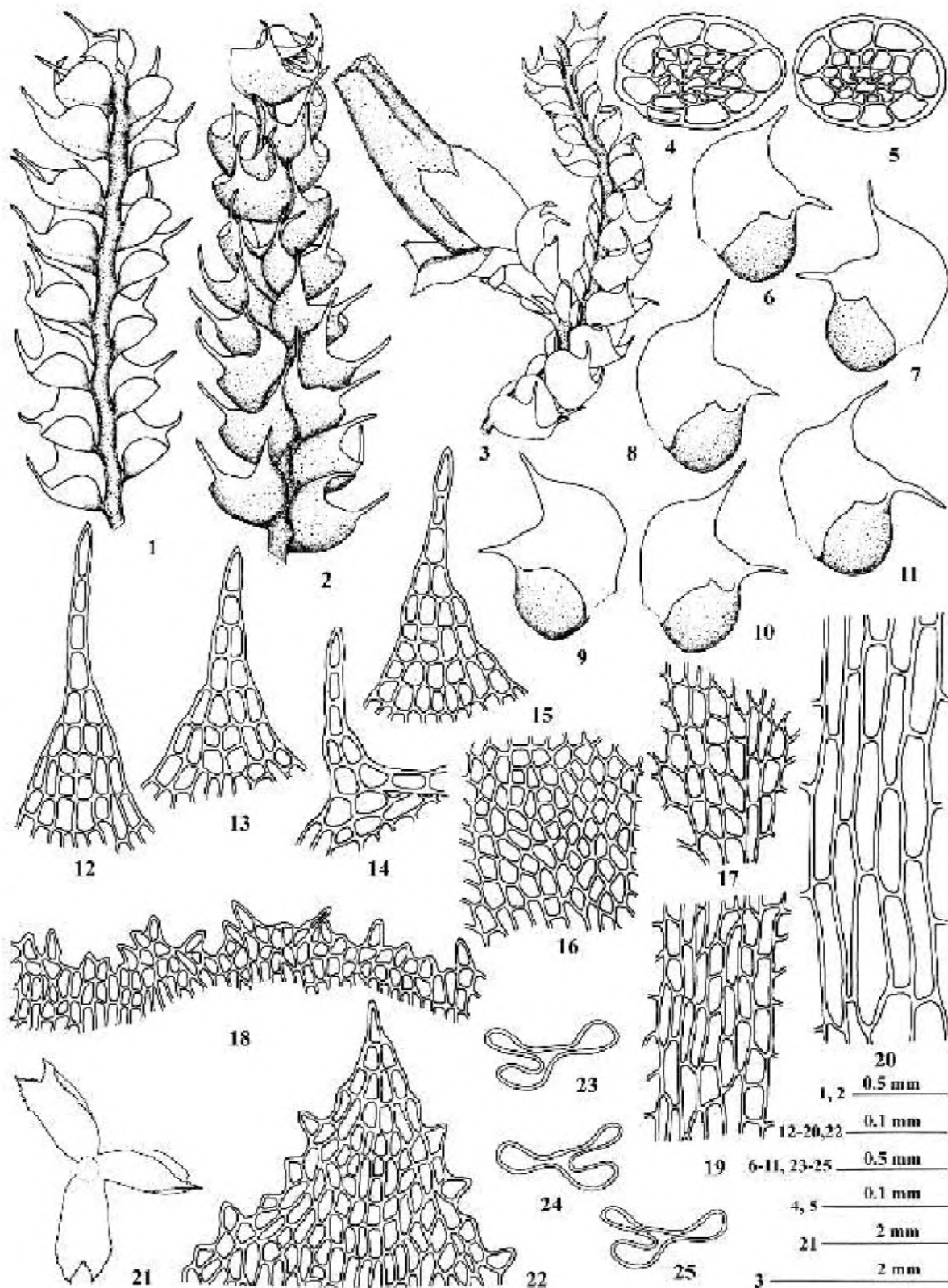


Fig. 1-25. *Nowellia curvifolia* (Dicks.) Mitt.: **1.** A portion of the plant in ventral view (rhizoids not drawn); **2.** The same in dorsal view; **3.** A portion of the female plant showing gynoecium; **4, 5.** Cross-sections of stem; **6-11.** Leaves; **12-15.** Apical cells of leaf; **16.** Median cells of leaf; **17.** Basal cells of leaf; **18.** Apical cells of perianth; **19.** Median cells of perianth; **20.** Basal cells of perianth; **21.** Female bracts and bracteole; **22.** Apical cells of bract; **23-25.** Cross-sections of perianth. (all figures drawn from 515A/1984)

contiguous, concave, inflated, (0.4-) 0.7 - 0.8mm long, (0.30-) 0.60 - 0.65mm wide, bilobed with wide sinus; lobes 1/3 - 1/2 of the leaf, long tapering, narrowly triangular, (5-) 7 - 13 (-16) cells long, (2-) 6 - 12 (-14) cells wide, (2-) 3 - 4 (-5) cells uniseriate towards apex, margin entire, dorsal margin arched, ventral margin broadly folded inward to form a ventral sac with the free margin of the sac rarely showing slight cellular protrusions; lamina 14 - 22 cells long, 32 - 40 cells wide at middle (without ventral sac); apical leaf cells triangular, $40.0 - 65.5 \times 7.5 - 17.6\mu\text{m}$; median leaf cells sub quadrate-polygonal, $12.6 - 27.7 \times 10.0 - 20.0\mu\text{m}$; basal leaf cells much elongated, $25.0 - 60.5 \times 7.5 - 27.7\mu\text{m}$; walls thin, trigones indistinct, intermediate thickening absent; cuticle smooth; oil bodies not seen. Gemmae not seen. Rhizoids few, scattered or somewhat fasciculate sometimes confined to the older portion of the stem.

Dioecious. Androecia not seen. Gynoecia terminal, usually on short lateral branches; bracts in 3 - 6 series, erect-suberect, oblong-elliptical in outline, $1.6 - 1.9 \times 0.8 - 1.1\text{mm}$, bilobed to 1/4 - 2/3 of the length, apical margin serrate; bracteoles identical in shape with bracts, free from each other or sometimes shortly united at base with one or both bracts. Perianth exerted, cylindrical, $2.8 - 3.6\text{mm}$ long, $0.6 - 0.7\text{mm}$ wide at middle, mouth narrowed, spinose-dentate; teeth 1 - 4 cells long, 1 - 3 cells wide at base, apical marginal cells of the perianth triangular or sub quadrate - polygonal, $10.0 - 42.5 \times 7.5 - 17.5\mu\text{m}$, median perianth cells sub quadrate-polygonal, $20.0 - 82.5 \times 7.5 - 20.0\mu\text{m}$, basal perianth cells much elongated, $100.0 - 210.0 \times 15.0 - 37.5\mu\text{m}$; keels 3 (2 lateral, 1 ventral). Mature sporophytes not seen.

Habitat: Terrestrial or epiphytic, growing on decaying wood in moist and shady places in association with *Blepharostoma trichophyllum* (L.) Dumort., *Isotachis japonica* Steph., *Cephalozia gollani* Steph., species of *Lepidozia*, *Riccardia*, etc., or forming pure populations on the bark of trees.

Distribution: India [Eastern Himalaya: Arunachal Pradesh-present study], China, Indonesia, Japan, Korea, Malaysia, Myanmar, Philippines, Russia, Sri Lanka, Taiwan, Thailand, Africa, North & South America, Europe, Australia (Grolle, 1968; Robinson, 1970; Schuster, 1974, 2002; Onraedt 1981; Tan & Engel 1986; Piippo 1990; Hong 1997; Yamada & Iwatsuki 2006; Söderström & al. 2007, 2010; Lai & al. 2008; Konstantinova & Bakalin, 2009; Chuah-Petiot, 2011; Pócs & al., 2012).

Specimens examined: India: Eastern Himalaya, Arunachal Pradesh, West Siang district, on way to Yapik from Shikar, c.1800m, 06.12.1984, D.K. Singh 515A/1984 (ASSAM); Lower Dibang Valley district, Mehao Wildlife Sanctuary, Mayodia-Chekhopani road, c. 2000m, 15.11.2000, D.K. Singh 98077; Mayodia top, c. 2850m, 18.11.2000, D.K. Singh 98222; 98238 (BSD).

Other Specimen examined: *Nowellia curvifolia* (Dicks.) Mitt. Hepaticae Selectae et Criticae (ed. Fr. Verdoorn), Series X, 1937, Hibernia, Kerry, Killarney, c. 300m, IX. 1936, Fr. Verdoorn (CAL).

DISCUSSION

Grolle (1968) and Robinson (1970) grouped various species of the genus into two subgenera, viz. subgen. *Nowellia* and subgen. *Metanowellia* Grolle. But, Schuster (1974) classified them into three Sections instead, viz. Sect. *Nowellia* (stem with up to 12 medullary cells; leaves deeply lobed with long-acuminate lobes and 10 - 15 cells high lamina), Sect. *Metanowellia* (Grolle) R.M. Schust. (stem with 3-6 medullary cells; leaves deeply lobed with long-acuminate lobes and 4 - 8 cells high lamina) and Sect. *Acronowellia* R.M. Schust. (leaves broadly lobed with the lobes acute-blunt or obsolete). *Nowellia curvifolia* belongs to Sect. *Nowellia*. The Arunachal populations of the species exhibit olive green to brownish-purplish plants with occasional ventral intercalary or *Frullania*-type lateral branching; stem with 8 - 9 vertical rows of much larger, slightly thick-walled, brownish cortical cells and 9 - 17 medullary cells (Figs. 4, 5); narrow, transverse insertion of leaves with its dorsal base extending up to the middle of stem (Fig. 2); leaves bilobed to 1/3 - 1/2 of their length with long-acuminate lobes, (5-) 7 - 13 (-16) cells long, (2-) 6 - 12 (-14) cells wide, (2-) 3 - 4 (-5) cells uniseriate distally (Figs. 1-3, 6 - 15) and the ventral margin broadly folded inward to form a water-sac (Figs. 6-11); leaf lamina 14 - 22 cells high from base to sinus; leaf cells without trigones (Figs. 12 - 17) and surface ornamentation; gynoecia borne on short lateral branches (Fig. 3); identical female bracts and bracteoles (Fig. 21) and long, cylindrical, 3-keeled perianth (2 lateral, 1 ventral) with spinose-dentate mouth (Figs. 3, 18, 23 - 25).

The Indian plants of *N. curvifolia* are comparatively more robust with the stem in cross-section having up to 17 medullary cells and the leaf lamina up to 22 cells high from the base to sinus, sometimes have opaque, pigmented cortical cells and lack stolons and gemmae. The plants from the two districts interestingly show certain degree of dimorphism in their pigmentation and stem and leaf characteristics. Those from Lower Dibang Valley are olive green to brownish green, more delicate with the stem in cross-section often as slender as $100 \times 90 \mu\text{m}$, 5 - 7 cells across diameter with hyaline cortical cells and 9 - 14 medullary cells, and smaller leaves, $0.40 - 0.55 \times 0.30 - 0.50 \text{mm}$ with smaller lobes, 6 - 7 cells long, 3 - 4 cells wide at base. Whereas, the plants from West Siang are chiefly purplish and have stem in cross-section as robust as $170 \times 119 \mu\text{m}$ with opaque, pale brown-purplish tinged cortical cells and 15-17 medullary cells, and larger leaves, $0.70 - 0.80 \times 0.60 - 0.65 \text{mm}$ with usually larger lobes, up to 16 cells long and up to 14 cells wide at base. However, these differences are well within the overall range of variations observed in Indian material and could be attributed to plants in two set of populations being at different stages of growth. The plants from Lower Dibang Valley are in vegetative condition, while those from West Siang bear well developed gynoecia.

N. curvifolia is the most widely distributed species of the genus spreading across all the continents, except Antarctica. Its present discovery in Indian bryoflora bridges the gap in its existing range of distribution.

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लिवरवर्ट वंश नाँवेलिया मिट्टेन (नाँवेलिया कर्विफोलिया (डिक्सन) मिट्टेन) का भारत के अरूणाचल प्रदेश राज्य से वर्णन किया गया है। यह इस वंश का भारतीय ब्रायोफ्लोरा में प्रथम अभिलेख है।