

LEJEUNEACEAE (MARCHANTIOPHYTA) OF THE WESTERN GHATS, INDIA

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Abstract: The present study reports 76 species of Lejeuneaceae present in the Western Ghats. Among these three species viz. *Archilejeunea abbreviata* (Mont.) Vanden Berghen, *Otolejeunea semperiana* (Gottsche et Steph.) Grolle and *Tuyamaella angulistipa* (Steph.) Schust. & Kachroo are new to India. One species viz., *Lejeunea cocoes* Mitt., is a new record for Southern India and three species viz., *Archilejeunea minutilobula* Udar & U.S.Awasthi, *Cololejeunea appressa* (A.Evans) Benedix and *Cololejeunea udarii* G. Asthana & S.C. Srivast. are new records for Kerala.

Introduction

The Western Ghats, also known as the Sahyadri Hills, are well known for their rich and unique assemblage of flora and fauna. Norman Myers included the Western Ghats amongst the 25 biodiversity hot-spots identified in the world. Geologically the Western Ghats may be divided into two segments. The hills north of the Krishna basin (largely Maharashtra and Gujarat) with fragile basaltic rocks are results of the same processes that gave rise to the Deccan trap. Isolated, conical, flat-topped hills occur here with steep sides, marked with striations. They seldom rise beyond 1500 m. South of the Krishna basin is the region of precambrian archean crystalline hard rocks (nearly 2000 million years old granites, schists, gneisses, quartzites, etc). Soils vary from humus rich peat in the montane areas to laterite in the lower elevation and high rainfall belts. Soils are generally acidic.

Arising abruptly from the narrow Konkan and Malabar coasts, these hills run 1600 km north-south between the river Tapti in Gujarat and Kanyakumari in Tamil Nadu covering an area approximately equal to 160,000 sq km. In the east, they slope gently towards the Deccan Plateau. The northernmost segment that extends into Gujarat merges in the east with the Surat Dangs. In the Nilgiris, Palanis and parts of Karnataka, the Western Ghats extend considerably eastwards, locally merging with the Eastern Ghats. Towards the south, the hill chain is divided into two by the Palghat Gap (a mere 13 km gap at its narrowest) rendering a physically homogeneous high altitude plateau into two rather distinct biogeographic units viz., the Nilgiris complex in the north and the Anaimalai-Palnis complex in the south. Here are found the highest peaks viz., Anaimudi (Anaimalai Hills) and Doddabetta (Nilgiri Hills), reaching well over 2695 and 2637m ASL respectively. Apart from these, a number of peaks reaching heights of over 2000 m are present in the southern half as that in Tamilnadu (Palnis) and Kerala (eg. High Wavy Mountains and Grass Hills).

Climatic conditions in the Western Ghats vary with the altitude and physical proximity to the Arabian Sea and the equator. Although the Western Ghats experience a tropical climate - being warm and humid during most of the year with mean the temperature ranging from 20⁰C in the south to 24⁰C in the north, the higher elevations experience subtropical climates and on occasions frost. Further, it has been observed that the coldest periods in the southern Western Ghats coincide with the wettest.

Whereas rainfall peaks of 9000 mm and above per year, are known locally, annual rainfall as low as 1000 mm are frequent in the east bringing the average to around 2500 mm. Interestingly, the total amount of rainfall received and the spread are not often correlated. Areas in the northern Western Ghats (in the State of Maharashtra) receiving the highest rainfall (locally over 9000 mm) experience dry weather over more than half the year. On the contrary, areas receiving much less rainfall in Kerala and closer to the equator experience rain almost all through the year. Much of the rainfall is received during the southwest monsoon season. Peak period of rainfall is July-August.

List of the Lejeuneaceae species of the Western Ghats.

The taxa are arranged alphabetically. For each species representative specimens with the following data are included as far as possible; locality, habitat, altitude, collector, collection number and range of the species. We considered as new to the area those species which are not represented in Bapna & Kachroo 2000, Daniels 2010, Manju *et al.* 2008, 2009, Manju & Rajesh 2011 and Pócs *et al.* 2007. The photographs of some species is provided in Plate 1&2.

Archilejeunea abbreviata (Mitt.) Vanden Berghen, Rev. Bryol. Lichénol. 20: 117. 1951.

Representative specimen/s examined: Thiruvananthapuram, Agasthyamalai BR (1000-1300 m) On bark, *Sreenivas* 106638 (CALI).

Range: Widespread in tropical Africa (Wigginton 2009). New to India (Kerala).

Archilejeunea apiculifolia Steph., Species Hepaticarum 6: 558. 1924.

Representative specimen/s examined: Tamil Nadu, On the way to Avalanche (2439 m), *R. Udar* 73 S/A (LWU) [Udar and Awasthi 1981].

Range: India (Tamil Nadu, Kerala: var. *dentifolia* Awasthi and Srivastava, 1985)

Archilejeunea minutilobula Udar & U.S.Awasthi, Geophytology 11: 77. f. 18-38. 1981.

Representative specimen/s examined: Kerala, Kannur, Aralam WLS (60 m) On bark, *MANJU* 087589 (CALI); Tamil Nadu, Mettupalayam, ca 500 m., 28 Dec 1965, *R. Udar & S.C. Srivastava* 200/65.

Range: India (Maharashtra, Tamil Nadu, Kerala). Western Ghats endemic. The present collection is a new record for Kerala.

Caudalejeunea reniloba (Gott.) Steph., Species Hepaticarum 5: 16. 1912.

Representative specimen/s examined: Kerala, Kasaragod, Kammadam Kavu (150), Epiphytic, *K.P. Rajesh*, 80050/a (CALI).

Range: Widespread from India to the Pacific islands.

Cheilolejeunea birmensis (Steph.) Mizut., J. Hattori Bot. Lab. 27: 139. 1964.

Representative specimen/s examined: Kanyakumari Dist., W. Ghats, Muthukuzhivayal, ca 1250 m., 26 Jan 2001, *Daniels* 1433 p.p. (MH, SCCN) [Daniels 2003]

Range: India (Tamil Nadu, Kerala, Karnataka), Myanmar.

Cheilolejeunea ghatensis G.Asthana, S.C.Srivast. & A.K.Asthana, Lindbergia 20: 132. f. 4. 1995[1996].

Representative specimen/s examined: Kerala, Thiruvananthapuram, Ponmudi (1200 m) *R.Udar & Party*, 6412/82 (LWU).

Range: This Indian endemic species is distributed in Kerala only (Asthana *et al.* 1995).

Cheilolejeunea intertexta (Lindenb.) Steph., Bull. Herb. Boiss 5: 79. 1897.

Representative specimen/s examined: Kerala, Kasaragod, Kammadam Kavu (150), *K.P.Rajesh*, 80050/b; Wayanad, Chandanathode (950 m), Corticolous, *MCN* 80083b; *MCN* 06476 b (CALI); Tamil Nadu, Kanyakumari Dist., W. Ghats, Klamalai, ca 450 m., 18 Oct 1999, *Daniels* 792 (MH, SCCN) [Daniels 2003].

Range: Distributed from Africa through tropical Asia to Tahiti.

Cheilolejeunea krakammae (Lindenb.) R.M.Schust., Beih. Nova Hedwigia 9: 112. 1963.

Representative specimen/s examined: – Kerala, Wayanad, Mananthavady (900 m); On bark, *Manju 80132* (CALI); Kanyakumari Dist., W. Ghats, Klamalai, ca 450 m., 18 Oct 1999, *Daniels 792* (MH, SCCN) [Daniels 2003].

Range: Widespread in tropical Africa, Asia and Oceania (see full synonymy and distribution in Zhu, 2006).

Cheilolejeunea laeviuscula (Mitt.) Steph., *Species Hepaticarum* 5: 668. 1914.

Representative specimen/s examined: – Dodabetta, Ootacamund, 24 Aug 1991, *D.Sharma, R.Dixit & A.Srivastava 9982/91* [Asthana *et al.* 1995].– Tirunelveli Dist., W. Ghats, Mancholai, ca 1100 m., 24 Aug 2001, *Daniels 1779* (MH, SCCN) [Daniels 2003].

Range: Nepal, Bhutan: Hatisar, India: Sikkim Himalaya, West Bengal (Bapna & Kachroo 2000), Karnataka and Tamil Nadu. Endemic to Indian subcontinent.

Cheilolejeunea mariana (Gottsche) B.Thiers & Gradst., *Mem. New York Bot. Gard.* 52: 75. 1989.

Representative specimen/s examined: – Kotagiri, *Sedgwick*, 1916, 223, det. F. Verdoorn [Chopra 1938: 249, as *Archilejeunea mariana*].

Range: Widespread Indomalayan-Oceanian species distributed from Sri Lanka and India to the Society Islands. The tropical Asian distribution is to be clarified (Zhu and So 2001).

Cheilolejeunea serpentina (Mitt.) Mizut., *J. Hattori Bot. Lab.* 26: 171. 1963.

Representative specimen/s examined: India, Kerala, Pakshipadalam, Wayanad (1100 m), epiphytic, *K.P.Rajesh 99749*; Ponkuzhi, wayanad (880 m), On tree trunk, *Manju 84384a*; Wayanad, Mananthavady (750 m), On rocks and soil near stream; Palakkad, Parambikulam WLS (1150 m) On Bark, *Manju 106817, Manju 106213b* (CALI).

Range: In India this species is distributed in Eastern Himalaya, Kerala and Tamil Nadu; Sri Lanka (Asthana, Srivastava & Asthana 1995). Widespread in the palaeotropics from Africa throughout tropical Asia to the Caroline Islands.

Cheilolejeunea subopaca (Mitt.) Mizut., *J. Hattori Bot. Lab.* 26: 183. 1963.

Representative specimen/s examined: India, Kerala, Kozhikode, Vellarimala (1950 m) Epiphyllous on *Leptochilus* sp., *Satheesh 87209* (CALI).

Range: India (Kerala, Sikkim, Assam, West Bengal), Nepal, Bhutan. Endemic to the Indian subcontinent.

Cheilolejeunea trapezia (Nees) Kachroo & R.M.Schust., *J. Hattori Bot. Lab.* 24: 282. 1961.

Representative specimen/s examined: Tamil Nadu, Dodabetta, Ootacamund, 25 Sep 1983, *R. Udar & party*, 10 collections as *C. imbricata* (LWU),

- [Asthana *et al.* 1995]. – Kanyakumari Dist., W. Ghats, Muthukuzhivayal, ca 1250 m., 26 Jan 2001, *Daniels 1433* p.p. (MH, SCCN) [Daniels 2003].
Range: Widespread palaeotropical species distributed from Africa through tropical and subtropical Asia to Oceania.
- Cololejeunea appressa*** (A.Evans) Benedix, Feddes Repert. Spec. Nov. Regni Veg. Beih. 134: 31. 1953[1953].
Representative specimen/s examined: India, Kerala, Kozhikode, Kakkavayal Reserve Forest (100m) *Jitha, Manju & Rajesh 395, 396* (ZGC); Tamil Nadu, Nilgiris, W. Ghats, Avalanche, ca 2439 m., 2 Jan 1972, *R. Udar & party 117S/72* (LWU); Palnis, W. Ghats, Kodaikanal, ca 2153 m., *R. Udar & party 7257/83, 7266/83* (LWU).
Range: In India this species is distributed in Kerala, Karnataka, Meghalaya, Tamil Nadu, Andaman and West Bengal; the present collection is a new record for Kerala. A Pantropical species.
- Cololejeunea cardiocarpa*** (Mont.) A.Evans, Hedwigia 29: 91. 1890.
Representative specimen/s examined: Tamil Nadu, Palnis, W. Ghats, Kodaikanal, Periakulam, ca 2000m., 1 Oct 1983, *R. Udar & party 7250/83, 7262/83, 7264/83* (LWU).
Range: Widespread in South India (Asthana & Srivastava, 2003). Pantropical species.
- Cololejeunea ceratilobula*** (P.C.Chen) R.M.Schust., Beih. Nova Hedwigia 9: 179. 1963.
Representative specimen/s examined:– Tamil Nadu, Palnis, W. Ghats, Kodaikanal, Periakulam, ca 2000m., 1 Oct 1983, *R. Udar & party 7255/83, 7256/83, 7266/83* (LWU).
Range: Sri Lanka, India (Kerala), Vietnam, Japan, Indonesia, Malaysia and Borneo
- Cololejeunea foliicola*** Srivastava & Srivastava, Proc. Indian Acad. Sci., Pl. Sci. 99: 86. f. 21--49. 1989.
Representative specimen/s examined: India, Kerala, Kannur, Aralam WLS (750 m); Foliicolous on *Mallotus* sp., *Manju 99719* (CALI).
Range: Earlier this species was known only from Karnataka, the present report extends its distribution range to Kerala also. (Endemic to South India)
- Cololejeunea furcilibulata*** (Berrie & E.W.Jones) R.M.Schust., Beih. Nova Hedwigia 9: 178. 1963.
Representative specimen/s examined: Kerala, Kannur, Aralam WLS (60 m), ramicolous; *K.P.Rajesh 80377/b, K.P.Rajesh 87579* (CALI); Kozhikode, Kakkavayal Reserve Forest (100 m) *Jitha, Manju & Rajesh 1058* (ZGC); Tamil Nadu, Kanyakumari Dist., W. Ghats, Mahendragiri, ca 450 m., 5 Aug 1995, *Daniels 2, 3* (SCCN), [Daniels 2001].

Range: Scattered over tropical Africa and India (Karnataka & Kerala [Asthana and Srivastava 2003]).

Cololejeunea hasskarliana (Lehm. & Lindenb.) Steph. , Hedwigia 29: 72. 1890.

Representative specimen/s examined: Kerala, Aralam WLS, Ambalappara (1450 m); On the leaf of *Leptochilus*, K.P. Rajesh 99844 (CALI).

Range: India (Kerala, Tamil Nadu, Karnataka), in Africa only Réunion and Seychelles, Widespread in tropical and subtropical Asia, Australia and Oceania.

Cololejeunea kashyapii Udar & Srivastava, Geophytology 15: 64. f. 1--22. 1985.

Representative specimen/s examined: India, Kerala, Kannur, Aralam WLS (400 m) Manju & K.P. Rajesh 87629, 87630 (CALI).

Range: Earlier this species was known only from Karnataka, the present report extends its distribution range to Kerala also. (Endemic to South India). A species very near to *Cololejeunea triapiculata* (Herz.) Tixier known from Sri Lanka to Java, Malaysia and Fiji Islands.

Cololejeunea lanciloba Steph., Hedwigia 34: 250. 1895.

Representative specimen/s examined: Kerala, Kannur, Aralam WLS (40m); on leaf of *Mangifera indica* Manju 99709; Thiruvananthapuram, Agasthyamalai BR (1000 m) Manju & K.P. Rajesh 106673 (CALI); Tamil Nadu, Kanyakumari Dist., W. Ghats, Muthukuzhivayal, ca 1250 m., 26 Jan 2001, Daniels 1332 p.p. (MH, SCCN).

Range: In India: Kerala, Andaman & Nicobar Islands, Meghalaya, Eastern Hiamalayas and Mysore. A widespread Palaeotropic species distributed from tropical Africa and Asia, Australasia and Oceania.

Cololejeunea latilobula (Herzog) Tixier , Bryophyt. Biblioth. 27: 156. 1985.

Representative specimen/s examined: Kerala, Thrissur, Peechi (100 m), on leaves of *Mangifera indica*, Manju 84647; Kasaragod, Kammadam Kavu (100 m) epiphyte on *Myristica* sp. K.P. Rajesh, 80052/a; Tamil Nadu, Ootacamund, Coonoor Sims Park, ca 2000 m, R.Udar & party 7218/83, 7220/83 (LWU); Palnis, Kodaikanal, Periakulam, ca 2000 m., 1 Oct, R. Udar & party 7266/83 (LWU).

Range: Palaeotropic species distributed from Africa to China and Vietnam and Fiji Islands, widespread in India.

Cololejeunea longifolia (Mitt.) Benedix, Feddes Repert. Spec. Nov. Regni Veg. Beih.134: 15. 1953.

Representative specimen/s examined: Kerala, Aralam WLS, Ambalappara (1450 m) On bark, K.P. Rajesh 99768 (08.10.2005) (CALI).

Range: India (Sikkim, Arunachal Pradesh, Kerala), Japan, Korea, Formosa, China, Malay Peninsula, Bangladesh, Thailand, Sri Lanka, Bhutan, New Caledonia, New Guinea and Fiji Islands.

Cololejeunea madothecoides (Steph.) Benedix, Feddes Repert. Spec. Nov. Regni Veg. Beih. 134: 81. 1953.

Representative specimen/s examined: Kerala, Kasaragod, Kammadam Kavu (150 m) Epiphyllous, *K.P. Rajesh 99768* (CALI); Kozhikode, Peruvannamuzhi, Pannikottoor Reserve Forest (50m), *Leena 864/per 15b, 866/Per5* (ZGC, CALI); Tamil Nadu, Palnis, W. Ghats, Kodaikanal, Periakulam, ca 2133 m., 1 Oct 1983, *R. Udar & party 7599/83* (LWU).

Range: India (Assam, Tamil Nadu, Kerala), from Indochina to Japan and Borneo.

Cololejeunea minutissima (Sm.) Schiffn., Hepat. (Engl.-Prantl 122. 1893.

Representative specimen/s examined: Neel-Gherries, *Perrottet s.n.* [Montagne 1842b: 14 as *Lejeunea minutissima*; Mitten 1861: 115; Ootacamund, Emerald, *R. Udar & party*, 26 Oct 1983, *R. Udar & party 7077/83, 7093/83* (LWU); Kodaikanal, Bear Shola, ca 2000m., 1 Oct 1983, *R. Udar & party 7669/83* (LWU); Kanyakumari Dist., W. Ghats, Muthukuzhivayal, ca 1250 m., 26 Jan 2001, *Daniels 1332* (SCCN); Tirunelveli dist., W. Ghats, Agasthyamalai, Vanathirtham ca. 300 m, 28 Apr. 2002. *Daniels 2200, 2201* (SCCN).

Range: India (Tamil Nadu; Neelgiri hills, Kodaikanal, Tirunelveli, Agasthyamalai). Pantropical and oceanic temperate.

Cololejeunea mizutaniana Udar & Srivastava, Misc. Bryol. Lichenol. 9: 138. f. 1. 1983.

Representative specimen/s examined: India, Kerala, Kannur, Aralam WLS (400 m) *Manju & K.P. Rajesh 87632b* (CALI).

Range: Earlier this species was known only from Karnataka, the present report extends its distribution range to Kerala also. (Endemic to South India)

Cololejeunea nilgiriensis Asthana & Srivastava, Bryophyt. Biblioth. 60: 27. 2003.

Representative specimen/s examined: India, Kerala, 099762; – Avalanche, Nilgiri hills, *R. Udar et al. 75S/72* (holotype), (LWU). Endemic to the Nilgiri Hills.

Range: Earlier this species was known only from Tamil Nadu, the present report extends its distribution range to Kerala too.

Cololejeunea planissima (Mitt.) Abeyw., Ceylon J. Sci., Biol. Sci. 2: 73. 1959.

Representative specimen/s examined: Kerala, Kozhikode, Kakkavayal Reserve Forest (100m) On bark, *Jitha, Manju & Rajesh 390, 397* (ZGC); CU Campus, (40 m) on small branches, *Manju 106385* (CALI); Tamil Nadu, Palnis, W. Ghats, Kodaikanal, ca 2133 m., 1 Oct 1983, *R. Udar & party 7709/83* (LWU)

Range: In India this species is distributed in Kerala, Tamil Nadu, Eastern Himalayas and Meghalaya. A palaeotropic species distributed from East

Africa through tropical and subtropical Asia to Australasia and Micronesia.

Cololejeunea pseudofloccosa (Horik.) Benedix, Feddes Repert. Spec. Nov. Regni Veg. Beih. 134: 36. 1953.

Representative specimen/s examined: India, Tamil Nadu, Avalanche, ca 2439 m., 2 Jan 1972, R. Udar & party 88S/72, 117S/72, 120S/72 (LWU).

Range: Distributed from Sri Lanka and India through tropical and subtropical Asia to Australia.

Cololejeunea raduliloba Steph., Hedwigia 34: 251. 1895.

Representative specimen/s examined: Kerala, Wayanad, Chembra hills (1720 m) Epiphyllous on *Trichomanes proliferum*, Manju 99681; Kannur, Aralam WLS, (60 m); Epiphyllous on *Trichomanes indicum*, K.P. Rajesh 80398 (CALI).

Range: India (Assam, Kerala), Nepal. From the East African islands through China, Japan, Vietnam, Taiwan, to Australia, New Caledonia and Fiji Islands (Pócs *et al.* 2011).

Cololejeunea spinosa (Horik.) S.Hatt., J. Indian Bot., 22: 166. 1942.

Representative specimen/s examined: Kanyakumari Dist., W. Ghats, Muthukuzhivayal, ca 1250 m., 26 Jan 2001, Daniels 1333, 1336, 1338 (MH, SCCN) [Daniels 2003].

Range: India (Eastern Himalayas, West Bengal, Arunachal Pradesh), Japan, China, Korea, Nepal, Philippines.

Cololejeunea udarii G. Asthana & S.C. Srivast., Bryophytorum Bibliotheca 60: 40. 2003.

Representative specimen/s examined: Kerala, Kozhikode, Kakkavayal Reserve Forest (100m), On fronds of *Angiopteris indica*, Jitha, Manju & Rajesh 389, 400 (ZGC); Tamil Nadu, Ootacamund (Dodabetta peak), Nilgiri hills, R. Udar *et al.* 6863/83 (holotype), 6892/83, 6900/83, 6908/83, 6923/83, 6965/83 (LWU) [Asthana *et al.* 1995].

Range: This Indian endemic species is distributed in Kerala, Karnataka, Tamil Nadu, Arunachal Pradesh and Assam. The present collection is a new record for Kerala.

Drepanolejeunea angustifolia (Mitt.) Grolle, J. Jap. Bot. 40: 206. 1965.

Representative specimen/s examined:– Kerala, Idukki, Eravikulam NP, Amarshole (2000 m), epiphytic; Manju 80241/b (CALI); Dodabetta, alto. 2670 m., 5 Jan 1972, R. Udar 132/72 (LWU) [Udar & Awasthi 1982b].

Range: India (Kerala, Tamil Nadu), Bhutan, Thailand, Cambodia, Vietnam, China and Japan, Indonesia, New Guinea, Philippines, New Caledonia .

Drepanolejeunea sikkimensis (Udar & U.S.Awasthi) Grolle, J. Hattori Bot. Lab., 55: 503. 1984.

Representative specimen/s examined:– Tamil Nadu, Kanyakumari Dist., W. Ghats, Upper Kodaiyar, ca 1250 m., 9 Nov 2000, Daniels 1246 p.p.

Range: Endemic to India: Sikkim, Tamil Nadu.

Drepanolejeunea ternatensis (Gottsche) Steph., *Hedwigia* 29: 73. 1890.

Representative specimen/s examined:– Tamil Nadu, Nilgiri Hills, on the way to Avalanche, 2439 m., 2 Jan 1972, R. Udar 57S/72, 68S/72, 86S/72 (LWU);

Range: India (Tamil Nadu). Widespread Palaeotropic species from East Africa through tropical Asia to Australia, New Guinea and Samoa.

Frullanoides tristis (Steph.) van Slageren, *Meded. Bot. Mus. Herb. Rijks Univ. Utrecht* 544: 110. 1985.

Representative specimen/s examined–Ernakulam, *Thattekkad Bird Sanctuary* (100m), *Nikesh, 101* (CALI) – Nilgiri Mountains, *Strachy s.n.* (NY, U) [Van Slageren 1985].

Range: India (Kerala, Tamil Nadu, Meghalaya [Singh & Asthana 2005]). Pantropical species distributed from tropical America through Africa to India and Nepal.

Lejeunea cavifolia (Ehrh.) Lindb., *Acta Soc. Sci. Fenn.*, 10: 43. 1871.

Representative specimen/s examined: Kotagiri, *Sedgwick*, 1916, 226; Kodaikanal, *Foreau*, 1934, 2163 [Chopra 1938: 250].

Range: India (Uttar Pradesh, Sikkim Himalaya, Assam-Shillong, Tamil Nadu), Nepal, China, Siberia, Caucasus, Europe and United States.

Lejeunea cocoes Mitt., *J. Proc. Linn. Soc. Bot.* 5: 114. 1861.

Representative specimen/s examined: India, Kerala, Kozhikode, Malabar Wildlife Sanctuary, Peruvannamuzhi (400 m), *Leena 723/L 10c* (ZGC, CALI); Kakkavayal Reserve Forest (100m), On bark and on small branches *Jitha, Manju & Rajesh 1069b, 1071b* (ZGC).

Range: India (Eastern Himalayas: Khasi hills, Cherrapunjii), Diego Garcia, Chagos, Sri Lanka, China incl. Taiwan, Java, Sarawak and Fiji Islands (Pócs *et al.* 2011). New to Southern India.

Lejeunea discreta Lindenb., *Syn. Hepat.* 361.1845.

Representative specimen/s examined: Kerala, Idukki, Eravikulam NP, Amarshole (2050 m), epiphytic; *Manju & Saju 80232*; Wayanad, Ponkuzhi (880 m) *Manju 84383* (CALI); Kodaikanal, 1909, *G. André s.n.*, syntype of *L. stahlia* (G-14272) [Mizutani 1971: 448].

Range: Indomalaysian species extending from India to Australia, New Guinea and Fiji Islands.

Lejeunea eifrigii Mizut., *J. Hattori Bot. Lab.* 33: 244. 1970.

Representative specimen/s examined: Thiruvananthapuram, Athirumala, (1200 m), on base of trees, *Sequera 80320/4* (CALI).

Range: In India it is reported only from Kerala (Pócs *et al.* 2007). Indomalaysian species, previously known from Malaysia to Papua New Guinea and to New Caledonia.

Lejeunea exilis (Reinw. *et al.*) Grolle, *J. Hattori Bot. Lab.* 46: 353. 1979.

Representative specimen/s examined: India, Kerala, Wayanad district, Chembra hills (1770 m) *Manju 99679* (CALI, EGR); Idukki, Eravikulam National Park (2250 m) *Manju 80243c* (CALI, EGR).

Range: India (Kerala). Indomalayan-Oceanian species distributed from Réunion through Asia and Australia to the Fiji Islands and to Samoa (Pócs *et al.* 2011).

Lejeunea flava (Sw.) Nees, Naturgesch. Eur. Leberm. 3: 277. 1838.

Representative specimen/s examined: Kerala, Kannur, Aralam WLS (1100 m) *K.P.Rajesh 99845/b*; Wayanad, Sulthan Batheri (933 m) Epiphytic, *Manju 84364* (CALI).

Range: Widespread Pantropical species.

Lejeunea helenae (Pears.) Pearson, Forh. Vidensk.-Selsk. Krist. 1886(3): 6. 1886.

Representative specimen/s examined: Kerala, Wayanad, Kalpetta (450 m) on logs, *Manju 99665b* (CALI).

Range: The known distribution of *L. helenae* is from Uganda and Malawi in Africa. Nair *et al.* (2005) recorded this species as new for India.

Lejeunea lowriana Steph., Sp. Hepat. 5: 779. 1915.

Representative specimen/s examined: Tamil Nadu, Kotagiri, *Sedgwick*, 1916, 224 [Chopra 1938: 250].

Range: Endemic to South India.

Lejeunea neelgherriana Gottsche, Syn. Hepat. 354. 1845.

Representative specimen/s examined:— Kerala, Idukki, Eravikulam NP, Amarshola (2050 m) Epiphytic, *Manju & Saju 80241* (CALI); Neel-Gherries (in montibus Nilgiriensibus), *Perrottet s.n.*, (holo)type (?G) [Montagne 1842b, as *Lejeunea inflexa?*; Mitten 1861: 115, as *Lejeunea nilgiriana*]. *Lejeunea olivacea* (Steph.) Steph. [non (Hook.f. & Taylor) Gottsche *et al.*] = *Lejeunea subolivacea* Mizut. [Mizutani 1965]

Range: Sri Lanka, India (Tamil Nadu, Kerala, Sikkim), Nepal, Bhutan and China, Japan and Korea (Zhu & So 2001).

Lejeunea obfusca Mitt., J. Proc. Linn. Soc. London 5: 114. 1861.

Representative specimen/s examined: Kerala, Thiruvananthapuram, Agasthyamalai BR (1300 m) *SVK 106620/c, 106636* (CALI)

Range: India (North-east India, Kerala, Tamil Nadu, Karnataka), Nepal and Sri Lanka. Very close to and maybe synonymous with *Lejeunea eifrigii* Mizut., which is distributed in China, Malaysia, Papua New Guinea and in the Philippines (Mizutani 1970, Zhu and So 2001).

Lejeunea pallide-virens S.Hatt., J. Hattori Bot. Lab. 12: 80. 1954.

Representative specimen/s examined: Kerala, Kasaragod, Kammadam Kavu (100 m) Epiphytic, *K.P.Rajesh 80055*; Wayanad, Ponkuzhi (880 m) Epiphytic, *Manju 84383* (CALI).

Range: Distributed in India (Kerala), China and Japan.

- Lejeunea perrottetii*** Steph., Hedwigia 29: xvii, 5. 1889.
Representative specimen/s examined: Nilgiri hills, *Perrottet s.n.* (G), holotype [Stephani 1917: 785].
Range: Endemic to South India.
- Lejeunea phyllobola*** Nees & Mont., Hist. Phys. Cuba, Bot., Pl. Cell., 9: 471. 1842.
Representative specimen/s examined: Tamil Nadu, Avalanche, 2 Jan 1972, R. Udar & S.C. Srivastava 805/72 (LWU) [Srivastava & Agarwal 1986, as *Rectolejeunea brittoniae*].
Range: A Pantropical species, widespread in tropical America and Africa, in Asia only in India: Eastern Himalaya and Tamil Nadu.
- Lejeunea princeps*** (Steph.) Mizut., J. Hattori Bot. Lab. 34: 454. 1971.
Representative specimen/s examined: Kerala, Kozhikode, Kakkayam (800 m) on small branches, *Manju 120134* (CALI).
Range: Endemic to the Indian subcontinent: India (West Bengal, Assam, Sikkim, Kerala) and Nepal.
- Lejeunea stevensiana*** (Steph.) Mizut., J. Hattori Bot. Lab. 34: 452. 1971.
Representative specimen/s examined: Kerala, Kozhikode, Kakkayam (850m) on rocks, *Manju 120125* (CALI).
Range: India (Sikkim, Himalayas, Khasi hills, Kerala), China, Bhutan and Nepal.
- Lejeunea subacuta*** Mitt., J.Proc. Linn. Soc. Bot. 5: 113. 1861
Representative specimen/s examined: Kerala, Kozhikode, Kakkayam (770 m) *Manju 120137*; Thrissur, Athirappalli (700 m); Follicolous on *Liparis viridiflora*, *Manju 106203* (CALI).
Range: China, India (Sikkim, Kerala), Nepal, Sri Lanka.
- Lejeunea tuberculosa*** Steph., Sp. Hepat. 5: 790. 1915.
Representative specimen/s examined: Kerala, Wayanad, Mananthavady (700 m) *Manju 80113b*. (CALI); Tamil Nadu, Kanyakumari Dist., W. Ghats, Upper Kodaiyar, ca 1250 m., 19 Apr 2002, *Daniels 2003* p.p. (MH, SCCN) [Daniels 2003].
Range: India (Sikkim, Kerala, Tamil Nadu), China, Bhutan, Nepal, Java, Philippines and Africa.
- Leptolejeunea balansae*** Steph., Hedwigia 35: 105. 1896.
Representative specimen/s examined: Kerala, Kasaragod, Kammadam Kavu (100 m) Epiphyllous, *KP. Rajesh 80052 b* (CALI); Kanyakumari Dist., W. Ghats, Upper Kodaiyar, ca 1250 m., 9 Nov 2001, *Daniels 1802* (MH, SCCN) [Daniels and Daniel 2004].
Range: Widespread in Andaman Islands, Malaysia, Indonesia, China to Vietnam and India (Kerala).
- Leptolejeunea elliptica*** (Lehm. & Lindenb.) Schiffn., Hepat. (Engl.-Prantl., 126. 1893.

Syn.: *Leptolejeunea subacuta* Steph. ex A. Evans, Proc. Wash. Acad. Arts Sci. 8: 149 (1906).

Representative specimen/s examined: Kodaikanal, 17 Dec 1971, *K.P. Singh* 323/71 (LWU) [Awasthi 1986: 123]. – Kanyakumari Dist., W. Ghats, Upper Kodaiyar, ca 1250 m., 19 Apr 2002, *Daniels* 1609,1611 (SCCN) [Daniels 2003]. Kerala, Aralam WLS, Ambalappara (1450 m); On bark, *K.P.Rajesh* 99877, *K.P. Rajesh* 099885; Palakkad, Parambikulam WLS (1150 m) On Bark, *Manju* 106817, *Manju* 10620; Kozhikode, Kakkayam (100 m) On bark, *Manju* 120170 (CALI).

Range: Pantropical.

Leptolejeunea foliicola Steph. Hedwigia 106. 1896.

Representative specimen/s examined: Kerala, Kozhikode, Kakkavayal (100 m) Foliicolous, Jitha, *Manju & Rajesh* 393 (ZGC).

Range: In India it is distributed in Kerala and Tamil Nadu. Also distributed in Japan, Java and Philippines.

Leptolejeunea maculata (Mitt.) Schiffn., Consp. Hepat. Arch. Ind., 275. 1898.

Representative specimen/s examined: Kanyakumari Dist., W. Ghats, Upper Kodaiyar, ca 1250 m., 26 Jan 2001, *Daniels* 1331, 1335, 1336, 1337 (MH, SCCN) [Daniels 2003].

Range: Widespread Pantropical species.

Leucolejeunea xanthocarpa (Lehm. & Lindenb.) A.Evans, Torreyia 7: 229. 1907.

Representative specimen/s examined:– Kodaikanal, Dec 1970–Jan 1971, *K.P. Singh* 5362/70 (LWU) [Udar & Nath 1971: 638; Udar & Awasthi 1983]. – Kodaikanal, Dec 1970–Jan 1971, *K.P. Singh* s.n. [Udar & Nath 1976]. – Kanyakumari Dist., W. Ghats, Muthukuzhivayal, ca 1250 m., 26 Jan 2001, *Daniels* 1394 (SCCN) [Daniels 2003].

Range: Widespread.

Lopholejeunea nigricans (Lindenb.) Schiffn., Consp. Hepat. Arch. Ind. 293. 1898.

Representative specimen/s examined: Kerala, Kannur, Aralam WLS (180 m), on small branches, *Manju* 87541; Palakkad, Parambikulam WLS, (1400 m) Epiphytic, *Manju* 10671, *Manju* 106819 (CALI).

Range: A widespread pantropical species distributed in Southern India (Kerala, Tamil Nadu), North-east India (Himalayas, Assam), Japan, China, Papua New Guinea, Brazil, Bolivia, Kenya and Africa.

Lopholejeunea subfusca (Nees) Steph., Hedwigia 29: 16. 1890.

Representative specimen/s examined: Kerala, Wayanad, Begur RF (845 m) *Manju* 84596; Kozhikode, Kakkayam (100 m) On bark, *Manju* 120161 (CALI).

Range: A widely distributed species.

Mastigolejeunea auriculata (Wilson & Hook.) Schiffn., Hepat. (Engl.-Prantl) 129. 1893.

Representative specimen/s examined: Kerala, Kozhikode, Guruvayurappan College Campus (70 m) On bark and branches of *Plumeria alba*, *Savitha 111606* (ZGC, CALI); Tamil Nadu, Kanyakumari Dist., W. Ghats, Edaicode, ca 50 m., 9–10 June 2002, *G. Shilu 167A, 175* (SCCN); Tirunelveli Dist. Chengaltheri, ca 650 m., Aug 1995, *Daniels 5* (SCCN) [Daniels 2003].

Range: A widely distributed pan tropical species.

Mastigolejeunea auriculata (Wilson & Hook.) Schiffn. var. *ciliata* (U.S.Awasthi & Udar)

A.E.D.Daniels & P.Daniel, Bull. Bot. Sur. India 49: 231. 2007.

Representative specimen/s examined:– Kanyakumari Dist., W. Ghats, Klamalai, ca 450 m., 18 Nov 1999, *Daniels 792* (SCCN) [Daniels 2003; Daniels & Daniel 2007a].

Range: Widespread.

Mastigolejeunea humilis (Gott.) Schiffn., in Engl. & Prantl, Nat. Pfl.-fam.1,3: 129. 1895.

Representative specimen/s examined: Kerala, Kakkayam (750 m) On bark *Manju 120110* (CALI).

Range: A widely distributed species India (Kerala, Meghalaya), Nepal, Japan, Java, Formosa and Ryukyu.

Mastigolejeunea indica Steph., Sp. Hepat. 4: 776. 1912.

Representative specimen/s examined: Kerala, Thrissur, Peechi (100 m), on bark, *Manju 80145* (CALI).

Range: A species known from Kerala, Andaman & Nicobar Islands and Thailand through Southern China to the Philippines and Australia.

Mastigolejeunea ligulata (Lehm. & Lindenb.) Schiffn., Consp. Hepat. Arch. Ind. 299. 1898.

Representative specimen/s examined: Kerala, Kasaragod, Kammadam Kavu (150 m), Epiphytic, *K.P.Rajesh, 80050/c* (CALI).

Range: Widespread in the Indo Pacific region, from India to New Guinea and to Australia.

Mastigolejeunea repleta (Taylor) A.Evans, Mem. Torrey Bot. Club, 8: 131. 1902.

Representative specimen/s examined: Madras, *Dr Wight*, (Hook. Herb. ?holotype of *Lejeunea repleta*) (G-1924, isotype) [Taylor 1846: 392; Mitten 1861: 110, as *Lejeunea repleta*; Verdoorn 1934: 109; Kitagawa 1973: 268]. – Perumalmalai, *Foreau 128* (NY) [Mizutani 1986: 285].

Range: China, Thailand, Malaysia, New Guinea, India (Arunachal Pradesh, Assam, Tamil Nadu)

Microlejeunea punctiformis (Taylor) Steph. Hedwigia 29:90. 1890.

- (Syn.: *Lejeunea punctiformis* Taylor, London J. Bot. 5 : 398. 1846).
Representative specimen/s examined: Kerala, Kozhikode, Kakkayam (850 m) on rocks, *Manju 120164*; Idukki, Eravikulam NP (2100 m) On bark, *Manju & Saju 80373/b* (CALI)
Range: Sri Lanka, India, Nepal, Bhutan, China incl. Taiwan, Thailand and Vietnam (Zhu and So 2001).
- Microlejeunea ulicina*** (Taylor) Steph., Hedwigia 29: 88. 1890.
Representative specimen/s examined: Tamil Nadu, Palni Hills, *Foreau*, 1934, 2123 [Chopra 1938: 250].– Kanyakumari Dist., W. Ghats, Klamalai, ca 1250 m., 26 Jan 2001, *Daniels 1332, 1433*.
Range: Northern temperate species distributed in Eurasia and North America.
- Otolejeunea semperiana*** (Gottsche et Steph.) Grolle, Haussknechtia 2: 53. 1985.
Representative specimen/s examined: India, Kerala, Kannur, Aralam WLS (400 m) *Manju & K.P. Rajesh 87633/a* (CALI).
Range: New record for India. Indomalayan species known from southern China, Indonesia, Malaysia, the Philippines and from Papua New Guinea.
- Ptychanthus striatus*** (Lehm. & Lindenb.) Nees, Naturgesch. Eur. Leberm., 3: 212. 1838.
Representative specimen/s examined: Idukki, Eravikulam NP, Erumapetty mala (2350 m) Epiphytic, *Manju 80211, 80217* (CALI).
Range: Widespread in the whole Indopacific region.
- Schiffneriolejeunea polycarpa*** (Nees) Gradst., J. Hattori Bot. Lab. 38: 335. 1974.
Representative specimen/s examined: Kerala, Parambikulam (1450 m) Palakkad, Epiphytic, *Manju 106717* (CALI); Neel-Gherries, *Perrottet s.n.* [Montagne 1842b: 15, as *Lejeunea polycarpa*]. – Nilgiri Hills, Naduvattam, ca 1982 m., 3 Jan 1972, *R. Udar et al 125S/72* (LWU) [Udar & Awasthi 1982c]. – Tirunelveli Dist., W. Ghats, Naalumukku, ca 130 m., 8 Nov 2000, *Daniels 1081*; Mancholai, ca 1100 m., 24 Aug 2001, *Daniels 1774C* (SCCN) [Daniels 2003].
Range: In India: Tamil Nadu, Kerala. A Pantropical species distributed from tropical America through Africa to Sri Lanka and southern India.
- Schiffneriolejeunea pulopenangensis*** (Gottsche) Gradst., J. Hattori Bot. Lab. 38: 335. 1974.
Representative specimen/s examined: – Kerala, Kozhikode, Guruvayurappan College Campus (60 m) On bark of *Polyalthia longifolia*, *Savitha 111626* (ZGC, CALI); Tamil Nadu, Kotagiri, *Sedgwick*, 1916, 233-237 [Chopra 1938: 249, as *Ptychocoleus pulopenangensis*]. – Tirunelveli Dist., W. Ghats, Mancholai, ca 1100 m., 24 Aug 2001, *Daniels 1775* (SCCN) [Daniels 2003, as *S. indica*].

Range: India (Kerala, Tamil Nadu, Karnataka), Sri Lanka, Malaysia, North Borneo, Moluccas and Japan.

Spruceanthus polymorphus (Sande Lac.) Verd., Ann. Bryol., Suppl. 4: 155. 1934.

Representative specimen/s examined: Kerala, Idukki, Eravikulam NP (2250 m) Epiphytic on *Ilex wightianum*, Manju 80216 (CALI).

Range: A species with wide Indopacific distribution from Sri Lanka to the Solomon Islands.

Spruceanthus semirepandus (Nees) Verd., Ann. Bryol. Suppl. 4: 153. 1934.

Representative specimen/s examined: Kerala, Thiruvananthapuram, Agasthyamalai BR (1450 m) Manju & K.P.Rajesh 106658 (CALI); Wayanad, Chembra (1770 m), Manju 120260 (CALI).

Range: It is distributed in South India (Kerala, Karnataka, Tamil Nadu), Northeast India (Western Himalaya, Sikkim, Meghalaya, Darjeeling), Sri Lanka, Japan, China, Java, Borneo, Philippines and Taiwan.

Trocholejeunea sandvicensis (Gottsche) Mizut., Misc. Bryol. Lichenol. 2: 169. 1962.

Representative specimen/s examined: Perumalmalai, Palni Hill, Foreau, 1924, 1932 [Verdoorn 1934: 56, as *Brachiolejeunea sandvicensis*]. – Kodaikanal, Foreau, 1934, 2158; Perumalamalai, Foreau, 1934, 2159 [Chopra 1938: 249]. – Madras, Kodaikanal, Georges Poreau s.n. [Mizutani 1989: 277]. *Tylimanthus indicus* Steph. = *Plagiochila ghatiensis* Steph. [Inoue 1975]

Range: Widely distributed in India, Pakistan, Bhutan, China, Vietnam, Japan, Korea, Malaysia.

Tuyamaella angulistipa (Steph.) Schust. & Kachroo, J. Linn. Soc., Bot., 56: 508. 1961.

Representative specimen/s examined: India, Kerala, Kannur, Aralam WLS (400 m) Manju & K.P.Rajesh 87633 b (CALI).

Range: New to India. Known from Malaysia (Pahang, Sabah), Vietnam and Java.

Discussion

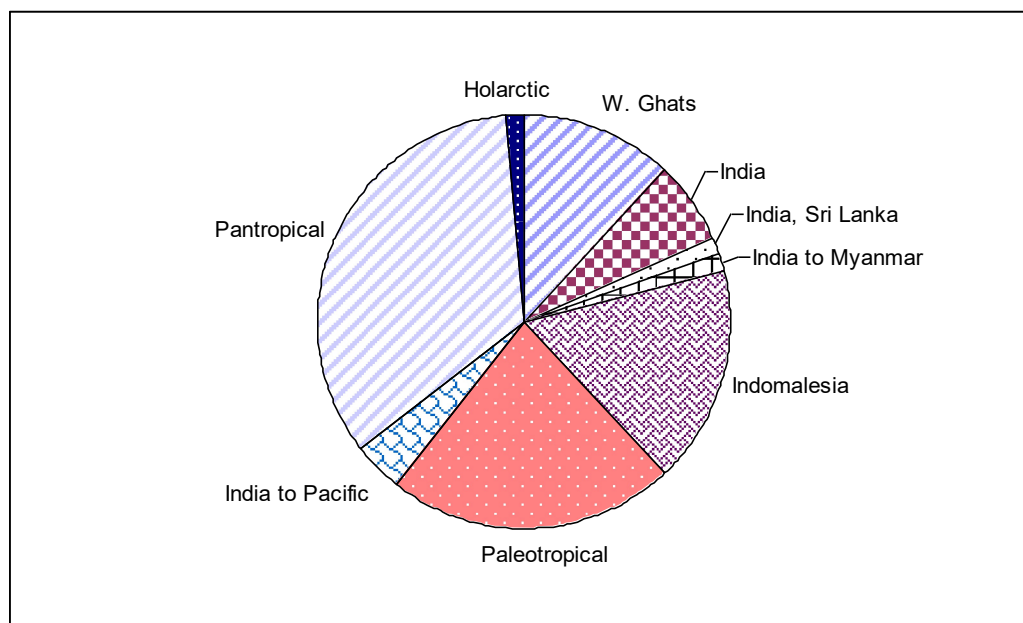
The forests of the Western Ghats support unique assemblages of biodiversity. The distribution of the Lejeuneaceae members is also unique in many respects, especially in supporting many endemics. Out of the 76 members studied in this paper, nine are Western Ghats endemics (Fig. 1). Five species are endemic to Indian subcontinent which include Nepal and Bhutan. One species, *Lejeunea obfusca* is confined to India and Sri Lanka. *Cheilolejeunea birmensis* is known to occur in India and Myanmar. Twelve species are Indo Malesian in distribution.

The present work also adds one more African element, i.e., *Archilejeunea abbreviata*, to India with other two, viz., *Cololejeunea furcilibulata* and *Lejeunea helenae*, totaling the number to three. The occurrence of *Microlejeunea ulicina*, the Northern temperate species distributed in Eurasia and North America is another notable feature of phytogeographical significance.

Seventeen paleotropical species occur in this region. Three species of Pacific-Oceania region are also present in the Western Ghats. Twenty six members of Lejeuneaceae of the Western Ghats, are Pantropical and enjoys widespread occurrence in areas, such as India-Sri Lanka to Pacific Islands through Africa.

In India most of the members were earlier known from the Himalayan area. The recent explorations resulted in recording many of them from the Western Ghats. The occurrence of Indo-Malesian elements, is represented by thirteen species, including the two species, *Otolejeunea semperiana* and *Tuyamaella angulistipa* added during the present study.

Fig. 1. Distribution pattern of Lejeuneaceae of the Western Ghats



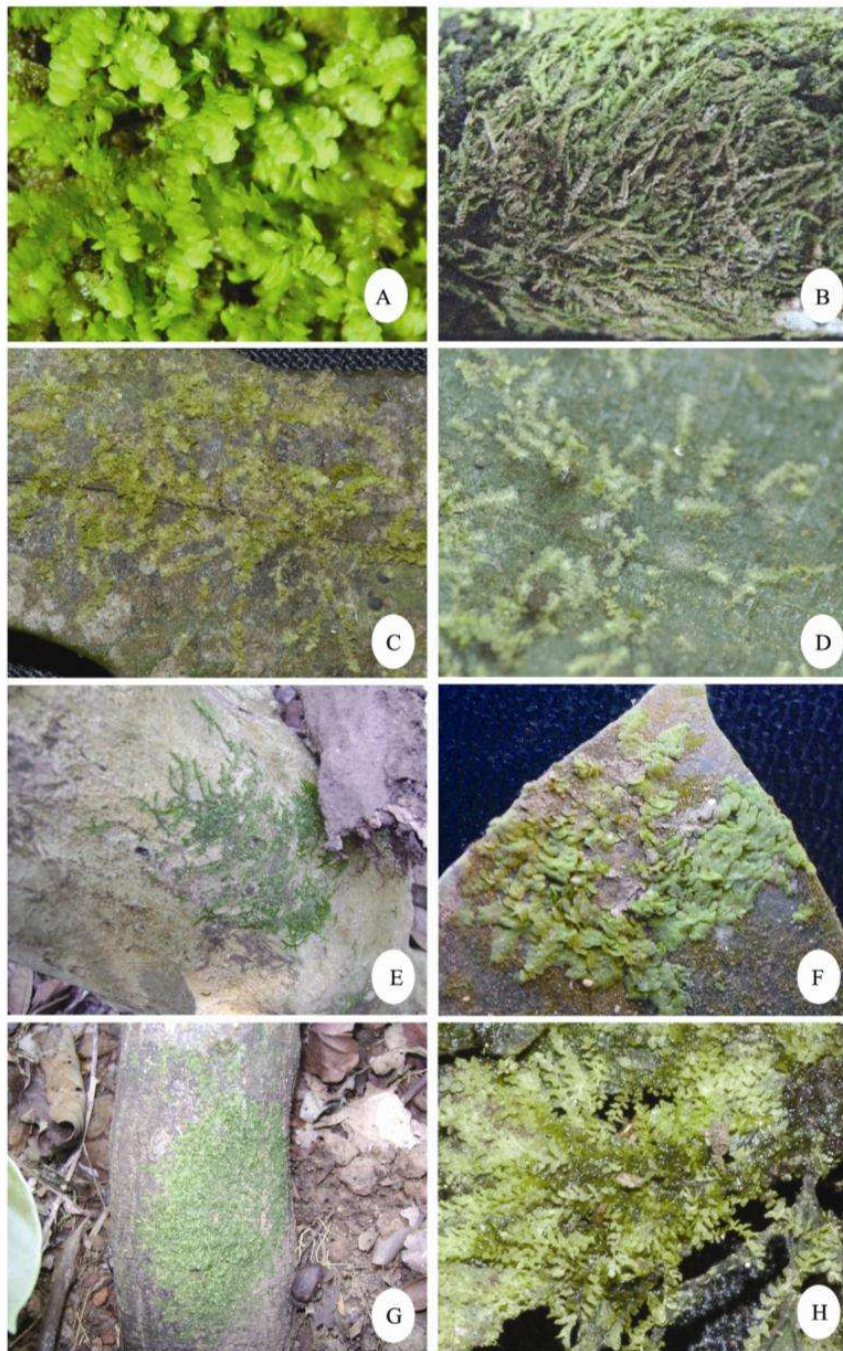


Plate 1

Plate 1: A: Cheilolejeunea giraldiana. B: Cheilolejeunea serpentina. C: Cololejeunea hasskarliana. D: Cololejeunea foliicola. E: Cololejeunea madothecoides. F: Cololejeunea lanciloba. G: Cololejeunea latilobula. H: Cololejeunea nilgiriensis.

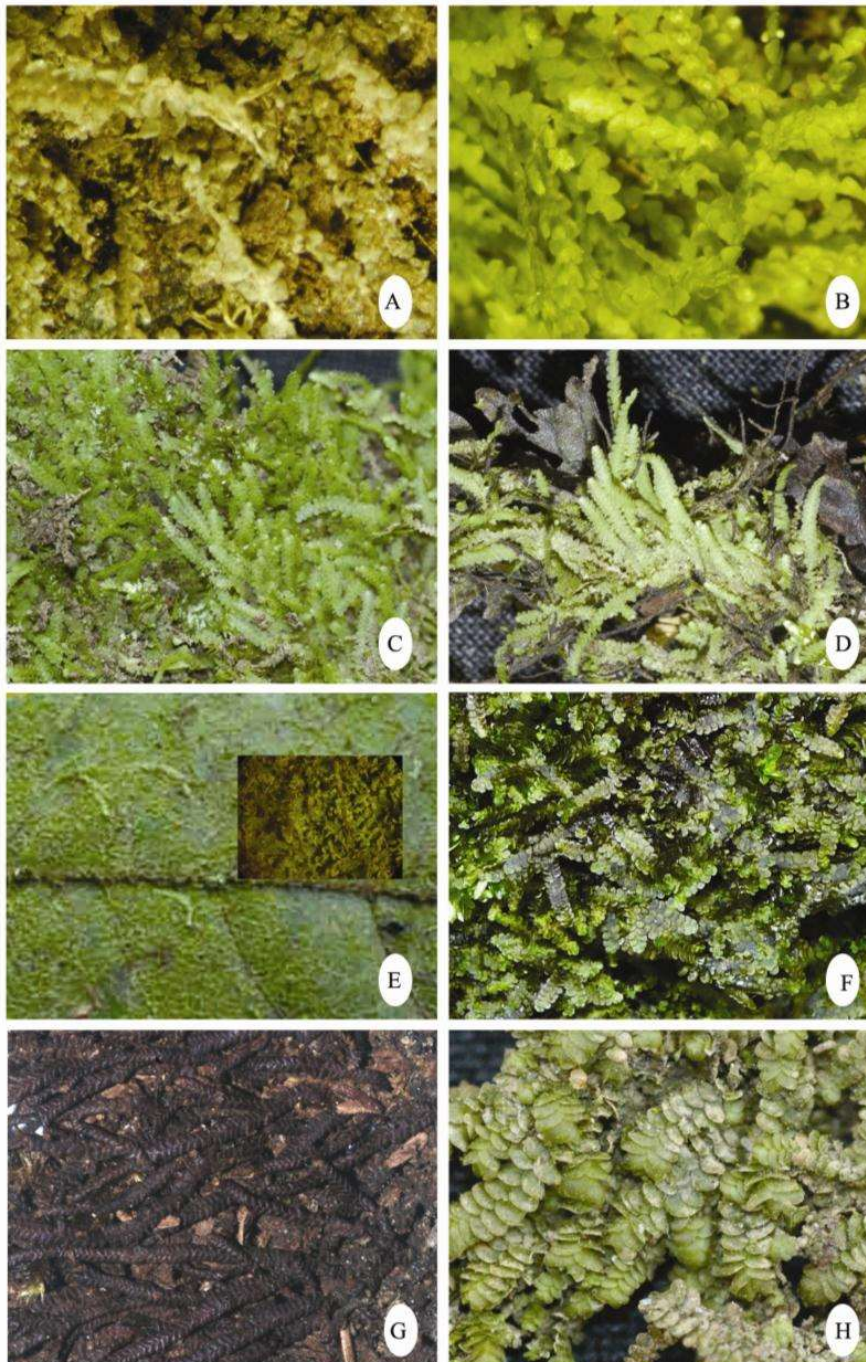


Plate 2

Plate 2: A.: Lejeunea helenae. B: Lejeunea stevensian., C: Lejeunea tuberculosa. D: Lejeunea flava., E: Leptolejeunea subacuta. F: Lopholejeunea sikkimensis. G: Schiffneriolejeunea polycarpa. H: Schiffneriolejeunea pulopenangensis.

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