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Bryophytes of Kakkayam forests in the Western Ghats and conservation

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A preliminary account of 52 species of bryophytes including 28 liverworts and 24 mosses of Kakkayam forests is presented here. This includes several new records of phytogeographical significance such as *Chiloscyphus polyanthus* (L.) Corda., *Cheilolejeunea subopaca* (Mitt.) Mizut., *Lejeunea punctiformis* Taylor, *Lejeunea stevensiana* (Steph.) Mizut., *Lejeunea subacuta* Mitt., *Fissidens jungermannioides* Griff., *Pogonatum decolyi* Gangulee, *Leucoloma taylori* (Schwaegr.) Mitt. and *Wijkia surcularis* (Mitt.) H.A.Crum found for the first time from Peninsular India and seven species *viz.*, *Calypogeia tosana* (Steph.) Steph., *Cheilolejeunea birmensis* (Steph.) Mizut., *Frullania gaudichaudii* Nees. & Mont., *Pallavicinia ambigua* (Mitt.) Steph., *Bryum alpinum* Huds. ex With., *Diphyscium involutum* Mitt. and *Barbella cubensis* (Mitt.) Broth. are new records to Kerala State.

Key-words-Bryophytes, Western Ghats, Kakkayam forests, Conservation

INTRODUCTION

THE preliminary assessment conducted by the Malabar Natural History Society (MNHS) as part of its biodiversity documentation and conservation programmes revealed rich biodiversity in Kakkayam Reserve Forest in Kozhikode District. This rapid assessment conducted during May 2003 has recorded more than 680 species of flowering plants in Kakkayam forests including 226 southern Western Ghats endemics. Sixty nine species belong to various 'threat' categories. A fairly good population of endemics such as *Meteromyrtus wayanaadensis*, *Syzygium stocksii*, *Atuna indica*, *Nostolachma crassifolia* and *Garcinia talbotii* are found here. The study also recorded more than 50 species of pteridophytes. The rich diversity of orchids, grasses and legumes indicates the high conservation potentials of the forest. Here we record 52 species of bryophytes from such a small area, which deserve better conservation status. All the bryophyte specimens collected are deposited in the Calicut University Herbarium (CALI).

STUDY AREA

Topographically, this part of the Western Ghats in the Kozhikode District comprises rugged, steep hills that rise from 50 m to 1,600 m. The area lies between 35°11'-35°40' Latitude and 75°55'-76°00' Longitude and is bordered by Wayanad District in the east, Kannur District in the north and Kozhikode in the south west (Fig. 1). The proximity of the Banasura Mala (2,059 m) and the varying altitudinal ranges have contributed to the rich biodiversity of the forest. It was once a good stretch of west coast tropical evergreen forest, lies contiguous with the forests of Wayanad and Aralam Wildlife sanctuaries of nearby Wayanad and Kannur District, respectively, and fragmented later by the construction of a reservoir for the Kuttiady Hydro Electric Project. Now it is one among the few evergreen forest patches left in the Kozhikode District. The river Kuttiadi, one of the major rivers of Kozhikode district originates from the Kakkayam forests. These forests form the catchment area of Kakkayam and Peruvannamoozhi reservoirs, the major source of water for irrigation and electricity production in the Kozhikode District. The Kuttiadi Power Project solely depend on these waters for the power generation in the Malabar part of Kerala. The vegetation of the area includes west coast tropical evergreen forests, west coast semi-evergreen forests, southern moist mixed deciduous forests, southern hilltop tropical evergreen forests and grasslands. The forest around the Kuttiady dam and reservoir (34 km^2) has already been declared as reserved forests. But the remaining part, which harbours much more biodiversity, is far from being protected but facing serious threats. This area has all the potentials for a wildlife sanctuary by adding the adjacent Ladysmyth reserve forest covering an extent of 100 Km^2. The MNHS has undertaken a biodiversity assessment programme to seek the potentials of establishing a protected area.

A preliminary checklist of the bryophytes of the Kakkayam forests is provided here, with details of microhabitat, altitude range, collection number, distribution and other relevant notes on some interesting species. The distribution data of the species is based on the authentic sources Asthana *et al.* (1995), Awasthi and Udar (1984), Awasthi *et al.*, (2000), Bapna and Kachroo (1999), Gangulee (1969-1980), Hattori (1973), Nath and Asthana (1998), Pande and Udar (1957), Srivastava and Srivastava (2002), Srivastava and Udar (1976), Udar and Kumar

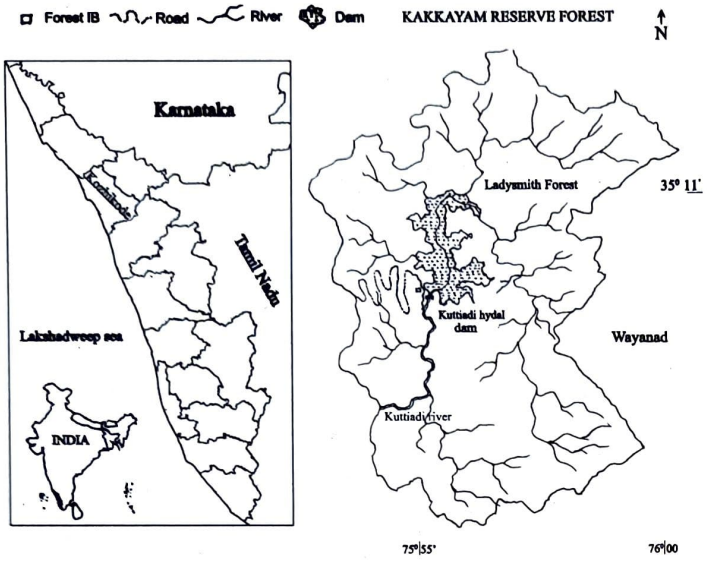

Fig. 1. Map showing location of Kakkyam Reserve Forest in Kozhikode District of Kerala.

(1982), Udar and Srivastava (1969), Udar and Kumar (1982) and W³MOST database (http://www.mobot.org/ MOBOT/ tropicos/most/welcome.shtml).

CHECKLIST OF BRYOPHYTES OF KAKKAYAM FORESTS

Liverworts

Family-Aneuraceae

1. ***Aneura pinguis*** (L.) Dum.

On rocks, 750 m (CALI 120120), A widely distributed species in India, recorded from Western Himalayas, Khasia hills, Palni Hills and from Kerala.

2. ***Riccardia multifida*** (L.) Dum.

On rocky patches near stream, 750-1000 m, (CALI 120101, 120169), A cosmopolitan species in India, known from Kerala, Tamil Nadu, Eastern Himalayas and Darjeeling.

3. ***Ricciardia tenuicostata*** Schiffn.

On soil cuttings, 700 m (CALI 120094 a), distributed in Singapore and Java, reported as a rare species in India, known from Kerala, Tamil Nadu, Darjeeling and Western Himalayas.

Family- Calypogeiaceae

4. ***Calypogeia tosana*** (Steph.) Steph.

On soil cuttings, 700 m (CALI 120098), recorded from Japan and China. In India from North-east India (Western Himalaya, Khasia Hills, Sikkim) and Tamil Nadu. This is the first record from Kerala State.

Family- Cephaloziellaceae

5. ***Cephaloziella kiaerii*** (Austin) Arnell SW.

On soil cuttings along with *Riccardia tenuicostata*, 700 m (CALI 120094 b), reported from Sri Lanka and China, widely distributed in Kerala and Tamil Nadu.

6. ***Cylindrocolea tagawae*** (N.Kitag.) Schust.

On soil cuttings, 750 m (CALI 120099), reported from Thailand, Southern Island of Ryukyu Islands, Hong Kong. The species in India has been reported from Western Himalayas, Tamil Nadu and Kerala. It is a widely distributed species in Western Ghats.

Family-Cyathodiaceae

7. ***Cyathodium cavernarum*** Kunze.

On soil cuttings, 850 m (CALI 120126), a widely distributed species.

Family-Fossombroniaceae

8. ***Fossombronia foveolata*** Lindb. var. *cristula* (Austin) Schust., R M

On soil cuttings, 900 m (CALI 120103), reported from Japan, Massachusetts, New York, North America and West Virginia, widely distributed species in India known from Kerala and Tamil Nadu.

Family-Jubulaceae

9. ***Frullania gaudichaudii*** Nees. & Mont.

Epiphytic, 1050 m (CALI 120185), reported from China, Japan and Sri Lanka, in India known from Tamil Nadu. This is the first record from Kerala State.

Family-Geocalycaceae

10. ***Heteroscyphus argutus*** (Reinw. *et al.*) Schiffn.

Epiphytic, 750-1050 m (CALI 120111, 120158), widely distributed in South Asia.

11. ***Chiloscyphus polyanthus*** (L.) Corda.

On soil cuttings, 800 m (CALI 120118), known reported from North-east India. This is the first record from Peninsular India.

Family-Jungermanniaceae

12. ***Jungermannia (Plectocolea)*** sp.;

On soil cuttings, 880 m (CALI 120114), This collection does not match with any of the species known from India. Further studies needed to fix the identity.

Family-Lejeuneaceae

13. ***Cheilolejeunea birmensis*** (Steph.) Mizut.

Epiphytic, 1000 m (CALI 120184 b), reported from Karnataka (Agumbe). This is the first record from Kerala State.

14. ***Cheilolejeunea serpentina*** (Mitt.) Mizut.

Epiphytic, 800-900 m (CALI 120122, 120138), a widely distributed species.

15. ***Cheilolejeunea subopaca*** (Mitt.) Mizut.

Epiphytic, 950 m (CALI 120157), reported from eastern Himalaya (Khasia, Darjeeling). This is the first record from Peninsular India.

16. ***Lejeunea discreta*** Lindenb.

Epiphytic, 900 m (CALI 120128), widely distributed species, reported from Kerala, Tamil Nadu, West Bengal, Himalayas and Sikkim in India.

17. ***Lejeunea punctiformis*** Taylor

Epiphyllose, 1050 m (CALI 120164), in India known from North-east India (Sikkim, Khasia hills) only. This is the first record from Peninsular India.

18. ***Lejeunea stevensiana*** (Steph.) Mizut.

On rocks, 850 m (CALI 120125), in India reported from North-east India (Sikkim, Himalayas, Khasia hills) only. This is the first record from Peninsular India.

19. ***Lejeunea subacuta*** Mitt.

On small branches, 770 m (CALI 120137), in India reported from Sikkim only. This is the first record from Peninsular India.

20. ***Lopholejeunea abortiva*** Steph.

Epiphytic, 880 m (CALI 120107), in India reported from North-east, Kerala and Tamil Nadu.

21. ***Lopholejeunea subfusca*** (Nees.) Steph.

Epiphytic, 1000 m (CALI 120161), a widely distributed species.

22. ***Mastigolejeunea humilis*** (Gott.) Schiffn.

Epiphytic, 750 m (CALI 120110), in India recorded from Kerala, Tamil Nadu, Eastern and Western Himalayas and Khasia Hills.

Family-Radulaceae

23. ***Radula kurzii*** Steph.

On rocks, 700-1050 m (CALI 120097, 120167), a widely distributed species.

24. ***Radula japonica*** Gottsche ex Steph.

Epiphytic and also on rock, 950 m (CALI 120149), Recorded from China and Japan, in India earlier reported from North-east and Wayanad of Kerala (Nair *et al.*, 2005).

Family-Marchantiaceae

25. ***Dumortiera hirsuta*** (Sw.) Nees.

On rocky patch near stream, 750- 1050 m (CALI 120145, 120181), a widely distributed species in high altitude areas.

Family-Pallaviciniaceae

26. ***Pallavicinia lyellii*** (Hook.) Carruth.

On rocks near streams, 1050 m (CALI 120182), a widely distributed species.

27. ***Pallavicinia ambigua*** (Mitt.) Steph.

Near riverine soil, 720 m (CALI 120100),), recorded from China and Japan, in India known from North-east and Tamil Nadu. This is a new record for Kerala.

Family-Ricciaceae

28. ***Riccia frostii*** Austin

On marshy area, 1050 m (CALI 120177), a widely distributed species.

Mosses

Family-Bryaceae

29. ***Bryum alpinum*** Huds. ex With.

On rock, 1050 m (CALI 120180), a widely distributed species, in India known from North-east (Sikkim, Khasi Hills, Shimla, Kashmir) and Tamil Nadu (Nilgiri Hills). This is the first record from Kerala State.

Family-Calymperaceae

30. ***Calymperes afzelii*** Sw.

On rocky soil and also at base of tree trunks, 900-1050 m (CALI 120124, 120166), a widely distributed species in tropics.

31. ***Calymperes erosum*** C.Muell.

Epiphytic, 970 m, (CALI 120152, 120162). It is a common species known from Sri Lanka, Myanmar, China, Africa and America, in India distributed in Goa, Kerala and Tamil Nadu.

32. ***Syrrhopodon leucophanoides*** Card. & P.Vard.

Epiphytic, 850 m (CALI 120109), a widely distributed species, in India recorded from North-east, Kerala and Tamil Nadu.

Family-Dicranaceae

33. ***Leucoloma amoene-virens*** Mitt.

Epiphytic, 780 m (CALI 120113), an Indo-Sri Lankan species distributed in South India (Tamil Nadu, Kerala), East India (Khasia Hills) and Sri Lanka.

34. ***Leucoloma taylorii*** (Schwaegr.) Mitt.

Epiphytic, 950 m (CALI 120150), a South-east Asiatic species reported from Western Himalaya. This is the first record from Peninsular India.

Family-Diphysciaceae

35. ***Diphyscium involutum*** Mitt.

On rocks, 700-1000 m (CALI 120096, 120188), a South-east Asiatic species reported from North-east (Khasia Hills) and Tamil Nadu (Palni Hills). This is the first record from Kerala State.

Family-Fissidentaceae

36. ***Fissidens ceylonensis*** Dozy & Molk.

On rocks, 900 m (CALI 120123), a widely distributed species.

37. ***Fissidens crispulus*** Brid. var. ***robinsonii*** (Broth.) B.C.Tan & Choy

On soil cuttings, 750 m (CALI 120159), it was earlier reported from China, Philippines and North India (Himalaya Nair *et al.* (in press).

38. ***Fissidens jungermannioides*** Griff.

On soil cuttings, 750 m (CALI 120195), according to Gangulee (1969) it is endemic in Khasia Hills. The present collection is the first record of its extended occurrence to Peninsular India.

39. ***Fissidens*** sp.

Epiphytic, 750 m (CALI 120112), the collection does not match with any of the species known from India. Further studies needed to fix the identity.

Family-Leucobryaceae

40. ***Octoblepharum albidum*** Hedw.

Epiphytic, 1000 m (CALI 120184 a), a widely distributed species.

Family-Orthotrichaceae

41. ***Macromitrium sulcatum*** (Hook.) Brid.

On logs, 900 m (CALI 120143), a widely distributed species.

Family-Meteoriaceae

42. ***Aerobryum speciosum*** (Dozy. & Molk.) Dozy. & Molk.

Epiphytic along with *Leucoloma taylorii* and *Meteoriopsis squarrosa*, 950 m (CALI 120151), an east and southeast Asiatic species, reported from North-east (Darjeeling, Arunachal Pradesh, Khasia Hills, Manipur, Meghalaya, Sikkim) and South (Western Ghats of Tamil Nadu and Kerala) India.

43. ***Barbella cubensis*** (Mitt.) Broth.

Epiphytic, 750 m (CALI 120116), known from North-east India (Arunachal Pradesh, Darjeeling, Khasia Hills) and South India (Tamil Nadu: Palni Hills and Karnataka: Coorg). This is the first record from Kerala State.

44. ***Meteoriopsis squarrosa*** (Hook.) Fleisch.

Hanging from small branches, 900 m (CALI 120139), a widely distributed species.

45. ***Floribundaria walkeri*** (Renauld & Cardot) Broth.

Epiphytic, 900 m (CALI 120135), Gangulee (1972) commented that it is an Indian endemic species distributed in Eastern Himalayas, West Bengal and Kerala. Literature shows that the species extends to China and Philippines.

46. ***Himantocladium plumula*** (Nees) M.Fleisch.

Epiphytic, 750-1000 m (CALI 120106, 120172), an Indo-Pacific species, in India known from Arunachal Pradesh, Assam, Khasia Hills and Kerala.

Family-Polytrichaceae

47. ***Pogonatum decolyi*** Broth ex Gangulee

On soil cuttings, 700 m (CALI 120095), an Indian endemic species earlier known only from North-east India (Darjeeling, Sikkim). This is the first record from Peninsular India.

Family-Pottiaceae

48. ***Hyophila involuta*** (Hook.) A.Jaeger

Epiphytic, 700 m (CALI 120105), a widely distributed species.

Family-Sematophyllaceae

49. ***Wijkia surcularis*** (Mitt.) H.A.Crum

Epiphytic, 750-1050 m (CALI 120127, 120186, 120196), reported from Nepal, China, Burma and Thailand and in India known from North-east (Sikkim and Khasia Hills) only. The present collection is a new record to Peninsular India.

Family-Thuidiaceae

50. ***Thuidium pristocalyx*** (C.Muell.) A.Jaeger

On rocky patches near streams, 1050 m (CALI, 120183), widespread in tropical and subtropical areas of Asia and Oceania.

Family-Brachytheciaceae

51. ***Brachythecium buchananii*** (Hook.) A.Jaeger

On small branches, 950 m (CALI, 120155), a widely distributed species.

Family-Hypnaceae

52. ***Vesicularia vesicularis*** (Schwaegr.) Broth.

On rocks near streams, 750-800 m (CALI 120102, 120121), this species was known in India as *V. montagnei* (Buck, 1998). This south and east Asiatic-Pacific species was distributed in North-east India (Western Himalaya, West Bengal, Arunachal Pradesh). Nair *et al.* (2006) recorded this species as new to Peninsular India

DISCUSSION

The present study, records the bryophytic richness of the region. This preliminary report includes 52 species of bryophytes including 28 liverworts and 24 species of mosses. Among these, nine species *viz.*, *Chiloscyphus polyanthus* (L.) Corda., *Cheilolejeunea subopaca* (Mitt.) Mizut., *Lejeunea punctiformis* Taylor, *Lejeunea stevensiana* (Steph.) Mizut., *Lejeunea subacuta* Mitt., *Fissidens jungermannioides* Griff., *Pogonatum decolyi* Gangulee, *Leucoloma taylori* (Schwaegr.) Mitt. and *Wijkia surcularis* (Mitt.) H.A.Crum are new records to Peninsular India. Seven species *viz.*, *Calypogeia tosana* (Steph.) Steph., *Cheilolejeunea birmensis* (Steph.) Mizut., *Frullania gaudichaudii* Nees. & Mont., *Pallavicinia ambigua* (Mitt.) Steph., *Bryum alpinum* Huds. ex With., *Diphyscium involutum* Mitt. and *Barbella cubensis* (Mitt.) Broth. are new records to Kerala State. To ascertain the full potential of the Kakkayam forests further detailed study is required. Presently only the forest around the Kakkayam dam and reservoir covering an area of about 34 km^2, has been protected as a reserve forest. Urgent steps have to be taken for the detailed documentation of the biodiversity of the area. It is recommended that the area of the Kakkayam Reserve Forest may be extended covering the adjoining forests which have been found rich in bryophytes and other plant life. By protecting the area, a unique assemblage of biodiversity including some of the Western Ghat endemics could be preserved in a comparatively small area.

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