

Macrolichens of Kanchendzonga Biosphere Reserve, Sikkim

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Sikkim Himalaya is well known for its rich plant wealth. The Kanchendzonga Biosphere Reserve (KBR) is located in North and West districts of Sikkim with a total area of 2619.92 sq km and represents one of the richest biodiversity centres in Eastern Himalaya. Lichen flora of the area is also rich both in abundance and species diversity. Macrolichens of KBR have been investigated resulting into documentation of 198 taxa. The enumeration of all the taxa, brief write-up on observations on vegetation types within the area and an assessment of past and present lichen flora of a well explored track in KBR area are provided.

Key-words - Macrolichens, Sikkim, Kanchendzonga Biosphere Reserve

INTRODUCTION

SIKKIM Himalaya is endowed with all glory of nature, especially with its extremely rich vegetal wealth. Kanchendzonga Biosphere Reserve (KBR) located between 27°15' and 27° 57' N latitude and 88° 02' and 88° 40'E longitude, with a total area of 2619.92 sq km, represents one of the richest biodiversity centres in Eastern Himalaya. It is situated in high altitude areas of North and West districts of Sikkim bordering northward and westward with China and Nepal. Its unique geographical position as well as the diverse topography corresponding to various climatic gradients, has immensely contributed to the vegetation from subtropical evergreen forests, temperate forests to alpine scrub forests. Lichen flora of the area is also rich both in terms of abundance and species diversity as evidenced by the existence of lichenological reports since the time of Sir J.D. Hooker. During post-Independence era Asahina (1966) and Awasthi (1988, 1991) made important contributions from the area. However, large tracts, particularly in North Sikkim district still remained unexplored. With the objective to investigate the lichen flora of Sikkim including the KBR, systematic explorations were made from different unexplored and under-explored areas, which resulted into documentation of 219 species (Sinha 1999). Specimens collected between 1994 and 2000 from Kanchendzonga Biosphere Reserve have been investigated, the study has resulted in to the

documentation of 198 macrolichen taxa from the area. An enumeration of all the taxa, brief write-up on observation of vegetation types met within the area and an assessment of past and present lichen flora of a well explored track in the studied area are provided.

MATERIAL AND METHOD

Different localities in buffer and core areas of KBR, were explored lichenologically between 1994 and 2000 while collecting specimens for state flora. A total of 1775 lichen specimens were collected during the period. The specimens were dried and mounted into suitable herbarium packets and investigated morphologically and anatomically. Lichen substances were investigated with the thin layer chromatography (TLC) using technique of Culberson (1972) and Walker and James (1985). Specific identifications were made with the help of monographic treatment of various genera. Most of these taxa were authenticated in the lichen herbarium of National Botanical Research Institute, Lucknow (LWG).

The present specimens have been compared with earlier report from KBR. The specimens are preserved at lichen herbarium of Botanical Survey of India, Sikkim Himalayan Circle, Gangtok (BSHC).

LICHEN VEGETATION

The lichen vegetation of Kanchendzonga Biosphere Reserve can broadly be classified in to following major types.

1. **Subtropical lichen vegetation:** This type of lichen vegetation occurs up to the altitude of 1800 m in environs of Kacheopalri, Labdang, Yoksun and Karchi area of West Sikkim and Bey, Mensithang, Sakyong, Pentong areas of North Sikkim. Both micro and macrolichens are found abundantly on the trunks of *Alnus nepalensis*, *Macaranga denticulata*, *Prunus cerasoides*, *Saurauia nepalensis*, *Schima wallichii*, etc. The common macrolichen taxa on these trees are *Everniastrum nepalense*, *Heterodermia boryi*, *H. diademata*, *Hypotrachyna koyaensis*, *Leptogium denticulatum*, *Parmelinella wallichiana*, *Parmotrema mellissii*, *Ramalina africana*, *Rimelia reticulata*, *Usnea baileyi* and *U. rubicunda*. The mossy boulders usually support the growth of *Cladonia*, *Labaria*, *Stereocaulon* and *Sticta*.
2. **Temperate lichen vegetation:** This type of vegetation occurs at the altitudes ranging between 1800 and 3600 m in the vicinity of Bakhim, Karchi, Phithang, Tsoka and upper Karchi areas of West Sikkim and Chaten, Jakthang, Kissong, Lachen, Tholung, Zema areas of North Sikkim. These forests can be distinguished as broad-leaved temperate forests between 1800 and 2700 m and coniferous forests above 2700 m elevations. These areas are usually dominated by macrolichen taxa, viz. *Bryoria*, *Cetrelia*, *Coccocarpia*, *Heterodermia*, *Hypogymnia*, *Myelochroa*, *Nephromopsis*, *Platismatia*, *Parmelia*, *Parmelaria*, *Punctelia*, *Ramalina*, *Sticta*, *Sulcaria* and *Usnea*. The lichens usually grow on the branches and trunks of *Acer campbellii*, *Betula utilis*, *Lithocarpus* spp., *Magnolia campbellii*, *Quercus* spp. *Rhododendron arboreum* and *R. grande*. The tall coniferous trees, viz. *Abies densa*, *Larix griffithi* and *Tsuga dumosa* usually support luxuriant growth of fruiticose taxa, viz. *Usnea longissima* and *Sulcaria virens* which cover the entire trees and present a very beautiful view. *Platismatia erosa*, a foliose lichen found abundantly on these coniferous trees, is a characteristic of temperate forests. Shrubby vegetation in these forests, particularly species of *Berberis*, *Cotoneaster* and *Rhododendron* can be seen laden with *Everniastrum cirrhatum*, *Hypogymnia hypotrpya*, *H. vittata*, *Nephroma helveticum*, *N. nakaoui*, and species of *Bryoria*, *Sulcaria* and *Nephromopsis*. The basal portion of these coniferous trees as well as the exposed roots of *Rhododendron* spp. are usually moist and support the uninterrupted growth of *Lobaria kurokawae*, *L. retigera*, *Sticta nylanderiana*, *Leptogium pedicellatum*, *L. trichophorum* while taxa, viz. *Baeomyces pachypus*, *Cladonia corniculata*, *C. furcata*, *C. squamosa*, *Peltigera collina*, *P. dolichorrhiza*, *Stereocaulon foliolosum*, *S. massartianum* and *S. myriocarpum* are common on the ground.
3. **Alpine lichen vegetation:** This type of vegetation occurs above 3600 m and up to the snow line. A majority of core zone of the KBR (out of 1784 sq km) area falls under this category in the vicinity of Dzongri, Lampokhari, Samiti, Thangsing, Zemathang areas in West Sikkim and Green Lake, parts of Llonakh valley, The La and areas west of Lachen river near Thangu in North Sikkim. Stunted shrubby vegetation and alpine meadows found in the area support a distinct lichen flora. This includes a number of microlichen taxa, out of which the species of *Rhizocarpon* with yellow areolate thallus are characteristic of alpine scrub vegetation. The shrubby plants of *Rhododendron anthopogon*, *R. ciliatum*, *R. lepidotum*, *Cassiope fastigata*, *Juniperus recurva*, *J. squamata* and species of genera *Berberis*, *Cotoneaster*, *Ribes*, *Salix*, *Vaccinium* are the suitable hosts for fruiticose taxa of *Beyoria*, *Evernia*, *Cetraria*, *Ramalina*, *Tuckermannopsis* and *Tuckneraria*. The large lichen colonies of *Cladonia arbuscula*, *C. delavayi* and *C. rangiferina* are also seen on the moist ground under these shrubs. The exposed boulders are the prominent features of this area which are usually seen with both microlichens species of *Bryoria*, *Cetraria*, *Cladonia*, *Evernia*, *Lethariella*, *Physcia*, *Umbilicaria* and *Xanthoparmelia*. The two other characteristic species of this area over and above *Rhizocarpon* are a fruiticose *Acrosyphus sphaerophoroides*

and an orange foliose lichen *Xanthoria elgans*. *Thamnolia vermicularis* a white fruticose lichen, used as 'dhoop' along with *Rhododendron anthopogon* and *Juniperus recurva*, is found almost everywhere on the ground. The ground lichens of cold deserts of The La and Llonakh valley represent *Allocetraria ambigua* and *Lethariella cladonioides* which are not seen in alpine areas of West Sikkim.

OBSERVATION

Within KBR, the Yoksum-Dzongri 16 km track, ranging between 1800 and 4000 m altitude, has been botanized since Hooker's time in 1849. Hooker's (1855) comments about the vegetation of this area in general as well as lichenogical observations as "The descent is so rapid, that in eight miles, the Raton waters every variety of vegetation, from the lichen of the poles to the palm of the tropics." and "there were few mosses, but crustaceous lichens were numerous, and nearly all of them of Scotch, Alpine, European and Arctic kinds.....The lichen called geographicus was most abundant and is found to indicate a certain degree of cold in every latitude..... It flourishes at 10,000 feet on the Himalaya, ascending thence to 18,000 feet" still holds good to date. Though the area has been under 'tourist map' and is visited by thousands of foreign and domestic tourists between April to June and September to November, the flora in general has not changed much. During the course of present investigations, most of the lichen taxa viz. *Acrosyphus sphaerophoroides*, *Bryoria bicolor*, *Bulbothrix meizospora*, *Cetrelia braunsiana*, *C. cetrarioides*, *C. pseudolivatorum*, *Cladonia delavayi*, *C. furcata*, *C. rangiferina*, *Evernisatrum nepalense*, *Heterodermia boryi*, *H. togashii*, *Myelochroa aurulenta*, *Oropogon formasanus*, *Parmelia adaugescens*, *P. saxatilis*, *Parmotrema nilgherrense*, *P. tinctorum*, *Rimelia reticulata*, *Stereocaulon coniophyllum*, *S. massartianum*, *S. myriocarpum*, *Sulcaria sulcata*, *Thamnolia vermicularis*, *Usnea baileyi*, *U. dendritica*, *U. himalayana*, *U. longissima*, *U. nepalensis*, *U. robusta* and *U. thomsonii* have been found again except *Evernia mesomorpha*,

Leprocaulon arbuscula, *L. pseudoarbuscula* and *Nephroma sikkimense*. Chopra (1934), has found that most of the lichen species which grew at higher elevations are becoming scarce due to human interference. Once a fairly common lichen *Solorina crocea*, which grew at lower elevations (1500-1700 m) up to the environs of Gangtok in East Sikkim, is now rare and could be located at Tholung (2400-2500 m) area of north Sikkim within KBR boundary only on a large boulder in dense and moist temperate forest.

List of species

Acrosyphus sphaerophoroides Lev., *Allocetraria ambigua* (Bab.) Kurok. & Lai, *A. globulans* (Nyl.) Thell & Randlane, *A. stracheyi* (Bab.) Kurok. & Lai, *Anzia physodea* Smith, *Artcoparamelia subcentrifuga* (Oxner) Hale, *Baeomyces pachypus* Nyl., *Bryoria bicolor* (Ehrh.) Brodo & D. Hawksw., *B. confusa* (Awasthi) Brodo & D. Hawksw., *B. himalayana* (Mot.) Brodo & D. Hawksw., *B. levis* Awasthi, *B. nitidula* (Th. Fr.) Brodo & D. Hawksw., *B. perspinosa* (Bystrek) Brodo & D. Hawksw., *Bulbothrix meizospora* (Nyl.) Hale, *Canomaculina subtinctoria* (Zahlbr.) Hale, *Cetraria islandica* (L.) Ach., *C. laevigata* Rassad., *C. melaloma* (Nyl.) Krempelh., *C. nigricans* Nyl., *C. muricata* (Ach.) Eckfeldt, *C. sepincola* (Ehrh.) Ach., *Cetrelia braunsiana* (Mull. Arg.) W. Culb. & C. Culb., *C. cetrarioides* (Delise ex Duby) W. Culb. & C. Culb., *C. collata* (Nyl.) W. Culb. & C. Culb., *C. pseudolivatorum* (Asah.) W. Culb. & C. Culb., *C. snaguinea* (Schaerer) W. Culb. & C. Culb., *Cetrelia rhytidocarpa* (Mon. & v.d. Bosch) Lai, *Cladia aggregate* (Swartz) Nyl., *Cladonia amourocraea* (Floerke) Schaerer, *C. arbuscula* (Wallroth) Hale & W. Culb., *C. chlorophaea* (Floerke) Sprengel, *C. coccifera* (L.) Willd., *C. corniculata* Ahti & Kashiwadani, *C. corymbescens* Nyl. ex Leighton, *C. delavayi* des Abb., *C. fenestralis* Nuno, *C. furcata* (Huds.) Schrader, *C. laii* S. Stenroos, *C. luteoalba* Wheldon & A. Wilson, *C. macilenta* Hoffm., *C. mongolica* Ahti, *C. ochrochlora* Floerke, *C. pocillum* (Ach.) Grognot, *C. pyxidata* (L.) Hoffm., *C. rangiferina* (L.)

- Nyl., *C. squamosa* Hoffm., *C. subulata* (L.) F. H. Wigg., *C. yunnana* (Vainio) des Abb. ex. J. C. Wei & Y. M. Jiang, *Coccocaripa erythroxyli* (Sprengel) Swinscow & Krog, *C. pellita* (Ach.) Mull. Arg., *Collema furfuraceum* (Arn.) Du. Reitz, *C. hookeri* Degel., *C. pulcellum* Ach., *Dibaeis baeomyces* (L. f.) Rambold & Hertel, *Evernisatrum cirrhatum* (E. Fries) Hale ex Sipman, *E. nepalense* (Taylor) Hale ex Sipman, *E. vexans* (Zahlbr. ex. W. Culb. & C. Culb.) Hale ex Sipman, *Flavocetraria cucullata* (Bellardi) Karnefelt & Thell, *Flavopunctelia flaventior* (Stirton) Hale, *Heterodermia angustiloba* (Mull. Arg.) Awasthi, *H. boryi* (Fee) K. Singh & S. R. Singh, *H. dactyliza* (Nyl.) Swinscow & Krog, *H. diademata* (Taylor) Awasthi, *H. firmula* (Nyl.) Trevisan, *H. hypocaesia* (Yasuda) Awasthi, *H. incana* (Stirton) Awasthi, *H. indica* (Magn.) Awasthi, *H. obscurata* (Nyl.) Trevisan, *H. pellucida* (Awasthi) Awasthi, *H. podocarpa* (Bel.) Awasthi, *H. pseudospeciosa* (Kurok.) W. Culb., *H. rubescens* (Rasanen) Awasthi, *H. speciosa* (Wulfen) Trevisan, *H. togashii* (Kurok.) Awasthi, *Hypogymnia alpina* Awasthi, *H. hypotrypa* (Nyl.) Rassad., *H. thomsoniana* (Mull. Arg.) Awasthi, *H. vittata* (Ach.) Gasilien, *Hypotrachyna crenata* (Kurok.) Hale, *H. koyaensis* (Asah.) Hale, *H. neodissecta* (Hale) Hale, *H. osseoalba* (Vainio) Park, *H. physcioides* (Nyl.) Hale, *H. rigidula* (Kurok.) Hale, *H. scytophylla* (Kurok.) Hale, *H. sinuosa* (Smith) Hale, *Lasallia pustulata* (L.) Merat, *Leprocaulon arbuscula* (Nyl.) Nyl., *L. pseudoarbuscula* (Asah.) Lamb & Ward, *Leptogium azureum* (Swartz) Mont., *L. burnetiae* Doge, *L. denticulatum* Nyl., *L. gelatinosum* (With.) J. Laundon, *L. pedicellatum* P.M. Jorg., *L. saturnium* (Dicks.) Nyl., *L. trichophorum* Mull. Aarg., *Lethariella cladonioides* (Nyl.) Korg, *Lobaria kurokawae* Yoshim., *L. pseudopulmonaria* Gyeln., *L. retigera* (Bory) Trevisan, *Melanelia hepatizon* (Ach.) Thell, *M. microglabra* Divakar, Upreti, Sinha & Elix, *M stygia* (L.) Essl., *Myelochroa aurulenta* (Tuck.) Elix & Hale, *M. irrugans* (Nyl.) Elix & Hale, *M. sikkimensis* Divakar, Upreti, Sinha & Elix, *M. xantholepis* (Mont. & v.d. Bosch) Elix & Hale, *Nephroma helveticum* Ach., *N. nakaoui* Asah., *N. sikkimense* Asah., *Nephromopsis isidioidea* (Ras.) Awasthi, *N. nephromoides* (Nyl.) Ahti & Randlane, *N. pallescens* (Schaerer) Park, *N. stracheyi* (Bel.) Mull. Arg., *Oropogon formasanus* Asah, *Parmelia adaugescens* Nyl., *P. saxatilis* Ach, *P. squarrosa* Hale, *Parmelinella wallichiana* (Taylor) Elix & Hale, *Parmotrema mellissii* (Dodge) Hale, *P. nilgherrense* (Nyl.) Hale, *P. praesorediosum* (Nyl.) Hale, *P. pseudonilgherrense* (Asah.) Hale, *P. sanctae-angelli* (Lyngé) Hale, *P. tinctorum* (Despr. ex Nyl.) Hale, *Peltigera cania* (L.) Willd., *P. collina* (Ach.) Schrader, *P. dolichorhiza* (Nyl.) Nyl., *P. polydactyla* (Neck.) Hoffm. var. *polydactyla*, *Pheaphyscia endococcina* (Koerber) Moberg, *P. endococcinodes* (Poelt) Essl., *P. hispidula* (Ach.) Moberg, *P. orbicularis* (Neck.) Moberg., *Physcia caesia* (Hoffm) Furnr., *P. dilatata* Nyl., *P. tribacoides* Nyl., *Physconia detera* (Nyl.) Poelt, *Platsimatia erosa* W. Culb. & C. Culb., *Punctelia rudecta* (Ach.) Krog, *Ramalina africana* (Stein) Dodge, *R. conduplicans* Vainio, *R. himalayensis* Rasanen, *R. roesleri* (Hochst. ex Schaerer) Hue, *R. shinanoana* Kashiw., *R. taitensis* Nyl., *Rhizoplaca chrysoleuca* (Smith) Zopf, *R. melanophthalma* (Ram. in Lam. & DC.) Leuckert & Poelt, *Rimelia reticulata* (Taylor) Hale & A. Fletcher, *Solorina crocea* (L.) Ach., *Stereocaulon alpinum* Laurer, *S. coniophyllum* Lamb, *S. foliolosum* var. *strictum* (Church Bab.) Lamb, *S. glareosum* (Savicz) Magn, *S. himalayense* Awasthi & Lamb, *S. massartianum* Hue, *S. myriocarpum* Th. Fr., *S. paradoxum* Lamb, *S. piluliferum* Th. Fr., *S. pomiferum* Duvgn, *S. togashii* Lamb, *Sticta cyphellulata* (Mull. Arg.) Hue, *S. nylanderiana* Zahlbr., *S. platyphylloides* Nyl., *Sulcaria sulcata* (Lev. in Jacquem) Bystrek ex Brodo & D. Hawksw., *S. virens* (Taylor) Bystrek ex Brodo & D. Hawksw, *Thamnolia vermicularis* (Swartz) Ach. ex Schaerer, *Tuckermannopsis chlorophylla* (Willd.) Hale, *Tuckernaria ahtii* Randlane & Saag, *T. laureri* (Krempelh.) Randlane & Saag, *Umbilicaria indica* Frey, *U. thamnoides* Hue, *U. vellea* (L.) Ach., *U. virginis* Schaerer, *U. yunnana* (Nyl.) Hue, *Usnea aciculifera* Ach., *U. baileyi* (Stirton) Zahlbr, *U. cineraria* Mot., *U. dendritica* Stirton, *U. eumitrioides* Mot., *U. fragilis* Stirton, *U. galbinifera* Mot., *U. himalayana* Bab., *U.*

longissima Ach., *U. montis-fuji* Mot, *U. nepalensis* Awasthi ex G. Awasthi, *U. orientalis* Mot., *U. pangiana* Stirton, *U. pseudosinensis* Asah., *U. rubicunda* Stirton, *U. sordida* Mot., *U. splendens* Stirton, *U. subsordida* Stirton, *U. thomsonii* Stirton, *U. undulata* Stirton, *Xanthoparmelia somloensis* (Gyeln.) Hale, *X. tinctina* (Mah. & gill.) Hale, *Xanthoria elegans* (Link.) Th. Fr., *X. soredata* (Vainio) Poelt.

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REFERENCE

- Asahina, Y 1966. Lichenes, pp. 592-605. In Hara. *The Flora of Eastern Himalaya*. Univ. Tokyo.
- Awasthi, DD 1965. Catalogue of Lichens from India, Nepal, Pakistan & Ceylon. *Beih. Nova Hedwigia* 17: 1-137.
- Awasthi, DD 1988. A key to the macrolichens of India and Nepal. *J. Hattori Bot. Lab.* 65: 207-302.
- Awasthi, DD 1991. A key to the microlichens of India, Nepal and Sri Lanka. *Bibliotheca Lichenol.* 40: 1-336.
- Chopra, GL 1934. *Lichens of the Himalayas. Pt. I. Lichens of Darjeeling and Sikkim Himalayas*. Punjab University, Lahore.
- Culberson, CF (1972). Improved conditions and new data for the identification of lichen products by standardized thin layer chromatographic method. *J. Chromatogr.* 72: 113-125.
- Hooker, JD 1855. *Himalayan Journals*, Vol. I & II, London, John Murry.
- Sinha, GP 1999. Lichens of Sikkim. Pp. 205-224. In K.G. Mukejee, B.P. Chamola, D.K. Upreti and R.K. Upadhyay (Eds.) *Biology of Lichens*. Aravali Books International, New Delhi.
- White, FJ & James, PW 1985. A new guide to microchemical techniques for identification of lichen substances. *Br. Lich. Soc. Bull.* 57(Suppl.): 1-41.