

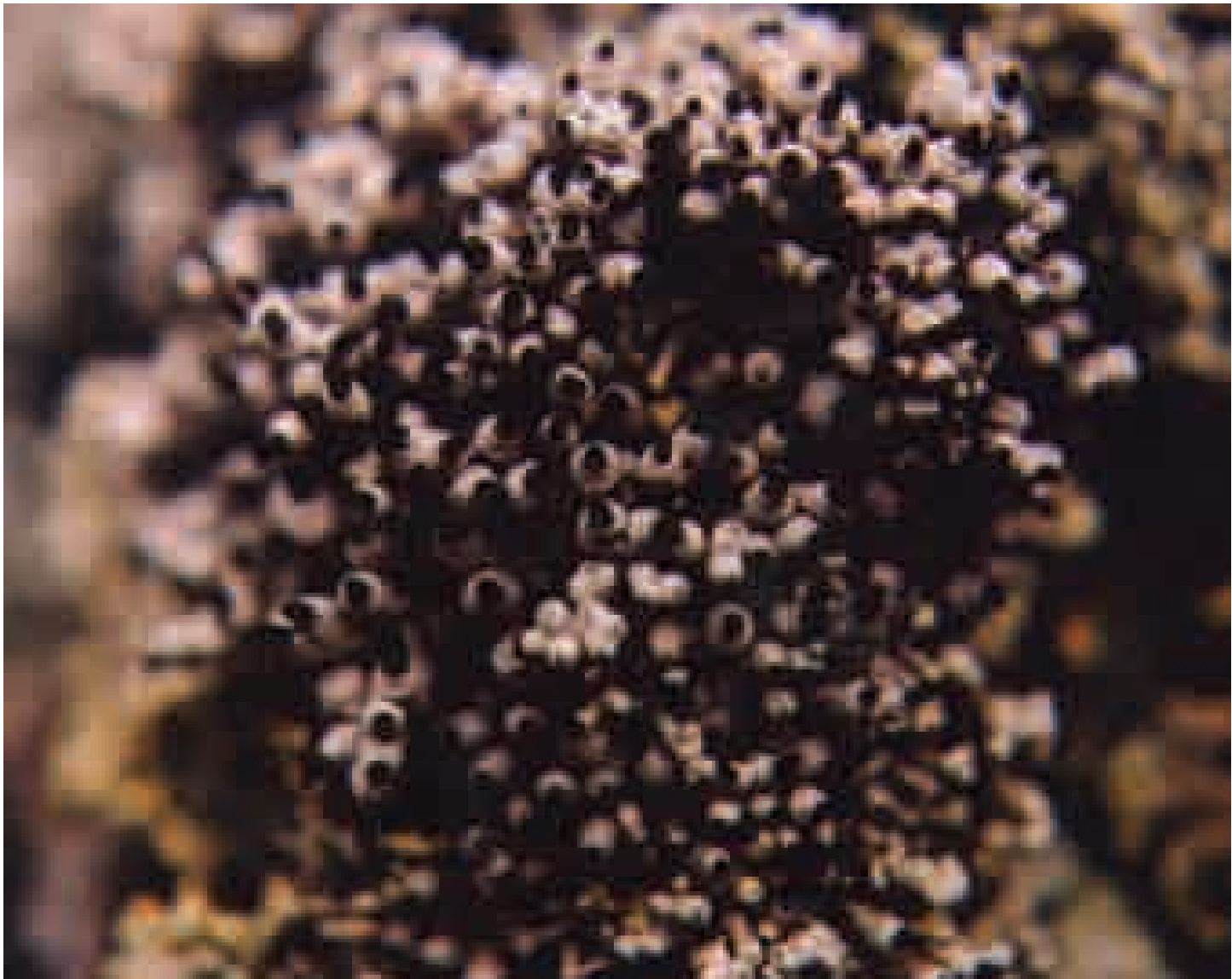
LICHEN DIVERSITY IN SIKKIM

G.P. Sinha and T.A.M. Jagadeesh Ram

ABSTRACT

Lichens, one of the excellent examples of symbiotic association, are group of non vascular cryptogams. They occur in all possible environmental habitats of the world, but are diverse in tropical region and luxuriant in temperate-alpine areas. Lichenologically, Sikkim along with north-eastern states of India is one of the richest zones in the country with abundance of many interesting taxa. The detailed study of lichens from Sikkim was initiated by Botanical Survey of India with the establishment of lichen section at Sikkim Himalayan Regional Centre, Gangtok in 1994. Systematic collections were made from different localities of Sikkim and the taxonomic investigations are not yet over. Based on these collections along with published information, an attempt is made here to discuss the diversity of lichens in Sikkim. A comparative up to date data on number of lichen taxa reported so far from Sikkim, West Bengal, North-eastern states of India; statistics of diversity of genera and species under dominant families and species under genera are discussed. A list of all the 506 lichen species known so far from Sikkim is also provided in Appendix for ready reference.

KEYWORDS: *Lichen diversity, Sikkim, Eastern Himalaya, North-east India*



Acrosyphus sphaerophoroides Lév. – a rare, non-endemic species, reported only from alpine bare rocks of West Sikkim in India



Usnea longissima Ach.- a common fruticose, pendulous lichen species of temperate areas

INTRODUCTION

Lichens, the nonvascular cryptogams and an excellent example of symbiotic association, have a composite thallus comprising of two components, mycobiont and photobiont. The association between the two has been so successful that a large number of fungi have opted for this symbiotic way of life resulting in recognition of *ca* 20,000 species in the world (Yamamoto, 1991). This symbiotic association in lichens is not just a random mixture of any fungal and algal species, but it is the manifestation of an extremely selective process that has evolved through ages and has developed in many directions. These along with mosses form dominant organism in ecosystem covering over 10 % of the earth's terrestrial habitat (Nash and Egan, 1988). Lichens with cyanobacterial symbionts contribute significantly to forest nitrogen fixation (Slack, 1988). Besides many other uses including folk uses, lichens are also used as pollution monitors and in dating of rocks.

Lichens are cosmopolitan in distribution and have adapted to all possible environmental habitats in the world. In Indian context, these are more prominent and diverse in mountainous ranges. Eastern Himalaya and Western Ghats are two main centers of diversity in India. The state of Sikkim on the western flanks of Eastern Himalaya, is also very rich in lichen flora like Angiosperms. Lichenologically this region together with north-eastern states of India is one of the richest zones in the country with abundance of many interesting taxa. However, Sikkim remained under-explored and less studied compared to vascular plants.

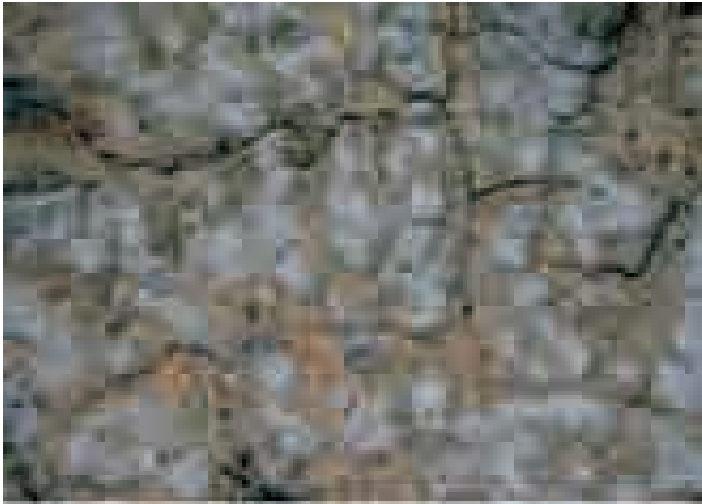
Lichen survey in Sikkim was initiated by Sir J.D.Hooker who botanised the state during 1846-48. Later his collections were worked out by Nylander (1860, 1863). After a long gap, Chopra (1934), Asahina (1966) and Awasthi (1965, 1988, 1991) made important contributions and total number of lichens reported by these workers were about 155 species. With the establishment of lichen section in the herbarium, Botanical Survey of India, Sikkim Himalayan Regional Centre, Gangtok (BSHC) in 1994, the studies on lichens of this state on intensive and extensive basis were planned. Systematic collections made from tropical, subtropical, temperate and alpine regions of all the four districts of Sikkim in preceding years resulted in collection of over 2500 specimens and several publications (Awasthi, 2007; Divakar *et al.*, 2001, 2003; Sinha, 1999, 2004a, b; Sinha and Chauhan, 1996, 1998; Sinha and Elix, 2003; Sinha and Singh, 2005; Upreti *et al.*, 2004). Based on published information (Singh and Sinha, 2010) and authors own first hand field observations during preceding years, an attempt has been made to discuss the diversity of lichens in Sikkim. A list of all the lichen species known so far from the state of Sikkim is also provided in Appendix for ready reference. Plant author names are not repeated which are available in Appendix to conserve space.

Lichen Vegetation

In general, the nature of lichen vegetation of an area is determined mainly by the variation in the altitude and climate. The lichen vegetation of Sikkim can be classified, as usually done for higher plants, into 4 major types viz. 1) Tropical lichen vegetation 2) Subtropical lichen vegetation 3) Temperate lichen vegetation and 4) Alpine lichen vegetation.

Tropical lichen vegetation

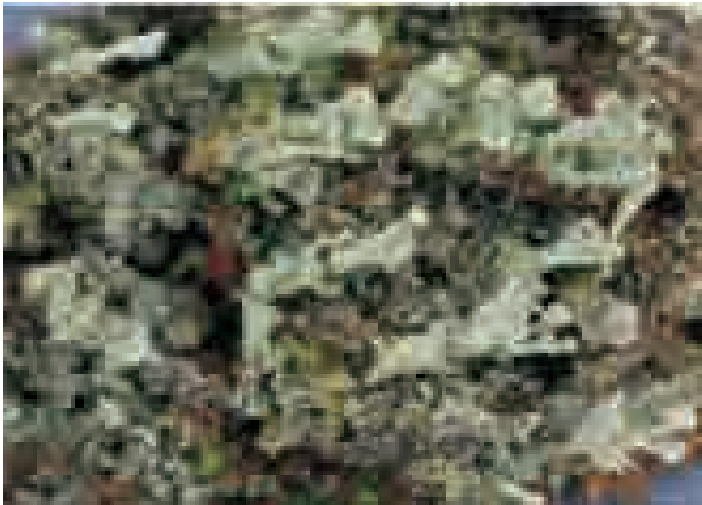
This type of lichen vegetation is usually found up to an altitude of 1000 m in the vicinity of Sanklang in North Sikkim district; Manpur, Majhitar, Jorethang in South Sikkim district; Adhari, Ahao, Assam-Lingzey, Aritar, Dikchu, Rangpo, Rhenok, Rongli, Rorathang, Simiklingey-Patukchandy, Singtam in East Sikkim district and Nayabazar in West Sikkim district. The foot hills below an altitude of 600 m usually have few lichens except in moist places. The lichen vegetation changes as the altitude increases. Here, the trunks of *Bischofia javanica* Blume, *Bombax ceiba* L., *Duabanga grandiflora* (Roxb. ex DC.) Walp, *Engelhardia spicata* Lechen ex Blume, *Schima wallichii* (DC) Korthals, *Terminalia bellirica*



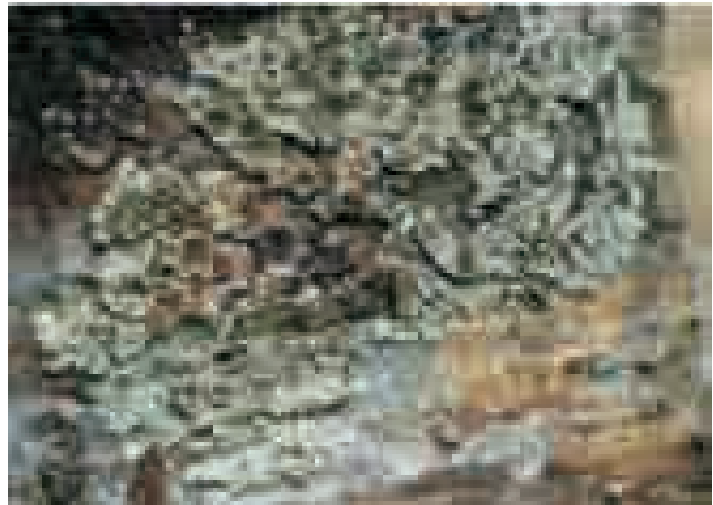
Arthothelium confertum (A.L. Sm.) Makhija & Patw. – a rare and endemic crustose species of North-Eastern India



Anthracothecium pustuliferum Ajay Singh – an endemic, but common crustose pyrenocarpous species of Eastern Himalaya



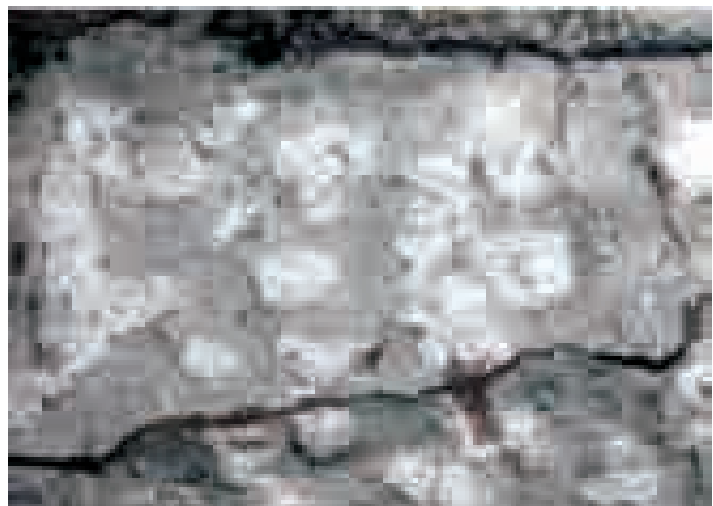
Cladonia coccifera (L.) Willd. – a common fruticose species of temperate areas



Bulbothrix meizospora (Nyl.) Hale - a common foliose species of tropical and subtropical areas



Cladonia furcata (Huds.) Schrad. - a common fruticose species of temperate areas



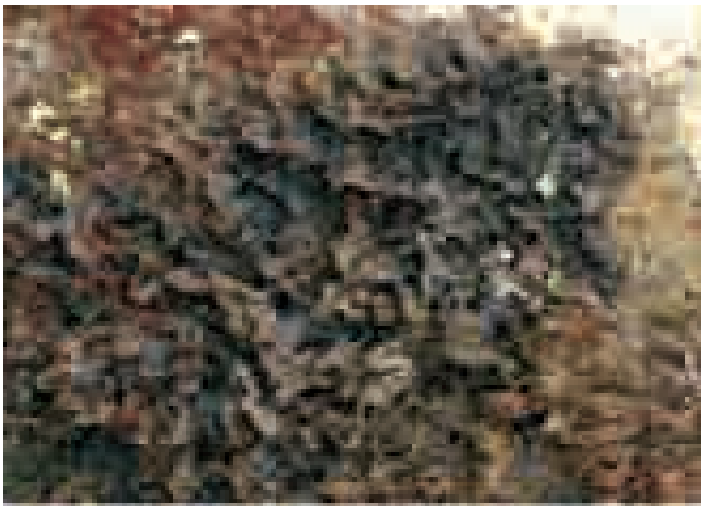
Cryptothecia farinosa Jagadeesh, G.P. Sinha & Kr.P. Singh – a newly described crustose species so far known from Sikkim only



Dimelaena oreina (Ach.) Norman – a common areolate-effigurate species characteristic of upper temperate areas



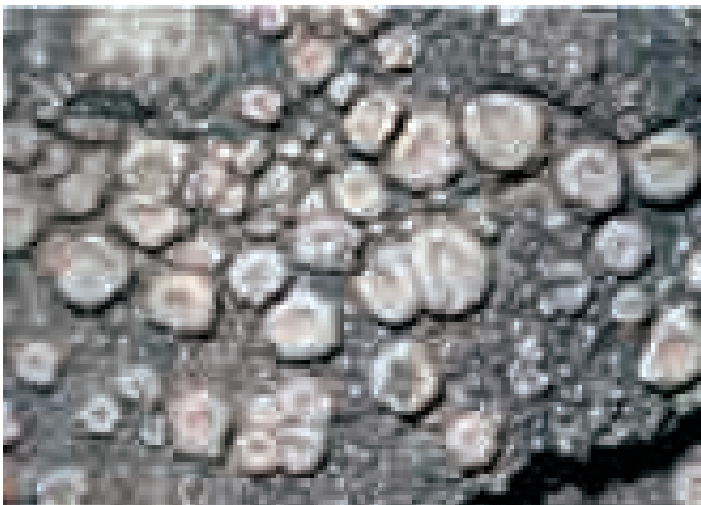
Herpothallon flavominutum Jagadeesh, G.P. Sinha & Elix – a newly described crustose species known from North-East India only



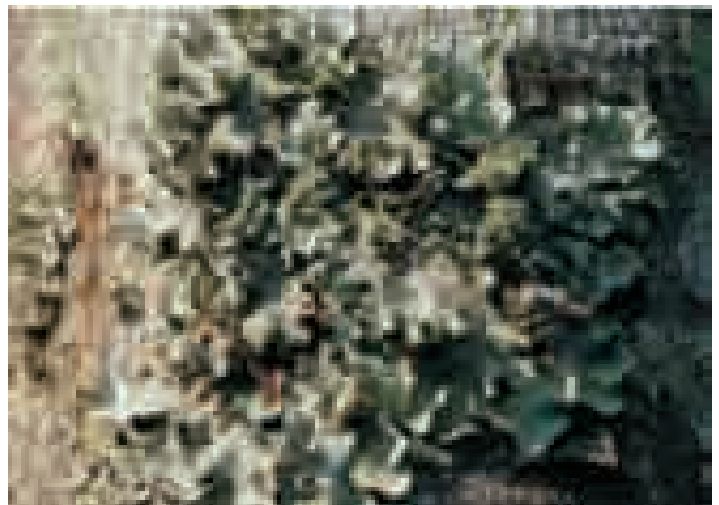
Leptogium trichophorum Müll. Arg. – a common foliose species of subtropical areas



Myelochroa xantholepis (Mont. & Bosch) Elix & Hale – a common foliose species of subtropical areas



Ochrolechia rosella (Müll. Arg.) Verseghy - a rare, crustose species of temperate areas



Parmotrema sancti-angelii (Lyngé) Hale - a common foliose species used as one of ingredients of 'Charrila' widely sold in Indian market



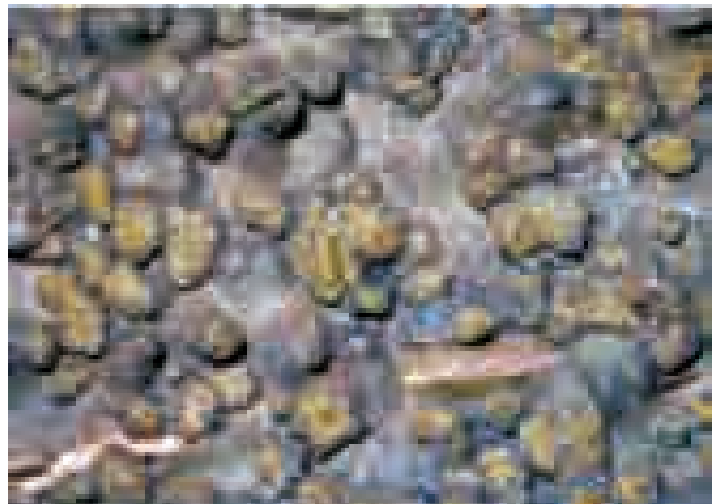
Xanthoria elegans (Link) Th. Fr. - a characteristic fruticose species of alpine vegetation.



Usnea pangiana Stirt. - a common fruticose species of temperate areas



Stereocaulon foliolosum Nyl. - a common fruticose species of rocks, used as a crude drug in urinary tract disorder



Trypethelium eluteriae Spreng. - a common crustose species of bark in tropical areas



Rhizocarpon geographicum (L.) DC. - a characteristic species of alpine vegetation

(Gaertn) Roxb., etc. support the growth of crustose lichens belonging to families Pyrenulaceae, Caliciaceae, Graphidaceae, Lecanoraceae, Pertusariaceae, Verrucariaceae and Arthoniaceae. Amongst foliicolous crustose lichens *Fellhanera bouteillei*, *Gyalectidium filicinum*, *Strigula maculata*, *Thelenella indica* are common. Few foliose lichens viz. *Bulbothrix setschwanensis*, *Dirinaria* spp., *Heterodermia diademata*, *Parmotrema praesorediosum* and *P. tinctorum*, etc. grow in moist open places in association with crustose taxa. In moist open places foliose forms of *Collema* spp., *Leptogium* spp., *Peltigera membranacea*, etc. grow on mossy rocks and lower portion of tree trunks. Fruticose forms are absent except *Usnea baileyi*, a cosmopolitan species seen growing sparsely on upper portion of tree branches and on exposed rocks.

Subtropical lichen vegetation

This type of vegetation occurs between the altitudes of 1000-1800 m in the vicinity of Bey, Mangan, Nampruk, Pentong, Sakyong, Upper Dzongu in North Sikkim district; Sumbuk-Kartikey, Ravangla, Tarku in South Sikkim district; Bhusuk, Chongey, lower ridges of Gangtok, Namthang, Pakyong, Ranipul, Regu, Rumtek, Sang, Saramsa, Setipul, Singtam, Tumin in East Sikkim district; Geyzing, Kacheopalri, Sombaria, Soreng, Tashiding and Yoksum in West Sikkim district. These areas have rich diversity of both crustose and foliose forms. Crustose lichens viz. *Cryptothecia farinosa*, *Diorygma junghuhnii*, *Glyphis cicatricosa*, *Graphis dendrogramma*, *G. scripta*, *Pertusaria composita*, *Phaeographis divaricoides*, *P. nilgiriensis* are abundant on trunks of *Alnus nepalensis* D. Don, *Eurya acuminata* DC., *Prunus cerasoides* D. Don, *Schima wallichii* (DC.) Korthals, *Terminalia* spp., along with many foliose species viz. *Bulbothrix isidiza*, *Coccocarpia erythroxyli*, *C. pellita*, *Everniastrum nepalense*, *Heterodermia diademata*, *Myelochroa subaurulenta*, *M. xantholepis*, *Parmelinella wallichiana*, *Parmotrema sancti-angelii*, *P. reticulatum*, *P. tinctorum*, *Pseudocyphellaria aurata*. In moist places *Leptogium burnetiae*, *L. delavayi*, *L. trichophorum*, *Lobaria retigera*, *Peltigera dolichorrhiza*, *P. praetextata* are more common. Foliicolous crustose lichens viz. *Aderkomycetes albostrigosus*, *Asterothyrium decipiens*, *Byssoloma leucoblepharum*, *B. subdiscordans*, *Coenogonium zonatum*, *Echinoplaca epiphylla*, *E. streimannii*, *Fellhanera bouteillei*, *F. semicarpi*, *Porina conica*, *Strigula maculata*, etc. grow profusely on leaves in moist shady places along streams and rivulets. Many fruticose species like *Ramalina conduplicans*, *Usnea baileyi*, *U. orientalis*, etc. grow on tree trunks while *Cladonia ramulosa*, *C. scabriuscula*, *C. squamosa*, *Stereocaulon foliolosum*, *S. piluliferum*, etc. are found on rocks.

Temperate lichen vegetation

This type of vegetation occurs at the altitudes ranging from 1800-3600 m in the vicinity of Chhaten, Jakthang, Lachen, Lachung, Phuni, Thangu, Tholung, Yakche, Yumthang, Zema in North Sikkim district; Damthang, Namchi, Rabangla, Samdruptse, Tendong in South Sikkim district; Gangtok, Karponang, Kyangnosla, Meimenchu, Penengla, Pangolakha, Pangthang-Rokshe, Phadamchen, Rechala in East Sikkim district and Bakhim, Barshey, Labdang, Karchi, Kongri, Pelling, Pemayangtse, in West Sikkim district. The temperate climate offers the optimum condition for luxuriant growth of foliose and fruticose forms. The trunks of *Acer campbellii* Hook.f. & Thomson ex Hiern, *Betula utilis* D. Don, *Castanopsis* spp., *Quercus lamellosa* Sm., *Rhododendron* spp., *Viburnum* spp. provide suitable habitat for growth of different species viz. *Nephromopsis nephromoides*, *N. pallescens*, *Cetrelia braunsiana*, *C. pseudolivatorum*, *Coccocarpia erythroxylii*, *Everniastrum cirrhatum*, *E. nepalense*, *E. vexans*, *Heterodermia comosa*, *H. incana*, *H. leucomelos*, *Parmelaria thomsonii*, *Parmotrema nilgherrense*, *Lobaria kurokawae*, *L. pseudopulmonaria*, *L. retigera*, *Platismatia erosa*, *Sticta indica*, *S. nylanderiana*, *Tuckneraria laureri*, etc. Crustose forms are usually fewer and grow on the grounds, boulders as well as on tree trunks. These lichen species mainly belong to the genera *Anthracothecium*, *Chapsa*, *Diploschistes*, *Lecanora*, *Mycobilimbia*, *Ochrolechia*, *Pertusaria*, etc. The fruticose forms like *Bryoria himalayana*, *Sulcaria sulcata*, *S. virens*, *Usnea himalayana*, *U. thomsonii*, are usually seen pendent from trees, while *Baeomyces pachypus*, *Cladonia arbuscula*, *C. furcata*, *C. pocillum*, *C. pyxidata*, *Dibaeis baeomyces*, *Stereocaulon massartianum*, *S. myriocarpum*, *S. paradoxum*, etc. grow abundantly on the ground as well as on exposed boulders in moist shady places. Foliose taxa viz. *Lobaria kurokawae*, *L. pseudopulmonaria*, *Nephroma helveticum*, *Peltigera canina*, *P. dolichorrhiza*, *Sticta nylanderiana*, *S. orbicularis*, *S. platyphylloides*, *S. weigeli*, etc. are well distributed in this zone and mostly grow on the dead wood fallen on the ground in association with mosses in moist places.

Coniferous forests which are found between 2750-3350 m altitudes in temperate zone with *Abies densa* Griff. ex Parker, *Larix griffithiana* Carriers, *Picea spinulosa* (Griff.) Henry, *Tsuga dumosa* (D. Don) Eichler as the dominant tree species hosting a multitude of *Nephromopsis stracheyi*, *Hypogymnia hypotrypa*, *Melanelia stygia*, *Parmelia adaugescens*, *Punctelia rudecta*, *Sulcaria virens*, *Usnea longissima*, *U. montisfuji*, *U. nepalensis*, *U. splendens*, etc.

Alpine lichen vegetation

This vegetation is usually found above 3600 m altitudes in the vicinities of Donkia La, Kissong La, Lashar, Llonak valley, Sebu La, Thangu, Theu La, Yomesamdong in North Sikkim district; Chhangu, Jelepla, Kupup, Nathula, Thegu, Sherathang, Yakla in East Sikkim district and Dzungri, Phedang, Samiti, Thangsing, Zemathang in West Sikkim district. A majority of alpine lichens are saxicolous or terricolous as trees are altogether absent. However, the dwarf bushes of *Berberis*, *Cassiope*, *Juniperus*, *Myricaria*, *Potentilla*, *Rhododendron* and *Salix* spp. are found laden with mainly fruticose species of genera *Bryoria*, *Cetraria*, *Lethariella*, *Ramalina* and *Usnea*. On exposed boulders, patches of fruticose *Acroscyphus sphaerophoroides*, *Cladia aggregata*, *Cladonia rangiferina*, *Stereocaulon himalayense*, *S. macrocephalum*; foliose *Nephroma helveticum*, *Nephromopsis* spp. *Lobaria* spp., *Physcia* spp., *Rhizoplaca chrysoleuca*, *R. melanophthalma*, *Umbilicaria indica*, *U. vellea*, *Xanthoria elegans*, and crustose species viz. *Aspicilia calcarea*, *Caloplaca scotoplaca*, *Dimelaena oriens*, *Rhizocarpon geographicum*, *R. sikkimense* are commonly seen. The ground cover is seen with patches of *Cetraria islandica*, *C. laevigata*, *C. melaloma*, *Cladia aggregata*, *Cladonia amourocraea*, *C. arbuscula*, *C. coccifera* and *Thamnolia vermicularis*. Some interesting lichens of this zone are *Acroscyphus sphaerophoroides*, *Allocetraria ambigua*, *A. stracheyi*, *Bryoria himalayana*, *B. implexa*, *Dimelaena oriens*, *Flavocetrariella melaloma*, *Lethariella cladonioides*, *Nephroma nakaoi*, *Rhizocarpon geographicum*, *Rhizoplaca chrysoleuca*, *Siphula ceratites*, *Usnea nepalensis* and *Xanthoria elegans*. As such, the alpine region has dominant and most luxuriant lichen vegetation in Sikkim.

The diversity

The lichen flora of Eastern Himalaya including North-Eastern states of India is richest in diversity and is represented by 1162 species. Based on earlier records and recent investigation, the state of Sikkim is represented by 506 lichen species under 128 genera, with many of the temperate and alpine tracts yet to be explored properly. Thus, it is evident from the above data that the state of Sikkim, which occupies only 0.2 % of geographical area of India and also harbors over 5,000 vascular plants, has richest diversity of lichens compared to other North-Eastern states. A comparative up to date data on lichen diversity in North-Eastern states, neighboring West Bengal (including plains) and Sikkim is presented in Table -1. Table -2 with statistics of genera and species under ten dominant families of India, Eastern Himalaya and North-Eastern states and Sikkim show that family Parmeliaceae holds first position in all the three categories. Family Graphidaceae (a crustose lichen family) is at number 2 in India as well as in Eastern Himalaya and North-Eastern states, while it is at number 4 in Sikkim. Similarly family Thelotremataceae (a family of crustose taxa) is at number 3 in India but find no place in eastern Himalaya and Sikkim. One of the important reasons of the anomaly, however, is that majority of microlichens (crustose) viz. families Arthoniaceae, Caliciaceae, Graphidaceae, Lecanoraceae, Pertusariaceae, Pyrenulaceae, Thelotremataceae, etc. remain to be studied properly from the area. The same is true even when statistics of species of 10 dominant genera under the 3 heads, as presented in Table-3, are compared. An analysis of species diversity in Sikkim leads to the following categorization.

Number of genera with 1 species	52
Number of genera with 2 species	28
Number of genera with 3 species	15
Number of genera with 4 species	03
Number of genera with 5 species	06
Number of genera with 6-10 species	13
Number of genera with 11-20 species	08
Number of genera with 21-30 species	02
Number of genera with 35 species	01

Here, it is interesting to note that maximum number of genera belong to 1 and 2 species category while maximum species diversity occurs in the genus (*Cladonia*) having 35 species. The available data also shows that Sikkim has some characteristic lichen genera e.g. *Acrosyphus*, *Oropogon* and *Siphula* which are hitherto unknown from other parts of India.

Table-1. Comparative data on lichen diversity in North-eastern states, neighbouring West Bengal and Sikkim

Name of States	Total geographical area (in sq km)	Actual forest cover (in sq km)	No. of species recorded so far
Arunachal Pradesh	83,743	68,757	477
Assam	78,438	24,751	141
Manipur	22,327	17,685	291
Meghalaya	22,429	15,875	179
Mizoram	21,081	18,553	02
Nagaland	16,579	14,321	306
Sikkim	7,096	3,033	506
Tripura	10,486	5,535	---
West Bengal (incl. plains)	88,752	8,015	510

Table-2. Total numbers of reported species under ten dominant lichen families of India, Eastern Himalaya & N.E. States and Sikkim

India	Eastern Himalaya & N.E. States	Sikkim
Parmeliaceae (345 spp.)	Parmeliaceae (221 spp.)	Parmeliaceae (164 spp.)
Graphidaceae (279 spp.)	Graphidaceae (142 spp.)	Physciaceae (39 spp.)
Thelotremaaceae (131 spp.)	Pyrenulaceae (87 spp.)	Cladoniaceae (37 spp.)
Pyrenulaceae (123 spp.)	Physciaceae (60 spp.)	Graphidaceae (34 spp.)
Caliciaceae (103 spp.)	Cladoniaceae (48 spp.)	Pyrenulaceae (22 spp.)
Lecanoraceae (99 spp.)	Lecanoraceae (46 spp.)	Collemaaceae (19 spp.)
Physciaceae (97 spp.)	Arthoniaceae (44 spp.)	Pertusariaceae (18 spp.)
Trypetheliaceae (79 spp.)	Trypetheliaceae (43 spp.)	Lecanoraceae (16 spp.)
Teloschistaceae (75 spp.)	Ramalinaceae (42 spp.)	Lobariaceae (15 spp.)
Collemaaceae (67 spp.)	Roccellaceae (37 spp.)	Peltigeraceae & Stereocaulaceae (12 spp. each)

Table-3. Total numbers of reported species under ten dominant lichen families of India, Eastern Himalaya & N.E. States and Sikkim

India	Eastern Himalaya & N.E. States	Sikkim
<i>Graphis</i> (111 spp.)	<i>Pyrenula</i> (64 spp.)	<i>Cladonia</i> (35 spp.)
<i>Pyrenula</i> (90 spp.)	<i>Graphis</i> (62 spp.)	<i>Usnea</i> (30 spp.)
<i>Lecanora</i> (83 spp.)	<i>Cladonia</i> (45 spp.)	<i>Heterodermia</i> (26 spp.)
<i>Caloplaca</i> (65 spp.)	<i>Lecanora</i> (41 spp.)	<i>Hypotrachyna</i> & <i>Graphis</i> (20 spp. each)
<i>Usnea</i> (60 spp.)	<i>Porina</i> (39 spp.)	<i>Pertusaria</i> (18 spp.)
<i>Porina</i> (58 spp.)	<i>Usnea</i> (38 spp.)	<i>Pyrenula</i> (15 spp.)
<i>Cladonia</i> (58 spp.)	<i>Heterodermia</i> (36 spp.)	<i>Lecanora</i> & <i>Leptogium</i> (13 spp. each)
<i>Parmotrema</i> (51 spp.)	<i>Pertusaria</i> (31 spp.)	<i>Stereocaulon</i> (12 spp.)
<i>Pertusaria</i> (50 spp.)	<i>Hypotrachyna</i> (27 spp.)	<i>Parmotrema</i> (11 spp.)
<i>Thelotrema</i> (42 spp.)	<i>Parmotrema</i> (25 spp.)	<i>Peltigera</i> (10 spp.)

The diversity is further enriched by mingling of the species of Japan, China and South-East Asian countries. Besides, many pantropical, pantemperate and transpacific elements are also present in Sikkim flora. Furthermore, the presence of some endemic taxa viz. *Cryptothecia farinosa*, *Hypogymnia sikkimensis*, *H. thomsoniana*, *Hypotrachyna neosingularis*, *Laurera sikkimensis*, *Nephroma sikkimensis*, *Rhizocarpon sikkimense*, *Sarcogyne sikkimensis*, *Thelenella indica*, *Tuckneraria sikkimensis*, etc. is the testimony of rich diversity of lichens in Sikkim. The list will further increase considerably as other localities get explored and the collection preserved in BSHC, BSA and LWG herbarium is identified in future. Detailed information on threat due to biotic activities and various developmental activities; list of endemic, rare and threatened lichens and measures for conservation will be possible when lichenological investigation is completed in due course. However, at this juncture, it can safely be said that the plant wealth including lichens are well protected under Khangchendzonga Biosphere Reserve and a number of Wildlife sanctuaries viz. Singbha Rhododendron Sanctuary, Barsey Rhododendron Sanctuary, Kyongnosla Alpine Sanctuary, Maenam Wildlife Sanctuary, Fambong Lho Wildlife Sanctuary and adjacent Reserve Forests. If these areas are protected with care, the lichens would need no special conservation measures separately.

ACKNOWLEDGMENTS

Authors are thankful to Dr. M. Sanjappa, Director, Botanical Survey of India, Kolkata and Dr. A.A. Ansari, Scientist-E & Head of Office, Botanical Survey of India, Allahabad for providing facilities.

APPENDIX (Alphabetical list of lichen species known so far from Sikkim)

- | | |
|---|---|
| <i>Acroscyphus sphaerophoroides</i> Lév. | <i>Aspicilia calcarea</i> (L.) Sommerf. |
| <i>Aderkomyces albostrigosus</i> (R. Sant.) Lücking <i>et al.</i> | <i>Asterothyrium decipiens</i> (Rehm) R. Sant. |
| <i>A. sikkimensis</i> Pinokiyo <i>et al.</i> | <i>Aulaxina microphana</i> (Vain.) R. Sant. |
| <i>Alectoria ochroleuca</i> (Hoffm.) A. Massal. | <i>Bacidia alutacea</i> (Kremp.) Zahlbr. |
| <i>Allocetraria ambigua</i> (C. Bab.) Kurok. & M.J. Lai | <i>B. nigrofusca</i> (Müll. Arg.) Zahlbr. |
| <i>A. denticulata</i> (Hue) A. Thell & Randle | <i>B. rubella</i> (Hoffm.) A. Massal. |
| <i>A. flavonigrescens</i> A. Thell & Randle | <i>Baeomyces pachypus</i> Nyl. |
| <i>A. globulans</i> (Nyl.) A. Thell & Randle | <i>Bryoria bicolor</i> (Ehrh.) Brodo & D. Hawksw. |
| <i>A. stracheyi</i> (C. Bab.) Kurok. & M.J. Lai | <i>B. confusa</i> (D.D. Awasthi) Brodo & D. Hawksw. |
| <i>Anthracotheceium assamiense</i> (Stirt.) Ajay Singh | <i>B. himalayana</i> (Motyka) Brodo & D. Hawksw. |
| <i>A. depressum</i> Müll. Arg. | <i>B. implexa</i> (Hoffm.) Brodo & D. Hawksw. |
| <i>A. maculatum</i> Nagarkar & Patw. | <i>B. levis</i> D.D. Awasthi |
| <i>A. platystomum</i> Müll. Arg. | <i>B. nitidula</i> (Th. Fr.) Brodo & D. Hawksw. |
| <i>A. pustuliferum</i> Ajay Singh | <i>B. perspinosa</i> (Bystrek) Brodo & D. Hawksw. |
| <i>A. thwaitesii</i> (Leight.) Müll. Arg. | <i>B. tenuis</i> (Å.E. Dahl) Brodo & D. Hawksw. |
| <i>A. variolosum</i> (Pers.) Müll. Arg. | <i>Buellia leptocline</i> (Flot.) Körb. |
| <i>Anzia physoidea</i> A.L. Sm. | <i>Bulbothrix isidiza</i> (Nyl.) Hale |
| <i>Arctoparmelia subcentrifuga</i> (Oksner) Hale | <i>B. meizospora</i> (Nyl.) Hale |
| <i>Arthonia dispersula</i> Nyl. | <i>B. setschwanensis</i> (Zahlbr.) Hale |
| <i>Arthothelium chiodectoides</i> (Nyl.) Zahlbr. | <i>Byssoloma leucoblepharum</i> (Nyl.) Vain. |
| <i>A. confertum</i> (A.L. Sm.) Makhija & Patw. | <i>B. subdiscordans</i> (Nyl.) P. James |
| <i>A. consociatum</i> Makhija & Patw. | <i>Calicium abietinum</i> Pers. |
| <i>A. deplanatum</i> (Müll. Arg.) Makhija & Patw. | <i>Caloplaca bassiae</i> (Willd. ex Ach.) Zahlbr. |
| <i>A. nigrescens</i> Makhija & Patw. | <i>C. saxicola</i> (Hoffm.) A. Nordin |

C. scotoplaca (Nyl.) H. Magn.
Candelaria concolor (Dicks.) Stein
C. indica (Hue) Vain.
Canoparmelia aptata (Kremp.) Elix & Hale
C. texana (Tuck.) Elix & Hale
Catillaria sikkimensis (Müll. Arg.) Zahlbr.
Cetraria islandica (L.) Ach.
C. laevigata Rass.
C. muricata (Ach.) Eckfeldt
C. nigricans Nyl.
Cetrelia braunsiana (Müll. Arg.) W.L. Culb. & C.F. Culb.
C. cetrarioides (Delise ex Duby) W.L. Culb. & C.F. Culb.
C. collata (Nyl.) W.L. Culb. & C.F. Culb.
C. delavayana W.L. Culb. & C.F. Culb.
C. japonica (Zahlbr.) W.L. Culb. & C.F. Culb.
C. olivetorum (Nyl.) W.L. Culb. & C.F. Culb.
C. pseudolivetorum (Asahina) W.L. Culb. & C.F. Culb.
C. sanguinea (Schaer.) W.L. Culb. & C.F. Culb.
C. sinensis W.L. Culb. & C.F. Culb.
Cetreliaopsis rhytidocarpa (Mont. & Bosch.) M. J. Lai
Chapsa pseudophlyctis (Nyl.) A. Frisch
Chrysothrix candelaris (L.) J.R. Laundon
C. chlorina (Ach.) J.R. Laundon
Cladia aggregata (Sw.) Nyl.
Cladonia amaurocraea (Flörke) Schaer.
C. arbuscula (Wallr.) Flot.
C. awasthiana Ahti & Upreti
C. borealis S. Stenroos
C. carneola (Fr.) Fr
C. cartilaginea Müll. Arg.
C. chlorophaea (Flörke ex Sommerf.) Spreng.
C. coccifera (L.) Willd.
C. corniculata Ahti & Kashiw.
C. corymbescens Nyl. ex Leight.
C. crispata (Ach.) Flot. var. *cetrariiformis* (Delise) Vain.
C. delavayi Abbayes
C. fenestralis Nuno
C. fruticulosa Kremp.
C. furcata (Huds.) Schrad.
C. kanewskii Oksner
C. kurokawae Ahti & S. Stenroos
C. laii S. Stenroos
C. luteoalba Wheldon & A. Wilson
C. macilenta Hoffm.
C. macroptera Räsänen
C. mongolica Ahti
C. nitens Ahti
C. ochrochlora Flörke
C. pocillum (Ach.) Grognot
C. pyxidata (L.) Hoffm.
C. ramulosa (With.) J.R. Laundon
C. rangiferina (L.) F.H. Wigg.
C. scabriuscula (Delise) Nyl.
C. singhii Ahti & P.K. Dixit
C. squamosa Hoffm.
C. stricta (Nyl.) Nyl.
C. submultiformis Asahina
C. subulata (L.) F.H. Wigg.
C. yunnana (Vain.) Abbayes ex J.C. Wei & Y.M. Jiang
Coccocarpia erythroxyli (Spreng.) Swinscow & Krog
C. palmicola (Spreng.) Arv. & D.J. Galloway
C. pellita (Ach.) Müll. Arg. em. R. Sant.
Coenogonium zonatum (Müll. Arg.) Kalb & Lücking
Collema flaccidum (Ach.) Ach.
C. furfuraceum (Arn.) Du Rietz
C. glaucophthamum Nyl. var. *implicatum* (Nyl.) Degel.
C. hookeri Degel.
C. japonicum (Müll. Arg.) Hue
C. pulcellum Ach. var. *subnigrescens* (Müll. Arg.) Degel.
Cryptothecia farinosa Jagadeesh *et al.*
C. scripta G. Thor
Dibaeis baeomyces (L.f.) Rambold & Hertel
Dimelaena oriena (Ach.) Norman
Diorygma junghuhnii (Mont. & Bosch) Kalb *et al.*
Diploschistes cinereocaesius (Sw. ex Ach.) Vain.
Diploschistes scruposus (Schreb.) Norman
Dirinaria aegialita (Afzel.) B.J. Moore
D. applanata (Fée) D.D. Awasthi
D. confluens (Fr.) D.D. Awasthi
D. consimilis (Stirt.) D.D. Awasthi
Echinoplaca epiphylla Fée
E. pellicula (Müll. Arg.) R. Sant.
E. streimannii Sérus.
Erioderma meiocarpum Nyl.
Evernia mesomorpha Nyl.
Everniastrum cirrhatum (Fr.) Hale ex Sipman
E. nepalense (Taylor) Hale ex Sipman
E. vexans (Zahlbr.) Hale ex Sipman
Fellhanera bouteillei (Desm.) V. da
F. semecarpi (Vain.) V. da

Flavocetraria cucullata (Bellardi) Kärnefelt & A. Thell
Flavocetrariella leucostigma (Lev.) D.D. Awasthi
F. melaloma (Nyl.) D.D. Awasthi
Flavoparmelia caperata (L.) Hale
Flavopunctelia flaventior (Stirt.) Hale
Glyphis cicatricosa Ach.
G. confluens Zenk.
Graphis acharii Fée
G. aurita Eschw.
G. chlorotica A. Massal & Kremp.
G. dendrogramma Nyl.
G. glauconigra Vain.
G. illinata Eschw.
G. intricata Fée
G. longiramea Müll. Arg.
G. marginata Raddi
G. persicina G. Mey. & Flot.
G. platycarpa Eschw.
G. proserpens Vain.
G. scripta (L.) Ach.
G. streblocarpa (Bél.) Nyl.
G. subducta Vain.
G. subvirginea Nyl.
G. supertecta Müll. Arg.
G. tenella Ach.
G. urandrae Vain.
G. vittata Müll. Arg.
Gyalectidium filicinum Müll. Arg.
Gymnoderma coccocarpum Nyl.
Haematomma leprarioides (Vain.) Vain.
H. puniceum (Sw.) A. Massal.
H. wattii (Stirt.) Zahlbr.
Hemithecium nakanishianum (Patw. & C.R. Kulk.) Makhija & A. Dube
Herpothallon flavominutum Jagadeesh *et al.*
H. isidiatum Jagadeesh & G.P. Sinha
H. philippinum (Vain.) Aptroot & Lücking
Heterodermia albidiflava (Kurok.) D.D. Awasthi
H. angustiloba (Müll. Arg.) D.D. Awasthi
H. awasthii (Kurok.) D.D. Awasthi
Heterodermia boryi (Fée) Kr.P. Singh & S.R. Singh
H. chondroidea Weber & D.D. Awasthi
H. comosa (Eschw.) Follmann & Redón
H. dactyliza (Nyl.) Swinscow & Krog
H. diademata (Taylor) D.D. Awasthi
H. dissecta (Kurok.) D.D. Awasthi
H. firmula (Nyl.) Trevis.
H. himalayensis (D.D. Awasthi) D.D. Awasthi
H. hypocaesia (Yasuda) D.D. Awasthi
H. hypoleuca (Ach.) Trevis.
H. incana (Stirt.) D.D. Awasthi
H. indica (H. Magn.) D.D. Awasthi
H. japonica (M. Satô) Swinscow & Krog
H. leucomelos (L.) Poelt
H. lutescens (Kurok.) Follmann
H. microphylla (Kurok.) Skorepa
H. obscurata (Nyl.) Trevis.
H. pellucida (D.D. Awasthi) D.D. Awasthi
H. podocarpa (Bél.) D.D. Awasthi
H. pseudospeciosa (Kurok.) W.L. Culb.
H. rubescens (Räsänen) D.D. Awasthi
H. togashii (Kurok.) D.D. Awasthi
H. tremulans (Müll. Arg.) W.L. Culb.
Hypogymnia alpina D.D. Awasthi
H. enteromorpha (Ach.) Nyl.
H. hengduanensis J.C. Wei
H. hypotrypa (Nyl.) Rassad.
H. physodes (L.) Nyl.
H. pseudohypotrypa (Asahina) Ajay Singh
H. sikkimensis G.P. Sinha & Elix
H. thomsoniana (Müll. Arg.) D.D. Awasthi
H. vittata (Ach.) Gasilien
Hypotrachyna adducta (Nyl.) Hale
H. crenata (Kurok.) Hale
H. dactylifera (Vain.) Hale
H. exsecta (Taylor) Hale
H. flexilis (Kurok.) Hale
H. imbricatula (Zahlbr.) Hale
H. incognita (Kurok.) Hale
H. infirma (Kurok.) Hale
H. koyaensis (Asahina) Hale
H. neodissecta (Hale) Hale
H. neosingularis Divakar *et al.*
H. osseoalba (Vain.) Y.S. Park and Hale
H. physcioides (Nyl.) Hale
H. pseudo-sinuosa (Asahina) Hale
H. radiculata (Kurok.) Elix
H. rhabdiformis (Kurok.) Hale
H. rigidula (Kurok.) Hale
H. scytophylla (Kurok.) Hale
H. sinuosa (Smith) Hale
H. sublaevigata (Nyl.) Hale
Ionaspis lacustris (With.) Lutzoni

Lasallia mayebarae (M. Sato) Asahina
L. pustulata (L.) Mérat
Laurera sikkimensis Makhija & Patw.
L. subbenguelensis Upreti & Ajay Singh
Lecanora achroa Nyl.
L. austrointumescens Lumbsch & Elix
L. chondroderma Zahlbr.
L. concilianda Vain.
L. fimbriatula Stirt.
L. flavidofusca Müll. Arg.
L. himalayae Poelt
L. imshaugii Brodo
L. iseana Räsänen
L. leprosa Fée
L. queenslandica C. Knight
L. rugosella Zahlbr.
L. tropica Zahlbr.
Lecidella bullata Körb.
Leprocaulon arbuscula (Nyl.) Nyl.
L. pseudoarbuscula (Asahina) I.M. Lamb & Ward
Leptogium arisanense Asahina
L. asiaticum P.M. Jørg.
L. askotense D.D. Awasthi
L. azureum (Sw. ex Ach.) Mont.
L. burnetiae C.W. Dodge
L. cochleatum (Dicks.) P.M. Jørg. & P. James
L. delavayi Hue
L. denticulatum Nyl.
L. gelatinosum (With.) J.R. Laundon
L. indicum D.D. Awasthi & Akhtar
L. pedicellatum P.M. Jørg.
L. saturninum (Dicks.) Nyl.
L. trichophorum Müll. Arg.
Lethariella cladonioides (Nyl.) Krog
Lobaria discolor (Bory) Hue
L. isidiosa (Müll. Arg.) Vain.
L. kurokawae Yoshim.
L. meridionalis Vain.
L. pseudopulmonaria Gyeln.
L. retigera (Bory) Trevis.
Megalaria laureri (Hepp ex Th. Fr.) Hafellner
Melanelia hepatizon (Ach.) A. Thell
M. stygia (L.) Essl.
M. tominii (Oksner) Essl.
Melanelixia glabroides (Essl.) O. Blanco *et al.*
Melanohalea olivacea (L.) O. Blanco *et al.*
M. poeltii (Essl.) O. Blanco *et al.*
M. septentrionalis (Lyngé) O. Blanco *et al.*
Menegazzia terebrata (Hoffm.) A. Massal.
Myelochroa aurulenta (Tuck.) Elix & Hale
M. metarevoluta (Asahina) Elix & Hale
M. perisidians (Nyl.) Elix & Hale
M. sikkimensis Divakar *et al.*
M. subaurulenta (Nyl.) Elix & Hale
M. xantholepis (Mont. & Bosch) Elix & Hale
Nephroma helveticum Ach.
N. isidiosum (Nyl.) Gyeln.
N. nakaoi Asahina
N. sikkimense Asahina
Nephromopsis ahtii (Randlane & Saag) Randlane & Saag
N. isidioidea (Räsänen) Randlane & Saag
N. laii (A. Thell & Randlane) Saag & A. Thell
N. nephromoides (Nyl.) Ahti & Randlane
N. pallescens (Schaer.) Park
N. stracheyi (C. Bab.) Müll. Arg.
N. togashii (Asahina) Randlane & Saag
Ochrolechia pallescens (L.) A. Massal.
O. rosella (Müll. Arg.) Verseggy
Oropogon formasanus Asahina
Pallidogramme chlorocarpoides (Nyl.) Staiger *et al.*
P. chrysenteron (Mont.) Staiger *et al.*
Parmelaria subthomsonii D.D. Awasthi
P. thomsonii (Stirt.) D.D. Awasthi
Parmelia adaugescens Nyl.
P. isidioclada Vain.
P. masonii Essl. & Poelt
P. meiophora Nyl.
P. saxatilis (L.) Ach.
P. squarrosa Hale
P. sulcata Taylor
Parmelina tiliacea (Hoffm.) Hale
Parmelinella wallichiana (Taylor) Elix & Hale
Parmelinopsis afrorevoluta (Krog & Swinscow) Elix & Hale
P. expallida (Kurok.) Elix & Hale
P. horrescens (Taylor) Elix & Hale
Parmotrema hababianum (Gyeln.) Hale
P. mellissii (C.W. Dodge) Hale
P. nilgherrense (Nyl.) Hale
P. pseudonilgherrense (Asahina) Hale
P. rampoddense (Nyl.) Hale
P. reticulatum (Taylor) M. Choisy
P. saccatilobum (Taylor) Hale

P. sancti-angelii (Lyngé) Hale
P. subsumptum (Nyl.) Hale
P. subtinctorium (Zahlbr.) Hale
P. tinctorum (Despr. ex Nyl.) Hale
Peltigera canina (L.) Willd.
P. collina (Ach.) Schrad.
P. dolichorrhiza (Nyl.) Nyl.
P. horizontalis (Huds.) Baumg.
P. macra Vain.
P. malacea (Ach.) Funck
P. membranacea (Ach.) Nyl.
P. polydactylon (Neck.) Hoffm.
P. praetextata (Flörke) Zopf
P. rufescens (Weiss) Humb.
Peltula obscurans (Nyl.) Gyeln.
Pertusaria amarescens Nyl.
P. ceylonica Müll. Arg.
P. composita Zahlbr.
P. coronata (Ach.) Th. Fr.
P. dehiscens Müll. Arg.
P. depressa (Fée) Mont & Bosch
P. himalayensis D.D. Awasthi & Preeti Srivast.
P. indica Preeti Srivast. & D.D. Awasthi
P. leucosora Nyl.
P. leucosorodes Nyl.
P. leucostoma (Bernh.) A. Massal.
P. multipuncta (Turn.) Nyl.
P. pallidula Stirt.
P. pseudococcodes Müll. Arg.
P. pustulata (Ach.) Duby
P. rigida Müll. Arg.
P. submultipuncta Nyl.
P. tropica Vain.
Phaeographina firmula (Stirt.) Zahlbr.
P. limbata Müll. Arg.
Phaeographis divaricoides Räsänen
P. nilgiriensis Kr.P. Singh & D.D. Awasthi
P. scalpturata (Ach.) Staiger
Phaeophyscia decolor (Kashiw.) Essl.
P. endococcina (Körb.) Moberg
P. hispidula (Ach.) Moberg
P. orbicularis (Neck.) Moberg
P. pyrrhophora (Poelt) D.D. Awasthi & M. Joshi
Phyllopsora corallina (Eschw.) Müll. Arg.
P. manipurensis (Müll. Arg.) Gotth.Schneid.
Physcia caesia (Hoffm.) Fürnr.
P. dilatata Nyl.
P. dimidiata (Arn.) Nyl.
P. tribacia (Ach.) Nyl.
P. tribacoides Nyl.
Physconia detersa (Nyl.) Poelt
P. muscigena (Ach.) Poelt
Platismatia erosa W.L. Culb. & C.F. Culb.
Platygramme caesiopruinosa (Fée) Fée
P. wattiana (Müll. Arg.) V. Tewari & Upreti
Platythecium albolabiatum (Patw. & C.R.Kulk.) A.W. Archer
Porina conica R. Sant.
P. dolichophora (Nyl.) Müll. Arg.
P. subcutanea Ach.
P. subhibernica Upreti
P. tetracerae (Ach.) Müll. Arg.
Porpidia crustulata (Ach.) Hertel & Schwab
Pseudocyphellaria aurata (Ach.) Vain.
P. clathrata (De Not.) Malme
Psilolechia lucida (Ach.) M. Choisy
Punctelia borreri (Sm.) Krog
P. rudecta (Ach.) Krog
Pyrenula astroidea (Fée) R.C. Harris
P. cayennensis Mull. Arg.
P. cuyabensis (Malme) R.C. Harris
P. globifera (Eschw.) Aptroot
P. interducta (Nyl.) Zahlbr.
P. leucostoma Ach.
P. leucotrypa (Nyl.) Upreti
P. macularis R.C.Harris
P. neoculata Aptroot
P. ochraceoflavens (Nyl.) R.C. Harris
P. oculata Ajay Singh & Upreti
P. pinguis Fée
P. quassiaecola Fée
P. subelliptica (Tuck.) R.C.Harris
P. subumbilicata (C. Knight) Aptroot
Pyxine retirugella Nyl.
P. sorediata (Ach.) Mont.
P. subcinerea Stirt.
Ramalina conduplicans Vain.
R. himalayensis Räsänen
R. roesleri (Hochst.) Hue
R. sinensis Jatta
R. shinanoana Kashiw.
R. taitensis Nyl.
Rhizocarpon geographicum (L.) DC.
R. sikkimense H. Magn.

R. superficiale (Schaer.) Malme
Rhizoplaca chrysoleuca (Sm.) Zopf
R. melanophthalma (DC.) Leuckert & Poelt
Rinodina sophodes (Ach.) A. Massal.
Sarcogyne sikkimensis Räsänen
Siphula ceratites (Wahlenb.) Fr.
Solorina crocea (L.) Ach.
S. simensis Hochst.
Sporopodium argillaceum (Müll. Arg.) Zahlbr.
Stereocaulon alpinum Laurer
S. coniophyllum I.M. Lamb
S. foliolosum Nyl.
S. glareosum (Savicz) H. Magn.
S. himalayense D.D. Awasthi & I.M. Lamb
S. macrocephalum Müll. Arg.
S. massartianum Hue
S. myriocarpum Th. Fr.
S. paradoxum I.M. Lamb
S. piluliferum Th. Fr.
S. pomiferum P.A. Duvern.
S. togashii I.M. Lamb
Sticta cyphellulata (Müll. Arg.) Hue
S. indica D.D. Awasthi & Upreti
S. limbata (Sm.) Ach.
S. nylanderiana Zahlbr.
S. orbicularis (R. Br.) Hue
S. platyphylloides Nyl.
S. praetextata (Räsänen) D.D. Awasthi
S. weigelii (Ach.) Vain.
Strigula maculata (Cooke & Masse) R. Sant.
Sulcaria sulcata (Lév.) Bystrek ex Brodo & D. Hawksw.
S. virens (Taylor) Bystrek ex Brodo & D. Hawksw.
Tapellaria saxicola V. Zda & Poelt
Tephromela khatiensis (Räsänen) Lumbsch
Thamnotia vermicularis (Sw.) Ach. ex Schaer.
Thelenella indica Pinokiyo & Kr.P. Singh
Trypethelium albopruinosum Makhija & Patw.
T. catervarium (Fée) Tuck.
T. eluteriae Spreng.
T. endosulphureum Makhija & Patw.
T. refertum Stirt.
Tuckermannopsis chlorophylla (Willd.) Hale
T. sepincola (Ehrh.) Hale
Tuckneraria laureri (Kremp.) Randle & A. Thell
T. sikkimensis Divakar & Upreti
Tylophoron moderatum Nyl.
Umbilicaria badia Frey
U. cylindrica (L.) Delise ex Duby
U. decussata (Vill.) Zahlbr.
U. indica Frey
U. nanella Frey & Poelt
U. thamnoides Hue
U. vellea (L.) Ach.
U. virginis Schaer.
U. yunnana (Nyl.) Hue
Usnea aciculifera Vain.
U. baileyi (Stirt.) Zahlbr.
U. bismolliuscula Zahlbr.
U. cineraria Motyka
U. compressa Taylor
U. dendritica Stirt.
U. eumitrioides Motyka
U. fragilis Stirt.
U. galbinifera Asahina
U. himalayana Bab.
U. leucospilodea Nyl.
U. longissima Ach.
U. luridorufa Stirt.
U. montisfuji Motyka
U. nepalensis D.D. Awasthi
U. nipparensis Asahina
U. norkettii G. Awasthi
U. orientalis Motyka
U. pangiana Stirt.
U. pectinata Taylor
U. pseudosinensis Asahina
U. robusta Stirt.
U. roseola Vain.
U. rubicunda Stirt.
U. sinensis Motyka
U. sordida Motyka
U. splendens Stirt.
U. subfloridana Stirt.
U. thomsonii Stirt.
U. undulata Stirt.
Vulpicida pinastri (Scop.) Mattson & M.J. Lai
Xanthoparmelia antleriformis (Elix) Elix & J. Johnst.
X. stenophylla (Ach.) Ahti & D. Hawksw.
X. tinctina (Maheu & A. Gillet) Hale
Xanthoria elegans (Link) Th. Fr.
X. sorediata (Vain.) Poelt

AUTHORS :

G.P. Sinha, Scientist –D, Botanical Survey of India,
Central Regional Centre, 10,
Chatham Lines, Allahabad – 211 002, Uttar Pradesh.
Telefax (O): 0532-2250179; (R) 0532-2441410
Mobile: 09956250352
Email: drgpsinha@yahoo.co.in, drgpsinha@gmail.com
(corresponding author)

Dr. T.A.M. Jagadeesh Ram, Scientist –C, Botanical Survey of India,
Andaman & Nicobar Regional Centre, Horticulture Road,
Haddo Post, Post Box No. 692, Port Blair – 744102, Andaman & Nicobar Islands.
Phone. (O): 03192-233224; Fax: 03192-230120
Mobile: 09531826800
Email: tamjagadeesh@yahoo.co.in

REFERENCES

- Asahina, Y. 1966. Lichens. In: *The Flora of Eastern Hiimalayas*, ed. Hara, pp. 592-605. Univ. Tokyo.
- Awasthi, D.D. 1965. Catalogue of Lichens from India, Nepal, Pakistan & Ceylon. *Nova Hedwigia* 17: 1-137.
- Awasthi, D.D. 1988. A Key to the macrolichens of India and Nepal. *Journal of the Hattori Botanical Laboratory* 65: 207-302.
- Awasthi, D.D. 1991. A Key to the microlichens of India, Nepal and Sri Lanka. *Bibliotheca Lichenologica* 40: 1-336.
- Awasthi, D.D. 2007. *A compendium of the Macrolichens from India, Nepal and Sri Lanka*. Bishen Singh Mahendra Pal Singh, Dehradun.
- Chopra, G.L. 1934. *Lichens of the Himalayas*. Punjab Univ. Press, Lahore.
- Divakar, P.K., Upreti, D.K., Sinha, G.P. and Elix, J.A. 2001. A new species of *Myelochroa* and new records in the lichen family Parmeliaceae (Ascomycotina), from Sikkim, India. *Mycotaxon* 79: 247-251.
- Divakar, P.K., Upreti, D.K., Sinha, G.P. and Elix, J.A. 2003. New species and records in the lichen family Parmeliaceae (Ascomycotina) from India. *Mycotaxon* 88: 149-154.
- Nash, T.H. and Egan, R.S. 1988. The Biodiversity of Lichens and Bryophytes. In: *Lichens, Bryophytes and air quality*, eds. Thomas Nash III, Volkmar Wirth. *ibid.* 30: 11-22.
- Nylander, W. 1860. *Synopsis methodica lichenum*, Vol. I. Paris.
- Nylander, W. 1863. *Synopsis lichenum*, Vol. II. Paris.
- Sinha, K.P. and Sinha, G.P. 2010. *Indian Lichens: An annotated Checklist*. Botanical Survey of India, Kolkata.
- Sinha, G.P. 1999. Lichens of Sikkim. In: *Biology of Lichens*, eds. K.G. Mukerji, B.P. Chamola, D.K. Upreti and R.K. Upadhyay, pp. 205-224. Aravali Books International, New Delhi.
- Sinha, G.P. 2004a. Macrolichens of Kanchendzonga Biosphere Reserve, Sikkim. *Geophytology* 35(1-2): 35-38.
- Sinha, G.P. 2004b. Additions to the Lichen Flora of India from Sikkim. *Bulletin of the Botanical Survey of India* 45(1-4): 221-224.
- Sinha, G.P. and Chauhan, A. S. 1996. Lichen Flora of Sikkim: Some New Generic Records. *Himalayan Paryavaran* 4(1): 75-78.
- Sinha, G.P. and Chauhan, A. S. 1998. Lichen Diversity in Sikkim. In: *Sikkim: Perspective for Planning & Development*, S.C. Rai, R.C. Sundriyal and Eklabya Sharma (eds.), pp. 233-240. Sikkim. Science Society, Gangtok & Bishen Singh Mahendra Pal Singh, Dehradun.
- Sinha, G.P. and Elix, J.A. 2003. A new species of *Hypogymnia* and a new record in the lichen family Parmeliaceae (Ascomycota) from Sikkim. *Mycotaxon* 87: 81-84.
- Sinha, G.P. and Singh, K.P. 2005. *Macrolichens of Sikkim*. Botanical Survey of India, Kolkata.
- Slack, N.G. 1988. The Ecological Importance of Lichens & Bryophytes. *Bibliotheca Lichenologica* 30: 23-53.
- Upreti, D.K., Chatterjee, S. and Divakar, P.K. 2004. Addition to the lichen flora of Sikkim, India. In: *Vistas in Palaeobotany and Morphology: Evolutionary and Environmental Perspectives*, Professor D.D. Pant memorial Volume, ed. P.C. Srivastava, pp. 329-338.
- Yamamoto, Y. 1991. *Plant Cell Culture in Japan*. Progress in production of useful plants metabolites by Japanese enterprise using Plant Cell Culture technology, eds. Alsushi Komamine and Frank Dicosmo, pp. 58-71. C.M.C. Co. Ltd. Tokyo.