# Agaricales of Sikkim Himalaya: A Review

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**Abstract:** The loss of biological diversity is a global crisis. There is hardly any region on the earth that is not facing ecological catastrophes. Sikkim Himalaya is a biologically enriched place of diverse flora and fauna because of its typical geographical situation. But as the population is increasing, socio-economic and environmental changes are going on rapidly, and the natural resources are at risk. Thus, conservation is a major concern at this moment. In the Sikkim Himalaya only a few work on Agaricales has been done after Berkley (1856). Literature survey has shown that no up to date list of Agaricales has been created from this area. In this review we have developed a diversity list of Agaricales of this region. [Researcher. 2010;2(5):29-38]. (ISSN: 1553-9865).

**Key words:** Agaricales, Sikkim Himalaya, Red data List, Species richness.

## 1. Introduction

Fungi are among the most diverse, important and omnipresent groups of organisms on earth, though they have received less attention than animals and plants, therefore related studies are mostly inadequate worldwide (Hawksworth, 1991; Cannon, 1997; Rossman and Farr, 1997; Guzman, 1998; Piepenbring, 2007). Fungi have high potential for indicating the holistic natural value of a habitat in a way that integrates inputs like historical, nature management, biodiversity, and conservation aspects (Coutecuisse, 2001). Along with other microorganisms, they not only make conditions suitable for the evolution and existence of macroscopic life forms, but also continue to drive many of the ecological processes like bioremediation, biogeochemical cycle, nutrient recycling, litter decomposition, soil formation, indicating perturbation within the environment and ecosystem maintenance related to anthropogenic activities (Cibula, 1974; Hawksworth, 1991; Hawksworth, 1995; Guzman, 1998; Hunt, 1999; Pilz and Molina, 2001; Gates *et al*., 2005). Mycorrhizal fungi are the key functional component of a forest ecosystem where they form symbiotic associations with the roots of 75-80% of vascular plants, enabling plants towards better nutrient uptake, which is especially crucial under adverse edaphic conditions (Hawksworth, 1991; Watling, 1997; Brown *et al*., 2006). Furthermore, fungi (in particular the mushroom-forming species) serve as valuable food sources for numerous invertebrate and vertebrate forest inhabitants (Hawksworth, 1991; Watling, 1997). Besides that, fungi find utilization in industry, agriculture, medicine (Cowan, 2001), food industry and textiles (Molina *et al*., 1993; Keizer, 1998; Pilz and Molina, 2001).

Inventorisation, mapping, monitoring and habitat modeling of bioresources as well as threats to the environment due to its depletion, has come to the forefront of the public and scientific concern of late and these programs are being used as important tools in identifying and prioritizing rare species (Coutecuisse, 2001). An organism is categorized as threatened when its ecological niche is threatened. Our knowledge of the microbial diversity is so meager that we do not yet know if and when most species are threatened. Our very inability to answer the question of threatened microbial species cries out loud for the need for microbial systematists and ecologists to begin to address the exciting challenges regarding our knowledge of the extent of microbial diversity on earth (Staley, 1997). The generally accepted estimate of the number of species of fungi on earth is a conservative 1.5 million of which only 1,00,000 have so far been described (Hawksworth and Rossman, 1997). One-third of the global fungal diversity is thought to be present in India alone, although, only 50% are characterized until now (Manoharachary *et al.,* 2005; Swapna *et al*., 2008).

Most of the fungal declines and extinctions are accounted for by problems deep-rooted in the fabric of modern society. We now are aware that the simple fragmentation, as well as outright destruction, of our natural areas is leading to an ever increasing decline in biodiversity worldwide (Kishbaugh and Yocam, 2000), including fungal species (Bunyard *et al.,* 1996). However, non-biologists may be excused for questioning whether microbial diversity is really under threat. At a superficial level, microorganisms seem to be tolerant of almost any set of conditions thrown at them. Also, they appear to have reproductive potentialities to generate populations of truly astronomic number in a very little time. However, that is a superficial understanding and any beliefs that

microbial species are not threatened are simply mistaken. Nearly 34 years ago the first reports concerning a decrease in fungal species diversity and the abundance of fungal fruit bodies across a wide geographic area originated in Europe (Schlumpf, 1976; Bas, 1978). The fear of mycologists and naturalists that the macrofungi were decreasing came true from the analysis of data and this awareness led to creation of Rarity, Endangerment and Distribution Data list or Red Data lists in 11 European countries in the next 15 years (Arnolds and De Vries, 1993). Attention to this phenomenon outside northern Europe was lacking until recently (Molina *et al*., 2001).

Considering the importance of creating a databank on the naturally occurring microbes, including fungi, in generating and maintaining the diversity at the genomic, taxonomic and ecological community levels, little work has been carried out from the Indian subcontinent. Also, in view of the fact that the North East India and the Eastern Himalayan region as one of the major biodiversity hotspots of the Indian subcontinent, no databank on the species richness and diversity of mycota are on records. Species diversity in the natural environment of a region is one of the basic requirements to estimate the richness of the habitat as well as to understand the natural structure of the ecosystems of the habitat. Also, the estimation of species diversity ensures the change in the nature of the ecosystem function and biological compositions.

The above features has already been considered and dealt with in the construction of Red Data list of IUCN. The first Red Data list of fungi appeared in 1982 and many European countries have also published or are enroute to publishing formal or informal Red Data lists. Many Red Data list are difficult to test because they are published in rather obscure journals or pamphlets. A survey of National Red Data list hopefully up to date is presented in table 1.

Table 1: National Red Data lists of macrofungi

| Country | Authors | Year | No of Species |
|---|---|---|---|
| Austria | Krisai | 1999 | 542 |
| Czech Republic | Kotlaba *et al.* | 1995 | 120 |
| Denmark | Vesterholt & Knudsen | 1990 | 898 |
| Estonia | Anon | 1995 | 76 |
| Finland | Rassi *et al.* | 1992 | 325 |
| Germany | Benkert *et al.* | 1992 | 1402 |
| Great Britain | Ing | 1992 | 453 |
| Greece | Diamandis | 2000 | 150 |
| Hungary | Rimóczi | 1998 | 535 |
| Latvia | Vimba & Peterans | 1996 | 38 |
| Lithuania | Kutorga *et al.* | 1999 | 740 |
| Macedonia | Karadelev | 2000 | 67 |
| Netherlands | Arnolds & van Ommering | 1996 | 1655 |
| Norway | Bendiksen *et al.* | 1997 | 831 |
| Poland | Wojewoda & Lawrynowicz | 1992 | 1013 |
| Spain | Calonge | 1993 | 153 |
| Sweden | Aronsson *et al.* | 1995 | 528 |
| Switzerland | Senn-Irlet *et al.* | 1997 | 232 |
| Ukraine | Shelyak-Sosonkn | 1996 | 56 |
| USSR (former) | Borodin *et al.* | 1984 | 17 |
| Yugoslavia | Ivancebic | 1998 | 97 |

In relation to the importance of estimating biological diversity of Mycota and to understanding the factors that involve in sustenance of the community of the Eastern Himalaya region, an attempt is being made here to present the diversity of Agaricales (Mycota: Eumycota: Basidiomycotina: Hymenomycetes: Holobasidieae) of the Sikkim Himalayan region which constitute critical centers for biodiversity and endemism in Eastern Himalaya. The hills of Sikkim (7096 sq km.) and Darjeeling (3149 sq km.) constitute the Sikkim Himalayan ensemble (Figure 1). The region is surrounded by vast stretches of Tibetan plateau in North, Chumbi valley and Kingdom of Bhutan in the east and Nepal in the west. The region has hilly and sloping terrain physiography in general and over which most habitation, agricultural activity and forest cover may found. Vertical range is from 100 m amsl (foothills), through 4000 m amsl (timberline), upto 8500 m amsl (the Kanchenjunga peak). The area experiences a heavy rainfall due to its proximity with the Bay of Bengal. Pre-monsoon rain occurs in April-May and Monsoon (South-West) operates normally from the month of May and continues up to early October. Average annual rainfall varies from 2000 mm at valleys to 4000 mm at the mountain ridges. The humidity remains very high during the rainy season (85-97%). There are three identified seasons in the region, among which rain and high humidity are recurring and predominant episodes. In such a small area sharp climatic differences in different ecological zones have promoted establishment of a rich biological diversity including wide variety of fungi.

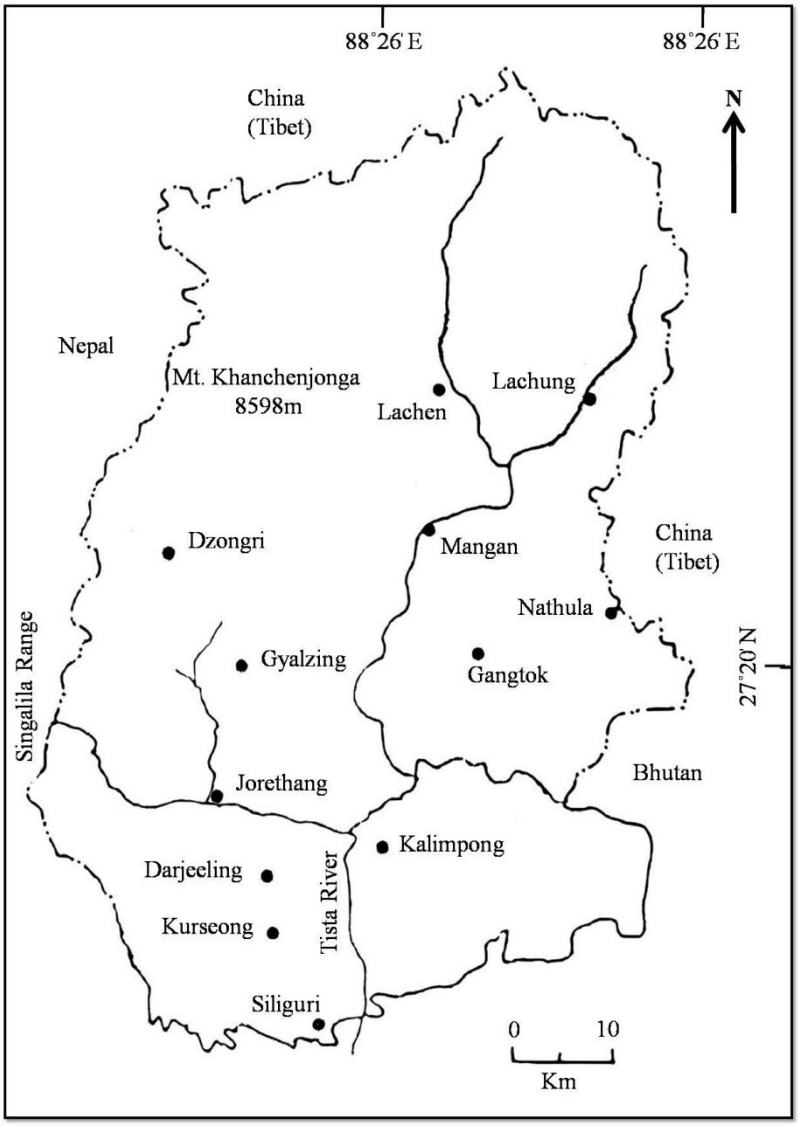


Figure 1: Sikkim Himalaya

The order Agaricales, commonly known as gill fungi contains 270 genera and around 4000 species. These include the mushrooms (the edible species) and the toad stool (the poisonous species). The order Agaricales for long had only one family, the Agaricaceae. Smith (1973) and singer (1975) have recognized 16 families in this order. Hawksworth *et al.*, (1983) who have followed the classification of Singer (1975) in the 7th edition of the 'Dictionary of the Fungi' have, however, excluded Boletaceae and Russulaceae from Agaricales. General characters of Agaricales are hymenophore either lamellate or porose; if porose, the tubes are easily removed from the pileus; basidiocarp fleshy, typically monomitic, rarely dimitic. In the modern sense, the boletes are placed in their own order, the Boletales. The oldest record of the detailed survey of naturally occurring Agaricales of Sikkim Himalaya comes from the study of Berkley (1856), who listed 131 species and provided taxonomic rank and nomenclature to 90 of them. Since then, little work has been carried out on this respect. A list of genera and species reported from Sikkim Himalaya till to date presented in Table 2.

**Table 2: List of Genera and Species were reported from Sikkim Himalaya**

| GENUS | SPECIES | HABITAT, PLACE AND AREA (References) |
|---|---|---|
| *Agaricus* L. ex Fr. | *A. exaltatus* Berk. | Clay earth banks, Darjeeling (a) |
| | *A. fulviceps* Berk. | Ground, Sikkim (a) |
| | *A. silvaticus* Schaeff. | Soil, Darjeeling (a) |
| *Amanita* (Pers. ex Fr.) S.F. Gray | *A. gemmata* (Fr.) Bertill. | Darjeeling (p) |
| | *A. muscaria* var. *flavivolvata* (Singer) Jenkins | Darjeeling (p) |
| *Amanitopsis* Roze. | *A. berkeleyi* (Hook.f.) Sacc. | Ground, Darjeeling (a) |
| | *A. eriophora* (Berk.) Sacc. | Ground, Darjeeling (a) |
| | *A. regalis* (Berk.) Sacc. | Ground, Darjeeling (a) |
| *Armillaria* (Fr.) Quel | *A. adelpha* Berk. | Dead wood, Darjeeling (a) |
| | *A. dichupella* Berk. | Dead wood, Darjeeling (a) |
| | *A. duplicata* Berk | Dead wood, Darjeeling (a) |
| | *A. horrens* Berk. | Bark old tree, Darjeeling (a) |
| | *A. mellea* Berk. | Root *C. japonica*, Calimpong (b). |
| | *A. multicolor* Berk. | Dead wood, Jalapahar (a) |
| | *A. omnituens* Berk. | Dead wood, Darjeeling (a) |
| | *A. vara* Berk. | Rotten timber, Sinchel (a) |
| *Clitocybe* (Fr.) Kummer | *C. incongrua* Berk. | On the ground, Jalapahar (a) |
| | *C. laccata* (Scop) Sacc. | Pine wood, Sikkim (a) |
| *Collybia* (Fr.) Quel | *C. antitypha* Berk. | Pine wood, Sikkim (a) |
| | *C. blandulq* Berk. | Wood, Darjeeling (a) |
| | *C. camptopoda* Berk. | Wood, Darjeeling (a) |
| | *C. dryophila* (Bull.) Fr. var. *Caespitis* Berk. | Amongst grass and moss, Lachen, (a) |
| | *C. macera* Berk. | Ground in pine wood, Sikkim. (a) |
| | *C. maculata* (Alb. & Schw.) Fr. | Pine wood, Lachen. (a) |
| | *C. napipes* Hook.f. in Berk. | Ground, Darjeeling (a) |
| | *C. papaveracea* Berk. | Ground, Darjeeling (a) |
| | *C. podagrosa* Berk. | Clay banks, Sinchal. (a) |
| | *C. raphanipes* Berk. | Jalapahar, Darjeeling (a) |
| | *C. rhodella* Berk. | Wood, Darjeeling (a) |
| | *C. stillaticia* Berk. | Dead, living tree, Jalapahar (a) |
| | *C. triplicata* Berk. | Sikkim (a) |
| | *C. undabunda* Berk. | Old timber wood, Darjeeling (a) |
| | *C. ustipes* Berk. | Ground, Darjeeling (a) |
| | *C. velutipes* (Curt.) Fr. | Dead wood, Darjeeling & Sikkim (a) |
| *Coprinus* (Pers. ex Fr.) S.F. Gray | *C. comatus* Fr. | Grassy land, Darjeeling (a) |
| | *C. disseminates* (Pers. ex Fr.) S.F.Grey | Forest floor, moist wall Darjeeling (o) |
| | *C .hookeri* Berk. | Grassy place, Jalapahar (a) |

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|---|---|---|
| | *C. micaceous* (Bull.) Fr.<br>*C. plicatilis* (Curt ex Fr.) Fr.<br>*C. vellereus* Berk | Rotten log, Darjeeling (o)<br>Grassy meadow, Darjeeling (o)<br>Dead wood & earth, Darjeeling (a) |
| *Cortinarius* S.F. Gray | *C. emodensis* Berk.<br>*C. flameus* Berk.<br>*C. saniosus* Fr.<br>*C. vinosulus* Sacc. | Pine wood, Lachen (a)<br>Pine wood, Sikim (a)<br>Pine wood, Sikim (a)<br>Pine wood, Sikim (a) |
| *Crepidotus* (Fr.) Staude | *C. mollis* (Schaeff.) Staude<br>*C. variabilis* (Pers.) P. Kumm. | Darjeeling (p)<br>Darjeeling (p) |
| *Entoloma* (Fr.) Kummer | *E. cystopodium* Berk.<br>*E. euthelum* Berk.<br>*E. goliath* Hook.f. | On dead leaves, twig, Darjeeling (a)<br>Pine wood, Sikkim (a)<br>Wood, Darjeeling (a) |
| *Flammula* (Fr.) Kummer | *F. chrysomyces* Berk.<br>*F. flavida* (Schaeff.) Fr.<br>*F. macrophala* (Berk.) Sacc.<br>*F. phelegmatica* Berk. | Dead wood, Darjeeling (a)<br>Pine wood, Sikkim. (c)<br>Tree trunk, Darjeeling (a)<br>Pine wood, Sikkim. (a) |
| *Flammulina* P. Karst. | *F. velutipes* (Curt. ex Fr.) Sing | Darjeeling (p) |
| *Galera* (Fr.) Quel. | *G. burkillii* Massee<br>*G. tenera* (Schaeff.) Fr.<br>*G. vinolenta* Berk. | Ground, Darjeeling (d)<br>Ground, Jalapahar, Darjeeling (a)<br>Wood in pine forest, Sikkim. (a) |
| *Hygrophorus* Fr. Kummer | *H. fulvus* Berk.<br>*H. miniatus* Fr. | Pine wood, Sikkim (a)<br>Pine wood, Lachen, Sikkim (a) |
| *Hypholoma* (Fr.) Quel | *H. atrichum* Berk.<br>*H. castanophyllum* Berk.<br>*H. condensum* Berk.<br>*H. fasciculare* (Huds.) Fr.<br>*H. hemisodes* Berk.<br>*H. sublateritium* (Schaeff.) Fr.<br>*H. velutinum* (Pers) Fr. | Dead timber, Darjeeling (a)<br>Ground, Darjeeling (a)<br>Ground, Darjeeling (a)<br>Dead wood, Darjeeling (a)<br>Earth Bank, Darjeeling (a)<br>Dead wood, Darjeeling (a)<br>Earthy bank, Darjeeling (a) |
| *Laccaria* Berk. & Br. | *L. laccata* (Scop.) Cooke. | Darjeeling (q) |
| *Lactarius* D.C. ex S.F. Gray | *L .deliciosus* (L.) Fr.<br>*L. vellereus* Fr. | Lachen, Sikkim (e), Darjeeling (m)<br>Fire wood, Sikkim (a), Darjeeling (m) |
| *Lentinus* Fr. | *L. coadunatus* Hook. f.<br>*L. hepaticus* Berk.<br>*L. hookerianus* Berk.<br>*L. inquinans* Berk.<br>*L. subdulcis* Berk.<br>*L. tecomtei* Fr. | Dead wood, Darjeeling (a)<br>Tree trunks, Darjeeling (a)<br>Dead wood, Darjeeling (a)<br>Dead wood, Sikkim. (a)<br>Dead wood, Darjeeling (a)<br>Wood, Tonglo, Sikkim (a) |
| *Lepiota* (Pers. ex Fr.) S.F. Gray | *L. delicolum* Berk.<br>*L. montosa* Berk. | Dead trees, Darjeeling. (a)<br>Ground, Sikkim. (a) |
| *Leucoagaricus* Singer | *L. excoriatus* (Schaeff. ex Fr.) Singer. | Ground, Darjeeling (f) |
| *Marasmius* Fr. | *M. caperatus* Berk.<br>*M. consocius* Berk.<br>*M. erythropus* Fr.<br>*M. hematodes* Berk.<br>*M. irridescens* Berk.<br>*M. rotula* (Scop ex Fr.) Fr. | Live &dead bush, Tonglo (a)<br>Dead twig, Darjeeling (a)<br>Ground, Darjeeling (a)<br>Pine twig, Sikkim. (a)<br>Mossy bark, Sikkim. (a)<br>Leaves of maple & pine wood, Sikkim (a) |
| *Mycena* (Fr.) S.F. Gray, | *M. bicrenata* Berk.<br>*M. broomiana* Berk.<br>*M. colligata* Berk.<br>*M. dentosa* Berk.<br>*M. discors* Berk.<br>*M. epipterygia* (Scop.) Fr.<br>*M. flavo-miniata* Berk. | Roots of trees, Sikkim (a)<br>Rotten wood, Jalapahar (a)<br>Dead wood, Darjeeling (a)<br>Pine wood, Sikkim (a)<br>Pine wood, Sikkim (a)<br>Pine wood, Sikkim (a)<br>Pine wood, Sikkim (a) |

| | | |
|---|---|---|
| | *M. galericulata* (Scop.) Fr. | Pine wood, Sikkim (a) |
| | *M. incommiscibilis* Berk. | Pine wood, Sikkim (a) |
| | *M. manipularis* Berk. | Trunk & stump, Sinchel (a) |
| | *M. myriadea* Berk. | Dead trunk, Darjeeling (a) |
| | *M. nubigena* Berk. | Old timber, Darjeeling (a) |
| | *M. prasia* Berk. | Ground, Tonglo (a) |
| | *M. puberula* Berk. | Pine wood, Sikkim (a). |
| | *M. pura* (Pers.) Fr. | Pine wood, Sikkim (a), Darjeeling |
| | *M. rubiaetincta* Berk. | Tree bark, Darjeeling (a) |
| | *M. rufata* Berk. | Tree trunk, Darjeeling (a) |
| | *M. rufo-picta* Berk. | Dead wood, Darjeeling (a) |
| | *M. russulina* Berk. | Tree trunk, Darjeeling (a) |
| | *M. xanthophylla* Berk. | Tree roots, Darjeeling (a) |
| *Naucoria* Fr. | *N. descendens* Berk. | Pine wood, Sikkim (a) |
| | *N. scrupea* Berk. | Moist earth, Darjeeling (a) |
| *Omphalia* (Fr.) Staude. | *O. radiatus* Berk. | Pine wood, Sikkim (a) |
| | *O. ranunculina* Berk. | On Turf, Lahu, Sikkim (a) |
| | *O. umbellifera* (L) Fr. | Pine wood, Sikkim (a) |
| *Oudemansiella* Speg. | *O. radicata* (Reih ex Fr.) Singer | Soil, Kurseong (g) |
| | *O. mucida* (Schrd.) Hoehn. | Sikkim (l) |
| *Panus* Fr., | *P. conchatus* Fr. | Darjeeling (a) |
| | *P. monticola* Berk. | Ground, Tonglo (a) |
| *Paxillus* Fr. | *P. chrysites* Berk. | Dead wood, Darjeeling (a) |
| | *P. pinguis* Hook.f. | Earth & mossy banks, Darjeeling (a) |
| | *P. sulphureus* Berk. | Dead wood & Ground, Darjeeling (a) |
| *Peniophora* Cooke | *Peniophora* sp. | Ground, Sikkim (h) |
| *Pholiota* (Fr.) Kummer | *P. aurivella* (Batsch.) Fr. | Tree stump, Darjeeling (a) |
| | *P. examinans* Berk. | Dead wood, Darjeeling. (a) |
| | *P. microspora* Berk. | Dead wood, Darjeeling (a) |
| *Pleurotus* (Fr.) Kummer | *P. anserinus* Berk. | Dead wood, Darjeeling. (a) |
| | *P. eous* Berk. | Dead tree trunk, Sikkim (a) |
| | *P. hapalosclerus* Berk. | Tree trunk, Darjeeling (a) |
| | *P. himalayensis* Thind & Waraitch. | Burnt wood & Soil, Darjeeling (i) |
| | *P. ninguidus* Berk. | Dead timber, Sikkim (a) |
| | *P. placentodes* Berk. | Birch wood, Sikkim (a) |
| | *P. salignus* (Pers.) Fr. | Sikkim (a) |
| | *P. verrucarius* Berk. | Dead wood, Darjeeling (a) |
| *Pluteus* Fr. | *P. chrysoprasius* Berk. | Burnt wood of *Abies,* Sikkim (a). |
| | *P. plumbinus* Berk. | Living tree trunk, Darjeeling. (a) |
| *Psathyra* (Fr.) Quel | *P. clavescens* Berk. | Mossy earth, Darjeeling (a) |
| | *P. flavo-grisea* Berk. | Dead wood, Darjeeling (a) |
| | *P. nassa* Berk. | Dead wood, Darjeeling (a) |
| *Psathyrella* (Fr.) Quel | *P. discolor* Berk. | Dead timber & ground, Darjeeling (a) |
| *Psilocybe* (Fr.) P. Kumm. | *P. caespiticia* Berk. | Clay banks, Darjeeling (a) |
| *Russula* Pers.ex S.F. Gray | *R. cinnabaarina* Hook.f. | Clay bank, Darjeeling (a) |
| | *R. emetica* Fr. | Clay bank, Darjeeling (a) |
| | *R. furcata* Fr. | Clay bank, Sinchel, (a) |
| | *R. grossa* Berk. | Darjeeling (a) |
| | *R. lepida* Fr. | Clay bank, Darjeeling (a) |
| | *R. ochroleuca* Pers. ex Fr. | Forest floor, Darjeeling (n) |
| | *R.rosacea* Fr. | Pine wood, Lachen, Sikkim. (j) |
| | *R. sororia* (Fr.) Romell. | Forest floor, Darjeeling (n) |
| | *R. xerampelina* Fr. | Forest floor, Darjeeling (n) |
| *Schizophyllum* Fr. | *S. commune* Fr. | Dead wood, Darjeeling (a) |
| *Stereogloeocystidium* Rick | *S. spadiceum* (Fr.) Rick | Dead wood, Darjeeling (f) |

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|---|---|---|
| *Stropharia* (Fr.) Quel. | *S. aureo-fulva* Berk. | Dead wood, Jalapahar (a) |
| *Tricholoma* (Fr.) Quel. | *T. cremoriceps* Berk. | Tree trunk, Darjeeling (a) |
| *Tricholomopsis* Singer | *T. rutilans* (Schaeff ex Fr.) Singh | Humicolous soil, Darjeeling (k) |
| *Volvaria* (Fr.) P. Kumm. | *V. thwaitesii* Hook. f. | Dead wood, Darjeeling (a) |
| *Xerotus* Hill ex Grev. | *X. cantharelloides* Berk. | Dead wood, Jalapahar (a) |

(a) Berkeley, M.J. (1856); (b) Bakshi, B.K. *et al.,* (1972); (c) Banerjee, S.N. (1947); (d) Massee, G. (1912); (e) Butler, E.J. and Bisby, G.R. (1931); (f) Ramakrishnan, K. and Sundaram, N.V. (1952); (g) Ghosh, R.N. *et al.,* (1967); (h) Banerjee, S.N. (1948); (i) Thind, K.S. and Waraitch, K.S. (1971); (j) Mundkur, B.B. (1938); (k) Sarwal, B.M. (1984); (l) Rai *et al.,* (2007); (m) Acharya *et al*., (2004a); (n) Acharya *et al.,* (2004b); (o) Rai *et al.,* (2005); (p) Acharya and Rai, (2003); (q) Rai and Acharya, (2006).

## 2. Conclusion

The hills of Darjeeling and Sikkim (Figure 1) seem to provide a wide range of habitats for the growth of Agaricales with 151 species belonging to 42 genera (Table 2). The number of representative species under each of the 42 genera is varied with 13 genera having a single species each and the genera *Mycena* and *Collybia*, having 20 and 16 species respectively (Figure 2, Table 2). The evenness of species distribution/genera is significantly low which supports higher diversity, assemblage and distribution of species. Maximum number of genera (31) supported species richness of 1-3/genera and only two genera had more than 10 representative species which indicates higher Agaricales diversity.

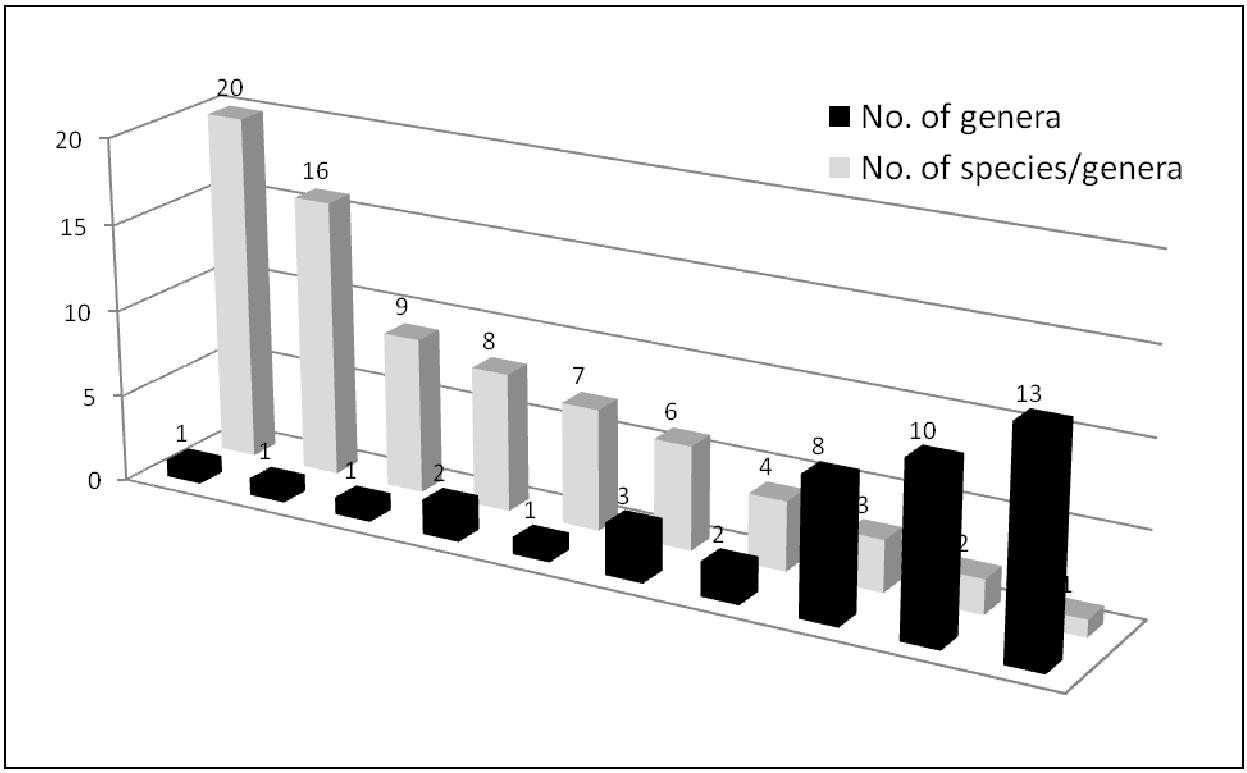


Figure 2. Species richness of Agaricales in the Sikkim Himalaya.

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