

The current status of the family Russulaceae in the Uttarakhand Himalaya, India

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The checklist provided herein represents a current assessment of what is known about the ectomycorrhizal family Russulaceae from the Uttarakhand Himalaya. The checklist includes 105 taxa, 55 of which belong to the genus *Lactarius* Pers. ex S.F. Gray and 50 are members of the genus *Russula* Pers. ex S.F. Gray. Eleven of the species of *Lactarius* (listed as *Lactarius* sp. 1 to 11 in the checklist) are apparently new to science and have yet to be formally described.

Key words – Ectomycorrhizal fungi – Himalayan Mountains – *Lactarius* – *Russula* – Taxonomy

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Introduction

The family Russulaceae is one of the largest ectomycorrhizal families in the order Agaricales. The family was established by Roze (1876) as the Russulariees (*non. nud.*) to include the two agaric genera *Russula* and *Lactarius*, both of which were described originally by Persoon (1796, 1797). The members of the Russulaceae are characterized by their fleshy and often brightly coloured fruiting bodies with prominent lamellae, a heteromerous context traversed by conducting hyphae, the absence of clamp connections in almost all of the known taxa and warty, light-colored amyloid spores that exhibit various types of exosporial ornamentation.

The northwestern subtropical and temperate forests of the Uttarakhand Himalaya are a major terrestrial carbon sink and represent one of the most threatened life support systems on earth. Having some knowledge of macrofungal diversity at the community and species level in these forests is an essential prerequisite for developing and understanding their overall ecology as well as assessing the

crucial niche relationships of the various elements that make up the forest biota, including the macrofungi themselves. The large gap that exists with respect to our knowledge of macrofungal diversity in the Uttarakhand Himalaya is currently a serious constraint for being able to develop any type of understanding. For proper planning and management of these forests and the conservation of their biodiversity, characterization of both the systematics and ecology of the assemblage of macrofungi present is essential. This paper represents a step towards developing a comprehensive database of macrofungal diversity in India, specifically the status of the family Russulaceae in the Himalayas. We hope that it can serve as a starting point for future studies.

Methods

All available publications possibly containing one or more records of members of the Russulaceae reported from the Uttarakhand Himalaya were examined. All of these records were compiled and the nomenclature used

for each species listed checked against the classification system provided on the Index Fungorum web site (<http://www.indexfungorum.org/names/names.asp>) and the nomenclature updated when necessary. The checklist compiled as a result of this effort is organized in alphabetical order. The name of the collecting locality and reference to the collector and/or source of the record are provided for each taxon. The 11 apparently new taxa in the genus *Lactarius* collected by the first two authors during studies carried out during the period of 2006 to 2009 are also included in the list.

It should be noted that the name used for the state of Uttarakhand in the checklist reflects changes that have occurred in the name of the state. Until 2000, it was part of the larger state known as Uttar Pradesh. However, in that year a portion of Uttar Pradesh was separated off to become the state of Uttaranchal. The name of the state was officially changed from its interim name Uttaranchal to Uttarakhand in 2007.

Study area

The Himalayas are one of the youngest folded mountainous formations in the world, and the youngest mountains in India. Uttarakhand is one of the hotspots of global biodiversity and is situated in the western part of the central Himalayas (Fig. 1). The unusually wide range of elevations, the rapid changes in environmental conditions that take place over even small distances and a high level of endemism make the region interesting for all types of studies. Uttarakhand enjoys one of the most important locations on the political map of India, extending from 28°43' N to 31°28' N latitude and 77°34' E to 81°03' E longitude. The total geographical area of the region is 53,483 km² which accounts for nearly 15.5 per cent of the total geographical area of the western Himalayas and 1.63 per cent of the total land area of India. The recorded forest area of the state is approximately 34,650 km² (Botanical Survey of India). Uttarakhand encompasses two distinct traditional politico-cultural regions, the first known as Garhwal and the second as Kumaon. The state consists of 13 districts. These are Chamoli, Pauri, Tehri, Uttarkashi, Dehradun, Haridwar and

Rudraprayag in the Garhwal region and Nainital, Almora, Pithoragarh, Udham Singh Nagar, Champawat in Kumaon region. The state shares an international boundary with China in the north and Nepal in the east. Two of the largest and most important rivers in India, the Ganges and the Yamuna, originate in the glaciers of Uttarakhand. Uttarakhand is located east of the Yamuna River and actually serves as an intermediate zone between the western and central Himalayas in almost all respects, including the diversity of species. The state can be divided into three physiographic regions—the Himalayas, the Shivaliks and the lower elevation plains. The state has a temperate climate except for the plains, which have a subtropical type of climate. The climate of the state is influenced by the monsoon rhythm and is characterized by a precipitation regime different from that of the states of Jammu & Kashmir and Himachal Pradesh to the west. The variable topography, soils, vegetation types and elevation are distinctive features of the state, resulting in a wide range of different microclimates from place to place. The high elevation regions of Uttarakhand Himalayas can be divided into three main climatic zones—the alpine zone, the temperate zone and the sub-tropical zone.

Six major forest types have been described in Uttarakhand. These are tropical moist deciduous forest, tropical dry deciduous forest, subtropical pine forest, Himalayan moist temperate forest, Himalayan dry temperate forest and subalpine/alpine forest (Champions & Seth 1968). The forest cover of the Uttarakhand Himalaya extends over an elevation range of 250 to 3500 m and most of the forests present are dominated by species of *Quercus*, *Rhododendron*, *Pinus*, *Cedrus*, *Cupressus*, *Abies*, *Picea*, *Shorea* and *Betula*. These forests provide sufficient diversity in vegetation and the favorable environmental conditions to support the growth and development of fleshy macrofungi.

Brief Review of the Russulaceae

Most studies of the systematics of the family Russulaceae have been carried out in Europe and North America. Maire (1910), Peck (1872, 1884, 1907), Burlingham (1907a, 1907b, 1908, 1910a, 1910b, 1913, 1915, 1918a,

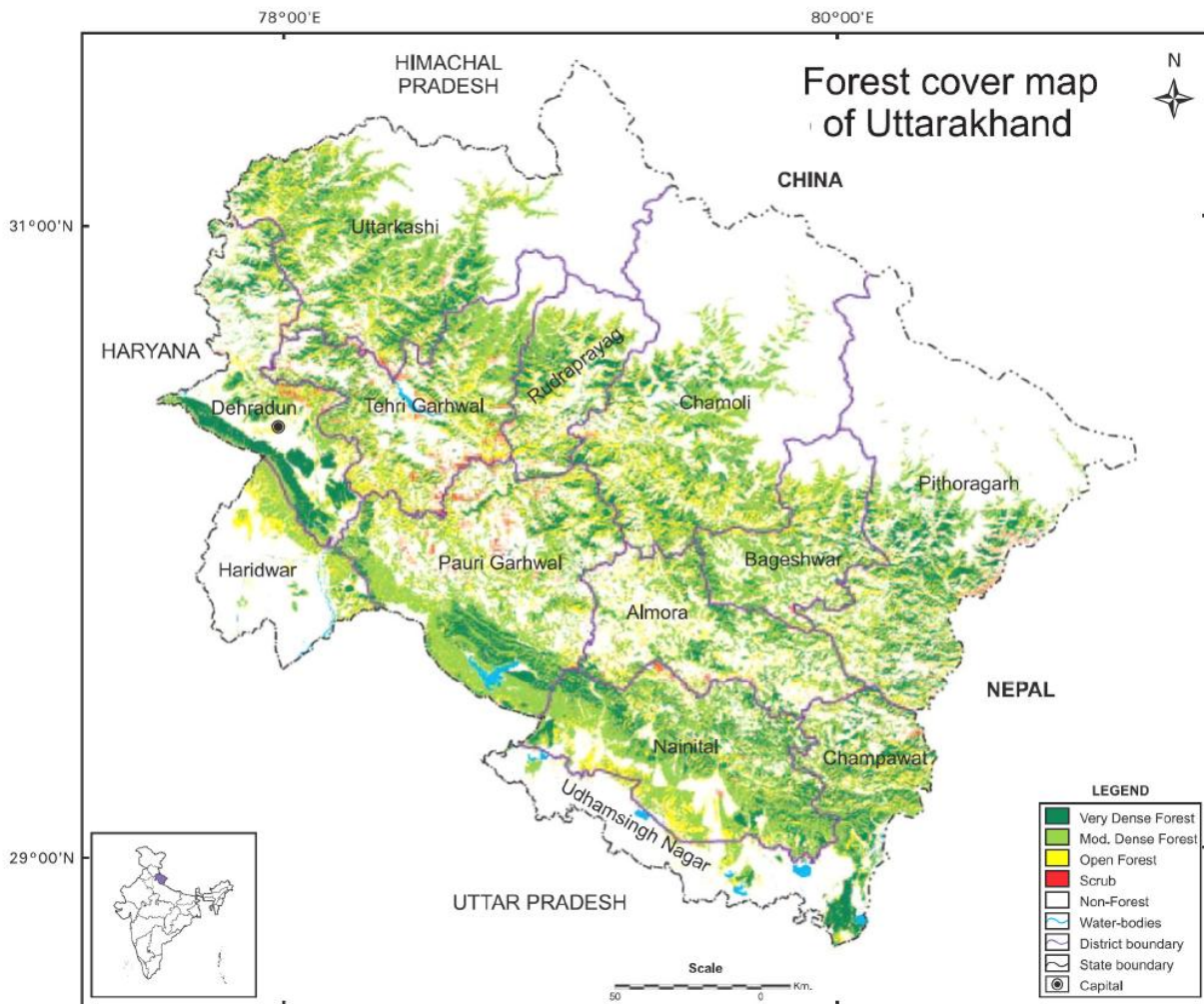


Fig. 1 – Map showing forest cover in the general study area.

1918b, 1921, 1924, 1932, 1940) and Beardslee (1918) were among the pioneer workers who initiated studies of the genera *Lactarius* and *Russula*. Knauth & Neuhoff (1937), Neuhoff (1956), Pearson (1950), Hesler & Smith (1960a, 1960b), Smith & Hesler (1962), Blum (1962), Singer (1975), Hesler & Smith (1979), Shaffer (1962, 1964, 1970a, 1970b, 1972) Schaeffer (1934), Romagnesi (1936, 1940, 1942, 1943, 1945, 1967, 1972), Singer (1926, 1928a, 1928b, 1986), Hesler (1960, 1961), Rayner (1968-1970), Buyck (1994, 1995, 1997), Kibby & Fatto (1990) and Sarnari (1998) are some of the major monographic treatments of the family Russulaceae.

Verbeken (1998a), based on studies of 23 species of *Lactarius* from Africa, amended the subgenus *Lactifluus* of the genus *Lactarius* and excluded the temperate sections *Albati* (Bat.) Singer and *Allardii* Hesler & Smith from the subgenus. Verbeken (1998b) also proposed

amending the subgenus *Lactariopsis* (Henn.) R. Heim. to include the temperate section *Albati* (Bat.) Singer emend. Hesler & A. H. Sm. She also discussed the relationships of the section *Chamaeleontini* with *Russula* subsection *Amoeninae* Singer ex Buyck and *Lactariopsis* with the genus *Pleurogala*. Verbeken & Horak (2000) proposed 19 new taxa for the genus *Lactarius* and included three species described previously. They also presented a key to the species, illustrations and a discussion of their infrageneric position. Verbeken et al. (2000) recorded 35 species of *Lactarius* from relatively xeric Zambezi miombo woodlands in Zimbabwe. Miller & Buyck (2002), Wang et al. (2006), Wang (2007), Nuytinck et al. (2006) and Buyck et al. (2007) studied the genus *Lactarius* in Madagascar. Huyen et al. (2007) and Buyck et al. (2008), who carried out molecular phylogenetic analyses of ribosomal genes (ITS–nuclear LSU) and part

of a protein-coding gene (RPB2), indicated that four phylogenetically distinct clades could be identified within the family Russulaceae. Stubbe et al. (2010) studied species delimitation within the *Lactarius gerardii* species complex and attempted to define its taxonomic and geographical extent. Van de Putte et al. (2009, 2010), Stubbe et al. (2011) and Montoya et al. (2012) are others who have made recent contributions to what is known about the genus *Lactarius*. An outstanding monographic work, published by Sarnari (1998), considers European species of *Russula*. It deals with a critical analysis of all of the various nomenclatural problems and is probably the best currently available classification for the genus. Sarnari divided the genus into six subgenera (*Amoenula*, *Compactae*, *Heterophyllidia*, *Incrustatula*, *Ingratula* and *Russula*) and stressed the importance of microscopic features. Adamcık et al. (2010) reported a new species of *R. ochrifloridana* from Florida, whereas other recent publications include those by Adamcık & Buyck (2011), Buyck & Adamcık (2011) and Buyck & Atri (2011).

Review of the Indian Literature

The taxonomic study of macrofungi in India dates back to Linnaeus, who in the 19th century was the first person to name a species from India. Berkeley (1851, 1852, 1854, 1876) made a major contribution by reporting many agarics from India, including nine species of *Russula* and five species of *Lactarius*. The specimens upon which these records were based, had been collected from the Eastern and Western Himalaya by J.D Hooker. All of these are deposited in the herbarium of the Royal Botanic Gardens, Kew (K). More than a century later, Chona et al. (1958) reported *Lactarius cillicoides* from Delhi. More recent contributions to the study of macrofungi in India that have included some records of *Lactarius* include those of Bakshi (1974) and Patil & Thite (1978) for western India; Sharma et al. (1978), Natarajan (1978), Kumar et al. (1979), Sathe & Daniel (1980), Watling & Gregory (1980) and Ray & Samajpati (1980) for eastern India; Abraham et al. (1980, 1981, 1984), Abraham & Kaul (1985) and Shajahan & Samajpati (1995) for the eastern Himalayas;

and Vrinda et al. 1997 for South India. Das et al. (2010) reported on the macrofungi of the Sikkim Himalaya. Dhancholia (2011) worked on family Russulaceae in Lahaul Valley, Himachal Pradesh.

Among the pioneer workers who made significant contributions to the study of the family Russulaceae in the northwestern Himalayas were Saini & Atri (1981, 1982a, b, 1984, 1989a, b, 1990, 1993), Atri & Saini (1986, 1988, 1989, 1990a, b, c), Saini et al. (1988, 1989), Atri et al. (1991a, b, c, d, 1992, 1993a, b, 1997), Rawla & Sarwal (1983), Rawla (1994, 2001, 2002), Sarwal (1984), Lakhanpal et al. (1987), Lakhanpal (1993), Bhatt & Lakhanpal (1988a, b, c, 1990), Bhatt et al. (1995, 1999, 2000), Das & Sharma (2001a, b, 2002b, 2003, 2004, 2005a, b), Sharma et al. (2005), Sharma & Das (2002, 2003), Das et al. (2002c, 2003b, 2004, 2005a, b, c, 2006a, b), Bhatt et al. (2007) and Dar et al. (2009).

Atri & Saini (1989) reviewed the work carried out on the taxonomy of the family Russulaceae in India, whereas Atri et al. (1994) catalogued 48 taxa in the genus *Lactarius* and 67 taxa in the genus *Russula* described from India in the form of a checklist. Manjula (1983) revised the agaricoid and boletoid basidiomycetes reported from India and provided a modern checklist along with keys to the species. Atri et al. (1997) described the taxonomy, distribution, ecology and edibility of members of the genus *Russula* in the northwestern Himalayas and listed 74 taxa. Das & Sharma (2002) provided a checklist of the genus *Lactarius* that included 56 species and 12 varieties described from India.

Taxonomy

The checklist that follows includes 105 taxa in the family Russulaceae recorded previously from the state of Uttarakhand. This total includes 95 species and 10 varieties. As mentioned earlier, *Lactarius* sp. 1 to 11 are apparently new and undescribed taxa represented by specimens collected in the Garhwal Himalaya. Most of the records in the checklist are based on material collected from forests of the temperate belt, within a range of elevations extending from 800 to 2300 m. Most of the taxa involved were associated with

various species of *Quercus* and *Pinus*, but *Lactarius* sp. 6 and *Lactarius* sp. 7 are two new species collected from *Shorea robusta* forests in the lower subtropical belt of the Sivaliks.

Lactarius Pers. ex S.F. Gray

Lactarius abbotanus K. Das & J.R. Sharma, Mycotaxon 88: 378 (2003)

Locality – Abbot Mount, Champawat (Kumaon), Uttaranchal (Sharma & Das 2003).

Lactarius alnicola var. *alnicola* A.H. Sm., Brittonia 12: 319 (1960)

Locality – Deoban, Chakrata, Uttar Pradesh (Atri & Saini 1986, 1988).

Lactarius camphorates (Bull.) Fr., Epicr. Syst. Mycol. (Upsaliae): 346 (1838) [1836-1838]

Locality – Bageshwar (Kumaon), Uttaranchal (Das & Sharma 2002).

Lactarius capitatus K. Das, J.R. Sharma & Montoya, Mycotaxon 90: 286 (2004)

Locality – Loharkhet Top, Bageshwar (Kumaon), Uttaranchal (Das et al. 2004b).

Lactarius corrugis Peck, Ann. Rep. N. Y. St. Mus. Nat. Hist. 32: 31 (1880) [1879]

Locality – Phedkhal (Garhwal), Uttar Pradesh (Bhatt et al. 1999).

Lactarius dafianus K. Das, J.R. Sharma & Verbeke, Mycotaxon 88: 338 (2003)

Locality – Kannar, Pithoragarh (Kumaon), Uttaranchal (Das et al. 2003).

Lactarius deliciosus var. *deliciosus* (L.) Gray, Nat. Arr. Brit. Pl. 1: 624 (1821)

Locality – Jamnotri (Garhwal) (Saini & Atri 1982b, 1984, Atri et al. 1991b), Deoban (Garhwal) (Saini & Atri 1982b).

Lactarius dhakuranius K. Das, Basso & J.R. Sharma, Mycotaxon 91: 3 (2005)

Locality – Dhakuri, Bageshwar (Kumaon), Uttaranchal (Das et al. 2005c).

Lactarius dwaliensis K. Das, J.R. Sharma & Verbeke, Mycotaxon 88: 334 (2003)

Locality – Khati, Bageshwar (Kumaon), Uttaranchal (Das et al. 2003).

Lactarius gerardii var. *subrubescens* (A.H. Sm. & Hesler) Hesler & A.H. Sm., North American Species of *Lactarius*: 114 (1979)

Locality – Dafia Dhura, Pithoragarh (Kumaon), Uttaranchal (Das & Sharma 2005a).

Lactarius himalayanus Rawla & Sarwal [as '*himalayana*'], Bibliothca. Mycol. 91: 42 (1983)

Locality – Mussoorie, Uttar Pradesh (Rawla & Sarwal 1983).

Lactarius hygrophoroides var. *hygrophoroides* Berk. & M.A. Curtis, Ann. Mag. Nat. Hist. Ser. 34: 293 (1859)

Locality – Devidhar (Chamoli Garhwal); Khirsu (Pauri Garhwal), Uttar Pradesh (Bhatt et al. 1999).

Lactarius hygrophoroides var. *lavendulaceus* Hesler & A.H. Sm. [as '*lavedulaceus*'], North American Species of *Lactarius*: 176 (1979)

Locality – Gudkhiakhal (Tehri Garhwal); Akhori, Khirsu, Uttar Pradesh (Bhatt et al. 1999).

Lactarius hygrophoroides var. *odoratus* Hesler & A.H. Sm., North American species of *Lactarius*: 173 (1979)

Locality – Dandapani, Khirsu, (Garhwal), Uttar Pradesh (Bhatt et al. 1999).

Lactarius hygrophoroides var. *rugatus* (Kühner & Romagn.) Hesler & A.H. Sm., North American Species of *Lactarius*: 175 (1979)

Locality – Nagdeva-Jhandidhar (Pauri Garhwal), Uttar Pradesh (Bhatt et al. 1999).

Lactarius indigo var. *indigo* (Schwein.) Fr., Epicr. Syst. Mycol.: 341 (1838) [1836-1838]

Locality – Majharatal (Tehri Garhwal), Uttaranchal (Sharma & Das 2002).

Lactarius lignyotus var. *canadensis* A.H. Sm. & Hesler, Brittonia 14: 398 (1962)

Locality – Dhakuri (Bageshwar), Mayawati (Champawat) Kumaon, Uttaranchal (Das & Sharma 2004).

Lactarius lignyotus var. *lignyotus* Fr., Nuovi Ann. Sci. Nat.: 25 (1857)

Locality – Dhakuri, Bageshwar (Kumaon), Uttaranchal (Das & Sharma 2005a).

Lactarius maitlyensis K. Das, J.R. Sharma & Verbeken, Mycotaxon 88: 336 (2003)

Locality – Maitly Top, Pithoragarh (Kumaon), Uttaranchal (Das et al. 2003).

Lactarius mayawatianus K. Das & J.R. Sharma, Mycotaxon 88: 380 (2003)

Locality – Mayawati, Champawat; Furti, Almora, (Kumaon), Uttaranchal (Sharma & Das 2003).

Lactarius montoyae K. Das & J.R. Sharma, Mycotaxon 89(2): 291 (2004)

Locality – Dhakuri, Bageshwar (Kumaon), Uttaranchal (Das & Sharma 2004).

Lactarius mukteswaricus K. Das, J.R. Sharma & Montoya, Fung. Diversity 16: 26 (2004)

Locality – Mukteshwar, Nainital (Kumaon), Uttaranchal (Das et al. 2004a).

Lactarius paradoxus Beardslee & Burl. [as '*Lactaria paradoxa*'], Mycologia 32: 584 (1940)

Locality – Deoban, Chakrata (Garhwal), Uttar Pradesh (Atri & Saini 1986).

Lactarius piperatus var. *glaucescens* (Crossl.) Hesler & A.H. Sm., North American Species of *Lactarius*: 186 (1979)

Locality – Almora, Pithoragarh, Uttarakhand (Das & Sharma 2002).

Lactarius piperatus var. *piperatus* (L.) Pers., Tent. Disp. Meth. Fung.: 64 (1797)

Locality – Pauri, Dehradun, (Garhwal); Pithoragarh (Kumaon), Uttaranchal (Das & Sharma 2002).

Lactarius romagnesii Bon, Docums Mycol. 9 (No. 35): 39 (1979)

Locality – Dhakuri (Kumaon), Uttaranchal (Sharma & Das 2001).

Lactarius rubrifluus Gillet, Bull. Soc. Linn. Normandie, Sér. 24: 255 (1870)

Locality – Budakedar, Tehri (Garhwal), Uttaranchal (Sharma & Das 2002).

Lactarius sanguifluus (Paulet) Fr., Epicr. Syst. Myc.: 341 (1838) [1836-1838]

Locality – Garhwal Himalaya, Uttaranchal (Bhatt et al. 2000).

Lactarius sanjappae K. Das, J.R. Sharma & Montoya, Fung. Diversity 16: 24 (2004).

Locality – Mukteshwar, Nainital (Kumaon), Uttaranchal (Das et al. 2004a).

Lactarius scrobiculatus var. *canadensis* (A.H. Sm.) Hesler & A.H. Sm., North American Species of *Lactarius*: 297 (1979)

Locality – Gobind Dham, enroute Badrinath (Garhwal), Uttar Pradesh (Atri & Saini 1988).

Lactarius scrobiculatus var. *scrobiculatus* (Scop.) Fr., Epicr. Syst. Mycol.: 334 (1838) [1836-1838]

Locality – Jamnotri, Hanuman Chatti (Saini & Atri 1982b, 1984); Chakrata, Deoban (Atri & Saini 1988) Garhwal, Uttar Pradesh.

Lactarius serifluus (DC.) Fr., Epicr. Syst. Mycol.: 345 (1838) [1836-1838]

Locality – Chamoli Garhwal, Uttarakhand (Das & Sharma 2002).

Lactarius subdulcis (Pers.) Gray, Nat. Arr. Brit. Pl. 1: 625 (1821)

Locality – Quinkaleshwar (Garhwal), Uttaranchal (Bhatt et al. 2000).

Lactarius subindigo Verbeken & E. Horak, Aust. Syst. Bot. 13: 651 (2000)

Locality – Abbot Mount, Champawat; Mayawati, Almora (Kumaon), Uttaranchal (Sharma & Das 2003).

Lactarius subisabellinus var. *murrillianus* (A.H. Sm. & Hesler) Hesler & A.H. Sm., North American Species of *Lactarius*: 122 (1979)

Locality – Oli Forest, Joshimath (Garhwal); Naini Peak, Nainital (Kumaon); Deoban, Kailana, Chakrata (Garhwal), Uttar Pradesh (Atri & Saini 1986, Saini & Atri 1990).

Lactarius subpurpureus Peck, Ann. Rep. N. Y. St. Mus. Nat. Hist. 29: 43(1878) [1876]

Locality – Deoban, Chakrata (Garhwal), Uttar Pradesh (Atri & Saini 1986, Saini & Atri 1990).

Lactarius subvellereus var. *subdistans* Hesler & A.H. Sm., North American Species of *Lactarius*: 203 (1979)

Locality – Mukteshwar, Nainital; Abbot Mount, Champawat; Sandev, Pithoragarh (Kumaon), Uttaranchal (Das & Sharma 2005a).

Lactarius vellereus (Fr.) Fr., Epicr. Syst. Mycol.: 340 (1838) [1836-1838]

Locality – Lal Tibba, Mussoorie (Garhwal), Uttar Pradesh (Rawla 1994).

Lactarius verbekena K. Das, J.R. Sharma & Montoya, Fung. Diversity 16: 29 (2004)

Locality – Mukteshwar, Nainital; Lohaghat, Champawat (Kumaon Himalaya), Uttaranchal (Das et al. 2004a).

Lactarius volemus var. *flavus* Hesler & A.H. Sm., North American Species of *Lactarius* (Ann Arbor): 165 (1979)

Locality – Enroute to waterfall, Chakrata (Garhwal), Uttar Pradesh (Atri & Saini 1986, Saini & Atri 1993).

Lactarius volemus var. *volemus* (Fr.) Fr., Epicr. Syst. Mycol.: 344 (1838) [1836-1838]

Locality – Chakrata (Saini & Atri 1984) and Mussoorie, Lal Tibba (Rawla 1994) (Garhwal), Uttar Pradesh.

Lactarius yazoensis Hesler & A.H. Sm., North American Species of *Lactarius*: 264 (1979)

Locality – Mussoorie, on the way to Mossy Falls (Garhwal), Uttar Pradesh (Atri & Saini 1986, 1988).

Lactarius zonarius var. *riparius* Hesler & A. H. Sm., North American Species of *Lactarius*: 252 (1979)

Locality – Pauri (Garhwal), Uttaranchal (Das & Sharma 2002).

Lactarius zonarius var. *zonarius* (Bull.) Fr., Epicr. Syst. Mycol.: 336 (1838) [1836-1838]

Locality – Mussoorie, Dhobighat (Garhwal), Uttar Pradesh (Saini & Atri 1982a, Atri & Saini 1988).

Lactarius sp. 1

Locality – Khirsu (Pauri Garhwal),

Uttarakhand. Collected August 2007, GUH M-25219. Found in association with *Quercus leucotrichophora*.

Lactarius sp. 2

Locality – Chandrabadni (Tehri Garhwal), Uttarakhand. Collected August 2009, GUH M- 25601. Found in association with *Quercus leucotrichophora* and *Picea* spp.

Lactarius sp. 3

Locality – Bugani (Pauri Garhwal), Uttarakhand. Collected August 2009, GUH M-25607. Found in association with *Pinus roxburghii*.

Lactarius sp. 4

Locality – Adwani (Pauri Garhwal), Uttarakhand. Collected August 2007, GUH M-25223; GUH M-25225. Found in association with *Quercus leucotrichophora* and *Rhododendron arboreum*.

Lactarius sp. 5

Locality – Khirsu (Pauri Garhwal), Uttarkhand. Collected August 2006, GUH M-25010; Adwani, August, 2006, GUH M-25026. Found in association with *Lyonia ovalifolia*, *Myrica esculenta*, *Quercus leucotrichophora* and *Rhododendron arboreum*.

Lactarius sp. 6

Locality – Nanda Ki Chowki (Dehradun), Uttarakhand. Collected September 2008, GUH M- 25568, September 2009, GUH M-25573. Found in association with *Shorea robusta*.

Lactarius sp. 7

Locality – Tapovan (Dehradun), Uttarakhand. September 2008, GUH M-25448. Found in association with *Shorea robusta*.

Lactarius sp. 8

Locality – Kansh Khet (Pauri Garhwal), Uttarakhand. Collected August 2006, GUH M-25012. Found in association with *Quercus leucotrichophora*.

Lactarius sp. 9

Locality – Gundiyat (Uttarkashi), Uttarakhand. Collected October 2009, GUH

M-25683; Found in association with *Cedrus deodara*.

Lactarius sp. 10

Locality – Hanuman Mandir (Pauri Garhwal), Uttarakhand. Collected August 2007, GUH M- 25230. Found in association with *Pinus roxburghii* and *Quercus leucotrichophora*.

Lactarius sp. 11

Locality – Jabbar Khet (Mussorie), Uttarakhand. Collected August 2009 GUH M- 25619. Found in association with *Quercus leucotrichophora* and *Rhododendron arboreum*.

Genus **Russula** Pers. ex S.F.Gray

Russula abbotensis K. Das & J.R. Sharma, Russulaceae of Kumaon Himalaya: 176 (2005)

Locality – Abbot Mount, Champawat, (Kumaon), Uttaranchal (Das & Sharma 2005b).

Russula adusta (Pers.) Fr., Epicr. Syst. Mycol.: 350 (1838) [1836–1838].

Locality – Kailana, Chakrata (Garhwal) (Saini & Atri 1984, Atri and Saini 1990b), Lohaghat; Mayawati; Jageshwar, Champawat (Kumaon), Uttaranchal (Das & Sharma 2005b).

Russula alachuana Murrill, Mycologia 30: 362 (1938)

Locality – Kailana, Chakrata (Garhwal), Uttar Pradesh (Atri & Saini 1986).

Russula albida Peck, Bull. N. Y. St. Mus. Nat. Hist. 1 (No. 2): 10 (1887)

Locality – Nagdev-Jhandidhar Forest, Khirsu Forest (Garhwal), Uttar Pradesh (Bhatt et al. 1995).

Russula albonigra (Krombh.) Fr., Hymenomyc. Eur.: 440 (1874)

Locality – Deoban, Chakrata (Garhwal), Uttar Pradesh (Saini & Atri 1984, Atri & Saini 1986, 1990a).

Russula amoenicolor Romagn., Bull. Mens. Soc. Linn. Lyon 31: 175 (1962)

Locality – Jabbar Khet, Mussoorie (Garhwal), Uttar Pradesh (Rawla & Sarwal

1983).

Russula amoenicolor var. **ramgarhensis** K. Das, J.R. Sharma & R.P. Bhatt, Russulaceae of Kumaon Himalaya: 127 (2005)

Locality – Ramgarh, Nainital (Kumaon), Uttaranchal (Das et al. 2005a).

Russula amoenolens Romagn., Contribution a l'Etude de Quelques Aspergilles 21: 111 (1952)

Locality – Nagdev-Jhandidhar Forest, Khirsu (Garhwal), Uttar Pradesh (Bhatt et al. 1995).

Russula anatina Romagn., Russules d'Europe Afr. Nord: 306 (1967)

Locality – Dafia Dhura, Pithoragarh; Dhakuri, Bageshwar (Kumaon), Uttaranchal (Das & Sharma 2003).

Russula appendiculata K. Das, S.L. Mill. & J.R. Sharma, Mycotaxon 95: 210 (2006)

Locality – Gagar, Nainital (Kumaon), Uttaranchal (Das et al. 2006a).

Russula atropurpurea (Krombh.) Britzelm., Bot. Zbl. 54: 99 (1983)

Locality – Chakrata (Garhwal), Uttar Pradesh (Atri & Saini 1986, Saini & Atri 1989b).

Russula aurata Fr., Epicr. Syst. Mycol.: 360 (1838) [1836–1838]

Locality – Deoban, Chakrata (Garhwal), Uttar Pradesh (Atri & Saini 1986, Saini & Atri 1989b, Saini et al. 1989).

Russula aurora (Krombh.) Bres., Fung. Trident. 2: 93 (1892)

Locality – Chakrata, Mussoorie, Uttar Pradesh (Saini et al. 1989).

Russula brevipes Peck, Ann. Rep. N. Y. St. Mus. 43: 66 (1890)

Locality – Jageshwar, Almora; Mayawati, Champawat (Kumaon), Uttaranchal (Das & Sharma, 2005b).

Russula brevipes var. **acrior** Shaffer, Mycologia 56: 223 (1964)

Locality – Lohaghat, Mayawati,

Champawat; Sandev, Pithoragarh (Kumaon), Uttaranchal (Das & Sharma 2005b).

Russula compacta Frost, Ann. Rep. Reg. N. Y. St. Mus. 32: 32 (1879)

Locality – Abbot Mt., Sandev, Dafia Dhura (Kumaon), Uttaranchal (Das & Sharma 2005b).

Russula congoana Pat., Cryptog. Mycol. 30(3): 336 (1914).

Locality – Mussoorie, Uttar Pradesh (Sarwal 1984).

Russula consobrina (Fr.) Fr., Epicr. Syst. Mycol.: 359 (1838) [1836-1838]

Locality – Jamnotri, Hanumanchatti (Garhwal), Uttar Pradesh (Atri & Saini 1986, 1990a).

Russula cynoxantha (Schaeff.) Fr., Monogr. Hymenomyc. Suec. 2(2): 194 (1863)

Locality – Chakrata, Kailana (Atri & Saini 1986, 1990c), Joshimath, Oli Forest (Atri & Saini 1990c), Ramgarh, Nainital; Lohaghat, Champawat; Dafia Dhura, Maitly, Pithoragarh (Das & Sharma 2005b).

Russula dafianus K. Das & J.R. Sharma, Russulaceae of Kumaon Himalaya: 166 (2005)

Locality – Dhakuri, Bageshwar; Dafia Dhura; Pithoragarh (Kumaon), Uttaranchal (Das & Sharma 2005b).

Russula decipiens (Singer) Bon, Docums Mycol. 15 (No. 60): 42 (1985)

Locality – Mukteshwar, Nainital (Kumaon), Uttaranchal (Das & Sharma 2005b).

Russula decolorans (Fr.) Fr., Epicr. Syst. Mycol.: 361 (1838) [1836-1838]

Locality – Champawat, Mayawati; Mornoulla, Almora; Nainital, Ramgarh (Kumaon), Uttaranchal (Das & Sharma 2003).

Russula delica Fr., Epicr. Syst. Mycol.: 350 (1838) (1836-1838)

Locality: Chakrata, Deoban; Nainital, Nainapeak (Kumaon), Uttar Pradesh (Atri & Saini 1986).

Russula dhakuriana K. Das, J.R. Sharma & S.L. Mill., Mycotaxon 95: 208 (2006)

Locality – Dhakuri, Bageshwar (Kumaon), Uttaranchal (Das et al. 2006a).

Russula dissimulans Shaffer, Brittonia 14: 267 (1962)

Locality – Adwani Forest (Garhwal), Uttar Pradesh (Bhatt et al. 1995).

Russula flavida var. ***dhakurianus*** K. Das, J.R. Sharma & R.P. Bhatt, Russulaceae of Kumaon Himalaya: 203 (2005)

Locality – Dhakuri, Bageshwar (Kumaon), Uttaranchal (Das & Sharma 2005a).

Russula flocculosa Burl., N. Amer. Fl. 9(4): 213 (1915)

Locality – Chobattakhal, Phaedkhal, Pauri Garhwal, Uttarakhand (Bhatt et al. 2007).

Russula foetens (Pers.) Pers., Observ. Mycol. 1: 102 (1796)

Locality – Joshimath, Nainital, Chakrata, Deoban, Jamnotri (Garhwal), Uttar Pradesh (Saini & Atri 1984).

Russula himalayana Rawal & Sarwal, Bibliothca Mycol. 91: 28 (1983)

Locality – Jabbar Khet, Mussoorie (Garhwal), Uttar Pradesh (Rawla & Sarwal 1983).

Russula mayawatiana K. Das, S.L. Mill. & J.R. Sharma, Mycotaxon 95: 206 (2006)

Locality – Champawat, Mayawati (Kumaon), Uttaranchal (Das et al. 2006a).

Russula minutula var. ***minutula*** Velen., České Houby 1: 133 (1920)

Locality – Alumandi, Kailana (Saini & Atri 1984, Saini et al. 1989); Mussoorie, enroute to Dhobighat; Joshimath (Saini et al. 1989) (Kumaon), Uttar Pradesh.

Russula mukteshwarica K. Das, S.L. Mill., J.R. Sharma & R.P. Bhatt, Mycotaxon 94: 86 (2005)

Locality – Mukteshwar, Nainital; Dafia Dhura, Pithoragarh; Nagdev Forest, Pauri

(Das et al. 2005b).

Russula mussooriensis Rawla & Sarwal, *Bibliotheca Mycol.* 91: 25 (1983)

Locality – Jabbar Khet, Mussoorie (Garhwal), Uttar Pradesh (Rawla & Sarwal 1983).

Russula mustelina Fr., *Epicr. Syst. Mycol.*: 351 (1838) [1836–1838]

Locality – Oli Forest (Saini & Atri 1984); Chakrata, Kailana (Atri & Saini 1986, 1990c).

Russula natarjanii K. Das, J.R. Sharma & Atri, *Mycotaxon* 95: 272 (2006)

Locality – Dhakuri, Bageshwar (Kumaon), Uttaranchal (Das et al. 2006b).

Russula nigricans Fr., *Epicr. Syst. Mycol.*: 350 (1838) [1836–1838]

Locality – Chakrata, Uttar Pradesh (Saini & Atri 1984, Saini et al. 1988).

Russula ochroleuca (Pers.) Fr., *Epicr. Syst. Mycol.*: 358 (1838) [1836–1838]

Locality – Chakrata, Uttar Pradesh (Saini et al. 1989).

Russula odorata Romagn., *Bull. Mens. Soc. Linn. Lyon* 19: 76 (1950)

Locality – Jabbar Khet, Mussoorie, Uttar Pradesh (Rawla & Sarwal 1983).

Russula pectinata (Bull.) Fr., *Fr. Epicr. Syst. Mycol.*: 358 (1838) [1836–1838]

Locality – Jabbar Khet, Mussoorie, Uttar Pradesh (Rawla & Sarwal 1983).

Russula praetervisa Sarnari, *Mongrafia Illustrata del Genere *Russula* in Europe* 1: 463 (1998)

Locality – Dhakuri, Bageshwar; Mayawati, Champawat; Mornoula, Champawat, Uttarakhand (Sharma et al. 2005).

Russula pseudolepida Singer, *Bull. Trimest. Soc. Mycol. Fr.* 55: 251 (1940) [1939]

Locality – Phedkhal, Pauri Garhwal; Mandal, Chamoli, Uttarakhand (Bhatt et al. 2007).

Russula puellaris var. ***atrii*** K. Das, S.L. Mill. & J. R. Sharma, *Mycotaxon* 95: 211 (2006)

Locality – Dhakuri, Bageshwar, Uttaranchal (Das et al. 2006a).

Russula pulverulenta Peck, *Bull. Torrey Bot. Club* 29: 70 (1902)

Locality – Teka, Gandra, Pauri Garhwal, Uttarakhand (Bhatt et al. 2007).

Russula raoultii Quél., *Compt. Rend. Assoc. Franc. Avancem. Sci.* 14(2): 449 (1886)

Locality – Dafia Dhura, Pithoragarh; Mornoula, Almora, Kumaon, Uttaranchal (Das & Sharma 2003).

Russula rhodomelanea Sarnari, *Riv. Micol.* 36: 53 (1993)

Locality – Dhakuri, Bageshwar, Uttaranchal (Das & Sharma 2001b).

Russula schaefferina Rawla & Sarwal, *Bibliotheca Mycol.* 91: 32 (1983)

Locality – Mussoorie, Uttar Pradesh (Rawla & Sarwal 1983).

Russula silvicola Shaffer, *Beih. Nova Hedwigia* 51: 229 (1975)

Locality – Khirsu, Pauri Garhwal, Uttarakhand (Bhatt et al. 2007).

Russula subfoetens W.G. Sm., *J. Bot., Lond.* 11: 337 (1873)

Locality – Chakrata, Uttar Pradesh (Atri & Saini 1986, Saini & Atri 1989a).

Russula velenovskyi Melzer & Zvára, *Arch. Přírodov. Výzk. Čech.* 17: 92 (1927)

Locality – Oli Forest, Joshimath, Uttar Pradesh (Atri & Saini 1986, Saini & Atri 1989b).

Russula virescens (Schaeff.) Fr., *Anteckn. Sver. Ätl. Svamp.*: 50 (1836)

Locality – Dhobighat, Mussoorie; Chakrata, Deoban, Uttar Pradesh (Saini et al. 1988).

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