



Wild edible mushrooms from high elevations in the Garhwal Himalaya-I

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Abstract

Information is provided on 15 species of wild edible mushrooms collected at elevations of 2000–3500 masl in the Garhwal Himalaya of Northern India. Except for *Morchella esculenta* ('Guchhi'), which is a member of the ascomycetes, all of the other macrofungi considered herein are basidiomycetes. The 15 species belong to 12 genera and 08 families and were collected from 08 different study sites in the Garhwal Himalaya.

Key words – Ascomycetes – Basidiomycetes – macrofungi – Northern India

Introduction

Wild mushrooms have been eaten by mankind since time immemorial. Their use in Indian literature dates back to 3000 B.C. They were highly prized by the Greeks, and the consumption of mushrooms in European nations has deep traditional roots. Edible mushrooms are considered one of the world's greatest natural resources since they have the ability to transform nutritionally valueless substances into high protein foods. Mushrooms are highly valued for their rich characteristic flavour, delicate taste and potent nutritional properties. They are low in calorific value but rank very high for their vitamin, mineral and protein contents. Their protein content is of good quality and characterized by high digestibility. Because of this, mushrooms are recognized universally as a highly desirable food.

Of the 14,000 species of mushrooms currently known, nearly 7000 species are well studied and have been shown possess varying degrees of edibility, whereas more than 3000 species spread over 31 genera are regarded as prime edibles (Chauhan et al. 2014). Several workers have studied the diversity of mushrooms in India. From the Garhwal Himalaya, only limited reports are available with respect to wild edible mushrooms (Rawla & Sarwal 1983, Harsh & Bisht 1985, Bhatt et al. 1999, 2000, Joshi et al. 2013, Vishwakarma & Bhatt 2013, Semwal et al. 2014, Bhatt et al. 2014). Despite the biogeographical significance of the Garhwal Himalaya, the region remains poorly documented in terms of the diversity of edible macrofungi. The present study was undertaken to document the wild edible mushrooms of higher elevations in the Garhwal Himalaya.

General Study Area

The Garhwal Himalaya is part of the Western Himalaya, located between 29° 31'9" and 31° 26'5" N latitude and 77° 33'5" and 80° 6'0" E longitude. With a total area of 29,089 km², it is the most frequented and best known region of the Himalaya. Beginning with the foothills in the South, it

encompasses all three sections of the Himalaya (i.e. the Outer Siwalik, the Lesser Himalaya made up of linear mountain ranges and the Great Himalaya, covering a total of about 40,000 km² of snowfields). The Garhwal Himalaya represents one of the most fascinating regions of the Indian subcontinent. Marked variations are noticeable in the type of vegetation present in relation to the different latitudinal, elevational and environmental conditions. Because of the wide range of climatic conditions and resultant diversity of vegetation, the Garhwal Himalaya is very suitable for the growth of macrofungi.

According to Rawat (2011), the high elevation areas of the Garhwal Himalaya can be divided into three main zones—the alpine zone, the subalpine zone and the montane zone. Most the forests present are dominated by species of *Quercus*, *Rhododendron*, *Pinus*, *Cedrus*, *Cupressus*, *Abies*, *Picea* and *Betula*, which provide favourable conditions to support the growth and development of macrofungi, especially ectomycorrhizal fungi (Semwal et al. 2005, 2006, 2014).

Materials and Methods

Numerous field trips were made for collection of macrofungi to eight study sites in the Garhwal Himalaya between March and September of 2013. These study sites, which were considered to be representative of the three main zones mentioned above, were Tungnath Trek, Chopta, Mandal, Devariatal, Baniyakund, Ukhimath, Kund and Nagdev-Jhandidhar (Fig. 1). Information related to the use of wild edible mushrooms by local villagers was collected through verbal interviews and questionnaires. Standard methods were followed for the collection, preservation and macro- and microscopic studies of the specimens (Singer 1986). Photographs of all specimens were obtained using a Sony digital DSC-W730 camera. Identification of species was based on critical observations of the specimens and perusal of the relevant literature (Moller 1950, 1952, Moser 1978, Hesler & Smith 1979, Miller 1981, Arora 1986, Singer 1986, Kibby & Fatto 1990, Phillips 1991, Yang 1997). The colour terminology used is that of the *Methuen Handbook of Colour* (Kornerup & Wanscher 1978). All specimens were deposited in the herbarium of the Department of Botany & Microbiology, HNB Garhwal University, (GUH) Srinagar, Garhwal, Uttarakhand, India.

Results and Discussion

A total of 219 specimens of macrofungi were collected from the eight study sites in the Garhwal Himalaya, and these were identified and assigned to 15 species, 12 genera and 08 families. Of the species collected, *Morchella esculenta*, *Cantharellus cibarius*, *C. minor* and *Grifola frondosa* are very commonly collected and consumed by the local villagers. In addition to the local villagers, the Nepali and Van Gujjar residing in these areas also consume these delicacies. *Morchella esculenta* (commonly called ‘Guchhi’) is reported to be the most preferred wild edible mushroom by the villagers in these areas. Among the fifteen species of edible mushroom recorded in the present study, only *Morchella esculenta* is used for trade in local markets. Ascocarps are cut open, air-dried and pickled for storage or used when fresh.

Information for all the above 15 species relating to their locality, habit, habitat, edibility and their associations with higher plants is provided below.

Amanitaceae

Amanita hemibapha (Berk. & Br.) Sacc., Syll. Fung. 5: 13. 1887.

Fig. 2G

Pileus 70–180 mm broad, hemispherical at first, becoming convex, finally applanate at maturity, often slightly umbonate over disc, surface shiny, dry, viscid when wet, orange (5A7) at umbo, deep orange (6A8) to orange red (8A8) outwards, deep yellow, yellowish orange (4A8–7) to deep orange (5A8–7) towards margin. Context white to yellowish white, soft, 5–10 mm thick; margin sulcate-striate, striations 18–65 mm long, recurved. Lamellae free, crowded, at first yellowish white (2A2), pastel yellow (2A4) to light yellow (2A4) in mature specimens, lamellulae numerous, of various lengths. Stipe 100–150 × 10–20 mm, central, tapering upward, connected to the volva only at its very base, yellowish orange (4A7) above annulus, maize yellow (4A6) to deep yellow (4A8) downwards, covered with appressed zigzag, finely ornamented yellowish fibrils to small squamules above and

below annulus; context white to light lemon yellow, soft, stuffed first with white, cottony material, hollowing with age. Annulus superior, skirt-like, persistent, yellow. Volva saccate, membranous, fleshy, white. Taste mild. Odour leathery to distinct. Spore deposit white.

Habit and Habitat – Solitary to scattered or sometimes gregarious, in mixed forests, associated with *Quercus leucotrichophora*, *Rhododendron arboreum* and *Myrica esculenta*.

Specimen Examined – India: Uttarakhand, Rudraprayag, Baniyakund, 5 August 2013, R. P. Bhatt/ U. Singh (RPB/US), GUH-M-26780.

Discussion – *Amanita hemibapha* is a fairly large and beautiful mushroom characterized by its orange to orange red, yellowish orange cap with a distinctly tuberculate-striated margin; pastel yellow to light yellow lamellae; stipe finally fibrillose, yellowish; annulus orangish yellow to pale yellow, large, pendant and volva thick, white, saccate, and broadly ellipsoid spores.

There seems to have been a controversy regarding the proper nomenclature for this species of *Amanita*. It has been variously described as *A. caesarea* (Scop.) Pers., *A. hemibapha* and *A. umbonata* Pomerleau. More recently, however, Pomerleau (1984) eliminated the name *A. umbonata* and replaced it with *A. jacksonii* (Jenkins 1986).

This mushroom is consumed by the local villagers in some parts of the general study area. Local villagers identify this fungus in the field on the basis of the ovoid structure of the primordial (button) stage, orange to orange red, yellowish orange colour and the medium to large fruiting body with a thick, saccate volva (cup) at the base of the stipe (Fig. 3G).

Edibility – Commented upon by Upadhyay et al. (2008), Vishwakarma & Bhatt (2013) and Semwal et al. (2014).

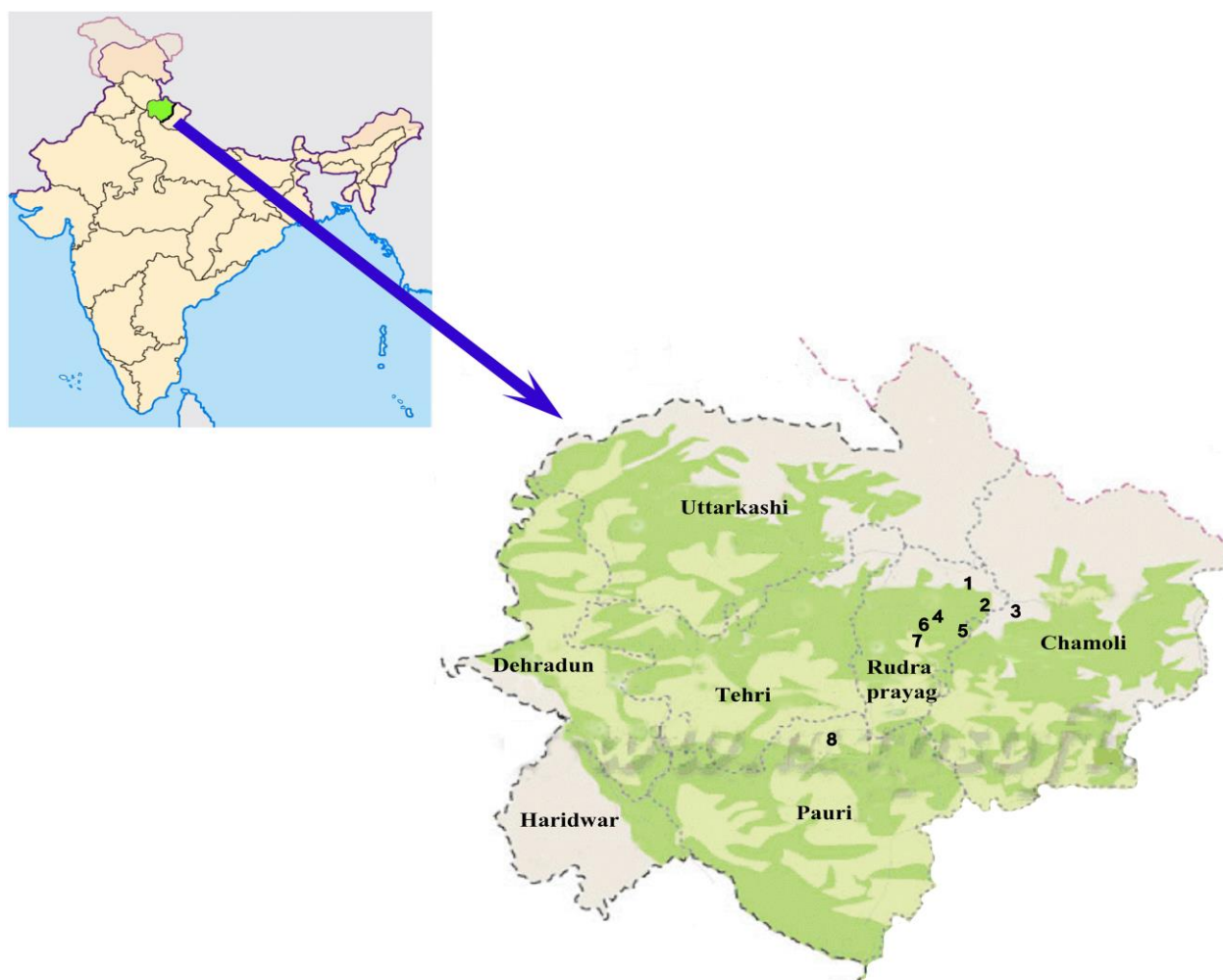


Fig. 1 – Map of the Garhwal Himalaya showing the eight study sites. 1 Tungnath Trek. 2 Chopta. 3 Mandal. 4 Devariyatal. 5 Baniyakund. 6 Ukhimath. 7 Kund. 8 Nagdev-Jhandidhar.



Fig. 2 – A *Cantharellus cibarius*. B *Cantharellus minor*. C *Lactarius subindigo*. D *Morchella esculenta*. E Local boy collecting morels. F Local villager drying the fruiting bodies of *Morchella*. G *Amanita hemibapha*.

Boletaceae

Boletus edulis Bull ex Fries, Syst. Myc. I: 392. 1821.

Fig. 3E

Pileus 50–110 mm broad, convex when young, broadly convex with age, yellowish brown (5E6) to dark brown (6F7), dusted with a whitish bloom, surface dry, viscid when wet, glabrous, smooth, uneven, wrinkled to somewhat shallowly pitted, margin regular, smooth, incurved when young. Context firm, 10–15 mm thick at disc, pure white, unchanging on exposure or bruising. Tubes 8–12 mm deep, adnexed but depressed around the stipe, pale whitish when young, yellowish white (2A2) to olive yellow (2C6) with age, unchanging on bruising, pores minute, roundish, stuffed when young, whitish first yellowish brown (5E8) in age, unchanging. Stipe 40–70 × 10–20 mm, central, bulbous or almost parallel, brown (6D8) in apical part, whitish yellow at base, reticulate in the upper

half, reticulations white, base subradicating. Taste mealy. Odour pleasant. Spore deposit olive brown (4E5).



Fig. 3 – A *Grifola frondosa*. B Local villager collecting fruiting bodies of *Grifola frondosa*. C *Grifola frondosa* being cooked by a local villager. D *Hydnum repandum*. E *Boletus edulis*. F *Lactarius deliciosus*. G Nepali man collecting the fruiting bodies of *Amanita hemibapha*.

Habit and Habitat – Solitary, scattered to gregarious, under *Quercus semecarpifolia*.

Specimen Examined – India: Uttarakhand, Rudraprayag, Baniyakund, 11 August 2013, RPB/US, GUH-M-26792.

Discussion – The specimens from the Garhwal Himalaya resemble the description of *B. edulis* as given by Smith and Thiers (1971). The shape of the stipe and colour of the pileus have been reported to vary a great deal. This is true in these populations as well. *B. edulis* has been recorded under a variety of conifers and deciduous trees. We have collected specimens of *B. edulis* under *Quercus semecarpifolia*. *Boletus regineus* is similar to the present species but can be distinguished by the whitish bloom in young stage and equal stipe at maturity. *Boletus edulis* is regarded as highly delicious and consumed in the Garhwal Himalaya. Local villagers, Nepali and Van Gujjar collect only fresh

specimens early in the morning. They identify this mushroom on the basis of the yellowish brown to dark brown colour, swollen stipe with fine reticulations and pleasant odour.

Edibility – Regarded as edible and choice; commented upon by Atkinson (1961), Krieger (1967), Smith & Thiers (1971), Miller (1981), Lincoff (1981), Purkayastha & Chandra (1985), Arora (1986), Phillips (1991) and Das (2009).

Strobilomyces floccopus (Vahl.ex Fr.) Karst, Bidr.Finl. Nat. Folk 37: 16. 1882.

Fig. 4G

Pileus 40–100 mm broad, convex to pulvinate, becoming applanate at maturity, surface dry, areolate, coarsely scaly, scales dark brown (6F7), greyish brown (5E3) between the scales; margin appediculate with remnants of greyish black, submembranous to fibrillose partial veil. Context soft, whitish, reddish brown (9E6) first and finally black on bruising or on exposure. Tubes 8–12 mm deep, adnate to subdecurrent, slightly depressed around the stipe, greyish white (1B1) at first, dark greyish (1F1) in age, stain reddish first and finally black when injured, pores angular, larger towards the stipe, greyish when mature, reddish first and then black on bruising. Stipe 40–100 × 10–20 mm, equal to slightly tapering upwards, surface rough, brownish grey (6F2), concolorous with cap, apex striate with longitudinal veins covered by a thick woolly sheath of veil leaving an annular zone, base tomentose, context white, reddish brown (9E6) to black on bruising. Taste mild. Odour indistinctive. Spore deposit dark brown (6F7).

Habit and Habitat – Solitary to scattered in broadleaf or mixed forests containing *Quercus leucotrichophora* and *Rhododendron arboreum*.

Specimen Examined – India: Uttarakhand, Rudraprayag, Kund, 25 July 2013, RPB/US, GUH-M-26713.

Discussion – *Strobilomyces floccopus* is easy to recognize in the field by its small to medium sized fruiting bodies, coarsely scaly, greyish-black cap with whitish to dark grey tubes, bruising reddish, then black, woolly-scaly, blackish stipe with greyish partial veil, leaving 1–2 woolly, sheath-like rings or zones on stipe, flesh whitish, bruising reddish, then black. *Strobilomyces confusus* Singer is very close to the present species but differs in having erect scales on the cap and spiny spores with an incomplete network of ridges.

The presence of distinct annulus relates this species to *S. annulatus* Corner, but *S. annulatus* has a relatively larger pileus, a shallowly reticulate stipe, echinulate-subreticulate spores and scales on the pileus which wash off with maturity. This mushroom is known as “Old Man of the Woods”.

Edibility – This bolete is edible but becomes unappetizing as it ages, so only young specimens should be used; commented upon by Christensen (1955), Atkinson (1961), Krieger (1967), Lincoff (1981), Miller (1981), Purkayastha & Chandra (1985), Arora (1986), Singer (1986), Phillips (1991), Das (2009) and Vishwakarma & Bhatt (2013).

Cantharellaceae

Cantharellus cibarius Fr., Syst. Mycol. I: 318. 1821.

Fig. 2A

Pileus 30–120 mm broad, convex at first with inrolled margin often becoming funnel-shaped with a wavy margin, pale yellow (2A3) to orange yellow (4B8) to almost orange (5B7), with a few tiny appressed fibers. Lamellae decurrent, close to subdistant, concolorous with pileus. Stipe 30–60 × 10–20 mm, thin, more or less equal, solid, smooth, concolorous with pileus, sometimes bruising brownish to orangish. Taste not distinctive. Odour fragrant. Spore deposit yellowish white (2A2) to pale yellow (2A3).

Habit and Habitat – Solitary to scattered, sometimes gregarious, in mixed forests, associated with *Quercus leucotrichophora*, *Rhododendron arboreum*, *Myrica esculenta*, *Cedrus deodara* and *Cupressus torulosa*.

Specimen Examined – India: Uttarakhand, Rudraprayag, Ukhimath, 12 September 2013, RPB/US, GUH-M-26841.

Discussion – This mushroom is commonly called the ‘Golden Chanterelle’. Local villagers easily identify this mushroom by its funnel-shaped structure and yolk yellow colour. This mushroom is

consumed by villagers in most parts of the general study area. It has good antioxidant activity (Vishwakarma et al. 2011).



Fig. 4 – A *Marasmius oreades* growing among grasses. B *Craterellus cornucopioides*. C *Russula virescens*. D *Russula brevipes*. E Nepali woman collecting *Russula brevipes*. F *Lactifluus hygrophoroides*. G *Strobilomyces floccopus*.

Edibility – Edible and choice; commented upon by Bose & Bose (1940), Christensen (1955), Atkinson (1961), Krieger (1967), Jong (1978). Phillips (1981), Weber & Smith (1985), Purkayastha & Chandra (1985), Arora (1986), Phillips (1991), Das (2009), Vishwakarma & Bhatt (2013) and Semwal et al. (2014).

Cantharellus minor Peck, Annual Rep. New York State Cab. 23:122. 1872.

Fig. 2B

Pileus 10–25 mm broad, convex when young, later expanded, sometimes umbilicate or centrally depressed and finally infundibuliform, smooth, yellowish orange to orange (4A7–5A7); margin incurved at first, becoming decurved to plane and finally arched, undulate, even. Context very thin, concolorous with pileus. Lamellae decurrent, close to sub-distant, very narrow, forked, not anastomosing, yellowish orange to orange (4A7–5A7); edges even, acute or obtuse. Stipe 15–30 × 2–3 mm, central, cylindrical, equal in diam. throughout or tapering slightly towards the base, solid, hollowing with age, smooth, yellowish orange to orange. Taste and Odour not distinctive. Spore deposit pale orange (5A3).

Habit and Habitat – Scattered, sometime in clusters. Growing on the ground in areas covered with decaying organic matter.

Specimen Examined – India: Uttarakhand, Rudraprayag, Kund, 15 September 2013, RPB/US, GUH-M-26875.

Discussion – It is commonly called as ‘Small Chanterelle’. Local villagers can’t distinguish this mushroom from *Cantharellus cibarius* and collect this mushroom along with the fruiting bodies of *C. cibarius*.

Edibility – Commented upon by Krieger (1967), Purkayastha & Chandra (1985), Phillips (1991), Metzler et al. (1992) and Semwal et al. (2014).

Craterellus cornucopioides Fries, Epicr. Syst. Myc. p. 532. 1838.

Fig. 4B

Pileus 25–60 mm broad, trumpet-shaped, hollow at the base, margin decurved at first but soon elevated, edge soon irregularly flared and undulate, surface opaque, brownish grey (5D2) to black, roughened with a few obscure blackish brown fibrous tufts or minute scales. Context very thin, brittle, concolorous with surface of pileus. Hymenium even, without gills, wrinkles or folds, ash gray to dark smoky brown. Stipe very short or not distinct, hollow, tapered to the base, concolorous with pileus. Taste and Odour not distinctive. Spore deposit white to dull white.

Habit and Habitat – Clustered to scattered, growing on the ground under oaks.

Specimen Examined – India: Uttarakhand, Rudraprayag, Tungnath Trek, 25 September 2013, RPB/US, GUH-M-26886.

Discussion – This mushroom is commonly called as ‘The Horn of Plenty’ and ‘Black Trumpet’. Villagers identify this mushroom on the basis of the ash grey colour and trumpet-like shape.

Edibility – Commented upon by Atkinson (1961); Lange & Hora (1963), Krieger (1967), Phillips (1981), Miller (1981), Purkayastha & Chandra (1985), Arora (1986) and Das (2009).

Hydnaceae

Hydnum repandum L.:Fr., Syst. Mycol. 1: 400. 1821.

Fig. 3D

Pileus 30–100 mm broad, convex, becoming nearly plane with a central depression, surface dry, smooth to slightly scaly, pale orange (6A3) to light orange (6A5), or paler (2A2); margin inrolled in the beginning, becoming lobed to undulate at maturity, bruising to brownish orange (6C8). Context white, often discolouring yellowish when exposed or bruised. Hymenophore decurrent, covered with spines or teeth, 2–6 mm long, pale or dull orange. Stipe 30–80 × 10–25 mm, equal to enlarged at base, surface dry, smooth, whitish or coloured like the pileus, bruising brownish orange (6C8). Taste mild or peppery. Odour pleasant. Spore deposit white.

Habit and habitat – Solitary, scattered to gregarious, mycorrhizal with broadleaf trees or conifers.

Specimen Examined – India: Uttarakhand, Rudraprayag, Ukhimath, 25 August 2013, RPB/US, GUH-M-26813.

Discussion – *Hydnum repandum* is commonly called the ‘Hedgehog Mushroom’ and ‘The Sweet Tooth’. This species resembles *H. umblicatum*, but the latter is smaller in size and has a central pit on the cap. Villagers identify this mushroom on the basis of pale orange colour and presence of spines under the cap. Fruiting bodies are washed, cut into small slices and fried along with garlic and ginger.

Edibility – Regarded as edible and choice; commented upon by Atkinson (1961), Krieger (1967), Phillips (1981), Miller (1981), Purkayastha & Chandra (1985), Arora (1986), Phillips (1991) and Das (2009).

Marasmiaceae

Marasmius oreades (Bott.:Fr.) Fr., Epicr. Syst. Mycol. 375. 1838.

Fig. 4A

Pileus 20–45 mm broad, at first convex, later flattened and broadly umbonate, cinnamon brown (6D6) to buff brown at the centre, yellowish white (4A2) towards margin; margin striate, upturned in age. Context whitish buff, thick at the centre, otherwise thin. Lamellae adnexed or free, distant, whitish becoming yellowish white (4A2). Stipe 25–70 × 2–5 mm, cylindrical, more or less equal or slightly tapered towards pileus, concolorous with cap, buff near to base. Context tough, whitish buff. Taste and Odour not distinct. Spore deposit white.

Habit and Habitat – Gregarious, in groups or in fairy rings on lawns, pastures and grasslands.

Specimen Examined – India: Uttarakhand, Rudraprayag, Baniyakund, 11 August 2013, RPB/US, GUH-M-26797.

Discussion – This species is commonly called the ‘Fairy Ring Mushroom’. The tough stipes and characteristic bell-shaped caps, along with its occurrence in grass, distinguish *M. oreades* from other common species of *Marasmius*. Villagers recognize this edible mushroom on the basis of its relatively small size, fairy ring formation and grassy habitat. The locals discard the tough stipes of this mushroom and use the caps whole.

Edibility – Commented upon by Christensen (1955), Atkinson (1961), Krieger (1967), Miller (1981), Purkayastha & Chandra (1985), Arora (1986) and Phillips (1991).

Meripilaceae

Grifola frondosa (Dicks.: Fr.) S F Gray, Nat. An. Brit. Plants 1: 643. 1821.

Fig. 3A

Pileus 40–90 mm broad, 5–10 mm thick, imbricate, petaloid, fan shaped, brownish grey (6E2), becoming darker and eventually dull brown, finely tomentose to glabrous, smooth or radiately rugose. Tube yellowish white (2A2), angular or rounded, 2–3 per mm, decurrent, 2–5 mm deep. Stipe 20–50 mm long, pale yellow (3A3) or greyish, laterally compressed, branched. Context white, soft and fibrous. Taste mild. Odour pleasant. Spore deposit white.

Habit and Habitat – Solitary, common, found at the base of living broadleaf trees and conifers, associated with *Quercus semecarpifolia* and *Cedrus deodara*.

Specimen Examined – India: Uttarakhand, Rudraprayag, Tungnath Trek, 5 August 2013, RPB/US, GUH-M-26784.

Discussion – This species is commonly known as ‘Hen of the Woods’ or ‘Maitake’. The fruiting body is a large clustered mass of flattened, fan- or tongue-shaped caps joined by short stipes to a central base. *Polyporus umbellatus* Pers. ex Fr. is similar, also edible, but has small (10–40 mm broad), centrally attached round caps. Local villagers, Nepali and Van Gujjar recognize this mushroom on the basis of its fan-shaped structure, brownish grey and tubes underside. They collect this mushroom during grazing time (Fig. 3B). It is delicious when cooked (Fig. 3C). Before preparation they wash the fruiting bodies thoroughly, check it carefully for worms and then cut the fruiting bodies into small pieces and fry with butter along with garlic and spices.

Edibility – Commented upon by Miller (1981), Arora (1986), Phillips (1991) and Das (2009).

Morchellaceae

Morchella esculenta (L.) Pers. ex Fr., Syst. Myc. 2: 6. 1822.

Fig. 2D

Pileus 35–80 mm long and 20–45 mm broad, sometimes convex, often globular, yellowish white (3A2) to yellowish brown (5D8), pitted; pits up to 15×10 mm, irregular to rounded, up to 7 mm deep, yellowish within, becoming brown to blackish on drying; ribs usually irregular rather than longitudinally disposed, anastomosing; edges obtuse, up to 1.5 mm thick, concolorous with the interior

of pits. Stipe 20–85 × 8–15 mm, sometimes slightly swollen at the base, whitish to yellowish, cylindrical, hollow, irregularly lacunose at the base but nearly even above, pubescent. Taste pleasant. Odour indistinctive. Spore deposit pale yellow (4A3).

Habit and Habitat – Solitary to widely scattered, gregarious or clustered, under conifers.

Specimen Examined – India: Uttarakhand, Pauri Garhwal, Nagdev-Jhandidhar, 4 April 2013, RPB/US, GUH-M-26708.

Discussion – *Morchella esculenta* is an edible morel mushroom, locally known as ‘Guchhi.’ It is highly prized in the Garhwal Himalaya and consumed locally by the villagers. Commercial cultivation of this mushroom has not yet been successful; hence its mycelium is extensively used as a flavouring agent. In the Himalayas, morels are cooked as food and used in medicine and health care systems by the traditional societies and also used clinically. Negi (2006) discussed the nutritional value and medicinal uses of *Morchella* spp. from the Darma valley, Pithoragarh district, Kumaun Himalaya, Uttarakhand.

This mushroom is fairly easy to recognize in the field by its yellowish brown colour, cap having pits and ridges and spongy nature. Villagers go to collect this mushroom immediately after lightning storms during March and April in the hills (Figs. 2E & 2F). Out of a total fifteen edible mushrooms described herein, *M. esculenta* is the only mushroom providing income to the local villagers as well as other inhabitants of this region.

Edibility – Regarded as edible and choice; commented upon by Chopra & Chopra (1955), Atkinson (1961), Krieger (1967), Jong (1978), Miller (1981), Purkayastha & Chandra (1985), Arora (1986), Phillips (1991), Vishwakarma et al. (2011), Vishwakarma & Bhatt (2013) and Semwal et al. (2014).

Russulaceae

Lactarius deliciosus (Fr.) Gray, Nat. Arr. Brit. Pls. 1: 624. 1821.

Fig. 3F

Pileus 40–75 mm broad, convex when young becoming plano-convex to plane on maturity, slightly depressed in the centre, surface glabrous, viscid when moist, zonate, light orange to orange (6A4–6A7), margin inrolled at first, broadly attached to spreading with age. Context up to 6 mm thick in the centre, thinning towards margin, pallid but spotted yellowish to orange from lactifers, finally staining greenish. Lamellae decurrent, crowded, orange (6A7) turn greenish when bruised, sometimes forked, lamellulae present in 2–3 tiers; edges smooth, entire. Stipe 25–50 × 5–14 mm, central, cylindrical, equal throughout or slightly tapering above, orange, solid when young, hollowing with age. Latex orange, turn greenish when exposed to air. Taste mild. Odour fruity. Spore deposit yellowish white (4A2).

Habit and Habitat – Scattered to gregarious, under *Quercus semecarpifolia* and *Abies pindrow*.

Specimen Examined – India: Uttarakhand, Rudraprayag, Chopta, 5 August 2013, RPB/US, GUH-M-26777.

Discussion – This mushroom is commonly called the ‘Delicious Milkcap’ or ‘Saffron Milkcap’. *Lactarius rubrifluus* is similar to the present species but has a dark reddish latex. Villagers recognize it by its saffron colour and orange latex. It is a delicious mushroom and consumed in various parts of the Garhwal Hills.

Edibility – Commented upon by Christensen (1955), Atkinson (1961), Krieger (1967), Singer (1975), Delmas (1978), Lincoff (1981), Miller (1981), Phillips (1981), Purkayastha & Chandra (1985), Phillips (1991) and Das (2009).

Lactarius subindigo Verbeken & E. Horak., Australian Systematic Botany 13: 651. 2000.

Fig. 2C

Pileus 55–70 mm broad, at first convex with depressed centre, later umbilicate when mature; surface viscid when moist, zonate, greyish blue (21C5) to dull blue (21D4) with silvery lusture, sometimes medium yellow with age; margin strongly incurved when young, plane when mature. Lamellae decurrent, crowded, lamellulae in several rows, light to greenish blue (24B7), more darker after bruising. Stipe 25–40 × 6–10 mm, cylindrical or gradually tapered towards base, concolorous

with pileus, scrobiculate, hollow. Context brittle, light blue (21A5). Latex greenish blue (24B7), unchanging. Spore deposit yellowish white (4A2).

Habit and Habitat – Solitary to scattered, common, usually on humus-rich soil, forming ectomycorrhizae with *Quercus leucotrichophora* in the temperate deciduous and mixed coniferous forests of the Garhwal Himalaya.

Specimen Examined – India: Uttarakhand, Chamoli, Mandal, 28 July 2013, RPB/US, GUH-M-26747.

Discussion – *Lactarius subindigo* is quite common in the Garhwal Himalaya and fairly easy to recognize in the field by its overall indigo blue fruiting bodies that become yellow with age, medium blue, viscid and zonate pilear surface with a silvery lustre, bluish latex and scrobiculate, hollow stipe.

This species is distinguished from the closely related *L. indigo* (Schwein.) Fr. by the absence of true pleurocystidia, cheilocystidia and smaller spores (ca $7\text{--}9.5 \times 6\text{--}7.5 \mu\text{m}$ in *L. indigo*) with wider and more rounded ridges (Verbeken & Horak, 2000). The overall bluish appearance of *L. subindigo* is also shared with *L. quieticolor*, but the pale yellowish pink to light orange lamellae, orange latex turning reddish brown on exposure and true cystidia clearly separate *L. quieticolor* from *L. subindigo* (Sharma & Das 2003).

Edibility – Regarded as edible and good; commented upon by Vishwakarma & Bhatt (2013).

Lactifluus hygrophoroides Berk. & Curt., Ann. Mag. Nat. Hist. 3rd Ser. 4: 293. 1859. Fig. 4F

Pileus 50–100 mm broad, convex when young becoming plane with maturity, centrally depressed, sometimes subinfundibuliform; surface dry and usually with a velvety sheen, azonate, at times rugose, golden yellow (5B7) to yellowish brown (5E8); margin inrolled when young becoming plane with age, smooth; pilear surface turns olive yellow (2C8) with KOH. Lamellae adnate to decurrent, distant, narrow to moderately broad, whitish to pale, not staining, lamellulae present in 1–2 tiers; edges even. Stipe 30–65 × 10–26 mm, short, solid, firm, more or less concolorous with the pileus, glabrous or with an unpolished velvety sheen. Context rigid but brittle, pallid. Latex white, unchanging, copious. Taste mild. Odour indistinctive. Spore deposit white.

Habit and Habitat – Solitary, scattered to gregarious, on humus-rich soil in broadleaf forests, commonly associated with *Quercus leucotrichophora*, *Lyonia ovalifolia*, *Myrica esculenta* and *Rhododendron arboreum*.

Specimen Examined – India: Uttarakhand, Rudraprayag, Kund, 15 September 2013, RPB/US, GUH-M-26863.

Discussion – This mushroom is commonly called the ‘Hygrophorus Milky’. This species is closely related to *Lactifluus volemus*, which is easily separated in the field on the basis of the close crowded gills. *Lactifluus corrugis* is also similar to the present species but differs in having corrugated cap and close gills. Villagers residing in the Garhwal Himalaya recognize this species by yellowish brown colour and milk-like latex.

Edibility – Regarded as edible and good; commented upon by Smith (1949), Miller (1981), Lincoff (1981), Weber & Smith (1985) and Phillips (1991), as *Lactarius hygrophoroides*.

Russula brevipes Peck, Annual Rep. New York State Mus. 43: 20. pl. 2. 1890. Fig. 4D

Pileus 60–155 mm broad, convex at first, later expanded and depressed centrally, firm, dry, white, soon becoming ivory (4B3) and spotted, pale (2A2), yellow ochre (5C7) especially at places where soil particles are attached; margin slightly incurved, undulate, smooth. Context 6–15 mm thick at disc, compact and hard, yellowish white (2A2), stains brown where eaten by larvae. Lamellae adnate to subdecurrent, crowded, forked, slightly intervenose, brittle, white when young, becoming cream colour with age, lamellulae numerous, of various lengths; edges entire. Stipe 30–65 × 10–30 mm, central, equal in diam. throughout or slightly tapered towards the base, solid when young, stuffed or hollow with age, white to ivory-colour (4B3), discolouring to slightly ochraceous towards the base, smooth, dry. Taste mild at first, becoming slightly acrid after sometimes. Odour pleasant. Spore deposit white to light cream (4A2).

Habit and Habitat – Solitary to scattered, on the ground in mixed coniferous and broadleaf forests where it is associated with *Cedrus deodara*, *Cupressus torulosa*, *Myrica esculenta*, *Pinus roxburghii*, *P. wallichiana*, *Quercus leucotrichophora* and *Rhododendron arboreum*.

Specimen Examined – India: Uttarakhand, Rudraprayag, Devariyatal, 30 July 2013, RPB/US, GUH-M-26751.

Discussion – This fungus is easily recognized in the field by the compact flesh of the fruiting body and numerous lamellulae. The fruiting bodies do not blacken with age and are usually covered with litter and raise as mounds on the surface of the ground. *Russula brevipes* var. *acrior* Shaffer differs in having a slightly to strongly acrid taste and the presence of a bluish green tinge on the lamellae or stipe apex or both. Villagers recognize this mushroom on the basis of its compact and hard flesh, numerous lamellulae and short stipe. This mushroom is consumed in some parts of the Garhwal Himalaya (Fig. 4E).

Edibility – Regarded as edible; commented upon by Orr & Orr (1968), Abraham et al. (1980), Miller (1981), Purkayastha & Chandra (1985), Arora (1986) and Bhatt et al. (2014).

Russula virescens (Schaeffer ex Secretan) Fr., *Epicrasis* Syst. Mycol. 355. 1838.

Fig. 4C

Pileus 30–120 mm broad, convex when young, becoming plane with a shallow depression in the centre, sometimes subinfundibuliform in age, cuticle thin, slightly viscid when moist, but soon dry, dull, breaking into small areolated patches, pale green (27A3), olive green (2F6), greyish yellow (2B5) to olive grey (1D2); margin incurved at first, becoming decurved to plane, usually even but occasionally in older specimens partly striated. Context 3–7 mm thick at disc, firm, brittle, unchanging when cut or bruised. Lamellae adnate to adnexed, close to subdistant, distinct, separable from the flesh, brittle, equal in length, often forked at or near the stipe, intervenose, pale yellow (4A3), unchanging when injured; edges entire. Stipe 30–75 × 10–25 mm, central, equal in diam. throughout or slightly tapering towards the base, glabrous, dry, solid at first, becoming stuffed with age, yellowish white (4A2). Taste mild. Odour indistinctive. Spore deposit yellowish white (4A2).

Habit and Habitat – Solitary to scattered, on humus-rich soil, under conifers and broadleaf trees, usually associated with *Cedrus deodara*, *Cupressus torulosa*, *Lyonia ovalifolia*, *Myrica esculenta*, *Quercus leucotrichophora* and *Rhododendron arboreum*.

Specimen Examined – India: Uttarakhand, Chamoli, Mandal, 2 September 2013, RPB/US, GUH-M-26837.

Discussion – *Russula virescens* is characterized by its pale green, olive green, greyish yellow to olive grey cap with usually smooth margin, at times margin faintly striated and the cuticle breaking into small, areolate to crustose patches.

Edibility – Regarded as edible and good; commented upon by Krieger (1967), Arora (1986), Phillips (1991) and Das (2009).

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