Mushrooms for Trees and People

A field guide to useful mushrooms of the Mekong region

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Kevin D Hyde

World Agroforestry Centre
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Foreword

Dr A.B (Tony) Cunningham

It is a great honour to have been invited to write the foreword to this practical, well-illustrated, and informative field manual to useful mushrooms of the Greater Mekong Subregion (GMS). Doing so brings back childhood memories of mushroom collecting in Africa as well as wonderful mushroom meals in Yunnan shared with many old friends there over the past 24 years. The GMS is not only known for the diversity of its people and political systems, or crucial water catchment of major regional value. The Mekong region is also famous for its mushroom diversity. With at least 650 edible and medicinal species, aided by wise management, the use, cultivation and wild harvesting of mushrooms can provide a cornerstone industry for generations to come.

Encompassing an area of approximately 2.5 million km^2 including parts of China's Yunnan Province, Thailand, Laos, Cambodia, and Myanmar, the GMS supports over 300 million smallholder farmers and city dwellers. The Mekong River is only one of the large watercourses flowing through the region; other rivers include the Salween (Nujiang in China), the Drung, and the Yangtze. But this is a region that contains more than rivers, people and politics. The Mekong is well known for its high levels of biodiversity. Steep elevation gradients ranging from 70masl to 6,500 masl, a wide range of tropical to alpine habitats, and not one, but two strong seasonal monsoons from the Indian and Pacific Oceans, all contribute to an amazing diversity of animals, plants and fungi, with globally significant levels of endemism. The number of species found growing in the GMS and nowhere else is one of the highest in the world.

As part of biodiversity in the GMS, fungi, and more specifically, mushrooms play a special role. Micro-and small enterprise development is widely recognized as important in many developing countries. Yet when it comes to people earning money from non-timber forest products (NTFP's), several studies of commercially traded NTFP's in Asia, Africa or Latin America have either cautioned against undue optimism[1;2;3] or been highly skeptical. However, in the Mekong region, many mushrooms not only provide a source of food, but in areas lucky enough to have songrong (*Tricholoma matsutake*), yangdujun (*Morchella*), gangbajun (*Thelephora ganbajun*) or dongchong xiacao (*Cordyceps sinensis*), provide a very

[1] Ruiz-Pe´rez M, Belcher B, Achdiawan R, Alexiades M, Aubertin C, Caballero J, Campbell B, Clement C, Cunningham AB, Fantini A, de Foresta H, Garcı´a Ferna´ndez C, Gautam KH, Hersch Martı´nez P, de Jong W, Kusters K, Kutty MG, Lo´pez C, Fu M, Martı´nez Alfaro M A, Nair TR, Ndoye O, Ocampo R, Rai N, Ricker M, Schreckenberg K, Shackleton S, Shanley P, Sunderland T, Youn Y (2004) Markets drive the specialisation strategies of forest peoples. Ecol Soc 9(2):4. http://www.ecologyandsociety.org/vol9/iss2/art4

[2] Kusters K, Achdiawan R, Belcher B, Ruiz Pe´rez M (2006) Balancing development and conservation? An assessment of livelihood and environmental outcomes of non-timber forest product trade in Asia, Africa, and Latin America. Ecol Soc 11(2):20. http://www.ecologyandsociety.org/vol11/iss2/art20/

[3] Belcher B, Schreckenberg K (2007) Commercialisation of non-timber forest products: a reality check. Dev Pol Rev 25:355–377

important source of income. In those areas, the “houses that mushrooms built” are proof of how much income people can get from wild harvested mushrooms, contradicting much of this skepticism regarding income from forest products[4]. Through wild gathering and the managed harvesting of plantations, mushroom pickers can earn up to five times as much income as farmers. During the rainy season throughout the GMS, a billion dollar industry awakens: lively markets spring to life and streets and roadsides are filled with mushroom sellers, restaurants specializing in mushroom dishes open their doors, and tours take prospective collectors out into the countryside in search of their favorite species. With exports totaling thousands of tons annually, mushrooms play a vital role in supporting the livelihoods of those lucky enough to be part of this network.

While the economic value of fungi in the GMS is immense, the ecological contributions of these organisms are incredibly important, yet almost impossible to quantify. With a diverse set of functions, ranging from decomposition, nutrient cycling, symbiotic relationships, pathogenic infections, and effects that stimulate growth in a wide range of organisms, fungi are an essential part of the fabric of terrestrial ecosystems. Many trees within GMS forests would not be able to survive without the aid of root fungi (mycorrhiza), which also happen to be responsible for the formation of many edible mushrooms. Fungi living in the soil often influence the types of trees growing in a forest and prevent the dominance of any single woody species, leading to more diverse forests. Through their role in decomposition, fungi contribute to the turnover of organic matter providing a living substrate for organisms from the smallest bacteria to the tallest trees. We are just beginning to learn about how fungi can contribute to agroforestry land-use systems that integrate trees and their fungal partners with commercial crops. And yet much of this essential ecological work goes on below ground hidden from our view.

This wonderful book takes on the task of turning something that appears to be invisible into something that we can see, touch and taste. The authors of this book give us an insider’s view of a world still largely unexplored, capturing organisms and ecological processes that exist largely out of sight below the ground. Amazingly they have already discovered over 200 new species of mushrooms in the GMS, most of which still await scientific classification. This provides a hint of just how much we don’t know and what remains to be discovered.

And the authors have done more. They have selected for us the most valuable, tasty, and sought-after species from the GMS, a difficult task given the wide range of fungi to choose from. Furthermore, this guide is user-friendly, providing clear descriptions of the species and their habitats, and useful tips on mushroom picking and classification. The book is aimed at local gatherers, aspiring mycologists, farmers and agricultural extension workers, and seasoned veterans of mushroom hunting alike. But the goal is the same: to open everyone’s eyes, mind, and taste buds to the wonderful world of mushrooms in the Mekong region.

[4] Arora, D. (2008) ‘The Houses That Matsutake Built’, *Economic Botany* 62, pp278–290

Acknowledgements

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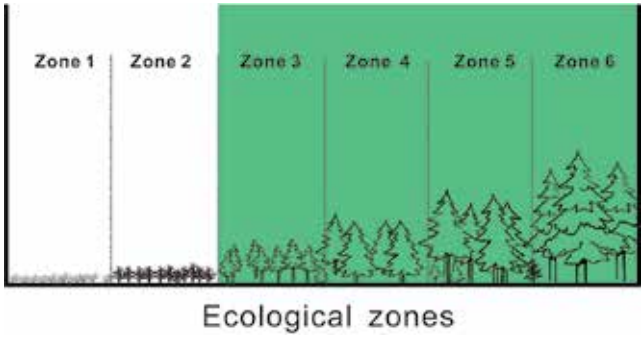
How to use this book

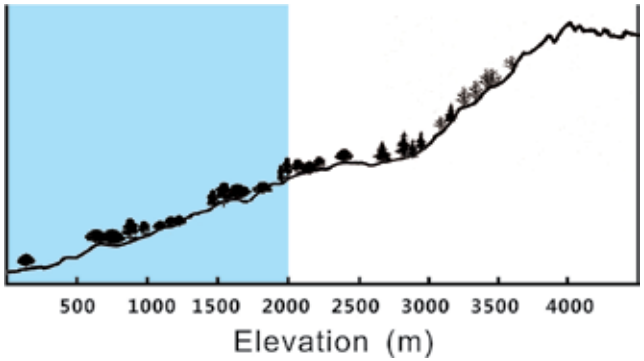
This book is a practical guide to some of the more common and valuable mushroom species of the Mekong region, thus we have tried to make it user friendly and provide easy to understand information. Each mushroom species description is accompanied by a list of local names, species distribution, morphological descriptions, uses, edibility and habitat types. Alongside each species are two diagrams depicting the ecological zones and elevation bands in which this species is known to occur.

Ecological zones (1–6) represent the various ecological habitats for the mushroom species discussed. Zone 1 represents Alpine rangelands; zone 2 depicts grasslands, initial successional stages (0– 5 years); zone 3 represents young forest stands, early successional stages (5–10 years); zone 4 shows the immature forest stands, early- mid successional (10–20 years); zone 5 is that of older forest stands, mid successional (20–30 years) and zone 6 depicts mature forests, in the late successional stages (30 years and older). The elevation bands represent the distribution of mushroom species across elevation gradients.

Pleurotus giganteus (Agaricales)

finely cover the pileus, especially at the early stages. The veil is thin, pale to dark brown, covered with soft hairs, soon reduced to soft hair remnants, but never forming a ring on the stalk. The thick stipe extension and broad lamellae are characteristic of *P. giganteus*.





Common names: Uru paha (Sri Lanka); Judarensen, Judaxianggu, Dabeixianggu, Daloudoujun and Daloudougu (China); Thoeng fon (Thailand and Laos).

When fully grown, the sporocarp of *P. giganteus* is light to dark brown, typically funnel-shaped and measures up to 35 cm in diameter and 28 cm in height, with concentrically arranged remnants of the veil on the cap surface. The solid stipe is fusiform, concolourous. Densely matted, woolly hairs, with indefinite zones of paler velar remnants,

Use: An excellent edible mushroom due to its high protein content and excellent taste.

Time of fruiting: This species normally appears at the middle of the rainy season. In Thailand, Laos, Sri Lanka and China, June and July are the best time for this species.

Habitat: Grows on the ground and is mostly solitary, but can be found in groups. Often occurs around stumps, buried wood, and apparently on dead roots, in open, lowland and mountain forest at an altitude of 3,000 m. Most commonly associated with *Artocarpus heterophyllus*, but also found in mixed vegetation.

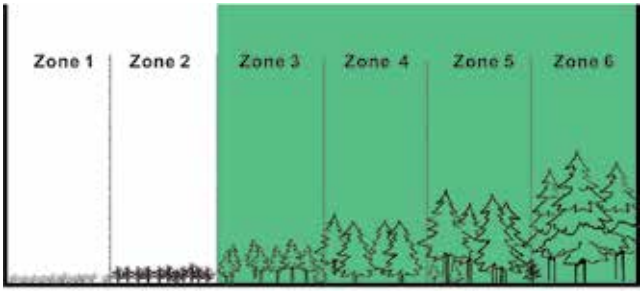
Distribution: This species has been recorded in Australia, Malay Peninsula, Sabah, Sri Lanka, Vietnam, Oceania, China, and Thailand. It is eaten in China, Taiwan, Thailand, Sri Lanka and Laos.

Lentinus roseus (Polyporales)

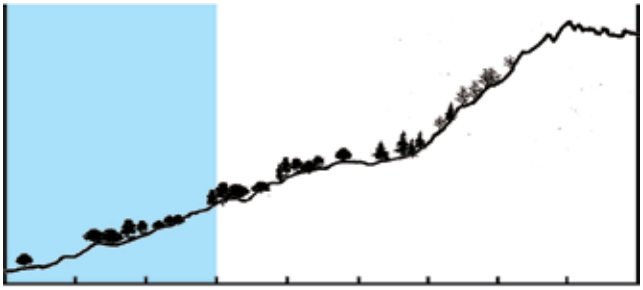
Common names: no common names have been recorded yet.

When fully grown, the sporocarp of *L. roseus* is yellowish pink, typically funnel-shaped, deeply cyathiform, measures up to 6 cm in diameter. and 2 cm high and is neither striate nor zonate. The stipe is solid, fusiform, attached to a discoid base, yellowish white to pink, with white cottony context. This new species forms clusters of basidiomes on dead and decaying wood. Initially, the young sporocarps are whitish pink and they become pink with maturity.

Use: An excellent edible mushroom because of its attractive appearance and excellent taste.



Ecological zones



Elevation (m)

Time of fruiting: Normally, this species appears at the middle of the rainy season. June and July are the best time for this species and it has only been recorded in Thailand,

Habitat: Grows on decaying wood, mostly as a cluster, often on stumps, buried wood, and apparently on dead roots, in open and lowland and mountain forest at an altitude of 1m500 m, mostly associated with forest with *Quercus, Castanopsis* and *Lithocarpus echinops*.

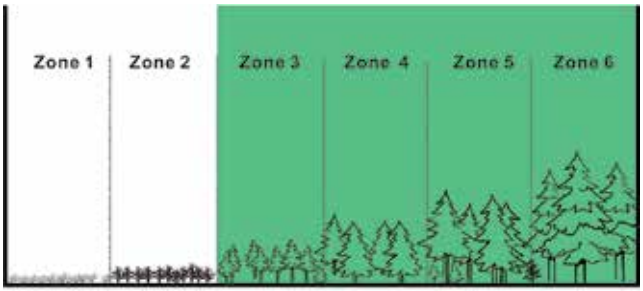
Distribution: This species has been recorded in northern Thailand only.

Lentinus connatus (Polyporales)

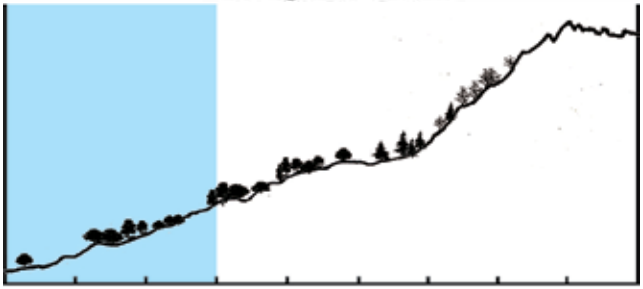
Common names: no common names have been recorded.

When fully grown, the sporocarp of *L. connatus* is applanate to deeply cyathiform, white to pale ochraceous, white in context and measures up to 20 cm in diameter and 8 cm high with a dry, leathery pileus surface. The solid stipe is cylindrical, extends up to 15 cm high, is eccentric or lateral and the white surface becomes greyish brown or darker. A ring does not form on the stipe.

Use: A good edible mushroom when the sporocarps are young.



Ecological zones



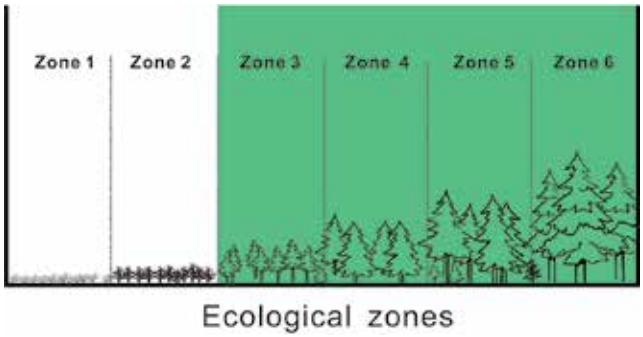
Elevation (m)

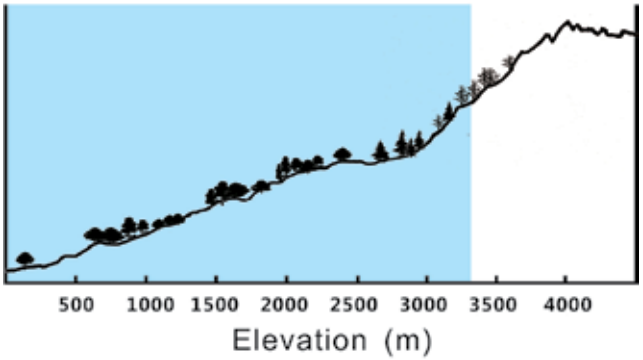
Time of fruiting: This species normally appears throughout the rainy season. In Thailand, Laos, Sri Lanka and China, June and July are the best time for this species.

Habitat: Grows on decaying wood, is mostly as a cluster, often on stumps, buried wood, and apparently on dead roots, in open and lowland and mountain forest at an altitude of 1,500 m, mostly associated with forest with *Quercus, Castanopsis* and *Lithocarpus echinops*.

Distribution: This species has been recorded in India, China and south-east Asia. It is eaten in China, Taiwan, Thailand, Sri Lanka and Laos.

Lactarius hatsudake (Russulales)





Common names: Hed chompooh mon (Thailand and Laos), Hongzhirugu (China), Hutsu take (Japan).

When fully grown, the medium to large sporocarps of *L. hatsudake* extend 3–10 cm in diameter, they're broadly spherical when young and later become funnel-shaped. The striking characteristics are pale reddish to dirty brownish pink buff with more or less concentric zonation. The cap becomes slightly translucent when wet and opaque when dry; the gill colour is a pale red when young, a pale to vinaceous red when mature and becoming ochraceous mixed with a green or bluish green when aged. The stalk is dull red and quite firm. The cap is the same colour and the species has hollow pith. This species exudes vinaceous red when injured, milk unchanging when exposed to the air, and flesh staining vinaceous red after cutting. The smell is sweetish, and the taste is mild. This species should not be confused in the field as it possesses some remarkable characteristicss i.e. milk and gill colour.

Use: This is one of the highly prized edible mushrooms in Japan and large parts of China and probably also in Korea and eastern Russia. But it is not known as an edible species in Thailand.

Time for fruiting: Normally appears in the rainy season from May to September.

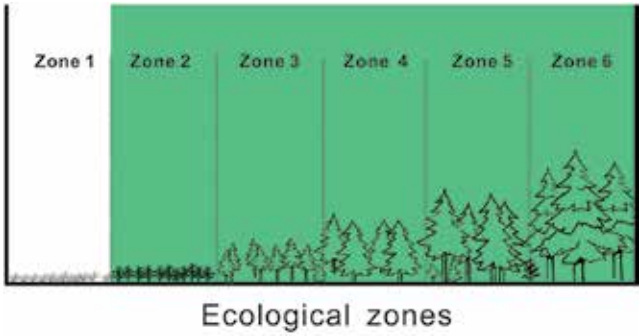
Habitat: They mostly group on the ground and associate with *Pinus kesiya*.

Distribution: This species has been found in Vietnam, Thailand, China, Japan, Korea, the Bonin Island and eastern Russia.

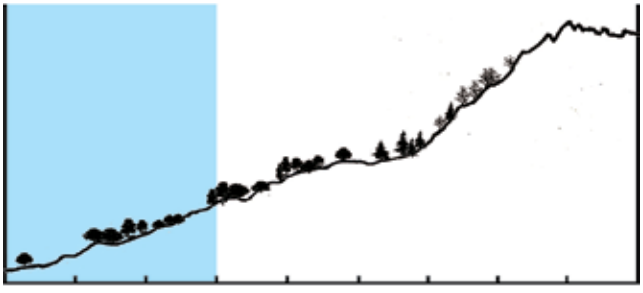
Agaricus flocculosipes (Agaricales)

Common names: No common names have been proposed yet.

This species has middle to large sporocarps. When mature, the cap can be 9–18 cm in diameter; hemispherical to convex, plano-convex, and then planes with age. The surface is dry, smooth or can be covered by light brown or brown fibrillose squamose against a snow white background. The cap usually has a pink to red tone in wet conditions. Lamellae are free, crowed, white when young but becoming pink, then brown and dark brown. The stipe is cylindrical with an abruptly bulbous, white base. The annulus is membranous and white. The lower surface has a heavily floccose structure. Its heavily floccose stipe, almond odour and distinctly



Ecological zones



Elevation (m)

yellowish discolouration on both the cap and the stipe make this species easy to distinguish.

Use: An excellent edible mushroom with an almond flavour and smell.

Time of fruiting: This species can be found throughout the entire rainy season: from May to September.

Habitat: Solitary, scattered, or gregarious on rich soil or heavily rotted wood in forests. Sometimes appears on vegetation waste.

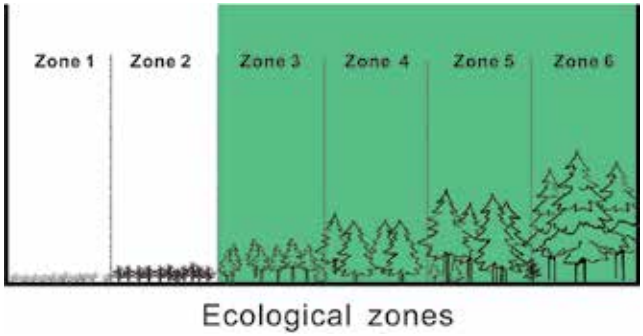
Distribution: This is a recently described species, which was introduced from Thailand. It has not been reported in other countries yet.

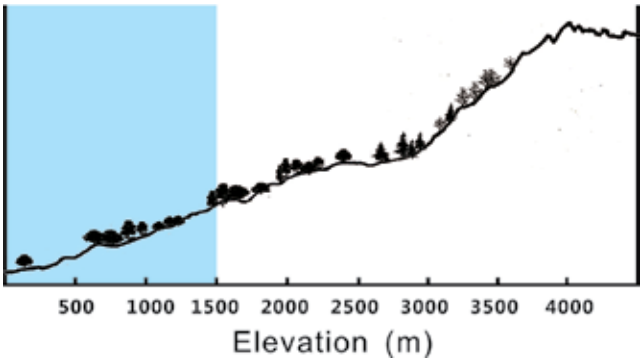
Auricularia auricula-judae (Auriculariales)

Common names: Jew's ear, Jelly ear, Judas' ear (English); Kikurage (Japanese); Mu er / Wood ear (Chinese), Hed hu nu (Thailand and Laos).

The sporocarp of *A. auricula-judae* is generally 3 to 8 cm across, but it can be up to 12 cm. Its shape resembles a floppy ear, although the fruit body can also be cup-shaped. The back surface of the cup is usually attached to the substrate, although there can also be a rudimentary stem. The fresh body has a hard, gelatinous, elastic texture; which dries out to become hard and brittle. The outmost surface is, for the most part, covered with tiny, grey downy hairs. The surface is a bright reddish-tan-brown with a purplish hint. The colour becomes darker over time. The inner touch is smooth and light grey to brown in colour. In common with other jelly fungi, *A. auricula-judae* sporocarps contain high levels of polysaccharides and these are the main bioactive component, although phenols have also been shown to contribute to the total antioxidant capacity.

Uses: This has been used as a medicinal mushroom in China for many centuries, particularly to cure haemorrhoids and strengthen the body and sometimes, to treat haemoptysis, angina, diarrhoea, and ward against gastrointestinal problems. It was used in folk medicine as recently as the 19th century for complaints including sore throats, sore eyes and jaundice, and as an astringent. At present, this fungus is a popular





component in many Chinese dishes, such as hot and sour soup. Through various experiments, it has been concluded that the fungus bears anti-tumour, hypoglycemic, anticoagulant and cholesterol-lowering properties.

Time of fruiting: Normally this species appears at the beginning of the rainy season. In Thailand, Laos, and China, June and July are the best time for this species.

Habitat: This species grows upon old rotten wood of deciduous trees and shrubs. It also forms on branches of frondose trees, usually elder. In Australia it was reported that the fungus was found in *Eucalyptus* woodland and rainforests, in which it grows in very large colonies whereas in Thailand, Laos and China it grows on dead wood of broadleaved trees.

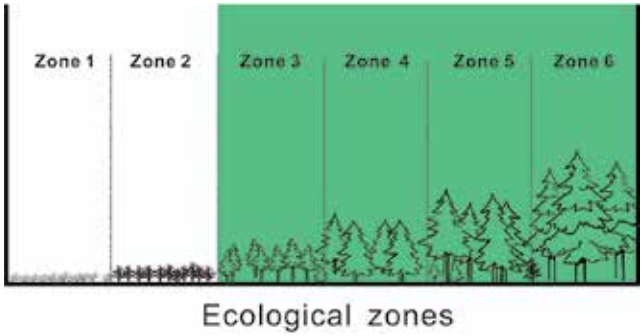
Distribution: This fungus has been recorded in temperate and sub-tropical zones worldwide, around Europe, North America, Asia (including Thailand, Laos and China), Australia, South America and Africa.

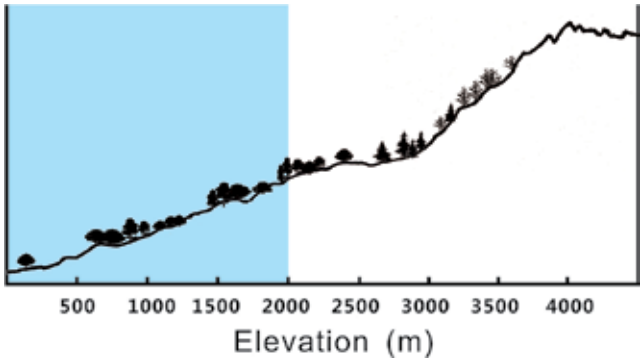
Tremella fuciformis (Tremellales)

Common names: Yin er, White jelly fungus, White jelly leaf ("shirokikurage"), White jelly mushroom, Silver ear mushroom, Snow mushroom, Chrysanthemum mushroom (English), Snow ear, Silver ear and White wood ear (Chinese), White tree jellyfish (Japanese), Hed hu nu kaaw (Thailand and Laos).

This species is a jelly fungus, which possesses a sporocarp of about 4 cm in height and 7.5 cm across, although cultivated specimens are larger. It is made up of thin, erect braches and is mostly crisped at its edges. The outer surface is smooth and shiny. Microscopically, the hyphae are clamped and occur in a dense gelatinous matrix. This mushroom develops as parasitic yeast and hyphae grow until it encountering a preferred hosts, after which fruiting occurs.

Uses: This species plays a significant role in sweet dishes in Chinese cuisine. Although it's tasteless, the species is valued for its gelatinous texture and medicinal benefits. Usually, this mushroom is prepared for a dessert soup called luk mei (六味), which includes jujubes and dried longans. It is also used as a drink and as an ice cream. This is a dynamic fungus with regard to its medical uses: it's used in radiotherapy, for circulatory disorders, neurological damage and memory impairment. It also has cosmetic applications.





Distribution: This species mainly occurs in tropical and subtropical ecosystems, but does occur in temperate areas. It is found in South and Central America, the Caribbean, parts of North America, sub-Saharan Africa, southern and eastern Asia, Australia, New Zealand and the Pacific Islands.

Time of fruiting: The mushroom commonly fruits in the middle of the rainy season in Thailand, Laos and the tropical part of China in June and July.

Habitat: This species following its host, fruit bodies are typically found on dead, attached or recently fallen branches of broadleaf trees. This fungus commonly prefers tropical and subtropical ecosystems.

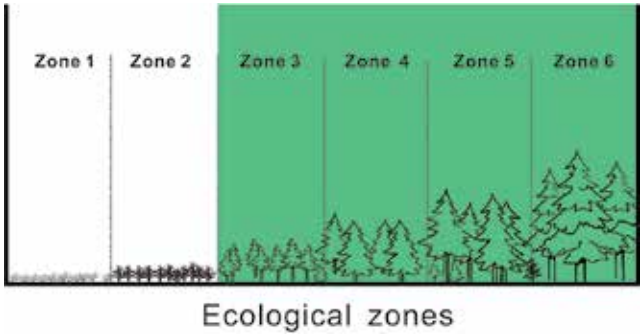
Laetiporus sulphureus (Polyporales)

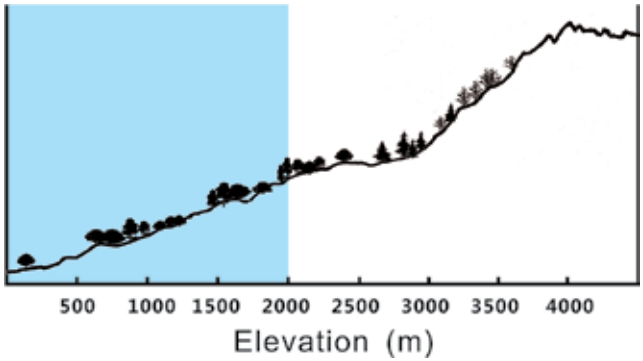
Common names: Sulphur polypore, Sulphur shelf, Chicken mushroom, Chicken of the woods (English) and Mushroom yellow chicken and Hed hing see luang neur kai (Thailand and Laos).

Laetiporus sulphureus is a species of bracket fungus that appears either individually or, more commonly, as large sporocarps. It is semicircular to fan-shaped, applanate and up to 20 cm. Its fruit bodies grow as striking golden-yellow shelf-like structures on tree trunks and branches. Like other bracket fungi, they may last many years and fade to pale grey or brown. The undersurface of the fruit body is made up of tube like pores rather than gills. Microscopically this species could be recognized from ellipsoid to ovoid, hyaline, smooth basidiospores, dimitic hyphal system and orange to sulphur yellow pore surface when fresh. *Laetiporus sulphureus* is a saprophyte and causes brown cubical rot in the heartwood of the trees on which it grows. Unlike many bracket fungi, it is edible when young.

Use: Sporocarp is used for culinary purposes and it has a long history of human consumption, especially in North America, but has to be cooked well and long.

Time of fruiting: Grows widely on decaying wood and living trees throughout the rainy season.





Habitat: Single to overlapping cluster on brown stumps, trunks and logs of deciduous trees.

Distribution: This species has been found in North America, Europe, and East Asia including Thailand, Laos and China.

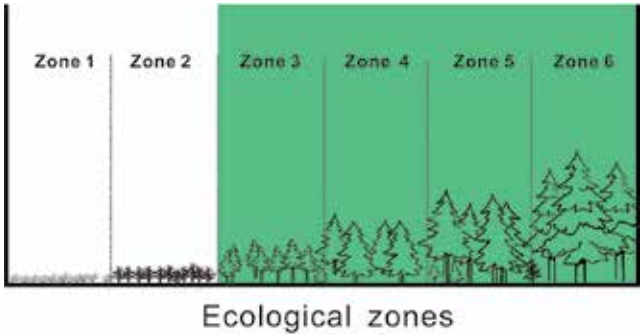
Tremella mesenterica (Tremellales)

Common names: Yellow brain, The golden jelly fungus, The yellow trembler and Witches' butter (English), Hed hing see luang neur kai (Thailand and Laos).

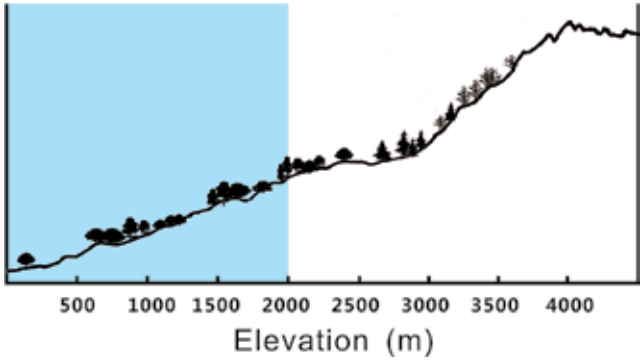
The fruit body of *Tremella mesenterica* possesses an irregular shape, which forms on the bark of dead branches of trees. It is usually 7.5 cm broad and 2.5 to 5 cm high in dimensions. The fruit body is similar to gelatine, which becomes tough when wet and hard when dry. Generally, the outer surface is smooth, the lobes translucent, deep yellow or bright yellow-orange and fading to pale yellow, rarely unpigmented and white or colourless in appearance. It turns dark reddish or orange when drying. The sporocarp is pustular when young and foliose when mature.

Uses: *Tremella mesenterica* is an edible mushroom, although it's flavourless. The gelatinous to rubbery consistency guides the pathway to soup bowls. Laboratory tests have associated a number of biological activities with *T. mesenterica* glucuronoxylomannan, including immunosti-mulatory, protecting against radiation, antidiabetic, anti-inflammatory, hypocholestero-lemic, hepatoprotective, and antiallergic effects.

Time of fruiting: This mushroom commonly fruits in the middle of the rainy season in Thailand, Laos and the tropical part of China (June and July).



Ecological zones



Elevation (m)

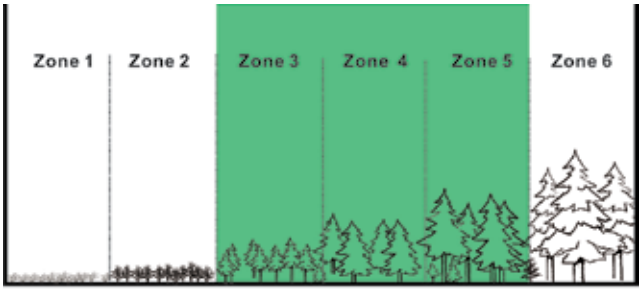
Habitat: The fruit bodies develop during wet periods throughout the year including spring, summer, fall and winter. It prefers to grow in habitats in the mesic to wet range. It is parasitic and grows on the wood-rotting corticoid fungi in the genus *Peniophora*.

Distribution: is widely distributed in Europe, North, Central, and South America, Africa, Australia and Asia.

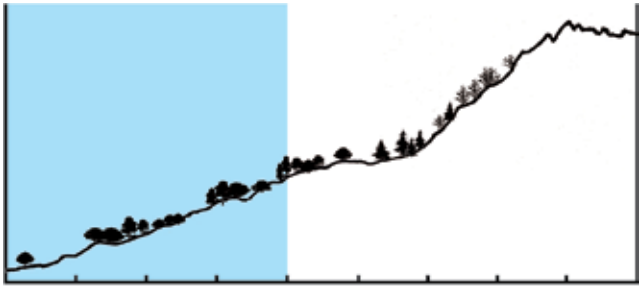
Clitocybe nuda (Agaricales)

Common names: Wood blewit, Blewitts, Blue stalk mushroom (English) and Hed chong ko (Thailand and Laos).

Clitocybe nuda (also recognized as *Lepista nuda* and *Tricholoma nudum*) is a fairly distinctive mushroom, with a colour range from lilac to purple-pink. Some North American specimens are duller and tend toward tan, but usually have purplish tones on the stem and gills. The gills are attached to the short, stout stem. Mature specimens have a darker colour and flatter cap; younger ones are lighter with more convex caps. The cap can grow to up to 16 cm. *C. nuda* can easily be distinguished by their odour, as well as by their spore print which is light (white to pale pink); whereas *Cortinarius* species produce a rusty brown spore print after several hours on white paper.



Ecological zones



Elevation (m)

Use: An edible mushroom, however they are known to cause allergic reactions in sensitive individuals and also contain antimicrobial compounds.

Time of fruiting: This species can be found in middle of the rainy season from June to July in Thailand.

Habitat: Solitary and scattered or in clusters in rich humus solid, decaying leaf litter.

Distribution: This species has been found in northern Europe, North America, Australia, China, Laos and Thailand.

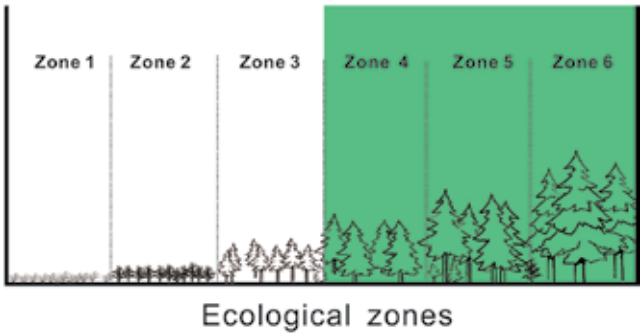
Ganoderma lingzhi (Polyporales)

Common names: Lingzhi mushroom, Varnish conks mushroom, Yeongji mushroom (China), Lingzhi mushroom (Thailand and Laos).

Ganoderma lingzhi is a polypore mushroom that is soft (when fresh), corky, and flat. It has a conspicuous red-varnished, kidney-shaped cap that grows up to 30 cm and, has white pores underneath when young, and turning to sulphur yellow at maturity, turning brown to dark brown when bruised. It lacks gills on its underside and the basidiospores are released through fine pores, leading to its morphological classification as a polypore. Microscopically this species is characterized as yellowish brown, double-walled, ellipsoid, truncated basidiospores and dimitic hyphal systems.

Use: An edible mushroom, used in traditional Chinese medicine.

Time of fruiting: Grows alone or gregariously, in late May, early June, well into July or later.



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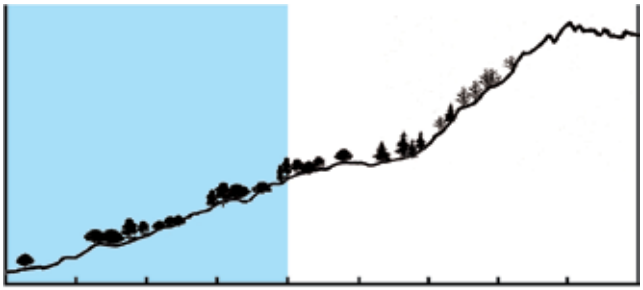
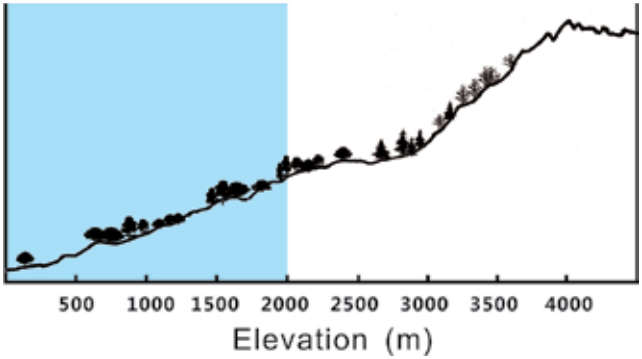


Elevation (m)

Habitat: Grows as a parasite or saprobe on a variety of decaying hardwoods and stumps of deciduous trees.

Distribution: This species is widely distributed in East Asia.

Ganoderma australe (Polyporales)



Common names: Southern Bracket (English), Hed hu chang (Thailand and Laos), Ling zhi (Chinese).

Ganoderma australe is a large bracket fungus that grows up to typically 25 cm across but exceptionally 50 cm, and 5 to 25 cm thick, with a pale margin and lower surface, and a dark brown or dark grey upper surface. The tube layer is brilliant white when ready to release spores, but as with other Ganoderma fungi the spores are brown and soon colour the surrounding area, including parts of the top of the bracket, with a dense brown dust.

The red-brown tubes of the *G. australe* are tiered, a new layer being produced each year. The small round pores, typically 3 or 4 per mm, are white when the fruiting body is growing and approaching the time when spores will be released, turning brown with age or when bruised. A new tube layer grows on the lower surface each year.

Uses: too tough to be edible

Time of fruiting: This species lives for many years, and sporulating especially in the middle of the rainy season.

Habitat: A perennial bracket fungus that causes white heart rot, produces brackets on the lower parts of tree trunks.

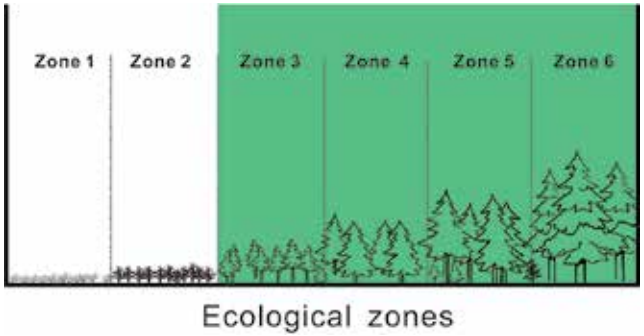
Distribution: This species is found throughout most of mainland Europe, southern China, Laos, and Thailand and; is most common in central and northern Europe.

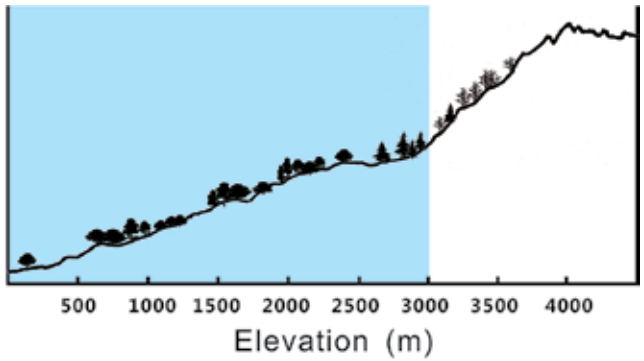
Cantharellus cibarius (Cantharellales)

Common names: Chanterelle, Yellow chanterelle, Pfifferling (German), Golden chanterelle, Girolle (French), Man pu yai/Kha min yai (Thailand and Laos).

Cantharellus cibarius is a thick and firm fungus, which is yellow to golden-yellow, with the colour fading with age. The cap is approximately 3–11 cm broad, and its frequently depressed but not funnel-shaped. The whole fungus exhibits the shape of a vase having an incurved margin, which deforms with the age. The upper surface is smooth, and the hymenius forms ridges and pleats on the outside. The odour is faintly fruity & it has a mild taste. Scientific research has revealed that *Cantharellus cibarius* may have potent insecticidal properties protecting the fungus from insects, which are harmless to humans.

Uses: This species is an edible mushroom, which appeared in palace kitchens to fulfil the diets of noble people from the early ages. Chanterelles as a group are rich in flavour, with a significant taste.





Time of fruiting: Fruiting time normally commences in early spring, and occasionally in late summer. In China, this species fruits in the middle of the summer, in June and July.

Habitat: This mushroom commonly grows gregariously, clustered or in fairy rings; preferring the shade of *Quercus agrifolia* (coast live oak) and less commonly found with *Lithocarpus densiflorus* (tanbark oak) and *Umbellularia californica* (California bay). This mushroom is normally found in mossy coniferous forests, but is also often found in mountainous birch forests and among grasses and low-growing herbs."

Distribution: *C. cibarius* is a species complex, with a wide distribution in Europe, North America including Mexico; and occurs in Asia including the Himalayas, Thailand, Laos and China.

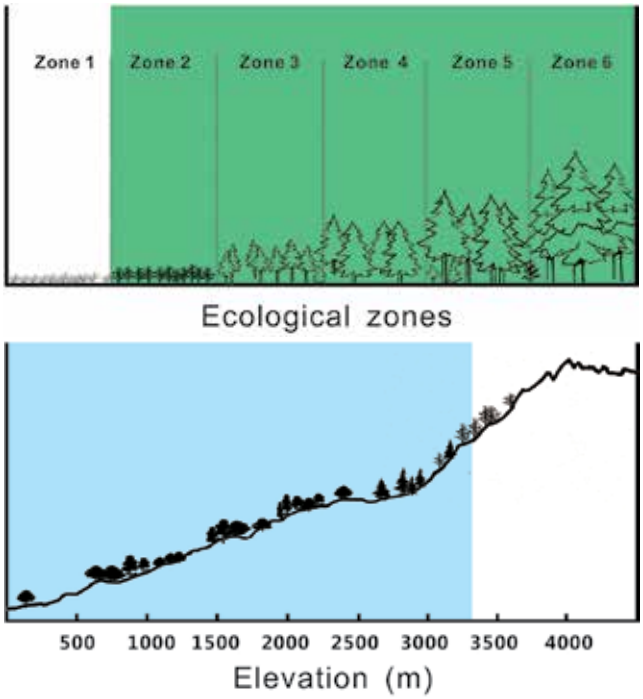
Catathelasma ventricosum (Agaricales)

Common names: Laorentou (Chinese); Gemu, Zhishu (Tibetan).

The young sporocarp of *C. ventricosum* is quite a stout cylinder wrapped in a membranous areolate grayish or whitish veil. The cap is plane with an uplifted margin measuring up to 16 cm in diameter. When fully grown, the cap is usually dry and covered with the remnants of the grayish or whitish veil, which are cracked exposing the white flesh beneath. The solid stipe is cylindrical with an abruptly tapering base, white above the annulus, concolourous with the cap below, measuring up to 12 cm long and 5 cm broad. The white gills are typically decurrent, white, some forked and up to 9 mm broad. The ring is double, membranous, thin, annealed, flaring against the gills and sheathing the lower stalk. The odour is somewhat the odour is farinaceous. The gargantuan and very firm sporocarp and the grayish or whitish veil remnants on the cap are characteristic of *C. ventricosum*.

Use: A famous edible mushroom because of its soft and delicious taste.

Time of fruiting: This species usually fruits in the middle of the rainy season. June to August is the best time for this species in Yunnan.



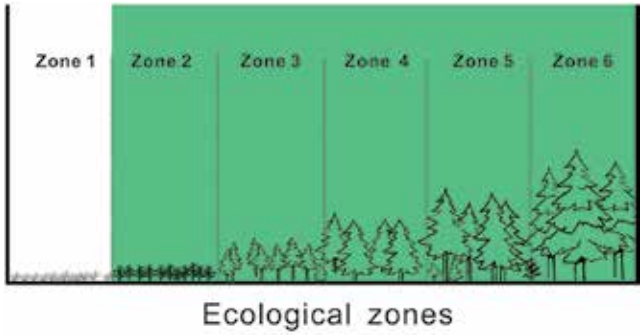
Habitat: Grows on the ground, usually solitary or in small groups in conifer forests (especially under spruce) at an altitude of 3,300 m.

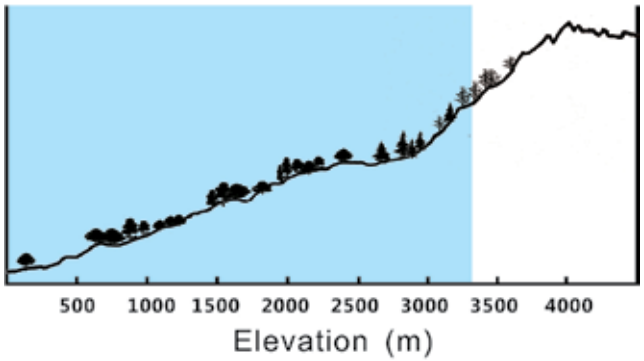
Distribution: This species has been reported from Europe, North America and China.

Lyophyllum fumosum (Agaricales)

Common names: Yiwojun (Chinese); Lei (Tibetan).

The sporocarps of *L. fumosum* usually form a compact cluster with one common base and can look quite spectacular on the ground. The pileus is usually whitish gray to grayish brown, it starts out convex, or plane with a wavy margin and measuring up to 12 cm in diameter upon maturity. The surface is smooth, moist when fresh, and slightly fibrillose. The firm and solid stipe is cylindrical, nearly equal, and white. The gills are white, close, adnate to decurrent, sometimes notched and produce white spores. It has a somewhat mealy smell, and no trace of veil throughout the growth. The dense clump growth habit and grayish cap are characteristic of *L. fumosum*.





Habitat: Grows in compact clusters on the ground, in conifer, especially pine, forests at an altitude of 3,300 m. It can be solitary.

Distribution: This species has been recorded in Europe, China and North America.

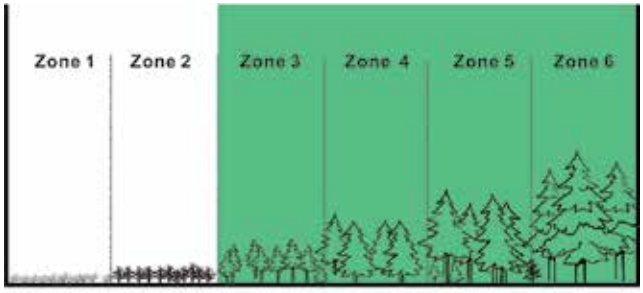
Use: A popular edible mushroom due to its wonderful taste.

Time of fruiting: This species fruits from the beginning of the rainy season until almost the end. June, July, August and September are the best times for this species in Yunnan.

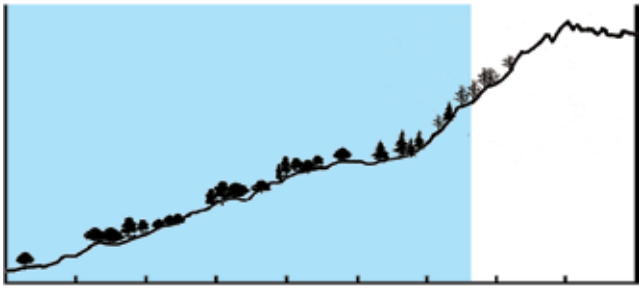
Russula cyanoxantha (Russulales)

Common names: Huagaigu (Chinese), Lom lai sri (Thailand and Laos).

The sporocarp of *R. cyanoxantha* is typically fleshy and firm. The pileus is often lilac or purple variegated with yellow, white or olive, especially at maturity. It is convex and becomes plane or plano-concave, sometimes with a vaguely striate margin measuring up to 13 cm in diameter upon maturity. The surface is smooth, usually slimy when fresh, but easily becoming viscid and dry. The thick stalk is white, cylindrical with a narrow base and stuffed. The gills are adenx, adnate or slightly decurrent, white, and medium close, forked and intervenose, with a typically soft texture. It has a mild odour and



Ecological zones



Elevation (m)

taste. The large size, white gills and variegatedly coloured cap are characteristic of *R. cyanoxantha*.

Use: An edible mushroom with a good flavour.

Time of fruiting: This species is abundant in September and October in Yunnan Province.

Habitat: Grows on the ground, usually solitary, sometimes occurring in small groups in conifer forests and mixed forests up to at an altitude of 3,300 m.

Distribution: This species has been recorded from North America, Europe and China.

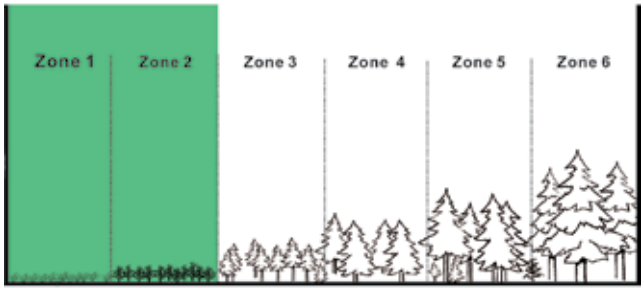
Stropharia rugoso-annulata (Agaricales)

Common names: Zhuashong (Chinese and Tibetan).

The cap of *S. rugoso-annulata* is strikingly wine-red when fresh and fades to white when weathered. It is, smooth and slightly viscid or dry, convex becoming plano-convex to plane and measuring up to 13 cm in diameter upon maturity. The firm stipe is cylindrical, slightly bulbous at the base, stuffed, white, and measures up to 15 cm long and 7 mm broad. The gills are adnex to adnate, close, white and gray, then purple black upon maturity. The annulus is exquisitely crown-shaped, thick and persistent and creamy or white. The superior stipe has a strongly striate surface and the margin splits into recurved teeth. The wine-red cap and the distinctive crown-shaped annulus are characteristic of *S. rugoso-annulata*.

Use: Edible with good flavour.

Time of fruiting: This species usually fruits in summer and autumn. In China (Shangri-la, Yunnan province) it appears until the end of September.



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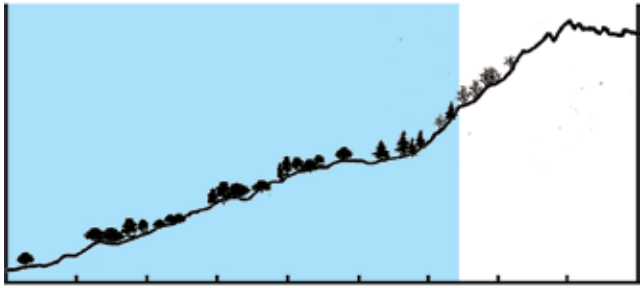
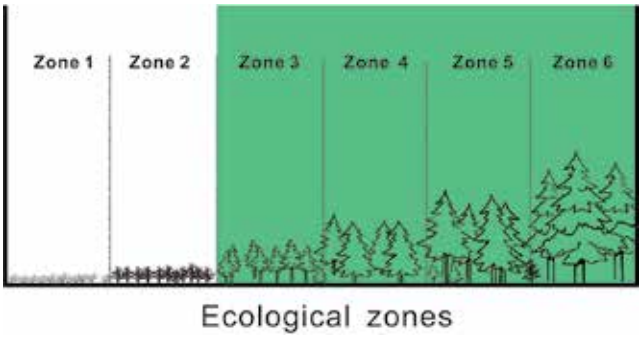


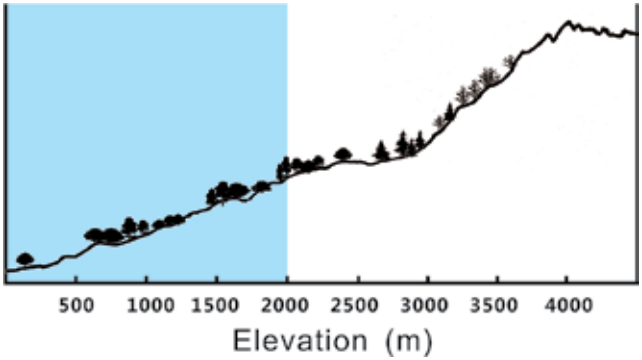
Elevation (m)

Habitat: Usually grows on dung, mostly appears solitary (occasionally in small groups) in meadows at an altitude of 3,200 m.

Distribution: This species has been recorded in North America, Europe, and China.

Fistulina hepatica (Agaricales)





Common names: Beefsteak polypore, Beefsteak fungi, Beefsteak mushroom, Ox tongue (English) and Hed lin- kwang (Thailand and Laos).

The sporocarps of *F. hepatica* grow up to 7–30 cm height, and 2–8 cm thick. They are usually fan shaped and irregular and reddish to brown (when fresh). It is dimidiate to reniform or subcircular. The tube layer consists of individual, congested, easily separated tubes. With age or on drying, specimens become soft, fibrous and pale brown, whitish cream become to reddish- brown. This species usually is a saprobe and sometimes a parasitic fungus that lives on hardwoods.

Use: This is an annual edible fungus that should be collected in the young stage for better taste and texture.

Time of fruiting: This species appears from August to November. In North America, the season is from July to October whereas in Thailand and Laos from May to September.

Habitat: Normally solitary but there may be several in a cluster. The species is distributed throughout temperate and subtropical hardwood forest ecosystems and grows on numerous hardwood species.

Distribution: This species has been recorded throughout Europe and North America. In Laos and China, it is usually found on decaying wood, rotten wood and tree trunks. In Thailand it has been recorded at Nam Nao Phurua National Park.

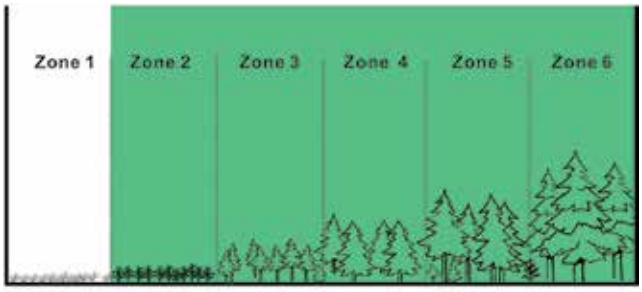
Agaricus subrufescens (Agaricales)

Common names: Almond mushroom, God's mushroom; Baximogu, Jisongrong (China); Himematsutake (Japan).

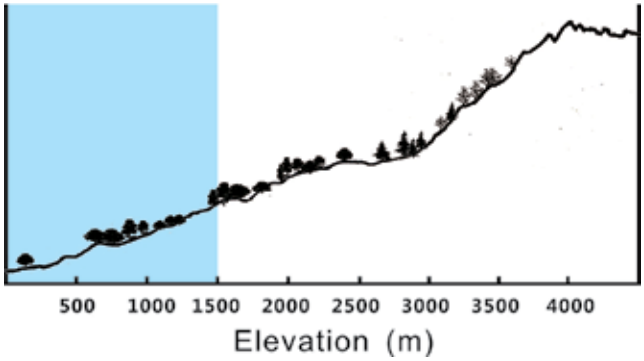
When fully grown, the cap of *A. subrufescens* can be 6–15 cm in diameter. It has a hemispherical shape when young, which becomes convex and finally flat with age. The surface has silk-like fibrils or formed squamulose. The colour varies from white to grayish or reddish brown in different continents. Lamellae of this species free, crowed, white when young, pink, to brown, dark brown with age. The stipe is cylindrical and white with a bulbous base. The annulus is double layered, white and the lower surface is covered with cottony scales. This species can easily be distinguished by its coloured fibrillose cap surface, almond odour and the distinctly yellowish discolouration that occurs on both the cap and stipe when bruised.

Use: A well-known mushroom for its medicinal properties and edibility. It has been commercially cultivated on a large scale in both China and Brazil.

Time of fruiting: This species normally appears from the middle of the rainy season to the end of September. July and August are the best time for this species.



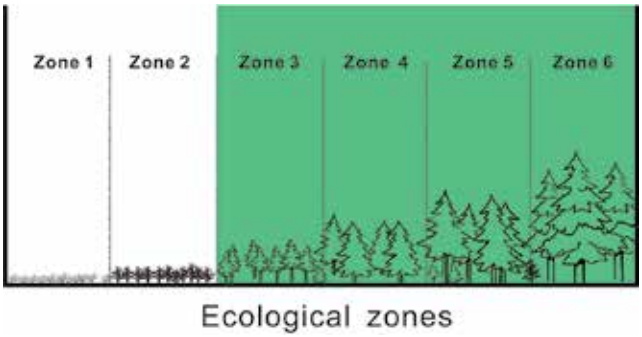
Ecological zones

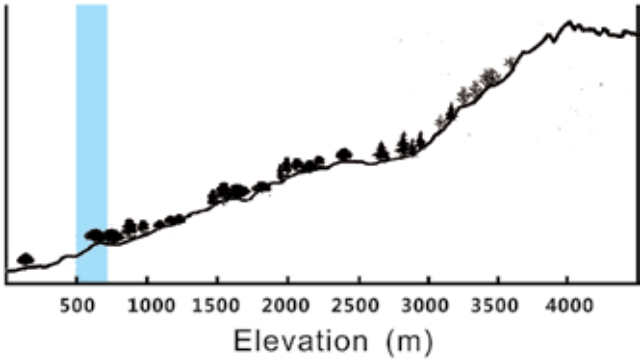


Habitat: Solitary, scattered, or in clusters on rich soil or in leaf litter. This prefers grassland.

Distribution: This is a widely distributed species that has been recorded in North and South America, Brazil, China, Europe, Philippines and Thailand.

Astraeus hygrometricus (Boletales)





Common names: Hygroscopic earthstar, Barometer earthstar, or False earthstar (English), Hed torp, Hed phor (Thailand and Laos).

When young, the sporocarp of *A. hygrometricus* is globose to subglobose (though it can vary in shape) and up to 3 cm in diameter. The surface of the sporocarp is light brown to dark brown, rough or smooth and sometimes has scales. Lamellae are absent. A stipe is absent, and there is a rhizomorph at the base. When fully mature, the peridium splits into segments at the top of the base, becoming star-like. The texture of exoperidium is complex with thick walls, inside is white when young and black when mature; the sac is grayish to grayish-brown, thin, with a pore at the top, which opens when fully mature. Spores are produced inside the sac and are dark brown to black.

Use: An excellent edible mushroom that has high magnesium content and an excellent taste.

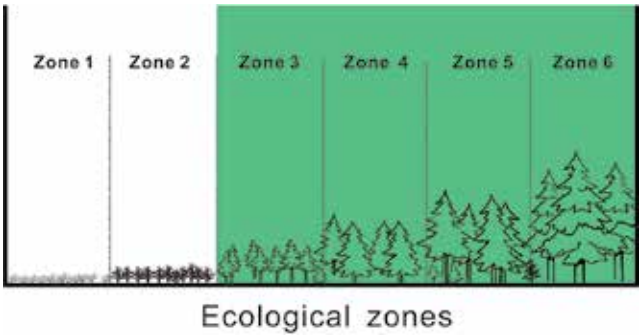
Time of fruiting: The species commonly grows during the wet season in Thailand, South China,

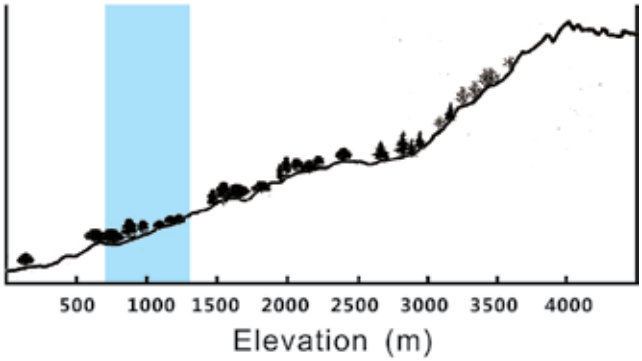
and Laos (May to September), but the best time for this species is the early wet season (May to June).

Habitat: The species is an ectomycorhizal mushroom, found in dry dipterocarp forest or dipterocarp-oak forests. The young sporocarp grows under soil or half-hidden in the soil and the sporocarp grows up to the soil surface when fully mature. The species can be solitary or can grow in a large group, at an altitude of 500-700 m.

Distribution: This species has been recorded in North America, Europe, China, India, Thailand, and Laos. It is eaten in China, Thailand and Laos.

Mycoamaranthus cambodgensis (Boletales)





Common names: Hed ham pra, Hed ham fan, Hed klam ma (Thailand and Laos).

The sporocarp of *M. cambodgensis* can be up to 5 cm in diameter, is globose to subglobose, the shape can vary and sometimes 2–3 sporocarps are connected. The surface is light to dark yellow, rough and may have yellow scales or grains. The surface and sporocarp may be broken when mature. Lamellae are absent. Stipe is absent. This species ranges from white to yellow when young and becomes light purple to dark purple when fully mature. It is soft, sticky, elastic or meat-like. Spores are produced inside sporocarp and are light brown.

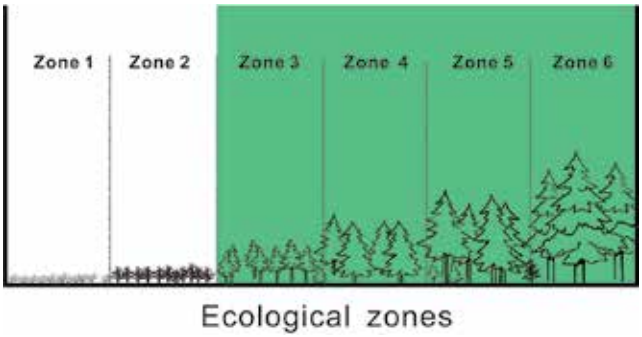
Use: An excellent edible mushroom when it is young and the texture is meat-like, but it is not eaten when mature.

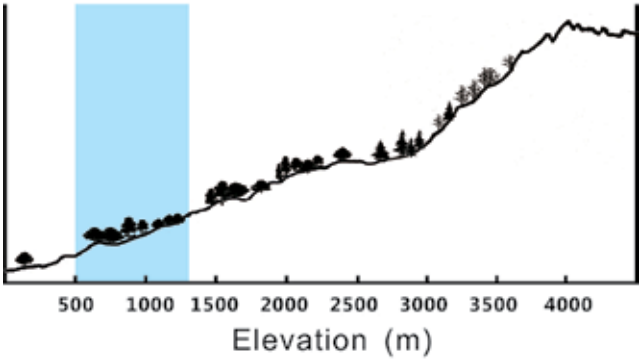
Time of fruiting: This species commonly grows during the wet season in Southeast Asia. The species is found during July and August in Thailand.

Habitat: This is an ectomycorhizal mushroom, found in dry, dipterocarp forests. It grows on the soil, either solitary or in a large group at an altitude of 700-1,300 m.

Distribution: This species has been recorded in Australasia, Africa, and Southeast Asia. It is eaten in Thailand.

Macrolepiota velosa (Agaricales)





Common names: Rom kan deat (Thailand and Laos).

When young, the sporocarps of *M. velosa* are large, the pileus is slightly globose to subglobose, expanding to hemispherical, parabolic to campanulate and 10–12 cm in diameter. It has a white to orange-white fibrillose surface. There is a 10–15 mm diameter and dark brown to black rounded/star shaped or calotte at the center, with dark brown warts or squamules around the center, toward the margin. Lamellae are free, white and remote from the stipe, of ventricose shape, 13 mm wide and turning brownish-orange at their edge. The stipe is long and cylindrical, but wider at the base. It measures approximately 190–150 X 8–10 mm, is grayish-brown to brown and has a smooth to slightly fibrillose surface. The annulus is ascending, thick and movable with a cuff. It is white to cream on the upper side and grayish orange on the under side. The volva is white and membranous. The

texture is in piles and the stipe is white. The spore print is white and the spores are hyaline under the microscope.

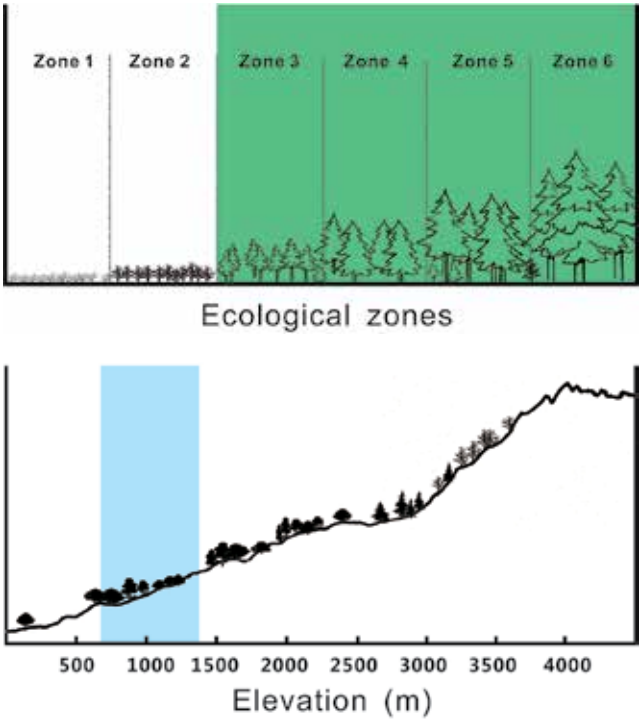
Use: The species is not reported as edible. This is one of the few *Macrolepiota* species with a volva and so it may be confused with some edible *Volvariella* and *Amanita* species.

Time of fruiting: This species grows during the wet season in China and Thailand (June to August).

Habitat: This species is a saprobic mushroom found on the rain forest floor. It is solitary with a few sporocarps, growing at an altitude of 500-1,300 m.

Distribution: This species has been recorded in China and Thailand.

Echinoderma asperum (Agaricales)



Common names: Hed kra dong saket yai laem (Thailand and Laos).

When young, the pileus is subglobose to parabolic, explanding to convex with less umbo, then campanulate or plano-convex with low umbo and a straight to inflexed margin. When young, the surface is completely brown and light brown when mature. The surface is densely set with dark brown squamulose or pyramidal squamules at the center toward the margin. Lamellae are free, very crowded, narrow and ventricose. They are 3–5 mm wide and white to yellowish white. The cylindrical, white stipe is long, 50–100 X 6–10 mm, with a bulb at the base, which is 10–12 mm wide and completely covered with fibrillose and brown to dark brown squamules or pyramidal squamules. The annulus is cortinate when young and connected to the pileus margin. It separates from the pileus when mature. It is membranous, attached to the up side of the stipe and hangs down. It is white to cream, and sometimes has mini, dark brown remnants of the squamules at the edge. The pileus and stipe are white to grayish orange.

Use: It is recommended not to eat this species, as close relatives contain alpha-amanitins.

Time of fruiting: The species grows during the wet season in Southeast Asia (June to September).

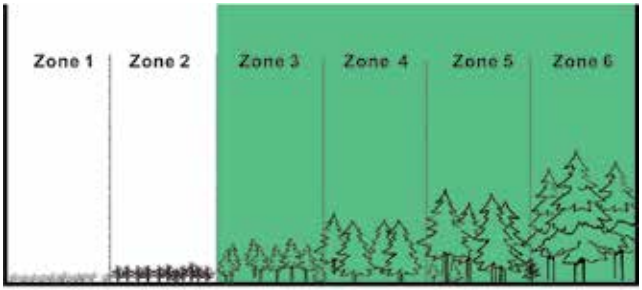
Habitat: The species is a saprobic mushroom, which is found on the rainforest floor. It can be anything from solitary to growing in a large group at an altitude of 700-1,400 m.

Distribution: This species has been recorded world-wide: America, Europe, North Africa and Asia; in Asia it has been recorded in China, Japan, Nepal and Thailand. It is also found in Papua New Guinea.

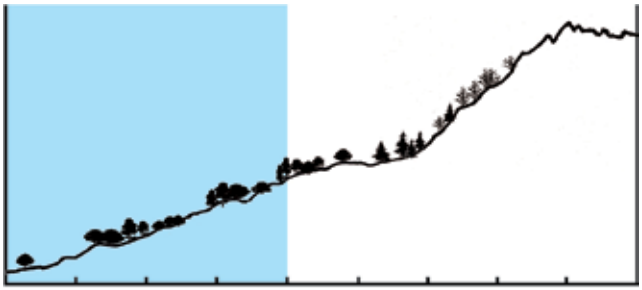
Chlorophyllum molybdites (Agaricales)

Common names: Hed kra dong kreep kiaw, Kra dong teen tum (Thailand and Laos).

The fruit bodies are large when young, the pileus is parabolic and expands from convex to umbonate and plano-convex. It is 5–7.5 cm in diameter, normally white on surface, fibrillose, covered with a light brown to dark brown star shape or calotte at the umbo, and brown squamules toward the margin. The lamellae are free, crowded, and white when young, becoming greenish to deep green with age. The white cylindrical stipe is 80–120 X 7–13 mm, slightly wider at the base and the surface turns red when touched or dried. The annulus is thick, moveable, and white on the upper side and covered with brown grains or squamules on the



Ecological zones



Elevation (m)

underside. The colour on the pileus and the stipe is white and turns reddish brown after sectioning. The spore print is deep green.

Use: This species causes severe stomach upsets and diarrhoea.

Time of fruiting: This species grows during the wet season of Southeast Asia (July to August).

Habitat: The species is a saprobic mushroom, found in grassland or light forest. Generally grows in a large group.

Distribution: This species has been recorded worldwide.

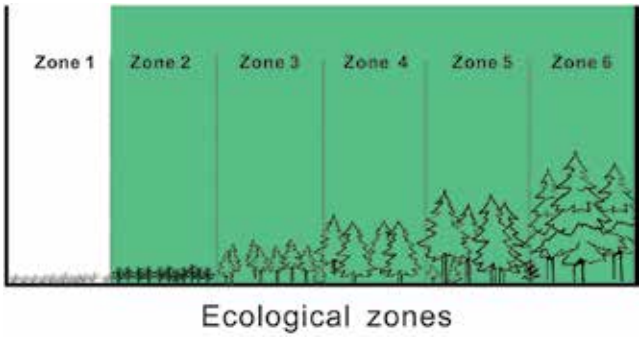
Agaricus megalosporus (Agaricales)

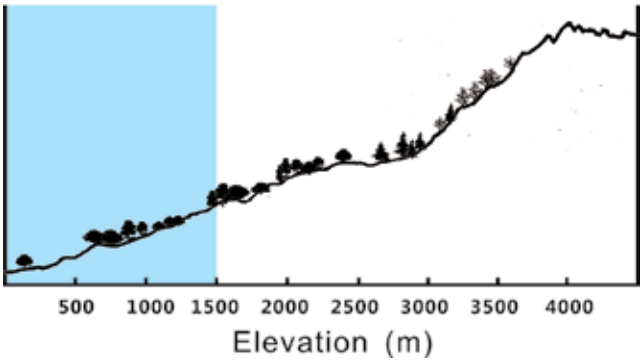
Common names: No common names have been published yet.

When young, the pileus of *A. megalosporus* is parabolic and truncated at the disc, then convex to plano-convex, flat or slightly depressed at the disc when mature. The sporocarp is medium to large with a cap diameter of 35–110 mm. The surface of the cap has purplish-brown to brown silk-like fibrils or squamulose, which are dense at the disc. The lamellae are free, crowded, and white when young and pink, to dark brown with age. The stipe is cylindrical-bulbous, the surface has white squamulose floccose below the ring, which the rain can easily remove. The annulus is simple, white and has fibrillose on the underside. This species can be distinguished by its purplish brown coloured fibrillose cap, simple annulus and almond odor.

Use: Edibility unknown.

Time of fruiting: This species usually appears from July to September of rainy season in Thailand.





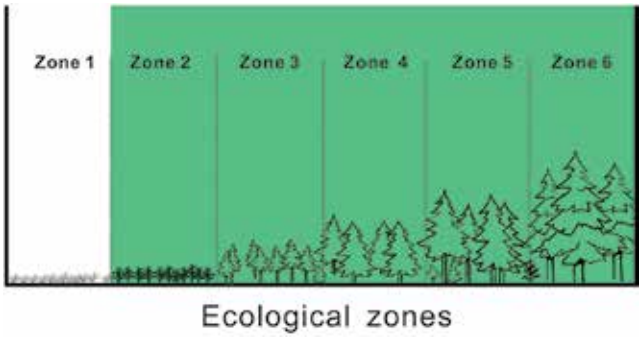
Habitat: The species can be solitary, scattered, or gregarious, growing on rich soil or leaf litter, in the open area of forest.

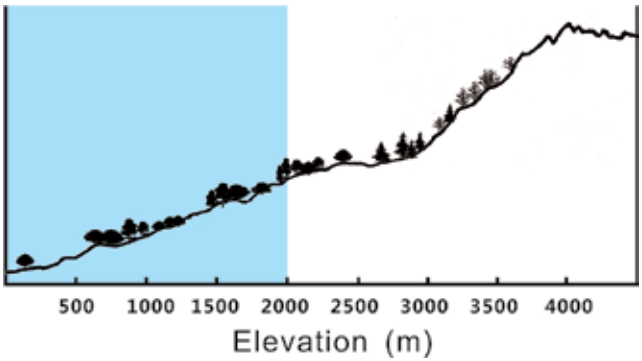
Distribution: This is a newly described species from Thailand and has not been recorded in any other countries.

Termitomyces taiwanensis (Agaricales)

Common names: Jizong, Chicken mushroom, Shredded chicken meat mushroom (English), Hed corn (Thailand and Laos).

The fully grown pileus of *T. taiwanensis* has a radius of roughly 6.5 cm and is plano-umbonate with a high spiniform perforatorium. The surface is dark brown at the centre, brown elsewhere and pales toward the margin. It is smooth and glabrous, striate and radially rimose. The margin is straight with a splitting fissile. Lamellae are free, up to 7 mm wide, white, and crowded, with lamellulae. The stipe is 7 cm long, 1.2 cm diameter, central, cylindrical and slender. The surface is pale grey, smooth and glabrous, longitudinally striate, lacking both an annulus and other velar remnants, solid and fibrous. The pseudorhiza is more than 13 cm long, cylindrical and slender. The surface is pale grey, solid, smooth, glabrous and fibrous. The





context of the pileus is white, fleshy, inflated, hyaline and thin-walled. This group of mushrooms is the food source for a subfamily of termites, the Macrotermitinae, who enjoy an obligate symbiosis with the genus similar to that between the American attine ants and the lepiotaceous mushrooms they cultivate. Despite this, their spore transfer mainly comes from the shedding of mushrooms, which protrude from the termite mounds.

Use: One of the most delicious species, rich in nutrition.

Time of fruiting: In China, Laos and Thailand this species fruits throughout the rainy season from May to September, if there is enough rain.

Habitat: This species is solitary and grows on soil covered with rich leaf-litter and dead wood. The base of the stipe has a long pseudorrhiza which extends deep into the soil.

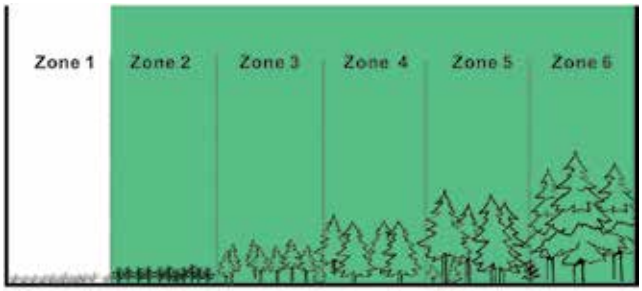
Distribution: This species is widely distributed throughout Africa and south and southeast of Asia. The species is well known around the south of the Yangtze River in China.

Termitomyces eurrhizus (Agaricales)

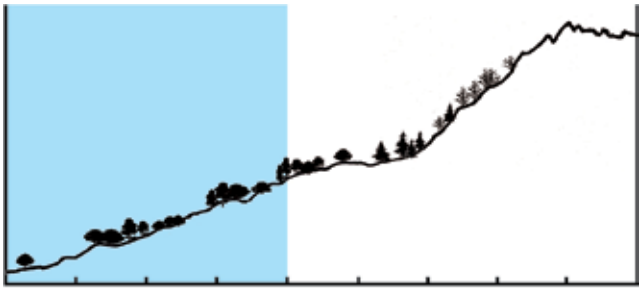
Common names: Jizong, Chicken mushroom, Shredded chicken meat mushroom (English), Hed corn (Thailand and Laos).

The colour of the pileus surface is usually grey with a diameter ranging from 5 to 20 cm. There is normally no ring around the stipe. Due to its nutritional and medicinal properties *T. eurrhizus* is a much sought after mushroom species. To date, no cultivation has been possible due to its mycorrhizal nature. The pileus is plano-convex, plano-concave, the centre part is subumbonate and aspects of the margin are inflexed and split. The surface is dry, smooth and sticky when it is wet. The centre is dark brown and otherwise light yellow or light brown. The context is 11 mm at the disc and white.

Lamellae are free, crowed, unequal, 7.5 mm wide and white becoming light yellow with age. The stipe is 175 mm (without pseudorrhiza), soli and the flesh is silk or fiber like. The stipe has three parts. The apex is cylindrical, 85 X 21 mm and white. The mid part is typically ventricose, 90 X 40 mm and gray or light brown. The base has a long pseudorrhiza extending from it, roughly 100-300 X 5 mm, which becomes thinner as it extends into the soil, It is dark brown or black brown and connects with the termites' nest under the earth. The surface is dry and smooth. The odour is typical for *Termitomyces* mushroom's fragrance. It tastes similar to chicken when cooked.



Ecological zones



Elevation (m)

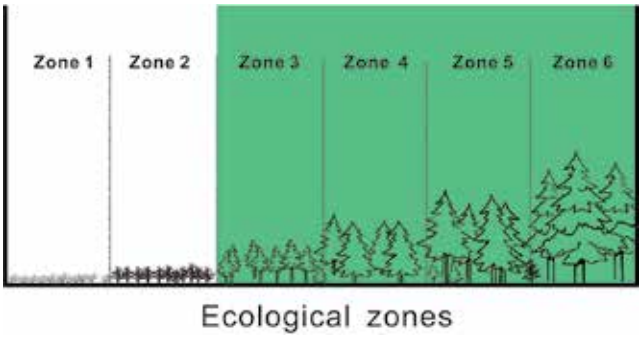
Use: This species is renowned for its taste and high nutritional value, with a high protein, polysaccharide, and amino acid content. Past studies have shown that it has anti-oxidant and anti-tumour properties.

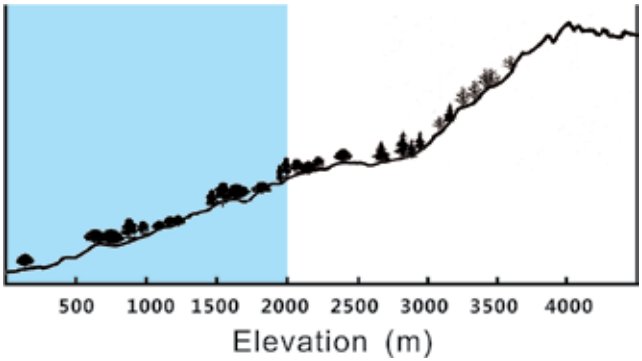
Time of fruiting: In China, Laos and Thailand, this species fruits throughout the rainy season, from May to September, if there is enough rain.

Habitat: This species is solitary and grows on soil covered with rich leaf-litter and dead wood. The base of the stipe has a long pseudorrhiza, which extends deep into the soil.

Distribution: Prefers the broad-leaved forests of tropical Africa and Asia including Thailand and Laos. In China, it is located in the tropical and subtropical areas of Yunnan and Sichuan provinces.

Volvariella volvacea (Agaricales)





Common names: Paddy straw mushroom or Straw mushroom (English), Hed fang (Laos and Thailand), Căogū (Chinese) and Nam rom (Vietnamese).

Volvariella volvacea is a species of edible mushroom cultivated throughout East and Southeast Asia and used extensively in Asian cuisines. They are often available fresh in Asia, but are more frequently found in canned or dried forms outside their nations of cultivation. Straw mushrooms are grown on rice straw beds and picked immature, during the button or egg phase and before the veil ruptures. They are adaptable and take four to five days to mature, and are most successfully grown in subtropical climates with high annual rainfall. This mushroom is one of the best edible mushrooms that can be grown in a tropical climate and fruits within 8–12 days. When fully grown, the Pileus expands up to 5–16 cm; egg-shaped when young, expanding to convex or broadly conic, becoming broadly convex or nearly flat; dry; radially streaked with hairs; gray to brownish gray, grayish brown or nearly black when young, with a paler marginal area; soft; the margin is not lined, but often splits with age. The base is encased in a thick, sack-like volva that is brownish gray to nearly black above and whitish below.

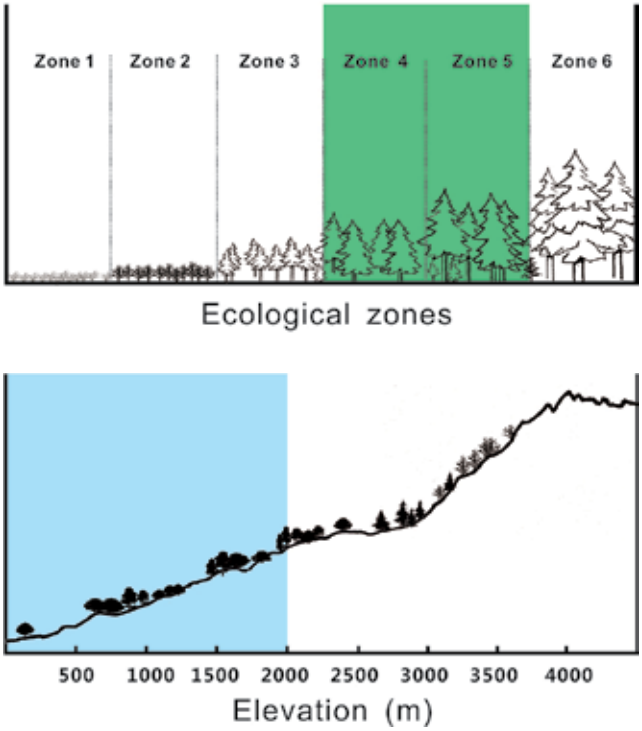
Use: A good edible mushroom and used extensively in Asian cuisines. It has one of the highest protein contents and is one of the fastest growing mushrooms. They resemble poisonous death caps, but can be distinguished by their pink spore print; the spore print is white for death caps. Many people in Southeast Asia, where the mushroom is commonplace, have been poisoned making this mistake.

Time of fruiting: In China, Laos and Thailand this species fruits in June and July (the middle of the rainy season).

Habitat: Can be found in woodchips, compost, greenhouses, and gardens.

Distribution: This species has been recorded in east and southeast Asia including Thailand, Laos and the tropical part of China. Thailand is the world largest straw mushroom producer and produces more than 600,000 ton per annum.

Phlebopus portentosus (Boletales)



Common names: “Hed har”, “Hed phueng tham kam” or “Hed tub tao dam” (Laos and Thailand), Black bolete (English).

When fully grown, the pileus of *P. portentosus* is about 4–14 cm, broad at first, then broadly convex and the margin remains decurved until maturity. It is dry, viscid when wet, smooth and mature samples have a slight depression at the centre. The pileus is dark brown when young and yellowish-brown when mature. The colors of the pileus and stipe surfaces do not change on bruising and there is no reaction with KOH. The context is yellowish-brown to light brown, 10–15 mm wide, narrower at the margin (5-8 mm wide) and similarly exhibits no colour change on bruising and no colour change with KOH. The spore print is light brow and the

odour is mild. *P. portentosus* is one of the most popular wild edible mushrooms in northern Thailand.

Use: A highly sought-after and valued edible mushroom, especially in northern and north-eastern Thailand. It has a sweet taste.

Time of fruiting: This species produces sporocarps from the end of the hot season until the early rainy season.

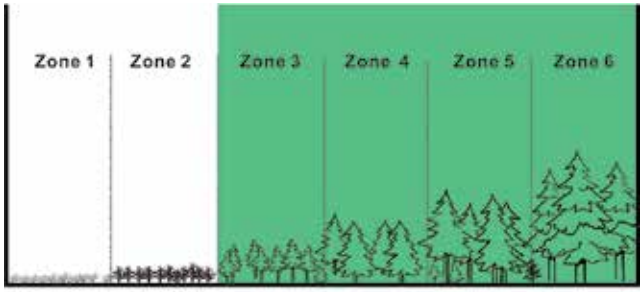
Habitat: An ectomycorrhizal species know to associate with several host species.

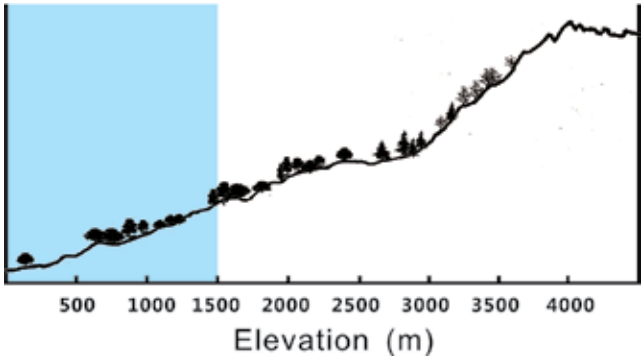
Distribution: This species has a wide distribution; it is reported from Australia, China, Indonesia, Malaysia, Mexico, New Zealand, Sri Lanka, Laos and Thailand

Lentinus squarrosulus (Polyporales)

Common names: Hed khon khao (Thailand and Laos).

This is a widespread and extremely common palaeotropical species, extending throughout equatorial Africa, south-east Asia, the Pacific islands, and Australasia, even reaching the north-east coast of Queensland, Australia. It is one of the most common macro-fungi of the area, growing in caespitose clusters, usually consisting of three to six basidiomes but occasionally a tuft of up to thirty basidiomes may be found. When fully grown, the sporocarp of *L. squarrosulus* reaches up to 2–7 (–10) cm diameter and the surface is milk-white or pinkish. It is typically convex becoming depressed, umbilicate to deeply infundibuliform and sometimes perofrate. It is radially innately striate,





with concentric zones of small squamules. Lamellae are deeply decurrent and occasionally, slightly interveined towards the stipe attachment. The solid stipe is central or excentric, rarely lateral, lapering below and sometimes with a subbulbous base. The flesh is leathery, white, consisting of a dimitic hyphal system with skeleto-ligative hyphae. Microscopically this is identified by 5.5–7.5 X 1.7–2.5 µm sized, cylindrical, thin walled, hyaline basidiospores. The basidiome is extremely variable, as indicated by the long synonymy. Typically this mushroom is a white rot fungus, superficially resembling *L. tigrinus* but with white, semi-erect squamules on both the pileal and stipe surfaces, also the crowded lamellae do not have a serrated or denticulate lamella-edge.

Use: An excellent edible mushroom because of its high protein content and excellent taste. This mushroom is also economically important as a causal agent of white rot on *Shorea robusta* Gaertn. in India.

Time of fruiting: This species usually appears in the middle of the rainy season. In Thailand, Laos, Sri Lanka and China, June and July are the best time for this species.

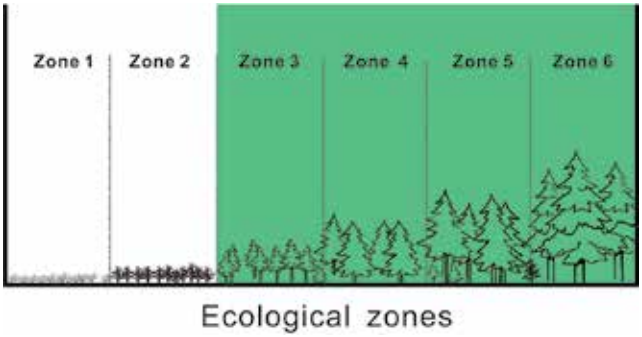
Habitat: Normally encountered under dense vegetation as well as in open habitats and so is exposed to large temperature variations. It grows in caespitose clusters, usually consisting of three to six basidiomes but occasionally a tuft of up to thirty basidiomes may be found.

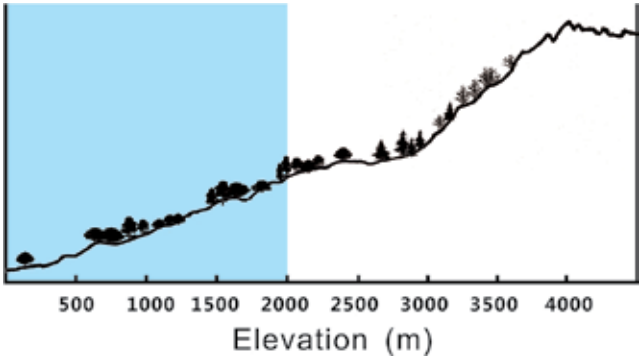
Distribution: This species has been recorded in Thailand, Laos, Burma, Malay Peninsula, Cambodia, Vietnam, Sarawak, Sabah, Andaman, Philippines, Pakistan, Nepal, India, Sri Lanka, China, Papua New Guinea, Bismarck Archipelago, Australia, Soloman Islands, New Caledonia, Sierra Leone, Ivory Coast, Ghana, Nigeria, Central African Republic, Venezuela, Zaire Republic, Ethiopia, Somalia, Kenya, Tanzania, Malawi, Zambia, and Madagascar.

Lentinus polychrous (Polyporales)

Common names: Hed hom kaaw (Thai and Laos), White rot fungus.

The gilled sporocarps of the white rot fungus are typically peltate (umbrella-shaped), semi-peltate (funnel-shaped) or even auriculate (ear-shaped), with one side curved like a ram's horn. Quite commonly bleached or dyed for potpourri, the native colour upon drying is beige with darker gills. When fully grown, the sporocarp of *L. polychrous* reaches up to 5–16 (–20) cm diameter and the surface is a pale ochraceous cream-colour, chamois brown to fuscous brown and more grayish brown towards the margin. It is typically convex becoming subinfundibuliform to flabelliform. The surface is uniformly covered by a fine tomentum, together with numerous, more or less concentrically arranged, minute, recurved fibrillose squamules, particularly at the centre. Lamellae are deeply decurrent, not furcate or exceptionally occourring over the stipe apex. The solid stipe is central or excentric, sometimes lateral, short, cylindric or lapering below. The flesh is leathery, white to ochraceceous brown consisting of a dimitic hyphal system with skeleto-ligative hyphae.





Microscopically this is identified by 6–9 X 2.7–3.3 µm sized, narrowly cylindric, often slightly curved, thin walled, hyaline basidiospores.

Use: A good edible species

Time of fruiting: This species usually appears at the middle of the rainy season. In Thailand, Laos, Sri Lanka and China, June and July are the best time for this species.

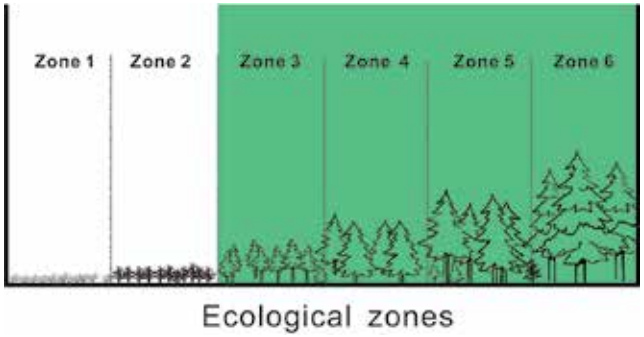
Habitat: Clusters are found on old stumps and fallen trunks in the forests of south east Asia, but not extending to Australasia. The caespitose habitat often results in distorted basidiomes with eccentric or lateral stipes. It is normally a saprobe but according to Bagchree (1960), causes a white rot of both the sap wood and heart wood of many trees, including the economically important crops of *Hevea* sp. and *Shorea* sp.

Distribution: This species has been recorded in Thailand, Laos, Burma, Malay Peninsula, Cambodia, Vietnam, Sarawak, Sabah, Philippines, Java, Sumatra, Nepal, Sri Lanka and India.

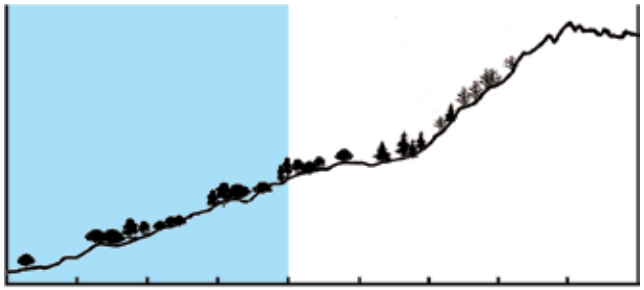
Lentinus sajor-caju (Polyporales)

Common names: Hed nang fah (Thailand and Laos).

Cultivator-mycologists often incorrectly use the name *Pleurotus sajor-caju* for some warm weather varieties of *Pleurotus pulmonarius*, a commonly cultivated species of Oyster mushroom. The real *P. sajor-caju* is a completely separate species of mushroom, which was returned to the genus *Lentinus* by Pegler in 1975. However, the name *P. sajor-caju* has been misapplied so often, even in scientific texts, that confusion about the species name is persistent. *Lentinus sajor-caju* (Fr.) Fries. (syn. *Pleurotus sajor-caju* (Fr.) Sing.) has a distinct veil, a persistent ring on the stipe, and flesh composed of trimitic or dimitic hyphae. *P. pulmonarius* is monomitic and has a bare stipe. When fully grown, the sporocarp of *L. sajor-caju* reaches up to 3–9 (–20) cm diameter The surface varies in colour, at first whitish and often mottled grey, then a cream colour and pale ochraceous. Typically, it has a soft coriaceous that dries hard and rigid, it is convex with a deeply umbilicate centre then cyathiform to infundibuliform, or excentric and flabelliform. The surface is dry glabrous and smooth or sometimes has small, appressed, darker squamules especially towards the center. Often they are finely radially striate and rimose in old specimens. The margin is initially incurved to involute then becomes striate, it's very



Ecological zones



Elevation (m)

thin, smooth, undulating and lobed. Lamellae are deeply decurrent, not furcate, whitish, concolourous with the pileus or becoming darker towards the edge. The solid stipe is central, excentric or lateral, short and cylindric. The flesh is leathery, white consisting of a dimitic hyphal system with skeleto-ligative hyphae. Microscopically this is identified by 5–9 X 1.5–2.5 µm sized, narrowly cylindric, often curved, hyaline, thin walled, basidiospores with few contents.

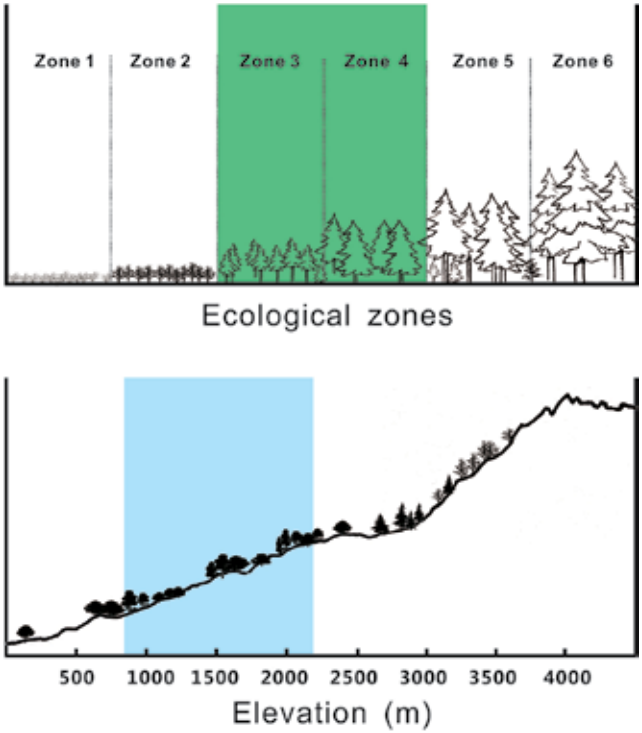
Use: An excellent edible mushroom because of its high protein content and excellent taste.

Time of fruiting: This species normally appears in the middle of the rainy season. In Thailand, Laos, Sri Lanka and China, June and July are the best time for this species.

Habitat: Found in clusters on old stumps and fallen trunks in the forests of south east Asia, but not extending to Australasia. The caespitose habitat often results in distorted basidiomes with excentric or lateral stipes. It is normally a saprobe but according to Bagchree (1960), causes a white rot of both the sap wood and heart wood of many trees, including the economically important crops *Hevea* sp. and *Shorea* sp.

Distribution: This species has been recorded in Thailand, Laos, Burma, Cambodia, Philippines, Java, Andaman, Nicobar, Malay Peninsula, Singapore, Java, Brunei, Sulawesi, China, Hong Kong, Vietnam, Nepal, Sri Lanka, India, Australia, Solomon Islands, Ivory Coast, Nigeria, Cameroons, Central African Rupublic, Gabon, Zaire, Burundi, Uganda, Kenya, Tanzania, Zanzibar, Mozambique, Malawi, Angola, Madagascar, Comoro, Seychelles, Mauritius, Reunion, and South Africa.

Thelephora ganbajun (Thelephorales)



Common names: Gangbajun, Songmajun and Xiuqiujun (China).

Thelephora ganbajun is a highly prized mushroom delicacy in Yunnan Province where it is eaten for its good taste and medicinal properties, such as the high aminophenol content, which is used in the production of paracetamol. The mushroom grows in whorls in natural vegetation and is collected from the end of June to early September. The demand for *T. ganbajun* is particularly high in Yunnan Province and with the increase in affluence in the Chinese population demand is likely to further increase, placing pressure on natural populations. The mushroom is ectomycorrhizal and there are presently no methods to commercially farm it, and hence only wild harvesting takes place. This mushroom is endemic to Yunnan Province, China, and grows primarily in association with pine trees, at an altitude of 800-2,200 m.

Use: Good taste and medicinal properties, such as the high aminophenol content, which is used in the production of paracetamol

Time of fruiting: From the end of June to early September in Yunnan Province, and northern Thailand.

Habitat: Associated with pure stands of *Pinus yunannensis* and *P. kesiya*, and to a lesser extent *Keteleeria evelyniana* and *Cunninghamia lanceolata* as well as mixed broad leaf/conifer forests.

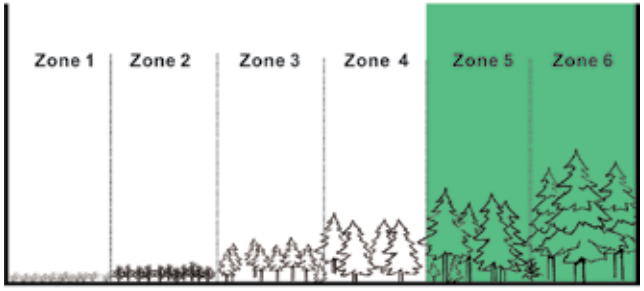
Distribution: *Thelephoras* grow in Laos and Thailand but no reports are available regarding *T. ganbajun*.

Tricholoma matsutake (Agaricales)

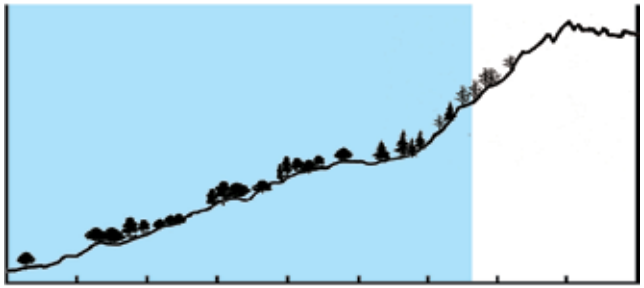
Common names: Matsu-take (Japanese), Pine mushroom (English), Songrong (Chinese).

Matsu-take literally means “pine mushroom” in Japanese; the equivalent Chinese name is *songrong* indicating the association of this mushroom with pine trees. It includes a group of edible species from the genus *Tricholoma*. They occur in Asia (with *T. matsuake* as principal species), North America (with *T. magnivelare* as principal species), Europe and North Africa (with *T. caligatum* as principal species). Matsutake mushrooms are perennial mycorrhizal fungi. Flavoured by the Japanese as a delicacy, matsutake is one of the most expensive mushrooms in the world. Depending upon the quality, the wholesale price in Japan varies from US$ 27–560 per kilogram. On average, the total consumption in Japan is 3,000 tonnes per year, of which one third comes from Yunnan Province, China, and the rest from other parts of China, America, Europe, Japan and Korea. Export of matsutake from Yunnan to Japan increased from 20 tons in 1985 to 1,420 tonnes in 2005 with an annual proximal value of US$ 44 million.

Use: A good edible species. A number of sterols have been isolated and contain antioxidant/ free-radical scavenging /anti inflammatory activity.



Ecological zones



Elevation (m)

Time of fruiting: In Yunnan province from June to November, but the best production occurs in August due to high temperature and abundant rain.

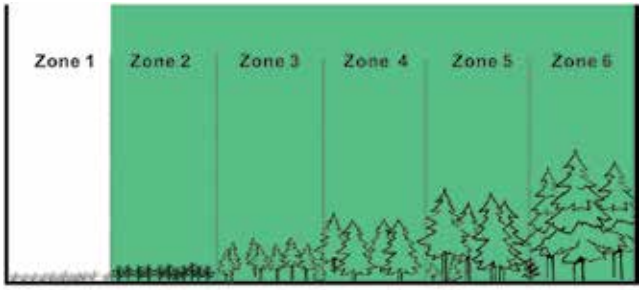
Habitat: As a mycorrhizal fungus, the distribution and habitat of matsutake is highly dependent on host tree species. *T. matsutake* mainly grows in pine (*Pinus*) and oak (*Quercus*) forests, and occasionally under *Picea* and *Castanopsis*. Apart from host trees, forest structure (including canopy cover, stand age and stand vitality), understory coverage, litter cover, soil and topographic characteristics are important habitat factors. In general, middle-aged host trees, slightly open canopies, sparse understory coverage and moderate litter cover are good for fruiting.

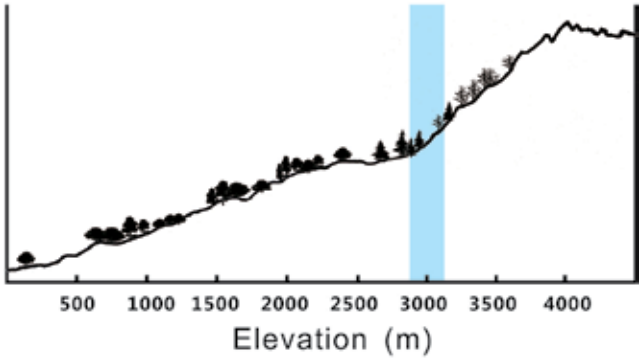
Distribution: In China, five species (and one variety) of *Tricholoma* are found in at least eight provinces, of which *T. matsutake* is the most valuable and intensively exploited. *Tricholoma* species are also distributed in China, Japan, Korea, and Russia. In China, *T. matsutake* is listed as a protected species.

Morchella conica (Pezizales)

Common names: Yangdujun (Chinese), Sponge mushroom, Molly moochers, Morels (English), Morel, Gutchichyau, Morelchyau, Chyau, Guche, Pote chyau (Nepali).

True morels (*Morchella* spp.), which belong to the ascomycetous fungi, are highly prized for their edibility and appearance. Due to their unique flavor and rich nutritional value they have long been used as a food source. *Morchella* is also well known for its medicinal value, acting as immunostimulant and antitumor agent. Morels occur in different types of forests, with different mycelial dynamics, alternating between saprotrophic and symbiotic behaviours. There is some debate on how many *Morchella* species there are, with some estimating as little as 3–6 species and others as many as 50 different species. In China morel mushrooms include *M. esculenta, M. crassipes, M. spongiola, M. conica* and *M. elata. M. conica* is the most marketable and widely distributed across China. The fruiting structure 'ascocarp' is differentiated into a conical cap shaped pileus and a cylindrical stipe. The stipe is 5–7.5 cm in height and 1.5 to 2.5 cm in width. The stipe is composed of compact





interwoven hyphae. The pileus has small depressions and ridges, and these are set with asci, and contain ascospores. The sporocarp is a creamy color and is always fleshy and leathery.

Use: Delicious edible species that fetch a high price with an increasingly high demand. Morels cannot be eaten raw.

Time of fruiting: Morels have two fruiting periods, from April to May, and from August to September, after rain.

Habitat: Morels occur in a variety of habitats, including riverbanks, mountain slopes, pastures, and burnt forests. Linked with the numerous habitats is the fact that morels have no special requirement for soil type, occurring in sand, moist soil with abundant organic matter, and in mud. In China, *M. conica* commonly grows at at an altitude of 2,900-3,100 m in several types of mixed forests, such as *Picea likiangensis*, *Abies* spp., *Betula albo-sinensis*, *Sorbus* sp., *Salix* sp., *Acer* sp., and *Populus bonatii*. Morel fruit bodies require scattered light with an optimum temperature ranging between 6–11°C and relative humidity ranging from 50–80%.

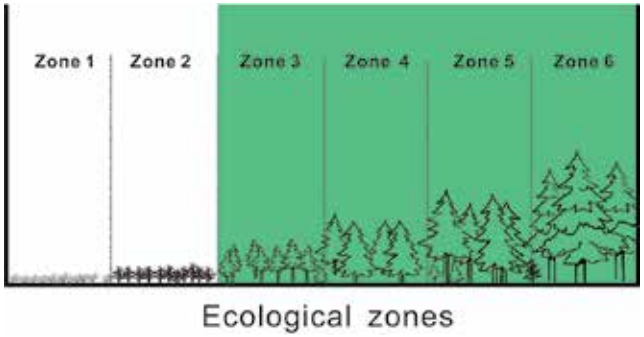
Distribution: Morels have been found in a wide distribution range across the Northern Hemisphere, from North America, Canada, through Europe and into Asia. Furthermore, within China they are widely distributed, ranging from Beijing to Tibet. They are also found in Thailand and Laos and other parts of SE Asia.

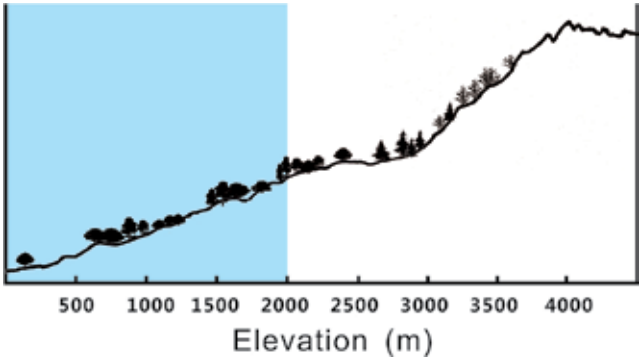
Pseudohydnum gelatinosum (Auriculariales)

The sporocarp is 2-5 cm broad and spatulate to fan-shaped. The upper surface is translucent, moist, slightly roughened, and white to grayish-white when young and pale gray to somewhat brownish as it ages. It has a hymenial surface on the underside, which is pale grey, consisting of minute conic spines on which the spores are formed. The flesh is rubbery-gelatinous. The stipe is 5 cm long, up to 1.5 cm broad, lateral, tapering downward, covered with fine hairs, densest at the base and the flesh is rubbery-gelatinous.

Use: Edible, can be eaten raw, but without a distinctive flavour.

Common names: Toothed jelly fungus, False hedgehog mushroom, Jelly tongue and White jelly mushroom, Cat's tongue (English), Hu nu fan nim (Thailand and Laos).





Time of fruiting: In Thailand, Laos and China, it fruits in the middle of the rainy season which is June and July.

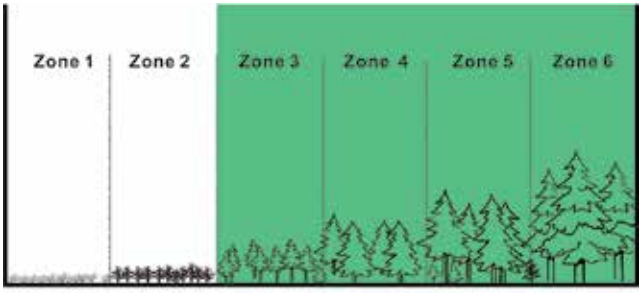
Habitat: Can be solitary, gregarious or found in a cluster on conifer logs and stumps.

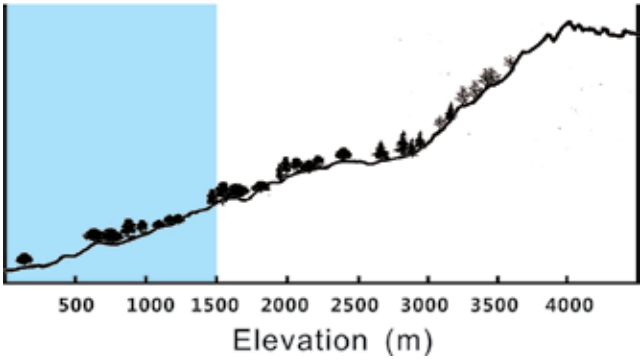
Distribution: This species has been recorded in America, Europe and some parts of Asia including Thailand, Laos and China.

Phallus indusiatus (Phallales)

Common names: Bamboo fungus, Bamboo pith, Long net stinkhorn, Crinoline stinkhorn, Basket stinkhorn, Veiled lady and Bridal veil lady (English), Kinugasatake (Japanese), Bamboo mushroom (Chinese), Rang hae kra pong yao (Thailand and Laos).

Mature fruit bodies of *P. indusiatus* are up to 25 cm tall with a conical to bell-shaped cap that is 1.5–4 cm wide. The cap is covered with a greenish-brown spore-containing slime, which attracts flies and other insects that eat the spores and disperse them. An edible mushroom featured as an ingredient in Chinese haute cuisine, it is used in stir fries and chicken soups. The mushroom, grown commercially and commonly sold in Asian markets, is rich in protein, carbohydrates, and dietary fiber. The mushroom also contains various bioactive compounds, and has antioxidant and antimicrobial properties. *P. indusiatus* has a recorded history of use in Chinese medicine extending back to the 7th century AD, and features in Nigerian folklore.





Use: A good edible species. It has medicinal properties taht have been ascribed to *P. indusiatus* from the time of the Chinese Tang Dynasty when it was described in pharmacopoeia. The fungus was used to treat many inflammatory, stomach, and neural diseases. Southern China's Miao people continue to use it traditionally for a number of afflictions, including injuries and pains, cough, dysentery, enteritis, leukemia, and feebleness, and it has been prescribed clinically as a treatment for laryngitis, leucorrhea, fever, and oliguria (low urine output), diarrhea, hypertension, cough, hyperlipidemia, and in anticancer therapy. Modern science has probed the biochemical basis of these putative medicinal benefits.

Time of fruiting: In Thailand, Laos and China, it grows throughout the rainy season among bamboo forests, and typically fruits after heavy rains.

Habitat: This species is saprobic, deriving nutrients from breaking down wood and plant organic matter. The fruit bodies grow singly or in groups in disturbed ground and among wood chips. In Asia, it grows among bamboo forests, and typically fruits after heavy rains.

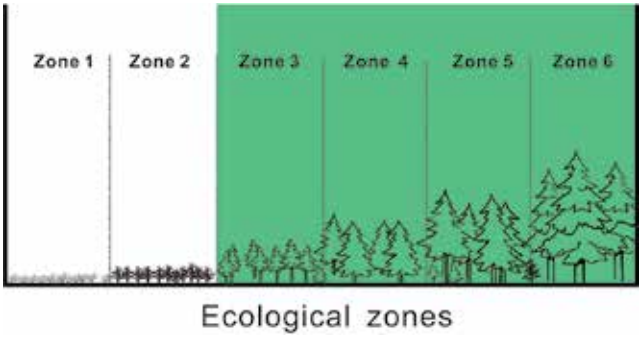
Distribution: Tropical, including Africa (Congo, Nigeria, Uganda, and Zaire), South America (Brazil Guyana, and Venezuela), Central America (Costa Rica), and Tobago. In North America, its range is restricted to Mexico. Asian localities include Indonesia, Malaysia, Thailand, Laos, Sri Lanka, India, Southern China, Japan, and Taiwan. It has also been collected in Australia.

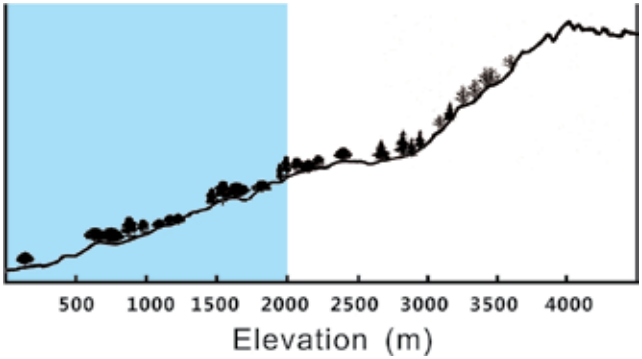
Trogia infundibuliformis (Agaricales)

Common names: Glass funnel mushroom (Thailand and Laos).

This genus contains species with clitocyboid (gilled mushrooms that lack partial veils and feature white, yellowish, or pinkish spore prints) to omphalinoid (mushroom with a decurrent gill attachment, a cartilage-like stem, a broad or depressed cap surface and lacking a ring and volva) fruit body types. The fruit bodies are tough when dry, but can revive when moistened. They grow on rotting wood or woody material. When fully grown, the sporocarp of *T. infundibuliformis* is lilac pink to light brown, typically deep, thin, translucent, slightly conical or funnel-shaped and measures up to 1–4 cm deep and lined with grooves from the center to the edge of the cap with curled edges. The solid stipe is 0.2–4 cm, cylindrical, and tapered down. It is concoloured with the cap. The flesh is tough and white. Microscopically this is identified by ellipsoid or conical, smooth walled, 6–8 X 3.5–4.5 µm sized basidiospores.

Use: As a wood-rotting fungus genus, species of *Trogia* have enzymes that break down lignin, a complex polysaccharide that is largely responsible





for giving wood its strength. *Trogia buccinalis* has been investigated for its ability to use these enzymes to break down common pollutant molecules such as anthracene, pentachlorophenol, and polyvinylchloride. One species, *Trogia venenata*, colloquially known as “little white” has been implicated in the deaths of around 400 people in Yunnan province, south western China. Appearing after local rainfall, the mushrooms contain toxic amino acids and seem to be cardiotoxic in susceptible people, causing fatal arrhythmia. According to taxonomist Yang Zhuliang, *Trogia* was not previously thought to contain poisonous species. A team led by the Chinese Center for Disease Control and Prevention epidemiologist Zeng Guang suggests that the element barium, present in local foods and contaminated water, may increase the toxicity of the *Trogia* mushroom.

Time of fruiting: This species usually appears in the middle of the rainy season. In Thailand, Laos, Sri Lanka and China, June and July are the best time for this species.

Habitat: Grows on rotting wood or woody material.

Distribution: Species’ in the genus are found in tropical and subtropical areas. *Trogia cantharelloides* (Mont.) Pat. is a widespread neotropical species, recorded in Puerto Rico, and Cuba among other places. This species has been recorded in Thailand, Laos and Yunnan, China.

Lentinus fasciatus (Polyporales)

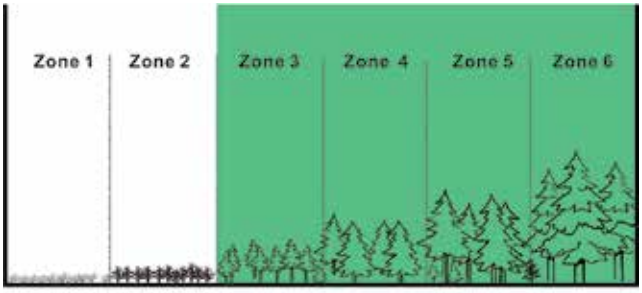
Common names: No common names have been recorded.

When fully grown, the sporocarp of *L. fasciatus* is pale brown to purplish pale brown, typically depressed or funnel-shaped and measures up to 20–70 cm in diameter with numerous hispid and downy hairs becoming longer towards the margin on the cap surface. The solid stipe is cylindrical, with hispid and soft hairs, concolorous with the cap or darker. The flesh is tough and white.

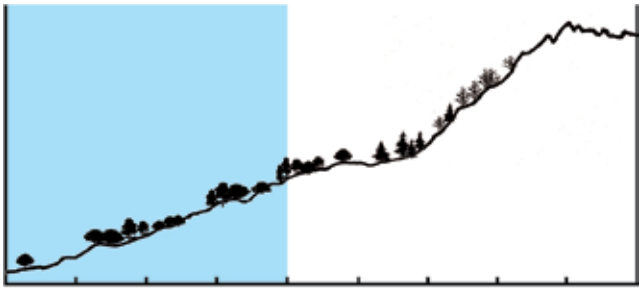
Microscopically this is identified by smooth, elliptical, thin walled, white basidiospores.

Use: Edible when the sporocarps are young.

Time of fruiting: This species usually appears in the middle of the rainy season. In Thailand, Laos, and China, June and July are the best time for this species.



Ecological zones



Elevation (m)

Habitat: Grows on fallen branches and logs, in groups.

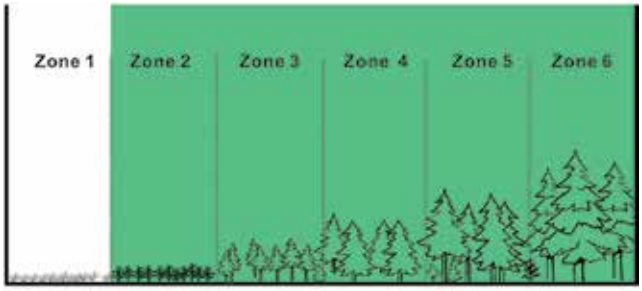
Distribution: This species has been recorded in Australia, Papua New Guinea, New Caledonia China, Laos, and Thailand.

Gomphus floccosus (Gomphales)

Common names: Woolly gomphus, Woolly chanterelle, Scaly chanterelle (English); Maodinggu, Maojiyoujun, Labadinggu, Labatuoluojun, Labajun (China); Zhangzhamuxi, Zaomolouma (Tibet), Kruai kret thong (Thailand and Laos).

This species is a medium to large sized mycorrhizal mushroom that prefers to grow with coniferous trees. When young, the sporocarp of *G. floccosus* is solid and more or less cylindrical. When fully grown, the sporocarp of *G. floccosus* is orange, yellowish or reddish orange to reddish brown, typically trumpet- or funnel shaped and measures up to 13 cm in diameter and 19 cm high. The pileus is depressed to create a hollow center, the surface is sticky when there is moisture, with orange floccose scales. It is recurved when dry, the margin often becomes wavy wuth age and the flesh is 0.3-0.5 cm thick, fibrous, white and slightly orange. The fertile side is white or creamy to orangish yellow, the decurrrent ridges are vein- or fork- like and the hollow stipe has no boundary with the pileus, and is central or eccentric but not straight.

Use: Some people eat this and use as a commercial mushroom in southwest China and Mexico, but, it is



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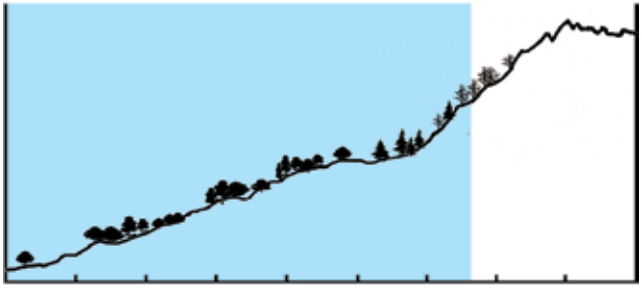


Elevation (m)

reported that this species has caused poisoning in Yunnan, China, and is considered mildly poisonous in North America.

Time of fruiting: This species fruits in late summer, autumn or early winter, even spring in North America. In Yunnan, China, the best time for this species is late summer to autumn.

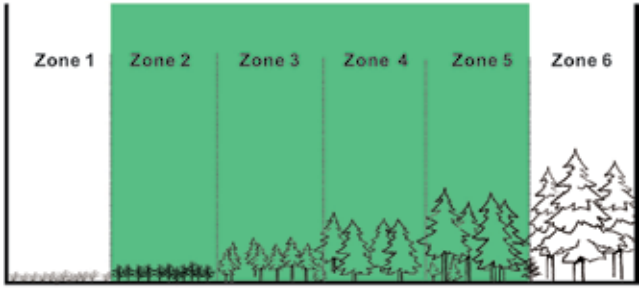
Habitat: Grows on the ground, mostly as a group or cluster, sometimes scattered and associated with broad leaved or coniferous forests. It can be found in coniferous forests at an altitude of 3,300 m in Shangri-la, China.

Distribution: This species has been recorded in North America, China, Korea, Tibet, Nepal and India.

Lycoperdon perlatum (Agaricales)

Common names: Common puffball, Warted puffball, Gem-studded puffball, Devil's snuffbox (English); Mabo, Mapipao, Wangwenmabo, Wangwenhuibao (China), Luk fun khrat hua waen (Thailand and Laos).

Lycoperdon perlatum is a medium sized widespread puffball, which has a well developed sterile base compared to other puffballs. It has a wrinkled stem and tapers at the base with age. The sporocarp of *L. perlatum* is 2–8 cm high, 1–6 cm wide and can be round, pear-shaped, peg-top shape or nearly spherical in shape. It is white when young and yellowish brown or grayish brown in age. The surface is covered with short, conical spines with granular warts, the larger spines are easily removed and leave clear scars when they are. The spines are white or gray and brown with age. When young, the inside layer is solid and white, turning soft and olive to brown with age. When fully matured, the sporocarp of *L. perlatum* is light and paper-like to the touch, an opening on the top releases the spores through outside force.



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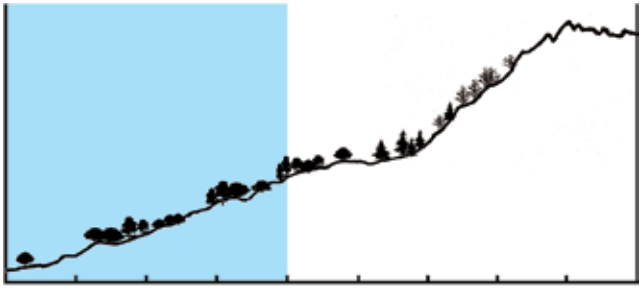


Elevation (m)

Use: This species can be eaten when young, and is also used as a medicinal mushroom in China for its function in detumescens, stanch bleeding and detoxication.

Time of fruiting: This species appears in the summer, autumn or winter. In China, the best season is summer and autumn, but autumn and winter are better for this species in North America.

Habitat: Grows on the ground and can be solitary, scattered, in a group or cluster. It associates with broad leaved, coniferous or mixed forests and is found on roadsides and grasslands.

Distribution: This species has a cosmopolitan distribution; it has been recorded many countries in Asia (including China and Thailand), America, Africa, Europe and Oceania.

Lentinus stupeus (Polyporales)

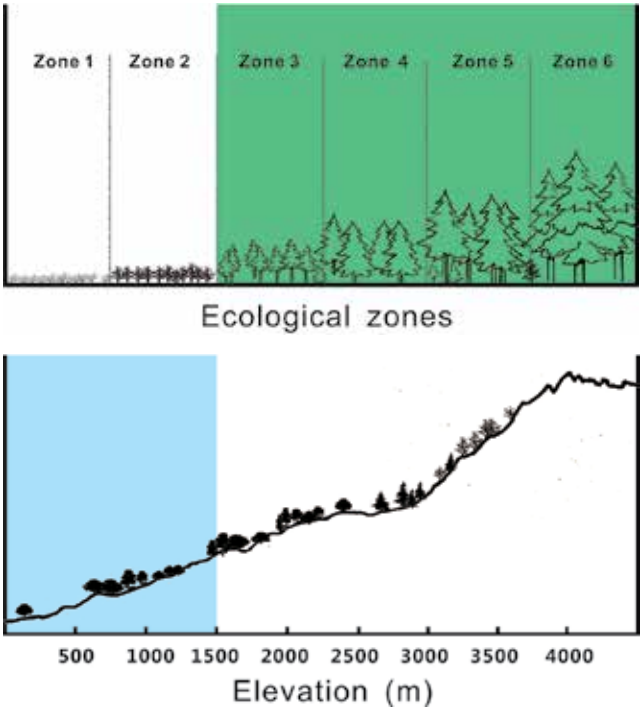
Common names: Scaly *Lentinus* (English).

When fully grown, the sporocarp of *L. stupeus* is dark purplish brown to black brown, typically convex and depressed at the center. It has densely curved hispid hair and the margin is strongly curved and up to 3–7 cm in diameter. The slightly decurrent gills have a tooth-like edge. The solid stipe is cylindrical, with yellowish brown, purplish tinted, cinnamon brown scales. The flesh is tough and white to pale brown. Microscopically this is identified by 6–8 X 2–3 µm sized, smooth, cylindrical, thin walled, white basidiospores.

Use: Edible when the sporocarps are young.

Time of fruiting: This species usually appears in the middle of the rainy season. In Thailand, Laos, and China, June and July are the best time for this species.

Habitat: Single to scattered on decaying deciduous trees.



Distribution: This species has been recorded in Ghana, Nigeria, W. Cameroons, Democratic Republic of the Congo, Uganda, Kenya, Madagascar, Mauritius, Zimbabwe, South Africa Thailand, Laos and China.

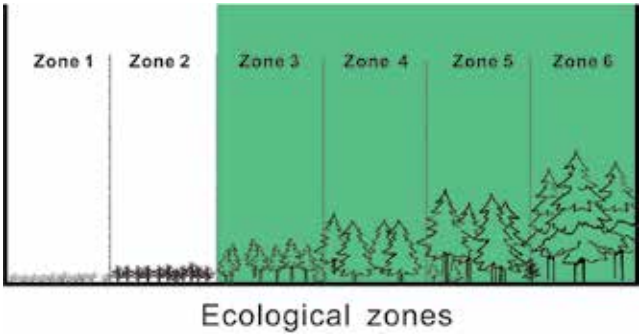
Lentinus swartzii (Polyporales)

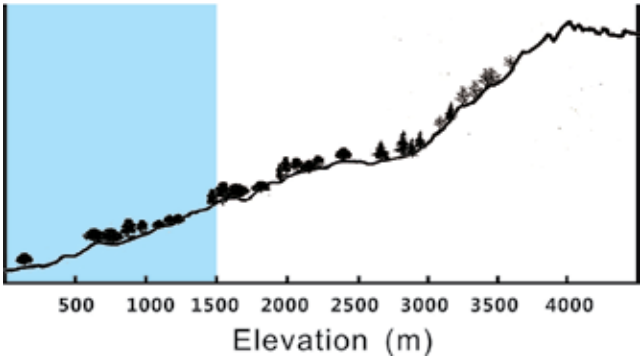
Common names: No common names have been recorded.

When fully grown, the sporocarp of *L. swartzii* is pale ochraceous to tawny brown. It is typically convex then depressed at the center to form a funnel shape, with concentric zones of curved, erect, triangular scales. The margin is incurved and 2–4 cm in diameter. It is slightly decurrent, narrow, and has crowded gills that are often tinted with purple when young. The solid stipe is cylindrical, with smooth, cottony pale to dark grayish brown scales. The flesh is leathery and pale brown. Microscopically, this is identified by 5–8 X 2–3 µm sized, smooth, cylindrical, thin walled, white basidiospores.

Use: Edible when the sporocarps are young, otherwise very hard.

Time of fruiting: This species usually appears in the middle of the rainy season. In Thailand, Laos, and China, June and July are the best time for this species.





Habitat: Grows on rotten stumps and dead hard woods.

Distribution: This species has been recorded in Cuba, Belize, Nicaragua, Jamaica, Trinidad, Guyana, Fr. Guiana, Brazil, Venezuela, Argentina and Thailand, Laos and China.

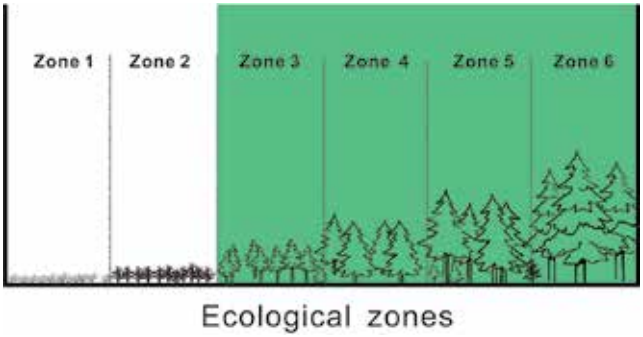
Lentinus zeyheri (Polyporales)

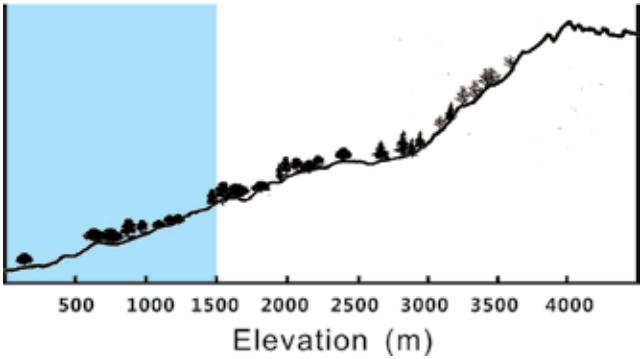
Common names: No common names have been recorded.

When fully grown, the sporocarp of *L. zeyheri* is pale yellowish brown, typically convex and depressed at the center to form a funnel shape. The, margin rolls then expands, is covered with dark brown, pointed square scales, which are concentrically arranged and hairy towards the margin (1–3.5 cm in diameter). It is slightly decurrent, narrow, crowded, the edge is tooth-like with dull yellow gills. The solid stipe is cylindrical, with short hairs. The flesh is thin, tough and pale brown. Microscopically, this is identified by 4.5–7 X 1.5–2 µm sized, narrow, cylindrical, thin walled, white basidiospores.

Use: Edible when the sporocarps are young otherwise very hard.

Time of fruiting: This species usually appears in the middle of the rainy season. In Thailand, Laos, and China, June and July are the best time for this species.





Habitat: Single and scattered on the logs of deciduous trees.

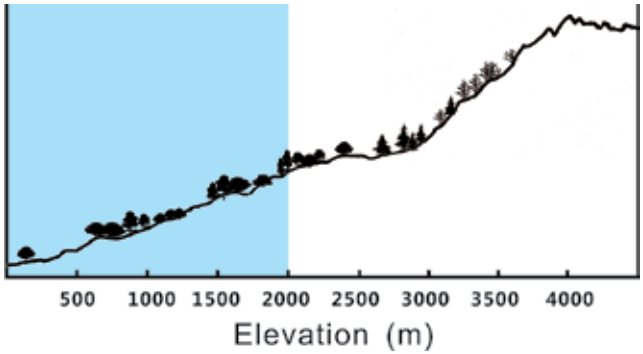
Distribution: This species has been recorded in South Africa, Thailand, Laos and China.

Austroboletus fusisporus (Boletales)

When fully grown, the sporocarp of *A. fusisporus* is yellowish brown, the cap is hemispherical, the surface has angular scales or cracks and it is up to 25–40 cm in diameter. The stipe is solid, centrally attached, brown and has a coarse texture that is sticky. The flesh is soft and white. Microscopically this is identified by 13.5–18 X 8–11 µm sized, dark brown, wide, fusiform, warty basidiospores with smooth ends. Pleurocystidia are scarce and fusiform.

Common names: Southern bolete (English).

Use: According to the records, these kinds of mushrooms have an aromatic odour and bitter taste.



Time of fruiting: This species appears in July in Yunnan province.

Habitat: Solitary, on the ground under broad-leaf forests.

Distribution: This species has been recorded in Thailand, Laos, Guangdong province in China and Taiwan.

Boletellus emodensis (Boletales)

Common names: Shaggy cap, Chrysanthemum bolete (English), Taps tao kret daeng khlam (Thailand and Laos).

B. emodensis is characterised by a distinctive reddish shaggy cap and grows in Eucalypt woodlands. It produces a brown spore print, and has fusiform (spindle-shaped) spores that are 16–20 X 7–9 µm with longitudinal grooves. When fully grown, the sporocarp of *B. emodensis* grows up to 45-80 mm in diameter and is hemispherical with a dry surface. It is covered with purple red to reddish brown scales and old scales become drab. The juvenile pileus margin extends and is surrounded by the hymenium part. The context is yellow, changing quickly to blue when exposed to air. The pores are broad, 1–2 mm wide, yellow, change quickly to blue when impaired and cave around the stipe. The stipe is 65–80 X 8–10 mm, approximately cylindrical and the base is slightly expanded with ciliary fringes on the surface. It is solid, the same colour as the cap with yellow flesh, which quickly changes to blue when exposed to air. Microscopically, this is identified by 18–23 X 8–10 µm sized, long oval, yellow-brown basidiospores, with distinct longitudinal striped ridges and fusiform to near fusiform pleurocystidia.

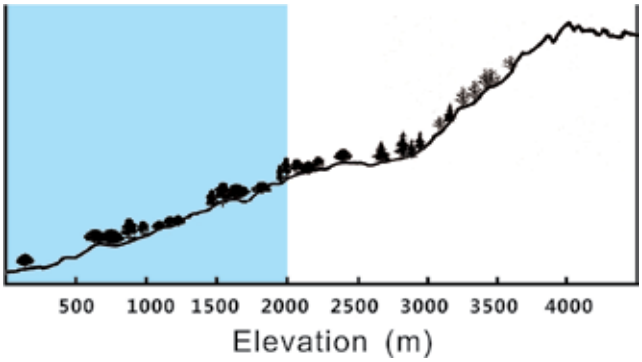
Use: Edible when young.

Time of fruiting: In Yunnan province China, and Thailand this species is found in July.

Habitat: Solitary or scattered, ectomycorrhizal, in broad-leaf forests, on or near stumps or rotten wood.

Distribution: This species has been recorded in Thailand; Laos; Fujian, Guangdong, Guangxi, Hainan, Yunnan in China; Tibet; Hong Kong and Taiwan.

Ecological zones

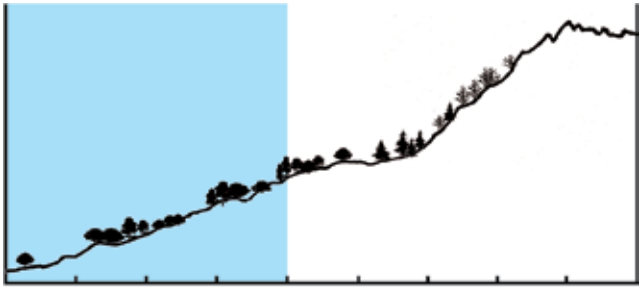


Strobilomyces polypyramis (Boletales)

Common names: Pineal gland bolete, Pine *Boletus*, Pine-cone *Boletus*, Old man on the wood (English).

When fully grown, the sporocarp of *B. polypyramis* is black to purple black with cone scales, up to 4-8 cm in diameter. The context is dirty gray and white, changing to dirty brown red when exposed to air. The pores are adnate or a little free, 0.4–1.5 mm length, hole polygonal, dirty white and become light black with age. The stipe is 40–80 X 10–20 mm, approximately cylindrical, solid, the same colour as the cap or lighter and with scales covering the surface. Microscopically, this is identified by 9–13 X 7–10 µm sized, ellipsoid to oval basidiospores, with densely verrucose ridges. This species is similar in

Ecological zones



Elevation (m)

appearance to *Boletellus ananiceps*, but the latter species is scaly rather than shaggy, has a pinkish tint, and lacks grooves in the spores.

Use: Edible, but not very popular.

Time of fruiting: In Yunnan province, China, this species appears mostly in July.

Habitat: Solitary on the ground in broad-leaf forests

Distribution: This species has been recorded in Thailand, Laos, Yunnan, Guangxi, Guizhou, and Sichuan provinces in China.

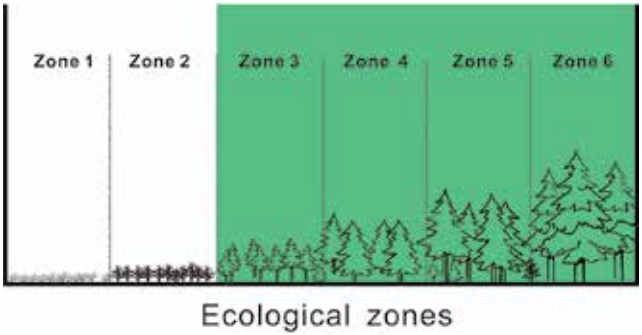
Micropsalliota globocystis (Agaricales)

Common names: No common names have been recorded yet.

This species has a wide range of pileus sizes. When mature, the cap can be 2–8 cm in diameter; it is hemispherical to convex, plano-convex and umbonate. The surface is dry and covered with purplish brown, grayish brown or reddish fibrillose-scaly squamose; the disc has dense and erect squamules. Lamellae are free, crowed, white when young and pale brown when mature. The stipe is cylindrical, smooth to tomentose and white. The annulus is membranous and white. The odour is similar to seaweed. The colour changes to yellow, then reddish brown when bruised. *M. globocystis* can easily be distinguished from other *Micropsalliota* sp. by its typically erect squamules at the disc.

Use: Unknown.

Time of fruiting: This species can be found in the rainy season from May to August. June and July are the best times for fruiting.



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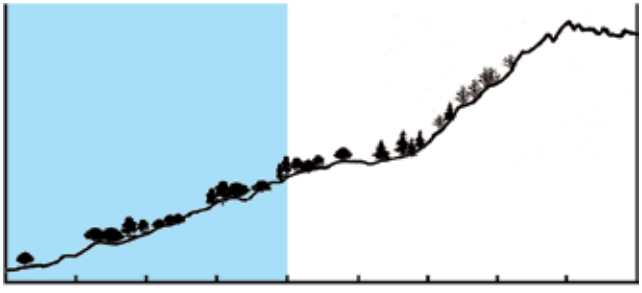


Elevation (m)

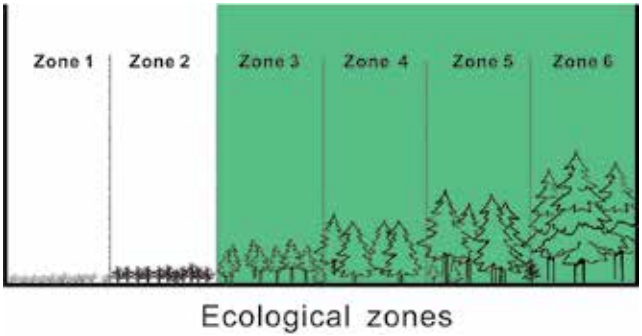
Habitat: Gregarious or occasionally solitary in the soil.

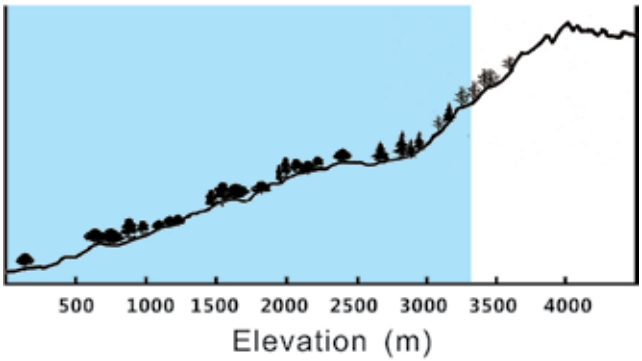
Distribution: This species was originally described from Singapore, and has been recorded in Thailand; recently we have also collected *M. globocystis* in Yunnan, southwest of China.

Lactifluus piperatus (Russulales)

Common names: Hed khing (Thailand and Laos), Larugu (Chinese), Peppery milk cap or Peppery milk mushroom (English) and Pfeffer-milchling (German), Maitorousku (Finnish), Lactaire poivre (French), Ji wari or Tsuchi kaburi (Japanese) and Trompa (Spanish).

This species has a medium to large sporocarp, 1.6–12.3 cm diameter, at first broadly convex with a slightly depressed center and becoming funnel-shaped with age. It is whitish colored with a smooth and glabrous cap surface that typically has yellowish or yellowish brown colored spots. The gill spacing is very crowded and they are yellowish white to pale yellow. The stalk is firm, white and smooth to wrinkled. It has a lot of milk, which is white and does not change with exposure. The milk does not react with KOH, smells faintly fruity and tastes very acrid. Morphologically, this species could be confused with a closely related species, *Lactifluus glaucescens*. However, this species can be distinguished from *L. glaucescens* due to the fact that the colour of the milk doesn't change when exposed and that it doesn't react with KOH.





Use: Edible but it is not recommended that it is eaten raw, due to its acrid taste.

Time for fruiting: Found in the rainy season from June to September.

Habitat: Grouped on the ground in deciduous forest, dominated by members of Fagaceae.

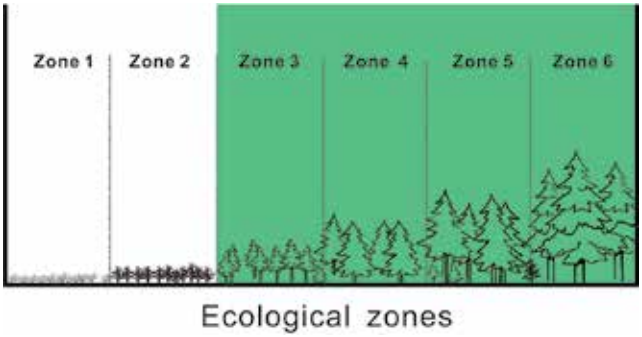
Distribution: Recorded in Europe, North America, Vietnam, Thailand and China.

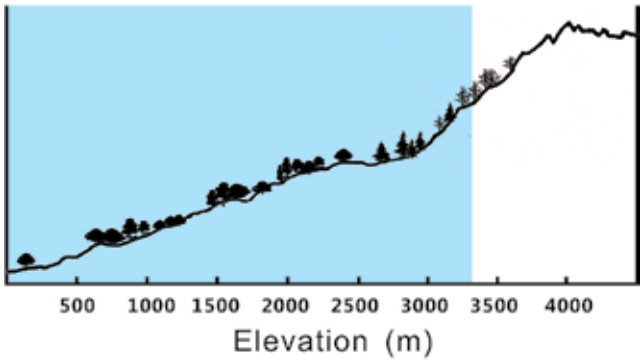
Lactifluus distantifolius (Russulales)

Common names: No names have been recorded.

This species has medium to large sporocarps that are 2–11.5 cm diameter. At first, they are broadly convex with a slightly depressed center and become funnel-shaped with age. The surface is concentric and wrinkled towards the margin. It is velvety, intensely rusty orange to yellowish orange, darker in the center and slightly paler yellowish towards the margin. The gill spacing is very distant and they are cream coloured but discolour brown to orange brown when injured. The stalk is firm, cylindrical and tapers downwards. It is centrally to eccentrically attached, the surface is dry, matt and wrinkled along the length. It is concolour with the pileus. Latex is white, abundant, unchanging when isolated, within few minute to half an hour turning dirty brown on gill and stalk. The mushroom smells like seafood and has a mild flavour. This species can be distinguished in the field by its rusty orange colour and very distant gills.

Use: Unknown.





Time for fruiting: Found in the rainy season from June to September.

Habitat: Grouped on the ground in Dipterocarp forest, associated with *Dipterocarpus tuberculatus*.

Distribution: Has been found in northern Thailand.

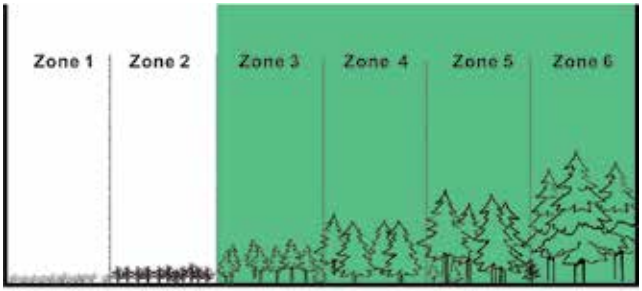
Lactifluus glaucescens (Russulales)

Common names: Hed kha (Thailand and Laos).

The medium to large sporocarps of *L. glaucescens* can be 3–15 cm diameter. At first, they are broadly convex and have a slightly depressed center, becoming funnel-shaped with age. Generally, they are whitish, sometimes turning pale yellowish. The cap surface is dry and smooth. The gills are densely crowded and yellowish white to pale yellow. The stalk is firm, white and smooth to wrinkled. The mushroom has a lot of milk, which is white, slowly turning to pale green when drying. The milk reacts with KOH, and turning yellow after a while. The smell is faintly fruity and the taste is very acrid. This species is very similar to *L. piperatus*. *L. glaucescens* can be distinguished from *L. piperatus* by colour changing reaction of milk on gills and flesh as well as the reaction of milk with KOH. However, the change of colour in the flesh sometimes takes several hours.

Use: Edible, but it is not recommended that it is eaten raw due to its acrid taste.

Time for fruiting: Found in the rainy season from June to September.



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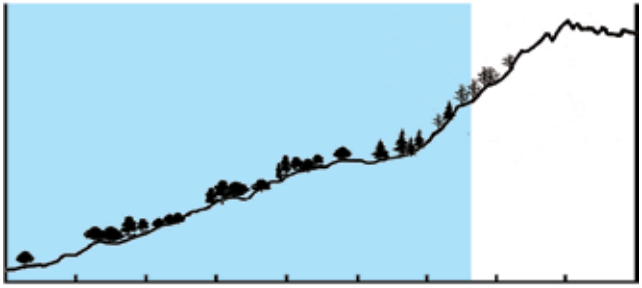


Elevation (m)

Habitat: Grouped on the ground in deciduous forests dominated by members of Fagaceae and Dipterocapaceae.

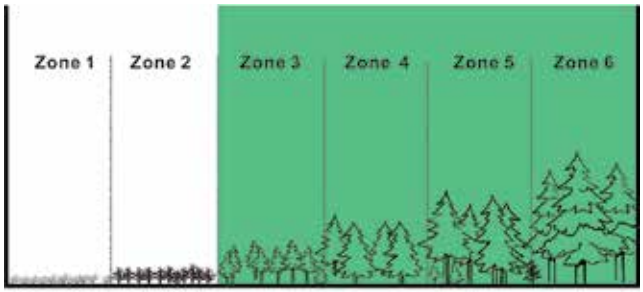
Distribution: Has been found in Europe, North America, Vietnam, Thailand and China.

Xerula radicata (Agaricales)

Common names: Rooted *Collybia*; Rooted agaric; Rooted *Oudemansiella*, Deep root mushroom (English), Khan nok or Khaeng nok (Thailand and Laos).

The cap of *X. radicata* is medium to large and can be 5–14 cm wide. When young, the cap can be bell-shaped to convex and flat with a large umbonate at center. It is pale brown, grayish yellow or yellowish brown, streaked and wrinkled and sticky when moist. The tough stem is a tall and slim structure, 85–180 X 4–8 mm high, white above and yellowish brown at the base of the stem. There is no ring or volva. The flesh is thin. The genus, *Xerula*, can be distinguished by its tall and slim stem stature and wrinkles on the cap. The spore print is white and the spores are broadly elliptic.

Use: An excellent edible and medicinal mushroom. *X. radicata* has been reported to have therapeutic effects on high blood pressure and inhibitory effects on thesarcoma 180 and Erhrlich carcinoma.



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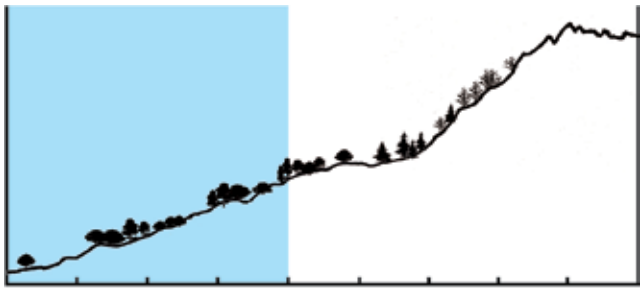


Elevation (m)

Time of fruiting: This species can be found during the season from May to September in Thailand.

Habitat: They are saprobes that inhabit buried wood or dead tree roots; found around or near trees in mixed forest.

Distribution: This species has been found in Europe, and Southeast Asia for example China and Thailand.

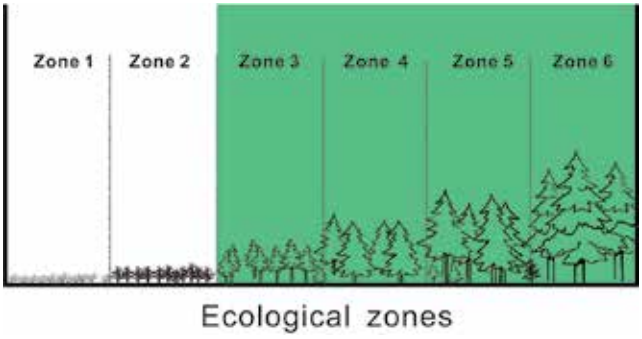
Lactarius akahatsu (Russulales)

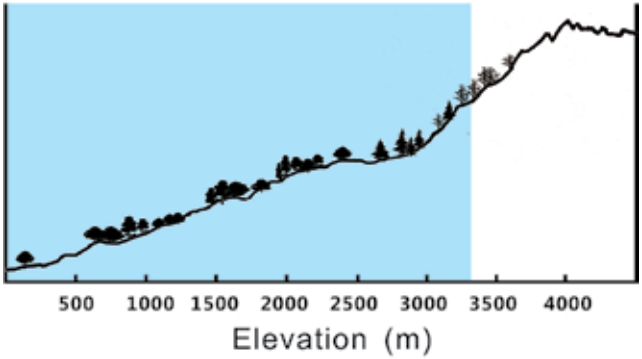
Common names: Aka hatsu (Japanese).

The medium to large sporocarp of *L. akahatsu*, can be 6–12 cm diameter. The shape is plano-convex to widely infundibuliform. The surface is smooth, slightly sticky, often has indistinct zonation at the center, with more distinct zonation near the margin. The colour is a slightly deeper orange near the center, otherwise pale orange and more whitish orange when dry. The gill spacing is subdistant and sometimes forking. The gills are orange and turn brownish orange when old. The stalk is firm, and the surface is smooth and slightly sticky. The colour is whitish orange to pale orange. Milk is scarce and orange. The milk smells quite sweet and has a mild taste. *L. akahatsu* can be recognized in the field by the pileus colour and remarkable milk colour.

Use: This is appreciated as an edible mushroom in Thailand.

Time for fruiting: Found in the rainy season from May to September.





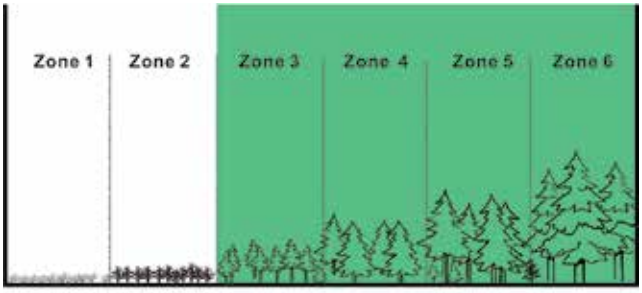
Habitat: Mostly grouped on the ground in pine forest.

Distribution: This species has been found in Japan and Thailand.

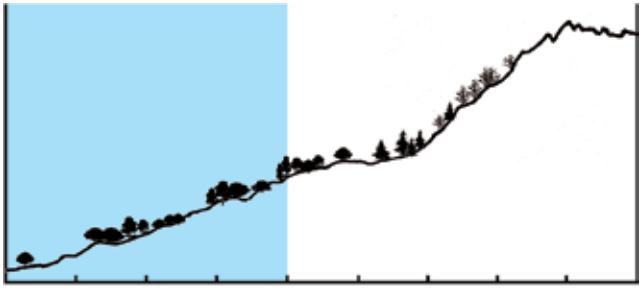
Amanita hemibapha subsp. *hemibapha* (Agaricales)

Common names: Half-dyed slender caesar (English), Hed ra ngong dang, Hed kai dang (Thailand and Laos).

When fully grown the cap of *Amanita hemibapha* subsp. *hemibapha* is 7.5–9 cm wide, when young the cap is hemispheric to umbo. It becomes convex and the margin widens upward with age. The colour is reddish or red when young; the disc is deep orange and the margin is sunflower yellow. An obvious striation or line is apparent around the disc, toward the margin or halfway up the cap. The flesh is 4-6 mm thick, white yellow or pale yellow. The gills are free, crowded, vanilla yellow and become light yellow with age. The stem narrows upward and is 6.5–15 X 0.6–1.3 cm high. It is vanilla yellow above and creamy white below, striate-like on the surface and has a superior skirt-like volva at the base of the stem. The colour of the outer surface of the volva is white and the inner surface is yellowish. The colour of the ring on the stem is vanilla yellow and the surface is striate. The spore print is white and the basidiospores are ellipsoid to elongate and inamyloid.



Ecological zones



Elevation (m)

Use: This species has an excellent flavour and is highly nutritious. This can be confused with some *Amanita* species, which contain deadly toxins.

Time of fruiting: This species can be found during the rainy season from May to September in Thailand.

Habitat: A mycorrhizal species, which has relationships with coniferous, hardwood, pine and dipterocarp forests.

Distribution: This species has been found in North America, and Southeast Asia: China, Thailand, Japan, Sri Lanka, and India.

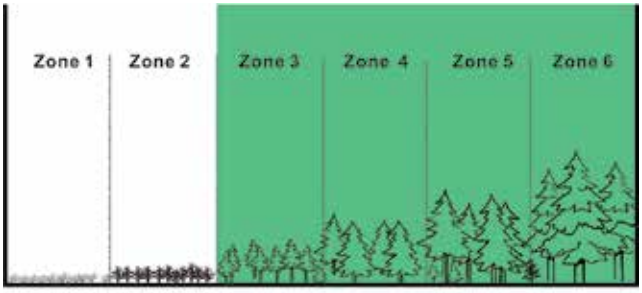
Amanita rubrovolvata (Agaricales)

Common names: Red volva *Amanita* (English), Hed teen dang (Thailand and Laos).

When fully grown the cap of *Amanita rubrovolvata* is 1.8–6 cm wide, convex to flat and slightly umbo. When young, it is red or tomato red, becoming orange to yellow toward the marginand covered with orange to yellowish floccose. Despite its small size, it has an obvious striate or line at the margin. The context is white to yellowish. The white, short gills are free. The sporocarps are very small to medium-sized, pale yellowish above and yellow to pale orange at the base. The ring above the stem is white to yellowish and the edge is orange.

The bulbous volva is covered with orange to yellowish floccose or powdery structures. The orange floccose can be seen on the cap, stem and volva. The odor and taste have not been reported. The spore print is white.

Use: Unknown



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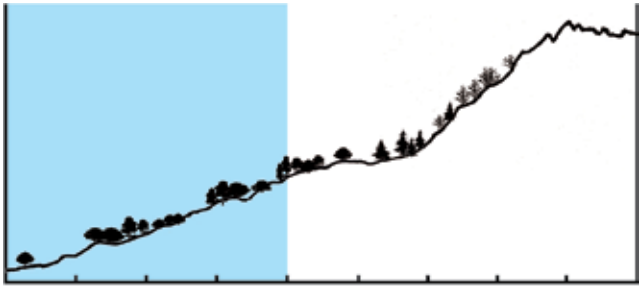


Elevation (m)

Time of fruiting: This species can be found during the rainy season from May to September in Thailand.

Habitat: A mycorrhizal species, which has relationships with coniferous, hardwood, pine and dipterocarp trees.

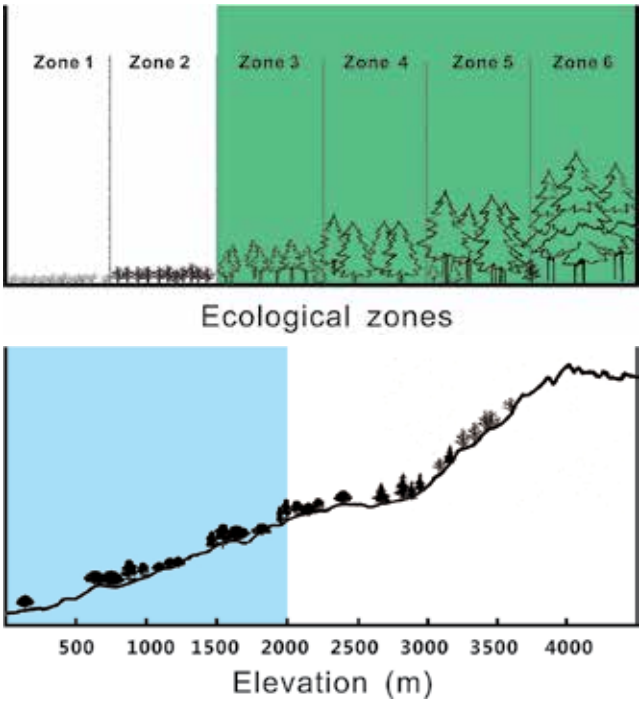
Distribution: Found in Southeast Asia, Japan, northern India Nepal and Thailand. This species was originally described in Japan.

Amanita vaginata (Agaricales)

Common names: Grisette (English), Hed ra ngong (Thailand and Laos).

The cap is 4–10 cm in diameter and gray to grayish-brown. When young, the cap is hemispheric to umbo, becomes convex and flat with a slight umbo. The center is dark gray or brown and sticky or slimy when moist. It is striated or lined at the margin. The white gills are free and close to crowded. The context is white. The sporocarps are 10–15 X 2–6 cm. The upper side of the stem is white and the lower side is dirty white or grayish, It is covered with powdery or tiny scales, which are grayish (particularly on the lower side). There is no ring. The sack-like volva at the base is dirty white or grayish white, quite big and not tightly attached to the stem. The spore print is white. This species can be recognized by the colour of the cap, which is grayish brown to gray, and the loosely arranged volva around the stem.

Use: Edible mushroom, that is rich in vitamins and some protein and fiber. However, other species of *Amanita* are poisonous and care should be taken.



Habitat: A mycorrhizal species, which has relationships with coniferous, hardwood, pine and dipterocarp trees.

Distribution: This species has been found in Europe, North America, Southeast Asia (Thailand) and China.

Glossary

A

Acrid: unpleasantly sharp, pungent, or bitter to the taste or smell.

Adnate: mushroom gills are broadly attached to the stalk slightly above the bottom of the gill, with most of the gill fused to the stem.

Adnex: gill much narrower where attached to the stipe.

Annulus: forms on the stalk when the veil splits and falls off the cap.

Applanate: flattened.

Ascocarp: is the fruiting body (sporocarp) of an ascomycete fungus.

Ascomycetous fungi: any fungus of the class Ascomycetes (or subdivision Ascomycota) in which the spores are formed inside an ascus.

B

Basidiome: is the sporocarp of a basidiomycete.

Basidiospores: a sexually produced fungal spore borne on a basidium.

Bracket fungi: a woody fungus that forms shelflike sporophores on tree trunks and wood structures.

Bruising: the color transformation on the mushroom as a result of pressure.

Bulbous: a bulb in shape; rounded or swollen.

C

Caespitose: growing in small dense clumps or tufts.

Calotte: a round cavity or depression.

Campanulate: shape like a bell.

Cap: the fleshy head of the mushroom, the top of the mushroom.

Cluster: a large grouping of mushrooms, growing from a centralized point on a root or stem.

Concentric: having a centralized meeting place, usually of equal length from the centering point.

Concolorous: of the same color throughout.

Cortinate: a cobweb-like remnant of the partial veil, which in some mature mushrooms hang from the edges of the cap.

Convex: having a surface or boundary that curves or bulges outward, as the exterior of a sphere.

Corky: of the nature of cork; corklike.

Crowded gills: a gilled mushroom, that has very tightly packed and numerous gill folds, sometimes wavy in appearance.

Cyathiform: in the form of a cup, a little widened at the top.

D

Decurrent: hymenophore of a basidiocarp (such as the lamellae or "gills" of a mushroom or the "pores" of a bracket fungus) when it is broadly attached to and extends down the stipe.

Decurved: bent or curved downwards.

Denticulate: finely toothed or notched.

Cylindrical: relating to, or having the shape of a cylinder, especially of a circular cylinder.

Dimitic hyphal system: clamped generative hyphae and unclamped skeletal hyphae.

Dimidiate: divided in halves.

E

Eccentric: not placed centrally or not having its axis or other part placed centrally.

Ectomycorrhizal mushroom: a mycorrhizal fungus which lives in symbiosis with host roots; the hyphae of ectomycorrhiza do not penetrate the cells of the plants' roots.

Edible: fit to be eaten, especially by humans.

Egg phase: button stages enclosed by a universal veil, as in a stinkhorn or Amanita.

Ellipsoid: having the nature or shape of an ellipsoid.

Elliptical: rounded like an egg.

Exoperidium: the outer of the two layers into which the peridium is divided.

F

Fertile: bearing functional reproductive structures such as seeds or fruit or material such as spores or pollen.

Fibrous: consisting of, containing, or resembling fibers.

Fibrillose: covered with fibrils more or less evenly disposed.

Flabelliform: fan shaped.

Fissile: tending to split or capable of being split.

Flavorless: lacking taste or flavor.

Floccose: consisting of, or covered with, woolly tufts or hairs.

Forking: the act of branching out or dividing into branches.

Free gills: a term used to describe that the gills (underside of the cap) are not attached to the stem.

Fruiting: a term used to say when mushrooms are beginning to develop in the immature stage.

Fruiting bodies: a macroscopic reproductive structure produced by some fungi (for example, mushrooms) and some bacteria (for example, myxobacteria). Fruiting bodies are distinct in size, shape, and coloration for each species.

Fungi: ecompasses the complex world of mushrooms, from the lowly molds to the choicest edibles.

Fusiform: elongated and tapering at both ends; spindle-shaped.

G

Gargantuan: immense in size, volume, or capacity.

Gelatinous: having the nature of, or resembling, jelly, especially in consistency; jellylike.

Gill: one of the thin, platelike structures on the underside of the cap of a mushroom or similar fungus.

Glabrous: having no hairs, projections, or pubescence; smooth.

Globose: having the shape of a sphere or ball.

Gregarious: growing in groups that are close together but not densely clustered or matted.

H

Hemispherical: relating to or being a half of a sphere bounded by a great circle.

Hollow: having a hole, cavity, or space within; not solid.

Hymenial surface: spore-bearing layer of the fruiting body of certain fungi (basidiomycetous and ascomycetous fungi), containing basidia or asci.

I

Inamyloid: does not turn red or blue when stained with Melzer's reagent.

Inedible: not fit to be eaten; uneatable.

Inflexed: curved or bent inwards and downwards towards the axis.

Inflated: hollow and enlarged or swelled out.

Infundibuliform: shaped like a funnel.

Immunostimulants: an agent that stimulates an immune response.

Insecticidal: of, or relating to, chemical substances used to kill insects.

Intervenose: veins in the spaces between the gills.

Interwoven: linked or locked closely together.

J

Juvenile: not fully-grown or developed; young.

K

KOH (Caustic Potash solution): Potassium hydroxide, used to help identify certain mushroom spores in a laboratory setting.

L

Lamellae: any of the radiating leaf like spore-producing structures on the underside of the cap of a mushroom or similar fungus.

Lamellulae: a short mushroom gill, which does not extend all the way from the edge of the cap to the stem.

Latex: the milky white ooze that comes from slicing the gills of the Lactarius or related species of mushrooms.

M

Margin: the edge of the cap or outer portion of cap.

Membranous: skin-like tissue making of the partial veil of some mushrooms.

Monomitic: containing only generative hyphae.

Mushroom: the fruiting body of a fleshy nature, characteristic of some fungi.

Mycelium: the collective name for the filaments (cell) of the vegetative part of a fungus.

N

Non-chlorophyllous: not containing chlorophyll.

O

Obligate symbiosis: known also as mutualism, takes place when two different species live interdependently in a mutually beneficial relationship in a way that one cannot survive without the other.

Opaque: impenetrable by light; neither transparent nor translucent.

Ovoid: egg-shaped with the broader end at the base.

P

Parabolic: curving and somewhat round in shape.

Partial veil: a covering that extend from the stem to the bottom edge of the cap. The part that remains will be called a ring or annulus.

Perforatorium: a pronounced umbo or papilla on some mushroom caps.

Persistent: remaining attached beyond the usual time.

Pileus: mushroom cap.

Plano-convex: having one side convex and the other side plane.

Plano-concave: having one side concave and the other side plane.

Pleurocystidia: relatively large cells found on the gill face of a basidiomycete.

Pore: the non-gill like structure of the Bolete, Polypores, etc. Often called tubes.

Pyriform: pear shaped.

R

Reniform: bean- or kidney-shaped.

Rimose: describes cracks in the caps.

Rhizomorph: a root-like structure, characteristic of many basidiomycetes, consisting of a mass of densely packed and intertwined hyphae.

Ring: the remains of a partial veil clinging to the stem of a mushroom.

Rubbery: describes the texture of feel of the mushroom.

Rudimentary stem: short or incomplete stem.

Rusty: a strong brown colour, sometimes with a reddish or yellowish tinge.

S

Saprophyte: an organism that feeds on dead organic matter especially a fungus or bacterium.

Scales: a piece of tissue that forms on the caps or stem of a mushroom, these curl upwards and look like shingles.

Serrate: part of the gills edge may be saw tooth or ragged in appearance.

Skeleto-ligative hyphae: thick-walled and very long hyphae in comparison to the frequently septate generative hyphae.

Solitary: alone.Spore: reproductive part of a fungus.

Spatulate: having a narrow base and a broad rounded apex.

Stalk, Stem, Stripe or Stipe: The part of the mushroom that supports the cap.

Squamose: covered with or formed of scales; scaly.

Striate: longitudinal furrows or lines on the stem.

Superior: pertaining to near the top of the stem.

Subcircular: nearly circular.

T

Tapering: gradually decreasing in size toward a point.

Tomentose: densely hairy, or woolly in appearance.

Tomentum: a covering of closely matted woolly hairs.

Translucent: allowing light to pass through partially or diffusely; semitransparent.

Trimitic hyphae: generative, skeletal, or binding hyphae.

Truncated: having little length or lacking in length.

Tubes: the underside of the caps of boletes and polypores.

U

Umbo: a knoblike protuberance arising from a surface.

Umbonate: cap with an umbo.

Universal veil: a tissue that surrounds the developing mushroom button.

V

Veil: a membranous covering or part, as that on the developing fruiting body of certain mushrooms; a velum.

Ventricose: having a swelling on one side; unequally inflated.

Verrucose: covered with warts or wart-like projections.

Viscid: mushrooms that are sticky of slippery, but not slimy.

Volva: remains of a universal veil at the base of the stalk or bulb.

W

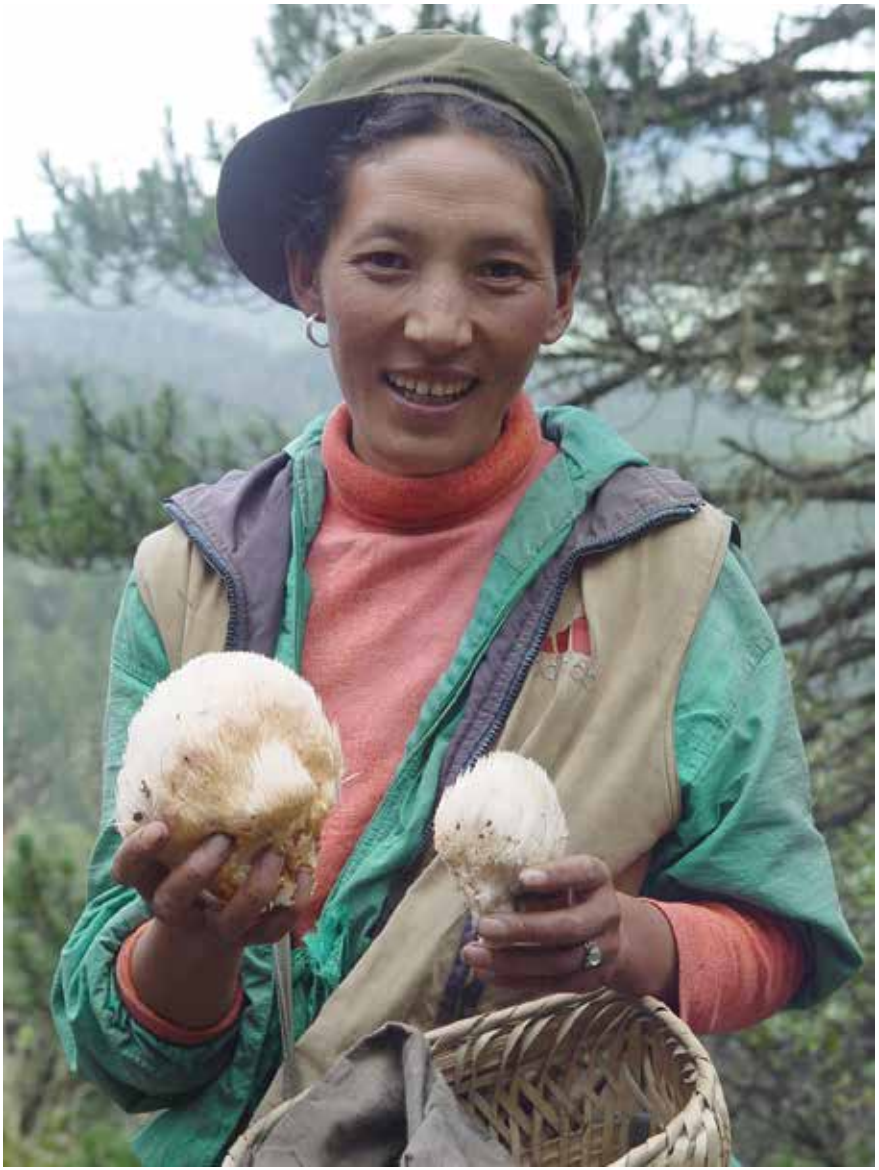
Warts: bumps on the top or caps of mushrooms.

White rot fungus/fungi: white-rot fungi break down the lignin in wood, leaving the lighter-colored cellulose behind; some of them break down both lignin and cellulose.

Z

Zonate: where the cap of a mushroom has concentric bands or zones of color circles.

Plates



A local mushroom hunter in Baoshan, carrying the edible and medicinal mushroom *Hericium erinaceus*

A local mushroom hunter in Baoshan with the edible mushroom *Boletus edulis*

Local mushroom hunters with baskets of *Lactarius deliciosus*, a popular edible mushroom in China

A local woman from Baoshan with a basket full of the popular edible mushroom *Lyophyllum fumosum*

Some Chinese researchers with a local mushroom hunter in Baoshan, displaying their collection of edible mushrooms: *Amanita hemibapha, Cantharellus cibarius, Hericium erinaceus,* and *Lyophyllum fumosum*

A villager in Baoshan with the prized and popular edible mushroom *Tricholoma matsutake*

A local mushroom gatherer showing his collection of the popular *Boletus edulis*, a prized edible mushroom

Notes:

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