

LECCINUM REVISITED

A NEW SYNOPTIC KEY TO SPECIES

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In the first issue of Field Mycology I presented a synoptic key to the genus *Leccinum* based largely upon the work of the (then) recent publications by Lannoy & Estadés (1995) and Korhonen (1995) and from feedback I believe the key worked very well on the whole. So why, seven years later, should it need revising again? The answer lies in one very short acronym—DNA.

Using the techniques of molecular analysis, mycologists' new-found ability to compare and contrast taxa based upon their genetic structure is revolutionising our understanding of Families, Genera and Species, not just in the fungi but in all organisms. In the larger fungi it has revealed what many had already suspected - that the fruitbodies we see and collect are often amazingly 'plastic' in their gross morphology. Differences and variations in appearance that formerly we would have been certain must reflect specific or generic differences, may now be revealed to represent simple extremes of external morphology. Often when their genetic structure is compared, little significant differences can be found and in the case of species such taxa must - in the opinion of many - be considered to represent one species.

Recently, H.C. den Bakker and M.E. Noordeloos among others, have been examining the genus *Leccinum*. Their results, published in 2005 (Bakker, 2005), presented some startling changes in our species concepts. From the 36 species presented by Lannoy and Estadés, plus the three species added by Korhonen, Bakker & Noordeloos have reduced the total to just 14, a dramatic reduction by any standards.

Presented here then is a revised synoptic key based on this work and my own field observations with notes and descriptions explaining some of the more surprising synonymies and name changes. It is important to stress, as do Bakker and Noordeloos, that our knowledge is not now complete, changes will undoubtedly continue to

be made as research continues. But it is fair to say that the view of species which they present probably reflects what is 'out there' more accurately than any other to date.

What has become clear is that the traditional macrocharacters of flesh colour changes and pileus colour are much more variable than we thought, and that some species have a wider host range than previously allowed.

Using the key

The approach used here, a synoptic key, is very different from the traditional dichotomous approach - not necessarily better, just different - and many people may find this method an easier way of tackling these often baffling organisms.

How do you use a synoptic key? Firstly, study the characters listed on the following pages - 5 characters in all. Read the descriptions carefully and select one from each set which best matches your fungus and note down the appropriate letter, i.e. your *Leccinum* might have a medium brown cap with distinct olive tones at the margin, so you would write down the letter E. If the stem also has olive tones, especially at the apex, then follow that with the letter J and so on until you have a 5-letter code such as EJLMQ. Then, scan down the alphabetical list of codes until you find the matching sequence. In some cases, you will arrive at a species name, in others you will be referred to a short dichotomous key, no more than 2-5 taxa in most cases. If uncertain of a particular character then note down both letters and try both code sequences, e.g. you may not be certain if the brown cap has olive tones so you would write down both C and E and try codes CJLMQ and EJLMQ and see which result fits the best. There is a brief description and notes on each species after the key.

One advantage of a synoptic key is that it is very easily modified and you can adjust the codes

to suit your own experience or add your own taxa, if you find things which do not fit the existing list. The microscopic characters used - the cap cuticle or pileipellis and the caulocystidia - are necessary since field characters alone are just not enough; some species are just too similar to be easily separable without referring to the microscope. To get a good sample of the cap cuticle (pileipellis), make a u-shaped incision with a razor blade, grasp the cut edge with a pair of forceps and peel off until it tears. The torn edge will be about 1 cell thick and is ideal for studying the arrangement of the hyphae. For the caulocystidia I use a pair of very sharp forceps (entomological forceps are ideal) and pluck a tuft of squamules off of the stem for examination, lightly staining the cells with congo red.

Very important - do not attempt to key out very old specimens, where the entire fruit body has turned a dull brown or olive overall; most species will end their lives in this condition. This will only lead to frustration, errors and wasted time. You should aim for just mature specimens where the colours are still fresh, the flesh is not soggy and collapsing and the stipe characters are clearly visible. Avoid specimens where slugs have eaten off the surface of the stipe (very common!).

The principal character states

Cap colours:

Once again, avoid very old specimens where the colour has completely changed, although, of course, this change should be noted where it occurs. Note the surface texture of the cap also. This is often useful and can range from wet, viscid to greasy, or from dry and felty to rather granular and cracking. Colour can be tricky and since fungi are living organisms they will, of course, not always follow the rules! Expect exceptions and oddities but, on the whole, a particular species will have a reasonably consistent colour range. If in doubt, try more than one colour series.

Stem squamules:

It is very important here to see young, fresh material. In most old specimens, the squamules will have aged deep brown to black. Look for the general background tone of the stipe, under the

squamules, especially important in species like *L. cyaneobasileucum*, *L. melaneum* and *L. aurantiacum*.

Stem basal colours:

This character can be very difficult to observe and sometimes there is only the faintest flush of colour present. A good place to see any blue-green tints is on the whitish mycelium found covering the extreme base of the stipe. This character can be considered an extension of the internal flesh colour changes but is included separately, because some species will exhibit blue-green on the outer surface even when the internal tissues are reluctant to change.

Flesh colour changes:

An important characters although not as critical as was once thought. When you cut the fungus in half to observe any changes **you must** rub the cut surface of one half and bruise it! The colour changes are initiated by air entering the tissues; if you use a sharp knife to cut the flesh then so little flesh is actually damaged - it is merely split apart - that very little change will take place thus giving a false reading. Bruising one half and leaving the other unbruised will ensure you have a controlled experiment, accurately revealing any colour changes. Observe the cut surface for about 20 mins returning frequently to look; the colour change will often fade after about half an hour and you may miss it if you don't look for a long time. Any blue-green stains, on the other hand, will often take an hour or much more to develop properly. I have had specimens of *L. varicolor* turn completely blue in the lower half if left overnight. A dull, pale pinkish buff is common in bruised specimens of the more or less 'unchanging' species.

Cap cuticle types:

Only 3 types are used here. Fungi being what they are, variations and overlaps may occur, although usually a thorough examination will allow a decision to be made as to type. The cellular cuticle is the most distinctive but is, so far, known from only two British species, *L. pseudoscabrum* and *L. crocipodium*. Species with long, non-disarticulating

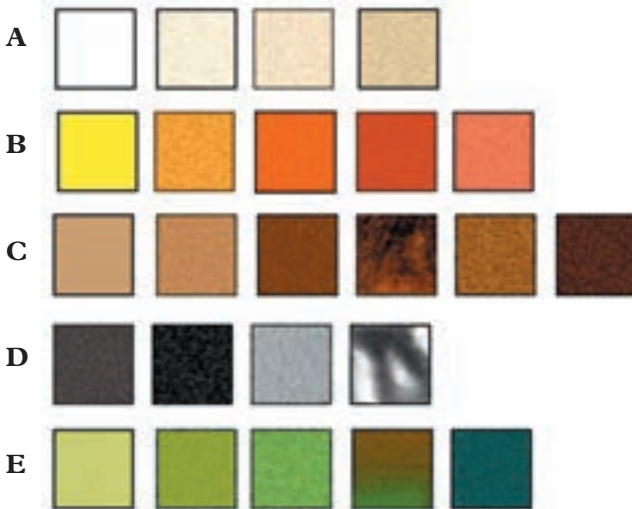
cap hyphae may have a few broader, shorter cells, while species with short, broad, disarticulating cells (cylindrocysts) may have longer cells mixed in, but these odd cells will always form a distinct minority. Observe first on low power, about $\times 40$ - $\times 100$ - to get an overall impression of type. Use higher power to see if any unusual cell types, such as encrusted or pigmented cells, are present. These may be diagnostic to species. Always observe first in plain water to see any inherent colours accurately before mounting in other media, such as 5% potassium hydroxide or 10% ammonia, which can help to clear and wet the tissues. A light stain with Congo Red in ammonia

is popular with many mycologists for general observation of hyphae. Make a note of any changes the chemical mountants may have on the cellular pigments, as it is common for pigments to separate into globules either inside the cell or on the outer cell wall when mounted in potassium hydroxide (KOH). Such notes may be of use in the future to help distinguish species, once we have a clearer understanding of the changes involved.

Leccinum species are beautiful, challenging and often difficult fungi to identify but we are closer now than ever before to understanding how the species are defined.

Key characters - select one character from each group

Cap colours



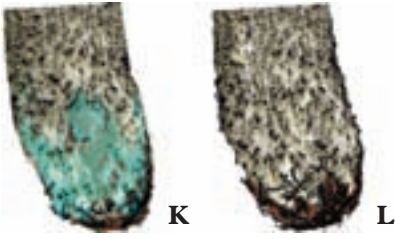
- A** From white to pale ivory or buff-ochre, with or without a pink flush or bruising pink (if white with green flush, then use E).
- B** Cream-yellow through mid-yellow, tawny, orange, brick, apricot or pinkish-orange.
- C** Shades of buff, ochre, yellow brown, nut brown, deep brown but not with greyish, blackish or truly yellow tones.
- D** From mouse-grey through deep grey, blackish, grey-sepia and sometimes with whitish blotches.
- E** With green, verdigris or glaucous tones, either overall or just marginally (i.e. a brown cap may be flushed olive at edge as seen in square 4).

Colour of stipe squamules



- F** White to pale cream or buff with age (some species are white when young, maturing to brown, orange etc.)
- G** More or less uniformly grey, felty, occasionally darker and with some black-brown squamules.
- H** With black or brown squamules on a pale ground (this is the commonest form in brown-capped species).
- I** Squamules tawny-brown to rich orange, foxy to brick-red, may become deep sepia with age but still with red-brown tones visible.
- J** Squamules vary from white to brown but stem (especially at apex) rapidly developing olive-green or blue-green tones. This does **not** refer to the blue-green stains at the base of the stem!

Stem basal colours

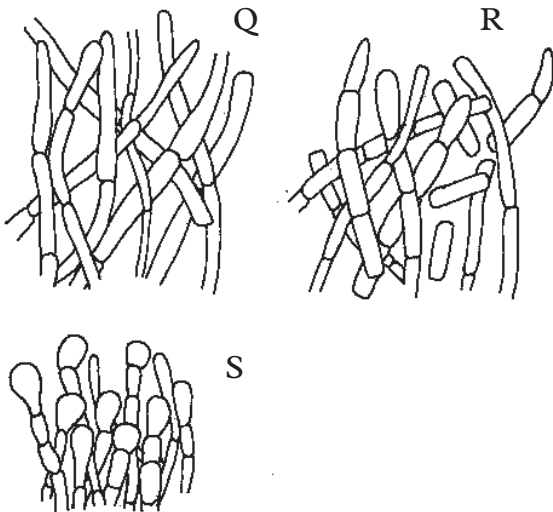


- K** With blue-green stains or flush at base (if even the slightest trace of green, use this letter), areas eaten by slugs are a good place to examine for this character.
- L** Without blue-green stains or flush at base.

Flesh colour changes



- M** Unchanging to dull buff or slightly olive but not truly reddish-pink or blue-green.
- N** With distinct pink to reddish-salmon but no blue-green tones. The pink colour will become especially strong after bruising the flesh.
- O** With reddish-pink above and blue-green stains in stem base. (The latter may be only very faint).
- P** Although it may start pink, it rapidly becomes dull slate-grey to violet or black.



- Q** With long, flexuose cells, length averaging more than 5 times their width, rarely mixed with large, short, brick-like cells. Cells rarely disarticulating (breaking apart).
- R** With numerous short, broad, brick-like cells (cylindrocysts), length only 3 or 4 times their width, sometimes intermixed with long, flexuose ones. These short cells may often disarticulate (break apart).
- S** With distinct, almost spherical or cubical cells (sphaerocysts) often in a layer.

Key Codes - match your alphabetical coding with the list below

AFKNQ	<i>scabrum</i> (<i>pale</i> = <i>L. avellaneum</i>)	CGLOR	<i>cyaneobasileucum</i>
AFKNR	<i>versipelle</i> (<i>white form</i>)	CHKMR	<i>scabrum</i>
AFKOQ	<i>holopus</i>	CHKNR	<i>scabrum</i>
AFKPQ	<i>versipelle</i> (<i>white form</i>)	CHKOQ	key 6
AFKPR	<i>versipelle</i> (<i>white form</i>)	CHKOR	key 7
AFLNQ	key 1	CHKPQ	key 8
AFLOQ	<i>holopus</i>	CHLMQ	key 9
AHKOQ	<i>holopus</i>	CHLMR	<i>scabrum</i>
AHLOQ	<i>holopus</i>	CHLNQ	key 10
AJKNR	<i>scabrum</i> (<i>greenish form</i>)	CHLNR	key 11
AJKOR	<i>scabrum</i> (<i>greenish form</i>)	CHLOR	<i>cyaneobasileucum</i>
AJLNQ	<i>holopus</i> (<i>old, greenish</i>)	CHLPS	<i>pseudoscabrum</i>
BFLPR	<i>alboostipitatum</i> (= <i>aurantiacum s.l.</i>)	CJLMQ	<i>scabrum</i> (<i>greenish form</i>)
BHKPR	key 2	DFKOQ	<i>schistophilum</i>
BHLMQ	<i>scabrum</i>	DFLOQ	<i>schistophilum</i>
BHLPR	key 3	DGKOQ	<i>schistophilum</i>
BHLPS	<i>crocipodium</i>	DGLNQ	<i>melaneum</i>
BIKMR	<i>vulpinum</i>	DGLOQ	<i>schistophilum</i>
BIKPR	key 4	DHKNQ	<i>melaneum</i>
BILPR	key 5	DHKNR	<i>variicolor</i>
BILPS	<i>crocipodium</i>	DHKOR	<i>variicolor</i>
CFKOQ	<i>holopus</i>	DHLNQ	<i>scabrum</i>
CFLNQ	<i>rotundifoliae</i>	DHLPR	<i>nigellum</i>
CFLOQ	<i>holopus</i>	DHLPS	<i>pseudoscabrum</i>
CGKNR	<i>cyaneobasileucum</i>	EFLNQ	<i>holopus</i>
CGKOQ	<i>schistophilum</i>	EJKNR	<i>variicolor?</i> (<i>old greenish form</i>)
CGKOR	<i>cyaneobasileucum</i>	EJLMQ	<i>scabrum</i> (<i>greenish form</i>)
CGLNR	<i>cyaneobasileucum</i>	EJLNQ	<i>holopus</i> (<i>greenish form</i>)

Key 1 AFLNQ

1. Cap white at first, then slowly flushed olive, dry, velvety, soon smooth and moist, often in *Sphagnum* swamps ***L. holopus***
- Cap very pale buff, ochre-brown, smooth to velvety, often cracking, subalpine to alpine under birches, sometimes in *Sphagnum* ***L. rotundifoliae***

Key 2 BHKPR

1. Cap bright apricot, pinkish-apricot to pale pinkish-buff with age, often woolly-scaly, stipe squamules densely and intensely black, young pore surface pale olive-buff ***L. atrostipitatum***
- Cap orange-tawny, yellowish-buff, to brick-red but without pinkish-apricot tones, stem not as densely scaly and young pore surface may differ also..... 2
2. Under birch, cap bright tawny-yellow, yellow-orange, young tubes dark grey, stem white to pale greyish with black squamules, spores 13 - 18 µm long ***L. versipelle***
- Under spruce or willow spp. cap much duller yellow-buff, tawny-brown, cinnamon-red, young tubes cream **3**

- 3. Under willow spp. in northern Scotland and outer Isles, cap surface often deeply cracked, flesh hardly changing colour when exposed . . . *L. aurantiacum* (= *L. salicola*)
- Under Norway spruce cap deep fox-red, red-brown, dry, fibrous-smooth, not cracking, flesh prominently greyish-rose to violet when exposed *L. piceinum*

Key 3 BHLPR

- 1. Growing under Norway spruce, cap deep fox-red to dull orange-brown, stem squamules blackish-brown; flesh grey-pink to slate-violet, often blue in base of stem . . *L. piceinum*
- Growing under birch , cap from pinkish-apricot to dull yellow-buff or bright orange 2
- 2. Cap a bright apricot to pinkish-apricot, often very woolly-scaly, stipe densely black squamulose, young tubes cream. *L. atrostopitatum*
- Cap yellow-ornage, tawny orange, smooth to woolly-scaly. Stem white to pale greyish with black squamules, young tubes deep grey-black, mature tubes cream, adnexed to stem, spores 13 - 18 µm long *L. versipelle*

Key 4 BIKPR

- 1. Under willow spp. in northern Scotland and the outer Isles, cap cinnamon-brick, often . deeply cracked. *L. aurantiacum* variety (= *L. salicola*)
- Under Scots pine, oak, aspen or birch 2
- 2. Under Scots pine in Scotland, cap deep fox-red to chesnut, purplish-brown *L. vulpinum*
- Under oak, aspen, rarely beech, lime or even willow, widespread, cap fox-red, brick to chesnut, stipe squamules white then soon deep reddish-brown to finally sepia *L. aurantiacum* (= *L. quercinum*, = *L. salicola*)

Key 5 BILPR

- 1. Under oak, aspen rarely beech and lime, widespread, cap fox-red, brick to chestnut, stipe squamules white then very quickly deep reddish-brown to finally sepia, pileipellis hyphae very dark brown intercellular encrusted. Spores 13 - 18µm long *L. aurantiacum*
- Under Scots pine in northern and central Scotland. Cap deep reddish-brown, fox-red, chestnut, to ochre-brown with age, stipe with deep brown squamules . . . *L. vulpinum*

Key 6 CHKOQ

- 1. Cap pale buff, fawn to clear brown, with age becoming flushed with olive-green especially at margin, stipe flushed olive above, occasionally bluish at base, flesh with obvious olive flush at apex or cortex, under Birch *L. holopus*
- Cap greyish-brown, increasingly greyish with age, only very slightly greenish with age, stipe white with brown to dark grey-brown squamules, flesh very pale reddish when cut, blue-green at base, in *Sphagnum* and *Polytrichum* moss in bogs under birch . . . *L. schistophilum* (= *L. palustre*)

Key 7 CHKOR

- 1. Cap pale brown, grey-brown to nut-brown, usually dry and felty, stipe in typical form very distinctive, uniformly woolly, pale grey, mouse-grey, sometimes slightly bluish at base, flesh pale rust-pink to rust, frequently yellow or blue-spotted at base, pileipellis with

numerous short, broad, disarticulating cells ***L. cyaneobasileucum***

- Cap deep blackish-grey, black-brown, deep brown, often blotched and streaked with whitish areas, without olive tones, flesh bright reddish-pink in cap and upper stipe, vivid blue-green in stipe base (the latter may take an hour or more to develop)..***L. variicolor***

Key 8 CHKPQ

1. Cap pale brown, buff, ochre-brown, grey-brown, growing under *Populus* sp., squamules grey-brown, fine and dense, flesh pink then slate-black with blue-green/yellow in base ***L. duriusculum***
- Cap deep brown, chesnut, black-brown, growing in mixed broad-leaved trees in wet areas, squamules rough, blackish, flesh pink then violaceous-black . . . ***L. fuscoalbum***

Key 9 CHLMQ

1. Cap drab, hazel, dark brown, rather soft-fleshed when mature (a finger pressed against the cap easily leaves an indentation), flesh unchanging to very pale buff when exposed ***L. scabrum***
- Cap pale buff, fawn to clear brown, with age becoming flushed with olive-green especially at margin, stipe flushed olive above, occasionally bluish at base, flesh with obvious olive flush at apex or cortex ***L. holopus***

Key 10 CHLNQ

1. Cap deep brown, blackish-brown, chestnut, rather greasy, flesh turning strongly red in cap and upper stem, stipe with black, almost sub-reticulate squamules over lower half ***L. scabrum* (pink-staining form = *L. roseofractum*)**
- Cap brown, ochre-brown, often rather granular and patchy with paler streaks from centre, flesh only very weakly and slowly reddish-buff, stipe squamules black-brown, fine ***L. scabrum***

Key 11 CHLNR

1. Cap pale tan, strongly cracking, flesh strongly pink-red, pileipellis with short, cylindric, disarticulating cells, under birch, ***L. variicolor?* form?**
- Cap tan, fawn, not cracking, flesh only weakly pinkish, pileipellis with elongate cells mixed with short, very broad cylindrocysts ***L. scabrum***

Notes — species accepted by me are in bold

• *L. aerugineum* = *L. holopus*

***L. allostipitatum* H.C. den Bakker & Noordel.** (= *L. aurantiacum* of most authors)

Although widely known as *L. aurantiacum* the original colour plate and description of that species shows a different taxon entirely (see discussion under *L. aurantiacum* below). To avoid confusion Bakker and Noordeloos decided it was better to re-describethis species under a new name. It is easily recognised by its completely white stipe ornamentation that only slightly darken with age, its bright orange cap colours and its association with *Populus* spp. (See photo on back page.)

***L. atrostipitatum* A.H. Sm., Thiers & Watling**

Collections matching this species quite well were made under Birch in Epping Forest many years ago. New collections to confirm its status here would be welcome. The beautiful pale apricot-peach, often broadly adpressed scaly cap with intensely black squamulose stem are very distinctive. Bakker &

Noordeloos however consider it likely that the species is conspecific with *L. versipelle*. However, knowing how often North American collections of *Leccinum* are misnamed, particularly in this section, I think it likely that they may not have had genuine material to work on; as they say, fresh collections are required. For the moment I prefer to keep this as a good species. The pictures reproduced in some European literature (e.g. Dermek, 1984) look distinctly unconvincing and certainly deserve synonymy with *L. versipelle*.

***L. aurantiacum* (Bull.) Gray (= *L. quercinum* of most authors, = *L. salicola*)**

Found under oak, aspen, lime and even beech or willow, this is best recognised by its deep fox-red to bright red-brown cap and stem scales with distinct flush of red-brown from inception. Widely known as *L. quercinum* a study of the original colour plate and description by Bulliard of *L. aurantiacum* (as pointed out by Bakker *et al.*) clearly shows that Bulliard was referring to the species with dark reddish stem scales i.e. *L. quercinum*, not the species with white, hardly discolouring stem scales which has become known as *L. aurantiacum* by modern authors. Since *L. aurantiacum* as a name predates *L. quercinum*, the name change is therefore unfortunate but inevitable. The white-stemmed species known formerly as *L. aurantiacum* has been renamed by Bakker & Noordeloos as *L. albobistipitatum*. (see photo on back page)

- *L. avellaneum* (J. Blum) Bon = *L. scabrum*
- *L. brunneogriseolum* = *L. cyaneobasileucum*
- *L. carpini* = *L. pseudoscabrum*
- *L. cerinum* Korhonen = *L. versipelle*

***L. crocipodium* (Letell.) Watling**

Found under oaks, this beautiful species with its bright yellow cap and stem rapidly cracks and discolours to almost black with age. The blackening flesh is also distinctive. A form with bright orange pores (*nigrescens* var *luteoporus* J. Blum) has been found in Epping Forest and needs to be re-collected to ascertain its true status. Photo on back page.

***L. cyaneobasileucum* Lannoy & Estadès (= *L. brunneogriseolum*)**

In the south of England at least, this is one of our commonest taxa and is usually easily recognisable by its uniformly brown, dry, felty cap, pale grey, woolly stipe, usually with bluish stains in the base and pale pinkish flesh. This has undoubtedly formed the principal component of *L. scabrum* in the past. The species can however be entirely white also! It grows under birch. Unfortunately the white form, although rather rare, was described by Lannoy & Estadès as *L. cyaneobasileucum* before the more familiar grey-stemmed species *L. brunneogriseolum*. Since they have been demonstrated by Bakker and Noordeloos to be identical, the earlier name takes precedence.

***L. duriusculum* (Schulzer) Singer**

A large, robust species with brown cap, greyish stem squamules and flesh turning slate-grey to violaceous, often with blue-green in the stipe base. Found under poplars, this seems to be a very localised species, at least in southern England, but often occurs in large numbers when it does appear.

***L. fuscoalbum* (Sowerby) Lannoy & Estadès**

This record is based, in part, on a collection made by me in Epping Forest, which agrees well with the original description. The dark cap colours and flesh staining pink then violet-grey are distinctive. A new collection has recently been made close to Birmingham, under mixed poplar and oak. Bakker and Noordeloos equate this with *L. duriusculum* but until fresh material is collected and genetically sampled I prefer to keep it separate.

***L. holopus* (Rostk.) Watling**

This appears to be a much more variable species than previously realised and records need to be treated with caution. The typical form with white cap discolouring pale olive-grey, long, narrow cap hyphae and habitat in *Sphagnum* swamps (particularly common in the north) is easily recognised, the darker buff to biscuit-coloured or greenish forms (= *L. nucatum*, *L. olivaceosum*, *L. aerugineum*) sometimes growing in drier habitats need more careful examination to establish their identity.

***L. melaneum* (Smotl.) Pilát & Dermek**

This problematic taxon does seem to be different from *L. scabrum* according to the molecular data even though it hardly differs macroscopically except in colour. The best field character seems to be the very dark cap combined with greyish-black stipital surface underneath the black stipe squamules. It is probably genuinely uncommon in the UK but certainly confused also. Bakker and Noordeloos point out that the name may never have been validly published.

- *L. molle* - a dubious species with poorly preserved type material, could be any one of several species when old and greenish.
- *L. murinaceum* - considered a nomen dubium by Bakker & Noordeloos since the type is in poor condition and the description could refer to *L. melaneum*.
- *L. nigellum* Redeuilh = *L. duriusculum*
- *L. nucatum* = *L. holopus*
- *L. olivaceosum* - probably identical with *L. holopus*.
- *L. oxydabile* (Singer) Singer - I agree with Bakker & Noordeloos that this name is so confused, and has had so many different interpretations - even by its author (!) - that it would be better dropped as a nomen confusum. It equates perhaps to *L. cyaneobasilicum*, while Lannoy & Estadès associate it with *L. variicolor*. Reported under birch.
- *L. palustre* Korhonen = *L. schistophilum*

***L. pseudoscabrum* (= *L. carpini*)**

Found under hornbeam and hazel, this is a very easily recognised species; the brown, glabrous, but often cracked and 'lumpy' cerebriform cap, combined with flesh staining violet-black are very distinctive. It is one of the earliest of boletes to appear in summer.

- *L. percandidum* (f. Blum) Lannoy & Estadès = *L. versipelle*

***L. piceinum* Pilát & Dermek**

One of a group of very similar species including *L. vulpinum*, *L. aurantiacum* etc each with different tree hosts, this species occurs under spruce. It is distinguished also by its deep reddish-brown, dull brown cap pigments and very dark black-brown stipe squamules. I am unaware of any British records but it is to be expected here.

- *L. populinum* Korhonen = *L. aurantiacum*
- *L. pulchrum* Lannoy & Estadès - British records probably refer to forms of *L. scabrum*.
- *L. quercinum* Pilát ex Pilát - see discussion under *L. aurantiacum*
- *L. rigidipes* P.D. Orton = *L. scabrum*
- *L. roseofractum* Watling = *L. scabrum*
- *L. roseotinctum* Watling = *L. aurantiacum*

***L. rotundifoliae* (Singer) A.H. Sm., Thiers & Watling**

Although not yet recorded in Britain, this subalpine to alpine species might be expected to occur in Scotland or the outer Isles so is included for completeness. Its small stature, pale colours and deeply cracking cap are characteristic, as is its occurrence under dwarf birch, *Betula nana*. Bessette *et al.* (2000) describe and illustrate a good macrochemical test for this species: the flesh turns instantly deep blue with FeSO₄.

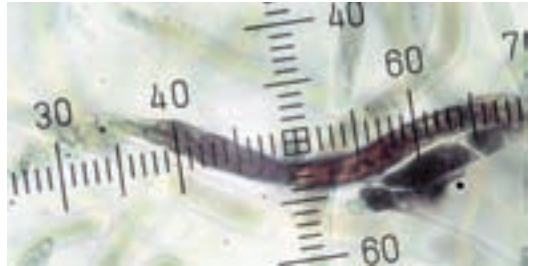
• *L. salicola* Watling = *L. aurantiacum*

***L. scabrum* (Bull) Gray (= *L. roseofractum*, *L. rigidipes*, *L. avellaneum*, *L. subcinnamomeum*)**

Although this is the species most commonly mentioned in books, it is frequently misidentified. Other species such as *L. cyaneobasileucum*, *L. schistophilum*, *L. melaneum* and *L. variicolor* must all be considered when trying to name collections. It is perhaps best distinguished by the usually coarse dark squamules on the lower stipe against pale background tissue, never having bluish discolourations in the flesh, very large, usually clavate caulocystidia as well as by the long, flexuose hyphae of the pileipellis. Flesh colour is now known to vary from unchanging to distinctly pinkish-red (forms formerly referred to as *L. roseofractum*, *L. rigidipes* etc).

***L. schistophilum* (= *L. palustre*)**

Described by Bon, this is another species confused with *L. holopus* or even *L. variicolor* because it sometimes grows in the same habitat - *Sphagnum* swamps - but is readily distinguished by its darker, grey-brown to brown cap, grey-brown squamules and flesh turning very pale reddish with bright blue spots in the base. The pileipellis has thick clusters of slender, heavily encrusted dark brown hyphae. Now known to occur in Britain but distribution is uncertain although it is quite common in parts of Scotland. It seems to prefer sandy or alkaline soils and is usually in wetter habitats than *L. scabrum*.



Cap cuticle of *L. schistophilum* showing the scattered dark brown encrusted hyphae typical for the species. Photograph © G. Kibby.

• *L. subcinnamomeum* Pilát & Dermek = *L. scabrum*

• *L. umbrinoides* (J. Blum) Lannoy & Estates uncertain but probably a mixture of species when they go old and olive-green, best considered a dubious species.

***L. variicolor* Watling**

This can be the most striking and beautiful species with its dark mouse-grey to sepia or blackish cap, frequently mottled and streaked with almost white areas. The stem has dark squamules and often has vividly blue-green stains over the lower half. The flesh rapidly turns a vivid pinkish-red in the cap and upper stem while becoming blue-green in the lower stem over a longer period. The cap cuticle is distinctive with numerous, short, broad, easily disarticulating cells (cylindrocysts). Forms with uniformly dark or pale caps can occur.

***L. versipelle* (Fr.) Snell (= *L. cerinum*, = *L. callitrichum*, = *L. percardidum*, = *L. roseotinctum*)**

A characteristic species of our birch woods and one of the largest *Leccinum* species commonly found. The bright orange-yellow (dull, tawny-yellow in the var. *flavescens*) are distinctive, combined with blackish stem squamules. The whitish species *L. percardidum* and *L. roseotinctum* are considered by Bakker

and Noordeloos to be synonyms as is also the recently described orange-capped *L. cerinum* of Korhonen. *L. callitrichum* is a more ochre-brown colour form with prominent felty cap scales.

***L. vulpinum* Watling**

A characteristic member of the Caledonian Forest in Scotland, this species is found under Scots pine. It does not seem to have spread as yet to pine plantations further south but may well occur and should be looked out for in suitable habitats. The cap and stem are deep fox-red (even between the squamules of the stem).

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Leccinum schistophilum growing in *Sphagnum*, it shows its typically greyish-brown cap and stem, with hints of blue green at the base. Microscopica examination is need to be absolutely certain of ones determinations.