KEYS TO NAUCORIA IN BRITAIN

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The keys presented here aim to consolidate the rather scattered information currently in print on *Naucoria* in Britain. The impetus to produce them was a valuable recent revision of *Alnicola*/*Naucoria* nomenclature by Pierre-Arthur Moreau (2005) which appeared too late for the 2005 *Checklist of the British and Irish Basidiomycota* (CBIB). It is a preliminary to an intended taxonomic revision promised soon. Moreau reported on numerous type studies, including several little-known species described from Britain by Reid or Orton. While he has clarified several issues, it is clear there is still much to be learnt. Two poorly known British species here retained in *Naucoria* and one listed as a *Hebeloma* all seem to need new homes, possibly in new genera. Nothing new is proposed here and no personal expertise is claimed in naming *Naucoria* collections.

Naucoria versus *Alnicola*

The Friesian concept of *Naucoria* (as a tribe within *Agaricus*) was fairly vague, based only on macroscopic characters. The seven names Fries grouped here and the many assigned here since, now belong in a wide assortment of modern genera. The 'correct' meaning of *Naucoria* depends on which of Fries's original names is chosen as the type of *Naucoria* and on what he meant by that name.

I follow here the British tradition (followed also by Moser and in Nordic Macromycetes) that the type species is *Agaricus eschariodes* Fr. and that the current interpretation of this name can be maintained. But there is a strong case (argued notably by Singer 1986) that nobody has a clue what Fries originally meant by this name (it could well have been a *Tubaria*), and thus both it and the generic name *Naucoria* are *nomina dubia*. If so, one should use *Alnicola* Kühner instead and possibly the name *A. melinoides* for our *N. escharioides*. Moreau adopts *Alnicola* while admitting that the decision is 'somewhat arbitrary' and taken partly in the interests of (French) continuity. The Dictionary of the Fungi 9th Edition stays with *Naucoria*, citing Reid (1984) as its authority for so doing, as does Ludwig (2001).

Some previous treatments

1. Orton (1960), in the Notes constituting Part III of the 1960 Check List, gave the first modern account of the genus (broadly conceived to include what are now *Simocybe* and *Phaeogalera*) with a key and descriptions of nine new species, three of which have been later reduced to synonymy but the other six survive (one now in *Simocybe*, one in *Galerina* and the other four in *Naucoria*).
2. Pegler & Young (1975) studied the spores of all the species recognised by Orton, separated out those belonging in other genera, and gave a key to the 15 species they retained in *Naucoria*.
3. Reid (1984) revised all the *Naucoria* material at Kew, described three new species and provided keys.
4. Orton (1984), virtually simultaneously with Reid and with no mutual consultation, revised his treatment of much of Section Submelinoides, in which he described four new species.
5. Bon (1992) gave extensive keys to *Alnicola* and related genera.
6. Marriott (1992) gave keys to *Naucoria* on damp ground, with descriptions and notes, especially on spore length. He included a translation of parts of Bon's keys.

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7. Ludwig (2001) describes and illustrates 17 species, including most of those keyed here, with much further supporting detail about each of them.

Notes on the keys that follow

• Species in [ ] or mentioned only in notes are unknown in Britain.

• Illustration references are to the following standard works: BK5 = Breitenbach & Kränzlin: *Fungi of Switzerland* Vol.5; Bon = *Mushrooms & Toadstools* 1987; C = Cetto: *I funghi dal vero*; CD = Courtecuisse & Duhem: *Mushrooms and Toadstools of Britain and Europe*; L = Lange: *Flora Agaricina Danica*; Lud = Ludwig: *Pilzkompendium* Part 1; MJ = Moser & Jülich: *Farbatlas*; RP = Roger Phillips: *Mushrooms* (1st Edn.).

• Warning: Many *Naucoria* species are very variable, both in macroscopic appearance (wet and dry, young and old) and in microscopic features (eg. a wide range of spore sizes and cystidia shapes). This may be related to the fluctuating humidity of their typical habitats. Identifications should be based on broad agreement in all aspects rather than precise matches of one or two key characters only.

Two Sections recognised

There are no pleurocystidia but the cheilocystidia, correlated with cap cuticle structure, have been widely used to divide *Naucoria* into two sections:

• Cheilocystidia with acute apex, often basally swollen with a narrow projecting beak (lageniform, urticoid); cap cuticle a cutis; clamps present in all species.
Section Naucoria Key I

• Cheilocystidia with obtuse apex, cylindrical to clavate or capitate; cap cuticle various: either cellular or heterocellular (i.e. with a few fine horizontal hyphae overlaying an otherwise cellular cuticle) or largely filamentous; clamps present or absent.
Section Submelinoides Key II

Key I - Section Naucoria

1 Cap fairly pale yellow-brown, even when fresh and moist; with *Alnus* **2**

1* Cap ± red-brown, at least when moist; various hosts (inc. *Alnus*) **4**

2 Moist cap strongly striate with darker disc .....See 8 below *N.striatula*

2* Cap not or scarcely striate, uniformly pale.....**3**

3 Veil fugacious; cap smooth, matt, ± atomate under lens, often cracked; stipe darkening from base with age.
Spores 8-12 x 4-5.5 µm, distinctly ornamented. The commonest *Naucoria* in Europe *fide* Ludwig.
N. escharioides (Fr.) P.Kumm. Bon231, Lud 53.8, RP157
Syn. *N.melinoides s.auct.* (a *nom.dub.* for Moreau) BK5/132, CD982
• The above spelling used by Fries is now considered correct; his own later 'correction' to 'escharoides' is deemed inadmissible.
• *N. suavis* Bres. (BK5/137, Lud 53.16), with a faint smell similar to *Inocybe fraudans* (*I. pyriodora*), has slightly smaller and smoother spores. Rare and possibly confined to *Alnus incana fide* Moreau.

3* Copious yellowish veil when young, appendiculate at first, leaving scattered patches on stipe and/or a weak ring zone; cap very pale, scurfy/fibrillose esp. at margin; stipe remaining fairly pale.

Spores 9-12 x 5-6 µm; taste bitter. Uncommon or overlooked, certainly much less common than the last. Collections at K from eg Wilts, Sussex, Angus, Dublin (the Sussex one partly 2-spored).

N. luteolofibrillosa (Kühner) Kühner & Romagn. BK5/131?, C2237, Lud 53.9, MJ3 (but the BK5 illustration looks different from the others)

• *N. cedriolens* (type missing) may be only a form; it smells of cedar wood and occurs in the Alps with *Alnus viridis*.

4 Spores rather large 9-13 x 5-7 µm and nearly smooth; veil absent **5**

4* Spores rarely over 5.5 µm wide, more distinctly ornamented; veil ± present though usually fugacious 7

5 With dwarf *Salix* spp.; cap small, 1-1.5(-2)cm

Calcicole. A widespread arctic/alpine species with *S. herbacea* but British records assigned here have been in dunes with *S. repens*, growing in small tufts in damp sand. Braunton Burrows, Devon 6.6.53 and again 9.11.69 (described in Orton 1984); Orkney with *Cladonia rangiferina* (Watling).

N. tantilla Favre BK5/140, Lud 53.11, MJ4

5* With *Alnus*; cap larger, 1-3cm, strongly hygrophanous, dark red-brown, striate when moist **6**

6 With *A. glutinosa* (and *A. incana*?)

A widely used name still not well clarified. Once thought common in Britain but Reid (1984) considered most collections at Kew so named were either *N. subconspersa* (RP157 is this) or *N. striatula*. He assigned only one collection here (from Radnor 5.11.69). However, Ludwig considers Reid's concept of *N. striatula* also belongs here.

N. scolecina (Fr.) Quél. Lud 53.13, L125F (*forma gracillima*), L125H

Possibly also BK5/135 (with *A. incana*), C1329, CD983, MJ5, but in all these *A. badia* is considered a synonym (see next).

6* With *A. viridis* (exclusively?), largely subalpine

Synonymised with last by most authors including CBIB, but distinct for Moreau (2005) who does not discuss the differences, but cites two BK5 plates.

[***Alnicola badia*** Kühner] BK5/136 (misdet. as *A. sphagneti*) BK5/138 (misdet. as *A. subconspersa*)

Syn. *N. phaea* Maire & Kühner (a necessary name change in *Naucoria*, where there is already an American *N. badia* Murrill).

7 With *Alnus* **8**

7* Seemingly with other associates **9**

8 Spores narrowly amygdaliform/fusoid 8-12 x 4-5.5(-6) µm; cap very striate when moist, dark date-brown at centre, paler at margin, hygrophanous, drying pale throughout; veil very fugacious, at margin only.

Widespread and quite common (in the New Forest the commonest after *N. escharioides*)

N. striatula P.D.Orton 1960 BK5/133 (as *A. paludosa*), C1772, Lud 53.10, MJ2

• Moreau considers this probably only a pale form of *Alnicola umbrina* (Maire) Kühner, but this epithet is unavailable in *Naucoria*, due to an earlier *N. umbrina* Bres.

- *Alnicola paludosa* (Peck) Singer is possibly an even earlier American name (adopted in BK5 but not yet assessed by Moreau). But this also is unavailable in *Naucoria*, due to *N. paludosa* Velen.
- *N. pseudoscolecina* Reid 1984, described as a *nom.nov*. for *N. scolecina f.gracillima* J.E.Lange (nom.nud.), is for Moreau doubtfully distinct, but for Reid close to *A. fellea* (Lud 53.12, not British). The only British material is the type (Surrey, Oct.1952 - host *Alnus* sp. *fide* Moreau but unstated by Reid in print or on the type packet).

8* Spores 'more squat' (Reid), 7-10(-13) x 4.5-5.5(-6) µm (but Marriott (1992) in extensive measurements found them no shorter; he didn't measure widths); cap weakly striate, more red-brown; entire cap usually scurfy-fibrillose from veil remains. "By far the most common and widespread of the red-brown species" (Reid, 1984).
NB. Some cheilocystidia can be subcapitate, up to 5(-6) µm wide. Includes most of *N. scolecina* sensu Orton 1960 key.
N. subconspersa P.D.Orton 1960 C1330, Lud 53.15
(but not BK5/138 which is misdet. *A. badia fide* Moreau)
Syn. *N. scolecina* sensu most older British records, inc. RP157
Syn. *N. silvaenovae* D.A.Reid 1984 *fide* Moreau 2005, who found no difference apart from being predominantly 2-spored (spp. 12-16 x 6-8 µm), a not uncommon phenomenon in 4-spored *Naucoria* species. But Reid thought his species (accepted in CBIB) probably closest to *N. luteolofibrillosa*. Described from a single collection from Denny Wood, New Forest.

9 Described as growing in *Sphagnum*; spores small and nearly smooth (finely punctate under oil), 7-9(-10) x 4.5-5(-6) µm.
Type from Rothiemurchus, one other collection at Kew from Kintyre.
A puzzle as *Naucoria* is mycorrhizal but the type description mentions no woody host and stresses the atypical habitat. Reported from eg. Germany, Switzerland, Italy, but the Cetto/Ludwig concept (with *Alnus*) may only be *N. subconspersa*, while BK5/136 (with *A. viridis*) is *Alnicola badia* (see 6 above). "Requires a complete revision" (Moreau).
N. sphagneti P.D.Orton 1960 BK5/136?, C2238?, Lud 53.7?, MJ4?

9* In other habitats, spores slightly larger.....**10**

10 On burnt soil, usually in dry, exposed sites, with no evidence of limitation to any particular tree host; taste very bitter.
Spores 8-10 x 4-5 µm (Reid) but rather larger for B&K5, NM2. Collections at K cited by Reid from Windsor, Wilts, Essex, Kent. Also eg. Orkney (Watling). The British concept (Orton 1960, Reid 1984) may be different from most European interpretations.
N. amarescens Quél. BK5/128? (might = BK5/130 *A. fellea fide* Moreau), Lud 53.17
- See also *Hebeloma pseudoamarescens*, similar but with cylindric/ clavate cystidia at Key II couplet 10. Both are often vernal.

10* In damp places, strictly with *Salix*?; smell of *Pelargonium*; taste mild.
Except in these key characters v.similar to last and reduced to a variety by Ludwig, Pilzcompendium 1:421 (2001), who considers it rare.
[***A. geraniolens*** Courtec.] CD981

Key II - Section Submelinoides

Recently found to consist mainly of species only distantly related to *Naucoria*. Some have thus been combined in *Hebeloma* or in *Galerina s.l.*, thereby making *Naucoria* more homogeneous but these other genera less so. In 1984 seven new British species were described in this section, three by Reid and four by Orton. Moreau (2005) reports on type studies of most of these; few seem likely to escape synonymy.

1 Clamps absent; predominantly 2-spored except in *N. spadicea* **2**
1* Clamps present; most species 4-spored; all little recorded **4**

[2) The *N. bohemica* complex, still poorly understood. In damp sites, usually with *Salix* or *Alnus*. Cap dark red-brown; stipe when young with silvery white fibrillose coating throughout. Collections vary widely in spore size and shape, in 2- or 4-spored basidia, in cylindric or clavate cheilocystidia and in cap cuticle structure (strictly cellular or with a thin overlay of hyphal elements - 'heterocellular'). These features appear poorly correlated, making species delimitation difficult.

2 Basidia all or mostly 4-spored.
Spores 10.5-15 x 6.5-9 µm often ± papillate, rough. Cap cuticle cellular with scattered dermatocystidia. British records from Hunts (habitat unrecorded) det.Reid plus e.g. several from the New Forest under *Alnus* det. Orton and others.
N. spadicea D.A.Reid 1984
Syn. *N. salicis* var. *spadicea* (D.A. Reid) E. Ludwig
Syn. *N. macrospora f.tetraspora* J.E.Lange (*nom.inval.*) L125D
- Described by Reid as a *nom.nov*. legitimising and upgrading Lange's taxon. Moreau leaves open the question whether *N. spadicea* is a species or a variety or no more than a 4-spored form, as Lange had it, of the species here listed below as *N. salicis*.
- ? Syn. *N. saliceti* P.D.Orton 1984. "Could perhaps be regarded as a 4-spored *N. salicis*" (Orton); described from *Salix*. Moreau reports that Horak found some predominantly 2-spored specimens within Orton's holotype, leaving the case for specific distinction from *N. salicis* even weaker than in *N. spadicea*.

2* Basidia all or mostly 2-spored.....**3**

3 Spores 11-15 x 6.5-8 µm; cystidia mostly ± cylindric, heads 5-8 µm wide.
Under damp *Salix*, *Alnus* and *Betula*. A well-known species, widespread and fairly common in S.England and Wales, also eg. Orkney.
N. bohemica Velen. BK5/129, Bon231, CD980, L125A, Lud 53.5, MJ1, RP157
- Reid (1984) also refers here a collection that was equally 2 and 4-spored with occasional clamps.

3* Spores 12-19 x 6.5-9 µm, very variable even in a single fr.body, sometimes with a few monstrous spores up to 25µm (presumably from 1-spored basidia); cystidia mostly swollen, heads 8-20 µm wide.
Cap often smaller and more striate than last. Mainly with *Salix* in very damp sites. Scattered English records.
N. salicis P.D.Orton 1960 BK5/134 (as *Alnicola salicis*), Lud 53.4
Syn. *Alnicola macrospora* J.E.Lange ex Favre 1948 MJ2
Possibly the correct name in *Alnicola*, but illegitimate when first described by Lange in *Naucoria* (L125B), as there was already an earlier *N. macrospora*.

Syn. *N. langei* Kühner, introduced to correct Lange's oversight, but itself invalid.
?Syn. *Alnicola mirabilis* (G.F.Atk. 1918) Singer, a still earlier American name, also blocked in *Naucoria* by *N. mirabilis* Velen. 1921.

Two further taxa in the *N. bohemica* complex:
Orton (1960) considered his *N. salicis* to have a strictly cellular cuticle in contrast to the heterocellular cuticle in *N. bohemica*. But Reid (1984) found them 'exactly similar' in this respect. Orton's reliance on this character must have influenced his 1984 decision to recognise two further 2-spored species in this complex (though with no discussion of clamps). The types of both are now known to lack clamps. They both appear weakly distinguished within the *N. bohemica* complex but are both accepted by Ludwig:
• ***N. badiolateritia*** Lud 53.6 (cuticle heterocellular) from Norfolk, Dorset and the New Forest, was described from drying out seasonally flooded *Salix* swamps, where it grew with the 4-spored *N. saliceti* (see above under *N. spadicea*). Probably only a rather small-spored *N. salicis* and treated as a synonym in CBIB.
• ***N. rubriceps*** Lud 53.3 from one Norfolk and one Suffolk collection in drier areas with unspecified hardwoods. Possibly only a rather pale, rather large-spored *N. bohemica,* with which it is synonymised in CBIB.

4 Cap cuticle ± cellular; 2- or 4-spored **5**
4* Cap cuticle largely of horizontal hyphae (species remote from *Naucoria s.s.*, now moved to *Galerina* - or in one case to *Hebeloma*) **7**

5 Cap cuticle cellular with a few thin horizontal hyphae above and some clavate dermatocystidia; 4-spored.
Spores 11-16 x 6-7(-8) µm, punctate-rough. Described from a seasonally flooded Norfolk site with *Corylus*, *Salix* and *Alnus*. Since reported eg. from two New Forest sites and from Orkney. As yet unknown outside Britain? "Has an ambiguous systematic position" Moreau.
N. clavuligeroides P.D.Orton 1984
• Presence of clamps established by Horak from type collection; these provide the main distinction from the *N. bohemica* complex.
5* Cap cuticle strictly cellular; 2- or 4-spored; only with *Alnus* (species with DNA nearer *Hebeloma* than *Naucoria*, but needing their own new genus *fide* Moreau) **6**

6 Basidia all or mostly 2-spored; spores 12-17 x 6-8 µm, moderately ornamented.
Cap fairly pale leather brown; stipe cream above, red-brown below. Cystidia ± cylindric, heads typically 8-9 µm wide. Smell and taste normally ± mealy. Occasional 4-spored basidia (Reid). Widespread with *Alnus* (Scotland to Surrey) but not very common.
N. alnetorum (Maire) Kühner & Romagn. BK5/127, MJ3
Syn. *N. celluloderma* Orton 1960 *fide* Reid (1984) C1331
• The widely used epithet *alnetorum* was only ever published provisionally *fide* Moreau, who considers the correct name to be *Alnicola inculta* (Peck) Singer. But Peck's *Galera inculta* has never been combined in *Naucoria*. So the correct name in *Naucoria* may currently be *N. celluloderma* for which Moreau reports "no reliable differences so far".
• Wrongly keyed as lacking clamps in Bon (1992).

6* Basidia 4-spored; spores 8.5-11 x 4.5-6 µm, finely ornamented.
Cap 1-3cm, dark brown, striate to half way when moist, hygrophanous. Uncommon in Europe, reported from the 1983 Nordic Congress at Kindrogan and from Norfolk, but needing confirmation as British.
[***N. submelinoides*** (Kühner) Maire] BK5/139, C2239, Lud 53.1, MJ5

7 Cap very small (7-10 mm), rather pale; spores 10-14 x 6-7 µm species of drier woodlands (cap cuticle interspersed with short cylindric to clavate/capitate dermatocystidia resembling the cheilocystidia) **8**

7* Cap 10-20 mm, darker; spores at most 12 x 6 µm; species of damp places with *Salix* or of burnt sites or damp peat.....**9**
[If spores larger, thick-walled, in moss esp. *Sphagnum* in the North see *Phaeogalera stagnina* BK5/404]

8 Cap viscid when fresh, ochre rusty with paler margin, drying somewhat glazed; spores finely ornamented.
On peaty soil. Very rare *fide* Kühner & Romagnesi (1953). British only on the strength of the probable synonymy of *N. salicetorum* Reid. Orton (1984) withdrew his own earlier tentative identifications of *N. clavuligera*, including a Norfolk one discussed by Pegler & Young (1975) p.236.
Galerina clavuligera (Romagn.) P.-A. Moreau 2005
Syn. *Hebeloma clavuligerum* (Romagn.) P. Collin
Syn. (probably) *Naucoria salicetorum* D.A.Reid 1984 (*fide* Moreau)
If Moreau's synonymy is correct then Reid missed the dermatocystidia. His species was described from one Warwicks collection in muddy soil under *Salix*. Recorded since from eg. Wales, Orkney.

8* Cap non-viscid, drying white scurfy-tomentose; spores smooth (even under oil).
Described by Reid as "extremely similar to *N. clavuligera* in many respects", from collections on woodchips and on a stump in mixed deciduous woodland, in Bucks and Warwicks. Unknown elsewhere since?
G. albotomentosa (D.A.Reid) E.Horak & P.-A. Moreau 2005
• Listed in CBIB as *Naucoria albotomentosa* Reid 1984.

9 Spores smooth; esp. with *Salix*, also known from bare peat and burnt heathland.
Cap date-brown, margin brighter yellowish; cystidia mainly narrow 4-8 µm wide, but some strongly capitate. Taste mealy. Little known, no coloured illustrations seen. See description in *British Fungus Flora* Vol. 7 p.34.
G. permixta (P.D.Orton) Pegler & T.W.K. Young
Syn. *Naucoria permixta* P.D. Orton 1960
Syn. *Naucoria cephalescens* T.J.Wallace *in* Orton (1960) (*fide* Reid 1984)

9* Spores at least finely ornamented; confined to burnt sites?.....**10**

10 Cap date brown; spores strongly ornamented, with a plage, spore wall tending to loosen.
In troops in burnt damp acid heathland. At first thought to be a *Naucoria* until the spores were found to have a plage (normally taken to indicate a *Galerina*). Taste mealy. Known from eg. Surrey, Berks, Inverness (and recently reported from Poland).
G. phillipsii D.A. Reid RP157 (photograph from type site)

10* Cap orange-brown; spores very finely ornamented without a plage.

Macroscopically very similar to *N. amarescens* (Key I couplet 10) same fire site habitat, and first described in *Alnicola*. Both are often vernal. Both taste bitter. British records only from Braemar 1961 and Surrey 1956 and 1985.

Hebeloma pseudoamarescens (Kühner & Romagn.) P. Collin BK5/116
C2668 (as *Naucoria* p.)

?Syn. *H. funariophyllum* Moser 1970 (a syn. for Romagnesi, Vesterholt, CBIB, but synonymy "not supported by type studies" Moreau)

- "A typical member of the genus *Hebeloma*" Moreau (2005).
  "Not a *Hebeloma*" Vesterholt (pers. comm.)
- The Surrey records are both by Orton from Juniper Hill, Mickleham; the first cited in Reid (1984) as *N. pseudoamarescens*, the second written up in Orton (1988) (with the earlier one forgotten?) as *H. funariophilum* new to Britain. So even if Moreau is right that the types are distinct, the evidence points to only one of these being so far known in Britain.

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