

Hygrophorus pacificus (new for Europe) and *H. hyacinthinus* (new for northern Europe) found in Kuusamo, northern Finland

Harri Harmaja

Botanical Museum, University of Helsinki, SF-00170 Helsinki, Finland

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The author has found the agarics *Hygrophorus pacificus* Smith & Hesler (one locality) and *H. hyacinthinus* Quél. (three localities) in Kuusamo, northern Finland. The former is new to Europe, the latter new to northern Europe. The characters of these species, especially those which separate them from their closest relatives, are presented and partly amended, and their habitat ecology and distribution are discussed. Both species are characterized especially through a strong fragrant odour. *H. hyacinthinus* occurs in forest on calcareous soil associated with *Picea* or *Abies* and possesses a boreal-montane distribution restricted to Europe. *H. pacificus* occurs in coniferous forest apparently always associated with *Picea* and has a boreal-montane distribution in North America with one locality in northern Europe.

Hygrophorus pacificus Smith & Hesler

In September 10th in 1970, when on a collecting trip in Kuusamo (northern Finland) in the company of Mr. and Mrs. Hans Haas from Stuttgart, Germany and Mr. Tauno Ulvinen from the University of Oulu, my attention was drawn to a solitary fruit body of some lamellate basidiomycete. When I picked up the fungus it was easy to recognize as a *Hygrophorus* s. str. It possessed a strong odour of oil of bitter almonds, being, however, certainly not *H. agathosmus* (Fr.) Fr. which to my knowledge should be the only European species of this genus with this kind of odour. None of us knew this peculiar fungus. After some search Mr. Ulvinen succeeded in finding another fruit body (which is now deposited in OULU while that collected by me is in H). Later a search in the literature and the study of the types of three North American *Hygrophori* yielded the result that the species concerned is *H. pacificus* Smith & Hesler (SMITH & HESLER 1939), which has not been recorded from Europe. Hitherto it was

only known from California, Idaho and Washington (U.S.A.) in northwestern North America and Nova Scotia (Canada) in the northeastern coast of that continent.

Some quite minor differences were observed between the type and the Finnish specimen: (1) the gills are strongly intervenose in the latter while they are not so in the type, (2) the gills are somewhat more distant in the latter, (3) the pileus surface is somewhat less viscid in the latter ("dry or somewhat viscid" according to my field notes) which can also be seen in anatomical sections of the pileus, (4) the hyphae of gill trama are at least in some places broader (and short-celled) in the latter, (5) the proportion of obovoid-lacrymoid spores is somewhat smaller in the latter, and (6) the spores of the Finnish specimen are possibly slightly narrower on the average. All these minor divergencies may quite simply result from non-genetic factors, e.g. the fact that the Finnish fruit bodies represent a more advanced stage than that from the type collec-

tion. Another explanation could be that these differences, or at least some of them, represent true genetic variation; the small amount of material and the character of these differences make it impossible to draw any taxonomic conclusions. Only future studies, which would include the whole North American material of *H. pacificus* and possible further European specimens, can decide whether the Finnish population falls within the continuous variation of *H. pacificus* or represents a taxon of its own.

H. pacificus can be recognized through the following characters (according to my observations on the Finnish specimen): *pileus* 3–8 cm broad, convex, pale rusty brownish or pale brownish buff with a somewhat darker disc when fresh, the colour becoming distinctly darker with drying being e.g. 12 E 7 (MAERZ & PAUL 1950), or cinnamon, for the most part when completely dry (the disc being even darker), surface slightly viscid in moist weather, polished and distinctly beset with dense concentric wrinkles when dry; *stipe* 4–7 x 0.8–1.5 cm, whitish, dry, at apex indistinctly mealy with very small granules concolorous with the surface; *lamellae* adnate or shortly decurrent by a tooth, yellowish to pale buff, darkening in drying, distant, very thick, intervenose in a striking manner; *odour* when fresh strongly of that of oil of bitter almonds, i.e., identical with that of *H. agathosmus*; *taste* mild; *spores* (in Melzer's unless otherwise stated) very large, ca. 10.0–18.0 x 5.3–8.0 μ m, very variable in size and shape, almost all of the detached ones single (i.e., not adhering to tetrads) in mounts of dried gills, great majority obtuse-based and oblong (a few being ellipsoid) the rest being acute-based and obovoid to lacrymoid, often with an abaxial depression, or constriction, wall slightly thickened, smooth, hyaline, inamyloid, cyanophobic, and carminophobic, hilar appendix very large measuring ca. 1.5–2.0 x 1.0–1.8 μ m, spore contents weakly cyanophilic, mostly \pm homogeneous but sometimes with oil drops, usually uninucleate (more rarely with two nuclei); *basidia* mostly 4-spored but some with two sterigmata; *epicutis* a narrow ixotrichodermium of narrow subparallel to somewhat interwoven and partly erect hyphae with amorphous gelatinous matter between them, subcutis/hypodermium not differentiated.

In Europe there now exist with certainty

two species of *Hygrophorus* with the characteristic fragrant odour, apparently resulting from the development of cyanic acid, HCN (or possibly benzoic aldehyde?) in the carpophores, *H. agathosmus* and *H. pacificus*. The latter differs distinctly in its colours and much larger spores. However, in North America there occur two species which are very closely related to *H. pacificus*: *H. monticola* Hesler & Smith and *H. vinicolor* Hesler & Smith, both described in HESLER & SMITH 1963. All three share the brownish colours which darken in drying (emphasized, as concerns *H. monticola*, by BIGELOW in BIGELOW & BARR 1966 and WELLS & KEMPTON 1968), the very thick distant lamellae, the penetrating odour of bitter almonds, the habitat in coniferous forest apparently always associated with *Picea*, and the boreal-montane distribution. *H. pacificus* can be distinguished from the others through its more rusty, or less vinaceous, colour of the pileus, which difference is according to my observations also distinct in dried basidiocarps, further in the densely wrinkled surface of its pileus when dry, the less decurrent lamellae, the distinctly gelatinized epicutis (it may be this structure of pileus cortex that accounts for the rather striking collapse of the cap surface in drying so as to cause it become densely wrinkled when dry), and the slightly larger often somewhat constricted spores with a smaller proportion of obovoid-lacrymoid ones; from *H. vinicolor* the species differs in addition by its totally mild taste and whitish (not pinkish) mealy apex of stipe.

The Finnish locality of *H. pacificus* is situated in the biological province of Kuusamo, in the commune of Kuusamo, Liikasenvaara village, in the southern slope of the hill Korvasvaara, lying ca. 280 m above the sea level. The vegetation of the site, a spruce-dominated mixed mesic heath forest, possesses characters of both the *Hylocomium-Myrtillus* forest site type (HMT) and the *Empetrum-Vaccinium* type (EVT), and comprises as main components *Picea abies*, *Populus tremula*, *Juniperus communis*, *Empetrum hermaphroditum*, *Vaccinium myrtillus*, *V. vitis-idaea*, and a thick moss carpet mainly composed of *Hylocomium splendens* and *Pleurozium schreberi*. The stipe of the fungus penetrated through this moss carpet as well as the humus layer and actually emerged from the surface of the mineral soil.

Hygrophorus hyacinthinus Quél.

This neglected rare species is very closely related to *H. agathosmus*, from which it is separated in the following features: (1) The stipe apex of *H. hyacinthinus* is almost glabrous, only bearing scanty mealy white covering with very small granules while the upper part of the stipe of *H. agathosmus* is beset with more distinct and larger whitish granules or flocks. (2) The fragrant odour of the former resembles much that of the blossom of the hyacinth (*Hyacinthus orientalis* L.), persisting in dried basidiocarps, while that of the latter fungus is clearly different being identical with the odour of oil of bitter almonds, essentially vanishing in drying. (3) The spores of *H. hyacinthinus* are broader on the average, measuring $7.5\text{--}12.0 \times 4.6\text{--}6.3$ (-7.2) μm while those of *H. agathosmus* are $7.5\text{--}11.0$ (-12.0) \times $4.2\text{--}5.5$ (-6.2) μm . (4) The spores of the former are also quite variable in shape a fairly good proportion of them being more or less fusiform and quite many obovoid to lacrymoid (e.g. distinctly oblong ones being few), while those of the latter are more uniform in shape the great majority being oblong (lacrymoid and especially fusiform ones being very scattered). (5) The former is apparently strictly calcicolous while the latter at most somewhat prefers calcareous soils. (6) *H. hyacinthinus* has a restricted boreal-montane distribution occurring, according to the present knowledge, only in Europe, where it has been collected in the Alps and neighbouring lower mountain ranges (such as Jura), the Carpathians, and now also in northern Fennoscandia, while *H. agathosmus* has a much wider area in Europe, also occurring in North America (HESLER & SMITH 1963) and eastern Asia (e.g. VASIL'JEVA 1973).

When I asked the Paris Herbarium (PC) for possible type material of *H. hyacinthinus* I was only sent one specimen, which, though originating from the classical grounds in the French Jura, was collected clearly posterior to the publication of the original description of the species and by a person other than Quélét. Anyway, this specimen (France, Jura, Arbois, Nov. 1903, leg. M. Hetier; PC) was very valuable for comparison: the Finnish specimens were found identical with it.

The pileus colour of the Finnish specimens of *H. hyacinthinus* varies slightly: it may be distinctly grey or pale greyish with a brownish

tinge. White fibrillose veil was observed to connect the cap margin and stipe apex in very young fruit bodies. The odour persists, at least for five years, in dried basidiocarps, and I have actually compared it with the odour of flowers of the hyacinth and can tell that the resemblance is in fact considerable. The odours of *Tricholoma caligatum* (Viv.) Ricken and *Inocybe godeyi* Gillet (and apparently certain other agarics such as *Hebeloma sacchariolens* Quél. and *Rhodophyllus icterinus* (Fr.) Quél.) are, according to personal experience, very similar. The chemical compound giving rise to this odour may be identical with or related to paradichlorobenzene. The basidia of *H. hyacinthinus* were observed to be mostly four-spored, a few bearing only two sterigmata. The spores are uninucleate, their wall being cyanophobic and carminophobic.

The Finnish sites of *H. hyacinthinus* are situated on pronouncedly calcareous soils, in woods with more or less distinct character of grass-herb forest, the spruce (*Picea abies*) being present in all of them. MOSER (1967) and ENGEL & FRIEDERICHSEN (1970) also mention the species from spruce woods (subalpine forest in the Tatra and montane woods in Tirol, respectively), the latter also reporting bedrock of limestone in the locality. QUÉLÉT (1888) himself observed his species in mixed *Abies alba*-*Fagus sylvatica* forests especially on limestone mountains such as the Jura.

Specimens examined

Kuusamo: Kuusamo, Oulanka National Park, the ravine of the brook Tulilammenpuro, ca. 225 m above the sea, luxurious grass-herb mixed forest with calcareous soil, some basidiocarps in litter composed of leaves of *Picea abies* and *Betula alba* coll. mixed with scanty mull, accompanied by an unusually rich flora of different plant groups including many calcicolous and calciphilous species, both northern and southern ones, which for the most part are mentioned in the description of the associated species *Tarzetta pusilla* Harmaja (HARMAJA 1974); to the flora of the grass-herb forest of the ravine can further be added: *Salix caprea*, *Daphne mezereum*, *Filipendula ulmaria*, *Gymnocarpium dryopteris*, *Paris quadrifolia*, *Maianthemum bifolium*, *Roegneria canina*, *Rubus idaeus*, *Trientalis europaea*, *Trollius europaeus*, *Rhytidadelphus triquetrus*, *Clitocybe lohjaënsis*, *Gerronema albidum*, *Lactarius scrobiculatus*, *Mycena pterigena*, *Helvella costifera* (northern dark form; "*H. acetabulum* coll." in HARMAJA

1974), *H. lacunosa*, *H. pezizoides*, *Heyderia abietis* and *Otidea propinquata* (*O. indivisa*), 1970-08-26, H. Harmaja (H). — Kuusamo, Juuma, northeastern end of the gorge Jäkälävuoma near Harrisuvanto, very close to the famous path "Karhunkierros", ca. 185 m above the sea, luxurious somewhat moist grass-herb mixed forest with calcareous soil, several basidiocarps among abundant *Diplazium sibiricum* (*Athyrium crenatum*) in litter composed of leaves of *Picea abies* and *Betula alba* coll. mixed with scanty mull, accompanied also by *Mnium stellare*, *Clitocybe gibba*, *C. lohjaënsis*, *Humaria hemisphaerica*, *Otidea propinquata*, *O. sp.* and *Podostroma sp.*, 1970-08-27, H. Harmaja (H). — d:o, Juuma, near the eastern end of the gorge Hautaniitynvaoma, not far from Harrisuvanto, ca. 180 m above the sea, on calcareous ground in mesic heath forest with characters towards grass-herb forest, perhaps best considered as belonging to the *Geranium* site type (GT), a group of fruit bodies in litter composed of leaves of spruce and

birch mixed with scanty mull, accompanied by, besides the trees mentioned, e.g. *Equisetum scirpoides*, *Geranium sylvaticum* and *Lactarius lapponicus*, 1970-09-12, H. Harmaja (H). — d:o, Juuma, northeastern end of the gorge Jäkälävuoma, several basidiocarps in exactly the same spot as in Aug. 27 two years earlier, 1972-08-28, H. Harmaja (H).

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ADDENDUM

Three further specimens representing both species appeared too late to have been incorporated in the above contribution. However, they all represent later collections from exactly (or almost) the same Kuusamo sites from which the species are known already according to the above records. The translated and shortened label notes of these specimens run as follows:

H. pacificus — Kuusamo: Kuusamo, Liikasenvaara, Korvasvaara (close to the original site), autumn

1974, T. Ulvinen & R. Tuomikoski (H).

H. hyacinthinus — Kuusamo: Kuusamo, Juuma, (north)eastern end of the gorge Jäkälävuoma (exactly the same spot as from where the fungus was twice before collected by H. Harmaja), 1975-08-15, T. Ulvinen (OULU). — d:o, Juuma, western end of the gorge Hautaniitynvaoma, ca. 180 m above the sea (not far from the previously known site), 1975-09-20, O. Ulvinen & E. Ohenoja (OULU).