

# Notes on the genus *Aporpium* (Auriculariales, Basidiomycota), with a new species from temperate Europe

Otto Miettinen\*, Viacheslav Spirin & Tuomo Niemelä

Finnish Museum of Natural History, Botanical Museum, P.O. Box 7, FI-00014 University of Helsinki, Finland (\*corresponding author's e-mail: otto.miettinen@helsinki.fi)

Received 11 May 2012, final version received 31 May 2012, accepted 1 June 2012

Miettinen, O., Spirin, V. & Niemelä, T. 2012: Notes on the genus *Aporpium* (Auriculariales, Basidiomycota), with a new species from temperate Europe. — *Ann. Bot. Fennici* 49: 359–368.

A new polypore, *Aporpium macroporum* Niemelä, Spirin & Miettinen, is described on the basis of material from Finland, Poland (Białowieża National Park; type locality), European Russia, Belarus, Estonia, and Latvia. It grows primarily on fallen aspen trees and prefers old forests with abundant coarse woody debris. *Aporpium caryae* is an American taxon, and its European kin is *A. canescens*; *A. macroporum* differs from them in having wider pores, softer consistency, and paler colours. The spores of the new species are wider than in *A. canescens*, and longer than in *A. caryae*. The three species can be distinguished by their ribosomal DNA ITS sequences. We briefly discuss the heterobasidioid genera *Aporpium*, *Elmerina* and *Protomerulius*.

## Introduction

Only one poroid heterobasidioid fungus is commonly acknowledged to occur in Europe and North America. In recent manuals, it is known as *Protomerulius caryae* or *Aporpium caryae*. We have collected specimens that look basically similar and have septate basidia, but are larger-pored, softer, and have thicker spores. As this taxon seems not to have been validly named, we describe it here as a new species, *Aporpium macroporum*. The identity of *A. caryae* itself deserved a closer look, too.

## Material and methods

The type material of *Polyporus caryae* from

Philadelphia (PH) was studied. The type of *Poria pilatii* was studied from the Národní Muzeum herbarium in Prague (PRM). Collections of the Helsinki University herbarium (H) were studied, including specimens named as *Protomerulius/Aporpium caryae*, and the type of *Poria canescens*. Fresh-character descriptions are based on our collections from Finland, Poland and Russia. The densities of pores were counted at young margins of the basidiocarps, where they have not yet merged together, specimen turned so that sight axis aligns with the middle axis of the tubes, scale bar turned in the direction where the highest pore number is obtained.

The microscopic routine used in this study was discussed in detail by Miettinen *et al.* (2006). The basic mountant used was Cotton Blue (CB) made in lactic acid, but reactions

in Melzer's reagent (IKI) and 5% KOH were tested, too. Entry CB+ means cyanophily, CB(+) weak but well visible cyanophilous reaction, CB- acyanophily; IKI- means neither amyloid nor dextrinoid reaction; KOH- no swelling or other changes in that medium. The microscopic drawings were made from slides mounted in CB.

The DNA sequences were produced from herbarium samples and one culture (from Forest Products Laboratory, Madison, WI, USA; Table 1). A sequence of *A. macroporum* from Estonia will be published separately by Kadri Runnel (Tartu University), the author of that sequence. DNA was extracted with DNeasy plant mini kit (QIAGEN, Hilden, Germany) or E.Z.N.A. Forensic DNA (Omega Bio-Tek, Norcross, GA, USA). Nuclear ribosomal ITS region was amplified with the primer pairs ITS1F-ITS4, ITS1-ITS4 or ITS1-LR21 (<http://www.biology.duke.edu/fungi/mycolab/primers.htm>). The sequencing primers were the same except that LR21 was replaced by LR22. The sequencing was done in Macrogen (Korea) or using Applied Biosystems 3130 Genetic Analyzer and BigDye 3.1 terminator sequencing chemistry (Applied Biosystems, Foster City, CA, USA).

The sequences were aligned manually. The length of ITS (as defined by <http://www.yeast-genome.org>) varied between 511 and 515 bp. The phylogram was produced with the program MrBayes 3.1.2 (Ronquist & Huelsenbeck 2003) using eight chains and three runs in paral-

lel, temp = 0.1, and SYM+I substitution model as recommended by AIC of MrModeltest 2.3 (Nylander 2004). The analysis was run for 4 million generations, sampling every 2000 generations. The runs converged well (average SD of split frequencies constantly < 0.01). Burn-in was set to 500 trees.

## Results and discussion

### *Aporpium macroporum* Niemelä, Spirin & Miettinen, sp. nova (Figs. 1–3)

MB800542

*Sicut Aporpium caryae et A. canescens, sed pori majores, contextus mollior et sporae majores, 5.0–7.0 × 2.7–3.7 μm.*

HOLOTYPE: Poland. Podlesie Reg., Hajnówka Dist., Białowieża Nat. Park, north of Poprzeczny Tryb, between Mogiłki and Łagiery, *Populus tremula*, big fallen tree, 14 Oct. 2008 Tuomo Niemelä 8488, Juha Kinnunen & Dmitry Schigel (holotype H 7005697, isotype KRA).

ETYMOLOGY: *macroporum* (Greek, adj.), referring to pores which are larger than in the related species; an homage to Emma Petrovna Komarova who coined the epithet for this taxon.

Basidiocarp annual, resupinate, usually appearing as a single ellipsoid patch 3–5(–10) cm wide, up to 5 mm thick in the middle, firmly attached to substrate, slightly darkening and roll-

**Table 1.** Sequenced (ITS) specimens used in this study. Two-letter codes after species names denote country of origin (ISO 3166).

Species	Country of origin	Specimen	INSDC acc. no.
<i>Aporpium canescens</i> FI 1	Finland	Miettinen 7327.1 (H)	JX044141
<i>A. canescens</i> FI 2	Finland	Hottola 2502 (H)	JX044150
<i>A. canescens</i> FI 3	Finland	Niemelä 7875 (H)	JX044151
<i>A. canescens</i> NO	Norway	Miettinen 13352.2 (H)	JX044152
<i>A. canescens</i> PL	Poland	Niemelä 8449 (H)	JX044149
<i>A. caryae</i> US 1	USA, MD	strain HHB-1657-Sp/FPL	JX044144
<i>A. caryae</i> US 2	USA, MA	Miettinen 14774 (H)	JX044145
<i>A. caryae</i> US 3	USA, MA	Miettinen 14756.1 (H)	JX044147
<i>A. macroporum</i> EE	Estonia	Runnel 173 (TU)	—*
<i>A. macroporum</i> FI 1	Finland	Miettinen 1032 (H)	JX044142
<i>A. macroporum</i> FI 2	Finland	Niemelä 7933 (H)	JX044143
<i>A. macroporum</i> PL	Poland	Niemelä 8488 (H)	JX044148
<i>A. macroporum</i> RU	Russia, Leningr.	Spirin 3302 (H)	JX044146

\* Will be published separately by the collector, see Material and methods.

**Fig. 1.** Young basidiome of *Aporpium macroporum* on fallen aspen tree [photographed *in situ*]. Specimen Niemelä 7366 (H).



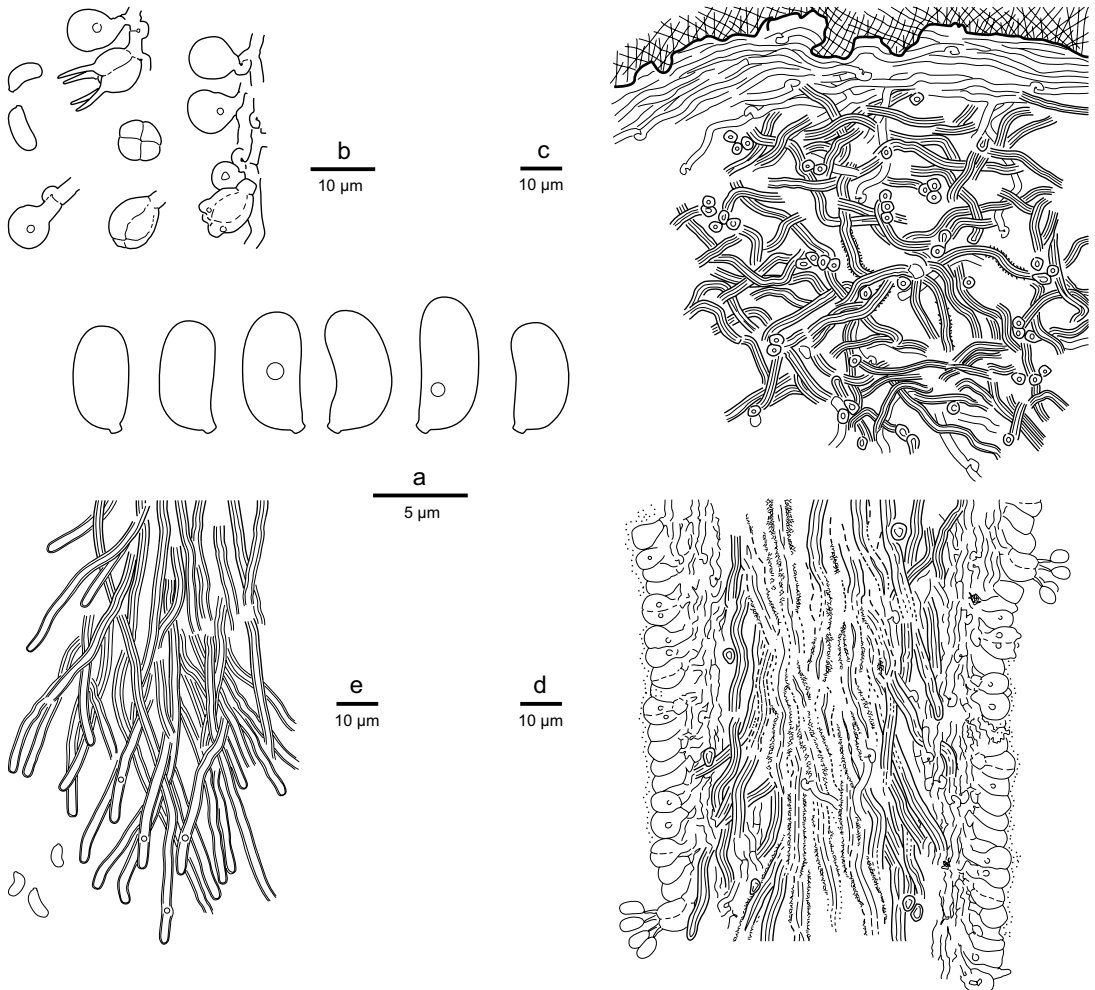
**Fig. 2.** Mature basidiome of *Aporpium macroporum* [photographed *in situ*]; characteristic colour change seen on a bruised patch of the pore surface. Specimen Niemelä 8684 (H).



ing inwards on drying. Sterile margin white, 1 mm wide, at first cottony and later fibrous, paler than pores. Pore surface even, or sloping step-wise in basidiomes growing on vertical surfaces, at first white with faint smoky grey hue and with resinous colour deep in tubes, changing into pale pinkish-brown when touched; old specimens greyish white with chocolate-brown tint in tube cavities; pores round, angular or even sinuous, (1–)2–3(–4) per mm, slightly shrinking on drying; tube orifices at first even, later dentate especially in oblique-grown areas. Section: subiculum white to pale brown, tight felty or corky, 0.2–0.5 mm thick, tubes mostly 3–4 mm

long, leathery when fresh, papery and soft brittle in herbarium specimens, greyish with tints of chocolate. Odour like in freshly peeled potato, taste mild or slightly acidic.

Hyphal structure dimitic, hyphae IKI–, KOH–, mostly CB(+) and hyaline, but yellowish and CB– in the subiculum/tube transition of old specimens and with a grey tint there (appearing as faintly amyloid); generative hyphae thin-walled, with clamps. Subiculum with interwoven mesh-like texture; skeletal hyphae (2.1–)2.7–4  $\mu\text{m}$  in diam., sometimes with thin sandy encrustation; generative hyphae 2.5–4.7  $\mu\text{m}$ , thickest ones seen at basal layer. Tube-trama hyphae tight



**Fig. 3.** Microscopy of *Aporpium macroporum*. — **a**: Spores. — **b**: Hymenial cells. — **c**: Subiculum. — **d**: Vertical section through tube, showing glued-together, encrusted skeletals in tramal core, and mucous layer on hymenium. — **e**: Hyphae at dissepiment edge. Specimens *Niemelä 8684* (**a**, **d**), *8488* (**b**, **e**) and *Penttilä 25* (**c**); all specimens in H.

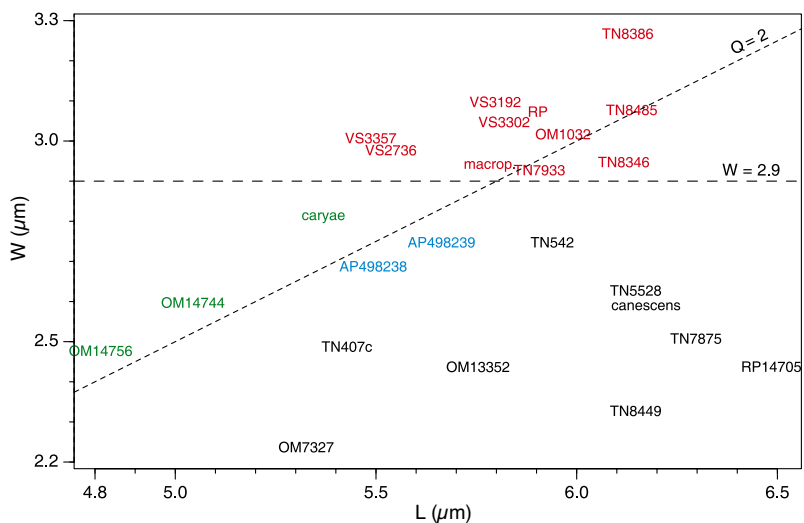
subparallel, skeletals (1.9–)2.5–4.7(–5.6)  $\mu\text{m}$ , old yellowish skeletals in inner parts subsolid and with a cover of sandy crystals; generative hyphae 1.6–2.8  $\mu\text{m}$ , often difficult to observe. Dissepiment edge composed of skeletals, which are rather thin-walled, stiff-looking, not encrusted. Subhymenium indistinct. Hymenium densely arranged, often with a mucous cover when old. Basidia (7.5–)9.3–11.5(–13)  $\times$  6.4–7.3(–8.2)  $\mu\text{m}$ , subglobose or thick pear-shaped, divided in four cells with membranous longitudinal septa; sterigmata thick, finger-like; basidioles subglobose or pyriform, 8–13  $\times$  5.4–6.6  $\mu\text{m}$ ; subulate cystidioles rare and inconspicuous.

Spores ellipsoid, phaseoliform or thick cylindrical and longer ones strongly curved, thin-walled, smooth, CB–, IKI–, (3.6–)5.0–7.0(–8.0)  $\times$  (2.4–)2.7–3.7(–4.0)  $\mu\text{m}$ ,  $L = 5.88 \mu\text{m}$ ,  $W = 3.03 \mu\text{m}$ ,  $Q' = (1.3–)1.7–2.2(–2.5)$ ,  $Q = 1.94$  ( $n = 330/11$ ), apiculus short but very thick.

### Notes on *Aporpium macroporum*

*Aporpium macroporum* differs from *A. canescens* (“European *A. caryae*”) in being softer, more large-pored, and in its deviating colour change: if fresh pore surface is bruised or

**Fig. 4.** Average spore sizes of the *Aporpium canescens* (black), *A. caryae* (green), *A. macroporum* (red), and *A. pilatii* (blue) specimens.  $L$  = average spore length,  $W$  = average spore width,  $Q = L/W$ . Based on their  $Q$  and  $W$ , the species can be divided into three groups. Collector abbreviations: AP = Pilát, OM = Miettinen, RP = Penttilä, TN = Niemelä, VS = Spirin; numbers = collection numbers; 'caryae', 'canescens', 'macrop.' denote type specimens.



scratched with a fingernail, the whitish colour changes into smoky pinkish brown, unlike the dark coffee-brown colour reaction in *A. canescens*. In the microscope a fairly loose structure, more pale-coloured skeletal and larger spores define the new species. Spore width in particular is characteristic, commonly 3 μm or more in the new species. Compare the brief description of *A. canescens* below.

In its habit and colours *Aporpium macroporum* reminds *Ceriporiopsis aneirina* and *C. pseudogilvescens* (see Kinnunen & Niemelä 2005), but differs in being dimitic throughout. Young *Antrodia mellita* is also fairly similar, albeit more yellow and with no encrustations on skeletal hyphae.

The main substrate of this species is *Populus tremula*, but there are occasional collections from other angiosperm hosts (*Betula*, *Salix*, *Tilia*). The species was collected mostly on very thick, fallen aspen trunks, mostly in nature reserves, and it seems to prefer old and rich near-virgin forests with abundant coarse woody debris, although a few collections derive from managed forests.

We have collected the species in Finland, Poland and northwestern and central parts of European Russia. Its first records may be those by Komarova (1959), who invalidly published the taxon as *Tyromyces resinascens* f. *macroporus*, and later (Komarova 1964) as *Aporpium caryae* f. *macropora*. No type was indicated and

so the description remained invalidly published. Komarova's material originates from the Belarusian part of the Białowieża (Belavezha) forest, not far from our Polish type locality. Bondartseva (1964) reported this form from the Leningrad Region, Russia, as well. A DNA sequence provided by Kadri Runnel from Tartu University shows that the species is present in Estonia. We have seen a collection (in H) from Latvia, and the description of *Protomerulius caryae* by Torkelsen (in Hansen & Knudsen 1997) fits better with our species than with *A. canescens* ("European *A. caryae*"), and so *A. macroporum* may also occur in Norway.

In order to find an earlier name for *A. macroporum*, the type of *Poria pilatii* was studied. It — as well as three other specimens collected by Pilát and likewise identified by Bourdot (1932) — represents a resupinate polypore with relatively small pores (4–6 per mm). The small pore size, hyphal structure and spore size (Fig. 4) match with *A. canescens* rather than *A. macroporum*.

#### ***Aporpium canescens* (P. Karst.) Bondartsev & Singer (Figs. 5 and 6)**

Mycologia 36: 67, 1944.

*Poria canescens* P. Karst., Rev. Mycol. 9: 10, 1887. — LECTOTYPE: Finland. Tammela, Särkjärvi, *Alnus*, 7 Nov. 1886. P. A. Karsten 1711 (selected by Teixeira & Rogers 1955, H 6006605, examined).





Fig. 5. *Aporpium canescens*. Specimen Niemelä 7875 (H).

Annual, resupinate, variably sized and often small but emerging in many adjacent areas, thin, leathery when fresh, hard when dry. Sterile margin thin and often inconspicuous. Pore surface even, at first greyish white or brownish and turning instantly coffee brown if scratched by a fingernail, finally and when dry dark brown all over but tube orifices sometimes with lighter pruina; pores 4–6 per mm. Specimens collected as mature and in perfect condition have a silky sheen on their pore surface. Section: subiculum tan coloured and thin, tubes 0.5–3 mm long, pale brown at orifices and coffee brown deeper in. Odour sharp pungent; taste mild, almost sweet.

Dimitic, hyphae IKI–, KOH–, mostly CB+ and hyaline, but brownish-yellow in inner structures and then CB–; generative hyphae with clamps. Subiculum tight interwoven, skeletal 2–3.8  $\mu\text{m}$ , usually encrusted; tube trama skeletal encrusted, (2.3–)2.9–4.5  $\mu\text{m}$ ; generative hyphae 2–3.7  $\mu\text{m}$ . Dissepiment edge composed of skeletal, which are sparsely encrusted in some specimens, smooth in others. Basidia 8.5–14  $\times$  6–9  $\mu\text{m}$ , subglobose, four-septate; cystidioles subulate, rare. Spores cylindrical and moderately curved, or short cylindrical and straight, or seldom ellipsoid, CB–, IKI–, (3.0–)5.1–6.9(–7.6)  $\times$  (2.0–)2.2–2.9(–3.2)  $\mu\text{m}$ ,  $L = 5.92 \mu\text{m}$ ,  $W = 2.52 \mu\text{m}$ ,  $Q' = (1.1–)2.0–2.8(–3.2)$ ,  $Q = 2.35$  ( $n = 320/11$ ), apiculus short but thick.

This species is smaller-pored and thinner-

spored than *A. macroporum*, and the overall colours are finally darker. Our observations indicate that pores of the American *A. caryae* are even smaller than in *A. canescens*, and spores have a smaller length/width ratio (Fig. 6 and Table 2). Available nrDNA ITS sequences show a small difference (3 bp) between Finnish and American specimens, whereas the difference to the *A. macroporum* material is greater (28 bp; Fig. 7).

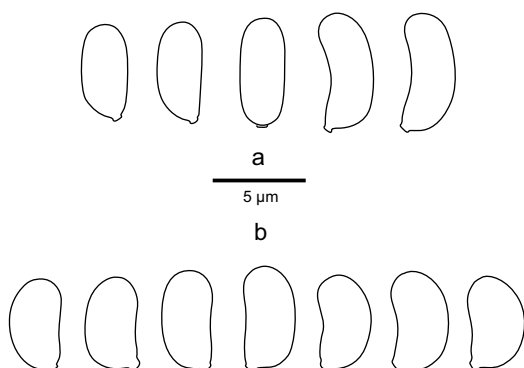
#### ***Aporpium caryae* (Schwein.) Teixeira & D.P. Rogers (Fig. 6)**

Mycologia 47: 410, 1955.

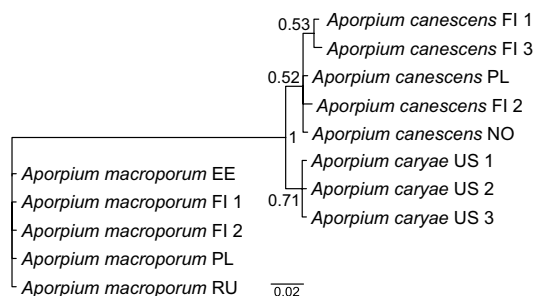
*Polyporus caryae* Schwein., Trans. American Philos. Soc., N.S. 4: 159, 1832. — TYPE: “Syn. Fung. 441–122, USA, Pennsylvania, Nazareth” [L. von Schweinitz] (PH 01097243, lectotype, designated by Bandoni *et al.* 1982; examined).

The characters agree otherwise with those of *A. canescens* except for the following: Basidiomes are up to 4 mm thick, and pores count 5–8 per mm. Odour was not recorded. Spores are short cylindrical and always curved, (4.2–)4.5–6.0(–6.3)  $\times$  (2.2–)2.3–3.0(–3.3)  $\mu\text{m}$ ,  $L = 5.12 \mu\text{m}$ ,  $W = 2.65 \mu\text{m}$ ,  $Q' = (1.5–)1.7–2.3(–2.6)$ ,  $Q = 1.93$  ( $n = 103/3$ ).

Our observations are only based on three specimens: the lectotype and two recent collections, all from the northeastern United States.



**Fig. 6.** Spores of *Aporpium* species. — **a:** *Aporpium canescens*. Specimen *Niemelä 7875* (H). — **b:** *A. caryae*. Lectotype (PH).



**Fig. 7.** Relationship of the three *Aporpium* species. Consensus phylogram of the 4503 trees retained in the Bayesian analysis of nrDNA ITS. Numbers up to one represent Bayesian posterior probabilities. Branch lengths reflect expected changes per site as indicated by the scale.

**Table 2.** Spore measurements of *Aporpium* species. Specimens marked with an asterisk (\*) are syntypes of *Poria pilatii*. Bold-face values are composite statistics for species. *L* = average of spore length, *W* = average of spore width, *Q'* = length/width ratio of individual spores, *Q* = *L/W*, and *n* = number of spores measured/number of specimens measured (if applicable). The whole range is given in parentheses; 90% range excluding 5% extreme values from both ends of variation is given without parentheses; in case the values are identical, parentheses are omitted.

Species/specimen	Length	<i>L</i>	Width	<i>W</i>	<i>Q'</i>	<i>Q</i>	<i>n</i>
<b><i>A. canescens</i></b>	<b>(3.0)–5.1–6.9(–7.6)</b>	<b>5.92</b>	<b>(2.0)–2.2–2.9(–3.2)</b>	<b>2.52</b>	<b>(1.1)–2.0–2.8(–3.2)</b>	<b>2.35</b>	<b>320/11</b>
lectotype	(5.1)–5.6–7.0(–7.2)	6.19	2.4–2.8(–2.9)	2.59	2.1–2.7(–2.8)	2.39	30
<i>Miettinen 13352.1</i>	(3.0)–5.3–6.3(–6.5)	5.77	2.2–2.8	2.44	(1.1)–2.0–2.7(–2.9)	2.37	30
<i>Miettinen 7327.1</i>	4.9–5.7(–5.8)	5.34	(2.0)–2.1–2.5	2.24	(2.0)–2.1–2.6(–2.8)	2.39	30
<i>Niemelä 407b</i>	(4.7)–4.8–6.0(–6.3)	5.44	(2.2)–2.3–2.9(–3.0)	2.49	(1.9)–2.0–2.4(–2.5)	2.19	30
<i>Niemelä 542</i>	(5.2)–5.3–6.5(–6.9)	5.95	(2.2)–2.4–3.0	2.75	(1.9)–2.0–2.4(–2.8)	2.17	30
<i>Niemelä 5528</i>	5.3–7.4(–7.5)	6.16	(2.2)–2.3–2.8(–3.2)	2.63	(1.9)–2.0–2.6(–2.7)	2.34	30
<i>Niemelä 7875</i>	(5.2)–5.8–7.4(–7.6)	6.31	(2.2)–2.3–2.7(–2.9)	2.51	(2.1)–2.2–2.8(–2.9)	2.52	30
<i>Niemelä 8449</i>	(5.4)–5.7–6.7(–6.9)	6.16	2.1–2.6	2.33	(2.3)–2.4–2.8(–2.9)	2.65	30
<i>Penttilä 14705</i>	(5.5)–5.8–7.2(–7.3)	6.50	2.2–2.8	2.44	(2.2)–2.3–3.1(–3.2)	2.67	30
<i>Pilät 498238*</i>	(4.9)–5.0–6.2(–6.7)	5.51	2.4–3.0	2.69	(1.7)–1.8–2.3	2.05	30
<i>Pilät 498239*</i>	4.1–6.2(–6.5)	5.68	2.4–3.0	2.75	1.7–2.2(–2.3)	2.07	20
<b><i>A. caryae</i></b>	<b>(4.2)–4.5–6.0(–6.3)</b>	<b>5.12</b>	<b>(2.2)–2.3–3.0(–3.3)</b>	<b>2.65</b>	<b>(1.5)–1.7–2.3(–2.6)</b>	<b>1.93</b>	<b>103/3</b>
lectotype	(4.8)–5.0–6.0(–6.3)	5.38	(2.2)–2.6–3.1(–3.3)	2.81	1.7–2.2(–2.6)	1.91	40
<i>Miettinen 14744</i>	4.5–5.8(–6.0)	5.06	2.3–2.8(–3.0)	2.60	(1.5)–1.6–2.3(–2.4)	1.95	33
<i>Miettinen 14756.1</i>	4.2–5.3(–5.6)	4.83	2.3–2.8(–3.0)	2.48	1.7–2.2(–2.3)	1.94	30
<b><i>A. macroporum</i></b>	<b>(3.6)–5.0–7.0(–8.0)</b>	<b>5.88</b>	<b>(2.4)–2.7–3.7(–4.0)</b>	<b>3.03</b>	<b>(1.3)–1.7–2.2(–2.5)</b>	<b>1.94</b>	<b>330/11</b>
holotype	(4.9)–5.0–6.3(–6.7)	5.78	(2.6)–2.7–3.3	2.94	(1.7)–1.8–2.1(–2.2)	1.97	30
<i>Miettinen 1032</i>	(5.2)–5.3–6.5(–6.6)	5.98	2.7–3.2(–3.3)	3.02	1.8–2.1(–2.2)	1.98	30
<i>Niemelä 7933</i>	(5.1)–5.2–6.5(–7.0)	5.92	2.7–3.2	2.93	1.8–2.3	2.02	30
<i>Niemelä 8346</i>	(3.6)–5.0–7.5(–8.0)	6.13	(2.5)–2.6–3.4(–3.7)	2.95	(1.3)–1.7–2.5	2.08	30
<i>Niemelä 8386</i>	(5.3)–5.4–7.0(–7.3)	6.14	(2.9)–3.0–3.5(–3.9)	3.27	(1.6)–1.7–2.1	1.88	30
<i>Niemelä 8485</i>	5.4–7.2(–7.4)	6.15	2.8–3.3	3.08	1.7–2.3	2.00	30
<i>Penttilä 25</i>	(4.5)–4.8–6.7	5.90	(2.5)–2.8–3.4	3.06	(1.4)–1.7–2.2	1.92	30
<i>Spirin 2736</i>	(4.5)–4.8–6.2(–6.3)	5.55	(2.7)–2.8–3.3	2.98	1.7–2.1	1.86	30
<i>Spirin 3192</i>	(4.7)–4.8–7.2(–7.4)	5.81	(2.4)–2.7–3.7(–4.0)	3.10	1.6–2.2(–2.5)	1.87	30
<i>Spirin 3302</i>	(4.8)–4.9–7.1(–7.3)	5.84	2.7–3.4(–3.6)	3.05	1.6–2.2(–2.3)	1.92	30
<i>Spirin 3357</i>	(4.8)–5.0–6.3(–6.5)	5.50	2.7–3.4(–3.6)	3.01	(1.6)–1.7–2.0	1.83	30

The name *A. caryae* has been used globally and we are convinced that material so named contains many species. There may well be several species present in North America alone, and care should be taken when applying this name in the strict sense.

We have concluded that the North European material represents a species separate from *A. caryae*. The morphological differences (spore size in particular; Fig. 4 and Table 2) and the small (3 bp) but consistent differences in ITS sequences (Fig. 7) point to this direction. Obviously more work is needed to establish what *A. caryae sensu stricto* is. At the time being we expect that it is unlikely that it occurs in Europe. Macrae (1955) studied Canadian strains of this species, and reported it to be heterothallic and to have the bipolar type of interfertility.

### ***Aporpium* vs. *Protomerulius***

Several genera have been described to accommodate polypores with septate basidia: *Protomerulius*, *Elmerina*, *Aporpium*, and *Protodadalea*. These have been variably used in the literature, but no author has recommended using all four. Ryvar den, for instance, has accepted two of these: *Protomerulius* and *Elmerina* (Ryvar den 1991, Núñez & Ryvar den 2001).

The septate basidial type alone is not a sufficient character to lump species, even poroid species, into a single genus. Morphological differences between *Aporpium africanum*, *A. canescens* and *Elmerina holophaea*, for instance, are so great in terms of pore morphology, basidiome consistency and hyphal structure that it is hard to believe they would fit in one genus. Our preliminary DNA sequence data (O. Miettinen unpubl.) show that several genera need to be acknowledged among poroid heterobasidiomycetes.

The genus *Aporpium* was described by Bondartsev and Singer (1941) to accommodate a group of resupinate polypores with leathery fruitbodies and small pores; *Poria canescens* was indicated as the type. Later Singer (1944) provided a Latin diagnosis to the description, and so validated the name. In Bondartsev's (1953) *opus magnum* eight species were included in the genus.

*Aporpium* means "clampless", and the absence of clamps was emphasised in the description as one of the main characters of the genus. However, all the species included do bear clamps, but they are small and inconspicuous. Teixeira and Rogers (1955) studied the generic type, *Poria canescens*, and claimed that *P. caryae* is conspecific and has priority over it — a conclusion that we cannot accept. Moreover, they found that the species has septate basidia, and therefore belongs to the so-called jelly fungi, at that time mostly included in the Tremellaceae.

Bandoni et al. (1982) discovered that the type of *Protomerulius* — *P. brasiliensis* from South America — is a polypore with schizobasidia. Their somewhat hesitating conclusion was to keep *Aporpium* distinct from *Protomerulius*. Setliff and Ryvar den (1982) hinted that *Protomerulius* might be an appropriate genus also for *Aporpium* species, and eventually Ryvar den (1991) transferred *A. caryae* in *Protomerulius*. Later Reid (1992) showed that *Elmerina* also belongs to the heterobasidiomycetes, and placed *A. caryae* in it. He did not discuss the oldest name *Protomerulius* at all, and so the reason for his solution remains somewhat obscure.

Unfortunately the type of *Protomerulius brasiliensis* (the generic type, HBG) was not available for this study. The description of the type by Bandoni et al. (1982) is sufficient to indicate that *P. brasiliensis* is not closely related to *A. canescens* (type of *Aporpium*). Differences include long gloeocystidia, thick hymenial/subhymenial layer, repeatedly simple-septate skeletal, and subglobose–ellipsoid spore shape.

We also consider *Elmerina* separate from *Aporpium* in the strict sense. The differences include basidiomes that drastically change their form upon drying, very large pores or gills, less distinctly dimitic hyphal structure, thicker hymenial layer, prominent and characteristic hyphal pegs, and very large, ellipsoid spores. Núñez and Ryvar den (2001) treated the type species of *Protodadalea* (*P. hispida*) as a taxonomic synonym of *Elmerina holophaea*, reducing the genus to a synonym of *Elmerina*. Whereas the status of *P. hispida* as a species might still be unresolved, the generic conclusion seems sound to us.

To conclude, we consider *Aporpium* to be a



good genus and the most suitable place for *A. canescens*, *A. caryae* and *A. macroporum*. The genus is characterised by its tight dimitic hyphal structure, robust and often encrusted skeletal, thick cylindrical spores with mostly concave ventral side, resupinate or effused-reflexed basidiomes, plus thin and tightly packed hymenial layer, in which the cells are glued together by a mucous substance. Clearly an in-depth analysis is needed for the generic concepts of polypores with septate basidia.

SPECIMENS EXAMINED (in herb. H, unless otherwise stated). — *Aporpium canescens*: **Czech Republic**. Bohemia, Sázkava, Studený Vrh Nat. Res., *Fagus sylvatica*, 21 Sep. 1991 Niemelä 5528 & Pouzar. **Finland**. Uusimaa Prov., Sipoo, Pohjois-Paippinen, *Populus tremula*, 30 Oct. 1976 Niemelä 542 & Rajala. Etelä-Häme Prov., Hämeenlinna, Lammi, Kotinen Nat. Res., *P. tremula*, 24 Sep. 2004 Niemelä 7933. Tammela [see lectotype]. Etelä-Savo Prov., Valkeala, Repovesi Nat. Park, *Betula*, 15 Sep. 2004 Niemelä 7875 & Kinnunen, Schigel. Pohjois-Karjala Prov., Ilomantsi, Lahnavara, *Betula*, 6 Sep. 2003 Penttilä 14383. Lieksa, *Betula*, 13 Sep. 2004 Hottola 2502, *Betula*, 23–25 Sep. 2003 Penttilä 14705. Kainuu Prov., Kuhmo, *P. tremula*, 21 Aug. 2003 Miettinen 7327.1. Kittilän Lappi Prov., Muonio, Ounas-Pallastunturi Nat. Park, Keimiö, *Alnus incana*, 29 Aug. 1970 Niemelä 407b. **Norway**. East Finnmark, Kárášjohka, Basevuovdi, *Betula pubescens*, 29 Aug. 2008 Miettinen 13352.2. **Poland**. Podlesie Reg., Hajnówka Dist., Białowieża Nat. Park, *P. tremula*, 12–14 Oct. 2008 Niemelä 8449, 8488 & Kinnunen, Schigel, Mleczeko. **Ukraine**. Zakarpaty Reg. (“Rossia Subcarpathica”), Kosivs’ka Polyana, Yalinka, *Fagus*, July 1930 Pilát 498238, 498239 [syntypes of *Poria pilatii*, PRM]. — *Aporpium caryae*: **USA**. Massachusetts, Worcester Co., Petersham, *Prunus*, 19 Sep. 2011 Miettinen 14756.1. Worcester, *Populus*, 20 Sep. 2011 Miettinen 14774. Pennsylvania [see lectotype]. — *Aporpium macroporum* (on *Populus tremula*, unless otherwise stated): **Estonia**. Tartumaa, Laeva, 13 Oct. 2010 Runnel 173 (TU). **Finland**. Uusimaa Prov., Porvoo, Tungräsk, 8 Oct. 2009 Penttilä 25. Vantaa, Herukkapuro Nat. Res., *Betula*, 21 Oct. 2006 Niemelä 8346. Etelä-Häme Prov., Hämeenlinna, Lammi, Kotinen Nat. Res., 9 Sep. 1999 Miettinen 1032, 10 Sep. 2001 Kotiranta 18792, 13 Sep. 2002 Niemelä 7366, 24 Sep. 2004 Niemelä 7933, 21 Sep. 2007 Niemelä 8386 & Schigel, 22–25 Sep. 2009 Niemelä 8678, 8684, 8685 & Schigel, 23 Sep. 2011 Niemelä 8838. **Latvia**. Felgavas Dist., Līvberze, 1997 Meiere H1. **Poland**. Podlesie Reg., Hajnówka Dist., Białowieża Nat. Park, *Betula pendula*, 14 Oct. 2008 Niemelä 8485 & Kinnunen, Schigel, Mleczeko; see holotype. **Russia**. Leningrad Reg., Podporozh’e, Nemzha, 20 Sep. 2009 Spirin 3302, Ostrechiny, 29 Sep. 2008 Spirin 2852, Tokari, 27 Sep. 2007 Spirin 2735. Volkhov, Chernetskoe, 17 Sep. 2009 Spirin 3318, Kisel’nya, *Salix caprea*, 17 Sep. 2009 Spirin 3192, Zagubie, 23 Sep. 2009 Spirin 3357. Nizhny Novgorod Reg., Semenov, Kerzhents Nat. Res., together with *A. canescens*,

10 Oct. 1999 Spirin (LE 213466, H); Sharanga, Kilemarsky Nat. Res., *Tilia cordata*, 19 Aug. 2004 Spirin 2236.

## Acknowledgements

We thank the collectors for valuable material. Prof. David Hibbett and the NSF grant DEB0933081 enabled OM to collect in the USA. OM was supported also by the Ella and Georg Ehrnrooth Foundation. Kadri Runnel generously provided DNA sequence and information on ecology of *A. macroporum* from Estonia. TN thanks Dmitry Schigel, Juha Kinnunen and Piotr Mleczeko for pleasant companionship and coworking while collecting the new species in Poland, and all the enthusiastic students in the 2002, 2004, 2007, 2009, and 2011 polypore courses in the Lammi Biological Station, during which the new species was repeatedly collected. In Białowieża, Poland, Dr. Czesław Okołów and Dr. Renata Krzyściak-Kosińska are warmly thanked for the possibility to study the magnificent forest and for practical arrangements there. Pirkko Harju and Tuuli Timonen kindly identified the hosts of two North American specimens. Leif Ryvarde and Teuvo Ahti revised the manuscript — once again many thanks to them!

## References

- Bandoni, R., Oberwinkler, F. & Wells, K. 1982: On the poroid genera of Tremellaceae. — *Can. J. Bot.* 60: 998–1003.
- Bondartsev, A. S. [Бондарцев, А. С.] 1953: [Poroid fungi of the European part of the USSR and Caucasia]. — Akademia Nauk SSSR, Moskva & Leningrad. [In Russian].
- Bondartsev, A. S. & Singer, R. 1941: Zur Systematik der Polyporaceen. — *Ann. Mycologici* 39: 43–65.
- Bondartseva, M. [Бондарцева, М.] 1964: [Species and forms of the Polyporaceae and Aporpiaceae new to the Leningrad Region]. — *Novosti Sist. Nizsh. Rast.* 1964: 186–195. [In Russian].
- Bourdot, H. 1932: Hyménomycètes nouveaux ou peu connus. — *Bull. Trimestriel Soc. Mycol. France* 48: 204–232.
- Hansen, L. & Knudsen, H. (eds.) 1997: *Nordic macromycetes 3. Heterobasidioid, aphylloroid and gastromycetoid Basidiomycetes*. — Nordsvamp, Copenhagen.
- Kinnunen, J. & Niemelä, T. 2005: North European species of *Ceriporiopsis* (Basidiomycota) and their Asian relatives. — *Karstenia* 45: 81–90.
- Komarova, E. P. [Комарова, Е. П.] 1959: [Rare species and new forms of poroid fungi, found in Belarusia]. — *Bot. Mater. Otd. Sporov. Rast.* 12: 249–257. [In Russian].
- Komarova, E. P. [Комарова, Е. П.] 1964: [Identification of poroid fungi of Belarusia]. — Nauka Tekhnika, Minsk. [In Russian].
- Macrae, R. 1955: Cultural and interfertility studies in *Aporpium caryae*. — *Mycologia* 47: 812–820.
- Miettinen, O., Niemelä, T. & Spirin, W. 2006: Northern

- Antrodiella* species: the identity of *A. semisupina*, and type studies of related taxa. — *Mycotaxon* 96: 211–239.
- Núñez, M. & Ryvardeen, L. 2001: East Asian polypores 2. Polyporaceae *s. lato*. — *Synopsis Fungorum* 14: 1–522.
- Nylander, J. A. A. 2004: *MrModeltest v2.3*. — Evolutionary Biology Centre, Uppsala University. [Program distributed by the author].
- Ronquist, F. & Huelsenbeck, J. P. 2003: MrBayes 3: Bayesian phylogenetic inference under mixed models. — *Bioinformatics* 19: 1572–1574.
- Ryvardeen, L. 1991: Genera of polypores. Nomenclature and taxonomy. — *Synopsis Fungorum* 5: 1–363.
- Setliff, E. C. & Ryvardeen, L. 1982: The genus *Aporpium* and two additional poroid fungi. — *Can. J. Bot.* 60: 1004–1011.
- Singer, R. 1944: Notes on taxonomy and nomenclature of the polypores. — *Mycologia* 36: 65–69.
- Teixeira, A. R. & Rogers, D. P. 1955: *Aporpium*, a polyporoid genus of the Tremellaceae. — *Mycologia* 47: 408–415.