

## Hymenochaete cruenta and *H. sphaericola*, two sibling species of Hymenochaetales (Hymenomycetes, Basidiomycota)

ERAST PARMASTO

Institute of Zoology and Botany, Estonian Agricultural University  
181 Riia St., 51014 Tartu, Estonia; e-mail: e.parmasto@zbi.ee

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*Hymenochaete cruenta* (syn.: *H. mougeotii*) has been considered a widely spread species in Eurasia and Australasia inhabiting both coniferous and angiospermic trees or bushes. A similar species, *H. murashkinskyi* was described by A. Pilát from Southern Siberia and later found also in the Russian Far East and China on *Rhododendron* spp. Study of herbarium specimens demonstrated that there are two closely related species with partly overlapping areas of distribution: *H. cruenta* on *Abies* (and other conifers?) in Eurasia, and *H. sphaericola* (syn.: *H. murashkinskyi*) on *Rhododendron*, *Quercus* and some other angiospermic trees in East, South-East and South Asia and Australasia.

**Key words:** Hymenomycetes, *Hymenochaete cruenta*, *Hymenochaete sphaericola*, taxonomy, distribution.

Parmasto E. (2001): *Hymenochaete cruenta* a *H. sphaericola*, dva sesterské druhy řádu Hymenochaetales (Hymenomycetes, Basidiomycota). – Czech Mycol. 52: 307–315

*Hymenochaete cruenta* (syn. *H. mougeotii*) byla považována za široce rozšířený druh v Eurasii a Australasii rostoucí na jehličnanech i na stromech a keřích krytosemenných rostlin. Podobný druh *H. murashkinskyi* byl popsán Pilátem z jižní Sibíře a později nalezen také na ruském Dálném východě a v Číně na různých druzích rodu *Rhododendron*. Studium herbářových dokladů ukázalo, že zde existují dva blíže příbuzné druhy jejichž rozšíření se zčásti překrývá — *H. cruenta* na *Abies* (a na dalších jehličnanech?) v Eurasii a *H. sphaericola* (syn. *H. murashkinskyi*) na *Rhododendron*, *Quercus* a některých dalších krytosemenných stromech ve východní, jihovýchodní a jižní Asii a v Australasii.

### INTRODUCTION

In the genus *Hymenochaete* a small group of species is characterized by basidiomata with a striking, bright or violaceous red hymenium. The name *H. cruenta* (syn.: *H. mougeotii*) has been used for such fungi found in Eurasia on *Abies* spp., in Asia and Australasia on *Quercus* spp., *Rhododendron* spp. and some other angiospermic trees. *H. sphaericola*, described by Lloyd from New Zealand in 1925 and not found later was synonymized with this species by Léger (1998). In 1934, A. Pilát described *H. murashkinskyi*, a species with similar basidiomata from South Siberia where it was growing on *Rhododendron*. Parmasto (1985) asserted that South Asian specimens called *H. cruenta* may belong to *H. murashkinskyi*.

Léger (1998) in his world monograph of the genus *Hymenochaete* distinguished both species but referred South Asian and Australasian specimens to *H. cruenta*.

Based on numerous herbarium specimens, the aim of this study is to clear up the taxonomy, nomenclature and distribution of the sibling species of the *Hymenochaete cruenta* group.

#### MATERIALS AND METHODS

The herbarium specimens were examined microscopically as hand sections or as squash mounts in 2% KOH solution at magnifications  $\times 700$  and  $\times 1000$ . Measurements of spores were made with the aid of a Sony CCD Video Camera attached to the microscope and analysed by Global Lab Image (Data Translation Inc.) software; 25 randomly taken spores were measured in each specimen. Colour notations were made in accordance with Munsell's Book of Color (1942; abbreviated: *M*) and Kornerup & Wanscher's (1978; abbreviated: *K & W*) Handbook of Colour. Herbarium acronyms are after Holmgren, Holmgren & Barnett (1990). Distribution map of species was compiled using the program MapPad Vers. 2.1.

#### KEY TO SPECIES

1. Hymenium with a violet or purple tint; setal hyphae (embedded setae) rare, but present; mean width of spores 2–2.5  $\mu\text{m}$ , mean length/width quotient  $Q = 2.9\text{--}4$ ; setal layer not stratose; on *Abies* (or other conifers) ..... *H. cruenta*
- Hymenium without a violet tint; setal hyphae absent; mean width of spores 2.6–4  $\mu\text{m}$ , mean length/width quotient  $Q = 1.8\text{--}2.7$ ; setal layer sometimes multistratose; on *Rhododendron*, *Quercus* or other angiospermic trees ..... *H. sphaericola*

*Hymenochaete cruenta* (Pers.: Fr.) Donk, Persoonia 1 (1): 51 (1959). — *Thelephora cruenta* Pers.: Fr., Syn. fung. 575 (1801); Fr., Syst. mycol. 1: 444 (1821) non Alb. & Schwein. (1805) = *Cytidia salicina* (Fr.) Burt. — *Thelephora mougeotii* Fr., Elench. fung. 1: 188 (1828). — *Hymenochaete mougeotii* (Fr.: Fr.) Cooke, Grevillea 8: 147 (1880).

Basidiomata effused, 200–500  $\mu\text{m}$  thick, up to 3 cm in diam, then confluent and up to 10 cm long, coriaceous, adnate, sometimes with slightly elevated (upper) margin 1–4 mm long, pileal surface with some concentric zones, tobacco brown; hymenium smooth or slightly tuberculate, indistinctly concentrically zonate, dark vinaceous, dark coral to light blood colour (*M*: 5–7.5 R 3–4/6–8; *K & W*: 10 D 6–7, 11 D 6 or 10 RP 4/6), sometimes with a thin greyish coating (then *M*: 5 R 5/6); margin of the effused part 1–5 mm broad, thin, fibrillose, then abrupt and concolorous with the hymenium or with a darker zone.

Tomentum up to 100  $\mu\text{m}$  thick or present as abhymenial hairs; cortex 20–35  $\mu\text{m}$  thick, of densely agglutinated brown hyphae; context composed of loosely or compactly arranged hyphae; setal layer absent or weakly developed, rarely 2-stratose.

Hyphal system subdimitic; generative hyphae yellowish, thin-walled, ramose, septate, yellowish, 2.5–3.5  $\mu\text{m}$  in diam; skeletoids thick-walled, brown, 2.5–4  $\mu\text{m}$  in diam; setal hyphae usually present but not frequent, (4-)5–8  $\mu\text{m}$  in diam. Setae numerous, subulate to fusoid, (40-)45–80(-95)  $\times$  6–10(-12)  $\mu\text{m}$ , emerging up to 65(-80)  $\mu\text{m}$ , usually without a hyphal sheath, in old hymenia sometimes with a granulose encrustation on tip. Dendrohyphidia not numerous, yellow or brownish, 20–55  $\mu\text{m}$  long, 2–4  $\mu\text{m}$  in diam, forked or with 3–4 branches, 2–4.5  $\mu\text{m}$  in diam, brown(ish), tips sometimes hyaline and 1–2  $\mu\text{m}$  in diam. Basidia subutriform (slightly constricted in upper part), thin-walled, hyaline, 20–30  $\times$  4–5  $\mu\text{m}$ , with 4 thin sterigmata 4–5  $\mu\text{m}$  long; spores cylindric, slightly curved, (5.5-)7.2–8.5(-8.8)  $\times$  1.5–2.8  $\mu\text{m}$ ; mean length/width quotient  $Q = 2.0$ –2.5.

Substrata. On bark of dead or fallen trunks and branches of *Abies alba*, *A. bornmuelleriana*, *A. holophylla*, *A. mayriana*, *A. nephrolepis*, *A. nordmanniana*, *A. sachalinensis*, *A. sibirica*; in South America found on an angiospermic tree; dubious data on occurrence on *Picea abies* and *P. sibirica*.

Distribution. Europe: Austria, Czech Republic, France, Germany, Italy, Poland, Romania, Russia – Komi, Perm, Tatarstan regions; Slovakia, Switzerland, Ukraine, United Kingdom; Asia-Temperate: Turkey, Russian Caucasus – Krasnodar Terr., Causasian Nature Reserve; Georgia; Siberia – Tyumen, Ekaterinburg, Krasnoyarsk, Irkutsk Terr., Altai, West and East Saiany Mts.; Russian Far East – Jewish, Khabarovsk, Primorsk and Sakhalin Terr. (incl. Kunashir Is.); China; Southern South America: Argentina (Tierra del Fuego).

Isotype (?) studied. *Thelephora cruenta* (K, Herb. Hookerianum 1867).

Other specimens studied. 190 specimens from the herbaria BAFC (1), BPI (45), K (43), NY (14), TAA (85), H (2). Seven specimens from southernmost localities studied by me are collected on unidentified coniferous trees in regions where *Abies* spp. occur: SOUTH-EAST CHINA: Guangdong, Hainan[do], Tiang-an [= Dingan?], 18 Nov and 23 Dec 1934 S. Q. Deng 6668 and 7916 (BPI 278251, 278255, 278883, 278252, 278249); Yunnan, Anhwei, Chiu-hua-shan, 18 Sep 1933 S. Q. Deng 529 (BPI 278250, 278254, 278892), *ibid.*, 18 Nov 1934 S. Q. Deng 6668 (BPI 278885), *ibid.*, 23 Dec 1933 S. Q. Deng 7916 (BPI 278249, 278252), Kushan [= Xueshan?], Foochow, 14 Aug 1933 S. Q. Deng 2205 (BPI 278248, 278886), Yen-tsin, 5 Apr 1934 Y. Tsiang 914 (BPI 278260). In South America found on an angiospermic tree: ARGENTINA: Tierra del Fuego, Puerto Haberton, coll. Wright & Del Busto 1 Feb 1973, det. D. J. Job (BAFC 29230).

Remark. Closely related to *H. sphaericola*; the differences are described below. Basidiomata usually have a violet tint; when basidia and spores are present, the

hymenium is slightly pruinose and greyish. Most of the specimens seen are without basidia and as a result are much more vividly coloured.

*Hymenochaete sphaericola* Lloyd, Mycol. Notes 7 (9) (no. 74): 1338, f. 3101 (1925). — *H. murashkinskyi* Pilát, Hedwigia 71: 322, f. 1–3 (1934). — *H. mougeotii* (Fr.) Cooke f. *murashkinskyi* (Pilát) Litsch. in Handel-Mazzetti (ed.), Symbolae Sinicae. Bot. 43 (1937). — *H. mougeotii* (Fr.: Fr.) Cooke *sensu* G. H. Cunningham, Balfour-Browne et al.

Basidiomata effused, 100–400  $\mu\text{m}$  thick, up to 3 cm in diam, then confluent, soft coriaceous, detachable from the substrate, usually with slightly elevated (upper) pileus-like margin; pileus (when present) up to 5 mm long, surface indistinctly zonate, dark sienna or umber (*M*: 5 YR 5/7; *K* & *W*: 7 D 7). Hymenium smooth, dark livid red, dark red, blood colour or umber bay (*M*: 5 R — 2.5 YR 4/4–6–8, when old sometimes 5 R — 5 YR 4/8–10; *K* & *W*: 6–8 E 6–7), when fertile (with spores) light chestnut, chestnut brown or dark brick (*M*: 7.5 R 3/4 to 2.5 YR 5/4, sometimes 5 R 4.5–6; *K* & *W*: 6–8 E 6), without a violet tint.

Tomentum present but thin; cortex 15–25  $\mu\text{m}$  thick, composed of brown agglutinated hyphae; context well developed, hyphae loosely more or less parallel intertwined; setal layer usually with 2–4, rarely up to 10 distinct or indistinct strata; when one-layered, then the setal layer is thickening and up to 200  $\mu\text{m}$  thick

Hyphal system subdimitic, setal hyphae absent; generative hyphae yellowish, thin-walled, ramose, with septa, 2–4  $\mu\text{m}$  in diam; skeletoids brown(ish), with thickened walls, 2–4  $\mu\text{m}$  in diam. Setae usually not numerous, conical-fusoid, (50-)60–100(-120)  $\times$  (7-)8–13(-15)  $\mu\text{m}$ , embedded, some emerging 20–50  $\mu\text{m}$  above the hymenium, mostly covered with a thin hyphal sheath, in old hymenia sometimes with a granulose encrustation at the tip. Dendrohyphidia yellow or brownish, usually not numerous, 32–40  $\mu\text{m}$  long, 2–4  $\mu\text{m}$  in diam, with thickened walls, with (2-)3–6(-8) branches. Basidia subutriform (slightly constricted in upper part), thin-walled, hyaline, 20–32  $\times$  5–8  $\mu\text{m}$ , with 4 thin sterigmata 3–4  $\mu\text{m}$  long. Spores cylindric, one side slightly curved, 6–8.2(-9)  $\times$  (2.5-)2.7–4.2  $\mu\text{m}$ ; mean length/width quotient  $Q = 1.8$ –2.7.

Substrata. On fallen trunks and branches of *Quercus* spp. and *Rhododendron* spp., but also several other angiospermic trees.

Distribution. Russian Far East and South Siberia (Saiany and Altai Mts.), China, Japan, India, Nepal, Australia, New Zealand.

Types studied. *H. sphaericola*: New Zealand, on an old *Sphaeria* sp. (= *Hypoxylon*?), J. Mitchell (holotype: BPI 329986, Lloyd Herb. 32642; isotype: K). *H. murashkinskyi*: Russia, Montes Saiany, alt. 600 m, on *Rhododendron dahuricum*, 25 Jul 1927 K. E. Murashinsky (holotype: PRM 686919; isotype: K).

Other specimens studied. AUSTRALIA: New South Wales, NW of Coo-pernook, 30 Mar 1983 R. Coveny 25 (BPI); Queensland, Eungella Nat. Park, 12

Nov 1985 G. Thor 5065 (TAA); Tasmania, G. Masee (NY). CHINA: G. Masee (NY); Guangdong, Sikang, Kiulunghsien, Hunba Forest, on *Rhododendron*, 5 Dec 1939 S. C. Teng 3345 (BPI 278875); Hainan, Ting-an, 18 Dec 1934 and 23 Dec 1934 S. Q. Teng 6668, 7916 (BPI 278251, 278249, 278252); Yunnan, Delavay (BPI, ex Herb. N. Patouillard); Nguluki, on *Rhododendron*, Sep-Oct 1916 Handel-Mazzetti 12952 (NY); Youngning, on *Rhododendron*, 2 Apr 1940 S. C. Teng 3512 (BPI 278277; NY); Likiang, on *Quercus*, 15 May 1940 S. C. Teng 3511 (BPI 278884); Xinjiang, Chensi Centralis, Seu toei chan, 14 Sep 1916 E. Licent 213 (PRM 501007). INDIA: Himachal Pradesh, Chamba, Sara, on *Quercus incana*, 27 Aug 1966 S. S. Rattan 5185, 5186, 5188 (BPI 349168, 349170, 349169; TENN); Simla, Kufri, on *Pyrus baccata*, 26 Sep 1967 S. S. Rattan 5307 (BPI 299847; TENN); Dalhousie, Daikund, on *Betula utilis*, 15 Apr 1971 S. S. Rattan 5497 (BPI 349395; TENN); Mahasu, Narkanda, on *Quercus incana*, 15 Aug 1971 S. S. Rattan 5598 (BPI 349393; TENN); E of Manali, Nagar, on *Rhododendron* sp. and *Prunus padus*, 22 Jun 1972 P. Uotila 18091 and 18023 (H); Jammu and Kashmir, Chandanwari, Pahelgam, on *Pyrus baccata*, 3 Sep 1967 S. S. Rattan 5275 (BPI 349171); Uttar Pradesh, Martoli, on *Betula*, 6 May 1908 W. Koelz 20277 (BPI 278259); Garhwal (NY); Gobindham, on *Rhododendron*, 15 Sep 1968 S. S. Rattan 5441-5443 (BPI 349164-349166); Mussoorie, on *Quercus*, 7 Sep 1968 S. S. Rattan (BPI 349167); Sikkim, between Dzongri and Thangshing, on living *Rhododendron* sp., 5 May 1997 M. Gregory (K 51866). JAPAN: Sendai, on *Quercus glandulifera*, 24 Sep 1919 A. Yasuda (BPI 278275, 278276); Sendai, on *Hamamelis japonica*, A. Yasuda (BPI 278270). NEPAL: Gosainkund, Chandanwari, 29 Aug 1969 S. S. Rattan 5463 (BPI 278261); Gandaki Prov., Kuldi, Anapurna trek, 2400 m, on *Rhododendron*, 1979-11-07 L. Ryvar den (O; K 19336). NEW ZEALAND: Auckland, on *Pittosporum eugenioides*, 8 Sep 1956 P. J. Brook (BPI 278274); Waitarua, on *Dysoxylum spectabile*, Nov 1948 J. M. Dingley 7156 (BPI 278269); Dunedin, H. K. Dalrympe (BPI 329937, Lloyd Herb. 32631); Wellington, Weraroa, 21 Aug and 31 Aug 1919 G. H. Cunningham 541 and 548 (BPI 278246, 278253). RUSSIA: Altai Mts., Altai Nature Reserve, Yailyu, on *Rhododendron dahuricum*, 14 Aug 1959 E. Parmasto (TAA7357); Khabarovsk Terr., Sofijsk, on *R. dahuricum*, 7 Aug 1982 E. Parmasto (TAA 104673); Primorsk Terr., Kavalerovo, on *R. mucronulatum*, 5 Oct 1977 E. Parmasto (TAA 101833); Sikhote-Alin Biosphere Reserve, Vodorazdel'naya, on *R. sichotense*, 29 Sep 1979 A. Kollom; 30 Sep 1979 E. Parmasto (TAA 127103, 102754); Kabanij, on *R. sichotense*, 19 Sep 1990 E. Parmasto (TAA 151233, 151276); Blagodatnoye, on *R. dahuricum*, 25 Sep 1990 (TAA 151453).

Remarks. Closely related to *H. cruenta*; it may be distinguished thanks to its vivid red colour without a violet or purple tint, absence of setal hyphae, better developed dendrohyphidia with several branches, and substrate (angiospermic trees and bushes). Spores of *H. cruenta* are more slender (specimens mean  $Q > 2.6$ )

**Table 1.** Mean spore length *L*, width *W* and spore length/width coefficient *Q* in *Hymenochaete sphaericola* and *H. cruenta*

L	W	Q	
<i>Hymenochaete sphaericola</i>			
7.08	3.99	1.78	China, Yunnan (BPI 278260)
6.88	3.46	1.99	Nepal (BPI 278261)
8.81	3.19	2.76	<b>type of <i>H. murashkinskyi</i></b> : Russia, S. Siberia (PRM 686919); spores few, damaged and deformed
6.55	3.07	2.13	<b>type of <i>H. sphaericola</i></b> : New Zealand (BPI 329986)
7.83	3.03	2.58	India, Uttar Pradesh (BPI 349165)
6.40	3.01	2.13	Australia, New South Wales (NSW 25)
6.76	2.97	2.28	Australia, Queensland (TAA, Thor 5056)
7.71	2.91	2.65	India, Jammu & Kashmir (BPI 349171)
6.52	2.85	2.29	New Zealand (BPI 78269)
6.66	2.90	2.30	India, Himachal Pradesh (TENN 39444)
6.61	2.66	2.48	Russian Far East (TAA 127103)
<i>Hymenochaete cruenta</i>			
7.20	2.53	2.86	Russian Far East (TAA 104960)
8.28	2.43	3.14	Russia, S. Siberia (TAA 103546)
7.86	2.35	3.37	Russian Far East (TAA 104657)
8.41	2.35	3.63	Russian Far East (TAA 104674)
7.67	2.33	3.29	Russia, Perm Prov. (TAA 104202)
7.83	2.33	3.35	Russia, Altai Mts. (TAA 7930)
8.11	2.33	3.48	Russian Far East (TAA 125340)
7.50	2.32	3.23	Poland (Domański 3785)
7.19	2.31	3.11	Argentina, Tierra del Fuego (BAFC 29230)
7.95	2.29	3.50	Russian Far East (TAA 125340)
7.73	2.28	3.38	Germany (TAA 150810)
7.04	2.26	3.11	Russia, Sakhalin Prov. (TAA 93188)
7.60	2.08	3.65	Russia, Komi Auton. Rep. (TAA 6019)
7.56	2.02	3.74	France (BPI 278265)
7.38	2.00	3.72	Russia, Sakhalin Prov. (TAA 102523)
7.69	1.99	3.89	Russia, Perm Prov. (TAA 104202)

and more narrow (specimens mean is less than 2.6  $\mu\text{m}$ ); however, the only fertile specimen collected in the region where both species have been found (Russian Far East), has spores of marginal size and form (cf. Table 1). Setal layer is distinctly stratified in the specimens of *H. sphaericola* growing in the boreal zone, but with few usually indistinct strata or not stratified when growing in southern (partly subtropic) regions. Bright coloured specimens are, as a rule, sterile or with only a few spores. I tried to find sporulating specimens in Russian Far East forests in



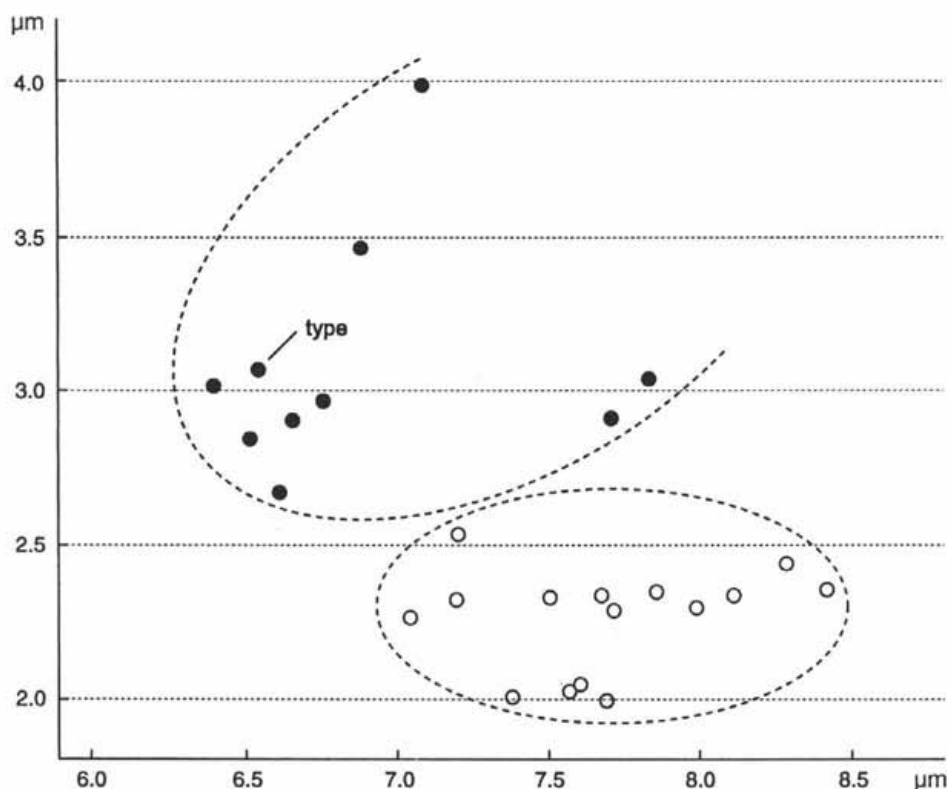


Fig. 1. Mean spore size of *Hymenochaete cruenta* (O) and *H. sphaericola* (●).

late spring, summer and autumn, but in vain. It is possible, that in those regions the sporulation period is the same as in corticioid *Corticium* (*Laeticorticium*) species, i e, very early spring just after melting of the snow.

#### DISCUSSION

*H. cruenta* and *H. sphaericola* are a 'classical' example of sibling species: the morphological differences are small, but the characters are not overlapping. Mean spore size and form are without intermediates when statistical study is used, but are very close (Table 1 and Fig. 1). However, this character can rarely be used since most of the (herbarium) specimens are sterile, or with a few damaged and deformed spores (as is the case with the type of *H. murashkinskyi*). One of the seemingly good distinguishing characters, the stratification of basidiomata (setal layers) in *H. sphaericola*, seems to be a variable adaptation and is only

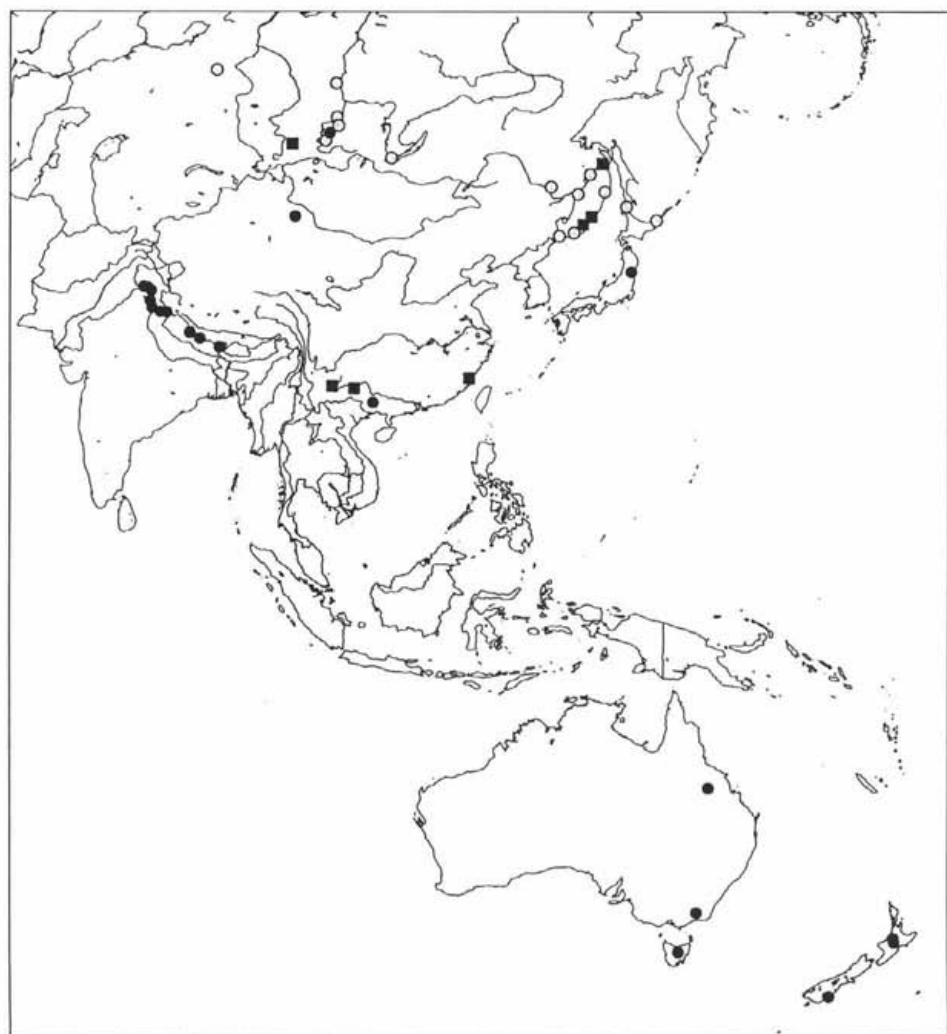


Fig. 2. Localities of *Hymenochaete cruenta* (O), *H. sphaericola* (●) and both species (■) in Asia and Australasia.

well expressed in northern regions of distribution and in mountainous areas. Setal hyphae are rare in *H. cruenta*, and their absence in a herbarium specimen is not a sure character to be used for distinguishing the species.

Both species have different areas of distribution, but are not distinctly allopatric: areas are partly overlapping in Middle Asia (Saiany and Altai Mts.) and East Asia (Russian Far East, China; cf. Fig. 2). *H. cruenta* grows especially on



*Abies*; the host spectrum of *H. sphaericola* is broader, but *Rhododendron* and *Quercus* are the main hosts among other angiospermic trees. In South-East China, several specimens have been found on conifers which are difficult to classify: they are all without spores and without a stratified setal layer. They have been placed under *H. cruenta* in this paper, but their true identity may be discovered only after fertile specimens are found or molecular markers used.

*H. cruenta* has also been found once in South America (Tierra del Fuego). According to spore size and form, presence of setal hyphae and colour of basidiomata, this is a 'typical' specimen of this species. Here it may be a Gondwanan relict of the formerly widespread species.

Leaving aside the possible presence of "intermediate" specimens, the species pair studied is a good example of sibling species differentiated in phylogenesis due to two co-ordinated processes: geographical disjunction and host specialization.

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