

## The genus *Chaenothecopsis* (Mycocaliciaceae) in Switzerland, and a key to the European species

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**Abstract:** Current knowledge about the non-lichenized genus *Chaenothecopsis* in Switzerland is reviewed. A characterization of the genus and a key to all accepted European taxa are presented, excluding the little known resinicolous species. The distribution of the 15 *Chaenothecopsis* species recorded in Switzerland is briefly summarized. Specimens in the herbaria belong mainly to *C. pusilla*, *C. rubescens* and *C. viridialba*; recent collections include rarer species such as *C. hospitans*, *C. ochroleuca*, *C. retinens* and *C. tasmanica*. It seems that many taxa occur predominantly in montane to subalpine forests in the Northern Prealps, although distributional data are still scarce.

**Key words:** *Chaenothecopsis*, key to European species, *Mycocaliciaceae*, Switzerland

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### Introduction

*Chaenothecopsis* Vain., a genus of the non-lichenized *Mycocaliciaceae*, is traditionally dealt with by lichenologists on account of the morphological similarity of the stalked, pin-like apothecia to lichenized *Caliciaceae* (Wirth 1995); moreover, many taxa grow in the same habitats and several are obligately or facultatively lichenicolous. The *Chaenothecopsis* species, their occurrence and distribution in Switzerland (and presumably in several other countries) have never been summarized and are only little known. In some cases, species records seem to be a by-product of lichen inventories and similar projects; obviously, *Chaenothecopsis* has been largely neglected in the past. Also, specimens are rather poorly represented in Swiss herbaria, which is true for several other genera of the calicioid lichens and fungi. Some distributional data were recently gathered in the mapping project for the Red List of Swiss epiphytic lichens (Dietrich *et al.* 2001); c. 45 records of eight *Chaenothecopsis* species were entered in a database during this project. However, the Red List of

Switzerland (Scheidegger & Clerc 2002) and the catalogue of Clerc (2004) cover only the lichenized species. Recent reports (Dietrich 1990; Wildi & Camenzind 1990; van den Boom *et al.* 1993; Camenzind-Wildi *et al.* 1996; van den Boom & Clerc 2000; Frei 2003; Mola 2005) include observations of no more than three *Chaenothecopsis* species.

The present overview includes a characterization of the genus *Chaenothecopsis* and the data currently available on the occurrence of the species known in Switzerland, many being reported here for the first time. Notes about the ecology and the global and Swiss distribution of the different species are added, as well as comments on herbarium specimens. A key compiled from the literature covering all taxa currently known in Europe including the Caucasus, but not the resinicolous species, is provided. It seems probable that several taxa are still waiting to be discovered or described (e.g. Coppins 1992), so that the key is far from being complete. The pertinent information was extracted from Coppins (1992), Peterson & Rikkinen (1999), Selva & Tibell (1999), Tibell (1996, 1999), Tibell & Ryman (1995), Titov (1998), Titov & Tibell (1993) and Wirth (1995). The knowledge of the

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species predominantly or exclusively growing on exudate (mainly resin) is too scanty for inclusion in the present key, although a few taxa have been described by Tibell & Titov (1995), Rikkinen (1999) and Titov & Tibell (1999).

### The Genus

Recent investigations of rDNA sequence data confirmed that *Mycocaliciales* form a monophyletic group, which is not closely related to the calicioid lichens (Tibell & Wedin 2000). The current circumscriptions of the *Mycocaliciaceae* and of the genus *Chaenothecopsis* are summarized and discussed against the historical background by Tibell & Vinuesa (2005). The genus is paraphyletic, based on LSU and ITS rDNA sequences, with respect to the other members of the *Mycocaliciaceae*, therefore the characters currently used for circumscription and delimitation of the genera, namely *Chaenothecopsis* and *Phaeocalicium*, must be reconsidered (Tibell & Vinuesa 2005). The following characterization refers to the presently accepted understanding of the genera.

*Chaenothecopsis* includes about 60 species. It generally differs from the other genera of the *Mycocaliciaceae* in the structure of the apex of the ascus and in the anatomy of the stalk, the inner part consisting of intricately intertwined hyphae (Tibell 1984; Tibell & Vinuesa 2005, table 2). *Mycocalicium* (*subtile*), *Phaeocalicium* and *Stenocybe* species have periclinally arranged hyphae in the stalks, and the apices of their asci are uniformly and strongly thickened and lack an apical canal. *Phaeocalicium* and *Stenocybe* have longer asci and larger spores, compared to *Chaenothecopsis*. The spores of *Mycocalicium* are non-septate and usually broadly fusiform; the spores of *Stenocybe* are thick-walled and 3- to 7-septate. All four genera have an active spore dispersal.

### *Chaenothecopsis* Vain.

*Acta Soc. Fauna Fl. Fenn.* 57(1): 70 (1927); type: *Chaenothecopsis rubescens* Vain. (lectotype, Schmidt 1970).

*Ascomata* sessile to long-stalked, usually dark coloured, without lichenized thallus. *Stalk* formed of periclinally arranged, dark coloured hyphae, sometimes pale below; inner part with interwoven and/or branched hyphae, colourless or paler than outer part; branched stalks occur occasionally. *Capitulum* mostly obovoid to lenticular, black; usually without mazaedium; head and/or stalk of some species with whitish or glaucous blue pruina; pruinose capitula rarely tinged reddish or yellow greenish. *Exciple* more or less well-developed, made up of dark brown periclinally arranged hyphae. *Hypothecium* well-developed, pale to variably coloured. *Hymenium* with narrow, dark epithecium. *Asci* cylindrical to subclavate, persisting; apex strongly thickened and in most species penetrated by a thin canal, visible in semi-mature asci (iodine stained;  $\times 1000$ ). *Spores* simple or 1-septate, dark brown to pale greenish brown; narrowly ellipsoid, ellipsoid or fusiform; surface smooth or with minute ornamentation. *Anamorphs* (conidiomata) of several types, some known from culture experiments (summarized in Tibell 1999).

*Chemistry.* No secondary substances detected by thin-layer chromatography; pigments in head and stalk (sections or squash preparations of apothecia) may change colour with KOH (K) or HNO<sub>3</sub> (N).

*Identification.* Species identification (see key below) is based mainly on the following characters: spores, pruina, colours and colour reactions, stalk length, host, and substratum. However, these features are not always reliable, for example, stalks may be quite pale, or some of the commonly epruinose species may have slightly pruinose capitula. In cases of doubt, alternatives in the key should be checked.

*Ecology and distribution.* Several species of *Chaenothecopsis* live as saprobes on bark, wood or resin, rarely on polypores. Others are parasites or parasymbionts on corticolous, lignicolous or saxicolous algae and crustose lichens, particularly on *Chaenotheca* species, or on cup lichens (*Cladonia* spp.).

Some taxa are specific with regard to the substratum or to the host, a few others occupy a rather wide range of substrata. In some cases, the *Chaenothecopsis* ascomata seem to be only loosely associated with algae (Wirth 1995). The parasitic and parasymbiotic taxa occur mainly in sheltered localities with rather high humidity and low light intensity, since many of their hosts, species of the *Caliciaceae* and algae, grow in such habitats (Tibell 1984). In contrast, saprobic species on wood are often found in well-lit, comparatively dry situations.

*Chaenothecopsis* is a cosmopolitan genus and several species occur in both hemispheres (Tibell 1984). While many species are widely distributed in temperate and cool temperate regions, some taxa are restricted to the tropics (Tibell 1996). In Central Europe, the species depend (with few exceptions) on undisturbed or less extensively managed forests, growing on bark of old trees and on wood (Wirth 1995). Together with other calicioid lichens and fungi, *Chaenothecopsis* species can be used as indicators of old growth forests and ecological continuity (Tibell 1992; Selva 1994, 2002).

Today, fifteen species of *Chaenothecopsis* are known to occur in Switzerland; the single collection of a resinicolous taxon is not included and will be presented elsewhere. Compared with the species lists of other European countries on the web (Feurerer 2005; Nimis 2003), this number seems to be notably high and suggests either a well-known flora or a rich species diversity. In the present case of a little-known non-lichenized genus, the higher number of taxa in Switzerland, compared to those of the neighbouring countries such as Austria, France, Germany or Italy, presumably reflects the state of knowledge rather than the number of existing species. Hence, species diversity and distribution are at present difficult to assess on the European scale.

Two of the Swiss taxa, *Chaenothecopsis rubescens* and *C. retinens*, grow predominantly on old oaks (*Quercus* spp.) and are therefore more or less confined to the country's lowlands, mainly the Central Plateau (Fig. 2).

*Chaenothecopsis viridialba* has a prealpine-alpine distribution (Fig. 3), whereas *C. pusilla* is widely distributed (Fig. 1). Surprisingly, only a few specimens of *Chaenothecopsis* have been collected in the Swiss Jura. *Chaenothecopsis pusilla*, *C. rubescens* and *C. viridialba* are the most frequent species; many other taxa have rarely been found and are currently known from very few (1 to 3) localities. More records are necessary to get an idea of the distribution patterns of these species. At present, the high montane and subalpine zones of the Alps seem to harbour the greatest diversity of *Chaenothecopsis* taxa, and future fieldwork may prove whether the species richness of some locations in the Northern Prealps (see specimens examined) are exceptions rather than the rule.

*Herbarium specimens.* About 35 *Chaenothecopsis* specimens over 100 years old and almost the same number of specimens less than 50 years old from Swiss locations were found in the large herbaria in Geneva (G) and Zurich (Z-ZT). The old specimens, including several duplicates, were deposited under other generic names, mainly as *Calicium*. In addition to these collections, eight of the smaller herbaria of cantonal museums (usually the 'Naturmuseum') were contacted. Two lichen collections (Graubünden & Neuchâtel) were not available for technical reasons, and four others (Aargau, Luzern, Solothurn & Thurgau) reported no relevant material. Only six other Swiss specimens were located in the remaining herbaria contacted (Basel & St. Gallen); therefore, few specimens are to be expected in the herbaria not included in this overview.

More than 120 specimens of *Chaenothecopsis* were seen during this study; roughly 60% belonging to the three species, *C. pusilla*, *C. rubescens* and *C. viridialba*. The *C. pusilla* specimens originated from different collectors; by contrast, most of the *C. rubescens* specimens were distributed by Hegetschweiler and Hepp. It appears as if Swiss botanists of the 19th century did not collect in the Prealps, because the rather widespread *C. viridialba* is not represented in

old collections. Moreover, no specimens on saxicolous lichens were seen, and *Chaenothecopsis* in general was evidently not collected in Switzerland in the years 1900–1950.

Collection localities on certain old herbarium labels are lacking or rather vague, for example 'K.Z.' or 'Z.H.' mentioned for the Canton of Zurich; moreover, many labels lack a collection date. Unfortunately, these specimens can hardly be used for a comparison of past species distributions. Several of the revised specimens were in a poor state or worthless, because of the lack of appropriate preparation at the time of collection, distribution or storage. In both old and recent specimens, many apothecia were broken off and the tiny capitula lost. Consequently, any collection of species with pin-like apothecia should include an appropriate preparation for storage in the herbarium (e.g. in small boxes).

### The Species

The better known synonyms and those encountered during the present revision are cited. Information about species distribution was taken from Tibell (1999) if not otherwise referenced.

#### *Chaenothecopsis consociata* (Nádv.)

##### A. Schmidt

Parasite or parasymbiont on *Chaenotheca chrysocephala*; widespread in the Northern Hemisphere. Collected mainly from *Picea abies* in the Swiss Alps and Northern Prealps.

*Specimens examined.* BE:<sup>1</sup> Rütli b. Riggisberg, 1989, *R. Camenzind* & *E. Wildi* 311 (G). GR: Salouf, *Larix decidua*, 1997, *I. Roth* 8029 (G). OW: Alpnach, 1964, *Ed. Frey* 26.938 (G). SG: Quarten, 2002, *E. Zimmermann* 7422/02 (hb. Zimmermann). SZ: Muotathal, 1989, *U. Groner* 765 (hb. Groner). UR: Altdorf, 1997, *M. Dietrich* 5945 (G).

#### *Chaenothecopsis debilis* (Sm.) Tibell

Saprobic on lignum of different trees; widely distributed in temperate and cool

<sup>1</sup>Swiss Cantons, abbreviated in the official style with two capital letters.

temperate areas of both hemispheres. Two Swiss records from wood, one on bark.

*Specimens examined.* BL: Lauwil, *Schaffert* (BAS). BS: Basel, *Quercus* sp., 1893, *Schaffert* (BAS). SZ: Muotathal, 2003, *U. Groner* 2771 (hb. Groner).

#### *Chaenothecopsis epithallina* Tibell

Parasitic or parasymbiotic on the thallus of *Chaenotheca trichialis*, in the Northern Hemisphere. Specimens collected on conifers in the Alps and Prealps.

*Specimens examined.* OW: Sachseln, *Abies alba*, 1997, *E. Zimmermann* (hb. Zimmermann). SZ: Muotathal, *Picea abies*, 2004, *U. Groner* 2821 (hb. Groner). VS: Grône, *Larix*, 1995, *C. Keller* 11580 (G).

#### *Chaenothecopsis hospitans* (Th.Fr.) Tibell

*Chaenothecopsis exserta* (Nyl.) Tibell

On corticolous *Lecanora* and saxicolous *Haematomma ochroleucum* as a parasite or parasymbiont; known from Central Europe, Scandinavia and the Caucasus (Tibell & Ryman 1995). Only two collections; on *Lecanora albella* in the Northern Prealps and *L. cf. carpinea* in the Southern Alps.

*Specimens examined.* GR: Brusio, *Acer pseudoplatanus*, 1995, *U. Groner* 4205 (G); SZ: Muotathal, *A. pseudoplatanus*, 1987, *U. Groner* 486 (hb. Groner).

#### *Chaenothecopsis nana* Tibell

Saprobic species mostly on bark of *Picea abies* in humid forests; widely distributed in both hemispheres. Species found in the Jura, in the Prealps and Alps.

*Specimens examined.* GR: Schiers, 1961, *Ed. Frey* 27.384 (G). JU: Les Bois, 2001, *E. Zimmermann* (hb. Zimmermann). LU: Flühli, 2005, *M. Dietrich* (hb. Dietrich). SZ: Muotathal, 1991, *U. Groner* 1192 (hb. Groner). VS: Grimentz, 1996, *E. Zimmermann* (hb. Zimmermann).

#### *Chaenothecopsis ochroleuca* (Körb.) Tibell & K. Ryman

*Chaenothecopsis koerberi* (Nádv.) Tibell

Parasite or parasymbiont on corticolous *Haematomma ochroleucum*; currently known

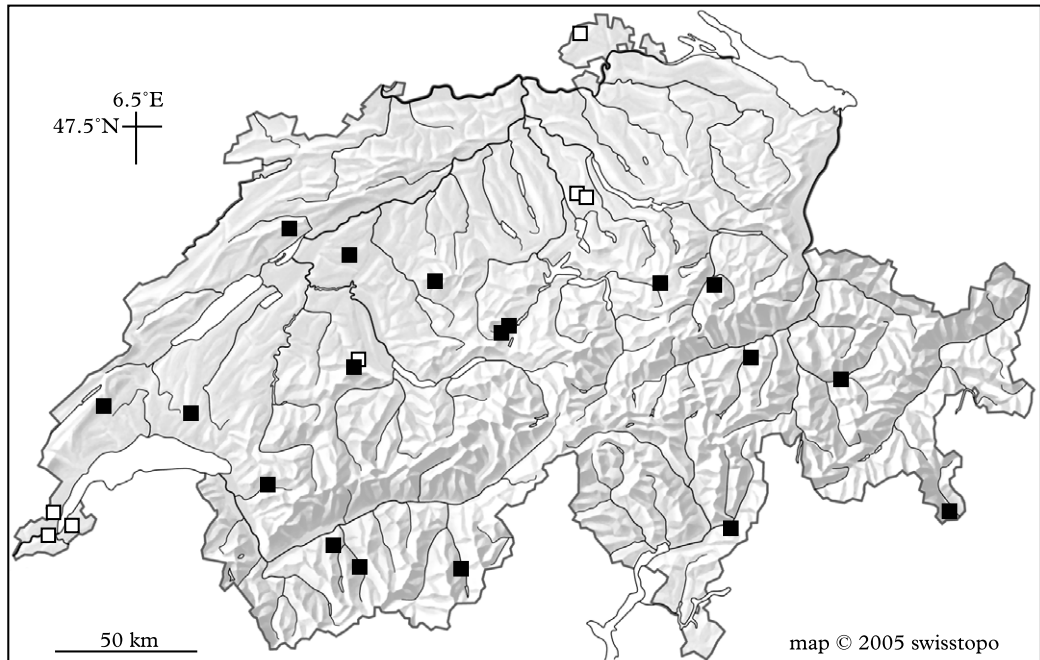


FIG. 1. The distribution in Switzerland of *Chaenothecopsis pusilla*; □ collected before 1900, ■ after 1950.

from Europe and other regions of the Northern Hemisphere (Tibell & Ryman 1995; Selva & Tibell 1999; Titov 2000). Two Swiss specimens from deciduous trees in the Alps.

*Specimens examined.* BE: Lauenen, *Alnus* sp., 1961, Ed. Frey 24.589 (G). SG: Grabs, *Acer pseudoplatanus*, 1995, C. Keller 10682 (G).

### ***Chaenothecopsis pusilla* (Ach.)**

**A. Schmidt**

*Chaenothecopsis parasitaster* (Bagl. & Carestia) D. Hawksw.  
*Chaenothecopsis subpusilla* (Vain.) Tibell

Widely distributed; occurring in Eurasia and North America, as well as in Australasia, Central and South America. This is the most frequent and widespread taxon with collections from many parts of Switzerland. Records include saprobic specimens on bark and wood, a single collection on resin, and parasitic/parasymbiotic specimens on *Cladonia* squamules, on algae and *Chaenotheca* species. More than 20 specimens seen from

old and recent locations (Fig. 1). Possibly a complex of unresolved species (Tibell 1999).

*Specimens examined.* Too numerous to cite individually.

### ***Chaenothecopsis pusiola* (Ach.) Vain.**

*Chaenothecopsis lignicola* (Nádv.) A. Schmidt

Taxon with a wide distribution in the boreal zone of the Northern Hemisphere; also occurring in New Zealand. Parasite or parasymbiont on *Chaenotheca* species growing on lignum predominantly of conifers. The two Swiss specimens, both from the Prealps, are associated with *Chaenotheca xyloxena*.

*Specimens examined.* LU: Flüfli, wood of *Pinus sylvestris*, 2005, U. Groner 2888 (hb. Groner). SZ: Muotathal, wood of *Picea*, 2004, U. Groner 2848 (hb. Groner).

### ***Chaenothecopsis retinens* (Nyl.) Tibell**

This species has long been known from the Channel Islands only (Jersey; Tibell &

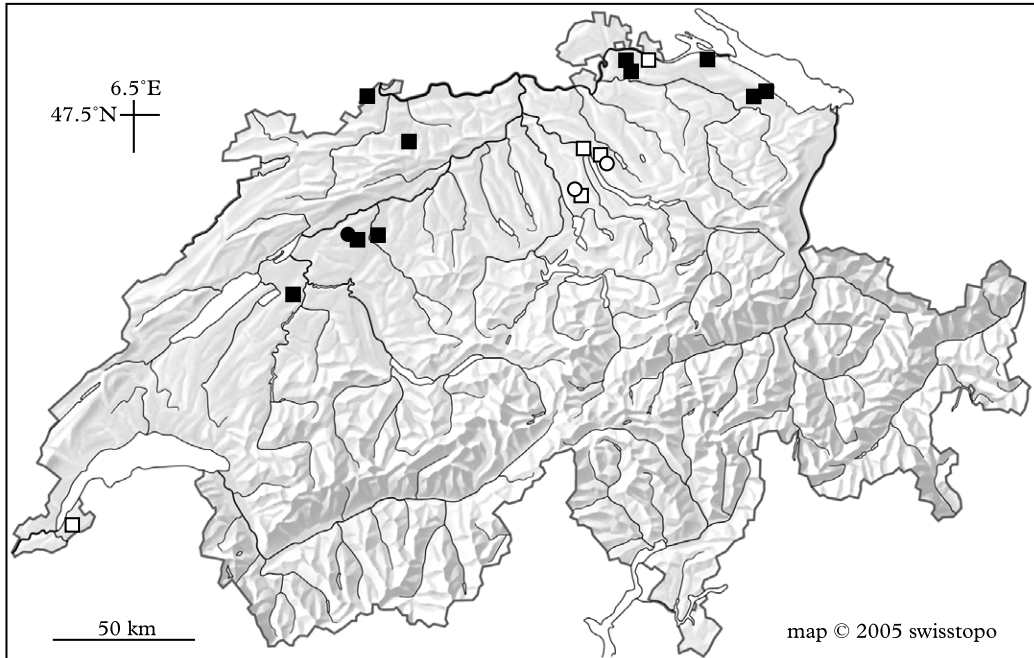


FIG. 2. The distribution in Switzerland of *Chaenothecopsis retinens* (●) and *C. rubescens* (■); ○□, collections before 1900; ●■, after 1950. Multiple collections from the same area are not differentiated.

Ryman 1995); it was recently discovered in England (Hitch 2003), and also in Switzerland. During the present revision *C. retinens* turned up twice in old collections of *C. rubescens*, on *Arthonia byssacea* found on *Quercus* sp. (Fig. 2). The specimen in Z-ZT, collected by Hegetschweiler, was part of Schaerer's *Lich. Helv. exs.* as '250. *Calicium nigricans*'. However, *C. retinens* was not found on the corresponding duplicates in G and BAS. A recent search for both species at Zollikon, the 1852 locality near Zurich was not successful.

*Specimens examined.* SO: Messen, *Quercus robur*, 2003, E. Zimmermann 6022/57 (hb. Zimmermann). ZH: Zollikon, 1852, C. Cramer (Z-ZT); Rifferswil, K. Hegetschweiler, Schaerer *Lich. Helv. exs.* no. 250 (Z-ZT).

### ***Chaenothecopsis rubescens* Vain.**

*Calicium albo-atrum* Flörke  
*Calicium nigricans* Schaer.  
*Cyphelium alboatrum* auct.

Parasitic or parasymbiotic on *Trentepohlia* and crustose lichens containing *Trentepohlia*;

in more or less temperate areas of the Northern Hemisphere only. In Switzerland predominantly on *Arthonia byssacea* growing on *Quercus*, less often on *Fraxinus*. Over 25 old and recent specimens seen (many duplicates), mostly from the Central Plateau (Fig. 2).

*Specimens examined.* Too numerous to cite individually.

### ***Chaenothecopsis savonica* (Räsänen) Tibell**

*Chaenothecopsis alboatra* auct., pro parte

Parasitic or parasymbiotic on lichen thalli or on algae on wood, more rarely on bark; widespread in cool temperate and temperate regions of the Northern Hemisphere, of South America and Australasia. Collected in the Southern Alps and in the Northern Prealps, from bark and wood.

*Specimens examined.* BE: Konolfingen, 1983, P. Clerc 83/49 (G); Rüti b. Riggisberg, 1988, R. Camenzind & E. Wildi 539 (G). GR: Bondo, 1991, C. Scheidegger (hb.

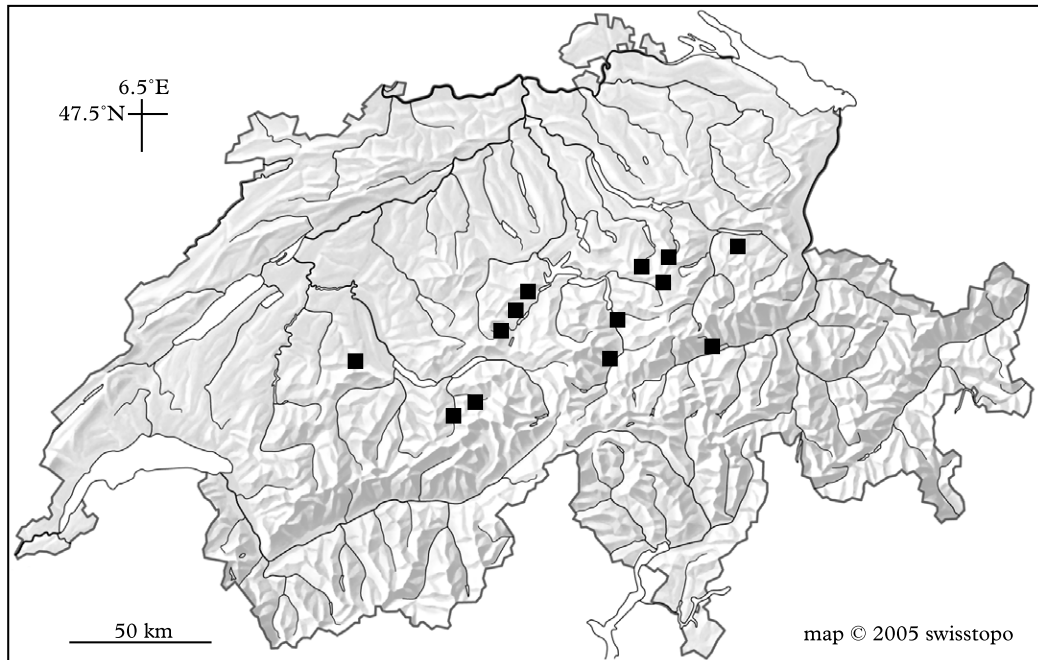


FIG. 3. The distribution in Switzerland of *Chaenothecopsis viridialba*.

Scheidegger). SZ: Muotathal, 1987, U. Groner 485 (hb. Groner).

*Specimen examined.* SZ: Muotathal, *Picea*, 1989, U. Groner 810 (hb. Groner).

### ***Chaenothecopsis tasmanica* Tibell**

Widely distributed in both hemispheres (Selva & Tibell 1999), but seldom reported from Europe. Parasitic or parasymbiotic on lichens with trebouxoid algae or on algal colonies. Currently a single Swiss location known in the Prealps; specimen found on thallus of *Chaenotheca chrysocephala*.

*Specimen examined.* SZ: Muotathal, on old *Picea*, 2004, U. Groner 2843 (hb. Groner).

### ***Chaenothecopsis vainioana* (Nádv.) Tibell**

Parasite or parasymbiont on algal colonies or lichens containing *Trentepohlia*; on deciduous trees, shrubs and conifers. Known to occur in temperate parts of Scandinavia, the British Isles and South America (Tibell 1998). Collected once in the Prealps growing on *Lecanactis abietina*.

### ***Chaenothecopsis viridialba* (Krempelh.) A. Schmidt**

Widely distributed in the boreal zone of the Northern Hemisphere. Saprobic on bark and wood; on Swiss specimens often associated with *Chaenotheca chrysocephala*. Rather regularly found in coniferous forests at higher altitudes, but not represented in old collections. More than 10 locations known in the country (Fig. 3).

*Specimens examined.* Too numerous to cite individually.

### ***Chaenothecopsis viridireagens* (Nádv.) A. Schmidt**

Saprobic, or parasitic on algae or lichens. Occurs in both hemispheres, distributed approximately as *C. pusilla*, but in Switzerland less frequent. Specimens from

bark and wood of conifers in the Alps and the Prealps.

*Specimens examined.* BE: Röthenbach, *Abies*, 1959, Ed. Frey 21.464 (G). BL: Liestal, *Pinus*, Schaffert (BAS). GR: Sent, *Pinus*, 1997, U. Groner 11901 (G); *Picea*, 1998, M. Frei 19920 (G). SZ: Muotathal, *Picea* wood, 2003, U. Groner 2765 (hb. Groner).

*Species currently not recorded in Switzerland, though present in Europe:*

**Chaenothecopsis brevipes** Tibell—reported from Spain (Tibell & Ryman 1995) and the Caucasus (Titov 1998); also known from North America, the Russian Far East, New Zealand (Tibell & Ryman 1995), South America (Tibell 1998) and China (Titov 2000).

**C. caespitosa** (Phillips) D. Hawksw.—known only from England (Coppins 1992).

**C. fennica** (Laurila) Tibell—a species of Northern Europe, possibly endemic.

**C. haematopus** Tibell—reported from Scandinavia (northern Sweden); widely

distributed in both hemispheres (Selva & Tibell 1999).

**C. irregularis** Titov—first European record from Russia (Titov pers. comm.) known from the Russian Far East (Titov & Tibell 1993), China (Titov 2000) and North America (Selva & Tibell 1999).

**C. nigra** Tibell—widely distributed in Central Europe, Scandinavia and the British Isles, also known from South America (Tibell 1998) and Australasia.

**C. subparoica** (Nyl.) Tibell—at present known from different parts of Europe and from North America (Peterson & Rikkinen 1999).

**C. trassii** Titov—described from the Caucasus (Titov 1998); another record from China (Titov 2000).

**C. ussuriensis** Titov—first western record from the Caucasus (Titov 1998); known from the Russian Far East (Titov & Tibell 1993), North America (Peterson & Rikkinen 1999) and China (Titov 2000).

**Key to European non-resiniculous *Chaenothecopsis* species**

- 1 Spores simple . . . . . 2
- Spores 1-septate . . . . . 13
- 2(1) On crustose lichens (*Haematomma ochroleucum*) on shaded siliceous rocks. Apothecia sessile to short-stalked; K+ red . . . . . *C. hospitans* 7
- Parasitic or saprobic, on bark and wood, rarely on saxicolous lichens . . . . . 3
- 3(2) Apothecia (particularly stalk) white pruinose or granular . . . . . 4
- Apothecia epruinose, stalk not granular . . . . . 6
- 4(3) Apothecia K−, N−; 0.25–0.45 mm tall. Stalk granular, rough, often white-pruinose, or shiny black; outer part of stalk with anticlinal hyphae. Hypothecium brown, well delimited; asci 25–35 μm. Spores obliquely or anticlinally orientated, 4.2–5 × 2.2–2.8 μm, surface with cracks. Saprobian on bark and wood . . . . . **C. ussuriensis**
- Apothecia K+ red, green or greenish . . . . . 5
- 5(4) Capitulum K+ red (fast fading), partly K+ green. Sessile to short-stalked, 0.25–0.5 mm tall; stalk pale brownish, with whitish granular pruina. Spores 6–9(–12) × 3–4.5 μm, fusiform. On corticolous *Haematomma ochroleucum* or *Lecanora* sp. . . . . **C. ochroleuca**
- Hypothecium and stalk in squash reddish brown, K+ green (aeruginose). Apothecia long-stalked, white-pruinose to -granular. Spores 6–10 × 2.5–3.5 μm, ellipsoid. On bark (particularly of *Picea*) or wood; saprobic, or associated with *Chaenotheca* . . . . . **C. viridialba**



- 6(3) Apothecia sessile or short-stalked, 0.1–0.4 mm . . . . . 7  
 Apothecia taller, >0.4 mm . . . . . 8
- 7(6) On corticolous *Lecanora* or saxicolous *Haematomma ochroleucum*. Apothecia sessile to short stalked, 0.1–0.3 mm; black. Stalk blackish, or pale below. Exciple and stalk with yellowish to red pigment, K+ red. Spores dark brown, 7.5–10 × 3.9–5 μm . . . . . **C. hospitans**  
 Associated with *Trentepohlia* or without photobiont, on bark. Apothecia 0.2–0.4 mm; black. Reddish pigment (crystals) K+ green (aeruginose). Spores pale brown, 5–8 × 2–3 μm . . . . . **C. trassii**
- 8(6) Apothecia K+ red or green; capitulum black . . . . . 9  
 Apothecia not K+ red or green, K+ or K– . . . . . 10
- 9(8) Apothecia 0.4–0.8 mm; stalk black to brown. Head and stalk in squash yellowish or greenish brown, pigmented parts K+ red. Spores 5–9 × 2.5–3.5 μm, surface minutely ornamented (x1000). On *Trentepohlia* or *Arthonia* species mainly on deciduous trees . . . . . **C. rubescens**  
 Apothecia 0.8–3.2 mm; stalk blackish to greyish brown (or dark red). Hypothecium and stalk with red crystals, K+ aeruginose. Exciple poorly developed. Spores 3.5–6 × 2–3.5 μm, ellipsoid, smooth. On wood; not associated with algae . . . . . **C. haematopus**
- 10(8) Asci 30–70 μm long . . . . . 11  
 Asci shorter, 22–35 μm . . . . . 12
- 11(10) Apothecia 0.7–1.6 mm; head and upper part of stalk sometimes pruinose. Outermost stalk layer consisting of brown interwoven hyphae. Asci 45–67 μm, apex penetrated by a canal. Spores narrowly ellipsoid, 6–9(–12) × 3.5–4.5 μm; sometimes with thin, unpigmented septum. K–, or greenish parts K+ intensifying, N–. Saprobiic on bark and wood of conifers . . . . . **C. irregularis**  
 Apothecia 0.4–1.2 mm. Stalk dark greenish to dark brown, with periclinal, sclerotized hyphae. Asci 30–60 μm, apex uniformly thickened, without canal. Spores ellipsoid-subfusiform, 5.5–9 × 2.5–4.5 μm, often accumulating on hymenium when mature. K–, N–, or slightly reddish brown. Saprobiic, mainly on wood . . . . . *Mycocalicium subtile* (Pers.) Szat.
- 12(10) Apothecia 0.4–1 mm. Spores pale greenish brown, with rounded ends, 4.5–7 × 2–3 μm. Exciple and stalk brownish (K–, N–) or greenish brown to blackish (K+ yellow brownish, N± greenish intensified). Parasite on calicioid lichens or algae, on wood and bark . . . . . **C. savonica**  
 Apothecia 0.4–0.8 mm. Spores dark brown, ellipsoid-fusiform, 5–7(–8.5) × 2.5–3.5 μm, oblique in semi-mature asci. Stalk brown to black, surface rarely glossy whitish. All parts K–, N–. Saprobiic, mainly on bark of conifers, rarely on wood (check *C. ussuriensis*) . . . . . **C. nana**
- 13(1) Apothecia large, 2–4 mm, in compact tufts, black. Spores 9–14 × 3–4.5 μm. On decaying polypores and rotten bark; not associated with algae . . . . .  
 . . . . . **C. caespitosa**  
 Apothecia <2 mm; scattered or aggregated . . . . . 14
- 14(13) Capitulum bluish white-pruinose or glaucous; spore septum distinct . . . . . 15  
 Capitulum not pruinose or glaucous . . . . . 16

- 15(14) Capitulum faintly bluish white-pruinose. Apothecia 0.9–1.7 mm tall; K–, N+ reddish brown. Asci 46–54  $\mu\text{m}$ , mature asci with widened apical canal; spores 7.5–9  $\times$  2.5–3  $\mu\text{m}$ . Saprobic on wood of *Pinus* and *Picea* . . . . . **C. fennica**  
 Capitulum black, often glaucous and/or with irregular shape. Apothecia 0.3–0.8 mm; dark brown to black, reddish brown in water mount, K+ yellowish to reddish brown, N–. Asci 30–50  $\mu\text{m}$ ; spores 5–8  $\times$  2.2–2.8  $\mu\text{m}$ , septum as dark as spore wall. Parasite on trebouxoid algae or crustose lichens containing *Trebouxia*, on bark (check *C. consociata*) . . . . . **C. tasmanica**
- 16(14) On red-fruited *Cladonia* sp.; K–, N– . . . . . *C. pusilla* 27  
 On bark and wood, parasitic or not associated with lichens or algae . . . . . 17
- 17(16) On *Chaenotheca chrysocephala* or *Ch. trichialis*; spores 6–8  $\times$  2–2.5  $\mu\text{m}$  . . . . . 18  
 Not as described above . . . . . 19
- 18(17) On *Ch. chrysocephala*. Capitulum often irregular and somewhat divided, sometimes grey whitish pruinose. Reddish pigmented parts K+ green (or olive, greenish, after rapidly fading red), N–. Spore septum paler than wall (check *C. tasmanica*) . . . . . **C. consociata**  
 On *Ch. trichialis*. Stalk entirely black, or brown below. Hypothecium greenish (aeruginose; K  $\pm$  brownish) or brownish (K–); all parts N–. Spore septum appearing as dark as the spore wall (check *C. pusiola*) . . . . . **C. epithallina**
- 19(17) On saxicolous leprose lichens (*Haematomma ochroleucum*). Apothecia black, short-stalked, 0.2–0.3 mm tall; sometimes aggregated. Outer layer of stalk with strongly sclerotized, intertwined hyphae. Excipulum greenish; K–, N– . . . . . **C. subparoica**  
 Not as above . . . . . 20
- 20(19) Stalk reddish in squash, N+ violet-red, K– or K+ purple, partly greyish. Hypothecium brownish or greenish, N– or N+ green or reddish brown (colour reactions may be hard to detect). Apothecia rarely with bluish white pruina or whitish cottony hyphae on the lower side. Spores sometimes constricted at septum. Not associated with algae; usually on wood . . . . . **C. debilis**  
 Stalk not N+ violet, mostly N–; or without pigments . . . . . 21
- 21(20) Stalk and head with yellow reddish, yellow brownish or greenish pigment, K+ red to purple, fast dissolving; N+ green, changing to reddish brown. Spore septum pale. Parasitic on *Chaenotheca* sp. or associated with *Stichococcus*; on wood, rarely on bark . . . . . **C. pusiola**  
 Stalk and head without yellowish K+ red pigment; K– or K+ greenish or brownish . . . . . 22
- 22(21) Reddish pigment K+ green, blue-green and/or olive-green. Head subspherical to lenticular. Spores 5–7  $\times$  1.8–2.8  $\mu\text{m}$ , septum thin, pale. Parasitic on *Calicium*, *Chaenotheca* (not *chrysocephala*) or on *Stichococcus*; on wood, rarely on bark . . . . . **C. viridireagens**  
 Without K+ greenish pigment . . . . . 23
- 23(22) Apothecia sessile to short-stalked, 0.1–0.25 mm tall; N– . . . . . 24  
 Apothecia >0.3 mm . . . . . 25

- 24(23) On *Arthonia* and *Lecanactis* sp. Stalk black, reddish below. Exciple brown, of isodiametric cells, K+ brownish. Spores 6–7 × 2–3 µm. On bark of deciduous trees . . . . . **C. brevipes**  
 On *Schimatomma cretaceum* or *Arthonia* sp. Apothecia almost lecideine, stalk immersed in host thallus; in section red. Exciple reddish, of intertwined hyphae with elongated cells; K–. Spores 7–11 × 2.5–3.5 µm. On *Quercus* . . . . . **C. retinens**
- 25(23) Spore septum darker than spore wall. Stalk black. Hypothecium and stalk in squash greenish, K+ slightly yellowish brown, N–. Spores pale, 5–6.5 × 1.5–2.2 µm. Parasitic on algae (usually *Stichococcus*) or *Chaenotheca* thalli; on wood and bark . . . . . **C. nigra**  
 Spore septum paler than wall . . . . . 26
- 26(25) Apothecia 0.7–1.6 mm; asci large, 45–67 µm . . . . . *C. irregularis* 11  
 Apothecia <1 mm; asci <52 µm long . . . . . 27
- 27(26) Associated with *Trentepohlia* or lichens containing *Trentepohlia*. Hypothecium <70 µm tall. Spores 6–9(–11) × 2–3(–3.3) µm, septum pale, distinct. Stalk dark brown (to partly colourless). Apothecia K+ dull brown, N+ slowly reddish brown. On bark, rarely on wood . . . . . **C. vainioana**  
 Saprobic, parasitic or loosely associated. Hypothecium usually >80 µm tall. Spores 5–7(–9) × 2–3 µm, septum paler than spore wall. Head black, rarely somewhat glaucous; in section usually greenish to brownish. Stalk black, greenish brown or brown, often pale below. K–, or K+ brownish, N–. On a variety of substrata, mainly bark and wood . . . . . **C. pusilla**

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