

# Clarification of the Nomenclatural Confusion of the Genus *Sparassis* [Polyporales: Sparassidaceae] in North America

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## Abstract

The scientific nomenclature of *Sparassis* [Polyporales: Sparassidaceae] remains confused in most field guides and even in the scientific literature despite a recent series of studies that have clarified much of the systematics of this genus. On the basis of DNA sequences, clamp connections, and morphology, seven described species and one undescribed taxon can be distinguished. All other specific epithets are synonyms, excluded taxa, or *nomina dubia*. At least three species occur in North America: (1) *Sparassis radicata* (often misidentified as *S. crispa*), found in the western portion of the continent, the Great Smoky Mountains and Georgia, (2) *S. spathulata*, widespread in the East, and (3) *Sparassis crispa* [*sensu lato*], which primarily occurs in Europe but possibly also in eastern North America. Other species include *S. brevipes* (northern Europe), *S. miniensis* (northwestern Spain), *S. cystidiosa* (Thailand), *S. latifolia* (China, Japan), and an undescribed taxon that occurs in Australia. Clamp connections are lacking in the context in *S. spathulata*, *S. brevipes*, *S. miniensis*, and the undescribed Australian species, but are present in the other four described species.

**Key Words:** Sparassidaceae, Cauliflower Mushroom, nomenclature, *Sparassis*, *S. spathulata*, *S. radicata*, *S. crispa*, *S. herbstii*.

The scientific nomenclature of *Sparassis* [Polyporales: Sparassidaceae] remains confused in most field guides and even in the scientific literature despite a recent series of studies that have clarified much of the systematics of this genus. Several popular and widely used field guides to North American mushrooms (e.g., McKnight and McKnight, 1987; Lincoff and Nehring, 1997; Russell, 2007) refer to the widespread Eastern Cauliflower Mushroom as *Sparassis crispa*, although numerous studies<sup>2</sup> have shown the vast majority of specimens to be a distinct species, *S. spathulata*. And most field guides<sup>3</sup> and many scholarly papers refer to the Western Cauliflower Mushroom as *Sparassis crispa*. However, compelling evidence indicates that this essentially western fungus also constitutes a distinct species, *S. radicata*. Interestingly, at least two older field guides (Fischer and Bessette, 1992; Roody, 2003)

*Sparassis* Fr. : Fr. 1819 [Polyporales: Sparassidaceae] is a genus of saprobic-parasitic brown-rot fungi found worldwide that cause root and heartwood rot in living trees. The small family Sparassidaceae Hert. contains the sole genus *Sparassis*.<sup>1</sup>

got this right. Curiously, the first set of authors later reversed themselves (Bessette et al., 1997), subsequently referring to the western species as *S. crispa* and the widespread Eastern Cauliflower Mushroom as *S. herbstii* (= *S. spathulata*, see below).

Dikaryon-monokaryon mating crosses were made in which dikaryotic hyphae of European *S. crispa* dikaryotized monokaryotic *S. radicata* isolates and formed clamp connections in the resulting Di-Mon mycelia. This was interpreted as evidence that *S. crispa* and *S. radicata* were conspecific (Martin and Gilbertson, 1976). These workers found *Sparassis* from the southeastern United States to be a distinct species, *S. spathulata*, that differed from both European *S. crispa* and *S. radicata* from western North America (Martin and Gilbertson, 1976; Burdsall and Miller, 1988a). *Sparassis radicata* was thus synonymized with *S. crispa* from Europe; the Japanese samples were likewise referred to *S. crispa* (Martin and Gilbertson, 1976). However, determinations based on the Di-Mon test were not supported by later molecular phylogenies (see below).

This arrangement has been followed by most subsequent authors (e.g., Gilbertson, 1981; Burdsall and Miller, 1988b; Lincoff and Nehring, 1997; Miller and Miller, 2006). Furthermore, Burdsall and Miller (1988a) synonymized all retained species of *Sparassis* with either *S. crispa* or *S. spathulata*, asserting that both species are cosmopolitan.

However, research involving David Hibbett's laboratory has clearly shown a distinct separation between *S. radicata*, *S. spathulata*, and *S. crispa*. Their conclusions were based on DNA sequence analyses, as well as reproductive and morphological criteria (Wang et al., 2004; Desjardin et al., 2004; Dai et al., 2006; Blanco-Dios et al., 2006). *Sparassis crispa* was reported from China (Tai, 1979) and Japan (Imazeki et al., 1998) on the basis of limited information at the time. With additional material and a more complete analysis, this Asian taxon was described as a new species, *Sparassis latifolia*, by Dai et al. (2006).

*Sparassis spathulata*, *S. radicata*, and several other species are often lumped together with *S. crispa* (Wulf.) Fr. However, *S. crispa* [*sensu stricto*] is found mainly in Europe. Despite being listed as

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Figure 1. *Sparassis spathulata*. The characteristic zonation and gentle undulations of the flabellae are clearly visible. Photo: Julian Robichaux.

common in several popular North American mushroom guides, only a very few samples from North America are referable to *S. crispa*; two atypical samples are *incertae sedis* and require further study (Wang et al., 2004). Most eastern collections of cauliflower mushrooms are referable to *S. spathulata*, which has also been called *S. herbstii* Peck [a later synonym of *S. spathulata* (Schwein.) Fr.] or misidentified as *S. crispa*. In western North America, the genus *Sparassis* is represented by *S. radicata* Weir (misidentified as *S. crispa* in most works), which differs from *S. spathulata* in several important respects as discussed below. *Sparassis radicata* also occurs as a disjunct in the Great Smoky Mountains of Tennessee (Wang et al., 2004) and in Georgia (Dr. David Porter, personal communication, January 1, 2009).

Thus, *S. crispa* occurs primarily in Europe and possibly also in eastern North America and two species of *Sparassis* are found exclusively in North America.



Figure 2. *Sparassis radicata*. The highly contorted, "crinkled," and azonate flabellae are clearly shown in this photo. Photo courtesy of Debbie Viess.

## *Sparassis spathulata* (Schwein.) Fr. 1828

### Synonymy:

**Basionym:** *Merisma spathulatum* Schwein. 1822.

*Stereum caroliniense* Cooke and Ravenel 1885 (Burdsall and Miller, 1988a).

*Sparassis herbstii* Peck 1895 (Burdsall and Miller, 1988a).

*Sparassis herbstii*: Bessette et al., 2007; Læssøe and Lincoff, 2002; Stamets, 2005.

**Misapplied name:** *Sparassis crispa*: Smith and Weber, 1980; McKnight and McKnight, 1987; Lincoff and Nehring, 1997; Schaechter, 1997; Stamets, 2005; Miller and Miller, 2006; Russell, 2006 (*non* Wulf. 1788).

**Identifying features:** *Macroscopic:* Basidiome consisting of densely grouped, flat, undulating, vertical branches (flabellae) emerging from a buried, branching, central base; flabellae whitish, yellowish, or tan, with distinct color zonations, becoming discolored with age, margins entire; attaining diameter and height of 35 cm (14–15 inches). *Microscopic:* Context hyphae lacking clamp connections; basidiospores smooth, elliptical,  $5.9\text{--}8.0 \times 4.7\text{--}5.8 \mu\text{m}$  (Wang et al., 2004). Not likely to be mistaken for anything else in most of its range.

**Habit and distribution:** Saprobic/parasitic, emerging singly or in groups from the ground at the base of oaks or pine trees July–October. Widespread in eastern North America, particularly in the South. Type locality: Salem, North Carolina (neotype designated by Burdsall and Miller, 1988a)

**Spore print:** White.

**Edibility:** Delicate flavor when young, becoming tough and less flavorful with age.



Figure 3. *Sparassis crispa*. Note the close resemblance of the flabellae to those of *S. radicata*. These species can be partially distinguished by the form of the base and their distributions. Photo: Igor I Savin.

**Remarks.** Burdsall and Miller (1988a) included *S. simplex* Reid 1958 in the synonymy of *S. spathulata*. However, this was based on a poor specimen from England and these authors expanded the concept of *S. spathulata* (here restricted to eastern North America) to include several European taxa. Material of *S. simplex* (known only from the type material of Reid) was unavailable for the studies of Wang et al. (2004) or Blanco-Dios et al. (2006), despite being included in a key to the known species of *Sparassis* in the latter paper. This taxon should probably be considered a *nomen dubium*.

### *Sparassis radicata* Weir 1917.

#### Synonymy:

*Sparassis radicata*: McKnight and McKnight, 1987; Lincoff and Nehring, 1997

**Misapplied name:** *Sparassis crispa*: Smith, 1949, 1975; Orr and Orr, 1979; Weber and Smith, 1985; Arora, 1986, 1991; Burdsall and Miller, 1988a, 1988b; Metzler et al., 1992; Molina et al., 1993; Læssøe and Lincoff, 2002; Stamets, 2005; Miller and Miller, 2006; Bessette et al., 2007; *Index Fungorum*, <http://www.indexfungorum.org/Names/Names.asp> (*non* Wulf. 1788).

**Identifying features:** *Macroscopic.* Basidiome azonate, uniformly white to yellowish; margins of flabellae variously incised; flabellae anastomosed, vertically subdivided, broad, somewhat contorted, arising from a single, large, thick (2–4 cm, Miller and Miller, 2006), deeply rooted central stalk; attaining a height and width of 50 cm (20 inches) and 35 cm (14–15 inches), respectively. *Microscopic:* Clamp connections present in context hyphae; basidiospores smooth, broadly elliptical to subglobose, slightly smaller than in *S. spathulata*, 3.9–5.0 × 6.3–7.0 μm (Wang et al., 2004), but this feature unreliable.

**Habit and distribution:** Saprobic/parasitic, solitary August–December at the base of conifers, especially *Pseudotsuga menziesii* (Mirb.) Franco, *Pinus muricata* D. Don, and *P. radiata* D. Don. Northern California to southern British Columbia, Idaho, usually in the fall; disjuncts in eastern North America: Tennessee (Wang et al., 2004), Georgia (David Porter, personal communication, January 1, 2009). Type locality: Priest River, Idaho; holotype growing at the base of *Pseudotsuga menziesii* (Burdsall and Miller, 1988a).

**Spore print and edibility:** As for *S. spathulata*.

### *Sparassis crispa* [*sensu lato*] (Wulf.) Fr. 1821

#### Synonymy:

**Basionym:** *Clavaria crispa* Wulf. ex Jacq. 1781  
*Manina crispa* Scop. 1772 (homotypic synonym)  
*Elvella ramosa* Schaeff. 1772

*Masseola crispa* (Wulf.) Kuntze 1891

*Clavaria crispa* (Scop.) Sacc. 1910

*Sparassis radicata*: of authors (in part, *non* Weir 1917)

*Sparassis crispa*: of authors, e.g., Martin and Gilbertson, 1976; Burdsall and Miller, 1988a; Wang et al., 2004

**Misapplied name:** *Sparassis spathulata*: of authors (in part, *non* Schwein. 1822)

**Identifying features:** *Macroscopic.* Basidiome azonate, uniformly white to yellowish, similar to *S. radicata*; Broad, short, dissected, contorted flabellae arising from several elongate flattened branches; attaining height and width of 40 cm (15.7 inches) and 20 cm (7.8 inches), respectively, occasionally larger. *Microscopic:* Clamp connections present in context hyphae; basidiospores smooth, elliptical, 4.9–6.9 × 4.0–4.9 μm (Wang et al., 2004).

**Habit and distribution:** Eastern North America (Massachusetts and Georgia; Wang et al., 2004) and Europe. August–December at the base of conifers. Type locality: Etterzhausen, Germany, at base of *Pinus sylvestris* L. (neotype designated by Burdsall and Miller, 1988b).

**Spore print and edibility:** As for *S. spathulata*.

**Remarks:** Eastern North American and European *S. crispa* are morphologically identical. However, molecular data do not confirm that the samples from both locations are conspecific. Two atypical isolates, one each from Massachusetts and Georgia, did not nest conformably in the *crispa* clade and are in need of further study (Wang et al., 2004).

#### Key to North American *Sparassis*

1. Flabellae zonate, clamp connections lacking, associated with conifers and hardwoods..... *S. spathulata*
- 1' Flabellae azonate, clamp connections present, restricted to conifers..... 2
2. Flabellae arising from an unbranched cylindrical stalk ..... *S. radicata*
- 2' Flabellae arising from a branched base ..... *S. crispa*

Polyporoid fungi primarily cause white rot; those that produce brown rot may constitute an evolutionarily derived clade (Hibbett and Donoghue, 2001 and references therein). The genera *Sparassis* and *Phaeolus* Pat.<sup>4</sup> constitute a monophyletic group that causes brown rot in living trees and exhibits a bipolar mating system (Wang et al., 2004).

#### Other species of *Sparassis* from around the world

*Index Fungorum* (IF), as of January 1, 2009, listed 14 species names in *Sparassis*.

*Sparassis minoensis* was listed in *IF* as a misapplied orthographic correction of *S. miniensis* Blanco-Dios and Wang, 2006. The *International Code of Botanical Nomenclature*, Vienna Code, 2005, Art. 60.1 states, "The original spelling of a name or epithet is to be retained, except for the correction of typographical or orthographical errors . . ." and Rec. 60D.1 states that "An epithet derived from a geographical name is preferably an adjective and usually takes the termination -ensis, -(a)nus, -inus, or -icus." Since the naming authorities for this species (Blanco-Dios and Wang, 2006) consistently used the epithet *miniensis* throughout their paper, including the abstract, this spelling was clearly intentional and was neither a mistake nor a typographical or orthographical error to be corrected. They began their species description as follows: "*Sparassis miniensis* Blanco-Dios and Zheng Wang, sp. nov. *Etym.*: *miniensis*, from the river Miño, Galicia (Spain)."

In response to our query, one of the authors confirmed that the species was definitely named for the Miño River region where it was found. He noted that the name of the Miño River comes from the Latin *Minius*. Rec. 60D. 1 of the *ICBN* recommends an adjective for an epithet derived from a geographical name. The adjectival form of *Minius* is *minio-*, and *miniensis* thus is the correct way to build up a specific epithet based on the *Río Miño* area (Zheng Wang, personal communication, 30 January 2009).

The epithet *miniensis* is thus *not* a typographical or orthographical error, but was clearly the intended form of the name. *Index Fungorum* therefore erred in emending it and *Sparassis miniensis* must be retained as the only correct and validly published name for this taxon.

We offer the following comments regarding the remaining epithets in *Index Fungorum* (*IF*):

- ◆ *Sparassis herbstii* Peck 1895 is a synonym of *S. spathulata* (Schwein.) Fr. 1828; *IF* incorrectly lists it as a synonym of *S. laminosa* Fr. 1836.
- ◆ *S. laminosa* and *S. nemecii* are synonyms of *S. brevipes* (see footnote 5).
- ◆ *S. ramosa* (Schaeff. 1772) is a synonym of *S. crispa* (Burdsall and Miller, 1988b).
- ◆ *S. simplex* was included as a synonym of *S. spathulata* in *IF*. We commented on this above. We don't know what this taxon is and it probably should be considered a *nomen dubium*.
- ◆ Types or authenticate material for *S. foliacea* St. Amans 1821 and *S. kazachstanicus* Shvartsman 1964 have not been available for study, and these names should probably be considered *nomina dubia* (Burdsall and Miller, 1988a).
- ◆ *Sparassis tremelloides* Berk. 1873 is listed as a validly published name in *Index Fungorum*. However, Burdsall and Miller (1988a) examined the type and relegated it as a synonym of a jelly fungus name, *Tremella reticulata* (Berk. 1856).



Figure 4. *Sparassis latifolia* found in China. Photo courtesy of Dr. Yucheng Dai.

Excluding these synonyms and *nomina dubia*, we are left with seven described species of *Sparassis* plus an undescribed species from Australia, "*Sparassis* sp. AUS31" (Desjardin et al., 2004; Wang et al., 2004; Blanco-Dios et al., 2006), all of which can be distinguished on the basis of basidiome structure and the presence or absence of clamp connections in the context hyphae:<sup>5</sup> *S. crispa* (Europe and possibly eastern North America), *S. brevipes* Krombh. 1834 (northern Europe),<sup>6</sup> *S. miniensis* Blanco-Dios and Wang, 2006 (in Blanco-Dios et al., 2006; northwestern Spain), *S. spathulata* (eastern North America), *S. radicata* (western North America), *S. cystidiosa* Desjardin and Wang, 2004 (in Desjardin et al., 2004; Thailand), and *S. latifolia* Dai and Wang 2006 (in Dai et al., 2006; China, Japan).

Clamp connections are present in the context hyphae in *Sparassis crispa*, *S. radicata*, *S. latifolia*, and *S. cystidiosa*, but are absent in *S. spathulata*, *S. brevipes*, *S. miniensis*, and the undescribed taxon from Australia. *Sparassis crispa* (Europe) and *S. radicata* (western North America) form clamp connections and are associated strictly with conifers (Desjardin et al., 2004; Wang et al., 2004). *Sparassis cystidiosa* also forms clamp connections and is restricted to the order Fagales (beeches, oaks, and related trees); *Sparassis spathulata* (eastern North America) and *S. brevipes* (northern Europe) do not form clamp connections and are associated with both conifers and Fagales (Desjardin et al., 2004). The size of the basidiospores is highly variable with considerable overlap between species and intraspecific inconsistencies in different reports (Blanco-Dios et al., 2006). This feature is of doubtful taxonomic value.

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greatly improved the paper. Dr. Zheng Wang, Yale University, very kindly provided critical nomenclatural information about *Sparassis miniensis* and offered helpful suggestions on the final version of our manuscript.

### End Notes

1. The monotypic genus *Sparassiella* Shvartsman was included in the family Sparassidaceae by Kirk et al. (2001), but no specimens are available for study; it appears to be very similar to *Sparassis* (Burdsall and Miller, 1988a).
2. For example, Martin and Gilbertson, 1976; Burdsall and Miller, 1988a; Wang et al., 2004; Desjardin et al., 2004; Dai et al., 2006; Blanco-Dios et al., 2006). And most field guides (e.g., Orr and Orr, 1979; Weber and Smith, 1985; Arora, 1986; Læssøe and Lincoff, 2002; Stamets, 2005; Miller and Miller, 2006).
3. For example, Orr and Orr, 1979; Weber and Smith, 1985; Arora, 1986; Bessette et al., 2007; Læssøe and Lincoff, 2002; Stamets, 2005; Miller and Miller, 2006.
4. A small genus with only four species that somewhat resemble *Sparassis*; however, the lamellae are thicker, more robust, and much more horizontal than in *Sparassis*. *Phaeolus schweinitzii* (Fr.) Pat. is widespread in North America.
5. Clamp connections are lacking in the context hyphae of *S. spathulata* and *S. brevipes*, but they may be present in the subhymenium and at the base of the basidia (Dai et al., 2006).
6. Synonyms include *S. laminosa* Fr. 1836 and *S. nemecii* Pilát and Vesely 1933 (Kreisel, 1983).

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Figure 5. *Sparassis miniensis* found in Spain. Photo courtesy of Jaime Blanco-Dios.

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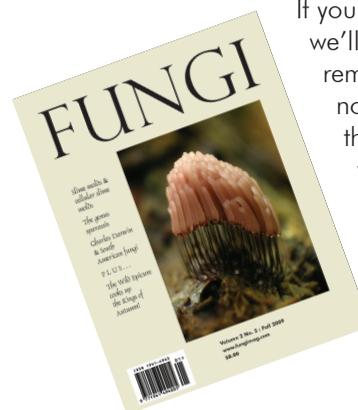
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