



A. Sporocarp (bar = 1 mm). B. Sporocarp (bar = 1 mm). C. Capillitium and spores (bar = 10 µm) [Photographs: A. Michaud].

Didymium dubium Rostaf., *Śluzowce (Mycetozoa) Monografia* Paris: 152 (1874, publ. 1875). [*Index Fungorum* 154052]

Physarum tussilaginis Berk. & Broome, *Annals & Magazine of Natural History Series 4*, **17**: 139 (1876). [*Index Fungorum* 247130]

Didymium tussilaginis (Berk. & Broome) Masee, *Monograph of the Myxogastres*: 244 (1892). [*Index Fungorum* 461891]

Didymium wilczekii Meyl., *Bulletin de la Société Vaudoise des Sciences Naturelles* **44**: 290 (1908). [*Index Fungorum* 185163]

Diagnostic features. Nivicolous species of *Didymium* can be identified provisionally in the field by the architecture and colour of the plasmodiocarps. *Didymium dubium* in particular has continuous white to pale grey plasmodiocarps with scattered depressions in the surface.

Sporocarps generally as plasmodiocarps, bolster-shaped or long and narrow and sometimes strongly curved, up to 0.3 mm high, 1–7 mm wide and up to 15 mm long, grey, with a surface covered by star-shaped lime crystals similar in size to the spores; the sporocarp floor often with a calcareous layer. *Hypothallus* inconspicuous. *Peridium* single-layered, membranous. *Columella* not observed. *Capillitium* radiating from the base, thin, branched, wavy to spirally coiled in the centre, colourless, elastic, forming a lax network and protruding after dehiscence of the peridium. *Spores* in mass dark brown, individually pale lilac-grey, globose, 10–12 µm diam., densely warted. *Plasmodium* yellow.

ASSOCIATED ORGANISMS & SUBSTRATA: **Animalia.** *Aves* indet. (dung); *Equus* sp. (dung); *Oryctolagus cuniculus* (L.) (dung). **Plantae.** *Carduus carlinoides* Gouan; *Digitalis purpurea* L.; *Empetrum nigrum* L.; *Gramineae* indet.; *Ilex aquifolium* L. (leaf); *Larix* sp.; *Larrea tridentata* Coville (stem); *Lonicera* sp. (branch, stem); *Lupinus* sp.; *Muscopsida* indet.; *Nardus stricta* L.; *Opuntia* sp. (cladode); *Picea abies* (L.) H. Karst.; *Plantae* indet. (bark, detritus, litter); *Rubus idaeus* L. (branch, stem), *Rubus* sp.; *Tussilago* sp. (leaf); *Urtica* sp. (branch, stem); *Vaccinium myrtillus* L.; *Yuca* sp. (leaf). **Other substrata.** Artefact (industrial wood).

INTERACTIONS & HABITATS: The ecological rôle played by myxomycetes (see Notes below) remains poorly understood. In general, these organisms are thought to be mainly saprobic, feeding only during their vegetative (also called ‘plasmodial’) state, and not feeding when in their fruiting state. They may be encountered on living plant material (e.g. leaves and twigs) in both vegetative and fruiting states, but in such cases the plant material is only a substratum, not a source of nutrition. When myxomycetes are found in their vegetative state specifically on dead plant material, that material may be both a substratum and a source of nutrition. It is also possible that, in their vegetative state, myxomycetes feed on dead animal remains, living and dead bacteria, fungal hyphae and spores, and other organic material. Nothing is known about interactions between the present species and other organisms, but its associated organisms, ecological preferences and geographical distribution suggest that, in interactions, it is similar to this general picture. *Didymium dubium* is one of the so-called ‘nivicolous’ or snowline myxomycetes, found on both living and dead plant material next to melting snow patches in mountainous habitats, typically where there is high insolation in spring. In the ‘nivicolous’ habitat, snow cover prevents abrupt soil temperature changes between night and day, provides free water and a ground-level microclimate beneath or near the melting snow favourable for development of vegetative and fruiting stages. RONIKIER & RONIKIER (2009), reviewing this ecological group, found they were typically montane, i.e. upland forest zone, in distribution rather than subalpine or alpine. Interestingly, in addition to occupying the nivicolous habitat, *D. dubium* has also been recorded from chaparral and dry grassland, including the Mexican part of the Sonoran desert. There are records varying in altitudinal range from 50 to 4000 m above mean sea level, but the species has been most often found from 1000 to 2000 m.

GEOGRAPHICAL DISTRIBUTION: NORTH AMERICA: Canada (Ontario), Mexico, USA (Alaska, Arizona, California, Colorado, Iowa, Kansas, Missouri, New Jersey, New Mexico, North Dakota, Oklahoma, Utah, Washington). CENTRAL AMERICA: Costa Rica, Guatemala. SOUTH AMERICA: Argentina, Colombia, Venezuela. ANTARCTICA: South Georgia. ASIA: China, India (Himachal Pradesh), Japan, Kazakhstan, Mongolia, Pakistan, Russia (Krasnoyarskyi krai, Respublika Buryatia, Sverdlovskaya oblast, Tiumen oblast). AUSTRALASIA: Australia (New South Wales), New Zealand. CARIBBEAN: Dominican Republic. EUROPE: France, Germany, Italy, Lithuania, Russia (Leningradskaya oblast, Murmansk oblast, Orenburg oblast, Respublika Kareliya, Volgograd oblast), Spain, Sweden, Switzerland, UK, Ukraine. PACIFIC OCEAN: USA (Hawaii).

ECONOMIC IMPACTS: Lack of information makes it impossible to place a monetary value on the ecological rôle of this species. There are no reports of it causing economic damage to crops or other organisms of value to humans, or of its use by humans. Each year, a few field meetings are organized in Europe devoted to the study of nivicolous myxomycetes, which therefore collectively generate low levels of nature tourism.

INFRASPECIFIC VARIATION: None reported.

DISPERSAL & TRANSMISSION: By spores. Insects may play a significant rôle in dispersal, as myxomycete spores are regularly found in their faeces. Other forms of spore dispersal probably include wind and melt water.

CONSERVATION STATUS: Information base. Over 1000 records from 1874 to 2007. The species has been recorded in February, March, April, May, June, July, August, September, October, November, December, with the main fruiting season in the northern hemisphere from April to June. Described by MITCHELL *et al.* (1980) as one of the most common montane snowbank myxomycetes in Colorado. **Threats.** This species is threatened by climate change. The strong association between ‘nivicolous’ myxomycetes and melting snow patches suggests that their distribution is likely to be strongly and negatively affected by global warming as winter snow cover diminishes in mountain regions. This is likely to result in these species gradually moving to higher altitudes and then becoming isolated at the tops of high mountains with no opportunity to move to higher latitudes. **Evaluation.** Using IUCN criteria (IUCN SPECIES SURVIVAL COMMISSION. 2006 *IUCN Red List of Threatened Species*, www.iucnredlist.org. Downloaded on 15 May 2006), the species is assessed globally as near threatened. **In situ.** There are no known conservation plans or activities specifically prepared for this species. **Ex situ.** No preserved living strains of this species are listed by the *World Federation of Culture Collections* (<http://wdcn.nig.ac.jp/wfcc/datacenter.html>).

NOTES: The list of synonyms follows the taxonomy in <http://eumycetozoa.com>. *Didymium dubium* is a myxomycete, i.e. a member of the protozoan phylum *Mycetozoa*. Although not strictly fungi, myxomycetes (also known as ‘slime moulds’) have been studied traditionally by mycologists. The taxonomy of this species remains unsettled. Many of the alpine collections are now regarded as *D. nivicola* Meyl., which has larger, more sharply marked spores and a flaky peridial covering. The lowland collections may be better placed in *D. leptotrichum* (Racib.) Masee (ING, 1999).

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Sources additional to those already cited from literature and the internet include:

- **On-line databases.** *Cybertruffle*, www.cybertruffle.org.uk/robitalia, 6 records.
Fungal Records Database for the British Isles, <http://194.203.77.76/fieldmycology/>, 18 records.
Global Biodiversity Information Facility, <http://data.gbif.org>, 921 records.
Landcare Research New Zealand, <http://nzfungi.landcareresearch.co.nz/html/mycology.asp>, 4 records.
USDA Fungal Database, <http://nt.ars-grin.gov/fungalatabases/index.cfm>, 5 records.
- **Personal communication.** M. Meyer.

See also the following internet pages:

- <http://eumycetozoa.com>;
- <http://slimemold.uark.edu>;
- www.discoverlife.org/mp/20m?kind=Didymium+dubium.

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