



A, B. Sporocarps, habit (bars = 1 mm). C. Spores (bar = 10  $\mu$ m). [Photographs: A. Michaud]

**Physarum mutabile** (Rostaf.) G. Lister, in A. LISTER. *A Monograph of the Mycetozoa* A Descriptive Catalogue of the Species in the Herbarium of the British Museum. Edn 2: 53 (1911). [*IndexFungorum* 434179; *Physaraceae*, *Physarales*]

*Crateriachea mutabilis* Rostaf., *Śluzowce (Mycetozoa) Monografia*: 126 (1874, publ. 1875). [*IndexFungorum* 181310]

*Didymium neapolitanum* Ces., in G.L. RABENHORST & G. WINTER, *Fungi Europaei et Extraeuropaei, Klotzschii Herbarii Vivi Mycologici Continuatio Cent.* 27: no. 2675 (1881). [*IndexFungorum* 613842]

*Physarum crateriachea* Lister, *Guide to British Mycetozoa Exhibited in the Department of Botany, British Museum* Edn 1: 20 (1895). [*IndexFungorum* 586488]

*Vernacular names.* Dutch: *withartkalkkopje*.

*Diagnostic features.* Stalked sporangia bear a superficial resemblance to some phases of *Craterium aureum* (Schumach.) Rostaf., but can be distinguished by the persistent capillitium which retains the sporangial shape after dehiscence and spore dispersal.

*On natural substratum. Plasmodium* watery grey or pale grey. *Hypothallus* white or ochraceous. *Sporocarps* stalked, but sometimes sessile or forming plasmodiocarps to 2 mm long, sometimes forming large colonies. *Sporothecae* subglobose or top-shaped, rugulose to erect-ovoid or cylindrical, 0.3–0.6 mm diam., usually white or pale grey, weathering to yellowish grey. *Stalk* when present yellow or brownish, usually enclosing lime, especially at the base, sometimes limeless. *Peridium* thin, single walls, wrinkled, bearing uniform, sometimes squamulose, smooth cover of white calcareous granules, lime deposits with evenly distributed lime-granules. *Capillitium* small-meshed, intricate, close, persistent, somewhat elastic, network of pale, colourless threads with few lime-knots, the nodes white, rounded, small, varying in size. *Columella* absent, but the lime generally aggregated in the centre to form a clavate pseudocolumella to the top of the sporangium, or shorter and linear in plasmodiocarps, or missing entirely. In the stalked forms tending to form a central, often cylindrical, pseudocolumella, sometimes with large crystalline nodules in the centre. *Spores* black *en masse*, purplish brown in transmitted light, minutely spinulose, 8–10(–12) µm diam.

**ASSOCIATED ORGANISMS & SUBSTRATA:** **Animalia.** *Isoptera* indet. (nest). **Plantae.** *Agave* sp.; *Cinnamomum camphora* (L.) J. Presl; *Dalbergia latifolia* Roxb. (leaf), *D. sissoo* DC. (leaf, pod); *Equisetum variegatum* Schleich. ex F. Weber & D. Mohr (stem); *Eucalyptus* sp.; *Ficus benghalensis* L. (leaf); *Fragaria* sp.; *Gramineae* indet. (leaf); *Hypochaeris* sp. (leaf); *Jatropha curcas* L. (bark); *Muscopsida* indet. (thallus); *Picea* sp. (twig); *Pinophyta* indet. (litter); *Plantae* indet. (bark, leaf, stem, twig, wood); *Poaceae* indet. (straw); *Quercus glauca* Thunb., *Quercus* sp. (leaf); *Saccharum* sp. (leaf); *Tectona grandis* L. f. (leaf); *Urtica dioica* L. (stem, straw). **Associated organism of type specimen.** *Plantae* indet. [as ‘*na suchych liściach*’ (‘on dry leaves’)].

**INTERACTIONS & HABITATS:** Most information about this species is based on sporocarps and spores (the dispersal phase), and observed associations with other organisms usually only indicate the physical substratum on which sporocarps form. Other observations are rare, particularly of trophic phases (myxamoebae and swarm cells [individual haploid amoeba-like cells], and plasmodia [multi-nucleate, diploid, and often extensive cytoplasm]), and dormant phases (microcysts and sclerotia). As a result, very little is known about nutrition and interactions beyond broad statements that myxomycetes feed on living bacteria and fungi, and on non-living organic material (MARTIN & ALEXOPOULOS, 1969). A study of temperate secondary forest in Japan, including the present species, showed that myxomycete diversity is greater when leaf litter is derived from more than one tree species and from tree species with different peaks for leaf fall (TAKAHASHI, 2013). A similar study, in warm temperate forest, also in Japan, investigated seasonality in myxomycete sporocarp production, and noted a peak of sporocarps of the present species in July and August (TAKAHASHI & HADA, 2012). In Costa Rica, a study of the effect of altitude on myxomycete diversity, including the present species, found no correlation (ROJAS *ET AL.*, 2016). This species has been observed on dead and dry leaves, living and dead leaves of grass, dead pods, and vegetation in dune slacks. It has been recorded from the following habitats: amenity & protected areas; coastal sand dunes; deserts (including desert shrub zones); grassland; woodland (including mixed semi-natural woodland); mountains (as a nivicolous species). Beyond what is known generally about the nutrition of *Physarum*, and a single record of this species on termite nests, there is no information about any specific associations with animals, fungi or micro-organisms.

**GEOGRAPHICAL DISTRIBUTION:** AFRICA: Angola, Cameroon, Madagascar, Morocco, Nigeria, Rwanda, Tanzania, South Africa. CENTRAL AMERICA: Costa Rica. NORTH AMERICA: Canada (Ontario), Mexico, USA (Arizona, California, Colorado, Florida, Illinois, Iowa, Kansas, Louisiana, Maryland, Pennsylvania, Texas). SOUTH AMERICA: Argentina, Brazil (Pernambuco, São Paulo), Venezuela. ASIA: China (Jilin), India (Andhra Pradesh, Chandigarh, Himachal Pradesh, Karnataka, Maharashtra, Tamil Nadu, Uttarakhand), Israel, Japan, Papua-New Guinea, Russia (Novosibirsk oblast), Sri Lanka, Taiwan. ATLANTIC OCEAN: Spain (Canary Islands). CARIBBEAN: Cuba. EUROPE: Austria, Belgium, Denmark, France, Germany, Iceland, Italy, Moldova, Netherlands, Norway, Romania, Russia (Moscow oblast, Murmansk oblast), Slovenia, Spain, Sweden, Ukraine, UK. INDIAN OCEAN: Seychelles. Probably cosmopolitan and presumably native throughout its known range. Records up to 3840 m above

sea level in Rwanda, 1570 m above sea level in Mexico [a *GBIF* record, accessed 8 August 2017, given as 5090 m above sea level, is probably 5090 feet = 1550 m above sea level], and 1300 m above sea level in Spain.

**ECONOMIC IMPACTS:** No evaluation has been made of any possible positive economic impact of this fungus (e.g. as a recycler, as a source of useful products, as a provider of checks and balances within its ecosystem, etc.). No reports of negative economic impacts have been found.

**INFRASPECIFIC VARIATION:** No subspecific taxa have been described [*SpeciesFungorum*, accessed 23 August 2017].

**DISPERSAL & TRANSMISSION:** Primarily by airborne spores, particularly for longer distances; some local dispersal may also occur by movement of myxamoebae and plasmodia.

**CONSERVATION STATUS: Previous evaluations.** None. **Information base.** Over 300 records (specimens, databases and bibliographic sources combined, excluding duplicates) from at least 1874 to June 2016, with observations in every month of the year. **Estimated extent of occurrence** [calculated using <http://geocat.kew.org>]. Over 93.2 million km<sup>2</sup> (Africa including Seychelles: 24.5 million km<sup>2</sup>; Asia: 43.0 million km<sup>2</sup>; Europe: 8.2 million km<sup>2</sup>; North America: 8.1 million km<sup>2</sup>; South America: 9.4 million km<sup>2</sup>). **Estimated area of occupancy** [calculated using <http://geocat.kew.org>]. Well over 470 km<sup>2</sup>. The method for estimating area of occupancy has produced an artificially low figure. The species is likely to be under-recorded, despite the admirable and well-organized enthusiasm of often amateur myxomycete experts, because compared with recording of flowering plants and vertebrates, so few people have the skills to search for and identify it. Many of the plants with which it is associated are common and widespread species. **Threats.** Insufficient information to enable threats to be identified. **Population trend.** In general, not known. Occasional in south India (STEPHENSON *ET AL.*, 1993). Of datable records, c. 25% are pre-1961, 65% post-1960 but pre-2001, and 10% post-2000. **Evaluation.** Using IUCN criteria (IUCN SPECIES SURVIVAL COMMISSION. 2006 *IUCN Red List of Threatened Species* [[www.iucnredlist.org](http://www.iucnredlist.org)]. Downloaded on 15 May 2006), the species is assessed globally as Least Concern. **In situ conservation actions.** None explicitly directed at this species, but many of the sites from which it has been recorded are protected, for example as nature reserves. **Ex situ conservation actions.** *Physarum* species grow readily in culture and, using simple techniques, can be induced to sporulate. There are, however, no living strains of this species listed by the Straininfo website [[www.straininfo.net](http://www.straininfo.net), accessed 4 August 2017]. Two partial nucleotide sequences of small subunit ribosomal RNA were found in a search of the NCBI GenBank database [[www.ncbi.nlm.nih.gov](http://www.ncbi.nlm.nih.gov), accessed 13 August 2017].

**NOTES:** The pseudocolumella and very smooth peridium of this species are characteristic. The shape of the sporangium is reminiscent of *C. leucocephalum* (Pers.) Ditmar, but lacking a lid. For further help with identification, the excellent keys provided by POULAIN *ET AL.* (2011) should be consulted.

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- *Discover Life (myxomycete pages)* [[www.discoverlife.org/mp/20q?guide=Myxomycetes](http://www.discoverlife.org/mp/20q?guide=Myxomycetes)].
- *Fungus Conservation Trust CATE2 Database* [[www.abfg.org](http://www.abfg.org)].
- *GBIF* [[www.gbif.org](http://www.gbif.org)].
- *Google* [[www.google.co.uk](http://www.google.co.uk)].
- *Landcare Research New Zealand* [<http://nzfungi2.landcareresearch.co.nz>].
- *Mycportal* [[www.mycportal.org](http://www.mycportal.org)].
- *Mycotaxon Regional Checklists in Downloadable Format* [[www.mycotaxon.com/resources/weblists.html](http://www.mycotaxon.com/resources/weblists.html)].

- *National Center for Biotechnology Information* [[www.ncbi.nlm.nih.gov](http://www.ncbi.nlm.nih.gov)].
- *Nomen.mycetozoa.com* - an online nomenclatural information system of Eumycetozoa [<http://eumycetozoa.com>].
- *USDA Fungal Databases* [<https://nt.ars-grin.gov/fungalatabases>].

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