



A. Sporocarps (bar = 1 mm). B. Capillitium and spores (bar = 20  $\mu$ m). [Photographs: A. Michaud]

- Lamproderma arcyrioides** (Sommerf.) Rostaf., *Śluzowce (Mycetozoa) Monografia*: 208 (1874) [publ. 1875].  
[*IndexFungorum* 198176; *Stemonitidaceae, Stemonitiida*]  
*Stemonitis arcyrioides* Sommerf., *Magazin for Naturvidenskaberne* 7: 298 (1827). [*IndexFungorum*  
146779]  
*Lamproderma violaceum* var. *arcyrioides* (Sommerf.) Torrend, *Brotéria Série Botanica* 7: 68 (1908).  
[*IndexFungorum* 403706]  
*Stemonitis violacea* Fr., *Systema Mycologicum* 3(1): 162 (1829), nom. illegit., *ICN Art.* 53.1 (non  
*Stemonitis violacea* Roth, 1788). [*IndexFungorum* 224643]  
*Lamproderma violaceum* Rostaf., *Versuch eines Systems der Mycetozoen*: 7 (1873). [*IndexFungorum*  
200062]  
*Lamproderma nigrescens* Sacc., *Michelia* 2(no. 7): 262 (1881), nom. illegit., *ICN Art.* 53.1 (non  
*Lamproderma nigrescens* Rostaf., 1873). [*IndexFungorum* 202573]  
*Lamproderma saccardianum* Massee, *A Monograph of the Myxogastres*: 101 (1892) [nom. nov., based on  
*L. nigrescens* Sacc., 1881]. [*IndexFungorum* 535769]

*Tilmadoche berkeleyi* Masee, *A Monograph of the Myxogastres*: 332 (1892). [*IndexFungorum* 189180]  
*Lamproderma violaceum* f. *calciferum* Meyl., *Bulletin de la Société Vaudoise de Sciences Naturelles* **50**: 3 (1914). [*IndexFungorum* 634759]  
*Lamproderma arcyrrioides* var. *leucofilum* H. Neubert, Nowotny & K. Baumann, *Carolinea* **47**: 39 (1989). [*IndexFungorum* 126590]  
*Lamproderma arcyrrioides* f. *leucofilum* (H. Neubert, Nowotny & K. Baumann) Y. Yamam., *A Myxomycete Biota of Japan*: 548 (1998). [*IndexFungorum* 450116]

*Vernacular names.* Czech: *lesklokoška vlnatkovitá*. Dutch: *purper parelmoerkopje*.

*Diagnostic features.* Sporocarps stalked, brightly coloured, iridescent, globose or subglobose sporangia; peridium not mottled with brown spots, but with needle-like crystals; capillitium turning white on periphery of net; spores warted, 9–13 µm diam., distinguish from similar *L. sauteri* Rostaf., which has larger spores (12–16 µm diam.), and from *L. scintillans* (Berk. & Brome) Morgan, which is smaller, grows on dead leaves, and has a longer stalk and capillitium colourless near the columella.

*On natural substratum.* Amoebal state no information. *Plasmodium* white, translucent. *Hypothallus* reddish brown, membranous, usually discoid. *Sporocarps* gregarious, stalked or rarely sessile sporangia, up to 2 mm high. *Stalk* black, opaque or red-brown in transmitted light, up to 75% of the total sporangial height. *Sporothecae* almost spherical, slightly prolate, 0.3–1.0 mm diam., shining, iridescent bright to dark blue, often with metallic violet, bronze or silvery reflexions, at the base flat or umbilicate, and often dark brown. *Peridium* colourless, often studded with needle-like crystals. *Columella* reaching the centre of sporotheca, blunt or club-shaped at the top, either membranously webbed, or speckled. *Capillitium* brown or darker, in transmitted light usually rusty, sometimes pale brown, branched to form a dense reticulum, often minutely roughened, rarely almost opaque, radiating mainly from the apex of the columella, rather straight and lax, branches dividing several times then paler toward the colourless tips, with some anastomoses forming an open net, at the periphery with many, often spotted nearly colourless, fine, free ends. *Spores en masse* black or dark brown, individually brown, or purplish grey to pale lilac-brown, 8–11.5 µm diam., covered with distinct minute, rather dense, regularly distributed warts.

**ASSOCIATED ORGANISMS & SUBSTRATA:** **Fungi.** *Corticaceae* gen. indet. (basidioma); *Physcia adscendens* H. Olivier (thallus); *Xanthoria parietina* (L.) Th. Fr. (thallus). **Plantae.** *Abies nordmanniana* subsp. *equi-trojani* (Asch. & Sint. ex Boiss.) Coode & Cullen [as *A. nordmanniana* subsp. *bornmuelleriana* (Mattf.) Coode & Cullen]; *Adenostyles alliariae* (Gouan) A. Kern.; *Calluna vulgaris* L.; *Carpinus betulus* L. (twig); *Corylus avellana* L.; *Cytisus* sp.; *Euonymus* sp. (twig); *Fagus sylvatica* L. (cupule, twig), *Fagus* sp. (leaf); *Fraxinus excelsior* L. (twig); *Gramineae* indet.; *Hedera helix* L.; *Heracleum sphondylium* L. (stem); *Juniperus communis* L.; *Lycopus europaeus* L. (stem), *Lycopus* sp. (stem); *Mangifera indica* L.; *Muscopsida* indet. (thallus); *Nothofagus pumilio* (Poepp. & Endl.) Krasser (wood); *Plantae* indet. (bark, debris, leaf, log, twig, wood); *Poaceae* gen. indet. (straw); *Populus nigra* L. (bark), *P. tremula* L. (branch), *Populus* sp.; *Prunus laurocerasus* L. (leaf); *Rubus* sp. (stem); *Vaccinium myrtillus* L.; *Vitis vinifera* L. (leaf, wood). **Associated organisms of type specimen.** *Populus* sp. and *Vaccinium myrtillus*. **Comment.** This species occurs on dead bark, leaves, logs, stems, twigs and wood of various angiosperms and gymnosperms. It has also been found on the thalli of mosses.

**INTERACTIONS & HABITATS:** For a thorough introduction to myxomycete ecology, see MADELIN (1984). The dead plant material with which myxomycetes are very widely associated, while undoubtedly a platform for their sporocarps, is not necessarily a source of nutrition. Sporocarps are the only stage in myxomycete life cycles where species can be identified by morphology. The other states, as amoebae and plasmodia, have received little attention. SHCHEPIN *et al.* (2019) suggested that populations of myxomycete amoebae may inhabit much wider ecological niches than indicated by records of their sporocarps. With the advent of molecular techniques (KAMONO *et al.*, 2013), specific information about the ecology and nutrition of the amoebal state of *L. arcyrrioides* is now starting to emerge (BORG DAHL, 2018). In their amoebal state, myxomycetes are known to feed on small organic particles and micro-organisms (including some fungi), but the identity of those micro-organisms is rarely, if ever, recorded. This species has been recorded from the following habitats: amenity & protected areas (nature reserves);

cultivated land (farmland), freshwater; grassland; margins (pond edge); woodland (semi-natural broadleaf woodland, semi-natural conifer woodland, semi-natural mixed woodland, mixed plantations). It is also known to be nivicolous (LADO *et al.*, 2005). TAKAHASHI (2004) suggested substratum hardness and state of decay may be significant when this species occurs on wood. Fungi have been observed growing on the same substratum. Although associations with animals and micro-organisms are known or suspected, no observations were found where the associated organism was identified to genus or species level.

**GEOGRAPHICAL DISTRIBUTION:** AFRICA: Algeria, Morocco, South Africa. NORTH AMERICA: Canada (Alberta, British Columbia, Nova Scotia, Ontario), Mexico, USA (Alaska, California, Colorado, Florida, Ohio, Oregon, Illinois, Iowa, Kansas, Maine, Maryland, Massachusetts, Michigan, Missouri, Montana, New Hampshire, New Jersey, New York, North Carolina, Ohio, Pennsylvania, Tennessee, Utah, Virginia, Washington, West Virginia). CENTRAL AMERICA: Costa Rica, El Salvador. SOUTH AMERICA: Argentina, Brazil (Amazonas, Pernambuco, São Paulo). ANTARCTICA: South Georgia and the South Sandwich Islands. ASIA: India (Himachal Pradesh), Indonesia, Japan, Russia (Chukotka Autonomous Okrug, Krasnoyarsk Krai, Novosibirsk Oblast, Tyumen Oblast), Turkey. AUSTRALASIA: Australia (Tasmania [including Macquarie Island], Western Australia), New Zealand. CARIBBEAN: Dominican Republic, Jamaica, Puerto Rico. EUROPE: Andorra, Austria, Belgium, Czech Republic, Denmark, Estonia, Finland, France, Germany, Greece, Iceland, Ireland, Italy, Lithuania, Netherlands, Norway, Poland, Portugal, Romania, Russia (Astrakhan Oblast, Karachay-Cherkess Republic, Komi Republic, Kursk Oblast, Leningrad Oblast, Moscow Oblast, Murmansk Oblast, Republic of Karelia), Slovakia, Spain, Sweden, Switzerland, Ukraine, UK. PACIFIC OCEAN: New Caledonia.

**Elevation (m above sea level).** Records up to 3350 (USA: Colorado); 2100 (Spain).

**Comment.** Native to cool temperate and mountainous areas of Europe, North America and northern Asia, and probably elsewhere; possibly also native in the rest of its known distribution, though lowland tropical records may represent lookalike taxa.

**ECONOMIC IMPACTS:** There is experimental evidence that this species can accumulate heavy metals (KRYVOMAZ, 2015; KRYVOMAZ & ANDRUSISHINA, 2015; KRYVOMAZ *et al.*, 2016, 2017). KRYVOMAZ (2017a) measured metal levels in samples of *L. arcyrioides*, and in its substrata. The levels of different elements were, in descending order, as follows [ $\mu\text{g}$  of metal per g of myxomycete tissue]: Mg (841.6), Fe (680.61), Ca (207), Al (141.8), Si (72.72), Zn (65.43), Cu (30), Pb (27), Mn (16.43), Ni (6), Cd (4.5). In comparison with other species included in the study, *L. arcyrioides* strongly accumulated the highly toxic heavy metals Cd and Pb. An accumulation coefficient was used to calculate the concentration ratios between myxomycete and substratum. In comparison with the substratum (a living branch of *Fagus sylvatica* from France), *L. arcyrioides* had very high accumulation coefficients for Cu (103) and Cd (86), and high levels for Pb (22), Fe (17) and Ni (17).

Heavy metal accumulating properties are likely to have significant positive economic potential (STEPHENSON & MCQUATTIE, 2000). Although nothing has yet been developed for the present species, there is considerable interest in use of fungi with similar abilities for bioremediation and other applications (GADD, 2007).

GRAHAM (1971) studied spores of myxomycetes, including the present species, and suggested that they could be used in palynology. No evaluation has been made of any other possible positive economic impact of this organism (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:** Some subspecific taxa described for other species are now considered to be the present species. They are listed in the synonymy above.

**DISPERSAL & TRANSMISSION:** For a general discussion about myxomycete dispersal, see KRYVOMAZ & STEPHENSON (2017). Myxomycete spores are dispersed considerable distances by wind. Field experiments and mathematical modeling have shown that, with winds of 0.1 m/s, spores can travel up to c. 1.8 km, and when wind speed reaches 28 m/s, this rises to over 500 km (TESMER & SCHNITTLER,

2007). Spores and myxamoebae may be dispersed by rainwater and water in soil. Some local dispersal may also occur by movement of myxamoebae and plasmodia. Insects and other invertebrates feed on sporophores, as probably do terrestrial vertebrates including birds, and myxomycete spores have been found in insect faeces, suggesting that animals may play a part in their dispersal. Plant debris floating in seawater may also contribute to dispersal between land masses.

**CONSERVATION STATUS:** The IUCN's Red Listing Criteria were originally designed for evaluation of vertebrate animals and flowering plants, and present challenges to those trying to apply them to organisms like myxomycetes which are unicellular for a significant part of their life cycle. A discussion of those challenges, particularly in respect of myxomycetes and climate change, is provided by KRYVOMAZ & STEPHENSON (2017). **Previous evaluations.** Extremely rare in Saxony, Germany (HARDTKE *et al.*, 2015). **Information base.** Over 900 records (specimens, databases and bibliographic sources combined, excluding duplicates) from at least 1827 to May 2018, with observations in every month of the year, and no obvious peak. **Estimated extent of occurrence** [calculated using <http://geocat.kew.org>]. Well over 77.3 million km<sup>2</sup> (Africa [sub-Saharan only]: insufficient data; Antarctica: insufficient data; Asia [excluding Turkey]: 31.2 million km<sup>2</sup>; Australasia: 4.5 million km<sup>2</sup>; Europe [including north Africa and Turkey]: 12.7 million km<sup>2</sup>; North America: 22.1 million km<sup>2</sup>; Pacific Ocean: insufficient data; South America: 6.8 million km<sup>2</sup>). **Estimated area of occupancy** [calculated using <http://geocat.kew.org>]. Well over 1116 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 because of the small number of people with the skills to search for and identify it. Some of the plants with which it is associated are common and widespread species. **Threats.** *Lamproderma arcyrioides* is considered by some to be nivicolous and, as such, is likely to be threatened by climate change. Insufficient information to enable other threats to be identified. In particular, possible vulnerabilities of the amoebal and plasmodial states of this species are currently completely overlooked. **Population trend.** Not known. 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 Data Deficient. **In situ conservation actions.** None noted. **Ex situ conservation actions.** 21 nucleotide sequences and 6 PopSet sequences were found in a search of the NCBI GenBank database [[www.ncbi.nlm.nih.gov](http://www.ncbi.nlm.nih.gov), accessed 11 November 2019]. No living strains of this species are listed by the ATCC, CABI and Westerdijk Institute [formerly CBS] culture collections.

**NOTES:** KOWALSKI (1970) provided a detailed description of sporocarp morphology in this species. FIORE-DONNO *et al.* (2012) have applied molecular techniques to investigate the phylogeny of the genus *Lamproderma*, the present species being one of those assessed. Molecular techniques are now also being developed to detect myxomycetes in soil, and this may make it possible to identify species in their amoebal state. *Lamproderma arcyrioides* was included in one such pioneering study (HOPPE & SCHNITTLER, 2015). Using molecular techniques on collections from Germany, FENG & SCHNITTLER (2017) demonstrated that at least two 'ribotypes' of *L. arcyrioides* exist, although this molecular variation has not yet been linked to differences in morphology. This raises the possibility that *L. arcyrioides* as currently circumscribed is, in fact, more than one cryptic species.

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**T.I. Kryvomaz<sup>1</sup>, A. Michaud<sup>2</sup> & D.W. Minter<sup>3</sup>**

<sup>1</sup>*Kyiv National University of Construction and Architecture, Kyiv, Ukraine*

<sup>2</sup>*93 Route de La Croizette, F-38360 Engins, France*

<sup>3</sup>*CABI Europe, Egham, UK*

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