



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

- Arcyria denudata** (L.) Wettst., *Verhandlungen der Zoologisch-Botanischen Gesellschaft zu Wien* **35**: 535 (1886), *nom. illegit.*, ICBN Art. 53·1, non *A. denudata* Fr. (1851) [see **Notes** below]. [*IndexFungorum* 120316]  
*Clathrus denudatus* L., *Species Plantarum* **2**: 1179 (1753). [*IndexFungorum* 200019]  
*Trichia denudata* (L.) Vill., *Histoire des Plantes de Dauphiné* **3**(2): 1060 (1789). [*IndexFungorum* 154801]  
*Stemonitis denudata* (L.) Relhan, *Flora Cantabrigiensis* Edn 3: 574 (1820). [*IndexFungorum* 150197]  
*Mucor clathroides* Scop., *Flora Carniolica* Edn 2, **2**: 493 (1772). [*IndexFungorum* 217199]  
*Arcyria clathroides* (Scop.) F.H. Wigg., *Primitiae Florae Holsatiae*: 109 (1780). [*IndexFungorum* 450812]  
*Embolus crocatus* Batsch, *Elenchus Fungorum Continuatio Prima*: 265, fig. 177 (1786). [*IndexFungorum* 148332]  
*Stemonitis crocata* (Batsch) Willd., *Flora Berolinensis Prodrromus*: 408 (1787). [*IndexFungorum* 496564]  
*Stemonitis coccinea* Roth, *Tentamen Florae Germanicae* **1**: 548 (1788). [*IndexFungorum* 146082]  
*Trichia graniformis* Hoffm., *Vegetabilia Cryptogama* **2**: 3 (1790). [*IndexFungorum* 163657]

- Trichia cinnabaris* Bull., *Herbier de la France* **11**(121–126): pl. 502, fig. 1 (1790, publ. 1791). [IndexFungorum 534418]
- Stemonitis crocea* J.F. Gmel., *Systema Naturae* **2**: 1467 (1792). [IndexFungorum 236352]
- Trichia rufa* With., *A Botanical Arrangement of British Plants* Edn 2, **3**: 478 (1792). [IndexFungorum 191683]
- Arcyria punicea* Pers., *Neues Magazin für die Botanik* **1**: 90 (1794). [IndexFungorum 236378]
- Arcyria conjugata* Schumach., *Enumeratio Plantarum* **2**: 215 (1803). [IndexFungorum 175378]
- Arcyria minor* Schwein., *Transactions of the American Philosophical Society of Philadelphia* New Series **4**: 259 (1832). [IndexFungorum 245513]
- Arcyria vernicosa* Rostaf., *Śluzowce (Mycetozoa) Monografia Supplementum* **1**: 36 (1876). [IndexFungorum 181727]
- Arcyria punicea* var. *cribroides* Raunk., *Botanisk Tidsskrift* **17**: 60, 108 (1890). [IndexFungorum 138921]
- Arcyria denudata* var. *globosa* Georgev., *Glasnik Skopskog Naučnog Društva* **6**: 131 (1929). [IndexFungorum 263019]
- Arcyria denudata* var. *rosea* Solacolu & Forstner, in FORSTNER, *Contribuțiuni la Studiul Myxomycetelor din România*: 56 (1940), *nom. inval.*, ICBN Art. 36·1. [IndexFungorum 353263]
- Arcyria assamica* Agnihothr., *Journal of the Indian Botanical Society* **37**: 501 (1958). [IndexFungorum 292675]
- Arcyria denudata* var. *macrodonta* Q. Wang & Yu Li, *Journal of Jilin Agricultural University* **17**(4): 85 (1995). [IndexFungorum 569125]

*Diagnostic features.* Bright red or reddish brown, upright sporangia, each with a funnel-shaped calyculus with a non-dehiscent capillitium firmly attached to calyculus even after expansion. Brown weathered sporocarps may be confused with *A. affinis* Rostaf., but in that species the stalk is slightly eccentric, and the capillitium detaches from the calyculus after expanding.

*Habit.* On dead wood, bark, fallen leaves, and occasionally other substrata. *Plasmodium* white. *Sporocarps* stalked, erect, crowded or gregarious, often in large colonies, deep red, crimson red, dark reddish orange, brick red, red-brown, fading to brown, 1–2 mm high, increasing to 2–4 mm after expansion of the capillitium. *Hypothallus* common to each group of sporocarps, thin, shining, reddish brown with a silvery sheen. *Stalk* cylindrical or slightly flexuous, longitudinally striate, concolorous, dark, red-brown to black, orange-yellow to dark reddish brown by transmitted light, 0·5–1·5 mm long, the lower part filled with subglobose cysts mostly 12–20 µm diam. *Sporangia* subglobose, ovoid, cylindrical or shortly cylindrical, erect with rounded or acute apices, 1·5–3 × 0·5–2 mm, with a plicate, funnel-shaped, usually rather small and shallow, rather coarsely papillate-reticulate calyculus, decorated with warts connected by a network of thin ridges. *Peridium* single, membranous, the inner surface with warts or spines connected by a reticulum or sometimes almost smooth, evanescent, dehiscence irregular or slightly circumscissile, disappearing except for the cap, sometimes with remaining fragments close to the apex of the sporotheca. *Capillitium* net rather dense, elastic, erect, flexuous, branched and anastomosed, with many attachments to the calyculus, entangled, not bi-refringent in polarized light, pale orange-yellow to yellow, not losing its colour in the mounting medium, the tubules slender, 3–4 µm diam., usually decorated with rings, cogs, spines, or coarse half rings arranged in a spiral, elsewhere smooth or minutely warted or with fine subreticulate ridges, warts and ridges forming a fragmented net. *Spores* reddish orange or bright red in mass, individually free, subglobose, pale yellow to colourless by transmitted light, faintly minutely and evenly warted (visible with oil immersion), with scattered groups of larger more prominent warts, 6–8 µm diam.

**ASSOCIATED ORGANISMS & SUBSTRATA:** **Animalia:** *Baeocera* sp. **Fungi:** *Ustulina zonata* (Lév.) Sacc. **Plantae:** *Acer rubrum* L. (wood); *Albizzia moluccana* Miq.; *Alnus glutinosa* (L.) Gaertn. (wood); *Bambusaceae* indet. (culm); *Betula pendula* Roth (wood); *Bryophyta* indet.; *Camellia sinensis* (L.) Kuntze; *Carpinus betulus* L. (stump, trunk); *Fagus sylvatica* L. (stump, trunk, wood); *Nyssa* sp.; *Opuntia ficus-indica* (L.) Mill. (phylloclade); *Ostrya* sp.; *Palmae* indet. (leaf); *Picea abies* (L.) H. Karst. (stump, trunk, wood); *Pinus patula* Schiede ex Schltdl. & Cham. (wood), *P. sylvestris* L. (wood); *Plantae* indet. (bark, branch, leaf, liana, log, stump, trunk, wood); *Platanus orientalis* L. (branch); *Populus alba* L.

(wood), *P. nigra* L. (wood); *Quercus agrifolia* Née, *Q. pyrenaica* Willd., *Q. robur* L., *Q. suber* L.; *Roystonea regia* (Kunth) O.F. Cook (trunk); *Saccharum officinarum* L. (stem); *Sambucus* sp.; *Ulex* sp.  
**Other substrata:** soil; wall.

**INTERACTIONS & HABITATS:** Nothing specific is known about interactions between *Arcyria denudata* and other organisms, but myxomycetes in general, in their plasmodial state, are known to feed on bacteria, yeasts and other single-celled organisms, and they themselves provide food for insects, particularly beetles, and other animals. In Pernambuco state of Brazil, individuals of the beetle genus *Baeocera* (*Staphylinidae*) have been observed on sporocarps of *A. denudata*. Some beetle species are known only from myxomycetes, and for some of these there may be a close symbiosis. Myxomycetes may also be found in association with fungi, and some fungi have been found only on myxomycete sporocarps and, presumably, derive their nutrition from them either as parasites or as saprobes. *Arcyria denudata* sporocarps are generally observed on dead parts of plants, using the plant material as a substratum, but probably not as a nutrient source. The species is very widely distributed and abundant, being regularly found in temperate, humid zones. It is particularly common on stumps and fallen trunks, especially of hardwood trees, and is frequent on wood of angiosperms but less so on gymnosperms.

**GEOGRAPHICAL DISTRIBUTION:** AFRICA: Algeria, Angola, Kenya, Liberia, Madagascar, Morocco, Réunion, South Africa, Sudan, Uganda. CENTRAL AMERICA: Belize, Costa Rica, Guatemala, Honduras, Nicaragua, Panamá. NORTH AMERICA: Canada (Alberta, British Columbia, Ontario, Québec), México, USA (Alaska, Arkansas, California, Iowa, Massachusetts, Minnesota, Mississippi, Nevada, North Carolina, Ohio, South Dakota, Texas, Washington, West Virginia). SOUTH AMERICA: Argentina, Bolivia, Brazil (Ceará, Goiás, Paraíba, Pernambuco, Rio Grande do Norte, São Paulo), Chile, Colombia, Ecuador, French Guiana, Perú, Surinam, Uruguay, Venezuela. ASIA: China, Georgia, India (Assam, Himachal Pradesh, Karnataka, Madhya Pradesh, Orissa, Uttar Pradesh, West Bengal), Indonesia, Japan, Kazakhstan, Malaysia, Nepal, Pakistan, Philippines, Russia (Altaiskyi krai, Magadan oblast, Republic of Buryatia, Sverdlovsk oblast), Singapore, South Korea, Taiwan, Turkey, Sri Lanka. AUSTRALASIA: Australia (Queensland, Northern Territory, Western Australia), New Zealand. CARIBBEAN: Antigua & Barbuda, British Virgin Islands, Cuba, Dominica, Dominican Republic, Grenada, Guadeloupe, Jamaica, Puerto Rico, Trinidad & Tobago. EUROPE: Belgium, Denmark, France, Germany, Greece, Ireland, Italy, Lithuania, Moldova, Norway, Poland, Romania, Russia (Astrakhanskaya oblast, Leningrad oblast, Moscow oblast, Republic of Karelia), Spain, Sweden, Ukraine, United Kingdom. PACIFIC OCEAN: French Polynesia, Marshall Islands, Samoa, USA (Hawaii), Vanuatu.

**ECONOMIC IMPACTS:** In recent years, exploration has begun of metabolites and other chemicals produced by myxomycetes. RAHMAN (2003) reported the isolation of arcyriaflavin A, a chemical with moderate antibiotic properties and possible potential as an anti-cancer drug, from *A. denudata*, and KAMATA *et al.* (2006) isolated a new bisindole sulfate, arcyroxocin B and three previously known bisindoles from wild sporocarps of *A. denudata*. The arcyroxocin B and one of the previously known bisindoles showed cytotoxicity against Jurkat cells (an immortalized line of T lymphocyte cells used to study acute T cell leukaemia). Chemicals derived from *A. denudata* thus have significant potential use in cancer research and other investigations, particularly where Jurkat cells are used. No evaluation has been made of any other possible positive economic impact of this myxomycete (e.g. as a source of useful products, as a provider of checks and balances within its ecosystem, or of other ecosystem services such as recycling, etc.). No reports of negative economic impacts have been found.

**INFRASPECIFIC VARIATION:** Three subspecific taxa have been described, all at varietal rank. The distinctions on which they were based have not received widespread acceptance, and all are listed above as synonyms of *A. denudata* (L.) Wettst.

**DISPERSAL & TRANSMISSION:** Nothing specific is known about *Arcyria denudata*. Myxomycete spores are produced in dry dusty masses inside sporocarps. The sporocarp outer wall fragments to expose the spores which are then, most probably, primarily dispersed by wind. This dispersal is likely to be totally random unless there is a strong prevailing wind in the vicinity. Insects are known to graze on

myxomycete sporocarps, and spores have frequently been found in their faeces. This is therefore also likely to be an important part of their dispersal mechanism. Insect dispersal has the potential to be less random than wind dispersal, but there seem to be no studies of how long spores may remain in an insect digestive tract or of insect movements in relation to myxomycete spore dispersal. As already noted, species of the beetle genus *Baeocera* have been observed on sporocarps of *A. denudata*. After the spores have landed on plant material, each may germinate to produce a single-celled zoospore with one or two flagella. This zoospore may then use its flagella to disperse locally. The zoospores subsequently transform into amoeba-like cells which reproduce by mitosis and aggregate, forming groups which are sometimes sufficiently large as to be seen with the unaided eye. These groups, which are called plasmodia, can also migrate, often in response to light. For almost the whole life cycle, therefore, myxomycetes are mobile organisms, with only the sporocarp stage being fixed in a single location. Unlike members of the kingdom *Fungi*, myxomycetes do not form hyphae, and do not derive nutrition from the plant substrata on which they are found. As a result, it is not meaningful to describe them in terms of transmission. There is no infection stage, and no colony formation inside plant material. Instead, the individual amoebae derive their nutrition by engulfing bacteria, yeasts and other single-celled organisms.

**CONSERVATION STATUS: Information base.** More than 3000 records (specimens, databases, bibliographic sources and field observations combined, excluding duplicates) from 1753 to September 2012, with observations in January, February, March, April, May, June, July, August, September, October and November, with the main fruiting season in the northern hemisphere from June to October. The species is widely regarded as common. Most if not all of its known associated organisms are common and likely to be classified as Least Concern by the IUCN. **Estimated extent of occurrence** [calculated using <http://geocat.kew.org>]. Nearly 127 million km<sup>2</sup> (Africa: 27.5 million km<sup>2</sup>; Central America: 0.2 million km<sup>2</sup>; North America: 10.6 million km<sup>2</sup>; South America: 14.6 million km<sup>2</sup>; Asia: 43.9 million km<sup>2</sup>; Australasia: 7.3 million km<sup>2</sup>; Caribbean: 1.0 million km<sup>2</sup>; Europe: 6.9 million km<sup>2</sup>; Pacific Ocean: 14.9 million km<sup>2</sup>). **Estimated area of occupancy** [calculated using <http://geocat.kew.org>]. About 446 km<sup>2</sup>. The method for estimating area of occupancy has probably produced an artificially low figure. **Population trend.** Not reported, but sufficient records exist for some analysis to be possible. **Threats.** No specific threats have been identified. **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 noted. Many recent records, however, originate from protected areas. **Ex situ conservation actions.** One protein sequence was found in a search of the NCBI GenBank database [[www.ncbi.nlm.nih.gov](http://www.ncbi.nlm.nih.gov)]. No living strains of this species were found in a search of the ATCC, CAB, CBS and ICMP culture collection on-line catalogues.

**NOTES:** There is a problem with the naming of this common, beautiful and easily-recognized species. The binomial *A. denudata* (L.) Wettst. (1886), in widespread use (and, as a result, used in this work), is seemingly illegitimate, being a later homonym of *A. denudata* Fr. (1851), which was based on a specimen collected in the Nicobar Islands. It is not clear if the organism described by Fries is the same species, but even if it is, Fries's binomial could not be used, as there are at least four other earlier competing epithets. The earliest available legitimate name is probably *Arcyria clathroides* (Scop.) F.H. Wigg. (1780).

GAMBOA-TRUJILLO *et al.* (2011) reported that *Arcyria denudata* was (and may still be) used by shamans of native peoples located in the Amazonian, coastal and sierra regions of Ecuador. Mythical uses were recorded for the Amazonian Kichwa community, which named this species 'supay ala' (meaning 'mushroom') and the Amazonian Secoya community, which called it 'ma a'ri teti' (meaning 'the red mushroom'). These communities used *A. denudata* medicinally (rubbing it on infections) and in recreational activities. In their publication the name *Arcyria incarnata* (Pers. ex J.F. Gmel.) Pers. was used, but it is clear from their photographs that the species is, in fact, *A. denudata*.

The distribution map of this species on the *Eumycetozoa Project* website [<http://slimemold.uark.edu>] provides further georeferenced records but some errors may have occurred in allocating latitudes and longitudes. The record on that map apparently from southeast Libya is, in reality, from Cuba, while the record apparently from Amurskaya oblast in Russia is, in fact, from Krasnoyarskiy krai.

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See also the following internet pages:

- *Checklist of Fungi of the British Isles* [[www.fieldmycology.net/GBCHKLST/gbchklst.asp](http://www.fieldmycology.net/GBCHKLST/gbchklst.asp)].
- *Cybertruffle* [[www.cybertruffle.org.uk](http://www.cybertruffle.org.uk)].
- *GBIF* [<http://data.gbif.org/welcome.htm>].
- *Google* [[www.google.co.uk](http://www.google.co.uk)].
- *Landcare Research New Zealand* [<http://nzfungi.landcareresearch.co.nz>].
- *Myxomycetes of Ukraine* [[www.myxomycet.com.ua/eng](http://www.myxomycet.com.ua/eng)].
- *National Center for Biotechnology Information* [[www.ncbi.nlm.nih.gov](http://www.ncbi.nlm.nih.gov)].
- *Nomen.eumycetozoa.com* [[www.nomen.eumycetozoa.com](http://www.nomen.eumycetozoa.com)].
- *The Eumycetozoan Project* [<http://slimemold.uark.edu>].
- *USDA Fungal Databases* [<http://nt.ars-grin.gov/fungalDATABASES/index.cfm>].

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