

Distribution and Ecology of *Clathrus archeri* in Romania

Ciprian BÎRSAN^{1*}, Ana COJOCARIU¹, Elena CENUȘĂ²

¹"Alexandru Ioan Cuza" University of Iași, "Anastase Fătu" Botanical Garden, 7-9 Dumbrava Roșie Street, 700487, Iași, Romania;

ciprian.birsan@uaic.ro (*corresponding author); ana.cojocariu@uaic.ro

²Calimani National Park, 54C Saru Dornei Village, Suceava County, Romania; ecenus@gmail.com

Abstract

Although *Clathrus archeri* is a widely spread species in the Western Europe, in Romania it is considered a rare species, identified from only eight sites. In July 2013, it was found in two new sites from Gurghiu and Bârgău Mountains, in the Romanian Eastern Carpathians. This paper presents a detailed description of the new recorded specimens and of the habitat where this fungus was found. Plant communities where *Clathrus archeri* was recorded belong to the "mountain hay meadows" habitat type (*Festuco rubrae* - *Agrostietum capillaris* community). Taking into consideration the previous published data, the comparison with other habitats types in which this species occurs suggests that *Clathrus archeri* has no special preferences for certain environmental conditions.

Keywords: habitats, macromycetes, National Red List, rare species, stinkhorns

Introduction

Clathrus archeri (Berk.) Dring [*Anthurus archeri* (Berk.) E. Fisch.] was introduced to Europe in 1914 in Eastern France (Vosges Mts.), probably together with wool imports from Australia (Kreisel H, 2006; Salcedo *et al.*, 2006). It has since spread throughout the whole Europe (Desprez-Loustau, 2009). Its name derives from the Greek *kleithron* = grid, box, cage and *archeri* = named after Archer.

This fungus, also named "devil's fingers", was first described as *Lysurus archeri* by Rev. M. J. Berkeley (1860) and later it was transferred to *Anthurus* because of its free arms (rather than having a cage form). After that, Dring (1980) transferred it to *Clathrus*, a genus that includes the so-called "cage fungi", many of them with tropical distributions or Southern Hemisphere origins. The history of its presence in Europe is interesting. The fungus spread fast throughout the northeast of France and was discovered in 1968 in Enfants Noyés region from Belgium (Piérart and Girard, 1969; Fraiture, 2010), which was for more than 20 years the only location in that country where the species was known. Later, it spread to Germany, Austria, Switzerland, Italy and the centre of France (Fourré, 1985). According to Parent *et al.* (2000), sporocarp abundance is high for this species. Other authors too (Parent and Thoen, 1986) regard the hypothesis that this fungus was introduced to Europe on the wool of sheep from Australia and New Zealand as plausible. According to these authors, the Australian fungus has become established in a large area of central Europe. Also, it has been recorded from the Iberian Peninsula

(Sarrionandia *et al.*, 2010). After reports of it spreading around Europe, its presence was also found in other regions such as Santa Cruz in California (North America) (Arora and Burk, 1982).

Clathrus archeri is a rare macromycetes species in Romania (Tănase and Pop, 2005) although it is one of the most recorded species of *Clathrus* in other European countries. It is also a red-listed species in several countries: Bulgaria (Gyosheva *et al.*, 2006), Ukraine (Didukh, 2009) and Denmark (Vesterholt, 1998).

During a mycological survey in the Romanian Carpathians, in July 2013, two new sites for *Clathrus archeri* were recorded. The purpose of this paper is to provide information regarding the distribution of this species in Romania (based on both current and historical data) and to determine the environmental and habitat characteristics of the places where the samples were found.

Materials and methods

The study is based on the material collected in the Romanian Eastern Carpathians: Bârgău Mountains (47°16'57.13" N, 24°56'37.05" E, 1.052 m altitude) and Gurghiu Mountains (46° 38'29.9" N, 25°10'42.05" E, 1.195 m altitude). The occurrence of *Clathrus archeri* in Romania has been mentioned previously in the scientific literature (Beres, 1996; Beres, 2012). The article has been structured in two parts. The first part contains information about the species distribution in Romania and the second part contains information about the sites recorded in 2013. Sites where the

species was found are shown on the map of Romania (Fig. 2). The material was identified based on macroscopic and microscopic characters analyses on the bases of the following literature: Breitenbach and Kränzlin (1986), Borgarino and Hurtado (2004), Bon (2004), Courtecuisse (2000), Consiglio and Papetti (2001) and Hans (2001). The scientific names have been updated using Index Fungorum database (<http://www.indexfungorum.org/names/names.asp>). One voucher specimen from the examined material was deposited in the Herbarium [I] of the “Alexandru Ioan Cuza” University from Iași, Faculty of Biology [voucher I 182335]. The description of the species is based on the new specimens collected by us from the two areas mentioned above. At the same time, we recorded all the plants species and vegetal communities in which the species occur.

Results and discussion

Clathrus archeri is easily recognized by its characteristic appearance, with 4-8 red radial branches. It can be confused with *Aseroe rubra* Labill. (Starfish fungus), but this species has a broad disk at the apex of the pseudostipe and numerous bifid arms. In past, this species was recorded as extremely rare species, known only from The Royal Botanical Garden Kew and from the Surrey region of England (Pegler et al., 1995), but in the last period *Aseroe rubra* is more extended in England.

In the early stage, the sporocarp is a white gelatinous ‘egg’, 2-4 cm in diameter, up to 6 cm tall, often smaller though, with a spherical to ovoid shape and a white rhizomorph at the base. It has a thick white to ochre peridium with a squamous surface and is furrowed due to the folded arms within the ‘egg’. The thin, gelatinous endoperidium is green-brown colored. The ‘egg’ bursts open at maturity with its 4-7 long slender arms (ca. 6-10 cm in length and 1.5-2 cm width) narrowing from the base to the apex, pale pink or red-orange, white at the base, and irregularly covered with the greenish brown gleba, fragile and spongy, slightly trapped inside the volva (remains of the ‘egg’). The gleba has an odor of rotting meat, which attracts flies and other insects. Usually, the red, transversely rugged arms are horizontally broken and spread around (Photo 1). Description of our specimens is in full agreement with the descriptions of *Clathrus archeri* provided in several other papers (Breitenbach and Kränzlin, 1986; Kreisel, 2001; Tănase et al., 2009; Pegler et al., 1995; Jülich, 1989; Calonge, 1998).

The basidiospores are elliptical, hyaline and smooth, with a size about 6-7.5 x 2-2.5 µm, grouped as 6 per basidium (Fig. 1).

Although some authors consider this species as inedible (Gerhardt, 1999; Consiglio and Papetti, 2001; Borgarino and Hurtado, 2004), others say that it is edible in its young stage despite its disagreeable smell and taste (Hans, 2001).

Beres (1996, 2012) identified eight sites where *Clathrus archeri* has been found in Romania. These sites are:

- Sighetu Marmăției, district Iapa, in grasslands, 400 m alt., NE aspect, in July 1993;
- Săpânța - Jilerescu, swamp, on the anthill with *Vaccinium vitis-idaea*, *Carex* sp., 800 m alt., in July 1993;

- Sighetu Marmăției, Solovan Hill, among *Scirpus sylvaticus*, 600 m alt., S aspect, in October 1996;
- Sighetu Marmăției, in a young forest of *Quercus petraea* with *Carpinus betulus*, 550 m alt., N aspect, in October 1996;
- Bârsana Secătura, Preluca Mejdii, hygromesophitic pasture, among moss and *Colchicum autumnale*, 900 m alt., E aspect, in October 1996;
- Vadul Izei - Șugău Valley, wet meadow, 400 m alt., NW aspect, in September 2001;
- Bocicoi, fruit garden, in a grassy place, in October 2006;
- Sighetu Marmăției, Mociar, valley of stream Ronișoara, underbrush of oak with hornbeam, 300 m alt., in July 2008.

Besides these eight sites for *Clathrus archeri* registered by Marta Beres in the Eastern Carpathians (Romania), we have identified two new sites situated in the Bărgău Mountains



Photo 1. *Clathrus archeri*: sporocarp

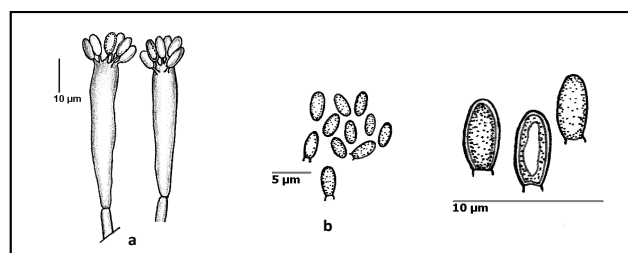


Fig. 1. *Clathrus archeri*: a) basidium; b) spores

and Gurghiu Mountains. Interestingly, we found this species in the most southern part of its Romanian areal (Poiana Repaş) and at the highest altitudes (approximately 1,200 m). This is its highest known location in Romania. Until now, it was found at altitudes ranging between 300 and 900 m. This confirms that this species has a broad altitudinal range.

Habitat

The habitat of the new locations where *Clathrus archeri* was found can be described as “6520 mountain hay meadows” (*Festuco rubrae - Agrostietum capillaris*) according to the Natura 2000 habitats classification system (Gafta and Owen, 2008). This widespread habitat includes, in the

investigated areas, secondary meadows of *Festuca rubra* (red straw) and *Agrostis capillaris*. In general, the land has different aspects with moderate soil moisture, are slightly acid and relatively poor in nutrients. This type of meadow has a high economic value and this has led to overgrazing. As a consequence, these meadows are invaded by *Nardus stricta* and, in these conditions, their productivity decreases (*-nardetosum strictae* subassociation). The herbaceous layer has 100% coverage and is very diverse in its species composition. It includes, besides *Festuca rubrae* and *Agrostietum capillaris*, many other species, as follows: *Arrhenatherum elatius*, *Briza media*, *Leucanthemum vulgare*, *Stachys officinalis*, *Deschampsia caespitosa*, *Festuca pratensis*, *Gymnadenia conopsea*, *Trifolium pratense*, *Anthoxanthum odoratum*, *Viola tricolor*, *Arnica montana*, *Luzula luzuloides*, *Veratrum album* etc. From a phytosociological perspective we registered a high constancy of some species characteristic for Cynosurion (*Cynosurus cristatus*, *Gentiana cruciata*, *Leontodon autumnalis*, etc.), Arrhenatherion (*Centaurea phrygia*, *Holcus lanatus*, *Stellaria graminea*, etc.), Deschampsion (*Deschampsia caespitosa*, etc.), Alopecurion (*Festuca pratensis*) alliances; for Arrhenatheretalia (*Thymus pulegioides*, etc.) and Molinieta (Linum catharticum, etc.) orders and Molinio - Arrhenatheretea class (*Rhinanthus angustifolius*, *Lotus corniculatus*, *Polygala vulgaris*, *Trifolium repens*, *Prunella vulgaris*, *Lathyrus pratensis* etc.).

The absence of any kind of ordinary maintenance, fertilization and the overgrazing by sheep, can create unfavourable conditions for growth and development of valuable autotrophic plants. Also, these processes create optimal conditions for the establishment and spreading of *Nardus stricta*. The areas with *Nardus stricta*, through overgrazing, depending on its intensity, will evolve either towards meadows of *Agrostis capillaris*, *Festuca rubra* and *Festuca nigrescens* by reducing the abundance of *Nardus stricta*, or to tall herb nitrophilous communities with *Rumex alpinus* and *Urtica dioica* through the complete removal of *Nardus stricta*. Therefore, these conditions offer few explanations for the connection between sheep grazing and the spreading of the fungus. This species of Australian origin prefers places with high intensity of grazing by sheep, or areas that are situated near these places.

The sporocarps were found inside the grass layer (20 cm height) dominated by *Nardus stricta* and obviously affected by overgrazing (Photo 2). Also, we identified two associated fungi species (*Bovista nigrescens* and *Annelaria semiovata*) which occur frequently in the over-grazed areas. In addition, *Macrolepiota procera* and *Lycoperdon perlatum* were found, species occurring from summer to autumn during wet periods.

A comparison with other habitats types in which this species have been identified suggests that *Clathrus archeri* has no special habitat preferences. It was identified within a wide altitudinal range and in a variety of habitat types. It has been found in Germany, in the Alps Mts., at 1,200 m altitude (Jü . x989). In the Ukraine it was found in the Ukrainian Carpathians in deciduous forests situated on areas with large quantities of organic matter (Zykova, 2007). In Poland, this species is commonly recorded in oak forests

and meadows adjoining forests (Halama et al., 2010; Szczepkowski and Obidziński, 2012). Also, *Clathrus archeri* is established in different man-made habitats such as cemeteries, parks, recreational forests that are close to cities, etc. In some European countries, this species is considered as invasive (Desprez-Loustau et al., 2007; Wojewoda and Karasiński, 2010). The only factor influencing the expansion of this species could be the calcium content of soil, as *Clathrus archeri* does not thrive on calcareous soils (Parent et al., 2000; Kreisel 2006).

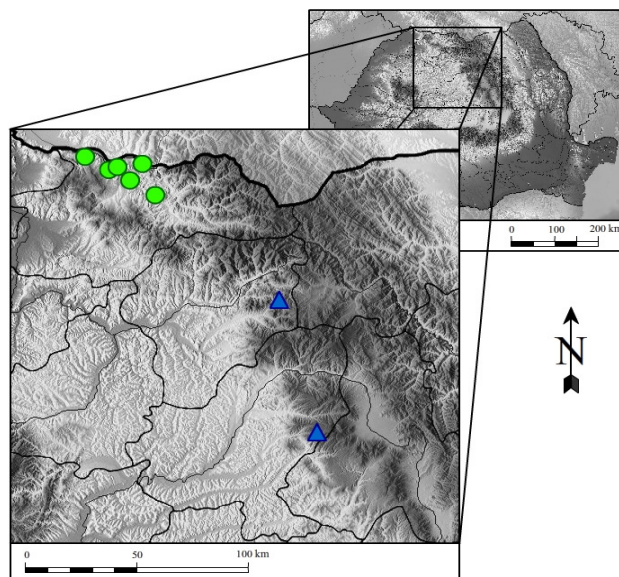


Fig. 2. Distribution of *Clathrus archeri* in Romania: ● - known locations; ▲ - new locations



Photo 2. Habitat of *Clathrus archeri* in Poiana Repaş (Romania)

Conclusions

The article presents two new (for Romania) sites in which *Clathrus archeri* has been identified. These sites are situated at the highest elevations in Romania, known for their alien species and are located in mountain hay meadows overgrazed by sheep, in Bărgău and Gurghiu Mountains. Taking into consideration the previous published data, the species does not prefer a certain habitat type. The only aspect linking the habitats where *Clathrus archeri* occurs is the strong impact of human activity.

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