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Rediscovery of the cnidarian *Craspedacusta sowerbii* Lankester, 1880 (Hydrozoa, Limnomedusae, Olindidae) in Romania

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Abstract. After its first and only documented occurrence in Romania in 1936, the presence of the invasive freshwater cnidarian *Craspedacusta sowerbii* was reported again in July 2019 in a lake in Bihor county, northwestern Romania.

Introduction

The freshwater jellyfish *Craspedacusta sowerbii* Lankester, 1880 (sometimes spelled *C. sowerbyi*) is the only freshwater cnidarian that has both polyp and medusa form, and is frequent in oxbows and gravel pits with clear water and gravel bed. The polyps are a few millimeters long and live in pairs on water plants or on the bottom and under favorable conditions produce the 1-2 mm wide medusa, which reaches 2 cm by the end of summer (Kriska 2014). The species was described from London and is one of the nine species of this East-Asian genus and the only freshwater medusa with cosmopolitan distribution (on all continents except Antarctica), occurring in temperate, subtropical and tropical ponds, lakes, reservoirs, and rivers, and apparently preferring eutrophic ponds over oligotrophic large lakes (Jankowski 2001). Currently it is the most abundant and widespread

freshwater cnidarian, and two of the resting stages of its reproductive cycle (podocysts and spherical frustules) are drought resistant (Dumont 1994). *C. sowerbii* is probably indigenous to the Yangtze River in China and the hydromedusae appear in shallow pools, isolated gravel pits, sand pits or quarries, and also in slow rivers (Didžiulis & Roman 2013). It is a thermophilous, eurybiontic hydrozoan with two adult forms, a fixed polyp and a free swimming, more visible medusa (the sexual form) which appears in bloom sporadically during the warm season (when water temperature rises to at least 25 °C), feeding on zooplankton, as well as on eggs and tiny larvae of fishes (Silva & Roche 2007, Didžiulis & Roman 2013). The lifespan is 34-51 days (Gang et al. 2006, cited in Didžiulis & Roman 2013), and adults are resistant on hypoxia (Wang et al. 2006).

Originally it started dispersing worldwide in the 1880s, mainly though unintentional introductions by humans of its drought-resistant diapausing stages. Its dispersion was possibly started in late 19th century by the increased commercial contacts with China and then continued unintentionally by the American troops stationed in Japan and in other Asian countries after World War II, as well as by the aquarium trade, plus through aerial dispersion by birds (Dumont 1994). The first record of introductions was from water-lily tanks in Regent's Park, London, in 1880, followed by polyps found in Philadelphia, USA, in 1885 (and then medusae in 1897). In 1901 it was found in France and in 1905 in Germany at Munich, then in Sweden it was first recorded in 1969 (Didžiulis & Roman 2013). It was first found in the Czech Republic in 1934 (Jaslovská & Stloukal 2004, cited in Jakovčev-Todorović et al. 2010) and in Ukraine in the 1950s in the cooling reservoir of the Chernobyl nuclear power plant, by means of negligent or irresponsible ornamental trade originating from South America (Protasov et al. 1981, cited in Alexandrov et al. 2007). It was known in the Rhine valley, Germany, since 1970, probably spread by aquarists, navigation and/or birds (Rey et al. 2000). It was recorded as an invasive species also in Hungary in 1957-1959 (Buchert 1960, cited in Abonyi et al. 2008), in Serbia since 1958 (Jakovčev-Todorović et al. 2010, Rat et al. 2016), in Slovakia in 1961 (Vranovský 2003), in Switzerland since 1962 (Lods-Crozet et al. 2013), in Italy since 1990 (Gherardi et al. 2013), in Bulgaria since 1991 (Trichkova et al. 2017), in Croatia since 1992 (Jaslovská & Stloukal 2004, cited in Jakovčev-Todorović et al. 2010), in Austria since 1998 (Grohs 1998, Kutzenberger 1998, cited in Gusenleitner & Aescht 2003), and in Lithuania since 2002 (Arbačiauskas & Lesutienė 2005), as well as in Greece (Karaouzas et al. 2015). The northernmost documented occurrence is from Finland (Väinölä 2002). Currently it is rather frequent in most European countries, except Albania, Belarus and some countries of former Yugoslavia (Didžiulis & Roman 2013).

In Romania it was first documented in 1936 (Șerbănescu & Panțu 1936) and there were no other published occurrences since then. The aim of the present paper was to record the rediscovery of the invasive species *C. sowerbii* in Romania.

Material and methods

On July 2. 2019, the author's colleague Cosmin Durgheu reported the presence of a group of "freshwater jellyfish" mostly in the pelagical region and close to the surface of the lake near the village Șauaieu, belonging to the commune Nojorid (Bihor county, northwestern Romania). The lake near Șauaieu is produced by an artificial dam and is surrounded by deciduous forests and by pastures.

Because of the small size and translucent habitus of the animals, no photos were taken at that time. Because of other circumstances, the present author was able to verify the site only on Oct. 2, 2019, together with Mr. Durgheu and photographer Ovidiu Pascu, sieving the water in several areas of the lake. In 2020 only several medusae were observed in August, during a rather cooler summer than in the previous year.

Results

The coordinates of the sighting are 46.944788 N, 21.921241 E. While verifying the site on Oct. 2, 2019, despite the weather still being rather warm, the water in the lake was already cooler and no freshwater jellyfish were found. Still, Mr. Durgheu, being an artist with a keen eye for details, provided a detailed verbal description of them. According to that, the observed hydrozoans (hydromedusae) were disc-shaped, about 20 mm in size, delicate and translucent, and with a whorl of many long and thin tentacles around the margin (Fig. 1). The mouth opening was central and a stomach structure (the manubrium) protruded down from the center of the bell. The animals had four noticeable, opaque white structures (the gonads) attached to four radial canals which are connected to a ring canal near the bell margin. The prominent size of the four perradial tentacles is a constant feature in *C. sowerbii* (Kramp 1951, cited in Jankowski 2001).

Thus, based on those descriptions, the habitat and the distribution data known for the species, the identification of the observed animals as medusae of *Craspedacusta sowerbii* Lankester, 1880 seems certain enough (Lankester 1880, Jankowski 2001), unless further verification would possibly identify another closely related species with invasive behavior.

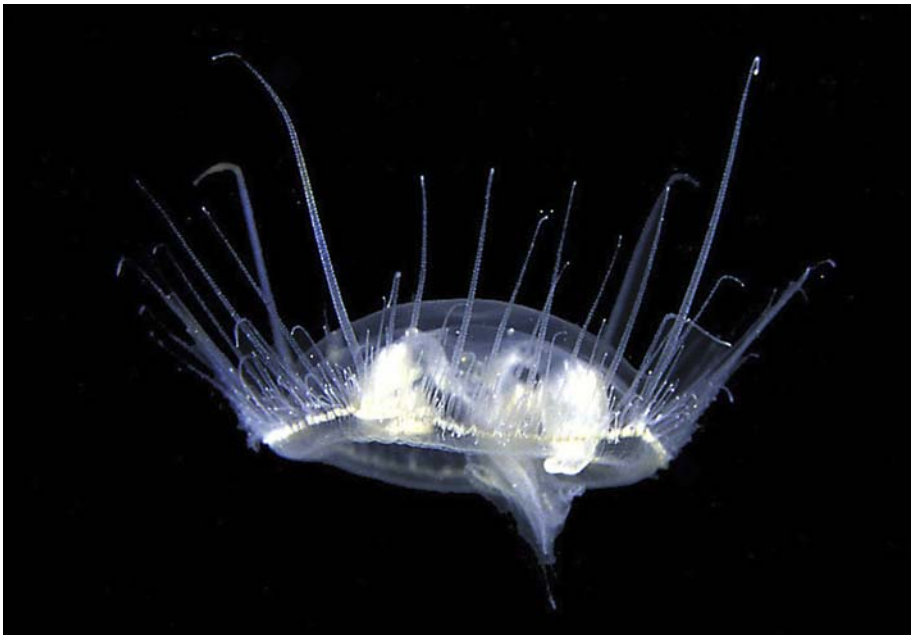

Figure 1. *Craspedacusta sowerbii* Lankester, 1880, medusa stage, habitus (photo after Christophe Dehondt).

Discussion

While this invasive species is widespread in Europe and cosmopolitan for decades, the recording of its presence in Romania was just a matter of time. *C. sowerbii* arrived in Romania before 1936, as briefly signaled in an ephemeral publication (Șerbănescu & Panțu 1936). Since then its presence there passed unnoticed because of its small size and inconspicuous nature, thus there are no other publications about it in Romania before the present documented rediscovery. The locals in Șauaieu report about sporadically noticing groups of "freshwater jellyfishes" in the lake near their village for several years when weather and water conditions were favorable (warmer), so an established population may exist in that lake.

C. sowerbii has circumglobal distribution, occurring in warm and temperate freshwater bodies (van der Land 2008; Schuchert 2019). The most probable vectors are shipping, waterfowl and unintentional or illegal introduction with fishes, crayfish or aquatic plants. As all Cnidaria, this hydromedusa is an opportunistic predator of zooplankton, benthic invertebrates, and fish eggs and larvae. It is harmless to humans and fish apparently do not consume it, but it is preyed on by *Or-*

conectes crayfish (DeVries 1992). Its impact on the plankton community, although currently insignificant, may increase with high medusae densities (Arbačiauskas & Lesutienė 2005), and blooms of polyps and medusae may have a cascading effect on primary producers and small herbivorous crustaceans, such as *Bosmina longirostris* and juvenile cyclopoid copepods during summer and in small lakes (Jankowski & Ratte 2001, Jankowski et al. 2005, Smith & Alexander 2008).

There are four hypotheses of invasion paths:

1. the natural distribution area was Eurasia;
2. polyps and medusae were transported with ornamental aquatic plants and fishes from the Yangtze River system (Slobodkin and Bossert 1991, Angradi 1998);
3. the dispersion was natural since the existence of Gondwana (Zienkiewicz 1940, cited in Didžiulis & Roman 2013); or:
4. it is a ponto-caspian species (Jankowski 2001).

Another possible way of invasion is by commensalism with the invasive zebra mussel *Dreissena polymorpha*. Polyps of *C. sowerbii* were found attached on its shells and they are sessile organisms without tentacles and with an apical mouth surrounded by nematocysts, so the strong water current generated by the bivalve's incurrent and excurrent siphons explains the preference of the polyps for that area of the shell (Stanković & Ternjej 2010). Another hypothesis about the success of *C. sowerbii* as invasive species could be related to the eutrophication of stagnant waters ("brownification", or higher content of dissolved organic matter and higher dissolved organic carbon concentration), which protects *C. sowerbii* individuals from the harmful effect of UV radiation (Caputo et al. 2018).

In recent years, interest appeared in keeping it in aquaria as an ornamental species, but this poses great potential invasive risk because of negligence in the aquarium trade industry (Skolka & Preda 2010). Supposedly as a result of climate change, recently it has reached northern regions, such as the Moscow River, which passes through the Russian capital (Bavaru & Bercu 2017). Other local invasions in Sweden and Lithuania in 2002 suggest recent climate warming as possible cause for its dispersal. Optimal water temperatures for medusa development are 19-30 °C. The inconspicuous polyp stage, more tolerant to lower temperatures and dying at temperatures above 30 °C (Acker & Muscat 1976), is possibly far more common than the planktonic medusa stage (Dumont 1994, Angradi 1998), in addition to the fact that it does not always produce medusae (Fritz et al. 2007). Therefore, the distribution of *C. sowerbii* may be much wider than currently recorded. One of the main factors for production of medusae is increased water temperature (over 25 °C), and mass production occurs only sporadically and thus it needs no control (Didžiulis & Roman 2013).

Interestingly, a single sexed population of medusae is usually observed, thus making sexual reproduction infrequent and casting doubts on the importance of medusae for population sustainability, as opposed to budding polyps (Pennak 1989, Arbačiauskas & Lesutienė 2005). The fact that within most countries only single-sexed medusae populations are present suggests that there were only a limited number of introduction events to single countries, but different habitats were colonized afterwards due to high mobility within regions, a hypothesis still to be verified by molecular analyses on populations (Fritz et al. 2007).

The biology of *C. sowerbii* is well known, but its distribution data are unpredictable and possibly underestimated. Therefore, registering its occurrences by asking people to inform local authorities in case they see the medusae in a particular place, e. g. through an online survey as applied in Germany and Poland (Didžiulis & Roman 2013), may provide material for further studies.

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