NEW RECORD IN ROMANIAN DANUBE DELTA PART AS AN EXTENSION IN THE LOWER DANUBE AREA OF THE NON-NATIVE BRYOZOAN *PECTINATELLA MAGNIFICA* (LEIDY, 1851)

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The water flow of the Danube River brings in the Danube Delta a lot of solid silt, big quantities of waters, but sometimes new living organisms. So, in 2016 it was first recorded in freshwater of the Romanian Danube Delta part a new non-native species *Pectinatella magnifica* (Leidy, 1851), a colonial organism, bryozoan, after that in 2017 more colonies of individuals were found in the Danube Delta Biosphere Reserve (DDBR).

Keywords: new record, Romanian Danube Delta, bryozoan, *Pectinatella magnifica*.

INTRODUCTION

The Chilia, Sulina and Sfântu Gheorghe arms of the Danube River are major paths which through the river transport water and solid flow across the delta towards the Black Sea. Before branching at "Ceatal" Chilia, multiannual mean Danube flow is estimated at 6515 m^3/s (Driga; 2004, Gâștescu & Știucă, 2008). According to the same authors, in the last century, the water flow in Chilia arm has decreased from 72% (1910) to about 54% possible less, at the beginning of the new millennium. The flow share of Tulcea arm increased from 28% to actually 46% or more after some unpublished scientific reports: less to Sfântu Gheorghe arm (from 20% to 25%), but especially because of the Sulina arm (from 8% to 23%, due to its continuous correction and dredging). The water flow from river discharge in the 3 units of the Danube Delta (Letea, Caraorman and Dranov units) about 5%, fuelling the lakes complexes (Bondar, 1994; Driga, 2004; Gâștescu & Știucă, 2008).

The consequences of biological invasions can be diverse, interconnected and complex (Zorić *et al*., 2015). Invaders can alter fundamental ecological properties, such as the dominant species in a community, the productivity and nutrient cycling, and thereby they can modify the structure and functioning of the ecosystem (Mack *et al*., 2000). The anthropogenic impact on the distribution of plants and animals is considered to be one of the major threats to biodiversity (Grigorovich, 2003). Aquatic ecosystems are not an exception when this aspect of disturbance is considered. The ballast waters of ships, deliberate fish stocking and aquaculture are potential means of introduction of non-native species.

The constructions of artificial channels, that connect previously geographically isolated river basins, facilitate the intensive dispersal of species and greatly contribute to the spread of non-native taxa (Leuven *et al*., 2009). This scenario has occurred at different sections along the Danube River. The river belongs to the Southern Invasion Corridor that links the Black Sea Basin with the North Sea Basin via the Danube and Main-Rhine Canal (reopened in 1992).

This corridor is one of the four principal routes for entry of invasive non-native aquatic organisms into Europe (Panov *et al*., 2009). This complex system of interconnected river basins and artificial channels (the Danube Delta, the Danube River, the Main – Danube Canal, the Main River, and the Rhine River) facilitates the spread of non-native taxa in both downstream and upstream directions throughout the Danube River Basin. The Danube River and its main tributaries are also exposed to aquatic invasions, *e.g.* the rivers Sava (Paunović *et al*., 2008; Žganec *et al*., 2009), Tisa (Tomović *et al*., 2013) and Velika Morava (Tomović e*t al*., 2012; Zorić *et al*., 2013).

Despite intensive research, it is still not possible to assess the real consequences of aquatic invasions and to provide effective solutions for proper management, especially in the case of large and complex systems such as the Danube River. A certain amount of progress has been achieved in evaluating the pressures of biological invasions on particular aquatic assessment units (Olenin *et al*., 2007; Arbačiauskas *et al*., 2008; Panov *et al*., 2009; Tricarico *et al*., 2010).

However, considerable efforts still need to be undertaken in order to fully understand invasion processes (Zorić *et al*., 2015).

The freshwater species *Pectinatella magnifica* (Leidy, 1851) (Bryozoa: Phylactolaemata: Plumatellida) is a non-native taxon exhibiting considerable long-distance spread, well away from its natural distribution range. This taxon is native to the eastern part of North America (from Ontario in Canada to Florida in the United States of America) (Zorić *et. al*., 2015).

However, nowadays it can be found in other parts of the USA (Balounová *et al.*, 2013). Its presence has been reported from several European countries, including Germany (Kraepelin, 1887; Grabow, 2005), France (Rodriguez, Vergon 2002; Devin *et al*., 2005; Nott Enghem, 2009), Czech Republic (Opravilova, 2005, 2006; Balounová *et al*., 2011), Poland (Balounová *et al*., 2013), Austria (Bauer *et al*., 2010), Hungary (Szekeres *et al*., 2013), Ukraine (Aleksandrov *et. al*., 2014) and from Asia Minor (Lacourt, 1968). In the Ukrainian part of the Danube Delta the abundance of *P. magnifica* is found mainly associated with *Phragmites australis* reedbeds that line the river (Aleksandrov *et al*., 2014). It is believed that the species was introduced to Europe in the 19th century. First it was reported in Hamburg in 1883 (Bernauer & Jansen, 2006).

The riverbed of the Danube at the sites (Figs. 1–2) where the magnificent bryozoan (Aleksandrov *et al*., 2014; Zorić *et al*., 2015) was recorded consisted predominantly of silt-clay and very fine sand substrate (mineral substrate classification according to Verdonschot (1999): grains not visibly perceptible; < 0.125 mm). The bank area at the sites was characterised by dense associations of aquatic vascular macrophytes.

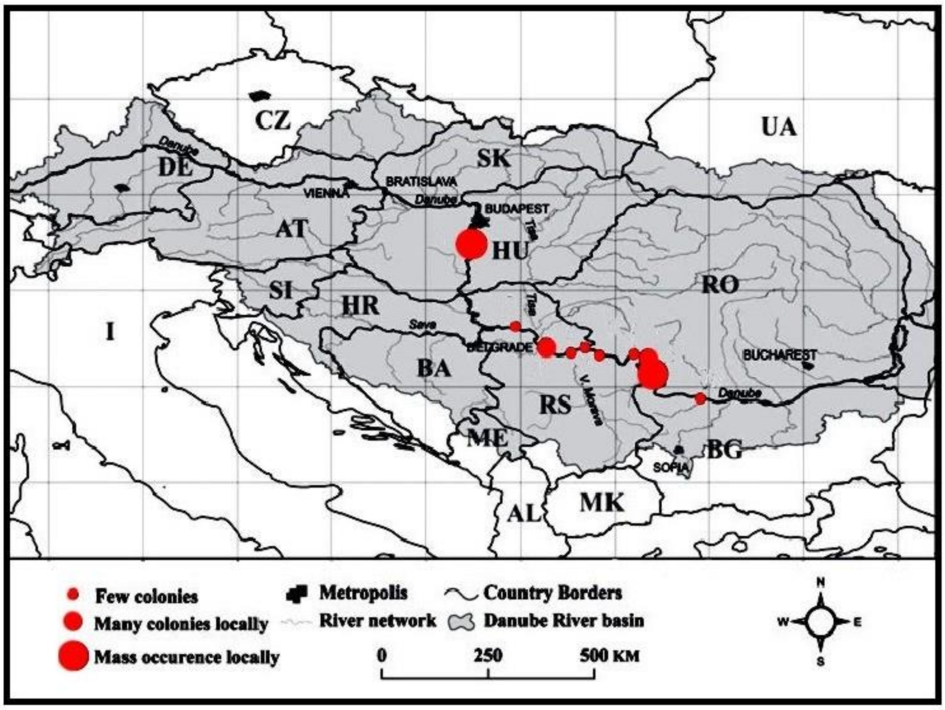

Fig. 1. Map showing the sites along the River Danube with records of *Pectinatella magnifica* (after Zorić *et al*., 2015).

The magnificent bryozoan is a colonial organism with ciliated tentacles that are attached to a large gelatinous mass (Pennak, 1989; Wood, 2010). The typical size of the colonies is between 10 and 20 cm, while the diameter of large colonies can be up to two meters. It feeds on diatoms, green algae, cyanobacteria, non-photosynthetic bacteria, dinoflagellates, rotifers, protozoa, small nematodes and microscopic crustaceans (Callaghan & Karlson, 2002). As in all bryozoan species, the life cycle of *P. magnifica* includes both sexual and asexual reproduction. During favourable temperature conditions (in temperate climate zone between May and June (Rodriguez & Vergon, 2002), *P. magnifica* reproduces sexually. Asexual reproduction includes simple bulking and formation of new individuals, but also formation of statoblasts that enable survival during unfavourable conditions, at lower temperature and during periods of draught. *Pectinatella magnifica* is a thermophilous species. The details of its life cycle, including literature reviews, are given in Rodriguez & Vergon (2002).

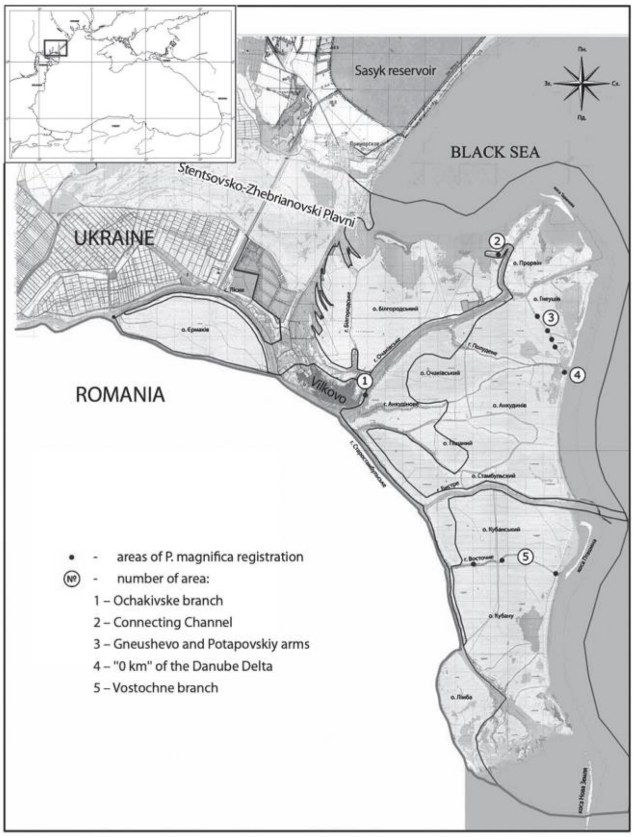

Fig. 2. Schematic Map showing the sites in Lower Danube in Ukrainian Danube Delta part (Kiliya branch) with records of *Pectinatella magnifica* (after Aleksandrov *et al*., 2014).

Close to Lower Danube River and Danube Delta always a new species stay to enter with water flow or with other vectors. For example, already adapted are some non-native species in Danube Delta Biosphere Reserve condition like: plants (*Amorpha fruticosa, Elodea canadensis,* plus other 54 plant species), molluscs (*Corbicula fluminea*, *Anodonta woodiana* and other 4 molluscs species), Decapoda-Crustacea species *Eriocheir sinensis* (Oţel, 2003–2004), fish species *Pseudorasbora parva, Hypophthalmychthys molitrix, H. nobilis, Ctenopharyngodon idella, Liza hematocheila, Lepomis gibosus, Percarina demidoffi* and the newest recorded species *Perccottus glenii* (recorded in 2007 by Năstase, actually acclimatised in the Danube Delta) fish species escaped from aquaculture, accidentally introduced or naturally entered. Also, *Phasianus colchicus,* bird and *Ondatra zibetica, Nyctereutes procyonoides* mammals are now found in the fauna of the Danube Delta.

The objective of this paper is to present first record of *P. magnifica* in the Romanian Danube Delta part based on the 2016 survey and image from territory, also many other colonies of *P. magnifica* were found in 2017.

MATERIAL AND METHODS

STUDY AREA AND SAMPLING PERIOD

Study area represents inferior sectors of the Danube River and lakes or canals from the Danube Delta. Sampling with direct observations was performed in the period May–September 2016, further more in 2017, but also a close relation with local's peoples and delta enthusiasts was very important in finding species first time.

The sampling methods for the Danube Delta include also collaborations with locals or environmental cares, which in *Pectinatella magnifica* case was beneficial to observe the species.

TAXONOMY AND ECOLOGY

The scientific name of species used is according to International Code of Zoological Nomenclature (ICZN).

RESULTS AND DISCUSSION

In the summer of 2016 a new species for Danube Delta – colonies of *Pectinatella magnifica* were found by chance by a local people, from Iacob Lake (Roșu-Puiu lakes-complex, the Danube Delta).

The freshwater bryozoan *P. magnifica* (Fig. 3) was recorded first time in the Danube Delta in Iacob Lake in the summer of year 2016 (Fig. 4), more individuals were found in Cazanele Channel in 2017 (Figs. 4–5).

Fig. 3. Colony of *Pectinatella magnifica* on the submerged stem of *Trapa natans* (the Danube Delta, Iacob Lake).

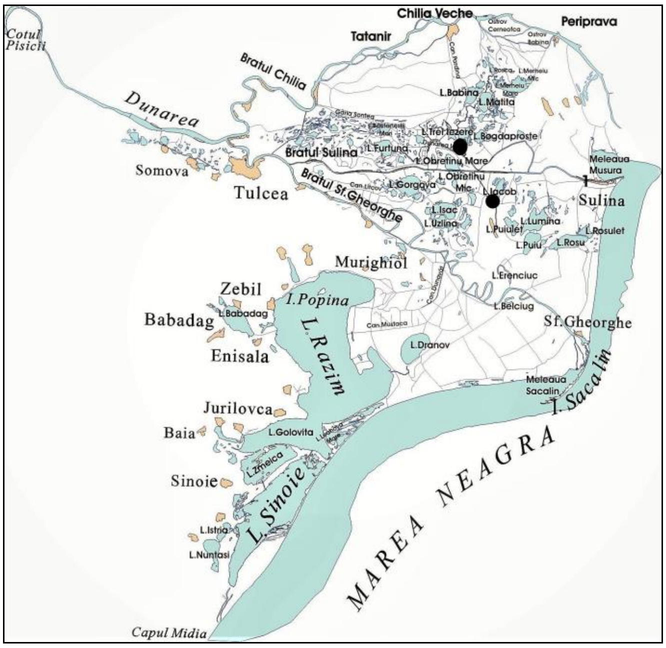

Fig. 4. Romanian Danube Delta part: the place (Iacob Lake)
where *P. magnifica* was first recorded in 2016 (Southern black dot),
more individuals were found in Căzănele Channel and neighborhood in 2017.

Fig. 5. Colony of *Pectinatella magnifica* stick on the submerged parts of some macrophytes, usually reed (Danube Delta, Căzănele Channel) observed in 2017.

The colonies were found on aquatic macrophytes (mostly *Trapa natans* species, as. *Trapetum natantis* Kárpáti, 1963) (Figs. 3–4) and woody debris of reed, submerged in the water (Figs. 4–5), mostly along the shore in channel or shallow lake (0.5–1.5 m deep). The recorded colonies were formed near the surface of the water, up to a depth of 15–30 cm.

The size of the colonies ranged between 10–15 cm in diameter.

Since the initial detection of the magnificent bryozoan in the Rackeve-Soroksar Danube River side arm in 2011 (Szekeres *et al*., 2013), it rapidly colonised a 900 km-long stretch of the Danube River. The organism is already a well-established inhabitant of the entire length of the Rackeve-Soroksar Danube River arm (Szekeres *et al*., 2013) and Zorić *et al*. (2015) data has confirmed the frequent appearance of extensive colonies of *P. magnifica* in the most downstream stretch of the side arm, immediately upstream from the lock.

Since its introduction to Europe in the 19th century, *P. magnifica* has invaded many parts of Europe (Kraepelin, 1887; Lacourt, 1968; Rodriguez & Vergon, 2002; Devin *et al*., 2005; Grabow, 2005; Opravilova, 2005, 2006; Nott Enghem, 2009; Bauer *et al*., 2010; Balounova *et al*., 2011; Aleksandrov *et al*., 2014; Zorić e*t al*., 2015) and Asia Minor (Lacourt, 1968). The species was given as a present also in Romania (Lacourt, 1968), data taken from Chirică (1906) (first record of species in Romania in Jijia river) and Căpușe (1962) (in Greaca Lake, near Danube, actually dry lake); other authors who have systematically dealt with bryozoan were Băcescu & Skolka O. (1982, 1983) (data taken from both Romanian authors Chirică and Căpușe), last record of species belonging to Cogălniceanu Dan 2012 (between discharging the river Nera and Orșova in the Danube), personal comunication to Skolka Marius, whose thinking is that species has "in jumps" development, the appearance of large and visible colonies being favored by certain external factors like temperatures. The species has also spread in North America, and is now found in Canada (Benson & Cannister, 2014), Texas (Neck & Fullington, 1983) and in 18 lakes in the Pacific Northwest, including the states of Idaho, Oregon and Washington (Marsh & Wood, 2002).

Based on Zorić *et al*. (2015) results, as well as on recent studies of other authors (Opravilova, 2005; 2006; Devin *et al*., 2005; Grabow, 2005; Nott Enghem, 2009; Bauer *et al*., 2010; Balounová *et al*., 2011; Szekeres *et al*., 2013) it can be speculated that this species is becoming increasingly common in areas outside its range.

The possible reasons for this species' invasiveness are related to its autoecological characteristics and changes of its freshwater habitats (Zorić *et al*., 2015).

The results of Zorić *et al*. (2015) suggest that the changes in habitats and reduced flow regimes provided favourable conditions for invasion by *P. magnifica*. Aside from habitats that are typical for this species (reservoirs) fish ponds and other aquatic habitats with altered hydrological conditions are also potentially suitable recipient ecosystems for the magnificent bryozoan.

Aquaculture (Seo, 1998; Nott Eghem 1999) and zoochory, dispersal of statoblasts by birds (Oda, 1974) are likely vectors for the spread of this invasive species.

The effect of the magnificent bryozoan on native ecosystems is still unknown. Mass occurrence of *P. magnifica* is suggested to improve water quality during the initial period of colonisation of new habitats (Zorić *et al*., 2015). Wood (2010) described increased transparency of water due to removal of suspended particles as a result of the feeding of individual zooids as a long term effect of colonisation. This in turn establishes conditions for increased algal production, which can severely affect the functionality of the aquatic ecosystem.

With regard to a more direct impact on humans, mass occurrence of the magnificent bryozoan has been reported to clog the drainage systems and water pipes in North America, and to cause unpleasant smell when large colonies remain in dried out areas after water level drawdown (Wood, 2010). But on the other hand, according to the experimental data obtained by Pejin *et al*. (2016), *P. magnifica* methanol extract may be considered as a good resource of novel natural products with potent antibiofilm activity against the bacterium (*Pseudomonas aeruginosa* PAO1) well known for its resistance.

Authors' opinion of coming in the Danube Delta Biosphere Reserve from Europe of *P. magnifica* is because of disperse species with solid flows transport by Danube's waters among the same native condition for species, into a general global warming of climate.

CONCLUSIONS

New record in 2016 for Romanian part of the Danube Delta is non-native colonial bryozoan *Pectinatella magnifica* (Leidy, 1851). Future studies are needed to determine the impact this species has on the Danube Delta ecosystems.

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