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The occurrence of the Chinese *Sinanodonta woodiana* (Lea, 1834) (Mollusca Bivalvia Unionidae) in Algerian dams

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ABSTRACT The Chinese pond mussel, *Sinanodonta woodiana* (Lea,1834) (Bivalvia Unionidae) is a large freshwater mussel from East Asia. This species lives in ponds and slow flowing rivers and channels. It was introduced in many places on the planet via the introduction of glochidium infested fishes and colonized many catchment basins. Its ecological characteristics make it a competitive and invasive species. The presence of *S. woodiana* in Algerian continental ecosystems was reported by a lot of fishermen in the many dams: dam of Djorf Etourba (Bechar), Timgad (Batna), dam of Brizena (El Bayadh) and the Beni Harron dam. This work presented some data of species collected in Beni Haroun dam.

KEY WORDS *Sinanodonta woodiana*; invasive; occurrence; Algeria.

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INTRODUCTION

In the last few decades, aquatic ecosystems have been extremely distressed by the introduction and spread of non-native invasive species. These species, in new environments, increase its populations, extended above large areas, compete with local organisms, change local habitats and influence ecosystem functioning (Occhipinti-Ambrogi, 2007). Some species of freshwater mussels, such as *Dreissena polymorpha* (Pallas, 1771) (Bivalvia Dreissenidae), have been found to be among the most important invaders of freshwater ecosystems (Paunovic et al., 2006; Zaiko, 2009; Lajtner & Crnčan, 2011). The Chinese pond mussel *Sinanodonta woodiana* (Lea, 1834) (Bivalvia Unionidae) is a species native to East and South East Asia; its distribution areas include the Amur River Basin, Lake Hanka, China, Hong Kong, Taiwan, Kampuchea, Thailand and Japan (Popa et al., 2007). In Europe it was first recorded in Romania fishfarms at Cefa-Oradea in 1979 (Sarkany-Kiss, 1986). It was observed in Hungary in 1980 (Sarkany-Kiss, 1986). In the meantime, this species has been discovered in several European countries: France (Girardi & Ledoux, 1989), Slovakia (Košel, 1995), Czech Republic (Beran, 1997), Austria (Reischütz, 1998), Italy (Manganelli et al., 1997, Lodde et al., 2005), Germany (Glöer and Zettler, 2005), Serbia (Paunovic et al., 2005), Poland (Kraszewski, 2007), Maldova (Munjiu & Shubernetski, 2008), Spain (Pou i Rovira et al., 2009), Croatia (Lajtner & Crnčan, 2011), Ukraine (Yermoshyna & Pavliuchenko, 2021) and Sweden (von Proschwitz, 2008). The occurrence of *S. woodiana* was also reported in some Indonesian islands, the Dominican

Republic and Costa Rica (Watters, 1997) and in the United States (Bogan et al., 2011). Finally, this species was also reported from Algeria (Bensaâd-Bendjedid et al., 2023).

Unionid mussels provide vital services in freshwater ecosystems by contributing to water purification, nutrient circulation, bottom bioturbation and provision of habitats (Urbańska et al., 2021, Vaughn, 2018). *Sinanodonta woodiana* has several preadaptations that let it invade quickly and successfully. It can be found in a variety of habitats, including ponds, reservoirs, lakes, irrigation channels, and rivers (Urbanska & Andrzejewski, 2019) with a predilection for sandy bottom surfaces. It is also resistant to pollution and poor water quality and has rapid growth and reproduction rates (Urbańska et al., 2021).

Sinanodonta woodiana's ability to outcompete native mussels is based on its large size, with a shell length of over 25 cm and a total wet body mass of over 1.5 kg (Urbańska et al., 2019), high filtration rates, ability to induce cross-resistance in the host fish, and a possible role in parasite and disease transmission (Taskinen et al., 2021).

To reduce the negative impacts of this species on the environment, several studies have been carried out on the use of the mollusks and bivalves species in waste water bioremediation. Zhou et al. (2018) and Sicuro et al. (2020) investigated a novel system, based on freshwater bivalves integrated with rainbow trout, for the bioremediation of inland aquaculture systems. The efficiency of freshwater bivalves in reducing the bacterial load, in particular toward *Aeromonas hydrophila* (Chester, 1901) Stanier, 1943 (a heterotrophic, Gram-negative, rod-shaped bacterium), indicates a bioremediation system with the possibility of interesting applications on inland fish farms, and as a biotechnological tool against the diffusion of antibiotic resistance in aquaculture.

Other studies have focused on the use of the shell of bivalves as a natural adsorbent for the removal of heavy metals such as nickel (Allaoui et al., 2021). Additionally, the shell fish waste-derived biochar can be effectively employed for the removal of various contaminants such as antibiotics, heavy metals, and excessive nutrients from aquaculture waste water (Mahari et al., 2022). Furthermore, Djebali et al. (2020) have studied and evaluated the potential of shells valorization in the production of alternative local cementitious materials by using residual shells material in formulations of alternative cementitious materials.

This paper reports new records of *S. woodiana* from Algerian continental ecosystems and providing the principal biometric characters of these populations.

MATERIAL AND METHODS

Samples of mollusks were collected from Beni Haroun Dam (BHD), a principal dam in northeastern Algeria. It is located in Mila province, 15 km from the city (Fig. 1). The main landscapes of the region are mountains and hills in the north, and plains and highlands in the south. Built in 2003, BHD receives water from a catchment area of 8815 km^2. The storage capacity of the reservoir is 795 Million cubic meters.

The collection of 230 individuals of *S. woodiana* was carried out during autumn 2021; after an exceptional summer drought which dried out several dams of Algeria mollusks sampling was carried out by local fishermen. The individuals transported to the laboratory, where the main biometric variables (shell length SL, height HL, and width WL) were immediately measured to the nearest 0.1 mm using ichtyometer since the total weight was determined

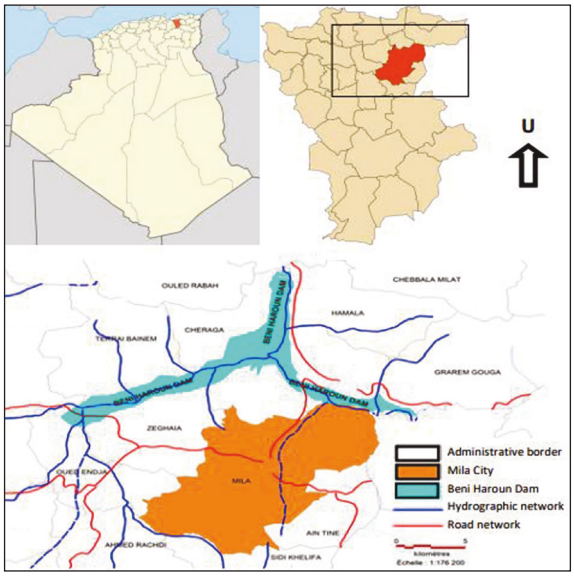

Figure 1. Geographical location of Beni-Haroun dam of Mila, north-eastern Algeria (Berrouk et al., 2018).

by a precision balance (0.01 g). The measures are given from a batch of 63 shells chosen randomly. The species identification of mollusks was carried out according to references cited in the text. Based on shell length specimens were classified into four size classes (Spyra et al., 2012): young with SL<50 mm, small 50≤SL≤100 mm, medium 100 ≤SL≤150 mm, and large SL> 150mm.

RESULTS AND DISCUSSION

The shell of the species collected is thin with pearly or whitish nacre, the periostracum outside is glossy light brown or yellowish with concentric growth lines with greenish patterns (Munjiu et al., 2020). According to the results obtained (Table 1), the length (L) of the shells ranged from 67 and 167 mm, shell height (H) fluctuated between 32 mm and 48. The shell width varied between 11.8 and 35 mm. The ration of the total length and height L/H reflects the more rounded or more elongate shape shells. In our study this ration varied between (0.48 and 0.32), while the L/W ration varied from (0.32 and 0.50). All young specimens of *S. woodiana* had rounded shells (Fig. 2), while the adult specimens had both rounded and elongated shells, with prevalence of the latter.

Size class mm	Specimens	Lengh (mm)		Height (mm)		Widht (mm)		Weight (g)	
		Mean	SD	Mean	SD	Mean	SD	Mean	SD
SL<50 mm	0	-	-	-	-	-	-	-	-
50≤SL≤100 mm	5	84.6	13.2	34	7.31	53.8	12.51	95	45.69
100 ≤SL≤150	51	124.8	14.3	51.21	6.7	80.49	10.02	265.96	94.06
SL> 150mm	7	157.8	6.3	65.42	5.44	108.1	8.09	525.95	87.33
all	63	121.85	11.34	50.21	6.48	80.79	10.26	295.63	75.69

Table 1. *Sinanodonta woodiana* biometric data collected in Beni-Haroun Dam in Decembre 2021.

Figure 2. Various shells of *Sinanodonta woodiana* from Beni Haroun Dam (Algeria).

The largest specimen recorded had a weight of 645 g, while the smallest on was only 45 g.

The most numerous groups of size classes was the IIIrd (medium) consisting of 51 specimens, while the IInd and the IVth had 5 and 7 specimens, respectively. The Ist, instead, was represented by 0 specimens.

The shell elongates very little with age (very low correlation, 0.08 between length and ratio height over length) and no longer thickens (correlation of 0.15 between the length and the thickness to length ratio) at the observed sizes (Fig. 3).

The introduction of the Chinese pond mussel to Beni Haroun dam seems to be closely correlated with the introduction of fish from East countries. Different species of carp fishes function as hosts, especially Silver Carp *Hypophthalmichthys molitrix* (Valenciennes, 1844) and Grass Carp *Ctenopharyngodon idella* (Valenciennes, 1844). According to Mienis (2003), Goldfish *Carassius auratus* (Linnaeus, 1758) and different species of Bitterling (*Rhodeus* spp.) are also possible hosts.

Algeria, like many other countries in the world, has been affected by the politics of introducing new species of fish in order to develop freshwater fish farming. Other introductions have been carried out without a precise purpose enrichment of the ichthyofauna (population of vacant ecological niches, introduction of species into bodies of water devoid of fish, reservoirs). The challallenge which is not limited to Algeria is to work out strategies that balance the need for fish supplies and sustainable use of natural resources and ecosystems.

Twenty seven species have been introduced into Algerian continental waters from 1859 to 2016 (Kara, 2012). The six most often introduced species were *Cyprinus carpio* Linnaeus, 1758, *Hypophthalmichthys molitrix*, *Hypophthalmichthys nobilis* (Richardson, 1845), *Oreochromis niloticus niloticus* (Linnaeus, 1758) and *Ctenopharyngodon idella*. The ornamental fish *Carassius auratus* has received identified introductions from four countries as France, Hungary, Egypt and DR Congo (Kara, 2012). It can be assumed that the importation of fishes from Hungary and France could be a possible vector of *S. woodiana* invasion in Algeria.

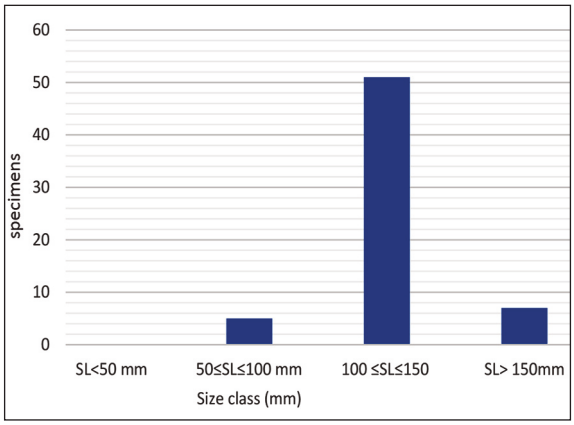

Figure 3. Size class distribution of *Sinanodonta woodiana* from Beni Haroun Dam (Algeria).

CONCLUSIONS

An investigation on the distribution of *S.woodiana* in Algerian continental ecosystems is necessary in order to identify the distribution and assess the impact of biological invasions on native communities, and to provide effective prevention measures for mitigating the introduction and dispersal of this invasive species.

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