



## THE FIRST RECORD OF THE ASIAN CLAM *CORBICULA FLUMINEA* (BIVALVIA: VENEROIDA: CORBICULIDAE) IN THE UPPER VISTULA (SOUTH POLAND)

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**ABSTRACT:** The Asian bivalve *Corbicula fluminea* was first reported from Poland in 2003, from the Odra (Oder) River. It was found in the lower and later in the middle course of the river. In May 2011 this invasive species was found for the first time in the Vistula River, in Cracow, which indicates an extension of its distribution range in Europe. The Vistula is the largest river in the Baltic Sea catchment area. The invasion of *C. fluminea* may threaten native species and natural habitats in the Vistula and its tributaries.

**KEY WORDS:** *Corbicula fluminea*, invasive species, freshwater bivalve, Vistula, distribution range

### INTRODUCTION

*Corbicula fluminea* (O. F. Müller, 1774) is a medium-sized clam whose shell may be up to 65 mm long, but normally does not exceed 25 mm. The shell is thick-walled, oval in its lower part and markedly triangular near the umbo, which is located more or less centrally. Its shape is variable and depends on the animal's habitat and age. The shell surface is covered with many growth ridges (concentric sulcations) and striae. Its colour is either light (yellowish-olive or yellow-brown) or dark brown (STAŃCZYKOWSKA & KOŁODZIEJCZYK 2011).

This ovoviviparous species originally comes from the basin of the river Ussuri in East Asia (LACHNER et al. 1970). In the 1930s the clam was recorded in North America, first in British Columbia, and in 1937 in Washington State (BALCOM 1924), and since then it has been continuing its expansion (STAŃCZYKOWSKA & KOŁODZIEJCZYK 2011). In the 1980s it was first recorded in Europe, near the western borders of Portugal and France (MOUTHON 1981, STAŃCZYKOWSKA & KOŁODZIEJCZYK 2008). In the following years the species has colonised Austria, Bulgaria, France, Germany, Luxembourg, the Netherlands, Poland, Portu-

gal, Spain, Switzerland and United Kingdom (ARAUJO et al. 1993, FAUNA EUROPEA 2004). The clam was also recorded in other countries, including the Czech Republic (BERAN 2000, 2006), Moldova (MANJIU & SHUBERNETSKI 2010), Hungary (CSÁNYI 1999), and Serbia (PAUNOVIĆ et al. 2008).

The first record of *C. fluminea* in Poland dates from 2003 (DOMAGAŁA et al. 2004). The species was then found in the lower stretch of the Odra, in a canal discharging cooling water from the Lower Odra Power Plant near Szczecin. As a result of further surveys, covering the entire river, *C. fluminea* was found in both the middle and the lower sections of the Odra (WAWRZYNIAK-WYDROWSKA 2007).

Since little is known about the biology of the species, it is impossible to clearly identify the factors facilitating its fast adaptation to the conditions of the colonised areas. It is expected that new breeding sites of the invasive clam may appear, as it keeps extending its geographical range.

This paper presents data on a new Polish record of this species, the first one in the Vistula River, greatly extending its distribution range.

## MATERIAL AND METHODS

Observations were carried out between May and October 2011 near the Wawel hill in Cracow, on the right bank of the Vistula River (Bulwar Poleski) (UTM DA24; 50°03'10"N, 19°55'53"E; ≈213 m a.s.l.). The material was collected by hand from a patch of river sand (a stretch 40 m long and 2 m broad). Shells protruding from the sand were collected for about 10 minutes. In October, samples were collected with a net from the river bed to the depth of about 40 cm.

The collected material was cleaned from sediments and labelled. Live specimens were preserved in 75% ethanol solution. The height and length of the shells were measured with a vernier calliper.

Species identification was based on shell shape, sculpture, and colour as well as hinge structure, according to GLÖER & MEIER-BROOK's (1994) key. Professor ANDRZEJ PIECHOCKI (University of Łódź) and Dr ANNA M. ŁABĘCKA (Jagiellonian University) confirmed the identification.

## RESULTS

Empty shells of *C. fluminea* (Fig. 1) were discovered in the study site on 29 May 2011, when 20 paired and

35 single valves were collected. The largest shell was 22.5 mm long and 20.6 mm wide.



Fig. 1. *Corbicula fluminea* from the Vistula River (photo: A. SULIKOWSKA-DROZD)

Field research was repeated on 18 June, 24 September, and 23 October 2011. Each time, several dozen shells in various condition were collected; most of them were single valves of various size (not larger than 25 mm). On some shells a line typical of temporary growth arrest was noticed. Some shells had a preserved ligament, and some had a complete endostracum.

Live specimens of *C. fluminea* were found on 23 October 2011. Three live bivalves were collected from the river bed at the depth of about 40 cm. Their shells were yellow (lighter than the shells found on the bank) and their length did not exceed 12 mm.

## DISCUSSION

It is difficult to determine precisely the circumstances under which *C. fluminea* appeared in the Vistula. Data from the Cracow Vistula Basin Management [Zarząd Zlewni Wisły Krakowskiej] indicate that engineering works were carried out in the river stretch under study in March and April 2009. A dredger then cleared the river bed, collecting sand. Some sand was moved towards the banks (R. JEZIOROWSKI, personal information). If the material collected in May 2011 was there as a result of the works, it should be assumed that the clam had been in the river at least since 2008.

Some shells have a line marking temporary growth arrest, which may indicate their second year of life (STAŃCZYKOWSKA & KOŁODZIEJCZYK 2011). If it was a pioneering generation, then their presence in the Vistula should be dated to 2008. The presence of young specimens reflects reproductive abilities of the population living in the river. Shell sizes suggest that the first generation of the invasive clam appeared in the Vistula not later than in 2008 and that the species successfully overwintered there in the natural environment.

In May 2010, high water levels were recorded in the Vistula in Cracow, which may have had an impact on the distribution of the species. Since *C. fluminea* reproduces hermaphroditically and its development is marked by the presence of the pediveliger larva (STAŃCZYKOWSKA & KOŁODZIEJCZYK 2011), the flood wave may have moved the clam population down the river. Therefore, it seems necessary to investigate the site of *C. fluminea* in the Vistula near the Wawel hill as well as the distribution of the species along the river and its tributaries.

In view of the Vistula catchment area, the presence of the species in the river is significant for its further invasion in Europe. Within a few years since its first record in Poland, the species has extended its range to include this largest river in the Baltic Sea catchment area. If the Asian clam finds the local conditions favourable – and the material collected shows that it

Apart from the species in question, the following molluscs were found in the sand and flood debris: *Bithynia tentaculata* (Linnaeus, 1758), *Potamopyrgus antipodarum* (Gray, 1843), *Planorbis planorbis* (Linnaeus, 1758), *Anodonta anatina* (Linnaeus, 1758) and one empty, damaged shell of the protected bivalve *Unio crassus* (Philipsson, 1788). Out of these, only *P. antipodarum* was numerous, while the other species were represented by single shells. One live specimen of *Sphaerium corneum* (Linnaeus, 1758) was recorded as well.

does – a faster expansion of the species further into Poland can be expected.

The expansion of *C. fluminea* is predicted to have a negative impact on the biological diversity of surface waters in the Vistula basin. STAŃCZYKOWSKA & KOŁODZIEJCZYK (2011) report that a single specimen releases from 320 to 387 larvae per day, i.e. approximately 35,000–70,000 larvae per season. Competition for food and the high fertility of the species pose a danger primarily to other bivalves, in particular those of the families Sphaeriidae and Unionidae (STAŃCZYKOWSKA & KOŁODZIEJCZYK 2011). Apart from further monitoring and measures preventing new introductions, there is no way to limit the population size of this invasive species. It is notable that *C. fluminea* in Poland in 2011 was included in an official list of alien species of plants and animals that may endanger native species or natural habitats if introduced to the natural environment (ROZPORZĄDZENIE 2011). Under Art. 120 section 2 of the Polish Nature Conservation Act (USTAWA 2004), the importing, keeping, breeding and marketing of such species require the consent of the Director-General for Environmental Protection. In view of the above, measures should be taken to increase awareness among the aquarists, who are most probably responsible for the introduction of *C. fluminea* in the Vistula.

Beside the closely related and very similar clam *Corbicula fluminalis* (O. F. Müller, 1774) and the Chinese pond mussel *Sinanodonta woodiana* (Lea, 1834), *C. fluminea* is a recent addition to the malacofauna of Poland (PIECHOCKI 2008). The speed with which the species is spreading is unknown, and human activity (deliberate or accidental) seems to be a decisive factor behind the spread. Observations in the middle course of the river Rhine suggest that the clam spreads at a rate of 85–115 km a year (STAŃCZYKOWSKA & KOŁODZIEJCZYK 2011). The results presented here show that the species has entered the Vistula, thus extending its range to the largest river of the Baltic Sea catchment area.





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