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THE OCCURRENCE OF THE PROTECTED SWAN MUSSEL *ANODONTA CYGNEA* (LINNAEUS, 1758) AND THE INVASIVE ALIEN CHINESE MUSSEL *SINANODONTA WOODIANA* (LEA, 1834) IN THE FISH PONDS IN THE WISŁOK RIVER BASIN (SE POLAND)

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ABSTRACT: The occurrence of the Chinese mussel *Sinanodonta woodiana* (Lea) was discovered in June and July 2011 in a fish pond located about 15 km north-west of Rzeszów (Subcarpathian region). Thirty six specimens (6 dead and 30 live) of the species were found. The Chinese mussel was absent in two other fish ponds in the same area, however the swan mussel *Anodonta cygnea* (L.) was found in these ponds (80 individuals: 45 dead and 35 live). At the time when the survey was conducted the ponds had already been drained for 3 to 8 months, so both populations will probably disappear from the locality. Nevertheless the new finding of the Chinese mussel in fish ponds confirms the possibility of occurrence of the species also in the waters with natural thermal regime.

KEY WORDS: *Anodonta cygnea,* endangered species*, Sinanodonta woodiana,* alien species, fish pond

The swan mussel *Anodonta cygnea* (Linnaeus, 1758) and the Chinese mussel *Sinanodonta woodiana* (Lea, 1834) are the largest unionid bivalves found in the Polish waters. The swan mussel is a native species and until the 1950s it was regarded as common (see distribution map in fig. 51 in PIECHOCKI & DYDUCH-FALNIOWSKA 1993). Due to habitat degradation, it is now becoming increasingly rarer. The swan mussel is fully protected and included in the Polish Red Data Book of Animals, with EN category – an endangered species (ZAJĄC 2004).

On the other hand, the Chinese mussel is an Asian species which was unintentionally introduced in Europe, first in Romania and Hungary, together with fish stocking material in the 1960s (PETRO 1984, SÁRKÁNY-KISS 1986). It was brought to Poland from Hungary twenty years later in similar circumstances. In our country, reproducing populations were recorded only in heated waters: the Konin lakes and canals (KRASZEWSKI & ZDANOWSKI 2001) and the canals of the lower Odra River (DOMAGAŁA et al. 2004). Other localities of *S. woodiana* in Poland were listed by KRASZEWSKI (2007) who suggested that the natural water thermal regime in our latitude was a factor that limited establishment of its populations. However, some observations suggest a possibility of establishing of permanent populations in waters of sub-optimum temperature (NAJBEREK et al. 2011).

Both these unionids were recorded on 29 June 2011 in fish ponds (50°9'38.6"N, 21°51'35.97"E) near the village of Budy Głogowskie, about 15 km north-west of Rzeszów (Subcarpathian region). These fish ponds were established at the beginning of the twentieth century. They were used commercially throughout the entire period of their existence; initially, the fish ponds were privately owned and, subsequently, they were operated as a state-run fish farm. Mainly carp *Cyprinus carpio* (Linnaeus, 1758) was kept

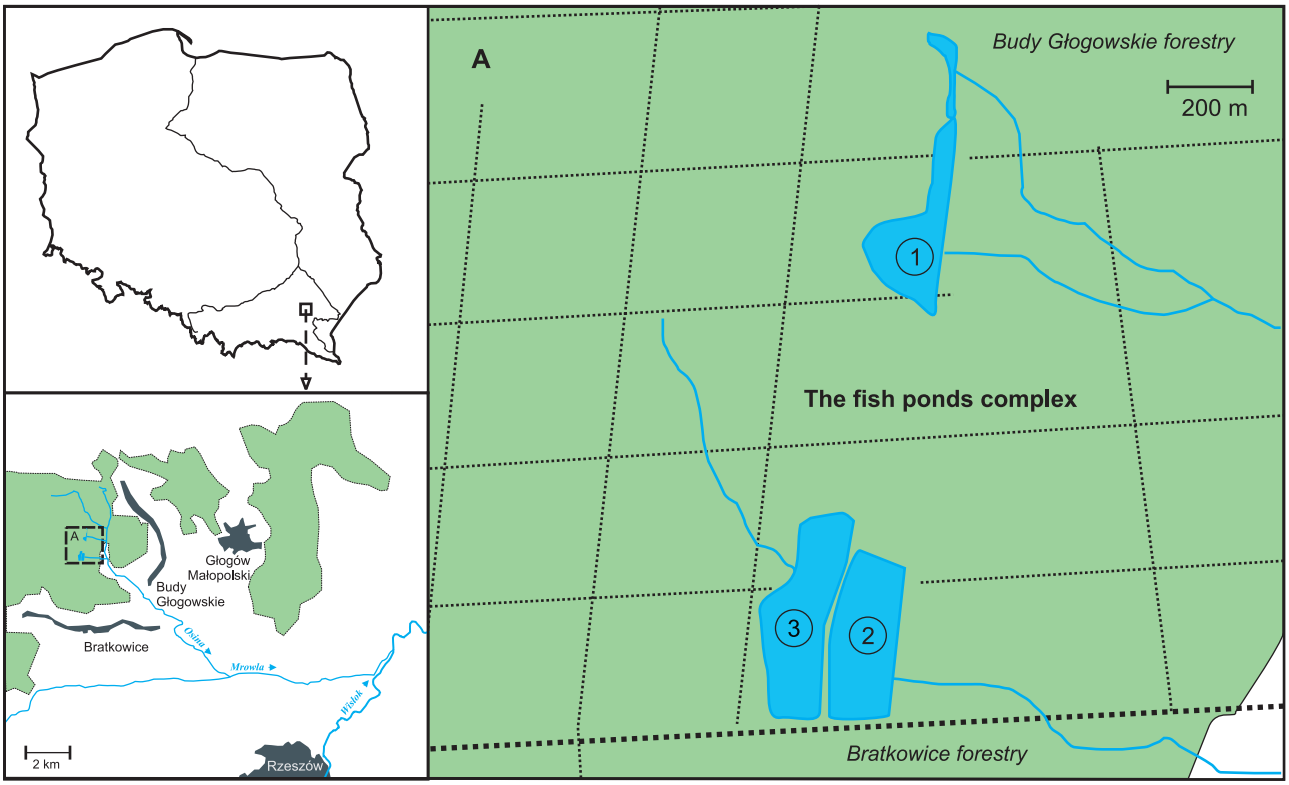

Fig. 1. Localities of *Anodonta cygnea* (Linnaeus, 1758) and *Sinanodonta woodiana* (Lea, 1834) in the fish ponds near Budy Głogowskie

there. Then, for over a dozen years, they were privately owned again. It is a complex of three ponds with an area of 4 ha (pond 1), 5.8 ha (pond 2), and 6.7 ha (pond 3), which are located in the middle of a forest complex. Two forest streams, which are the Osina River tributaries, feed all the ponds (Fig. 1). In the autumn of 2010, ponds 2 and 3 were drained, while pond 1 was drained in the spring of 2011, which made it possible to collect the specimens.

Each bivalve individual found was measured (length, width, and thickness) according to URBAŃSKA & MIZERA (2009), and photographed (Fig. 2). Ba-

Table 1. Descriptive statistics of *Sinanodonta woodiana* (Lea, 1834) and *Anodonta cygnea* (Linnaeus, 1758) from the fish ponds near Budy Głogowskie

	N	min (cm)	max (cm)	Mean±confidence limit	SD	V%
Sinanodonta woodiana						
Pond 1						
length	36	9.3	21.4	14.68±1.02	3.00	20.5
width	36	5.4	13.1	9.75±0.62	1.84	18.8
thickness	36	3.6	8.2	5.99±0.4	1.18	19.6
Anodonta cygnea						
Pond 2						
length	17	11.5	18.9	14.61±0.94	1.83	12.5
width	17	6.4	9.1	7.94±0.36	0.72	9.0
thickness	17	3.4	6.4	5.10±0.48	0.94	18.4
Anodonta cygnea						
Pond 3						
length	57	10.0	19.0	15.17±0.52	1.96	12.9
width	57	5.8	10.0	7.86±0.25	0.94	12.0
thickness	57	3.2	6.5	5.04±0.20	0.77	15.23

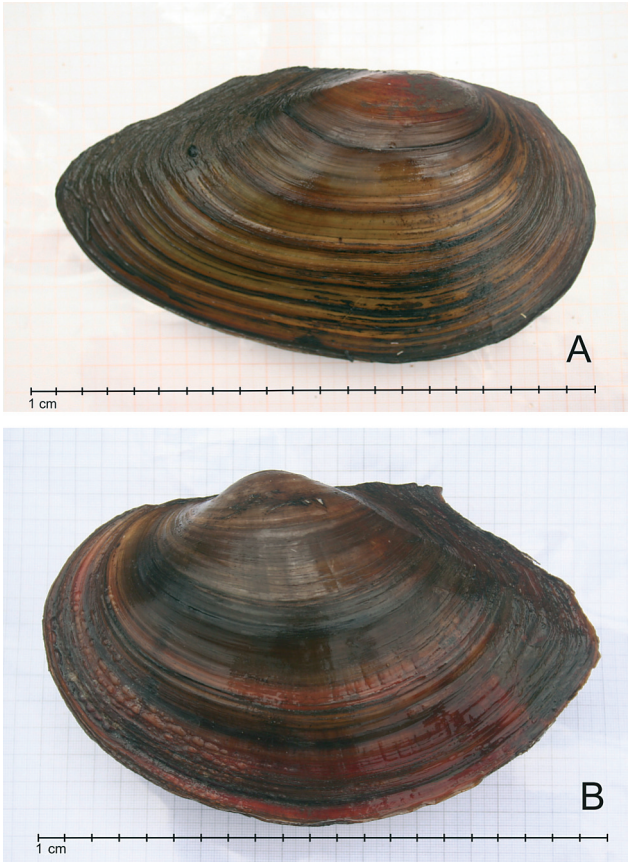

Fig. 2. A nine-year old specimen of *Anodonta cygnea* (Linnaeus, 1758) (A) and a more than three-year old specimen of *Sinanodonta woodiana* (Lea, 1834) (B) found in the fish ponds near Budy Głogowskie. Photo: ANDRZEJ WOJTON

sic descriptive statistics for the studied populations are given in Table 1.

The Chinese mussel was recorded only in the first pond. In all, 36 specimens were found ($\bar{x}$ length = 14.68 cm, $\bar{x}$ width = 9.75 cm, $\bar{x}$ thickness = 5.99 cm). Six of the specimens were empty shells. Shell fragments, preserved to varying degree, were also found in great numbers on the bottom of the pond. No other unionids were found there.

During the same survey 17 dead swan mussel individuals ($\bar{x}$ length=14.61 cm, $\bar{x}$ width=7.94 cm, $\bar{x}$ thickness= 6.4 cm), as well as broken shell fragments, were found in the second pond of this complex (5.8 ha). During the second survey (10 July 2011), 35 live and 28 dead individuals of this species were found in the third pond ($\bar{x}$ length=15.17 cm, $\bar{x}$ width=7.86 cm, $\bar{x}$ thickness= 5.04 cm). The shell morphometric variation was distinctly smaller than in the case of the Chinese mussel.

All the live individuals were found in the channel of the stream feeding pond 3 and in the still wet, muddy part of the pond. The long time of exposure of the bivalves may have caused many individuals to desiccate, be collected by people, or eaten by predators. Cases of predation of several mammal species on large freshwater bivalves are known (WOŁK 1979, KOPIJ 2011).

It was also possible that the swan mussel and the Chinese mussel occurred in the neighbouring pond complex called Zabłocie (ca. 70 ha), ca 1.5 km away. However, sand and soil extraction operations carried out in this pond complex precluded futher survey.

There are almost no literature data on the occurrence of the swan mussel in the study area. The only documented locality from the area of Rzeszów, which cannot be found now, was reported by BĄKOWSKI (1880). In recent years (1991–2000) the occurrence of the swan mussel in the Wisłok River Basin was reported only in the fish ponds in Korniaktów (K. ZAJĄC pers. comm.). In the neighbouring basins in the Subcarpathian region only one record was made in Myczkowce in the San River (ZAJĄC 2004).

At the time of this survey, there was only a residual population of the swan mussel. The large size (old age) of some individuals, now rarely recorded (KOŁODZIEJCZYK & KOPERSKI 2000), may suggest the existence of an old population. As a result of the long-lasting draining of the ponds, the population will probably disappear from the study area. As pointed out by WIDUTO (1968), long periods of exposure can reduce the unionid numbers or contribute to their complete local extinction.

The exact distribution of the Chinese mussel and its impact on native species are unknown. The bivalve seems not to have all the characteristic features of a species which may threaten the native biological diversity but, on the other hand, a number of physiological and ecological traits are mentioned which indicate its strong competitive ability against the native malacofauna (KRASZEWSKI 2007, URBAŃSKA & MIZERA 2009). The swan mussel and the Chinese mussel were found to co-occur in the fish ponds in Spytkowice (NAJBEREK et al. 2011). A trait that can limit the spread of the Chinese mussel is its sensitivity to low temperatures (KRASZEWSKI & ZDANOWSKI 2008, URBAŃSKA & MIZERA 2009).

So far, only six localities of the Chinese mussel with natural thermal regime were known in Poland; four of them were fish ponds. The earliest such record, made in the 1990s, was from a fish pond in Zgliniec (W. Poland) (ŁAKOMY et al. 2012). The next records came from commercial fish ponds in the region of the Sieraków Landscape Park (MIZERA & URBAŃSKA 2003) and from the ponds in the Barycz River Valley, where several hundred individuals of this species were found (GĄBKA et al. 2007). In both the above-mentioned cases, there is no reason to think that these populations are permanent (KRASZEWSKI 2007). The last report on the occurrence of the species in Poland comes from the Vistula River Valley where three dead individuals were found in the Spytkowice ponds. The varying age of individuals found indicated the possi-

bility of the existence of a reproducing population (NAJBEREK et al. 2011).

The record of the Chinese mussel from the fish pond complex near Budy Głogowskie (near Rzeszów) is the first documented occurrence in the Wisłok River Basin. The collected individuals were aged up to 4 years which confirms the suggestion that the species may also occur in waters of lower temperature. In the places where stable populations exist, the Chinese mussel is frequently the dominant component of the bottom fauna (KRASZEWSKI & ZDANOWSKI 2001, 2008, KRASZEWSKI 2007), which can be a potential threat to the existence of native unionids.

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