

**THE INVASIVE CHINESE POND MUSSEL (SINANODONTA
WOODIANA, LEA, 1834) AS A DANGER FOR WATERSIDE
TOURISM**

**INVAZIVA MIDIE CHINEZ DE BALT (SINANODONTA
WOODIANA, LEA, 1834), UN PERICOL PENTRU TURISMUL DE
COASTA**

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***Abstract:** Waterside tourism give the majority of the total touristic activity and the income in Hungary. The mass of tourism and guests naturally concentrated around the lake Balaton, and Tisza-pond, but smaller ponds, riversides also preferable places. Unfortunately in the past decade a sudden mass death of a big and invasive mussel *Sinanodonta woodiana*, sin: *Anodonta woodiana* species occurred and caused little panic and discomfort in the tourists and risk the incomes. The ruination of this species effects huge amounts of smelly carcasses swimming on the surface, and perished the season for weeks. This work try to simulate and forecast this collapses based on the population dynamic, the behaviour and the propagation features of this species.*

***Key words:** *Anodonta woodiana*, population dynamics, ruinations, production, biomass*

INTRODUCTION

The invasive, habitat generalist Chinese Pond mussel (*Sinanodonta* “*Anodonta*” *woodiana woodana* LEA, 1834) was introduced to East-Europe inadvertently by the herbivorous Chinese fish in the 1960. The species were observed first in Romania (Sarkany-Kiss, 1986), Hungary (Petró, 1983), and later dispersed in all Europe by the commercial fish transport.

The species feel well in the moderate belt, but like the warmer water bodies or heated lake system (Kraszewski and Zdanowski, 2007).

The mussel is the biggest mollusk in the European waters. The estimated life span of the mussel is about 8-12 years, with 190-200 mm final length (Kiss-Pekli, 1988). It has parasitic larvae (glochidia) which cling up to a host fish fin or gill, spend 7-10 days on it in 20-22° C, and after the metamorphosis, the young mussels sink to the bottom and start its own life. *A. woodiana* hasn't special host fish, common carp, catfish, pike, breams or

other Cyprinidae can be host fish equally. It is generally agreed that exports of fish for commercial purposes (mainly carp species from East Asia) can be the main pathway of dispersal (Watters, 1997).

RUINATION PROBLEMS

The species might reach 80-90 % of total biomass of Unionidae mussels in a few years, which can reach the 10-30 tons per hectare. Parallel it causes the reduction of native Anodonta species unfortunately. In some special eutrophic waters (mainly fish ponds or backwaters) *A. woodiana* is the dominant now (with relative biomass of 95-98 %). (Kiss A.,-Petro E. 1992)

Since the Chinese pond mussel occupied the European waters, observations reports the increasing of the biomass of the mussel. Moreover in the past decade several populations of *A. woodiana* had collapsed in Hungary. Unfortunately the biggest ruinations occurred in tourism favoured places mainly, where thousand of 13-15 cm big dead mussel body poisoned the water body and smell the environment for weeks. Some of them:

- 1992 (?) - Tata punter pond.
- 2006 - River Tisza under Szeged, Körös-oxbow at Békésszentandrás. Mártély-oxbow, Kígyós-pond at Bácsalmás.
- 2007 – River Kurca, Tisza -reservoir, Orfű- reservoir, Rivers of Körös
- 2008 – Deseda reservoir, Tisza-pond, Öcsöd
- 2009 – Sio-canal
- 2010 - Tisza-pond
- 2010 - Tisza, Kurca, Maros oxbows
- 2010 - Békésszentandrás oxbow
- 2011 - Mártély -Körtvélyes oxbow, Nagykanizsa punter-pond
- 2011 - Markaz reservoir

The reasons were generally unknown, but these always happened in hot summer days when the temperature is high. Because of mussels generally doesn't prayed, populations can “overrun” and periodically collapses. This process may occur in the native populations also, but the native species are smaller, the density is lower, and their shells are too heavy, and won't lift up after death, so the carcasses are decomposed in the bottom without any observation.



Fig. 1. *Anodonta (Sinanodonta) woodiana*

The main problems caused by Chinese pond mussel:

1. The population collapses causes thousands of smelly carcasses which are frightening the tourists and anglers.
2. The sharp shell can cut the legs of swimmers in shallow waters. This can cause serious injuries, and make swimming impossible or harmful.
3. Parasitic larvae (glochidia) of the mussel can kill or infect the fish fingerlings, cause higher mortality (this effect occurs in nursing fish pond mainly).

We focused the attention to the first point, because the most remarkable events is the population collapses and the discomfort effects.

MATERIAL AND METHODS

Previous ecological and laboratory investigations of the mussel behaviour were investigated from 1985-1990, and several parameter of the species were determined earlier. (Kiss, A. 1995).

Known or estimated data:

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- The size and weight of age groups (see Table 1.) (Dudgeon D.-Morton B.,1983), (Kiss, A., Pekli, J.,1988)
- The approximate biomass of the age groups. (see Table 1.) (Kiss, A., 1995)
- The age of maturation (reproduction process) started after the 3rd or 4th year. (Kiss, A.1995)
- Mortality rate. This is an estimation, which is fit to the observations. We assume that the mortality of the juvenile are higher (80 %), and the average lifespan is 10 years, and than the mortality should be 100 %. (see Table 1.)
- The success of spawning (survived juveniles/female/year) – this is an estimation, depend on water parameters, water types and the available host fish.
- The number of impact – we estimated that one hundred of mussel impact the water body by a fish transport, because this is the most probable way of spreading.
- The natural limitation of specimen/area or biomass/area -variable.

Moreover we set the maximum age to 10 years, and the maximum length to 175 mm, with 613,5 g living weight in the simulation. Although some specimen can reach the 220-240 mm with 1000-1500 g, in natural circumstances, but this is not the general.

The Living weight was calculated with the following equation, which were determined previously from few hundred mussels. (Kiss A.1995)

$$Living\ weight(g) = 1,6864 E - 04 \ Length(mm)^{2,925}$$

T able 1.
Estimated data of the age groups of *S. woodiana* (*A. woodiana*)

Age group	Size (mm)	Weight(g)	Mortality %
1	30	3,5	80
2	60	26,8	10
3	100	119,4	10
4	130	257,1	10
5	150	390,8	10
6	160	472,0	10
7	170	563,6	10
8	172	583,2	10
9	174	603,3	10
10	175	613,5	100

With the help of these data we made a simple simulation how to behave a population, and how to predict and forecast these collapses.

The simple algorithm:

1. We start the impact with 100 juvenile mussel.
2. We reduce the number of mussel with the actual mortality rate of the age group, and count the biomass and number of the survivors.
3. We count the matured mussels (4 year or older) and multiple them with the estimated success of propagation.
4. We sum up the biomass of the age groups or generations.
5. We set some limitation if were necessary (for example we can limit the density, the food, biomass etc.) and if the population reach this limit, we increase the mortality rate from 10 % to 90 % in different age groups.

RESULTS AND DISCUSSION

Simulations showed a 30 years period from the first impact and show the biomass and number of population if we use different starting parameters. Naturally several results can be produced, we show only three base figures in this work.

The balanced population occurs when one female produce average 1,3 survived juvenile mussel/year. (Fig.2). In this model, the population reach a balanced status after one big collapse in the 10th year.

The second status shows a continuously increasing (not possible) status when the population grows exponentially (Fig. 3). If the juvenile/female ratio is 5, the population will overrun.

The observed and mostly imaginable process shown in the Fig.4. We set a density limitation. When the population reach this limit, the 4th and the 5th age groups collapsed, and this ruinations occurs frequently every 1-3 years.

Very important, that this figure occurs only when the increased mortality (90 %) reduce the 4th and the 5th age groups only. If we set the increased mortality rate in the 2nd and 3rd age group, the population die out. To increase the mortality in the 7-8 year old age groups only, nothing happen. The Fig 4. fit to the observations better than any other simulation.

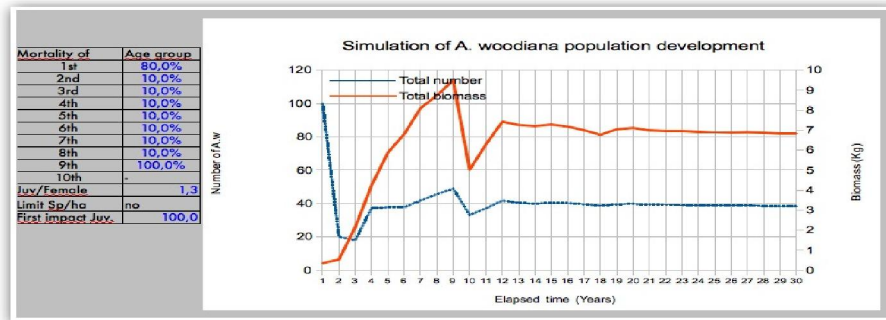


Fig.2. Balanced population, when 1,3 juvenile mussel survived/female

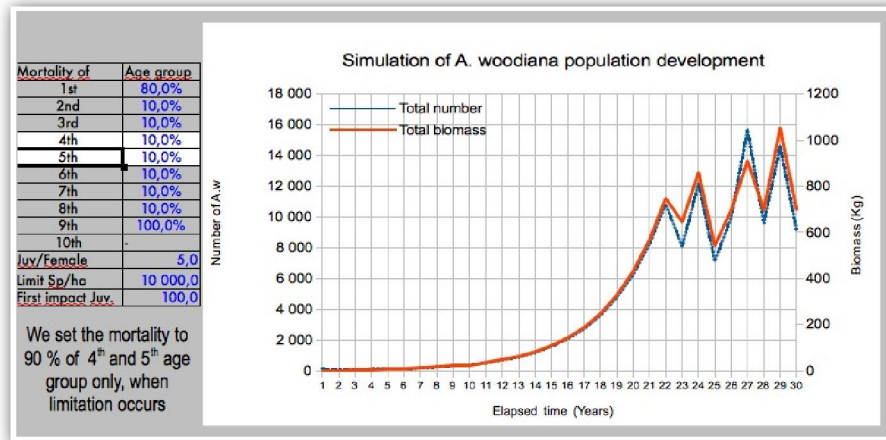


Fig.4. Increasing and collapsing population when 5 juvenile mussel survived/female and there is density limitation

CONCLUSIONS

To forecast the population collapses of Chinese pond mussel, the simulation shows that in a 30 year period balanced population can be

formed only if a female has average 1.2-1.4 survived juvenile mussel. Below this value the population disappear soon, or will overrun if the success of propagation is better than 1.3/year.

Naturally -as the observations shows- more than 1.3 juvenile survive, so sooner or later the *S. woodiana* population overgrow in the water, and collapse. This process take about 10-15 years after the first impact, so it is very important to monitor the tourism preferred water and if the mussel is found, annual investigation is necessary.

REFERENCES

1. **DUDGEON D.-MORTON B. (1983):** The population dynamics and the sexual strategy of *Anodonta woodiana woodiana* (Bivalvia: Unionacea) in Plover Cove Reservoir, Hong Kong. *J. Zool. London* 201, 161-183
2. **KISS A., -PETRO E. (1992):** Distribution and biomass of some chinesemussel (*Anodonta woodiana woodiana* Lea, 1834) (Bivalvia: Unionacea) population in Hungary - Abstracts of the XII International Malacological Congress in Siena, *Unitas Malacologica* 31-33
3. **KISS, A., (1995):** The propagation, growth and biomass of the Chinese huge mussel (*Anodonta woodiana woodiana* 1834) in Hungary, , University of Agricultural Sciences of Godollo. Hungary, Privat Edition, Second Ed. 33 pp;
4. **KISS, A., PEKLI, J.,(1988):** On the growth rate of *Anodonta woodiana woodiana* (Lea 1834), (Bivalvia: Unionacea) - *Bull. of Agric (1988) Sci*, 1, pp. 119-124
5. **KRASZEWSKI, A., ZDANOWSKI., B. (2007):** *Sinanodonta woodiana* (LEA, 1834) (Mollusca) a new mussel species in Poland: occurrence and habitat preferences in a heated lake system. *Polish Journal of Ecology* 55 (2): 337–356
6. **SÁRKÁNY-KISS, A.(1986):** *Anodonta woodiana woodiana* (LEA, 1834) a new species in Romania (Bivalvia: Unionacea). *Extrait des Travaux du Museum d'Histoire naturelle Grigore A. Vol. XXVIII Bucurest*, 1986
7. **PETRÓ, E.(1984):** The occurrence of *Anodonta woodiana woodiana* in Hungary. *Állattani Közlemények* LXXI, 84: 189-191
8. **WATTERS, G.T.(1997):** A synthesis and review of the expanding range of the Asian freshwater mussel *Anodonta woodiana* (Lea,1834) (Bivalvia: Unionidae). *Veliger* 40:152–156