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# New data on an exotic *Nippotaenia mogurndae* (Cestoda), newly introduced to Europe

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**Summary**

Data on prevalence and current distribution of the cestode *Nippotaenia mogurndae* Yamaguti and Miyata, 1940 (Nippotaeniidea) in Slovakia, are provided. A total of 163 fish from 8 localities of different types in the Tisa River basin were infected with *N. mogurndae*. The mean intensity of infection was 1.8 with a maximum of 5 tapeworms. The expansion of the distribution of the cestode corresponds well with the spreading of its host, the invasive fish Amur sleeper *Perccottus glenii* Dybowski, 1877. The Spearmann correlation coefficient was used to test the relationship between the intensity of infection and standard length of the fish ($r = 0.36$; $n = 163$; $P < 0.05$), condition coefficient of the fish ($r = 0.22$; $n = 115$; $P < 0.05$) and season ($r = -0.37$; $n = 355$; $P < 0.05$). A significant correlation was confirmed for each pair of variables. There is a statistically significant difference between the prevalence of the cestode in two functional size groups ($t = 3.28$; $n = 163$; $P < 0.05$). The prevalence of the cestode increased with the standard length of fish. The potential risk of further expansion of *N. mogurndae* to other countries is discussed.

Key words: *Nippotaenia mogurndae*, non-native species, Amur sleeper**,** risk of invasion, Tisa River basin

## Introduction

Spontaneous migration or dispersal of exotic fish species (connected with human activities) beyond their natural ranges and the localities of their initial introduction represents recently a serious problem and threat. Expansion of the Amur sleeper, *Perccottus glenii* Dybowski, 1877 (Perciformes: Odontobutidae), a freshwater invasive fish with its origin in East Asia (Reshetnikov, 2004) to Eastern Europe, had as one of its consequences also the introduction of the exotic cestode *Nippotaenia mogurndae* Yamaguti and Miyata, 1940 to Slovakia (Košuthová *et al.*, 2004; Bombarová *et al*., 2005). This is a member of a small order Nippotaeniidea known only from the freshwater fishes of Japan, China, New Zealand and Russia (Akhmerov, 1941; Dubinina, 1962, 1971, 1987; Hine, 1977; Bray, 1994). The cestode has a complex life cycle that involves one intermediate host – a planktonic copepod (Copepoda: Cyclopoida) such as the *Diaptomus incongruens*, *Eucyclops serrulatus*, *Mesocyclops leuckarti* and *Mesocyclops crassus* (Demshin, 1985; Pronin *et al.*, 1998).
In this paper, data on the current distribution and prevalence of *Nippotaenia mogurndae* in eastern Slovakia are presented.

## Material and Methods

*Study area*
The study was conducted in the localities of East Slovakian Lowland, in the original floodplain of the Latorica, Bodrog and Tisa Rivers (21˚N, 48˚E) (Fig. 1). Fish were sampled from 12 sampling sites (drainage canals, oxbows and borrow pits), all belonging to the upper part of the Tisa River (Fig. 2). The area comprises a network of interconnected drainage canals, which cover the whole territory. During floods, water in the canals flows in the opposite direction and all canal networks and normally isolated habitats are connected. As demonstrated by earlier observations (Koščo *et al*., 2003), populations of *P. glenii* were mostly abundant in microhabitats with aquatic vegetation.

*Field and laboratory methods*
From May 2003 to April 2006 a total of 432 *P. glenii* from 12 localities were examined for helminth parasites. The fish were caught predominantly by electrofishing (using a direct pulsating electric current 170 – 220 V, 0.5 – 3.5 A). The number and frequency of samples corresponded with the fluctuated level of Amur sleeper density in the sampling sites (Koščo *et al*., 2003). All fish were placed into aerated tanks and carried alive to the laboratory. Each

specimen was individually killed and examined by necropsy (Ergens & Lom, 1970). Standard length (Sl) of fish ranged between 18.0 – 103.8 mm. Cestodes isolated from the host's intestine were washed in saline, fixed in hot 4 % formaldehyde and determined using morphological characters by Dubinina (1971, 1987). In fact, that *Nippotaenia* is hyperapolytic, only the complete bodies with scolex were counted.

*Data analysis*

Parasite infection was characterized by the prevalence and mean and maximum intensity of infection (Bush *et al.*, 1997).

The cluster analyses yielded functional groups of distinct diet composition that were highly size-dependent. Based on the frequency of food components, two functional groups (Sl) were defined in Amur sleeper populations: 1) size < 70 mm and 2) size ≥ 70 mm. Copepods dominated in lower size classes, cannibalism was significant from 80 mm (Koščo *et al*., 2008). Difference between the prevalence of cestode in these groups was tested by t-test for percentage values after arcsin transformation. Spearmann correlation coefficient was used to test the relationship between the Sl groups intensity of infection of *N. mogurndae*, the intensity of infection and condition coefficient of the fish host (K) ($K = m/l^3$) and between the intensity of infection and season (m = weight, l = length). Statgraphics 4.0 (Koschin, 1992) software was used to calculate this coefficient.

## Results

*Occurrence of Nippotaenia mogurndae*

In eastern Slovakia, in the so called Medzibodrozhie region the Amur sleeper has recently rapidly spread with increasing density (Fig. 1) and the expansion of its cestode corresponds well with the host distribution (Fig. 2). Localities where *N. mogurndae* is present are situated most frequently in flooded areas. The dissemination of the parasite is significantly influenced by high water levels and the connected floods as reported by Elovenko (1981) that also was the case of the Bodrog and Tisa drainage areas in eastern Slovakia (Koščo *et al*., 2003).

A total of 163 fish from 8 localities were infected with *N. mogurndae*. The mean intensity of infection was 1.8 with a maximum of 5 tapeworms. The increasing tendency of the average and maximum prevalence within the years in sampling sites Svätá Mária and Somotor has been registered (Fig. 3a, b). The values of prevalence in Svätá Mária sampled repeatedly in April and May 2003 – 2006 ranged between 40.6 – 81.0 % (Table 1) and the mean intensity of infection was 2.1.

*Relationship of Nippotaenia mogurndae infection versus fish size and season*

The prevalence of cestodes in the functional size group Sl < 70 mm was 57 % (125/71) and in the functional group Sl ≥ 70 mm the prevalence reached 84 % (38/32). There is a statistically significant difference between the prevalence of the cestode for two functional size groups (t = 3.28; n = 163; P < 0.05). Intensity of infection was observed to increase with the increasing Sl of the fish (r = 0.37; n = 163; P < 0.05). The significant association was confirmed also for the relation of condition coefficient of the fish and intensity of infection (r = 0.22; n = 115; P < 0.05).

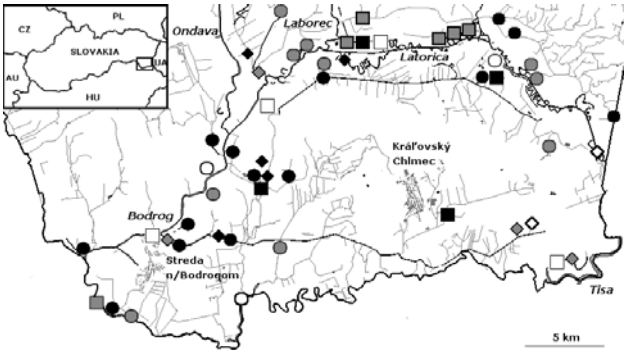


Fig. 1. Spreading of *Perccottus glenii* in Slovakia during the study period (2003 - diamond, 2004 - circle, 2005 - square) and its relative abundance (white < 5 %, grey 5 – 30 %, black > 30 %) in positive localities.

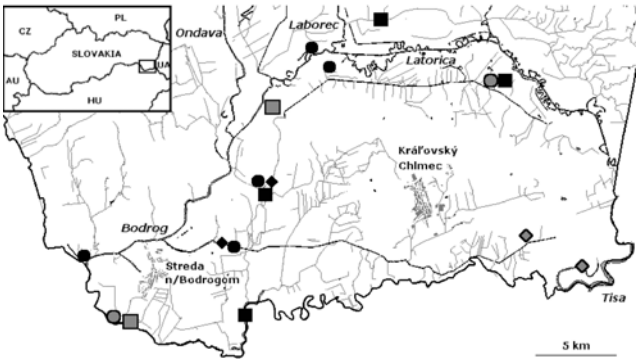


Fig. 2. Distribution of *N. mogurndae* in Slovakia - positive (black) and negative (grey) localities during the study period (2003 - diamond, 2004 - circle, 2005 - square).

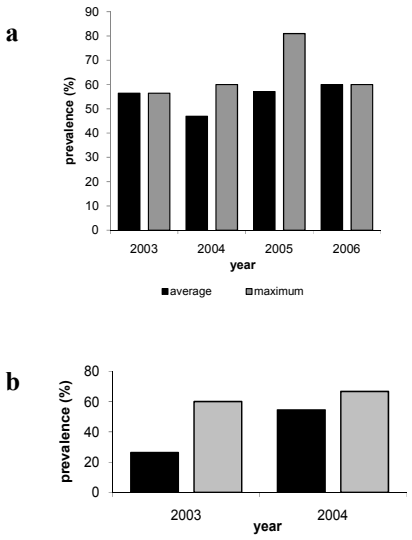


Fig. 3. Increasing tendency of *N. mogurndae* prevalence in Bodrog River basin, sampling sites Svätá Mária (a) and Somotor (b).

Table 1. The prevalence of *Nippotaenia mogurndae* in *Perccottus glenii*

| Localities investigated | | | Date | No. of fish | Prevalence (%) |
|---|---|---|---|---|---|
| Sampling site | River drainage | Biotop | | | |
| Svätá Mária | Bodrog | canal | May, 2003 | 117 | 56.4 |
| | | | May, 2004 | 32 | 40.6 |
| | | | July, 2004 | 25 | 52.0 |
| | | | September, 2004 | 2 | 1/2 |
| | | | November, 2004 | 5 | 60.0 |
| | | | April, 2005 | 21 | 81.0 |
| | | | October, 2005 | 14 | 21.4 |
| | | | April, 2006 | 10 | 60.0 |
| Somotor | Bodrog | canal | April, 2003 | 5 | 60.0 |
| | | | May, 2003 | 31 | 22.6 |
| | | | July, 2003 | 2 | 0.0 |
| | | | April, 2004 | 3 | 2/3 |
| | | | May, 2004 | 3 | 2/3 |
| | | | September, 2004 | 5 | 40.0 |
| Zatín | Latorica | borrow pit | June, 2004 | 3 | 1/3 |
| Borša | Bodrog | borrow pit | July, 2004 | 11 | 54.5 |
| Oborín | Laborec | oxbow | | | |
| | | | August, 2004 | 11 | 27.3 |
| Leles | Latorica | oxbow | November, 2004 | 11 | 0.0 |
| | | | September, 2005 | 33 | 9.0 |
| Veľký Kamenec | Bodrog | oxbow | April, 2005 | 7 | 71.4 |
| Beša | Latorica | canal | July, 2005 | 12 | 58.3 |
| Total fish examined from positive localities | | | | 363 | |

Seasonal differences in occurrence of *N. mogurndae* were observed. Fish were more heavily infected in spring (samples in April and May, with values of prevalence usually between 60 – 80 %) than in summer (June – August, 30 – 55 %) and autumn (September and November, 40 – 60 %). The decreasing tendency of the prevalence between individual seasons in the most sampled site - Svätá Mária, has been observed (Fig. 4). Significant variation was found in intensity of infection in different months ($r = -0.37$; $n = 355$; $P < 0.05$).

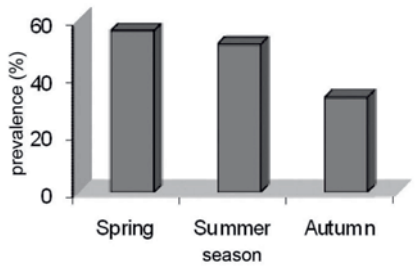


Fig. 4. Decreasing tendency of prevalence within the seasons in the locality Svätá Mária.

## Discussion

Pronin *et al.* (1998) recorded *Nippotaenia mogurndae* as the dominant parasite of the Amur sleeper in the Baikal Region (prevalence up to 71.8%). Ermolenko (2004) has also confirmed this cestode species in *P. glenii* from water basins of the Primorsk Region (the Amur River basin). The present study demonstrates that *N. mogurndae* has become a common parasite of the Amur sleeper in East Slovakia since its first finding in 2003 (Košuthová *et al*., 2004). However, the risk of further expansion of this invader is fairly high because drainage canals, where the parasite occurs, are interconnected during the floods. This fact increases the risk of the cestode transfer with Amur sleeper populations to new localities and even outside Slovakia through the Tisa River that connects the region with the Danube River.

Spreading of the cestode in the last decades is apparently due to the rapid expansion of its definitive host, which has become the dominant or even exclusive species in the local fish communities in this region of Slovakia (Koščo & Košuth, 2002; Koščo *et al.*, 2003). The life cycle of this cestode, which includes copepod species common also in Europe (Terek, 1990), also contributes to the ability of *N. mogurndae* to establish in the regions very distant from its original distributional area, similarly as it was the case of another successful tapeworm colonizers, the pseudophyllidean *Bothriocephalus acheilognathi* Yamaguti, 1934 (see, e.g., Kennedy, 1993; Scholz, 1999; Salgado-Maldonado & Pineda-López, 2003), *Khawia si-*

*nensis* Hsü, 1935 (Chubb & Yeomans, 1958) or *Atractolytocestus huronensis* Anthony, 1958 (Chubb *et al*., 1996; Oros *et al.*, 2004).

The tendency of *N. mogurndae* to prevail in larger fish, indicated by the present data, may be related to the postcyclic transmission, i.e. transfer of cestodes via cannibalism. According to Koščo *et al.* (2008) the frequency of cannibalism increased in fish larger than 60 mm. On the contrary, Ermolenko (2004) observed heavier infections in smaller fish, which, however, might be related to the different ecological conditions in the Primorsk Region. Positive correlation between the infection rate and size of fish hosts was previously observed in many fish helminth parasites, including tapeworms (for review see Chubb, 1982). Similarly, the postcyclic transmission has been proven for numerous helminths (Odening, 1976; Moravec, 1979, 1984; Priemer, 1987; Kennedy, 1999; Nickol, 2003 etc.).

Variation in the intensity of infection with *N. mogurndae* in different months is probably related to the seasonal occurrence of copepods (Terek, 1990). Crustaceans form a dominant part of fish diet in April; thereafter the frequency of crustaceans in diet of fish decreases (Koščo *et al.*, 2008).

The present results show the necessity to study the parasite fauna, adaptation and life cycles of *P. glenii* and other invasive fishes. Increasing findings of *N. mogurndae* entail the risk of its potential transfer to native or endemic species with the same ecological niche like *Umbra krameri* (Walbaum, 1792). Laboratory experiments are necessary to clarify the possible role of cannibalism in the accumulation of *N. mogurndae* tapeworms in larger Amur sleeper.

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