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# The parasites of the invasive Chinese sleeper *Perccottus glenii* (Fam. Odontobutidae), with the first report of *Nippotaenia mogurndae* in Ukraine

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## ABSTRACT

***Key-words:*** *Chinese sleeper, parasites,* Nippotaenia mogurndae*, non-indigenous species, neobiota*

The parasites of the Asian invasive fish, Chinese sleeper *Perccottus glenii*, were studied in 6 localities in different parts of Ukraine. In total, 15 taxa of parasites were registered; among them were 1 species of Microsporidia, 5 species of ciliates, 2 species of cestodes, 2 species of trematodes, 2 species of nematodes, 1 species of acanthocephalan, 1 species of parasitic crustacean and 1 mollusk (glochidia). The invasive Chinese sleeper is included as a paratenic host in the life cycle of the parasites of indigenous reptiles in Europe. The non-indigenous cestode *Nippotaenia mogurndae* occurred in the intestine of the Chinese sleeper from the Ivachiv Reservoir (Dniester River basin). This cestode is recorded for Ukrainian fauna for the first time. In addition, 3 species of parasites were recorded in the Chinese sleeper for the first time: *Nicolla skrjabini*, *Cosmocephalus obvelatus* and *Pomphorhynchus laevis*. We note the low similarity among the different localities and the low parasite richness, that suggest that the parasite fauna of the Chinese sleeper in Ukraine is in transition.

## RÉSUMÉ

### Les parasites de l'espèce invasive Goujon de l'Amour *Perccottus glenii* (Fam. Odontobutidae) avec le premier signalement de *Nippotaenia mogurndae* en Ukraine

***Mots-clés :*** *Chinese sleeper, parasite,* Nippotaenia mogurndae*, espèces exotiques, neobiota*

Les parasites du poisson asiatique invasif, Goujon de l'Amour *Perccottus glenii* (Fam. Odontobutidae), ont été étudiés dans 6 localités de différentes régions d'Ukraine. Au total, 15 taxons de parasites ont été rencontrés, parmi eux, 1 espèce de microsporidies, 5 espèces de ciliés, 2 espèces de cestodes, 2 espèces de trématodes, 2 espèces de nématodes, 1 espèce d'acanthocéphale, 1 espèce de crustacé parasite, et 1 mollusque (glochidies). Le Goujon de l'Amour invasif est considéré comme hôte paraténique dans le cycle de vie des parasites de reptiles indigènes en Europe. Le cestode non-autochtone *Nippotaenia mogurndae* est présent dans l'intestin du Goujon de l'Amour du réservoir d'Ivachiv (bassin de la rivière Dniestr). Ce cestode est rencontré pour la faune ukrainienne pour la première fois. En outre, 3 espèces de parasites ont été enregistrées dans le Goujon de l'Amour pour la première fois : *Nicolla skrjabini, Cosmocephalus obvelatus* et *Pomphorhynchus laevis.* Nous notons la faible similitude entre les différentes localités et la richesse parasitaire faible suggérant que la faune parasitaire du Goujon de l'Amour en Ukraine est en transition.

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# INTRODUCTION

The Chinese sleeper *Perccottus glenii* Dybowski, 1877 (Actinopterygii: Odontobutidae) is an invasive fish species indigenous to the freshwaters of Eastern Asia from the Sea of Okhotsk basin in the North, to the Yellow Sea basin in the South (Mori, 1936; Berg, 1949). Now, the invasive Chinese sleeper is widely distributed in the freshwaters of Eastern and Central European countries, such as Belarus, Bulgaria, Estonia, Hungary, Lithuania, Latvia, Moldova, Poland, Romania, Russia, Slovakia, Serbia and Ukraine, where it has high climatic suitability and may continue invasion in the future (Reshetnikov and Ficetola, 2011). In Ukraine, the Chinese sleeper was first found in the upper Dniester River basin in 1980 where it was introduced in the 1970s (Reshetnikov, 2009). It first occurred in the Dnieper river basin near Kiev in 2001, and in the Ros' River (right tributary of the Dnieper River, downstream of Kiev) in 2005 (Sabodash *et al*., 2002; Kutsokon and Negoda, 2006; Kutsokon, 2010). In the Danube River basin the Chinese sleeper was first recorded in 1995–1996 in the Latorica River, western Ukraine (a part of the western Ukrainian population of the Chinese sleeper), but only in 2011 in the Danube delta (Sivokhop, 1998; Kvach, 2012). This fish is currently found in different parts of the upper streams of the Dniester basin, Transcarpathian waters (Danube basin), in the Dnieper River, and in the Danube River delta.

The parasites of the invasive Chinese sleeper have been thoroughly studied in the European part of Russia (Reshetnikov *et al*., 2011; Sokolov *et al*., 2011a, 2011b, 2012) as well as in Poland (Mierzejewska *et al*., 2010; 2012), including collections from Serbian (Nikolic *et al*. 2007) and Slovakian waters (Košuthová *et al*., 2004, 2008, 2009; Oros and Hanzelová, 2009). In Ukraine, the first study of the Chinese sleeper parasites was carried out by Maslovsky *et al*. (2011), who reported *Trichodina* sp. and *Crepidostomum farionis* Müller, 1780 in the Vereshchytsia River (Dniester River basin). Davydov *et al*. (2011) reported parasites of the Chinese sleeper in the Nyvky ponds (Kiev). They reported 8 parasite species: *Saprolegnia* sp., *Trichodina nigra* Lom, 1960, *Trichodina* sp., *Ichthyophthirius multifiliis* Fouquet, 1876, *Bothriocephalus acheilognathi* Yamaguti, 1934, Nematoda sp., *Argulus foliaceus* (Linnaeus, 1758) and Unionidae gen. sp. glochidia.

Three non-indigenous parasites were introduced into European waters together with the Chinese sleeper: the monogenean *Gyrodactylus perccotti* Ergens and Yukhimenko, 1973, the cestode *Nippotaenia mogurndae* Yamaguti and Miyata, 1940, and the nematode *Philometroides moraveci* Vismanis and Yunchis, 1994 (Košuthová *et al*., 2004; Nikolic *et al*., 2007; Moravec, 2008; Ondračková *et al*., 2012). The non-indigenous *G*. *perccotti* is 1 of 2 monogenean species specific to the Chinese sleeper in its native range (Ergens and Yukhimenko, 1973). In Europe it is detected only in the Włocławek Reservoir (Vistula River basin) in Poland; it was not reported from the rivers of the Black Sea basin (Ondračková *et al*., 2012). *P*. *moraveci* is a specific parasite of this fish in the Far East (Ermolenko, 2004). It was reported in Serbia as *Philometroides parasiluri* (Yamaguti, 1935) (Nikolic *et al*., 2007) and later re-identified by Moravec (2008). *N*. *mogurndae* was first described from the dark sleeper, *Odontobutis obscura* (Temminck and Schlegel, 1845), in Japan (Yamaguti and Miyata, 1940). This tapeworm infects many species of fish of the Odontobutidae family which inhabit the freshwaters of East Asia (Japan, China and Russia) (Yamaguti, 1959). In Europe it was first found in the introduced Chinese sleeper from Slovakia in 2003 (Košuthová *et al*., 2004). Later, it was found in the lower Vistula River in 2007 and 2008 (Mierzejewska *et al*., 2010) and in the middle section of the Volga River basin in 2008-2010 (Reshetnikov *et al*., 2011).

Information about the parasites of the Chinese sleeper from Ukraine is poor and sporadic, and data about the non-indigenous parasite species are absent. The aim of the present study is to describe the parasite fauna of the Chinese sleeper in Ukrainian waters and to clarify the presence of non-indigenous parasite species in Ukraine.


***Figure 1***
*The schematic map of the investigated area. The sampling localities are marked by dots with corresponding numbers. 1. Desna River. 2. Lake Berizka. 3. Novosilky Pond. 4. Trubizh River. 5. Ivachiv Reservoir. 6. Danube delta.*

## MATERIAL AND METHODS

Fish were sampled by trawl (8 m long, 0.5 cm in cell diameter) and deep net (1 m/0.5 m, 0.5 cm in cell diameter) at depths from 0.5 to 1.2 m in different water bodies of Ukraine (Figure 1, Table I).

A total of 158 specimens of the Chinese sleeper were studied for parasites. The fish were transported alive in aerated cans to the laboratory of the Odessa Branch of the Institute of Biology of the Southern Seas, stored in aquaria, and dissected within 2 days.

The standard (SL) and total length (TL) of fish were measured before dissection. The skin, fins and gills were scraped off by scalpel, and smears were prepared and studied using light microscopy. If ectoparasites were observed, the smears were dried to prepare the slides. Then, the skin, fins, gills, muscles, brain, eyes, gut, liver, spleen, kidneys, body cavity and mesentery were examined for endoparasites under the dissecting microscope. The encysted larvae were first isolated from cysts and the parasites were fixed in hot formalin. Ciliates were stained with silver nitrate for study of the adhesive disc (Klein, 1958). Trematodes and cestodes were stained in acetic carmine and mounted in Canada balsam for identification (Georgiev *et al*., 1986). Nematodes and acanthocephalans were studied in glycerine gel temporary mounts. Identification of parasites followed Bauer (1984, 1987), Moravec (1994) and Sudarikov *et al*. (2002), as well as original species descriptions for various taxa.

The parasitological indices were calculated according to Bush *et al*. (1997): prevalence (*P* %), intensity (presented as min-max), mean intensity (*MI*) and abundance (*A*). The standard deviation of mean values (sd) was calculated. For microparasites, only prevalence was calculated. The gradual scale for the intensity of infection was adopted: 1) sporadic occurrence, "S" – 1 or a few specimens in the examined material; 2) not numerous, "NN" – a few specimens in a few fields of vision; 3) numerous, "N" – up to 20 individuals in most fields of vision; 4) very numerous, "VN" – more than 20 individuals in most fields of vision; 5) mass occurrence, "M" – hundreds of individuals in each field of vision.

***Table I***
*Sampling localities, their coordinates, sampling periods, the number of sampled fish in each locality (specimens) and their standard (SL, cm) and total length (TL, cm); m ± sd (min-max).*

| # | Locality name | Locality description | Coordinates | Sampling time | Number of fish sampled in reference period | Total number of sampled fish | Standard length | Total length |
|---|---|---|---|---|---|---|---|---|
| 1. | Desna River | Near the Lyubychiv Island | 50° 45′N 30° 44′E | September 2011 | 14 | 29 | 3.2 ± 0.4 (2.5–4.4) | 4.0 ± 0.5 (4.2–5.4) |
| | | | | August 2012 | 15 | | | |
| 2. | Lake Berizka | Kiev, on the Hydropark Island, the Dnieper River | 50° 26′N 30° 34′E | October 2011 | 16 | 31 | 4.9 ± 1.5 (3.0–11.2) | 6.1 ± 1.7 (4.0–13.2) |
| | | | | April 2012 | 15 | | | |
| 3. | Novosilky Pond | Kiev, right bank of the Dnieper River | 50° 21′N 30° 27′E | November 2011 | 15 | 35 | 5.9 ± 0.9 (3.2–8.7) | 7.3 ± 1.7 (4.5–10.8) |
| | | | | April 2012 | 20 | | | |
| 4. | Trubizh River | Pereyaslav, Dnieper River basin | 50° 4′N 31° 27′E | October 2011 | 15 | 30 | 4.4 ± 1.7 (2.4–10.4) | 5.4 ± 2.0 (3.1–12.5) |
| | | | | May 2012 | 15 | | | |
| 5. | Ivachiv Reservoir | Near Malashivtsi, the Dniester River basin | 49° 40′N 25° 29′E | June 2012 | 20 | 20 | 8.6 ± 5.0 (4.9–27.8) | 10.1 ± 5.1 (5.9–29.3) |
| 6. | Danube delta | Vilkove | 45° 24′N 29° 35′E | May 2011 | 2 | 13 | 4.6 ± 3.2 (2.5–12.2) | 5.6 ± 3.6 (3.2–14.3) |
| | | | | October 2012 | 11 | | | |

The relative importance of parasites was judged by the core-satellite concept according to their abundance (*A*): $>2$ = core species, 0.6–2 = secondary species; 0.2–0.6 = satellite species; and $<0.2$ = rare species (Zander *et al*., 2000).

The Index of Czekanowski-Sørensen, ICS (Sørensen, 1948), was used to compare the parasite faunas: $ICS = \frac{2c}{a+b} \times 100\%$, where *a* is the number of parasite species found in locality *A*, *b* is the number of parasite species found in locality *B*, and *c* is the number of parasitic species common to both localities. Because of the presence in many cases of unidentified species of *Trichodina*, these ciliates were combined as *Trichodina* spp. for the comparative study.

## RESULTS

A total of 15 taxa of parasites are reported in the Chinese sleeper in Ukraine (Table II); among them were 1 unidentified species of Microsporidia, 5 species of ciliates, 2 species of cestodes, 2 species of trematodes, 2 species of nematodes, 1 species of Acanthocephala, 1 species of parasitic crustacean and 1 species of mollusk glochidia. In some cases the ciliates were not identified to species level but reported as *Trichodina* sp.

Only *Trichodina* spp. were found in all 5 localities studied (Table II). Also, *Holostephanus luhei* Szidat, 1936 metacercariae were found in 2 localities and *Spiroxys contortus* (Rudolphi, 1819) in 3 localities. All other parasites occurred in 1 locality each.

The ciliates were represented by five species: *Trichodina acuta* Lom, 1961, *Trichodina intermedia* Lom, 1960, *Trichodina nigra*, *Trichodina mutabilis* Kazubski and Migala, 1968 and *Trichodina pediculus* Ehrenberg, 1831. *Trichodina* spp. were not identified in sporadic infections. Those sporadic scarce infections were recorded from the Novosilky Pond and the Trubizh

***Table II***
*Parasites of the Chinese sleeper in different water bodies of Ukraine.*

| Parasite species | | Desna River | Lake Berizka | Novosilky Pond | Trubizh River | Ivachiv Reservoir | Danube Delta |
|---|---|---|---|---|---|---|---|
| 1 | | 2 | 3 | 4 | 5 | 6 | 7 |
| **MICROSPORIDIA** | | | | | | | |
| **Microsporidia gen. sp.** | *P* | 3.4 | | | | | |
| | *IR* | S | | | | | |
| **CILIATA** | | | | | | | |
| ***Trichodina* spp.:** | *P* | 24.1 | 51.6 | 5.7 | 26.7 | 75.0 | 38.5 |
| | *IR* | S-VN | S-M | S | S-NN | S-M | S-VN |
| *T. acuta* | | | + | | | | |
| *T. intermedia* | | | + | | | | + |
| *T. mutabilis* | | | + | | | | + |
| *T. nigra* | | | | | | + | + |
| *T. pediculus* | | + | + | | | | + |
| *Trichodina* sp. | | + | | + | + | + | |
| **CESTODA** | | | | | | | |
| ***Nippotaenia* mogurndae** | P | | | | | 55.0 | |
| | *MI* | | | | | 5.3 ± 5.3 | |
| | *IR* | | | | | 1–19 | |
| | *A* | | | | | 2.9 | |
| ***Ophiotaenia europaea* pl** | *P* | | | | | | 7.7 |
| | *MI* | | | | | | 1.0 |
| | *IR* | | | | | | 1 |
| | *A* | | | | | | 0.1 |
| **TREMATODA** | | | | | | | |
| ***Holostephanus luhei* met** | *P* | 3.4 | | | | | 7.7 |
| | *MI* | 3.0 | | | | | 3.0 |
| | *IR* | 3 | | | | | 3 |
| | *A* | 0.1 | | | | | 0.2 |
| ***Nicolla skrjabini*** | *P* | | | | 16.7 | | |
| | *MI* | | | | 1.8 ± 0.8 | | |
| | *IR* | | | | 1–3 | | |
| | *A* | | | | 0.3 | | |
| **NEMATODA** | | | | | | | |
| ***Cosmocephalus obvelatus* L3** | *P* | | | | | 10.0 | |
| | *MI* | | | | | 2.0 ± 1.4 | |
| | *IR* | | | | | 1-3 | |
| | *A* | | | | | 0.2 | |
| ***Spiroxys contortus* L3** | *P* | 13.8 | | 2.9 | | | 7.7 |
| | *MI* | 3.5 ± 2.1 | | 1.0 | | | 3.0 |
| | *IR* | 1–6 | | 1 | | | 3 |
| | *A* | 0.5 | | 0.03 | | | 0.2 |
| **ACANTHOCEPHALA** | | | | | | | |
| ***Pomphorhynchus laevis*** | *P* | | | | | 5.0 | |
| | *MI* | | | | | 1.0 | |
| | *IR* | | | | | 1 | |
| | *A* | | | | | 0.1 | |

***Table II***
*continued.*

| Parasite species | | Desna River | Lake Berizka | Novosilky Pond | Trubizh River | Ivachiv Reservoir | Danube Delta |
|---|---|---|---|---|---|---|---|
| 1 | | 2 | 3 | 4 | 5 | 6 | 7 |
| **CRUSTACEA** | | | | | | | |
| ***Argulus foliaceus*** | *P* | | | | | 10.0 | |
| | *MI* | | | | | 1.5 ± 0.7 | |
| | *IR* | | | | | 1–2 | |
| | *A* | | | | | 0.2 | |
| **MOLLUSCA** | | | | | | | |
| ***Pseudoanodonta complanata* gl.** | *P* | | 9.7 | | | | |
| | *MI* | | 3.0 ± 1.7 | | | | |
| | *IR* | | 2-5 | | | | |
| | *A* | | 0.3 | | | | |

In the table: *P* – prevalence, %; *MI* – mean intensity ± standard deviation; *IR* – intensity range; *A* – abundance; *pl* – plerocercoid; met – metacercaria; L3 – 3rd stage larvae; gl. – glochidia.

River (Table II). *T*. *pediculus* was found in 3 localities: the Desna River, Lake Berizka and the Danube delta. *T*. *nigra* occurred in 2 localities, Ivachiv Reservoir and the Danube delta. *T*. *mutabilis* and *T*. *intermedia* were common in Lake Berizka and the Danube delta. *T*. *acuta* was only found in Lake Berizka.

Adults of 3 species of helminths (*Nippotaenia mogurndae*, *Nicolla skrjabini* (Iwanitzki, 1928) and *Pomphorhynchus laevis* Müller, 1776) were found. Larvae of 4 other helminth species were also collected: 1 plerocercoid, 1 metacercaria, and 2 3rd stage larvae of nematodes. A plerocercoid of the cestode *Ophiotaenia europaea* and larvae of the nematodes [*Cosmocephalus obvelatus* (Creplin, 1825), *S*. *contortus*] occurred in the mesentery. The metacercaria of 1 species of trematode (*H*. *luhei*) was located in the muscles of the stomach.

Only the cestode *N*. *mogurndae* is considered as a core species (Table II). *N*. *skrjabini*, *C*. *obvelatus* L3, *Argulus foliaceus* and *Pseudoanodonta complanata* (Rossmässler, 1835) gl. are considered satellite species. *S*. *contortus* L3 was a satellite species in the Desna and Danube rivers but rare in the Dnieper River. *H*. *luhei* was a satellite species in the Desna River but rare in the Danube delta. *O*. *europaea* was rare.

Among the non-indigenous parasites, only *N*. *mogurndae* were found in the intestine of the Chinese sleepers from the Ivachiv Reservoir (Dniester basin). Fifty-five percent of fish sampled in the Ivachiv Reservoir were infected with 1–19 parasites (Table II). In addition to scolices with young proglottids, there were numerous detached gravid proglottids. The morphological characteristics of cestodes are typical for this species (Figure 2). The body of cestodes consists of 2–11 proglottids. The anterior 2–4 proglottids are wider than they are long. The scolex is 0.41–0.90 mm long and 0.25–0.50 mm wide. The single apical sucker with a sphincter is round, and 0.18–0.30 mm in diameter. It is located on the top of the scolex.

Gravid proglottids and detached proglottids are elliptical, 1.2–4.3 mm long and 0.8–0.92 mm wide. The testes are anterior and circular, with more then 20 per proglottid. The uterus has transverse coils. The single ovary consists of 2 symmetrical lobes. The vitellaria are placed superiorly, forming 2 reciprocal lobes. Eggs are spherical.

## DISCUSSION

The cestode *Nippotaenia mogurndae* is recorded in Ukraine for the first time. The Chinese sleeper population in the upper Dniester River basin is the oldest in Ukraine, where it was first reported in 1980 (Reshetnikov, 2009). According to Reshetnikov *et al*. (2011), the presence/absence of *N*. *mogurndae* in the Chinese sleeper population is in agreement with the

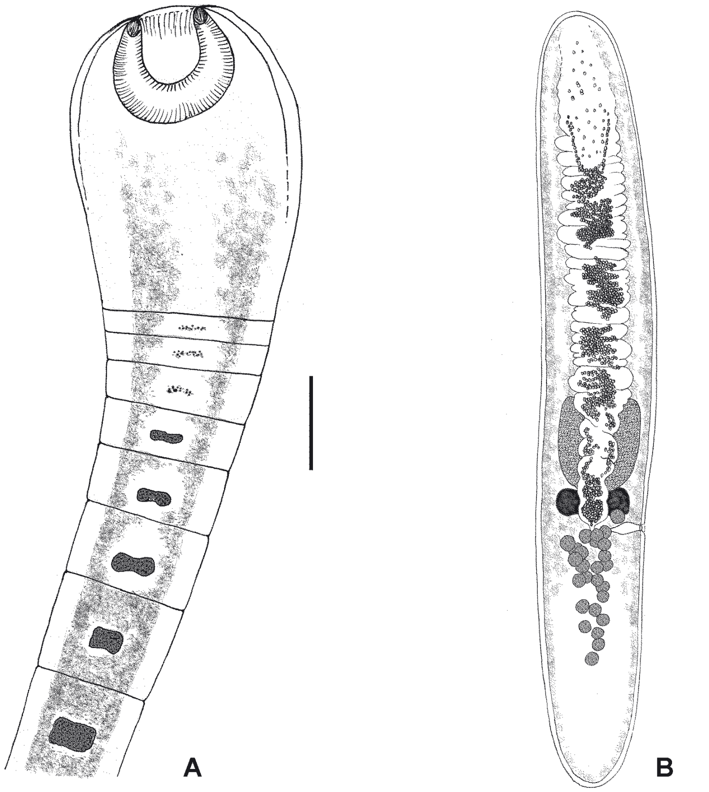


***Figure 2***
Nippotaenia mogurndae *ex.: the Chinese sleeper,* Perccottus glenii*. Locality: Ivachiv Reservoir, Dniester River basin, Ukraine. A – scolex, B – detached gravid proglottid. Scale: 0.2 mm.*

vectors of the fish's introduction. The Chinese sleeper population in the Western Ukraine was a source of this fish invasion in the Danube basin in Slovakia, then in other Danube countries (Koščo *et al*., 2010; Kvach, 2012). The presence of this parasite in Western Ukraine (current data) and in Slovak waters (Košuthová, 2004; Košuthová *et al*., 2008, 2009; Oros and Hanzelová, 2009), as well as its absence in Southern Ukraine, show the vector of the fish invasion. Thus, we predict the occurrence of *N. mogurndae* in the Danube delta in the near future. The presence of this species of cestode is confirmed in different localities in the Volga basin, but information from the Russian section of the Dnieper basin is absent (Reshetnikov *et al*., 2011; Sokolov *et al*., 2012). Because the origins of the Chinese sleeper population in the Ukrainian sector of the Dnieper River are unknown, we cannot consider the invasion vector from Russia to Ukraine.

The first intermediate hosts of *N. mogurndae* are planktonic copepods, such as *Neutrodiaptomus incongruens* (Poppe, 1888), *Eucyclops serrulatus* (Fischer, 1851), *Mesocyclops crassus* (Fischer, 1853) and *M. leuckarti* (Claus, 1857), which are common in Europe (Demshin, 1985; Terek, 1990; Pronin *et al*., 1998). Košuthová *et al*. (2008) assume that the increasing occurrence of *N. mogurndae* carries the risk of the potential transfer of this parasite to native fish species with similar ecology. Despite this hypothesis, the fact of *N. mogurndae* occurrence in native fish has not been mentioned until now.

Except for *N. mogurndae*, 2 other helminths used the Chinese sleeper in Ukraine as a definitive host: *Nicolla skrjabini* and *Pomphorhynchus laevis*. The latter is detected in the Chinese sleeper for the first time; this is the first record of an acanthocephalan in the invasive population of the Chinese sleeper.

Four helminth species use the Chinese sleeper as a paratenic host. The definitive hosts of 2 of them, *Holostephanus luhei* and *Cosmocephalus obvelatus*, are fish-eating birds. The nematode *C. obvelatus* is recorded in the Chinese sleeper for the first time.

***Table III***
*The matrix of the Index of Czekanowski-Sørensen (ICS, %) among the Chinese sleeper parasite fauna in different water bodies of Ukraine (current and published data).*

| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 |
|---|---|---|---|---|---|---|---|---|
| **1** | 100 | 33.33 | 66.67 | 18.18 | 33.33 | 22.22 | 33.33 | 75.00 |
| **2** | | 100 | 50.00 | 44.44 | 50.00 | 28.57 | 50.00 | 33.33 |
| **3** | | | 100 | 22.22 | 50.00 | 28.57 | 50.00 | 66.67 |
| **4** | | | | 100 | 22.22 | 33.33 | 22.22 | 18.18 |
| **5** | | | | | 100 | 28.57 | 50.00 | 33.33 |
| **6** | | | | | | 100 | 28.57 | 22.22 |
| **7** | | | | | | | 100 | 33.33 |
| **8** | | | | | | | | 100 |

1. Desna River (current data), 2. Lake Berizka (current data), 3. Novosilky Pond (current data), 4. Nyvky ponds (Davydov *et al*., 2011), 5. Trubizh River (current data), 6. Ivachiv Reservoir (current data), 7. Vereshchytsia River (Maslovsky *et al*., 2010), 8. Danube Delta (current data).

Two other larval parasites use reptiles as definitive hosts. The cestode *Ophiotaenia europaea* is a parasite of the water snakes *Natrix* sp. but the larvae live in Anuran amphibians (Biserkov and Kostadinova, 1997). This tapeworm has already been reported from the Chinese sleeper in the European part of Russia, where it infects from 3.6% to 37.5% of fish (Sokolov *et al*., 2011b, 2012). The nematode *Spiroxys contortus* is a parasite from the European pond terrapin [*Emys orbicularis* (L., 1758)] but the paratenic hosts are different small-sized fish, insect larvae, tadpoles and adult frogs (Hedrick, 1935; Moravec, 1994). It is considered a common parasite of the invasive Chinese sleeper in Russian waters, infecting up to 100% of fish (Sokolov *et al*., 2011b, 2012). The invasive Chinese sleeper functions as a paratenic host in the life cycle of the parasites of indigenous reptiles in Europe. The larvae of frogs are important food items of the invasive Chinese sleeper (Reshetnikov, 2001; Plusnina, 2008), therefore they could be a source of larvae of *O*. *europaea* and *S*. *contortus*.

The oldest Chinese sleeper population in Ukraine is in the Upper Dniester River basin (Reshetnikov, 2009). This region is characterized by the presence of the specific parasite of the Chinese sleeper, *N*. *mogurndae*. This is the only core parasite in the parasite community of the Chinese sleeper in Ukraine.

The richness of the Chinese sleeper's parasites in Ukraine is comparable with that of Slovakia, where two species (*Asymphylodora* sp. and *N. mogurndae*) were found in the Bodrog River, and 3 species [*Orientocreadium gobii* Bychowski & Dubinina, 1954, *N. mogurndae* and *Paraglaridacris gobii* (Szidat, 1938)] in the Latorica River (Košuthová *et al*., 2009; Oros and Hanzelová, 2009), in addition to data from some lakes in the Volga River basin: in the lakes Maloe Vetino, Klukvennoe boloto and Ilyevskoe there were 1 to 7 species (Sokolov *et al*. 2012).

Generally, the richness of the Chinese sleeper's parasites in Ukraine is low. For example, 12 species were found in the Neverovski Karyer Reservoir, 13 species in Lake Krugloe (both in the Volga basin), 16 species in Lake Glushitsa Podstepnaya (Don River basin), and 18 species in the Włocławek Reservoir on the Vistula River (Sokolov *et al*., 2011a, 2011b, 2012; Mierzejewska *et al*., 2012). The sizes of fish were not larger than in our study: TL = 7.4–21.0 cm in the Neverovski Karyer Reservoir, TL = 4.9–22.8 cm in Lake Krugloe, TL = 5.0–19.5 cm in Lake Glushitsa Podstepnaya, and TL = 4.1–14.4 cm in the Włocławek Reservoir (Sokolov *et al*., 2011a, 2011b, 2012; Mierzejewska *et al*., 2012). In all cases the authors did not present data on the average values and standard deviation. Therefore, the data are not statistically comparable; only the disparity of sizes. The Chinese sleeper parasite richness in its native habitats is even higher: 24 species in Lake Sladkoe (Sakhalin Island) and from 11 to 28 species in different localities of the Russian continental Far East (Ermolenko, 2004; Sokolov and Frolov, 2012).

The parasite communities of the Chinese sleeper in different localities of Ukraine are characterized by low similarity (Table III). According to the ICS data, there is relatively high similarity among the Desna River, the Novosilky Pond and the Danube delta, due to the presence of *S*. *contortus* and *H*. *luhei*. Only ciliates, *Trichodina* spp., are common for all localities studied, as in all published reports (Table II; Maslovsky *et al*., 2010; Davydov *et al*., 2011). The ciliates are characterized by low host specificity; all *Trichodina* found are generalists, therefore they adapted to new hosts quickly. The minimal similarity is between the Nyvky ponds (Davydov *et al*., 2011) and Desna River and the Danube River (Table III).

Usually, invasive species have less parasite richness than in their native habitats (Torchin *et al*., 2003). The release of parasites and pathogens is one of the conditions of successful invasion. This is supported by studies on the invasive gobiid parasites in North America (Kvach and Stepien, 2008). However, long-term observations of invasive gobiid parasites in the same locality (Lake St. Clair) showed increasing parasite richness (Gendron *et al*., 2012). The parasite fauna of invasive fish in different non-native localities is characterized by low similarity (Kvach and Stepien, 2008; Kvach and Winkler, 2011). The low similarity between different localities shows that the parasite fauna of the Chinese sleeper is in transition. This is suggested by the low parasite richness of the Chinese sleeper in Ukraine, compared with other localities of its new and native habitats.

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