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TRICHODINIDS (CILIOPHORA, PERITRICHIA) OF *PERCCOTTUS GLENII* (ACTINOPTERYGII, ODONTOBUTIDAE) IN THREE UKRAINIAN RIVERS

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Trichodinids (Ciliophora, Peritrichia) of *Perccottus glenii* (Actinopterygii, Odontobutidae) in Three Ukrainian Rivers. Drobiniak, O., Kutsokon, Yu., Kvach, Yu. — The Chinese sleeper *Perccottus glenii* Dybowski, 1877 (Actinopterygii, Odontobutidae), alien for Ukrainian rivers, was examined for presence of trichodinids (Ciliopora, Peritrichia). Six species belonging to the genus *Trichodina* were found: *Trichodina acuta* Lom, 1961; *T. intermedia* Lom, 1961; *T. mutabilis* Kazubski et Migala, 1968; *T. nigra* Lom, 1960; *T. pediculus* Ehrenberg, 1838; *T. perforata* Lom, Golemansky et Grupcheva, 1976. For the first time for Chinese slipper, *T. perforata* and *T. intermedia* were recorded. Morphometric data of all found species were compared with those from previous descriptions.

Key words: Chinese sleeper, invasive species, ciliates, Trichodinidae, parasite.

Триходиниды (Ciliophora, Peritrichia) у *Perccottus glenii* (Actinopterygii, Odontobutidae) из трёх украинских рек. Дробиняк А., Куцоконь Ю., Квач Ю. — Ротан *Perccottus glenii* Dybowski, 1877 (Actinopterygii, Odontobutidae) — вселенец в украинских реках — исследован на наличие триходинид (Ciliopora, Perutrichia). Обнаружено 6 видов, принадлежащих к роду *Trichodina*: *Trichodina acuta* Lom, 1961; *T. intermedia* Lom, 1961; *T. mutabilis* Kazubski et Migala, 1968; *T. nigra* Lom, 1960; *T. pediculus* Ehrenberg, 1838; *T. perforata* Lom, Golemansky et Grupcheva, 1976. Впервые для ротана отмечены *T. perforata* и *T. intermedia*. Проведено сравнение полученных морфометрических показателей обнаруженных видов с предыдущими описаниями.

Ключевые слова: ротан, виды-вселенцы, инфузории, Trichodiniidae, паразит.

Introduction

Representatives of the family Trichodinidae Claus, 1951 occur in a wide range of aquatic invertebrate and vertebrate hosts (As van, Basson, 1989). Five trichodinid genera were recorded in fish; *Trichodina* spp. were registered on the gills and body surface (Lom, Dykova, 1992).

The Chinese sleeper *Perccottus glenii* Dybowski, 1877 (Actinopterygii, Odontobutidae) is an invasive fish species indigenous for the freshwaters of the Eastern Asia from the Sea of Okhotsk basin in the north to the Yellow Sea basin in the south (Mori, 1936; Berg, 1949). In Ukraine the Chinese sleeper was first found in the upper Dniester River basin in 1980 (Reshetnikov, 2009), later it spread to such water bodies as the Middle Dnieper (Kutsokon, 2010) and the Danube River basins (Sivokhop, 1998; Kvach, 2012).

The data on the trichodinids infecting invasive Chinese sleeper in Eastern Asia are presented in Sokolov et al. (2011 a, b, 2012), who registered six taxa of these ciliates: *Trichodina* sp.; *Trichodina acuta* Lom, 1961; *Trichodina nigra* Lom, 1961; *Trichodina pediculus* Ehrenberg, 1838, and *Trichodina mutabilis* Kazubski et Migala, 1968. *Trichodina domerguei* Wallengren, 1897 was registered in the invasive Chinese sleeper in Poland (Mierzejewska et al., 2012).

In Ukraine the first study of the Chinese sleeper parasites was carried out by Maslovsky et al. (2011), who reported *Trichodina* sp. for the Vereshchytsia River (Dniester River basin). Davydov et al. (2011) published the data about the parasites of the Chinese sleeper in the Nyvky ponds (Kyiv). Eight parasite species including two ciliates were reported: *T. nigra* and *Trichodina* sp.

The information about parasite ciliates of the alien Chinese sleeper in Ukraine is sporadic and incomplete. Nevertheless, these parasite species were registered in all published data, and as such they are important

elements in the parasite fauna of this host species. Therefore, the aim of the presented study was to clarify taxonomic status of parasitic ciliates of the Chinese slipper in Ukraine.

Material and methods

In total, 158 specimens of the Chinese sleeper were inspected for the presence of trichodinid parasites. The 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) in different water areas of Ukraine (fig. 1): 1 — the Desna River near Lyubychiv Island, 50°45′ N, 30°44′ E (29 specimens); 2 — Lake Berizka in Kyiv, 50°26′ N, 30°34′ E (31 specimens); 3 — the Novosilky Pond in Kyiv, 50°21′ N, 30°27′ E (35 specimens); 4 — the Trubizh River in Pereyaslav, 50°4′ N, 31°27′ E (30 specimens); 5 — Ivachiv Reservoir near Malashivtsi, the Dniester River basin, 49°40′ N, 25°29′ E (20 specimens); 6 — the Danube delta in Vilkove, 45°24′ N, 29°35′ E (13 specimens). The depth of the sampling was 0.5–1.2 m. The fish were transported alive in aerated casks to the laboratory of the Odessa Branch of the Institute of Biology of the Southern Seas, kept in aquarium and then dissected in two days.

The infection prevalence (P, %) was calculated (Bush et al., 1997). The species description was based on the study of air-dried smears impregnated with silver nitrate (Klein, 1958) for study of the adhesive disc. All measurements were made on microscope Motic Images 2000 1.3 and given in micrometers following the uniform specific characteristics by Lom (1958). Extremum values are given, followed in parentheses by the arithmetic mean, standard deviation and number of measured specimens. The description of denticle elements follows the recommendations by Van As and Basson (1989).

Results

Six species of parasitic ciliates were registered on the body surface and gills of the Chinese sleeper collected in different waterbodies of Ukraine (table 1). Maximal prevalence for all species of trichodinids (70 %) was observed in Ivachiv Reservoir near Malashivtsi, the Dniester River basin. In the other localities, the prevalence values were the following: 29 % at Lake Berizka in Kyiv, the Dnieper River, 26.7 % at Trubizh River in Pereyaslav, 20.7 % at the Desna River near the Lyubychiv Island, 5.7 % at the Novosilky Pond in Kyiv, right bank of the Dnieper River, and 7.7 % at Danube delta in Vilkove.

Fig. 1. The schematic map of investigated area. The sampling localities are mentioned by dots with corresponding numbers.

Рис. 1. Карта мест исследований. Пункты сбора отмечены точками с соответствующими номерами.

Trichodina acuta Lom, 1961 (fig. 2, *a*)

Locality. Lake Berizka in Kyiv (table 1).

Description. Cell diameter 76.7 (1), diameter of adhesive disc 61.8 (1). Denticle number 21 (1). Width of border membrane 5.4 (1), diameter of denticle ring 53.4 (1), number of radial pins per denticle 5 (1). Central zone of the denticle ring is clear and evenly impregnated by silver. Blade sickle-shaped and broad, filling most of space between y-axis; Tangent point sharp, with distal margin slightly higher or at same level as tangent point. Distal surface with slight slope towards prominent blade apex that almost touches or extends only slightly beyond y-axis. Posterior blade margin forming deep curve, with deepest point lower than blade apex. Blade apophysis strongly developed and angular, coinciding with well developed posterior projection in previous denticle; length of blade 7.1 (1). Rays are broad and tapering downward, little recurved, but are flush with blades, length of rays is 8.3 (1). Central parts squat and well developed, extending slightly more than halfway towards y–1–axis.

Trichodina intermedia Lom, 1961 (fig. 2, *b*)

Locality. Lake Berizka and the Danube delta (table 1).

Description. Cell diameter 48.9 (1), diameter of adhesive disc 44.0 (1). Denticle number 28–29 (2). Width of border membrane 3, diameter of denticle ring 25.0–26.3 (2). Central zone of the denticle ring is clear and evenly impregnated by silver. Blade rectangular and almost without curve, parallel to each other and stand forward of rays, length of blades 5.2–5.5 (2). Rays thin, filiform, clearly directed posteriorly, length of rays 6.3–6.7 (2). Anterior and posterior margins of blades are parallel to y–axis and y–1–axis, central part is thin and located behind y–axis.

Table 1. Morphometric data of trichodinids of the Chinese sleeper

Таблица 1. Морфометрические данные триходинид от ротана-головешки

Parameters, μm	*Trichodina acuta* (Lake Berizka)	*Trichodina intermedia* (Lake Berizka, Danube delta)	*Trichodina mutabilis* (Lake Berizka, Danube delta)	*Trichodina nigra* (Lake Berizka, Ivachiv Reservoir, Danube delta)	*Trichodina pediculus* (Desna River, Lake Berizka, Danube delta)	*Trichodina perforata* (Lake Berizka)
Number of measured specimens	1	2	14	8	9	1
Diameter of body	76.7	48.9	51.1–82.4 (64.7 ± 10.6)	54.6–70.3 (60.6 ± 8.8)	51.1–62.3 (57.6 ± 3.9)	35.3
Diameter of adhesive disc	61.8	44.0	41.3–68.4 (54.1 ± 8.4)	43.0–60.0 (49.9 ± 6.4)	46.1–53.5 (49.1 ± 2.9)	31.3
Dimension of denticle ring	37.0	25.0–26.3	24.1–35.1 (30.6 ± 3.1)	25.0–34.7 (29.1 ± 3.7)	25.5–32.6 (28.5 ± 2.4)	19.6
Width of border membrane	5.4	3.0	3.0–5.5 (3.9 ± 0.8)	—	2.2–4.3 (3.6 ± 1.2)	2.7
Number of denticles	21.0	28–29	23–29 (25.6 ± 2.0)	20–26 (23.1 ± 1.7)	22–26 (23.3 ± 1.9)	28
Length of blade	7.1	5.2-5.3	6.0–8.8 (7.5 ± 0.9)	6.3–8.0 (7.3 ± 0.6)	6.1–8.1 (7.1 ± 0.6)	4.0
Length of ray	8.3	6.3-6.7	5.3–8.3 (7.1 ± 0.9)	6.0–8.5 (7.4 ± 0.9)	6.5–8.0 (7.2 ± 0.5)	4.5

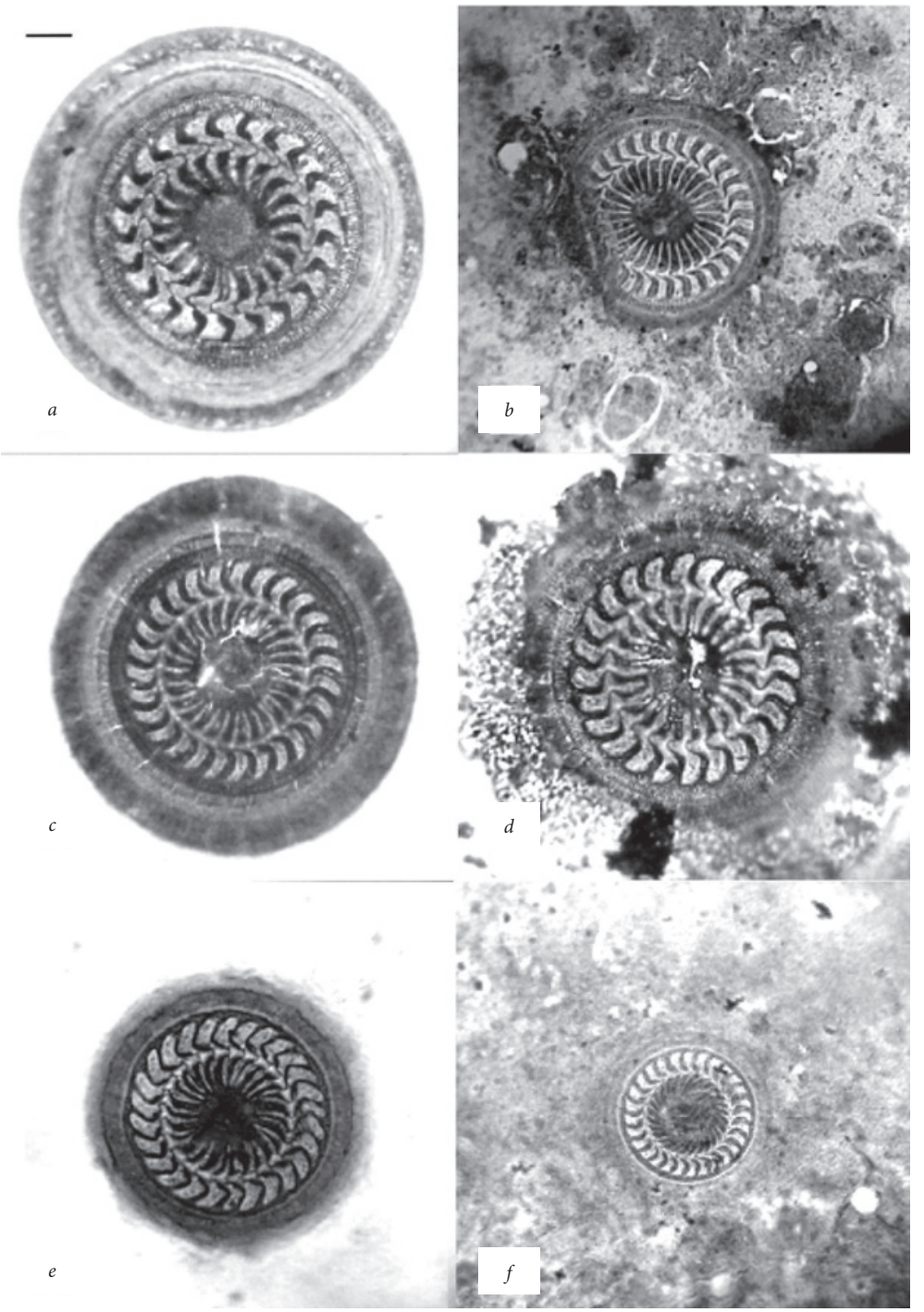

Fig. 2. Smears impregnated with silver nitrate (Klein 1958) from Chinese slipper from Ukrainian rivers: *a* — *Trichodina acuta* Lom, 1961; *b* — *Trichodina intermedia* Lom, 1961; *c* — *Trichodina mutabilis* Kazubski et Migala, 1968; *d* — *Trichodina nigra* Lom, 1960; *e* — *Trichodina pediculus* Ehrenberg, 1838; *f* — *Trichodina perforata* Lom, 1976. Scale bar 10 μm.

Рис. 2. Образцы импрегнированные серебром от ротана-головешки из украинских рек: *a* — *Trichodina acuta* Lom, 1961; *b* — *Trichodina intermedia* Lom, 1961; *c* — *Trichodina mutabilis* Kazubski et Migala, 1968; *d* — *Trichodina nigra* Lom, 1960; *e* — *Trichodina pediculus* Ehrenberg, 1838; *f* — *Trichodina perforata* Lom, 1976. Масштабная линейка 10 мкм.

Trichodina mutabilis Kazubski et Migala, 1968 (fig. 2, *c*)

Locality. Lake Berizka and the Danube delta (table 1).

Description. Cell diameter 51.1–82.4 (64.7 ± 10.6; 14), diameter of adhesive disc 41.3–68.4 (54.1 ± 8.4; 14). Denticle number 23–29 (25.6 ± 2.0; 14). Width of border membrane 3.0–5.5 (3.9 ± 0.8; 14), diameter of denticle ring 24.1–35.1 (30.6 ± 3.1; 14). Central zone of the denticle ring is clear and evenly impregnated by silver. Blade rectangular, length of blade 6.0–8.8 (7.5 ± 0.9; 14); the blade having rounded distal edge with the tangent point lower than the distal point; posterior blade surface almost straight, forming very shallow curve; distal surface of the blade rounded and not parallel to border membrane; central part delicate and closely associated with the following denticle. Rays thin and straight clearly directed posteriorly, length of ray 5.3–8.3 (7.1 ± 0.9; 14).

Trichodina nigra Lom, 1960 (fig. 2, *d*)

Locality. Lake Berizka, Ivachiv Reservoir, the Danube delta (table 1).

Description. Cell diameter 54.6–70.3 (60.6 ± 8.8). Diameter of adhesive disc 43.0–60.0 (49.9 ± 6.4; 8). Denticle number 20–26 (23.1 ± 1.7; 8). Diameter of denticle ring 25.0–34.7 (29.1 ± 3.7; 8). Central zone of the denticle ring is clear and evenly impregnated by silver. Blade curved, broad, with truncated apex, closely located to each other; length of blade 6.3–8.0 (7.3 ± 0.6; 8); anterior and posterior margin of blade almost parallel to y–axis. Rays broad in apical margin and tapering downward, clearly directed anteriorly, length of ray 6.0–8.5 (7.4 ± 0.9; 8). The central part is broad. Width of border membrane and diameter of body were not measured.

Trichodina pediculus Ehrenberg, 1838 (fig. 2, *e*)

Locality. Desna River, Lake Berizka, the Danube delta (table 1).

Description. Cell diameter 51.1–62.3 (57.6 ± 3.9; 9), diameter of adhesive disc 46.1–53.5 (49.1 ± 2.9; 9). Denticle number 22–26 (23.3 ± 1.9; 9). Border membrane 2.2–4.3 (3.6 ± 1.2; 9) in width. Diameter of denticle ring 25.5–32.6 (28.5 ± 2.4; 9). Central zone of the denticle ring is clear and evenly impregnated by silver. Blade curved, broad, with truncated apex, length of blade 6.1–8.1 (7.1 ± 0.6; 9). The blade is sickle-shaped, tapering towards the sharp tangent point; apex blade is extends beyond for y–axis. Rays thin and tapering downward, clearly directed anteriorly, length of ray 6.5–8.0 (7.2 ± 0.5; 9). There is no clear connecting part between the ray and the central part. Length of blades and rays is same; this distinguishes samples found in the Chinese slipper from other samples.

Trichodina perforata Lom, Golemansky et Grupcheva, 1976 (fig. 2, *f*)

Locality. Lake Berizka (table 1).

Description. Cell diameter 35.3 (1), diameter of adhesive disc 31.3 (1). Denticle number 28 (1). Width of border membrane 2.7 (1), diameter of denticle ring 19.6 (1). Central zone of the denticle ring is clear and evenly impregnated by silver. Blade as plates, expanding to broad upper part with sharpened apex, length of blade 4.0 (1). Rays thin, filiform, curved forward, length of ray 5.0 (1).

Discussion

Previously, only two taxa of parasitic ciliates were recorded for the Chinese slipper from Ukraine: *Trichodina* sp. and *Trichodina nigra* (Maslovsky, 2010; Davydov, 2011).

Two of six species of the recorded ciliates (*Trichodina intermedia* and *Trichodina perforata*) are reported on the Chinese sleeper for the first time. *Trichodina intermedia* Lom, 1961 was previously listed as parasite of Cyprinidae, Esocidae, Salmonidae, Percidae. Studied

samples of ciliates have higher denticle number and larger sizes of denticle than in Bauer's (1984) description.

Three taxa of trichodinids (*T. acuta*, *T. mutabilis*, *T. nigra*) registered in the present study were also found on the Chinese slipper from the Far East (Ermolenko, 2004). *Trichodina acuta* is common parasite of freshwater Cyprinid fish species (Kostenko, 1981), but also found in seven cichlid species. The variability in size and denticle dimensions of *T. acuta* has been described in relation to season and other environmental parameters (Kazubski, Migala, 1968). *T. mutabilis* is a well known and widely distributed on gills, mainly of carp, *Cyprinus carpio* Linnaeus, 1758, in Europe. The ciliate was first described by Kazubski, Migala (1968) from the breeding carp from Poland. Since then this species has been recorded mainly on the gills of cyprinid fishes from various places in Eastern Europe, the former USSR, South Africa, Israel and Taiwan (Kazubski, Migala, 1968; Migala, 1970, 1971; Basson, As van, 1994). Our specimens have smaller dimensions than those in original description. *Trichodina mutabilis* was recorded in representatives of the family Odontobutidae. Previously, this species was found only on cyprinids, such as *Carassius auratus* (Linnaeus, 1758), *C. carpio*, *Hypophthalmichthys molitrix* (Valenciennes, 1844), *Barbus paludinosus* Peters, 1852, *B. trimaculatus* Peters, 1852 and once in *Nandus nandus* Hamilton, 1822 – Percifomes, Nannidae (Mitra, Bandyopadhyay, 2005). *Trichodina nigra* was originally described from various cyprinid and perciform fishes, and also on several unidentified species of tadpoles (Lom, 1961). *Trichodina pediculus* has been isolated from a range of hosts including hydras, fishes (Centrarchidae, Cichlidae, Cyprinidae) and amphibians (Raabe 1959; Kazubski, Migala, 1968; Lom, 1970; Arthur, Lom, 1984; Lom, Dykova, 1992; As van, Basson, 1989), all from freshwater habitats. *Trichodina pediculus* was described as *Cyclidium pediculus* Müller, 1786 from *Hydra* sp.; later it was redescribed by Ehrenberg (1838).

The ciliates are characterized by low host specificity and high morphological variability. But, all host species of the trichodinids belong to only two orders: Cypriniformes Bleeker, 1859 and Perciformes Bleeker, 1859, and to 5 families (Cyprinidae Rafinesque, 1810, Nannidae Bleeker, 1852, Cichlidae Bonaparte, 1835, Centrarchidae Bleeker, 1859, Odontobutidae Hoese et Gill, 1993). Representatives of these species usually keep hold of in aquatic plants vegetations (for hunting, spawning or feeding). Ciliates use water plants for moving, and exactly in thickets of aquatic plants fishes have the highest chance to become infected by parasitic ciliates. We suggest that the prevalence of infestation may depend on substrate of sampling site or presence or absence of aquatic plants, consequently, depend on number of host specimens.

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References

As van, J. G., Basson, L. A further contribution to the taxonomy of Trichodinidae (Ciliophora: Peritrichida) and a review of the taxonomic status of some ectoparasitic trichodinids // Syst. Parasitol. — 1989. — **14**. — P. 157–179.

Arthur, J. R., Lom, J. Trichodinid Protozoa (Ciliophora: Peritrichida) from freshwater fishes of Rybinsk Reservoir, USSR // J. Protozool. — 1984. — **31**. — P. 82–91.

Basson, L., As van, J. G. Trichodinid ectoparasites (Ciliophora: Peritrichida) of wild and cultured freshwater fishes in Taiwan, with notes on their origin // Acta Protozool. — 1994. — **28**. — P. 197–222.

Bush, A. O., Lafferty, K. D., Lotz, J. M., Shostak, A. W. Parasitology meets ecology on its own terms: Margolis et al. revisited // J. Parasitol. — 1997. — **83**. — P. 575–583.

Davydov, O. N., Kurovskaya, L. Ya., Temnikhanov, Yu. D., Neborachek, S. I. Parasites of some invasive fishes of the fresh waterbodies of Ukraine // Hydrobiological Journal. — 2011. — **47**. — P. 76–89. — Russian : *Давыдов О. Н., Куровская Л. Я., Темниханов Ю. Д., Неборачек С. И.* Паразиты некоторых инвазийных рыб пресных водоемов Украины.

Ermolenko, A. V. Parasite fauna of the Amur sleeper Perccottus glehni (Eleotridae) // Parazitologiya. — 2004. — **38**. — P. 257–260. — Russian : Ермоленко А. В. Фауна паразитов головешки ротана Perccottus glehni (Eleotridae) Приморского края.

Kazubski, S. L., Migala, K. Urceolariidae from breeding carp Cyprinus carpio L. in Zabieniec and remarks on the seasonal variability of trichodinids // Acta Protozool. — 1968. — **6**. — P. 137–160.

Klein, B. M. The dry silver method and its proper use // J. Protozool. — 1958. — **5**. — P. 99–103.

Kostenko, S. M. Urtseolyariidy (Peritrikhi, Mobilina). — Kyiv : Nauk. dumka, 1981. — 147 p. — (Fauna Ukrainy ; Vol. **36**, is. 4.). — Ukrainian : *Костенко С. М.* Урцеоляріди (Peritrikhi, Mobilina).

Kutsokon, Yu. K. Distribution and morphological and biological traits of alien fish species in the Ros River basin (tributary to the Dnieper) // Rus. J. Biol. Inv. — 2010. — **1**. — P. 106–113.

Kvach, Yu. First record of the Chinese sleeper Perccottus glenii Dybowski, 1877 in the Ukrainian part of the Danube delta // BioInvasions Records. — 2012. — **1**. — P. 25–28.

Lom, J. A contribution to the systematics and morphology of endoparasitic trichodinids from amphibians with a proposal of uniform specific characteristics // J. Protozool. — 1958. — **5**. — P. 251–263.

Lom, J. Ectoparasitic trichodinids from freshwater fish in Czeshoslovakia // Acta Societatis Zoologicae Bohemoslovenicae. — 1961. — **25**. — P. 215–228.

Lom, J., Dykova, I. Protozoan parasites of fishes // Developments in Aquaculture and Fisheries Science. — 1992. — **26**. — P. 1–315.

Maslovsky, O., *Tafiychuk, R.*, *Lyesnik, V.* Parasite fauna of the Chinese sleeper (Perccottus glenii Dybowski) in the water bodies of western Ukraine // Youth and Progress of Biology: abstracts book of the VI International Scientific Conference of Students and PhD Students (Lviv, September 21–24, 2010). — Lviv, 2010. — P. 128–129. — Ukrainian : *Масловський О., Тафійчук Р., Лєснік В.* Паразитофауна ротана (Perccottus glenii Dybowski) в водоймах заходу України // Молодь і поступ біології : Збірник тез VI Міжнар. наук. конф. студентів та аспірантів (Львів, 21–24 вересня 2010 р.).

Mierzejewska, K., Kvach Yu., Woźniak, M., Kosowska, A., Dziekońska-Rynko, J. Parasites of an Asian fish, the Chinese sleeper Perccottus glenii, in the Włocławek Reservoir on the Lower Vistula River, Poland: in search of the key species in the host expansion process // Comp. Parasitol. — 2012. — **79**. — P. 23–29.

Mitra, K. A., Bandyopadhyay, P. K. First records of Trichodina japonica Imai, Miyazaki et Nomura 1991 and Trichodina mutabilis Kazubski et Migala 1968 (Ciliophora, Trichodinidae) from Indian fishes // Protistol. — 2005. — **4**. — P. 121–127.

Raabe, Z. Trichodina pediculus (O.F. Mtiller, 1786) Ehrenberg, 1838 et Trichodina domerguei (Wallengren, 1897) // Acta Parasitol. Pol. — 1959. — **6**. — P. 189–202.

Reshetnikov, A. N. The current range of Amur Sleeper Perccottus glenii Dybowski, 1877 (Odontobutidae, Pisces) in Eurasia // Rossiiskii Zhurnal Biologicheskikh Invasii. — 2009. — **1**. — P. 22–35. — Russian : *Решетников А. Н.* Современный ареал ротана Perccottus glenii Dybowski, 1877 (Odontobutidae, Pisces) в Евразии.

Sokolov, S. G., Protasova, E. N., Kholin, S. K. Parasites of the introduced Amur sleeper, Perccottus glenii (Osteichthyes): Alpha-diversity of parasites and age of the host // Izvestiya RAN. Ser. Biol. — 2011 a. — **5**. — P. 584–592. — Russian : *Соколов С. Г., Протасова Е. Н., Холин С. К.* Паразиты интродуцированного ротана Perccottus glenii (Osteichthyes): альфа-разнообразие паразитов и возраст хозяина .

Sokolov, S. G., *Protasova, E. N.*, *Reshetnikov, A. N.*, *Voropaeva, E. L.* Interactions of the introduced rotan Perccottus glenii Dybowski, 1877 (Osteichthyes, Odontobutidae) with aboriginal fish species: a parasitological aspect // Povolzhskiy Ekologicheskiy Zhurnal. — 2011 b. — **2**. — P. 203–211. — Russian : *Соколов С. Г., Протасова Е. Н., Решетников А. Н., Воропаева Е. Л.* Взаимодействие интродуцированного ротана Perccottus glenii Dybowski, 1877 (Osteichthyes, Odontobutidae) с местными видами рыб: паразитологический аспект проблемы.

Sokolov, S. G., Protasova, E. N., Reshetnikov, A. N., Shed'ko, M. B. Parasites of introduced rotan Perccottus glenii (Actinopterygii: Odontobutidae) from water bodies of European Russia // Uspekhi Sovremennoy Biologii. — 2012. — **132**. — P. 477–492. — Russian : *Соколов С. Г., Протасова Е. Н., Решетников А. Н., Шедько М. Б.* Паразиты ротана Perccottus glenii (Actinopterygii: Odontobutidae), интродуцированного в водоемы европейской части России // Успехи современной биологии.

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