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PARASITOLOGY OF HYDROBIONTS

Parasite Fauna of Chinese Sleeper *Perccottus glenii* Dybowski, 1877 (Actinopterygii, Odontobutidae) in the Point of the Primary Introduction of the Host

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Abstract—A parasitological examination of the Chinese sleeper *Perccottus glenii* was carried out in the water bodies of St. Petersburg and its environs. Twenty-seven parasite species/taxa have been recorded. Host-specific heteroxenous parasites of the Chinese sleeper were not found; this corresponds to the origin of the local populations of this fish from the aquarium-released specimens.

Keywords: Perccottus glenii, parasites, biological invasions, Gulf of Finland

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INTRODUCTION

Chinese sleeper *Perccottus glenii* Dybowski, 1877 is an alien species of the Far Eastern ray-finned fish introduced into the reservoirs of Europe and Siberia. The neighborhood of St. Petersburg is chronologically the point of the primary introduction of the Chinese sleeper. In 1916, specimens were released from an aquarium into one of the suburban garden ponds [6]. Now this species is found in many water bodies of St. Petersburg and Leningrad oblast, including the desalinated eastern part of the Gulf of Finland [2, 8, 11]. It was first discovered in the early 1950s in the littoral part of the Gulf of Finland [6].

Large-scale parasitological studies of the Chinese sleeper were carried out in 2008–2015 [26]. Nevertheless, some new territories of the expanded range of this fish species, including the northwest of Eastern Europe, have not yet been covered by these studies.

This study aims to describe the parasitic fauna of the invader *Perccottus glenii* in the reservoirs of St. Petersburg and its environs (Russia).

MATERIALS AND METHODS

The Chinese sleeper was caught in the reservoirs of St. Petersburg and its environs: the artificial ponds of Aviator Park (59°52′ N, 30°18′ E) and Sosnovka Park (60°10′ N, 30°21′ E), the dammed Zybin Brook (59°58′ N, 30°28′ E), and the desalinated water area of the eastern part of the Gulf of Finland. Five specimens were examined from the pond in Aviator Park (total length of body (L) 105–175 mm, June 2015), one specimen from the pond of Sosnovka Park (L = 91 mm, June 2015), and four specimens from the Zybin Brook (L = 115–160 mm, June 2015). In the Gulf of Finland, the Chinese sleeper was caught in the coastal area of Kotlin Island (60°10′ N, 29°43′ E) and in the water area free from thickets near the city of Sestroretsk (60°5′ N, 29°54′ E). Fourteen specimens were examined from the area of Kotlin Island (L = 62–156 mm, May 2016) and two specimens from the area nearby Sestroretsk (L = 220–250 mm, June 2015). Freshly caught specimens were examined. Fixation and subsequent treatment of parasites were carried out by standard methods [5]. To identify the parasites, the taxonomical keys [3, 4, 17, 18, 21] and research data [1, 7, 9, 12, 20, 22] were used. Two indicators of host contamination were used: the prevalence expressed in terms of the number of infected fish (for all groups of parasites) and the intensity of infection (the number of parasite individuals found in the host) for macroparasites only.

RESULTS AND DISCUSSION

Twenty-seven parasite species/taxa have been found in the studied fish (Table 1). Specific parasites for this host were represented by one species only, *Goussia obstinata* Sokolov et Moshu, 2014. The species composition of parasites of the individuals caught in the park ponds and the dammed Zybin Brook was extremely poor; most of the parasite species were presented in the fish sampled in the Gulf of Finland. The larvae and juveniles of the imaginal phase of development prevailed among the macroparasites recorded in the Chinese sleeper of this reservoir, both in number of

Table 1. Parasites and indices of infestation of the Chinese sleeper in the studied reservoirs of St. Petersburg and its environs

Parasite species and its localization	Pond in Sosnovka Park, $n = 1$	Pond in Aviator Park, $n = 5$	Zybin Stream, $n = 4$	Gulf of Finland	
				coastal zone of Kotlin Island, $n = 14$	in vicinity of Sestroretsk City, $n = 2$
Goussia obstinata, int	–	–	–	2	–
Spironucleus sp., int	1	1	2	13	–
Trichodina mutabilis, g	–	–	–	2	–
T. nigra, g	–	–	–	1	–
Trichodina sp., g	–	1	–	–	–
Rhipidocotyle campanula juv, int	–	–	–	–	1 (2)
Bucephalus polymorphus juv, int	–	–	–	–	1 (1)
Sphaerostoma globiporum, ad, juv, int	–	–	–	1 (2)	2 (1, 27)
S. bramae juv, int	–	–	–	1 (1)	1 (34)
Bunodera luciopercae, ad, int	–	–	–	–	1 (4)
Parasymphylodora parasquamosa juv, int	–	–	–	4 (1–10)	–
P. markewitschi, juv, int				1 (2)	–
Echinostomatidae gen. sp., mtc, ocw	–	–	–	2 (1)	–
Echinochasmidae gen. sp., mtc, g	–	–	–	6 (1–3)	–
Prohemistomidae gen. sp., mtc, m, ocw	–	–	–	–	2 (1, 2)
Diplostomum chromatophorum, mtc, len	–	–	–	2 (10)	–
Eubothrium rugosum, pl, int	–	–	–	1 (1)	–
Diphyllobothrium vogeli, pl, int	–	–	–	1 (1)	–
Acanthocephalus ranae, juv, int	–	–	–	2 (1–2)	–
Camallanus lacustris, ad, J_4, int	–	–	–	1 (2)	2 (1, 2)
C. truncatus, ad, int	–	–	–	–	1 (1)
Acuariidae gen. sp., J_3, ew, ms	–	–	–	2 (1–2)	1 (4)
Contracaecum sp., J_3, int	–	–	–	1 (1)	–
Raphidascaris acus, J_3, liv, ms, iw	–	–	–	5 (1–3)	2 (1, 6)
Pseudocapillaria tomentosa, ad, int	–	–	–	–	1 (5)
Unio tumidus, gl, g	–	–	–	–	1 (6)
Colletopterum piscinale, gl, f, g, ocw	–	–	–	–	2 (3, 6)

n is the total number of the analyzed fish; (ms) mesentery; (g) gills; (int) intestine; (m) skeletal musculature; (liv) liver; (f) fins; (ew) esophageal wall; (ocw) oral cavity wall; (iw) intestinal wall; (len) lens; (gl) glochidium; (mtc) metacercaria; (pl) plerocercoid; (J_3 and J_4) nematode juveniles of the 3rd and 4th stages of development, respectively; (ad) mature individuals; and (juv) juvenile specimens. Numbers without brackets indicate the number of infected fish; numbers in parentheses show the intensity of infection expressed as a number of parasite individuals.

species and in number of individuals (Table 1). Sexually mature specimens of macroparasites have been registered only in the largest fish.

The Gulf of Finland, as a very large natural body of water with a rich parasitofauna, has a considerable potential for this fish species in regard to being a host for parasites. However, in the studied Chinese sleeper individuals, this potential was realized only for a part of species/taxa: for all protists, glochidia, metacercariae, and nematode juveniles with tissue localization, as well as, possibly, for plerocercoid of *Eubothrium rugosum* (Batsch, 1786). The Chinese sleeper is an undoubted eliminator for *Acanthocephalus ranae* (Schrank, 1788). Tailless amphibians are the obligatory final hosts of *A. ranae* [18]. In the vicinity of St. Petersburg, the coastal zone of the Gulf of Finland is inhabited by at least one of the species of these vertebrates, *Pelophylax ridibundus* (Pallas, 1771) [10]. For many intestinal helminths (juveniles of Bucephalidae, Lissorchiidae, and Opecoelidae families of trematodes, as well as juveniles of *Camallanus*), the degree of suitability of the Chinese sleeper as a host is unclear.

The facts of registration of adult worms *Sphaerostoma* spp., *Camallanus* spp., and *Bunodera lucioperсae* (Müller, 1776) in some specimens of the Chinese sleeper are unlikely to clarify this issue (Table 1). It is known [2, 23] that large individuals of the Chinese sleeper in the eastern part of the Gulf of Finland feed mainly on fish, and these parasites could pass to them from the swallowed fish. It should be noted that, in a number of other European water bodies, *Camallanus* sp., *Bucephalus polymorphus* Baer, 1827, *Sphaerostoma globiporum* (Rudolphi, 1802), and *Parasymphylodora markewitschi* (Kulakowskaya, 1947) have been registered in the Chinese sleeper; all of these parasite species were represented by juvenile individuals (larvae and young marites) [13, 26]. The plerocercoid *Diphyllobothrium vogeli* Kuhlow, 1953 was found in the intestine of one individual, where it passed undoubtedly from a three-spined stickleback *Gasterosteus aculeatus* Linnaeus, 1758 that it had swallowed; the last is the obligate second intermediate host of this cestode species (its remains were present in the intestines of the Chinese sleeper). Among the parasites recorded in the Chinese sleeper in the Gulf of Finland, there were no species reliably attributed to the marine fauna. It is noteworthy that there were no Chinese sleeper-specific parasites with a heteroxenous life cycle found in the reservoirs of St. Petersburg and its environs; this agrees with the origin of local populations of this fish species from the aquarium individuals [24, 25].

Chronologically, the second point of introduction of the Chinese sleeper (in 1950), associated with the release of individuals from aquaria, refers to the upper part of the Moscow River basin [19, 28]. In comparison with that population [15, 25, 26], fewer species/taxa of parasitic ciliates (5 versus 10), in particular, of ectoparasitic infusorians (3 versus 7), but more metazoan parasites (22 versus 11), have been recorded in the Chinese sleeper from the water bodies of St. Petersburg and its environs (Table 1). In this case, all types of parasite–host relations (from obligate to captive) in the Chinese sleeper were taken into account. These differences in the number of species/taxa of metazoan parasites are regular. The species richness of the parasites of the introduced Chinese sleeper is largely due to the diversity of the fish in the recipient reservoir [13]. The qualitative and quantitative composition of the freshwater and euryhaline fish in the eastern part of the Gulf of Finland [19] is richer than that of all the surveyed reservoirs near Moscow (the Neverovo sand-pit, Glubokoe Lake, etc.) [14, 15]. Differences in the species composition of the ectoparasitic ciliates are apparently random. The Chinese sleeper from the Gulf of Finland and from the ponds of St. Petersburg was infested by them poorly (Table 1), which depleted their species composition. Accordingly, in order to obtain representative data on the species richness of the ciliates parasitizing on the Chinese sleeper in the Gulf of Finland and in the city ponds of St. Petersburg, additional studies are needed.

CONCLUSIONS

Twenty-seven species/taxa of parasites have been registered in the Chinese sleeper sampled in the first chronological point of the primary introduction; one of these parasite species (*Goussia obstinata*) is species-specific for this host. The species composition of parasites is consistent with the origin of the local populations of this fish species from the aquaria individuals. The maximum species richness of parasites (26 species/taxa) is found in the Chinese sleeper sampled in the desalinated water area of the eastern part of the Gulf of Finland. The suitability of the Chinese sleeper as a host is unequal for all parasites found.

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COMPLIANCE WITH ETHICAL STANDARDS

Conflict of interests. The authors declare that they have no conflict of interest.

Statement on the welfare of animals. All applicable international, national, and/or institutional guidelines for the care and use of animals were followed.

REFERENCES

1. Antonova, L.A., Identification of mature glochidia of European species of Unioninae and Anodontinae, *Tr. Zool. Inst.*, 1986, vol. 148, pp. 46–53.
2. Antsulevich, A.E. and Yakovlev, A.S., Chinese sleeper *Perccottus glenii* Dybowski, 1877 in the Neva Bay and the eastern part of the Gulf of Finland, in *2-i Mezhdunarodnyi simpozium "Chuzherodnye vidy v Golarktike (Borok-2)", Tezisy dokladov* (The 2nd Int. Symp. "Alien Species in the Holarctic (Borok-2), Abstracts of Papers), Borok, 2005, p. 135.
3. Bauer, O.N., *Opredelitel' parazitov presnovodnykh ryb fauny SSSR* (Identification Guide to Parasites of Freshwater Fishes of the Fauna of the USSR), Leningrad: Nauka, 1984, vol. 1.
4. Bauer, O.N., *Opredelitel' parazitov presnovodnykh ryb fauny SSSR* (Identification Guide to Parasites of Freshwater Fishes of the Fauna of the USSR), Leningrad: Nauka, 1987, vol. 3.
5. Bykhovskaya-Pavlovskaya, I.E., *Parazity ryb. Rukovodstvo po izucheniyu* (Parasites of Fishes: A Study Guide), Leningrad: Nauka, 1985.
6. Dmitriev, M., Caution: Chinese Sleeper!, *Rybovodstvo Rybolovstvo*, 1971, no. 1, pp. 26–27.

7. Koval', V.P., Flukes of the genus *Sphaerostomum* Stiles et Hassal in fishes of water bodies of Ukraine, *Gidrobiol. Zh.*, 1970, vol. 6, no. 6, pp. 78–86.
8. Kuderskii, L.A., Chinese sleeper in ponds of Leningrad oblast, *Sb. Nauch. Tr. Gos. Nauchno-Issled. Inst. Ozern. Rechn. Rybn. Khoz.*, 1982, no. 191, pp. 70–75.
9. Kulakova, A.P., A new species of the genus *Parasymphylodora* Szidat, 1943 (Trematoda, Monorchiidae) and its larva, *Parazitologiya*, 1972, vol. 6, no. 2, pp. 137–142.
10. Mil'to, K.D., Amphibians and reptiles of the North-West of Russia: biodiversity assessment, *Extended Abstract of Cand. Sci. (Biol.) Dissertation*, St. Petersburg, 2007.
11. Popov, I.Yu., New fish species in the Russian part of the Gulf of Finland and inland water bodies of St. Petersburg and Leningrad oblast, *Russ. J. Biol. Invasions*, 2014, vol. 5, no. 1, pp. 90–98.
12. Sokolov, S.G. and Moshu, A.Ya., *Goussia obstinata* sp. n. (Sporozoa: Eimeriidae), a new coccidian species from intestines of the Amur sleeper Perccottus glenii Dybowski, 1877 (Perciformes: Odontobutidae), *Parazitologiya*, 2014, vol. 48, no. 5, pp. 382–392.
13. Sokolov, S.G., Baklanov, M.A., and Zinov'ev, E.A., Peculiarities of the Chinese sleeper (*Perccottus glenii* Dybowski, 1877, Actinopterygii, Odontobutidae) parasite fauna in reservoirs of Perm, *Russ. J. Ecol.*, 2014, vol. 45, no. 5, pp. 437–440.
14. Sokolov, S.G., Protasova, E.N., Reshetnikov, A.N., and Voropaeva, E.L., Interaction of the introduced rotan *Perccottus glenii* Dybowski, 1877 (Osteichthyes, Odontobutidae) with aboriginal fish species: a parasitological aspect, *Povolzhsk. Ekol. Zh.*, 2011, no. 2, pp. 203–211.
15. Sokolov, S.G., Reshetnikov, A.N., Protasova, E.N., and Voropaeva, E.L., New data on alien species of parasites and hosts in the ecosystem of Lake Glubokoe (Moscow oblast, Russia), *Russ. J. Biol. Invasions*, 2017, vol. 8, no. 1, pp. 108–114.
16. Spanovskaya, V.D., Savvaitova, K.A., and Potapova, T.L., Variability of Chinese sleeper (*Perccottus glenii* Dyb. Fam. Eleotridae) during acclimatization, *Vopr. Ikhtiol.*, 1964, vol. 4, no. 4, pp. 632–643.
17. Sudarikov, V.E., Shigin, A.A., Kurochkin, Yu.V., et al., *Metatserkarii trematod—parazity presnovodnykh gidrobiontov Tsentral'noi Rossii* (Metacercariae of Trematodes—Parasites of Freshwater Aquatic Organisms of Central Russia), Moscow: Nauka, 2002, vol. 1.
18. Khokhlova, I.G., *Akantotsefaly nazemnykh pozvonochnykh fauny SSSR* (Acanthocephalans of Terrestrial Vertebrates of the Fauna of the USSR), Moscow: Nauka, 1986.
19. Golubkov, S.M., Changes of biological communities in the eastern gulf of Finland during the last century, *Tr. Zool. Inst. Ross. Akad. Nauk*, 2009, vol. 313, no. 4, pp. 406–418.
20. Moravec, F., Some notes on the larval stages of *Camallanus truncatus* (Rudolphi, 1814) and *Camallanus lacustris* (Zoega, 1776) (Nematoda; Camallanidae), *Helminthologia*, 1971, vol. 10, nos. 1–4, pp. 129–135.
21. Moravec, F., *Parasitic Nematodes of Freshwater Fishes of Europe*, Praha: Academia, 1994.
22. Niewiadomska, K. and Niewiadomska-Bugaj, M., Optimal identification procedure for *Diplostomum paracaudum* (Iles, 1959) and *D. pseudospathaceum* Niewiadomska, 1984 metacercariae (Digenea) based on morphological characters, *Syst. Parasitol.*, 1995, vol. 30, no. 3, pp. 165–171.
23. Orlova, M.I., Telesh, I.V., Berezina, N.A., et al., Effects of nonindigenous species on diversity and community functioning in the eastern Gulf of Finland (Baltic Sea), *Helgol. Mar. Res.*, 2006, vol. 60, pp. 98–105.
24. Reshetnikov, A.N., Sokolov, S.G., and Protasova, E.N., The host-specific parasite *Nippotaenia mogurndae* confirms introduction vectors of the fish *Perccottus glenii* in the Volga River basin, *J. Appl. Ichthyol.*, 2011, vol. 27, no. 5, pp. 1226–1231.
25. Reshetnikov, A.N., Sokolov, S.G., and Protasova, E.N., Detection of a neglected introduction event of the invasive fish *Perccottus glenii* using parasitological analysis, *Hydrobiologia*, 2017, vol. 788, pp. 65–73.
26. Sokolov, S.G., Reshetnikov, A.N., and Protasova, E.N., A checklist of parasites in non-native populations of rotan *Perccottus glenii* Dybowski, 1877 (Odontobutidae), *J. Appl. Ichthyol.*, 2014, vol. 30, no. 3, pp. 574–596.

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