Rapid Communication

First record of the invasive Chinese sleeper, *Perccottus glenii* Dybowski, 1877 (Gobiiformes: Odontobutidae) in the Black Sea

Yuriy Kvach[1,2,*], Yuriy Karavanskyi[1], Pavlo Tkachenko[3] and Veniamin Zamorov[1]

[1]*Odessa I. I. Mechnikov National University, Dvoryanska St., 2, 65002 Odessa, Ukraine*
[2]*Institute of Marine Biology, National Academy of Science of Ukraine, Pushkinska St., 37, 65048 Odessa, Ukraine*
[3]*Black Sea Biosphere Reserve,National Academy of Science of Ukraine, Lermontova St., 1, 75600 Gola Pristan, Ukraine*
Author e-mails: *yuriy.kvach@gmail.com (YKv), tetra2000@ukr.net (YKar), tkachenko.bsbr@gmail.com (PT),v.zamorov@onu.edu.ua (VZ)*
**Corresponding author*

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Abstract

Here, we report on the finding of an Asian invasive fish, the Chinese sleeper (*Perccottus glenii*), in the Gulf of Yahorlyk in the Black Sea. On 11 October 2019, a single mature *Perccottus glenii* female was captured in the Gulf, representing the first record of this fish in Black Sea open waters. This observation of an individual distant 100 km from the nearest freshwater population suggests that the Chinese sleeper may be tolerant to mesohaline waters and thus could spread between the riverine mouths along the coast line. If confirmed, it is highly likely that the Chinese sleeper will invade small rivers in southern Ukraine in the near future.

Key words: brackish water, invasive fish, Gulf of Yahorlyk, new findings, range expansion

Introduction

Over recent decades, the global rate of detection for aquatic non-indigenous species has increased rapidly, peaking at roughly 66 primary detections per year (Bailey et al. 2020). One important means of spread for aquatic invasive species in Europe has been through so-called aquatic invasion corridors (Bij de Vaate et al. 2002). Two of these corridors pass through Ukraine, i.e. the Southern Invasion Corridor, via the Danube basin, and the Central Invasion Corridor, via the Dnieper basin (Panov et al. 2009). At present, nine non-native fish species, as well as several neolimnetic species, are known to have increased their ranges along the Central Invasion Corridor via the River Dnieper (Semenchenko et al. 2011, 2016; Kvach and Kutsokon 2017).

The Chinese sleeper (*Perccottus glenii* Dybowski, 1877; Gobiiformes: Odontobutidae) was first transported to the European continent from the River Zeya in the Russian Far East to St. Petersburg in 1912 as an ornamental fish (Nabatov 1914). The species first became established in Central and Eastern Europe in 1972, when it was introduced into a fish farm near the City of Lviv, Ukraine (summarised in Kutsokon 2017). Later, it spreads

around the rivers of the Carpathian region and at present, this "Carpathian population" inhabits the Dniester, Dnieper, Danube, Vistula and Southern Bug riverine basins (Grabowska et al. 2020). The Chinese sleeper was first recorded in the Dnieper river basin in the City of Minsk, Belarus, in the 1970s (Rizevskiy et al. 1999), and in the Ukrainian sector near Kyiv in 2001 (Sabodash et al. 2002). In the main Dnieper flow, the southernmost finding of this fish was reported in the Kaniv Reservoir, where it occurred in the diet of European catfish (*Silurus glanis* L., 1758) (Didenko and Gurbyk 2016). Finally, isolated populations of the Chinese sleeper were recorded in the freshwater part of the Dnieper Estuary itself in 2016 (Kvach et al. 2016).

Invading Chinese sleeper has been shown to have a range of impacts on receiving ecosystems. The species competes with local fishes for food, habitat and spawning sites, for example, and preys on small-sized fish (Hoch and Kvasha 2003; Koščo et al. 2008; Reshetnikov 2013; Kati et al. 2015; Rau et al. 2017; Grabowska et al. 2009, 2019). Presence of Chinese sleeper can also affect amphibian populations, causing significant impacts on the biodiversity of the invaded ecosystem (Reshetnikov 2013; Rakauskas et al. 2016; Pupina et al. 2018). In some cases, the species has formed monospecific fish communities (Kutsokon et al. 2021). The species can also act as a host for parasites dangerous for both humans and aquacultural fish species. In the Dnieper basin, for example, the species is a host to *Isthmiophora melis* (Schrank, 1788), a trematode that can also infect humans (Kvach et al. 2020).

A number of previous studies have already documented the spread of Chinese sleeper along the Central Invasion Corridor (Kutsokon and Negoda 2006; Kutsokon et al. 2013; Kvach et al. 2016; Kutsokon 2017), through which it colonised the Dnieper river drainage from north to south. Here, we present new data documenting the first occurrence of the invasive Chinese sleeper in Black Sea open waters.

Materials and methods

The species was discovered during an ichthyological survey provided during standard monitoring of fauna in the Black Sea Biosphere Reserve by the National Academy of Sciences of Ukraine on 11 October 2019. During the survey along the water's edge in the Gulf of Yahorlyk, Black Sea (46.333108; 31.867847; Figure 1), a fish of untypical shape was accidentally spotted in the macrophyte beds and captured using a dipnet. Further dipnet survey of the beds did not result in capturing similar individuals. At the point of capture, water salinity varies from 15–16‰ in spring to 17–18‰ in summer (data from long-term monitoring provided by the Black Sea Biosphere Reserve management). After catching, the fish was immediately preserved in 4% formalin then transported to the Department of Hydrobiology and General Ecology of Mechnikov Odessa National University, where it was identified to species level.

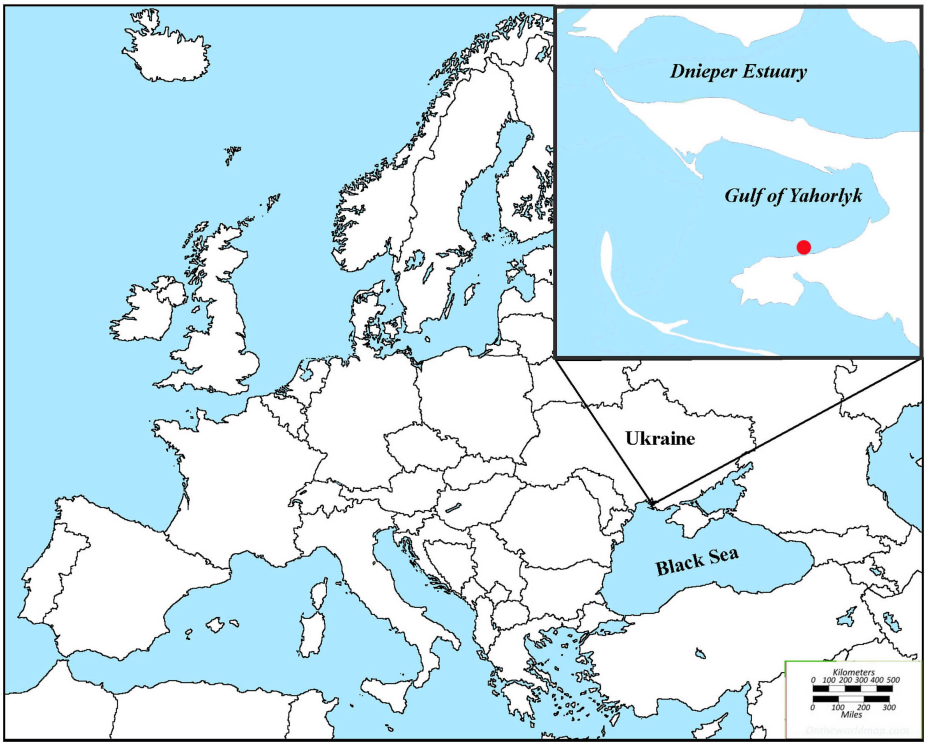

Figure 1. Location of the Gulf of Yahorlyk on the Back Sea. The red circle indicates the recording site of the Chinese sleeper.

The standard (SL) and total (TL) length of the fish was measured in mm, as well as head length and width of body at its central part. The identification of the fish species was provided in accordance to the descriptions in Kottelat and Freyhof (2007), Movchan (2011). The number of rays was counted for each fin (D1 – first dorsal fin, D2 – second dorsal fin, C – caudal fin, A – anal fin, P – pectoral fins and V – ventral fins), with the hard spines and soft rays counted separately (spines marked with Roman numerals, soft rays with Arabian numbers).

Results

The single fish caught was positively identified as a female Chinese sleeper (Figure 2). The individual has now been deposited in the Ichthyological collection of the Natural History Museum of the National Academy of Sciences of Ukraine in Kyiv (the catalogue accession #10388).

Characteristics

Sex = female,
TL = 100 mm, SL = 80 mm, Head length = 30 mm, Body width = 30 mm.
Fins: D1 VII; D2 II 11; C 12; A II 7; P 19; V I 5

We found no evidence of asymmetry in either the pectoral or ventral fins. At the time of catching (11.10.2019), the female was full of eggs and the gonads were at the fourth stage of development. There was evidence of body deformation due to overfilling with eggs (Figure 2).

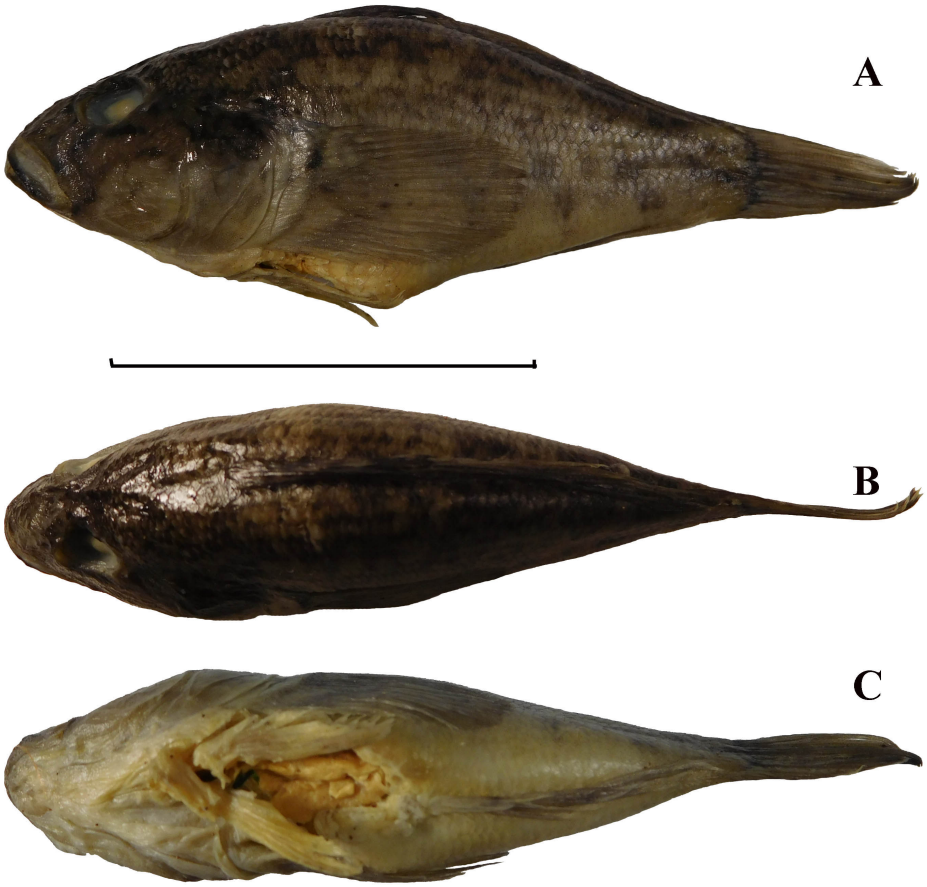

Figure 2. Image of the Chinese sleeper caught in the Gulf of Yahorlyk, Black Sea.(A) lateral view, (B) dorsal view and (C) ventral view; scale: 50 mm. Photographs by Yuriy Kvach.

Discussion

The occurrence of Chinese sleeper in the Gulf of Yahorlyk is the first record of the species in Black Sea open waters, the species having been previously registered only in freshwater stretches of the Dnieper Estuary and the Danube delta (Kvach 2012; Kvach et al. 2016). The Gulf of Yahorlyk is close to the Dnieper Estuary and, as such, the current finding possibly represents an individual from the Dnieper River basin population, which spreads from north to south via the Central Invasion Corridor (Figure 3). Because whole the water body is a part of the natural protected zone (Black Sea Biosphere Reserve), we consider the direct introduction with human vector (aquarium release/bait fish) highly unlikely. Taking into account that only a single fish was captured, the further monitoring yet has to confirm presence/absence of an established population in the brackish water. Notably, no Chinese sleeper was confirmed in the concurrent monitoring of the fish fauna in the Gulf of Yahorlyk (a fyke-nets installed overnight for 12 hours; P. Tkachenko *unpublished data*).

The Chinese sleeper is a typical inhabitant of lentic waters, such as ponds, small lakes and canals (Bogutskaya and Naseka 2002; Kottelat and Freyhof 2007), thus its presence in sea waters is not typical. The only stable population previously reported from sea waters is that in the Gulf of Finland,

Figure 3. The finding localities of the Chinese sleeper in Ukraine. Black spots – registrations according to Kutsokon (2017) updated by the data of Didenko and Gurbyk (2016), Kvach et al. (2020); red star – current registration.

in the Russian/Finish Baltic Sea (Haahti and Kangas 2004; Popov 2014). Note, however, that the Gulf of Finland, and especially its eastern part, so-called Neva Estuary, is freshwater, with salinity range 0.07–0.2‰ (Golubkov 2009), and differs considerably from the brackish waters of the Ukrainian Black Sea, where salinity ranged between 15–18‰, depending on the season. The species' resistance to salinity has previously been recorded in the literature, with Karedin (1966) reporting findings of Chinese sleeper in the brackish waters of Far-Eastern Russia, and Elovenko (1981) hypothesising that the fish is able to survive in brackish waters for short periods following riverine inflow during the spring floods. According to Bogutskaya and Naseka (2002), presence of Chinese sleeper in northern Sakhalin was the result of its introduction via the Tartar Gulf, Sea of Japan, during the spring floods (probably alongside ice flows). The present finding is about 100 km along the coast line from the next nearest site of Chinese sleeper occurrence (Dnieper Estuary; see Kvach et al. 2016); thus, it is possible that the fish was carried with riverine inflow during the spring floods. As the fish was caught in autumn, this would imply that the species survived in mesohaline waters throughout the summer. Except of spring flood, the autumn outflow of freshwater caused by intensive wind, could be a reason of the appearance of this fish in the mesohaline waters. This outflow is a cause of appearance in the gulf of many other freshwater fish during the autumn period (Tkachenko 2001).

The spread of freshwater invasive fishes between estuaries of the Black Sea rivers has previously been described by a number of authors. In Ukraine, the invasive pumpkinseed (*Lepomis gibbosus* L., 1758) was first recorded in the Danube delta, but has since invaded the rivers Dniester and

Dnieper by moving from south to north-east (Afanasyev et al. 2017). Notably, pumpkinseed was registered in the Gulf of Yahorlyk in 1992–1994, before its introduction into the Dnieper Estuary (Pinchuk and Tkachenko 1996). Likewise, the Prussian carp (*Carassius gibelio* Bloch, 1782) was registered in the Gulf of Odessa, Black Sea (Kvach 2015) and has now been found in coastal waters off Snake Island, which are fed by riverine inflow (Snigirov et al. 2020). In all these cases the freshwater fish did not establish stable populations in the Black Sea and boat transport still cannot be excluded as a vector for the between-estuary movements. Based on the sequence of the findings, however, it was hypothesized that (at least short-time) tolerance of these species to the sea water make the natural spread between river deltas possible (Pinchuk and Tkachenko 1996). Based on our finding, we can hypothesise the same for the Chinese sleeper. If confirmed, it is highly likely that the Chinese sleeper would invade small rivers in southern Ukraine in the near future.

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References

Afanasyev SA, Gupalo YA, Manturova OV (2017) Distribution and peculiarities of biology of the pumpkinseed *Lepomis gibbosus* (Perciformes: Centrarchidae) in the water bodies of Kyiv City. *Hydrobiological Journal* 53: 14–25, https://doi.org/10.1615/HydrobJ.v53.i3.20

Bailey SA, Brown L, Campbell ML, Canning-Clode J, Carlton JT, Castro N, Chainho P, Chan FT, Creed JC, Curd A, Darling J, Fofonoff P, Galil BS, Hewitt CL, Inglis GJ, Keith I, Mandrak NE, Marchini A, McKenzie CH, Occhipinti-Ambrogi A, Ojaveer H, Pires-Teixeira LM, Robinson TB, Ruiz GM, Seaward K, Schwindt E, Son MO, Therriault TW, Zhan A (2020) Trends in the detection of aquatic non-indigenous species across global marine, estuarine and freshwater ecosystems: A 50-year perspective. *Diversity & Distribution* 26: 1780–1797, https://doi.org/10.1111/ddi.13167

Bij de Vaate A, Jazdzewski K, Ketelaars HAM, Gollasch S, Van der Velde G (2002) Geographical patterns in range extension of Ponto-Caspian macroinvertebrate species in Europe. *Canadian Journal of Fisheries and Aquatic Science* 59: 1159–1174, https://doi.org/10.1139/f02-098

Bogutskaya NG, Naseka AM (2002) *Perccottus glenii* Dybowski, 1877. Freshwater fishes of Russia. Zoological Institute RAS. http://www.zin.ru/animalia/pisces/eng/taxbase_e/species_e/perccottus/perccottus_glenii_eng.pdf

Didenko AV, Gurbyk AB (2016) Spring diet and trophic relationships between piscivorous fishes in Kaniv Reservoir (Ukraine). *Folia Zoologica* 65: 15–26, https://doi.org/10.25225/fozo.v65.i1.a4.2016

Elovenko VN (1981) Taxonomic status and geographical distribution of the eleotridid fish (Eleotridae, Gobioidei, Perciformes) introduced in water bodies of the European part of the SSSR, Kazakhstan and Middle Asia. *Zoologicheskiy Zhurnal* 60: 1517–1522 [in Russian]

Golubkov SM (2009) Changes of biological communities in the eastern Gulf of Finland during the last century. *Proceedings of the Zoological Institute RAS* 313(4): 406–418

Grabowska J, Grabowski M, Pietraszewski D, Gmur J (2009) Non-selective predator - the versatile diet of Amur sleeper (*Perccottus glenii* Dybowski, 1877) in Vistula River (Poland), a newly invaded ecosystem. *Journal of Applied Ichthyology* 25: 451–459, https://doi.org/10.1111/j.1439-0426.2009.01240.x

Grabowska J, Błońska D, Kati S, Nagy SA, Kakareko T, Kobak J, Antal L (2019) Competitive interactions for food resources between the invasive Amur sleeper (*Perccottus glenii*) and threatened European mudminnow (*Umbra krameri*). *Aquatic Conservation: Marine and Freshwater Ecosystems* 29: 2231–2239, https://doi.org/10.1002/aqc.3219

Grabowska J, Kvach Y, Rewicz T, Pupiņš M, Kutsokon I, Dykyy I, Antal L, Zięba G, Rakauskas V, Trichkova T, Čeirāns A, Grabowski M (2020) First insight into the molecular population structure and origins of the invasive Chinese sleeper (*Perccottus glenii*) in Europe. *NeoBiota* 57: 87–107, https://doi.org/10.3897/neobiota.57.48958

Haahti H, Kangas P (2004) State of the Gulf of Finland in 2003. MERI Report Series, No. 51. Finnish Institute of Marine Research, Helsinki, 20 pp

Hoch IV, Kvasha VI (2003) Ecological characteristic of *Perccottus glehni* Dybowski (Eleotridae) from reservoirs of the Western-Podolian Prydnistrovya. *Naukovi Zapysky Ternopilskoho pedahohichnoho universytetu (Biology)* 2(21): 68–71 [in Ukrainian with English summary]

Karedin EP (1966) Pitanie massovykh vidov ryb oz. Khasan [The diet of the mass fish species in Lake Khasan]. *Voprosy Ikhtiologii* 6(3): 540–549 [in Russian]

Kati S, Mozsár A, Árva D, Cozma NJ, Czeglédi I, Antal L, Nagy SA, Erős T (2015) Feeding ecology of the invasive Amur sleeper (*Perccottus glenii* Dybowski, 1877) in Central Europe. *International Review of Hydrobiology* 100: 116–128, https://doi.org/10.1002/iroh.201401784

Koščo J, Manko P, Miklisová D, Košuthová L (2008) Feeding ecology of invasive *Perccottus glenii* (Perciformes, Odontobutidae) in Slovakia. *Czech Journal of Animal Science* 53: 479–486, https://doi.org/10.17221/340-CJAS

Kottelat M, Freyhof J (2007) Handbook of European freshwater fishes. Publications Kottelat, Cornol, Switzerland, 646 pp

Kutsokon I (2017) The Chinese sleeper (*Perccottus glenii* Dybowski, 1877) in Ukraine: new data on distribution. *Journal of Applied Ichthyology* 33: 1100–1107, https://doi.org/10.1111/jai.13454

Kutsokon YK, Negoda VV (2006) Chinese sleeper *Perccottus glenii* (Odontobutidae, Perciformes) - a new species for River Ros' basin. *Vestnik Zoologii* 40(3): 282 [in Ukrainian]

Kutsokon Y, Pukhtayevych P, Kolomytsev G (2013) Spreading of Chinese sleeper (*Perccottus glenii* Dybowski 1877) in Zhytomyr Region (Ukraine). *Studia Biologica* 7: 259–264, https://doi.org/10.30970/sbi.0703.316 [in Ukrainian with English summary]

Kutsokon I, Tkachenko M, Bondarenko O, Pupins M, Snigirova A, Berezovska V, Čeirāns A, Kvach Y (2021) The role of invasive Chinese sleeper *Perccottus glenii* Dybowski, 1877 in the Ilgas Nature Reserve ecosystem: an example of a monospecific fish community. *BioInvasions Records* 10: 396–410, https://doi.org/10.3391/bir.2021.10.2.18

Kvach Y (2012) First record of the Chinese sleeper *Perccottus glenii* Dybowski, 1877 in the Ukrainian part of the Danube delta. *BioInvasions Records* 1: 25–28, https://doi.org/10.3391/bir.2012.1.1.05

Kvach Y (2015) The fish assemblage on the coastal shallow waters of the Gulf of Odessa and its diel changes. *Studia Biologica* 9: 191–200, https://doi.org/10.30970/sbi.0901.392 [in Ukrainian with English summary]

Kvach Y, Kutsokon Y (2017) The non-indigenous fishes in the fauna of Ukraine: A potentia ad actum. *BioInvasions Records* 6: 269–279, https://doi.org/10.3391/bir.2017.6.3.13

Kvach Y, Dykyy I, Janko K (2016) First record of the Chinese sleeper, *Perccottus glenii* Dybowski, 1877 (Actinopterygii: Odontobutidae) in the Dnieper Estuary, southern Ukraine (Black Sea drainage). *BioInvasions Records* 5: 285–290, https://doi.org/10.3391/bir.2016.5.4.14

Kvach Y, Kutsokon I, Roman A, Čeirāns A, Pupins M, Kirjušina M (2020) Parasite acquisition by the invasive Chinese sleeper (*Perccottus glenii* Dybowski, 1877) (Gobiiformes: Odontobutidae) in Latvia and Ukraine. *Journal of Applied Ichthyology* 36: 785–794, https://doi.org/10.1111/jai.14100

Movchan YV (2011) Ryby Ukrainy [Fish of Ukraine]. Zoloti Vorota, Kyiv, 444 pp [in Ukrainian]

Nabatov AA (1914) Komnatnyi presnovodnyi akvarium [Home freshwater aquarium]. Akvarium, Petrograd, 660 pp [in Russian]

Panov VE, Alexandrov B, Arbačiauskas K, Binimelis R, Copp GH, Grabowski M, Lucy F, Leuven RSEW, Nehring S, Paunović M, Semenchenko V, Son MO (2009) Assessing the risks of aquatic species invasions via European inland waterways: from concepts to environmental indicators. *Integrated Environmental Assessment and Management* 5: 110–126, https://doi.org/10.1897/IEAM_2008-034.1

Pinchuk VI, Tkachenko PV (1996) Fish of sea waters. The vertebrate animals of Black Sea Reservation (annotated list of species). *Vestnik Zoologii* Suppl. 1: 5–14 [in Russian with English summary]

Popov IY (2014) New fish species in the Russian part of the Gulf of Finland and inland water bodies of St. Petersburg and Leningrad Oblast. *Russian Journal of Biological Invasions* 5: 90–98, https://doi.org/10.1134/S207511171402009X

Pupina A, Pupins M, Nekrasova O, Tytar V, Kozynenko I, Marushchak O (2018) Species distribution modelling: *Bombina bombina* (Linnaeus, 1761) and its important invasive threat *Perccottus glenii* (Dybowski, 1877) in Latvia under global climate change. *Environmental Research, Engineering and Management* 74: 79–86, https://doi.org/10.5755/j01.erem.74.4.21093

Rakauskas V, Masiulytė R, Pikūnienė A (2016) Predator-prey interactions between a recent invader, the Chinese sleeper (*Perccottus glenii*) and the European pond turtle (*Emys orbicularis*): a case study from Lithuania. *Acta Herpetologica* 11: 101–109, https://doi.org/10.13128/Acta_Herpetol-18261

Rau MA, Plavan G, Strungaru SA, Nicoara M, Rodriguez-Lozano P, Mihu-Pintilie A, Ureche D, Klimaszyk P (2017) The impact of Amur sleeper (*Perccottus glenii* Dybowsky, 1877) on the riverine ecosystem: food selectivity of Amur sleeper in a recently colonized river. *Oceanological and Hydrobiological Studies* 46: 96–107, https://doi.org/10.1515/ohs-2017-0010

Reshetnikov AN (2013) Spatio-temporal dynamics of the expansion of rotan *Perccottus glenii* from West-Ukrainian center of distribution and consequences for European freshwater ecosystems. *Aquatic Invasions* 8: 193–206, https://doi.org/10.3391/ai.2013.8.2.07

Rizevskiy VK, Plyuta MV, Ermolaev VV (1999) Morfologicheskaya kharakteristika rotana-goloveshki (*Percottus glehni* Dybowski) iz vodoyemov vodnoy sistemy Minska [Morphological description of the Chinese sleeper (*Perccottus glehni* Dybowski) from the waterbodies of Minsk municipal system]. *Vestsi Natsiyanalnay Akademii Navuk Belarusi, Serya Biyalagichnykh Navuk* 3: 119–121 [in Russian]

Sabodash VM, Tkachenko VA, Tsyba AA (2002) The *Perccottus glenii* (Pisces, Odontobutidae) population discovered in basins in Kyiv Region. *Vestnik Zoologii* 36(2): 90

Semenchenko V, Grabowska J, Grabowski M, Rizevsky V, Pluta M (2011) Non-native fish in Belarusian and Polish areas of the European central invasion corridor. *Oceanological and Hydrobiological Studies* 40: 57–67, https://doi.org/10.2478/s13545-011-0007-6

Semenchenko V, Son MO, Novitski R, Kvach Y, Panov VE (2016) Checklist of non-native benthic macroinvertebrates and fish in the Dnieper River basin. *BioInvasions Records* 5: 185–187, https://doi.org/10.3391/bir.2016.5.3.10

Snigirov S, Zamorov VV, Karavanskyi YV, Pitsyk VZ, Kurakin OP, Abakumov OM, Liumkis PV, Snigirov PM, Morozov YV, Kvach Y, Kutsokon I (2020) Taxonomic and eco-faunistic features of the nowadays fish fauna of the Gulf of Odesa, the Dniester mouth forefront near-shores and coastal waters of the Snake (Zmiinyi) Island. *Visnyk Odessa University, Seria Biology* 25: 113–139, https://doi.org/10.18524/2077-1746.2020.2(47).218060

Tkachenko PV (2001) Presnovodnye ryby za zonoy kontakta Dneprovsko-Bugskogo limana [Freshwater fish outsite the contact zone of the Dnieper-Bug Estuary]. *Rybne hospodarstvo* 59–60: 83–85 [in Russian]