Unwanted appearance of invasive species in the transboundary Irtysh river basin

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Abstract. This paper presents data on the size and weight characteristics of the Amur sleeper (Perccottus glenii) in floodplain reservoirs of the transboundary Irtysh river basin: Bezymyannoe Lake, Amalby Lake, Mangadaevo Lake (Yarkovsky District), and Andreevskoe Lake (Tyumen District) of the Tyumen Region.

1. Introduction
The Irtysh River is the largest tributary of the Ob River, it originates in the mountains of the Mongolian Altai, being called as “Black Irtysh,” flows until it flows into the Zaisan Lake, then it continues its way through China, Kazakhstan, Omsk, and Tyumen Regions. The area of the Irtysh basin is 1.64 million km², 0.52 million km², or about 32% of them are drainless areas [1].

The appearance of such an invasive species as the Perccottus glenii and Dybowski (1877) in the basin of the transboundary Irtysh river leads to undesirable consequences for the aboriginal structure of the ichthyofauna. Features of the Irtysh River basin and its floodplain reservoirs contribute to the penetration of a typical representative of alien ichthyofauna and the creation of sustainable Perccottus glenii populations. On the territory of the basin, a large number of dead lakes. They are well heated due to the shallow depth with stagnant water and an abundance of higher aquatic vegetation. These lakes are a typical habitat of native species, such as the silver and gold crucian carp, which are the only representatives of commercial ichthyofauna due to their high resistance to oxygen deficiency [2], [3], [4], [5], [6]. The Amur sleeper (Perccottus glenii) is well accustomed to these lakes and began to crowd out the local ichthyofauna [2], [6]. Because of its biological characteristics, in particular, undemanding to environmental factors of the environment, including oxygen content, and also due to the lack of a sufficient number of predators (pike, pike-perch, perch) and parasites characteristic of the natural range, the Amur sleeper expansively develops in water bodies and water courses [7-9].

The natural range of this species is the Amur region, Primorsky region, northeastern China and north Korea [10-12]. At the beginning of the twentieth century, he was introduced by aquarists to the European part of Russia, from where he actively settled in shallow reservoirs. In the basin of the Irtysh river, a “golovoshka” type of the Amur sleeper (Perccottus Clenii Dybowski) appeared relatively recently [13], [14].

The purpose of this work is to study the characteristics of a “golovoshka” type of the Amur sleeper (Perccottus Clenii Dybowski) from the water bodies of the basin of the transboundary Irtysh river.
2. Materials and Methods

The material was collected for research on the water bodies of the Irtysh River basin in the south of the Tyumen Region. In particular, we obtained our materials in the Yarkovsky District in 2011, 2016, and in the Bezymyanoye, Amalba and Mangadaevo Lakes in 2017, as well as in the Tyumen region of Andreevskoe Lake in 2015. The lakes are characterized by a high overgrowth of the higher aquatic vegetation. Trapping was done by fixed nets with different meshes. The size and age structures were determined, along with the sex composition. Studies of ichthyological materials were carried out according to standard ichthyological methods [15], [16]. Statistical data processing was carried out according to the standard data processing method [17].

3. Results

The age composition of our samples in catches of floodplain lakes was represented by individuals from 2/2+ to 6/6+. In the Bezymyannoe and Mangadaevo Lakes, the prevailed age groups was 2/2+ to 4/4+, as well as from 3/3+ to 5/5+ in Andreevskoe and Amalba Lakes (Table 1).

Table 1. The size and age structure of the Amur sleeper in floodplain water bodies of the Irtysh River basin.

| Lake, District, Date | Indicator | 2/2+ | 3/3+ | 4/4+ | 5/5+ | 6/6+ | Average Indicators |
|----------------------|-----------|------|------|------|------|------|-------------------|
| Bezymyannoye, Yarkovsky, Autumn 2011 | \(l_{\pm m}\), cm | 8.0±0.3 | 12.0±0.6 | 14.2±0.6 | 16.9 | 17.7 | 11.7±0.4 |
| | \(M_{\pm m}\), r | 16.3±2.7 | 52.6±5.7 | 76.1±7.5 | 126.3 | 145.5 | 52.6±4.3 |
| | \(CV_l/ CV_m\) | 23.3 / 83.2 | 32.0 / 73.3 | 21.9 / 49.5 | - | - | 34.3 / 82.1 |
| | n, instances | 26 | 46 | 25 | 3 | 1 | 101 |
| Andreevskoe, Tyumen, Autumn 2015 | \(l_{\pm m}\), cm | - | 12.6±0.1 | 13.3±0.1 | 15.7±0.4 | 18.5±1.4 | 14.3±0.3 |
| | \(M_{\pm m}\), r | - | 48.3±2.3 | 59.9±2.2 | 100.1±6.1 | 203.6±43.1 | 80.2±6.6 |
| | \(CV_l/ CV_m\) | 4.7 / 20.5 | 4.9 / 18.9 | 9.8 / 25.8 | 17.7 / 51.9 | 15.9 / 68.1 |
| | n, instances | - | 18 | 26 | 18 | 6 | 68 |
| Amalby, Yarkovsky, Spring 2016 | \(l_{\pm m}\), cm | 10.4 | 11.7±0.2 | 13.9±0.3 | 15.2±0.4 | 17.0 | 13.2±0.3 |
| | \(M_{\pm m}\), r | 34.3 | 47.1±2.4 | 82.6±5.6 | 107.3±9.5 | 154.1 | 71.9±4.6 |
| | \(CV_l/ CV_m\) | - | 8.3 / 24.3 | 7.8 / 27.8 | 8.1 / 26.6 | - | 13.9 / 45.6 |
| | n, instances | 1 | 22 | 17 | 9 | 1 | 50 |
| Mangadaevo, Yarkovsky, Autumn 2017 | \(l_{\pm m}\), cm | 9.7±0.04 | 12.6±0.1 | 15.2±0.07 | 15.9±0.49 | 18.7 | 12.4±0.36 |
| | \(M_{\pm m}\), r | 24.5±0.34 | 61.3±1.6 | 110.3±1.43 | 136.9±10.7 | 234.24 | 66.1±6.41 |
| | \(CV_l/ CV_m\) | 9.9 / 33.7 | 13.2 / 43.5 | 4.9 / 14.3 | 7.5 / 19.1 | - | 22.7 / 74.5 |
| | n, instances | 24 | 17 | 11 | 6 | 1 | 59 |

Note: “l” is the fishing length; “m.” is the average error; “M” is the total mass of fish; “n” is the number; “CV” is the coefficient of variation in length; “CVm” is the mass variation coefficient.

The ratio of females and males in the samples from the lakes was as follows: in Bezymyannoe Lake, 73 specimens are females out of 101 specimens, and 28 specimens are males; in Amalby Lake, out of 50 specimens, 30 specimens are females and 20 specimens are males. That is, in both lakes, females prevailed (72 and 60%, respectively).

In Andreevskoe Lake, out of the 60 Amur sleepers being captured, 27 specimens are males and 33 specimens are females. In Mangadaevo Lake, the proportion of males was 52.5% (31 specimens), with females of 47.5% (28 specimens), respectively. That is, the sex ratio is 1: 1. (Figure 1).
When comparing the size and weight characteristics of the Amur sleepers from the lakes, it can be seen that length variations in all age groups are within the same limits. The variability of signs along the length in all water bodies is weak or medium (CV<10%, 10%<CV<25%) with the exception of the age group 3 - 3+ of the Bezymyannoye Lake. Mass fluctuations begin with an age group of 4/4+. By mass, the variability is medium or high (CV>25%), especially in the Bezymyannoye Lake in age groups of 2/2+ and 3/3+, where CV is equal to 83.2 and 73.3%, respectively. This is due to the large variation in weight from 13.5 to 47.8 g (2/2+) and from 27.3 to 98.2 g (3/3+).

4. Discussion
The existence in the studied reservoir of different age groups of the Amur sleepers indicates its acclimatization to the conditions of the region and the process of penetration of this invasive species into the floodplain reservoirs of the Irtysh and Ob rivers and the rivers themselves, which is confirmed by literary data [18], [19].

Comparing our data with the data of other authors [20], [21], we note that the linear and weight characteristics of the Amur sleepers inhabiting floodplain water bodies of the Irtysh river are higher than those of natural habitat.

Since 2007, the inclusion of the Amur sleeper in the field statistics of the Tyumen region indicates an increase in the number of species. Since this year, this fish is included in the forecast of the size of the allowable catch of the species in the water bodies of the Tyumen region. The Amur sleeper became an ordinary representative of ichthyofauna of the Karas Lakes and such rivers as Pyshma, Tura, Iset, Irtysh [2], [9].

5. Conclusion
Thus, the naturalized in the floodplain waters of the transboundary Irtysh river basin of the Tyumen region. The main size and weight characteristics of this invasive species are relatively high compared to its natural range. A wide range of variation of these indicators indicates a high adaptive capacity, which leads to an increase in the number and inclusion in the field.

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