

# Morphological and biological characteristic as an indicator of population of the Siberian roach (*Rutilus rutilus lacustris*) from the Chulym river in the conditions of food competition with invasive species

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**ABSTRACT.** Biological invasions are the second most significant threat to biodiversity and native ecosystems, after direct destruction of habitats. Due to the mutual action of natural (climate change) and anthropogenic (the introduction of an alien species) factors, bleak was dispersed from the Novosibirsk reservoir to the nearest reservoirs. After sometime of the settlement of Bleak (*Alburnus alburnus*) along lower reaches of the Chulym river quality of the Siberian Roach (*Rutilus rutilus lacustris*) population in the zone of thermal pollution began to deteriorate. The analysis of the obtained data showed that the populations of roach living in the zone where the phenomenon of food competition is present and without it have significant differences in a number of morphological and biochemical indicators. It could be due to the presence of a competitive invasive species – bleak, which lives below dam of the Nazarovskaya SDPS. Thus, in the diet of a population where bleak is absent, many insects remains were found, while in the diet of the roach population, plant remains predominate, due to its competition with bleak for animal feed.

**Keywords:** Morphological characteristic, *Rutilus rutilus lacustris*, river ecosystems, food competition, invasive species

## 1. Introduction.

As a result of human activity, many reservoirs have undergone modifications of the natural ichthyocenosis by changing the habitats of many species - invade in new habitats. Biological invasions are the second most significant threat to biodiversity and native ecosystems, after direct destruction of habitats. The main danger of infestations of alien fish species is the reduction of populations of native commercial fish species. Due to greater plasticity, alien species can occupy a trophic niche like local species, thus entering competitive relations (Alimov et al., 2004).

Research on the impact of invasive species on native fauna is important from a fundamental point of view. Such works allow us to find out some aspects of interspecific relations between an indigenous species and an alien one. In addition, such research can have significant practical value. Thus, during the settlement of bleak in the lower reaches of the Chulym river since the 1990s, there has been a deterioration in the commercial quality of the population of Siberian

Roach (*Rutilus rutilus lacustris*) in this area, which may probably be associated with the appearance of this alien species (Perepelin et al., 2020). We assume that bleak, occupying the ecological niche of roach below the confluence of the heated waters of the discharge channel of the Nazarovskaya SDPS, affects the morpho-biological indicators of the roach population in this territory. In this paper, research is underway in the morpho-biological characteristics of Siberian roach in terms of food competition with an alien species on the example of two populations living in the Chulym river. The aim of the work was to study the morpho-biological characteristics of Siberian Roach from the Chulym river in competition with an alien species.

## 2. Materials and methods.

Samples were collected from the Chulym river, in the Krasnoyarsk region, in the area of Nazarovo 13 kilometers above fairway from confluence of the heated waters of the NSDPS discharge channel (56.046180, 90.457138) and in the area of Achinsk 248 kilometers

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**Table.** Morphological features of Siberian Roach of the middle course of the Chulym river (August 2019. Sample 1-to the dam of the NazarovskayaSDPS, sample 2 - the area of Achinsk).

Characteristic	Sample		U	P
	1	2		
Length withoutC, ad, mm	88.8±2.9	154.8±2.4	0.0	<b>0.0000</b>
<b>% body length</b>				
Snoutlength, an	5.4±0.1	5.0±0.0	0.0	<b>0.0000</b>
Eyediameter, np	6.1±0.1	5.3±0.0	0.0	<b>0.0000</b>
Occlusal part of the head, po	8.8±0.1	9.9±0.1	33.0	<b>0.0000</b>
Head length, ao	19.6±0.1	19.0±0.1	76.0	<b>0.0000</b>
Headheight at the back of the head, lm	14.9±0.1	14.3±0.1	109.0	<b>0.0000</b>
Forehead width	7.3±0.1	6.8±0.0	40.0	<b>0.0000</b>
Maximum body height, gh	21.6±0.2	24.2±0.2	25.0	<b>0.0000</b>
Minimumbody height, jk	7.6±0.1	8.0±0.1	166.0	<b>0.0011</b>
Antedorsaldistance, aq	43.7±0.2	43.3±0.2	204.0	<b>0.0092</b>
Postdorsaldistance, rd	28.3±0.2	31.6±0.2	2.0	<b>0.0000</b>
Caudal peduncle length, fd	13.5±0.2	15.0±0.2	97.0	<b>0.0000</b>
Base of dorsal fin length, qs	11.2±0.3	12.2±0.1	160.5	<b>0.0007</b>
Maximum dorsal fin height, tu	18.3±0.3	18.4±0.1	233.0	<b>0.0362</b>
Base of anal fin length, yy1	10.6±0.2	9.2±0.1	55.5	<b>0.0000</b>
Maximum anal fin height, ej	12.5±0.2	12.3±0.1	351.5	0.9930
Pectoral fin length, vx	14.4±0.2	15.7±0.1	118.0	<b>0.0000</b>
Ventral fin length, zz1	13.8±0.2	15.1±0.1	90.0	<b>0.0000</b>
Pectoral and ventral fin distance, vz	21.0 ±0.2	22.9±0.2	34.0	<b>0.0000</b>
Ventral and anal fin distance. zy	18.1±0.2	21.0±0.1	19.0	<b>0.0000</b>
<b>% head length</b>				
Snout length, an	27.6±0.3	26.4±0.1	174.0	<b>0.0017</b>
Eye diameter, np	31.3±0.5	27.9±0.2	30.0	<b>0.0000</b>
Forehead width	37.4±0.4	35.7±0.1	155.5	<b>0.0005</b>

below fairway from confluence of the heated waters of the NSDPS discharge channel (56.294780, 90.495174) where thermal pollution has already been dispersed. In the process of collecting material 76 individuals of Siberian Roach were selected. 22 individuals were collected in the area of the Chulym river above the NSDPS dam, without thermal pollution. 34 individuals were collected 248 kilometers below confluence of the heated waters of the NSPDS discharge channel, in the area of Achinsk.

Fishes were collected by using hook tackle. The samples were analyzed by using morphometry to determine meristic (quantitative) and plastic (qualitative) characteristics specifically for cyprinid fish (Pravdin, 1966). All individuals were measured by using a caliper along the lines of measurements with an error of 0.05 mm. 7 individuals were frozen for subsequent muscle analysis, and 69 were formaline-fixed. All the measured individuals were dissected to determine fat content by using the Prozorovskaya method (Nikolsky, 1974) and to count the stamens on the gill arches. Stomachs were seized from 30 individuals to study the food supply. Scales were also collected and registered in scale books, where information about all opened and measured individuals of roach was entered. Statistical processing was performed using standard methods: the normality of the distribution

according to the Kolmogorov-Smirnov criterion, the confidence score was determined by the Mann-Whitney criterion. Descriptive statistics was used to characterize the material, average values and standard errors of the average SD were calculated for all indicators. The multivariate principal component analysis (PCA) was performed to determine the morphological parameters that make the greatest contribution to the differences in the studied samples.

### 3. Results and discussion.

There were no statistically significant differences in morphological characteristic of males and females individuals within the same sample. Both samples of Siberian Roach have significant differences for most of the morphological parameters (table 1). In order to exclude age influence on parameters, a similar analysis was also performed for individuals of the same age from both populations. The main differences between populations were mass and size. Probably, the reason for such differences could be the difference in the food supply. A study of the composition of stomach contents and biomarker fatty acids was conducted, which showed the use of different food sources by these populations of roach. Thus, in the diet of the roach population where bleak was absent, many insects remains were found,

while in the diet of the roach population cohabitating with an alien species, plant remains predominate, due to its competition with bleak for animal feed. This is probably because bleak has occupied the roach's food niche, thus forcing it to switch to more affordable plant food.

#### **4. Conclusions**

As the result of the analysis of morphological indicators, a distinction was established between a population without the invasive species and a population where the invasive species are present. During the analysis of the Siberian Roach diet, it was found that the diet of roach living without of food competition with the invasive species contains a large number of insects and benthic, when roach living in the conditions of food competition in the diet contains much more plant food.

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