Morphobiological and Ecological Characteristics of the Common Perch (Perca fluviatilis L.) in the Sub-Dam Zone of the Krasnodar Reservoir

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Abstract. This paper presents the results of a study of common perch (Perca fluviatilis L.) growth in the Pashkovsky floodplains below the dam of the Krasnodar Reservoir in the autumn of 2025. Based on the biological and ecological characteristics of common perch specimens caught with recreational fishing gear, data on the age and sex structure of the population, size and weight characteristics are presented, and the growth rates of the different sexes of the perch are analyzed. It was found that the proportion of females with reproductive products in recreational float fishing catches is 31.0%. The food chains of common perch in the predatory stage of development in the Pashkovsky floodplains are examined. Based on the data obtained, the maximum sizes and weights of common perch of both sexes inhabiting the Pashkovsky floodplains below the dam of the Krasnodar Reservoir are estimated.

1 Introduction

The common perch (Perca fluviatilis Linnaeus, 1758) is one of the most widespread freshwater fish in Russia, as well as on the European continent [1]. In the Krasnodar Territory, the common perch is found in large numbers in freshwater bodies of the Kuban River basin and the Azov estuaries. Leading a predatory lifestyle and being practically omnivorous, the common perch controls the growth of the population of peaceful fish, eating both the young of valuable fish and low-grade ordinary fish species. In addition to its negative qualities for the fish farming industry, the perch is one of the main objects of sport and recreational fishing and is caught in significant quantities by amateur anglers. The biology and ecology of the common perch in the under-dam zone of the Krasnodar Reservoir have been virtually unstudied. Available data on the biological characteristics of the common perch in the Kuban River basin in the literature are quite contradictory. Thus,

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the maximum weight characteristics for common perch in the basins of the Krasnodar Territory are systematically reduced in authoritative literary sources, and for the oldest documented data they are 1500 g, but for the most recent data from 800 to 1200 g or 1100 g [1-3]. However, there are no exact data on the maximum sizes of common perch from the Kuban River basin.

2 Material and methods

The objective of the study was to investigate the biological characteristics of the common perch population living in the under-dam zone of the Krasnodar Reservoir within the city limits of Krasnodar, in the so-called Pashkovsky floodplains, based on an analysis of catches by recreational fishing gear using live bait. The Pashkovsky floodplains, located within the city limits of Krasnodar (Fig. 1, map), are the old channel of the Kuban River prior to the construction of the Krasnodar Reservoir dam, and represent a right-bank bay within the current Kuban River channel after the dam. In terms of hydrochemical and hydrological components, the conditions in the Pashkovsky floodplains are similar to the modern Kuban River channel due to intensive water exchange. Hydrologically, the Pashkovsky floodplains are a shallow bay with a maximum depth of 2.5-2.6 meters in June (maximum depth of approximately 1.5-1.6 meters in September-October). They have a sandy-silty bottom with well-developed higher aquatic vegetation in the upper part and a stream with a depth of 20 to 60 cm flowing into the headwaters, originating from the base of the Krasnodar Reservoir dam. In winter, the Pashkovsky floodplains are covered with ice, with a maximum thickness of 110-130 mm measured by us, for a total of 12 to 18 days over three winter months, depending on weather conditions.

Fig. 1. Map of the under-dam section of the Kuban River indicating the catch zone for ichthyological material.

Fishing material for analysis was collected in the autumn of 2025, from September 20 to November 10. A total of 85 common perch specimens were caught using float rods with a single #6 hook (according to the national classification) and live juveniles of small carp (bleak, sunbleak, roach, and white bream) with a full length of 35-70 mm. These specimens

were caught in the coastal zone at fishing sites using a 5-mm mesh minnow net. To eliminate selective fishing, telescopic rods with 4.5-5.5-meter reels were used, allowing for fishing within a range of 7-12 meters from the edge of the water and 6-10 meters from coastal vegetation. Food boluses from 55 of the largest common perch specimens, weighing over 30 grams, were also analyzed. Ichthyological material was processed using generally accepted standard methods for measuring length according to Smith, total length, and fish weight. Linear-mass growth indices were determined using an instrumental measuring ruler, with an accuracy of 0.1 mm, and electronic scales with a 0.1-gram resolution. Fish age was determined using gill covers using the method of N.I. Chugunova and in accordance with recommendations in [5-6].

3 Results

As is known, the average size of common perch in Krasnodar Territory waters does not exceed 20–25 cm, and the maximum sizes recorded for the Kuban River basin in Krasnodar Territory are up to 36 cm in full length, according to the most recent literature data. The research suggests that common perch forms two races in the Azov estuaries: a small-sized reed perch (with a bluish body colour) and a large-sized deep-water perch (with a greenish body colour) [2-4].

The work indicates that the linear and mass growth of individuals of the common perch living in the Akhtarsky estuary of the Krasnodar Territory is gradual, without sharp jumps, however, the data are provided only up to the age group 5+ with a maximum weight of individuals of 226.5 g for the year 2018. These data [9] also show that upon reaching the age of 5+, the growth rate of individuals of the common perch in the Akhtarsky estuary slows down significantly.

The age structure of the common perch specimens we caught varied from one-year-olds to five-year-olds, with the proportion of older ages systematically decreasing (Fig. 2). This is likely due to both natural mortality and recreational fishing of large common perch specimens in this location by residents of Krasnodar. The group we caught was dominated by one-year-olds with a standard length of 93 to 118 mm and a body weight of 16 to 26 g. This agrees well with data from a study analyzing the age composition of common perch from 38 lakes in Poland, which indicated that common perch specimens with an average full length of approximately 120 mm and a body weight of 30-40 g predominate [2].

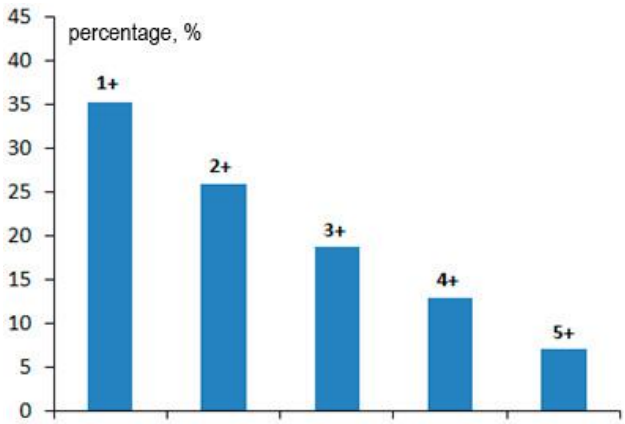

Fig. 2. Age structure of the studied sample of common perch from the Pashkovsky floodplain.

As is known, due to its wide geographic distribution, there are significant differences in the growth rates and timing of sexual maturity of the common perch. It is also known that the growth rate of the common perch is highly dependent on the state of the food supply in the reservoir, the presence and quantity of competitors in the diet, the depth of the reservoir and the average water temperature in it [3-5]. Thus, slow-growing populations of the common perch live in shallow lakes with little food, especially with regard to small-sized food fish. In the situation with reservoirs with an extensive food supply, especially with a large number of juvenile carp fish, and the presence of nutrients at a sufficiently great depth of the reservoir, the growth rate of the common perch can be significant It is also known that the growth rate of the common perch is associated with the genetic characteristics of its population [3].

It is known that the transition of the common perch to feeding on young fish, according to various sources, occurs in European waters when the full length reaches more than 110 mm in the second year of life, and in Turkish Ladik Lake at a length of more than 140 mm, whereas in Swedish lakes this transition to predation occurs at a full length of more than 60 mm, and in Siberian waters this transition is often observed at a full length of individuals over 30 mm. According to our data, in the under-dam zone of the Krasnodar Reservoir, the common perch switches to pronounced predation in the middle of the second year of life at a standard length of more than 90 mm. At the same time, according to our data, the consumption of food fish by the common perch decreases in the order of their occurrence in food boluses: common bleak *(Alburnus alburnus)* > sunbleak *(Leucaspius delineatus)* >> roach *(Rutilus rutilus)* > white bream *(Blicca bjoerkna)* > small specimens of gobies of different species *(Neogobius fluviatilis, Neogobius syrman, Knipowitschia caucasica)*. It is worth noting that in Lake Ladik, Turkey, the preferred fish food of the common perch is rudd and, less commonly, white bream, whereas in our study, the rudd was not found in the food boluses of the fish examined, although it inhabits the grassy zone of the Pashkovsky floodplains in significant numbers. A probable explanation for this observation lies in the morphological features of the common perch's prey. It is known that in piscivorous fish, such as the common perch, there is a close relationship between the height/girth of the prey's body and the size of the predator's gaping mouth, and the shape and size of the predator's mouth determine the type and size of the prey swallowed. Based on this concept, it can be assumed that it is the native small, agile carp fish (common bleak and sunbleak) that are the main food for the common perch in the Pashkovsky floodplains, since swallowing full-bodied yearlings and two-year-olds of common crucian carp, rudd or common ruff for perches with a body size of less than 130 mm and a weight of less than 50 g is difficult and practically impossible [2-4].

Despite the common perch's cohabitation in sandbanks, clay pits, and grassy backwaters of the Pashkovsky floodplains with the common ruff *(Gymnocephalus cernuus)*, crucian carp *(Carassius carassius)*, silver carp *(Carassius gibelio)*, and rudd (Scardinius erythrophthalmus), according to our data, these fish are not prey for common perch in this local environment. No cases of cannibalism were observed among the common perch specimens we studied, based on food bolus analysis and the observed lack of bites on juvenile perch measuring 35-48 mm in size across multiple experiments. Since the intensity of intraspecific cannibalism for common perch varies depending on its population size, it can be concluded that there is no overpopulation in the common perch population in the Pashkovsky floodplains. Furthermore, we hypothesize that the observed significant food resource base in the form of fattening carp fry significantly reduces the likelihood of intraspecific cannibalism for common perch in the Pashkovsky floodplains [3-5].

In our opinion, the food competitors of adult common perch in the under-dam zone of the Krasnodar Reservoir are, in order of importance: asp *(Aspius aspius)* > pike *(Esox lucius)* > pike-perch *(Sander lucioperca)* > large gobies of various species *(Neogobius*

syrman, Neogobius fluviatilis, Neogobius melanostomus). According to our observations, juvenile common asp fatten intensively during the autumn months in the Pashkovsky floodplains and consume large quantities of common bleak and sunbleak found there. This is manifested in the form of the joint feeding of schools of common asp and common perch, which we have repeatedly observed. Schools of asp occupy the upper water horizon up to 50-60 cm, while groups of perch from the lower horizon of 60-100 cm push the school of prey upward, consuming them.

The relationship between the mass and body length of immature individuals, males and females of common perch in the Pashkovsky floodplains is shown in Figure 3.

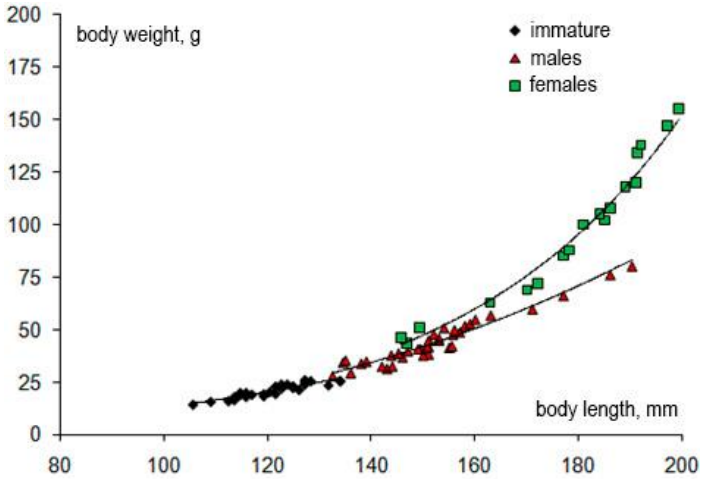

Fig. 3. The relationship between the weight and body length of immature individuals, males and females of the common perch in the Pashkovsky floodplains.

The data in Figure 3 clearly demonstrates pronounced sexual dimorphism in the common perch population we studied. Upon reaching sexual maturity, female common perch exhibit more intense growth and efficient weight gain.

Table 1 presents the total body length as a morphological feature for the studied part of the common perch population from the Pashkovsky floodplains, broken down into different age groups.

Table 1. Total body length (mm) for the studied part of the common perch population from the Pashkovsky floodplains (N = 85).

Age, years	Min-Max	L_{cp}	σ	CV, %
1+ (immature individuals)	105.7-134.0	121.0	7.1	5.87
males				
2+	132.9-154.6	145.3	6.8	4.68
3+	151.1-158.2	154.4	2.4	1.55
4+	159.1-177.1	166.0	7.8	4.67
5+	186.0-190.2	188.1	3.0	1.58
females				
2+	147.1-149.4	147.5	1.9	1.29
3+	162.9-178.1	172.0	6.1	3.55
4+	180.8-191.1	186.1	3.7	1.97
5+	191.2-199.3	194.9	3.9	2.01

Table 1 shows that variations in the total body length of common perch from the Pashkovsky floodplains area across age groups were insignificant. The coefficient of variation (CV) for body length did not exceed 4.68% for mature individuals.

Table 2 presents body weight as a morphological trait for the studied population of common perch from the Pashkovsky floodplains area, broken down by age group.

It is believed that female common perch become sexually mature and ready for their first spawning as early as three to four years of age, while males are ready to produce reproductive products as early as their second year of life. We caught 40 male and 18 female common perch with reproductive products, resulting in a 31.0% proportion of females with reproductive products relative to males with milt [3-5].

Table 2. Morphological characteristics of body weight (g) for the studied part of the common perch population from the Pashkovsky floodplains (N = 85).

Age, (t)	Min-Max	m_{cp}	σ	Cv, %
1+ (immature individuals)	14.5-25.8	21.1	3.2	15.31
males				
2+	28.1-42.4	36.9	4.3	11.70
3+	45.2-52.3	48.3	2.5	5.07
4+	53.1-66.4	58.4	5.2	8.88
5+	76.4-80.5	78.5	3.7	2.91
females				
2+	43.5-50.9	46.8	3.8	8.04
3+	62.9-87.7	75.7	10.4	13.78
4+	99.8-120.2	108.8	8.5	7.76
5+	134.1-154.8	143.5	9.3	6.47

It was found that in the under-dam zone of the Krasnodar Reservoir, male common perch were largely sexually mature at age 2+, while females were mostly sexually mature at age 3+. However, three small, sexually mature females at age 2+ were also found. The actual age of sexual maturity in common perch is known to vary greatly depending on its growth rate, with slower-growing populations requiring longer to reach maturity. According to our data, in the conditions of the under-dam zone of the Krasnodar reservoir, male common perch become sexually mature at a body length of more than 117 mm and upon reaching a weight of more than 27 g, and females at a body length of more than 125 mm and upon reaching a weight of more than 40 g. These data are close to similar characteristics of reaching sexual maturity of common perch for reservoirs of the lower Ob and southern Transbaikalia and for lakes in Sweden [4-6].

The relatively low proportion of female common perch caught by us is unexpected, since authoritative data on the predominance of the proportion of sexually mature females in common perch populations has been repeatedly cited. However, it is known that, according to various data, at the sexually mature age of 3 to 10 years, the mortality rate for male common perch is more than 2-3 times higher than that for females, which may in turn characterize the increased caution of female common perch compared to their male counterparts. In our view, this important defense mechanism allows female common perch to survive under the high fishing pressure observed in urban waters. Furthermore, observations show that, due to their larger size and body weight, females inhabit the deeper zone of the Pashkovsky floodplains, which is more difficult to fish, reducing the likelihood of catching them with float and spinning tackle. Furthermore, underwater video camera observations of common perch attacks on carp fry revealed a significantly higher linear movement speed (>1.3 times) for smaller, more agile male common perch compared to their larger, slower female counterparts. Therefore, we have repeatedly observed situations

where more agile male common perch in the fishing area were able to attack fry on the fishing gear faster than nearby females [5-7].

On the other hand, the repeated heavy spinning fishing we observed in the Pashkovsky floodplains area, targeting large perch using silicone lures and spoons ranging from 45 to 70 mm in length, may lead to a sharp decline in the proportion of female common perch in the population, as they constitute the largest portion of recreational catches. Therefore, the sex ratio in a reservoir subject to fishing pressure in the form of frequent spinning may become equal or even shift in favor of males among fish of "sufficient culinary size," as recreational anglers capture almost all the large females they catch, while smaller males, caught as bycatch, are released back into the water.

We did not detect the possible presence of representatives of two size-distinct populations of common perch in the Pashkovsky floodplains. However, on the same days of fishing in the same areas, we observed individuals of similar size, both with a bright greenish body coloration and distinct stripes, and with a bluish body coloration, and, less commonly, fish with a sandy-greenish coloration and indistinct stripes. This is likely an example of manifestation of adaptive camouflage coloration of the common perch, which inhabit different parts of the reservoir with different bottom types and colors, varying levels of illumination, and the presence or absence of aquatic vegetation.

It is known that the physiological optimum temperature for the growth of common perch lies in the range of 20-28°C. It has also been previously shown that in Russia, common perch grows most rapidly in the Volga Delta and in the lower reaches of the Dnieper, where the frost-free period lasts about 250 days per year, and grows much more slowly in the cold waters of Karelia and the Kola Peninsula, in Lake Chudskoye and the Ivankovskoye Reservoir, where the frost-free period is about 100 days per year. According to available meteorological data, for the under-dam zone of the Krasnodar Reservoir, the frost-free period in recent years has lasted about 210-226 days per year, which probably partially explains the average growth rates of common perch in this hydrological section of the Kuban River, despite a fairly extensive food supply [7-9].

According to our data, with increasing age of the specimens of common perch studied by us, the rate of linear growth of these fish slows down at 3-4 years of age, which is most likely associated with the onset of sexual maturity, as a result of which a large amount of energy obtained from food is spent on the maturation of reproductive products. In addition, it has been shown that for common perch, with an increase in its body mass, the optimal water temperature for development progressively decreases due to the required content of dissolved oxygen in the water necessary for respiration, which likely partially explains the decrease in growth rates with age of common perch under the conditions of the hot months of summer and September in the area of the city of Krasnodar. It is also known that large specimens of common perch require depths of more than 2.5-3.5 meters with cool water, which is not found in the waters of the shallow Pashkovsky floodplains [8-10].

Using the available data, we calculated the Fulton's condition factor (K) as an indicator for assessing the condition (fatness) of the studied perch specimens in different age groups, based on the fish total length and weight. The resulting calculated data are presented in Table 3.

Table 3. Distribution of the Fulton's condition factor by age group for common perch from the Pashkovsky floodplains ($\alpha = 0.95$).

Age, (t)	immature individuals	males	females	females (adjusted)
1+	1.74±0.11	–	–	–
2+	–	1.80±0.14	2.33±0.11	2.17±0.09
3+	–	1.94±0.08	2.38±0.10	2.33±0.09
4+	–	1.87±0.11	2.78±0.04	2.61±0.04
5+	–	1.71±0.03	3.11±0.02	2.91±0.02

4 Discussions

According to the obtained data, sexual dimorphism of the common perch from the Pashkovsky floodplains is clearly reflected in its morphobiological characteristics of growth and fatness after reaching sexual maturity, which is consistent with the data of [11-13]. For example, it is assumed that after reaching sexual maturity, females grow 20% faster and reach significantly larger sizes than males [11]. According to our data, with practically the same length as males, female common perch in the autumn period at the age of 3+/4+ are characterized by a larger weight by 42-55% and a fatness coefficient that is one and a half times higher, which is in good agreement with the data of the work [28], in which female common perch of 5 years of age are characterized by a weight almost 50% greater than that of males of the same age.

According to the data in Table 3, the common perch inhabiting the Pashkovsky floodplains is characterized by a fairly high body condition. Female common perch are known to be characterized by greater body condition [11-13] and have a higher degree of obesity than males, especially in the presence of eggs. The determined mass fraction of eggs in large female perch in the first ten days of November 2025 was 6.96±0.78% (mass), decreasing from 7.29% for large females to 5.89% for small females. In accordance with this figure, the adjusted values of the Fulton coefficient for the studied female common perch were calculated (given in the far right column of Table 2). However, it should be noted that a comparison of the Fulton coefficient for males and females of common perch, even from the same population, is not entirely correct, since after reaching the age of 4+, females are characterized as fish with a deeper body (14-17% greater height) compared to slender males of similar length. In general, the values of the Fulton condition coefficient determined by us for males of common perch are in the range from 1.71 to 1.94 and for females of common perch in the range from 2.33 to 3.12, which is in good agreement with the literature values of K = 2.00±0.33 for individuals of common perch inhabiting the Temirtau Reservoir (Kazakhstan), and the range of K of 1.62-2.22 for common perch from water bodies of the middle Dnieper basin [14].

A noticeable decline in body condition among male common perch in older age groups is observed. We hypothesize that the observed age-related emaciation of male common perch, primarily those living in the grassy coastal zone, is due to anthropogenic pollution of the reservoir by discharge water from the nearby Teuchezhsky Building Materials Plant. This wastewater from the industrial site contains large amounts of dissolved and precipitated iron. Following this discharge into the reservoir, within a radius of less than 7-10 meters from the discharge source (a spillway), with a plume of orange iron oxyhydroxides, common perch were not caught for several days. In addition, we found fragments of yellow "Tanta/leech" type silicone fishing lures in the stomachs of some medium-sized and large male common perch (4 cases out of 7 specimens), indicating the negative role of recreational spinning fishing using so-called "mormyshing" (jigging) in this area, even using the popular "catch-and-release" approach. Furthermore, it is known that female common perch live longer than males for both behavioral and genetic reasons. In a classic study, Le Cren noted that among large and old specimens of common perch, females almost exclusively predominate, while males rarely survive to an age of 7+ years and a full length exceeding 250 mm [15].

5 Conclusions

According to the data we obtained on the growth rates of males and females of common perch in the Pashkovky floodplains of the under-dam zone of the Krasnodar Reservoir, using the Le Cres method, it can be estimated that in these less than favorable ecological

and hydrological habitat conditions in the autumn, males of common perch can, at a maximum calculated age of 15 years, theoretically reach a weight of up to 260±7 g, and females – a weight of up to 1350±97 g, with a maximum body length of 293±4 mm. These figures, especially for the predicted weight, should be considered optimistic, since the approach used does not take into account the aging processes of female common perch individuals, reflected in a decrease in the rate of mass accumulation upon reaching an age of over 7-8 years. Nevertheless, our estimates of the maximum size and weight characteristics of perch from the Pashkovsky floodplains are in good agreement with known early data on the maximum sizes of common perch in the reservoirs of the Krasnodar Territory.

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