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Age and growth of pike-perch (*Sander lucioperca* (L.)) in Tudakul reservoir, Uzbekistan

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Abstract

A study was carried out from November 2011 to October 2012 in Tudakul reservoir, Uzbekistan. A total of 178 pike-perch, *Sander lucioperca* (Linnaeus, 1758), were sampled including 81 females and 97 males. The ages, total lengths and weights of the samples ranged between 1 to 6 years, 25 to 74 cm and 72 to 4.945 g, respectively. The relation between the total length (TL) and weight (W) was described by equation $W = 0.003 * TL^{3.2639}$ ($r=0.99$). The relationship between the total length (TL) and the standard length (SL) was described by linear equation: $TL = 1.0885 * SL + 2.1825$ ($r = 0.99$). The mean back calculated total length was 26.4 cm at age I; 44.5 cm, II; 53.4 cm, III; 67.4 cm, IV; 70.4 cm, V; 76.2 cm, VI. R. Lee's phenomenon was not manifested as the fishing company is oriented to the catches of large fish.

Keywords: Pike-perch, *Sander lucioperca* (L.), age estimation, back calculation, growth

1. Introduction

Pike-perch, *Sander lucioperca* (L.), is one of the most important fish species as for commercial fisheries, so for recreational and Amudarya rivers. From the River Amudarya pike-perch has spread into the River Zarafshan through Amu-Bukhara channel including the Tudakul reservoir in 1960-1970 s. Many aspects of pike-perch biology were studied in reservoirs of the River Zarafshan [1, 2]. But those data were obtained in 1980-1990s. The study of age and growth is essential for fisheries and management. Age and growth provides information on the productivity of a stock and at what rate it can be sustainably harvested. The ageing of fish from calcified structures is in important tool in fisheries sciences. Age can be reliably estimated by examining calcified structures such as fin rays, vertebrae, opercular bones and others; scale is one of such calcified structure. Pike-perch is scaled fish [3-7].

Tudakul reservoir is one of the most important water bodies for fisheries in Uzbekistan. It was created for water storage and transition in the lower stream of Zerafshan River, Uzbekistan (39°51'15"N 64°50'29"E) (Fig. 1).

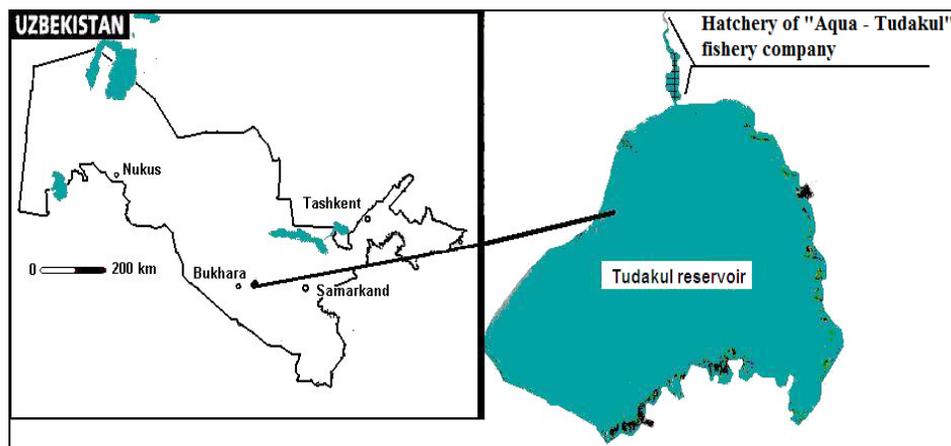


Fig. 1: Tudakul reservoir, Uzbekistan

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This is an arid zone with an extremely continental temporary climate. Summer is hot (average monthly air temperature is about 29 °C in July, it often reaches 35-42 °C in daytime and can be even higher). Winter is rather cold (average monthly temperature is -2 °C in January, water bodies with stagnant water are often covered with ice for up to 1.5 months). The total area of reservoir is 22.000 ha, the average depth is about 5 m, the maximal depth, 22 m. Pike-perch is one of the most important species in capturing in this water body. The goal of this research was to study the age and growth of pike-perch in Tudakul reservoir.

2. Materials and Methods

Fish samples were collected every 15 days from November 2011 to October 2012 from Tudakul reservoir by using gill nets with 24, 32, 36, 40, 50, 60, 70, 90, 100, 110 and 120 mm in mesh size.

The total length (TL) to the nearest 1 mm and body weight (W) to the nearest 1 g were recorded for each fish. Because standard length (without caudal fin) was the main body size parameter in the former USSR, its relationship with total length was studied. Standard length (SL) was also measured to the nearest 1 mm for each fish.

Scales were taken from the area in the mid-part of the body above the lateral line, just behind the first ray of dorsal fin. Scales were cleaned in water and examined under a binocular microscope for age determination. The ageing was made according to the number of annuli developed on the scales. The growth was determined by back-calculation from scale measurements made under a microscope fitted with an eyepiece graticule according to Lea-Freser method using radii of winter rings measured from the focus [5]. Back-calculations were made individually; then values were averaged and growth by year-class-strengths were studied on the obtained data.

The length-weight relationship was determined according to the equation given by Ricker (1975): $W = a \times TL^b$, where W = fish weight in grams, TL = total length in centimeters, 'a' and 'b' are constants.

3. Results

A total of 178 pike-perch were sampled including 81 females and 97 males. The overall sex ratio between females and males was 1:1.19. The ages, total length and weight of the samples ranged between 1 to 6 years, 25 to 74 cm and 72 to 4.945 g, respectively. There were no significant differences between lengths of the fish of different sexes, so all of calculations were made using combined date (female + male). The relation between total length and weight were plotted for combined sexes (Fig. 2).

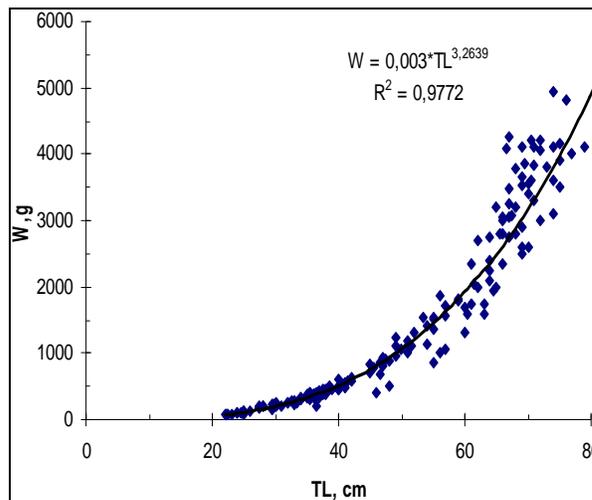


Fig. 2: Relationship between body weight (W) and total length (TL) of pike-perch in Tudakul reservoir, Uzbekistan

The relationship between the total length and standard length was described by linear equation: $TL = 1.0885 \times SL + 2.1825$ ($r = 0.998$; $n = 178$).

The observed mean lengths and weights of different ages of pike-perch carp are given in Table 1.

Table 1: Mean length (TL) and weight (W) of pike-perch by age groups (Min – Max / Mean)

	Age groups					
	I	II	III	IV	V	VI
TL (cm)	$\frac{22 - 48}{32.6}$	$\frac{27.5 - 54}{40.7}$	$\frac{37.5 - 65}{53.9}$	$\frac{59 - 76}{69}$	$\frac{62 - 75}{68.4}$	$\frac{70.5 - 81}{76.9}$
W (g)	$\frac{72 - 570}{273.8}$	$\frac{200 - 3100}{956.4}$	$\frac{445 - 3665}{1471}$	$\frac{1820 - 4945}{3476}$	$\frac{2705 - 4110}{3379}$	$\frac{3600 - 4200}{3975}$
Fish number	33	77	20	34	5	6

Back-calculated growth of pike-perch is given in Table 2. Phenomenon of R. Lee was not manifested.

Table 2: The mean calculated total length (cm) determined by back-calculation method according to age groups of pike-perch (males and females combined)

Year class	Age group	Number fish	Back-calculated length according to age group					
			I	II	III	IV	V	VI
2011	I	33	26,24					
2010	II	77	26,13	43,11				
2009	III	20	25,26	42,35	52,80			
2008	IV	34	28,31	50,29	63,14	69,23		
2007	V	5	23,41	37,23	50,40	61,07	68,25	
2006	VI	6	26,24	41,48	54,76	62,05	72,17	76,20
Mean total length			26,40	44,45	53,35	67,37	70,39	76,20
Mean annual increment			26,40	18,05	8,90	14,02	3,02	5,81

4. Discussion

Pike-perch is important species in an fish capturing in Uzbekistan and, in particular, in Tudakul reservoir. Since 2003 “Aqua-Tudakul” Fisheries Company has begun development of culture based fisheries project in that water body. Fisheries management has been using regular stocking of common carp (*Cyprinus carpio* Linnaeus, 1759) with the density 19-150 (70 in average), silver carp (*Hypophthalmichthys molitrix* (Valenciennes, 1844)), 5-33 (12), bighead carp (*H. nobilis* (Richardson, 1845)), 5-33 (12), and grass carp (*Ctenopharyngodon idella* (Valenciennes, 1844)) 3-28 (15) summerlings per ha since 2004. The size of summerlings of different species was 74 – 154 g in average in different years. The idea was to produce bigger carps (of more than 1.5 kg), so they would not compete with cultured carps from aquaculture ponds (0.5-1.5 kg) and be more valuable at the same time. One of the decisions was to use only seine-nets (with large meshes, more than 70 mm) in reservoir. Such catch regime has impacted stocks of local wild fish populations including pike-perch. Proper fishing techniques and following the fishing restrictions exclude fishing of immature pike-perch with small size in the reservoir. It is

fruitful base for pike-perch production. Pike-perch annual catches have increased from 2.4 – 5.6 tons in 1994-2003 up to 163.7 tons in 2006; 377.8 tons in 2011 in Tudakul reservoir^[8]. Fish ageing and growth study provide robust estimates of individual and population growth variables under environments in different ecosystems or management manipulations^[6, 7]. Pike-perch matures at III-IV year when the body weight is 600-900 g, total length is 21-23 cm for both sexes in Tudakul reservoir^[9, 10]. Our results show that at present pike-perch generations at age 1 - 4 years are abundant (19-44% each) in population structure in the reservoir (Table 1). In a fish population, if the age composition has a wide range, it indicates that this population has a sufficient food supply and favorable environment^[11].

There were no significant sexual differences in fish growth of pike-perch in Tudakul reservoir.

Comparison of pike-perch growth rates in different parts of species area provides with useful information. In many-years studies, length without tail was used to estimate growth parameters of inland fishes including silver carp in the former-USSR, and the total length in many other countries (Table 3).

Table 3: Growth of silver carp in different regions

Region	Length*	Mean length in each age (cm)								Authors
		I	II	III	IV	V	VI	VII	VIII	
Talimardjan reservoir, Uzbekistan	SL	17.3	28.8	38.3	44.1	48.6	51.6			[1]
Yujnosurk-han reservoir, Uzbekistan	SL	22.5	35.5	43.4	51.7	59.7				[1]
Lake Stzetch, Hungary	SL	17.1	26.7	34	40.6	46.9	53	55.9		[12]
Lake Eğirdir, Turkey	TL	18.5	24.7	30.4						[13]
Gulf of Finland	TL	-	18.8	25.8	31.9	38.2	40	41.6	44.2	[14]
Lake Ivösjön, Sweden	TL	13.8	24.8	35.2	44.2	51.1	57	63.5	67.7	[15]
Gravel pit Créteil, France	TL	9.1	20.1	31.6	41.7	49.1	54.6	59.5		[16]
Vaccares la-noon, Fran-ce	TL	23	42.5	51.5	59	66	71			[17]
Lake Peipsi, Estonia	TL	12.7	20.7	28.8	36.7	43	49.1	54.3	58.5	[18]
Tudakul reservoir, Uzbekistan	SL	22,3	38,8	47	59,9	62,7	68			This study
	TL	26,4	44,5	53,4	67,4	70,4	76,2			

* - TL – total length, SL – standard length

In Tudakul reservoir, pike-perch growth for ages 1 through 6 years is fast in comparison with other areas of the temporary climate zone, including inland freshwater water bodies and lagoons of Turkey, Hungary, France, Estonia, Finland and Sweden^[1, 12-18].

5. Conclusion

A conclusion can be made that the environment of Tudakul reservoir, its fisheries management in total is at present favorable for pike-perch population. R. Lee’s phenomenon was not manifested because “Aqua-Tudakul” fishing company is oriented to the catches of large-sized fish. So, fish of first three-four years escape seines and all fish with different growth are presented in the reservoir.

The experience of fisheries management in Tudakul reservoir done by “Aqua-Tudakul” as a culture based fisheries can be useful for other plain water bodies of Uzbekistan.

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