Ecological Life Sciences
ISSN: 1308 7258
Article ID: 5A0251

Status : Research Article
Received: 19.03.2026
Accepted: 26.07.2026

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DOI	http://dx.doi.org/10.12739/NWSA.2026.21.3.5A0251	
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THE COMPARISON OF SOME GROWTH PROPERTIES OF *Paracapoeta trutta* (HECKEL, 1843) INHABITING KEBAN AND KARAKAYA DAM LAKES

ABSTRACT

In this study, the growth characteristics of *Paracapoeta trutta* populations inhabiting Keban and Karakaya Dam Lakes were investigated and compared. For this purpose, a total of 405 specimens (218 individuals from Keban Dam Lake and 187 individuals from Karakaya Dam Lake) were examined. Age determination was performed using scales, and the age composition of the populations from both reservoirs ranged from I to VII years. The von Bertalanffy growth equations for the Keban Dam Lake population were estimated as: $L_t = 83(1 - e^{-0.068(t+3.555)})$ for length and $W_t = 7091(1 - e^{-0.010(t+0.456)})^{2.8258}$ for weight in *P. trutta* population from Keban Dam Lake $L_t = 78.23(1 - e^{-0.055(t+4.744)})$ for length and $W_t = 6775(1 - e^{-0.007(t+0.759)})^{2.9922}$ for weight in *P. trutta* population from Karakaya Dam Lake. The length–weight relationships of *P. trutta* populations form Keban and Karakaya Dam Lake populations were determined as $W = 0.0168TL^{2.8358}$ and $W = 0.01093TL^{2.9922}$ for all individuals, respectively. Overall, the growth parameters estimated for the C. trutta populations from Keban and Karakaya Dam Lakes were highly comparable, suggesting similar growth dynamics and life-history characteristics in the two reservoir ecosystems.

Keywords: *Paracapoeta trutta*, Keban Dam Lake, Karakaya Dam Lake, Growth

1. INTRODUCTION

Fish growth is influenced by various factors such as genetic structure, environmental conditions, and food availability. Differences in habitat characteristics such as water quality, trophic status and ecological interactions often result in variations in growth parameters among populations of the same species. Growth characteristics such as length, weight, age composition, and condition factor are fundamental indicators used to evaluate fish population dynamics, ecological adaptation and habitat quality. These parameters are also essential for fisheries management and stock assessment. *Paracapoeta trutta* (Heckel, 1843), a dominant cyprinid species in the Tigris-Euphrates basin, is widely distributed in large reservoirs such as Keban and Karakaya Dam Lakes [1, 2, 3, 4, and 5]. These reservoirs differ in age, limnological features, and productivity, making them ideal systems for comparative growth studies. Previous studies have demonstrated that fish populations living in different habitats may exhibit variations in length-weight relationships and growth parameters despite belonging to the same species [6, 7, 8, 9, 10, and 11]. Therefore, the aim of this study is to compare the growth properties of *P. trutta* populations inhabiting Keban and Karakaya Dam Lakes. Specifically, the study evaluates age distribution, length–weight relationships, growth parameters, and condition factors

How to Cite:
Çalta, M. and Çökmez, T., (2026). The comparison of some growth properties of *Paracapoeta Trutta* (Heckel, 1843) inhabiting Keban and Karakaya Dam Lakes. Ecological Life Sciences, 21(3):92-100, DOI: 10.12739/NWSA.2026.21.3.5A0251.

to determine whether significant differences exist between the two populations.

2. RESEARCH SIGNIFICANCE

This study compared the growth properties of *Paracapoeta trutta* fish species from Keban and Karakaya Dam Lakes. This species is a dominant and economically important cyprinid species of these dam lakes.

Highlights:

- Growth properties of *Paracapoeta trutta* populations from Keban Dam Lake and Karakaya Dam Lake were comparatively evaluated. Age composition, length–weight relationships, condition factor, and von Bertalanffy growth parameters were determined for both populations.
- Significant differences were not observed in growth performance and population structure of *Paracapoeta trutta* between the two dam lakes.
- Length–weight relationship analysis indicated isometric growth in both populations. Small environmental and ecological differences between the dam lakes may not influence the growth characteristics of the *Paracapoeta trutta* fish species.

3. MATERIALS AND METHODS

This study was carried out on *P. trutta* collected from two major reservoirs (Keban Dam Lake and Karakaya Dam Lakes) located on the Euphrates River in the eastern region of Turkiye (Figure 1). Fish samples consisting of 218 individuals from Keban Dam Lake and 187 individuals from Karakaya Dam Lake were collected using gillnets with mesh sizes of 24, 36, 48, 60, 72, 88, and 100 mm. They were immediately transferred to laboratory in Fisheries Faculty of Fırat University. Total lengths (TL) and weights (W) of each fish specimen was measured at a sensitivity of 1.0 mm and 0.1g respectively. Scales from each fish were taken from anterior part of dorsal fin lateral line region for age determination. They were kept in 5% KOH for 24 hours and then removed into 70% ethyl alcohol for 3 min. Age of fish were determined under a binocular microscope [12].

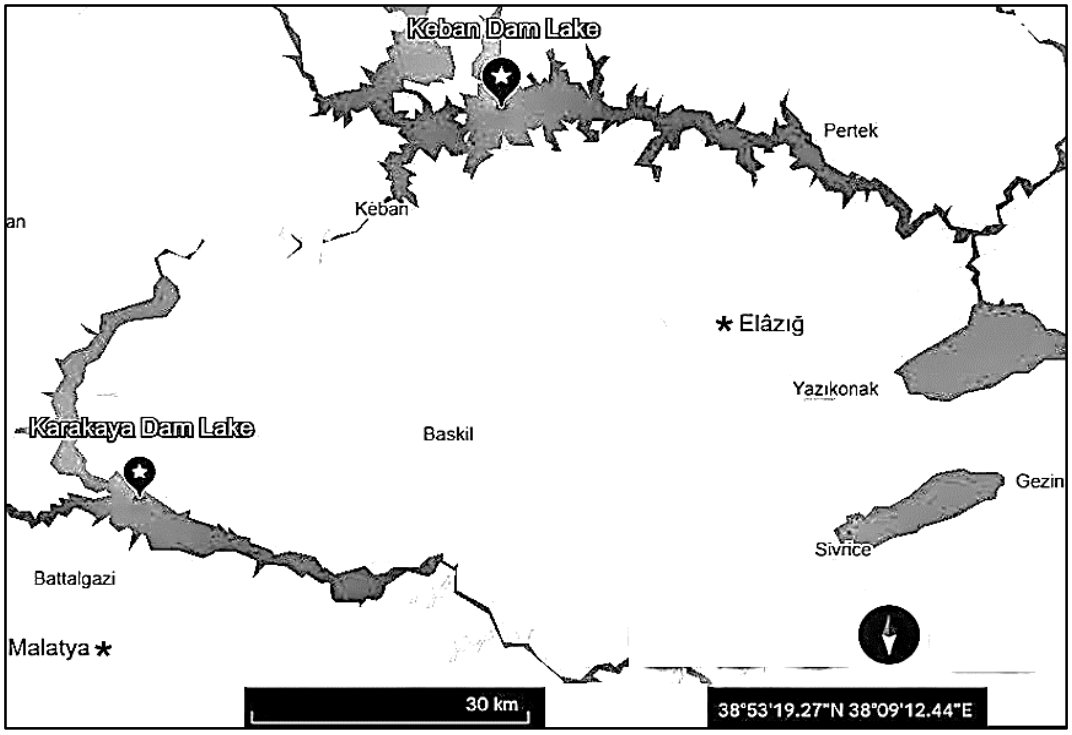

Figure 1. Map of the Keban and Karakaya Dam Lakes [13]

The total length–weight relationships (LWRs) was calculated using the equation:

$$W = a * TL^b \quad [14]$$

Absolute growth (AG) refers to the actual increase in size (length or weight) of a fish over a specific time period and relative growth (RG) expresses growth as a percentage of a fish during a specific time-period. They were calculated according to King (2007) [15] using the following equations:

$AG = TL_t - TL_{t-1}$ and $RG = \left(\frac{TL_t - TL_{t-1}}{TL_{t-1}}\right) * 100$ for length

$AG = W_t - W_{t-1}$ and $RG = \left(\frac{W_t - W_{t-1}}{W_{t-1}}\right) * 100$ for weight

Condition factor for total length (KF_{TL}) was calculated using equation:

$$KF_{TL} = \left(\frac{W}{TL^3}\right) * 100 \quad [16]$$

The von Bertalanffy growth model was used to estimate growth parameters:

$L_t = L_\infty(1 - e^{-k(t-t0)})$ for length and $W_t = W_\infty(1 - e^{-k(t-t0)})^b$ for weight [17].

Differences between populations were evaluated using appropriate statistical tests (t-test and ANOVA) with significance set at $p<0.05$.

4. RESULTS AND DISCUSSION

4.1. Some Water Quality Parameters

In this study, selected water quality parameters measured seasonally from Keban Dam Lake and Karakaya Dam Lake are presented in Table 1. No statistically significant differences were observed between the dam lakes for the measured parameters for each season (Student's t-test, $P>0.05$). The similarity in water quality observed between the dam lakes may be explained by their occurrence within the same geographical region and their dependence on Euphrates catchment area, which likely results in comparable physicochemical characteristics.

Table 1. Some water quality parameters in Keban and Karakaya Dam Lakes observed during the study. Values are mean ± standard deviation (n=12)

Keban Dam Lake				Karakaya Dam Lake		
Seasons	Temperature (°C)	pH	Total Hardness ($CaCO_3$-mg L^{-1})	Temperature (°C)	pH	Total Hardness ($CaCO_3$-mg L^{-1})
Winter	7±2	8.2±0.3	16.0±1.6	8±3	7.9±0.2	18.1±0.6
Spring	14±7	7.6±0.4	15.3±1.1	12±4	8.0±0.1	19.3±0.2
Summer	26±1	7.5±0.3	15.7±0.7	25±4	8.3±0.1	18.6±0.4
Autumn	21±3	8.2±0.6	16.6±0.8	17±5	8.0±0.1	17.8±0.8

4.2. Age and Sex Composition

In this study, a total of 405 *P. trutta* specimens (218 individuals from Keban Dam Lake and 187 individuals from Karakaya Dam Lake) were investigated. The distribution of age groups are shown in Figure 2. The age distribution of the examined *P. trutta* populations in both reservoirs was determined to range from I to VII years. In the *P. trutta* population from Keban Dam Lake, the highest abundance of individuals was recorded in age group IV, whereas in the *P. trutta* population from Karakaya Dam Lake, the dominant age group was V. Hoxmeier et al., [18] showed that age composition variation in fish populations from different reservoirs is influenced by site-specific environmental conditions and habitat differences.

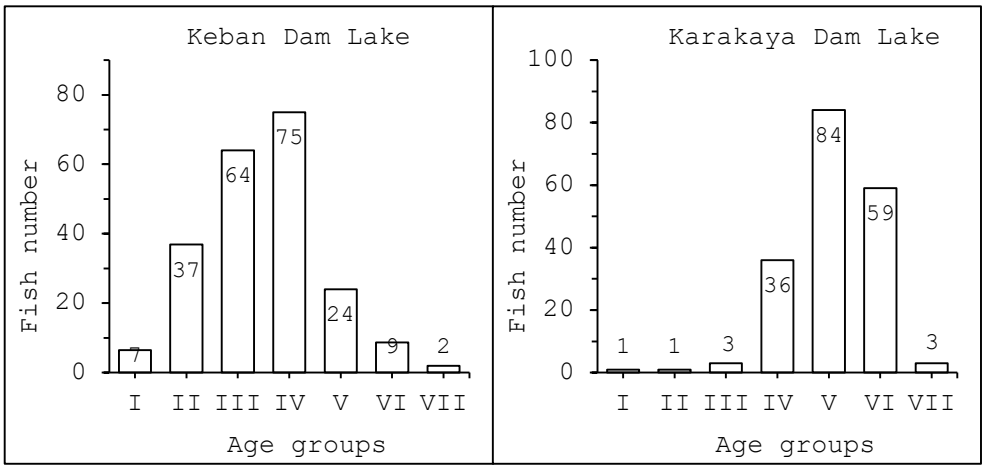

Figure 2. Frequency distribution of the examined *P. trutta* numbers according to age groups

Some characteristics of the *P. trutta* populations from Keban and Karakaya Dam Lakes are given in Table 2. The number of males was higher than that of females and the differences in sex ratio were found to be statistically significant ($P<0.05$). No statistically significant differences ($P>0.05$) were observed in the mean values of all ages for total length, body weight, or condition factor between the *P. trutta* populations from Keban and Karakaya Dam Lakes (Table 2).

Table 2. Some characteristics of the *P. trutta* obtained from Keban and Karakaya Dam Lakes during the study. Mean± Standard deviation (Minimum-Maximum)

	Keban Dam Lake	Karakaya Dam Lake	Statistical Significance
Fish Number (N) Total	218	187	
Male	124	97	
Female	94	90	
Age groups	I-VII	I-VII	
Total length (cm)	29.9±4.3 (18.7-40.3)	30.4±2.8 (20.2-39.0)	P>0.05
Weight (g)	258.4±108.7 (64.5-556.0)	261.6±82.0 (78.8-557.2)	P>0.05
Condition Factor (%)	0.912	0.908	P>0.05

The distributions of total length, body weight, and condition factor values across age groups of *P. trutta* from Keban and Karakaya Dam Lakes are presented in Table 3. As shown in Table 3, the total length, body weight and condition factor values of *P. trutta* populations from Keban and Karakaya Dam Lakes were found to be similar and statistically insignificant in younger individuals (P>0.05), whereas in older individuals (especially after age VI), significant differences in those values were observed (P<0.05). In older fish, these differences may be explained by irregular growth patterns associated with sexual maturation, as well as potential errors in age reading resulting from the irregular formation of annuli in bony structures used for age determination [19 and 20].

4.3. Length-Weight Relationship (LWR)

Length–weight relationship of *P. trutta* from Keban and Karakaya Dam Lakes were found as $W = 0.0168TL^{2.8358}$ and $W = 0.0093TL^{2.9922}$, respectively (Figure 3). The length–weight relationship is one of the most widely used parameter in fisheries biology and fish population dynamics. It describes the mathematical relationship between the length and body weight of fish and provides important information about growth patterns, physiological condition, and ecological characteristics of fish populations. In the length-weight equation, the parameter "b" is biologically important because it indicates the type of growth exhibited by the fish population. If the "b" value is equal or close to 3, the fish exhibits isometric growth. Isometric growth indicates that body weight increases proportionally to the cube of body length. In the present study, the "b" values estimated for the *P. trutta* populations inhabiting Keban Dam Lake (b=2.8359) and Karakaya Dam Lake (b=2.9922) were found to be close to 3. These findings indicate that the T. trutta populations from both reservoirs exhibit isometric growth patterns (Figure 3).

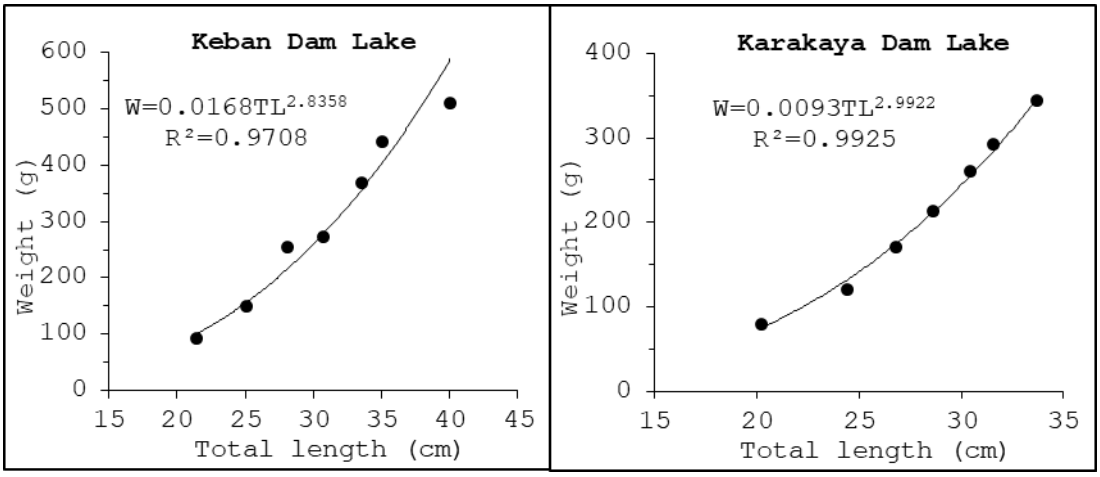

Figure 3. Length-weight relationship of *P. trutta* from Keban and Karakaya Dam Lakes

Length-weight relationships are influenced by numerous factors, including species, sex, age, maturity stage, feeding intensity, habitat conditions, season and environmental variables. Therefore, LWR parameters may vary among populations inhabiting different ecosystems [21 and 22]

Table 3. The comparison of total length, fish weight and condition factor values (Mean ± standard deviation with Min.-Max. values in bracket) according to age groups of *P. trutta* from Keban and Karakaya Dam Lakes

Age Groups	Number of Fish (N)		Total length (cm)		Fish Weight (g)		Condition Factor (%)	
	A	B	A	B	A	B	A	B
I	7	1	21.41±1.73 (18.7-23.8)	20.23	92.14±17.53 (66.4-120.3)	78.80	0.933±0.059 (0.855-1.015)	ND
II	37	1	25.11±4.03 (18.9-31.7)	24.42	149.98±65.22 (64.5-259.3)	120.50	0.892±0.065 (0.701-1.023)	ND
III	64	3	30.57±2.81^{a} (26.1-39.6)	26.80±0.55^{a} (26.3-27.4)	253.68±78.69^{a} (133.8-517.7)	170.56±18.08^{b} (151.2-187.0)	0.859±0.161^{a} (0.529-1.327)	0.891±0.147^{a} (0.735-1.027)
IV	75	36	30.71±3.12^{a} (23.4-40.3)	28.60±1.89^{a} (25.7-34.7)	273.84±81.14^{a} (123.7-509.5)	213.49±50.22^{a} (119.5-390.6)	0.926±0.095^{a} 0.642-1.144)	0.903±0.108^{a} (0.550-1.245)
V	24	84	33.57±2.76^{a} (27.5-39.9)	30.43±2.43^{a} (26.7-38.3)	368.11±82.73^{a} (192.2-510.8)	260.94±69.47^{b} (129.9-481.6)	0.965±0.125^{a} 0.729-1.216)	0.912±0.124^{a} (0.549-1.469)
VI	9	59	35.00±2.89^{a} (29.8-37.8)	31.58±2.96^{b} (26.6-39.0)	440.84±108.48^{a} (225.7-556.0)	292.44±95.81^{b} (122.2-557.2)	1.007±0.086^{a} 0.852-1.109	0.905±0.140^{b} 0.533-1.480)
VII	2	3	36.60±3.11^{a} (34.4-38.8)	33.63±2.63^{b} (30.6-35.4)	452.10±11.20^{a} (444.2-460.0)	341.50±120.11^{b} (264.5-479.9)	0.986±0.063^{a} (0.941-1.030)	0.887±0.213^{b} (0658-1.081)

A: Keban Dam Lake, B: Karakaya Dam Lake, ND: not detected
Significant differences ($p<0.05$) are indicated by different alphabetic superscripts

4.4. Absolute and Relative Growth

Absolute and relative growth in total length and weight between ages of *P. trutta* form Keban and Karakaya Dam Lakes are given in Table 4. Absolute growth refers to the actual increase in size (length or weight) of a fish over a specific time period. Relative growth expresses growth as a percentage of the initial size. In many fish species, absolute growth and relative growth rate increase during early life stages, reaches a maximum at intermediate ages and declines in older individuals due to energy allocation toward reproduction rather than somatic growth [23]. In the present study, a similar growth pattern to

those reported for many fish species was observed. Both absolute and relative growth rates of the *P. trutta* population inhabiting Keban Dam Lake were higher than those of the population from Karakaya Dam Lake.

Table 4. Absolute and Relative growth rates in total length and weight between ages of *P. trutta* form Keban and Karakaya Dam Lakes

		Growth rate in length		Growth rate in weight	
Lakes	Age groups	Absolute (g)	Relative (%)	Absolute (g)	Relative (%)
Keban Dam Lake	I-II	3.70	17.28	57.84	62.77
	II-III	2.96	11.79	103.70	69.14
	III-IV	2.64	9.41	102.16	70.95
	IV-V	2.86	9.31	94.27	34.43
	V-VI	1.43	4.26	72.73	19.76
	VI-VII	1.02	4.34	69.16	15.69
Karakaya Dam Lake	I-II	4.20	20.79	41.70	52.92
	II-III	2.40	9.84	50.06	41.54
	III-IV	1.80	6.72	42.93	25.17
	IV-V	1.83	6.40	47.45	22.23
	V-VI	1.15	3.78	31.50	12.07
	VI-VII	1.12	3.71	31.06	11.46

4.5. Growth Parameters

The von Bertalanffy growth equations were estimated as: $L_t = 83(1 - e^{-0.068(t+3.555)})$ for length and $W_t = 7091(1 - e^{-0.010(t+0.456)})^{2.8258}$ for weight in *P. trutta* population from Keban Dam Lake $L_t = 78.23(1 - e^{-0.055(t+4.744)})$ for length and $W_t = 6775(1 - e^{-0.007(t+0.759)})^{2.9922}$ for weight in *P. trutta* population from Karakaya Dam Lake.

The growth parameters of *P. trutta* populations from Keban and Karakaya Dam Lakes calculated using the von Bertalanffy growth equation are given in Table 5. Comparison of the growth parameters demonstrated that the *P. trutta* populations inhabiting Keban and Karakaya Dam Lakes exhibited similar growth patterns.

Table 5. Growth parameters of *P. trutta* populations inhabiting Keban and Karakaya Dam Lakes estimated using the von Bertalanffy growth equation

	N	L_∞	W_∞	a	b	t_o	K
Keban Dam Lake	218	83.006	7090.980	0.0168	2.836	-3.554	0.068
Karakaya Dam Lake	187	78.231	6775.075	0.009	2.992	-4.744	0.055

Comparison of the von Bertalanffy growth parameters with those reported in previous studies revealed a high degree of agreement, with the values obtained in the present study remaining within the reported range for *P. trutta* populations from Keban and Karakaya Dam Lakes [8 and 9]. This finding suggests that growth patterns of the species have remained relatively stable across these reservoir ecosystems despite potential spatial and temporal variations in environmental conditions.

NOTICE

This study was derived from the M.Sc. thesis of Tayfun Çökmez.

CONFLICT OF INTEREST

The authors declare that there is no conflict of interest.

FINANCIAL DISCLOSURE

This study was financially supported by the Scientific Research Projects Coordination Unit (FÜBAP) of Fırat University under Project No: 842.

DECLARATION OF ETHICAL STANDARDS

The authors declare that the materials and methods used in this study do not require ethics committee approval and/or legal special permission.

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