

## INVESTIGATION OF THE GROWTH PROPERTIES OF PIKE (*Esox lucius* L., 1758) IN KAPULUKAYA DAM LAKE

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### ABSTRACT

This study is related to the investigation of the growth properties of pike (*Esox lucius* L., 1758) in Kapulukaya Dam Lake. There were 328 fish caught between November 2002 – October 2003 ranging between I - VII years of age. Von Bertalanffy growth equations for the females and males were found as  $L_t = 1678.98 (1 - e^{-0.045 (t + 4.25)})$ , and  $L_t = 803.18 (1 - e^{-0.142 (t + 3.09)})$ . Length-weight relations for the females and males were  $W = 0.00004532 \times L^{2.7105}$  and  $W = 0.00023207 \times L^{2.4372}$ . The condition factor for the general population was found as 0.806.

**Keywords:** *Esox Lucius*; pike; growth; Von Bertalanffy, Kapulukaya Dam Lake.

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### 1. INTRODUCTION

Pike (*Esox lucius* L., 1758), is an economically viable fish which shows a wide spread distribution in fresh waters of Turkey [1]. It is an essential element of the ecosystem as a piscivore and can tolerate a wide range of environmental conditions [2]. It is necessary that the growth properties of pike and other fish populations in water systems should be thoroughly investigated in order to enlighten the underlying reasons in the decrease in their numbers.



There is a very wide literature upon the growth properties of pike in various water reservoirs. Ömeroğlu [3] and İlhan [4] in Işıklı Lake, Owens and Pronin [5] in Lake Baikal, Lorenzoni et al. [6] in Trasimeno Lake, Özuluğ [7] in Terkos Lake, Griffiths et al. [8] in northern Ontario River, Çubuk et al. [1] in Karamık Lake, Erdem et al. [9] in Uluabat Lake, Žiliukienė and Žiliukas [10] in Lake Rubikiai (Lithuania), Abbasi et al. [11] in Anzali and Amirkelayeh wetlands, Krainyuk and Asylbekova [12] in K. Satpayev's channel reservoirs and from some Central Kazakhstan waters, Milardi and Juntunen [13] in Finland, Benzer and Benzer [14] in Mogan Lake.

This study aims at elucidating the growth properties of pike (*Esox lucius* L., 1758) from Esocidae family in Kapulukaya Dam Lake about which there was no previous scientific data.

## 2. MATERIAL AND METHODOLOGY

### 2.1 Description of the study area

Kapulukaya Dam was constructed on Kızılırmak River 15 km south of Kırıkkale province at Değirmen region. It was completed in 1989 and started to collect water. It has a drainage area of 28.604 km<sup>2</sup> and 2.655 hm<sup>3</sup> annual water flow with a flow rate of 84 m<sup>3</sup>/sn. The maximum water code is 724.00 m. At maximum water code the lake covers an area of 20.60 km<sup>2</sup> with a maximum depth of 60 m [15].

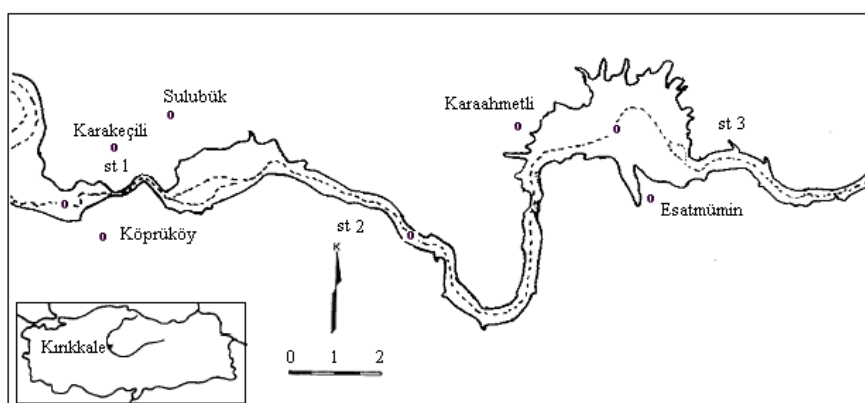
### 2.2 Sample collection and analysis

The study was carried out between November 2002 and October 2003. The fish was hunted by the use of nets with different mesh sizes at three different stations on monthly basis (Fig. 1). The fork lengths and the weights of 328 *Esox lucius* were determined in cm and g. The gender and the sexual maturity of the species were determined by the microscopic investigation of the gonads. The age of the specimens was determined from their scales according to Lagler [16] method.

The fish samples were classified as Female, Male and Female + Male after the determination of their age and genders. Then their mean lengths and weights were calculated by the use of their fork lengths. Using these values Bertalanffy growth parameters and equations were computed from the formulas  $L_t = L_\infty (1 - e^{-K(t-t_0)})$  [17].

The relations between the length and weight were computed by the use of the formula of  $W = a \times L^b$  developed Le Cren [18].

The condition factor of the fish, a parameter dependent upon the size and the environmental conditions, was determined by the use of the formula of  $K = W \text{ (g)} \times 10^5 / L^3 \text{ (mm)}$  [19].

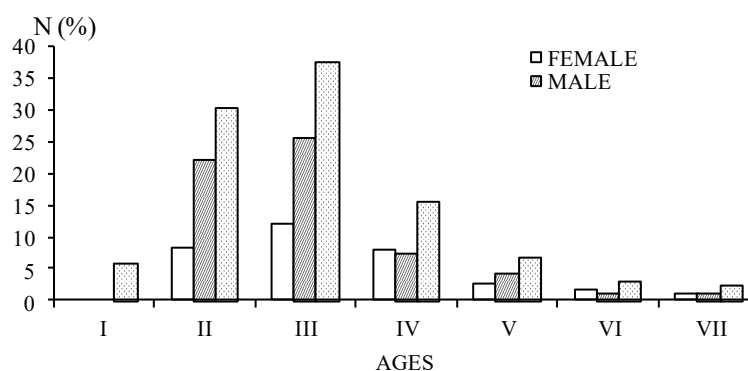


**Fig.1.** Kapulukaya Dam Lake and sampling stations

### 3. RESULTS AND DISCUSSION

#### 3.1 Age Distribution

The ages of 328 *Esox lucius* caught in Kapulukaya Dam Lake were found to range between I to VII years (Fig.2). There was no fish encountered above VII years of age. It was not possible to determine the gender of the samples at I year of age (5.79%) and they were classified as Female+Male. The number of males (60.37%) is higher than females (33.84%).



**Fig. 2.** The distribution of *Esox lucius* according to their age and genders

### 3.2 Growth

Table 1 lists the mean lengths and the weights of the fish according to their genders and Fig. 3 shows the length - weight distribution. It was determined that the males are longer than females at the age of IV and the opposite was the case for other ages. The shortest and the longest fish were 265 mm and 730 mm respectively. The length of the females ranged between 340 mm and 730 mm while the length of the males changed between 300 mm and 650 mm. The weight of the while *Esox lucius* samples investigated changed between 120 g and 2450 g. The weight of the females was between 330 g and 2450 g. while the males ranged between 290 g and 1650 g. The Von Bertalanffy growth parameters and length weight regression equations ( $W = a \times L^b$ ) of *Esox lucius* samples caught in Kapulukaya Dam Lake were tabulated in Table 2.

The age -length and age-weight relations found for *Esox lucius* living in Kapulukaya Dam Lake according to Von Bertalanffy is  $L_t = 1678.98 (1 - e^{-0.045 (t + 4.25)})$  for females and  $L_t = 803.18 (1 - e^{-0.142 (t + 3.09)})$  for males.

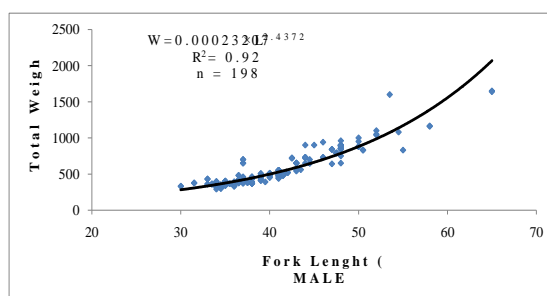
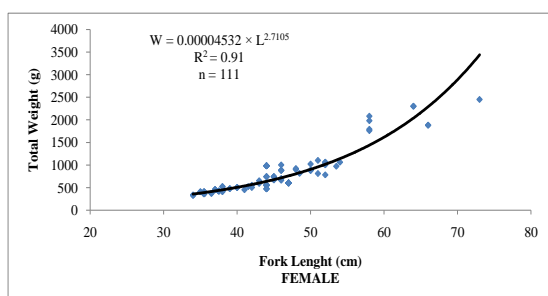
The length-weight relations for the *Esox lucius* living in Kapulukaya Dam Lake were found as  $W = 0.00004532 \times L^{2.7105}$  for female,  $W = 0.00023207 \times L^{2.4372}$  for Male and  $W = 0.00010908 \times L^{2.5636}$  for Female+Male. The b value for the Female-Male group was found as 2.5636.

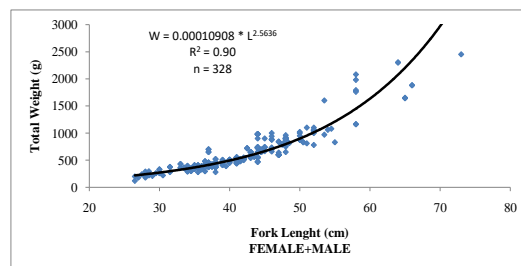
**Table 1.** The mean length, mean weight and condition factor values of *Esox lucius* living in Kapulukaya Dam Lake

Age	Gender	Frequency		Mean length (cm) ± SD	Mean weight (g) ± SD	CF
		N	%			
1	F+M	19	5.79	300.53 ± 7.96	239.21 ± 11.30	0.903 ± 0.051
	F	27	8.23	356.48 ± 1.94	392.96 ± 7.85	0.865 ± 0.008
2	M	72	21.95	354.17 ± 2.28	385.75 ± 9.09	0.875 ± 0.021
	F+M	99	30.18	354.80 ± 1.74	387.72 ± 6.94	0.872 ± 0.015
	F	39	11.89	416.41 ± 4.42	587.95 ± 30.53	0.802 ± 0.028
3	M	83	25.30	410.30 ± 2.69	534.22 ± 12.56	0.766 ± 0.008
	F+M	122	37.19	412.25 ± 2.31	551.39 ± 13.10	0.777 ± 0.010
	F	26	7.93	469.81 ± 2.89	748.58 ± 26.71	0.722 ± 0.025
4	M	24	7.32	473.33 ± 2.60	825.00 ± 16.37	0.781 ± 0.022
	F+M	50	15.25	471.50 ± 1.95	785.26 ± 16.72	0.751 ± 0.017
	F	9	2.74	524.44 ± 7.84	1075.56 ± 97.07	0.735 ± 0.037
5	M	13	3.96	498.46 ± 8.90	952.69 ± 68.11	0.757 ± 0.028
	F+M	22	6.70	509.09 ± 6.64	1002.95 ± 56.64	0.748 ± 0.022
	F	6	1.83	575.83 ± 19.93	1618.33 ± 198.94	0.835 ± 0.075
6	M	3	0.92	550.00 ± 17.32	1015 ± 98.28	0.614 ± 0.072
	F+M	9	2.75	567.22 ± 14.46	1417.22 ± 165.55	0.761 ± 0.064
	F	4	1.22	667.50 ± 21.36	2232.5 ± 122.70	0.759 ± 0.068
7	M	3	0.92	626.67 ± 23.33	1483.33 ± 161.69	0.597 ± 0.001
	F+M	7	2.14	650.00 ± 16.62	1911.43 ± 175.91	0.690 ± 0.049
	F	111	33.84	440.76 ± 7.42	732.63 ± 43.05	0.793 ± 0.013
Sum	M	198	60.37	408.71 ± 4.29	564.61 ± 17.31	0.802 ± 0.010
	F+M	328	100	420.22 ± 3.92	624.97 ± 19.53	0.806 ± 0.081

### 3.3 Condition Factor

Table 1 lists the condition factors of Female, Male and Female+Male groups based on their ages. The condition factor for the general population was found as 0.806.





**Fig. 3.** Length – weight distribution according to gender

*Esox lucius* samples caught from the dam lake were found to range between I to VII years of age (Table 1). The most number of samples were seen in II. and III. age groups. According to Nikolskii [20], the age distribution is affected by various ecological factors and the prime factor is the availability of food. Factors such as the mortality rate and hunting pressure also play an important role. Factors such as mortality rate and hunting pressure also play an important role. The age distribution of *Esox lucius* in various locations are as follows in Işıklı Lake I-VI [4]; in Apolyon (Uluabat) Lake I-VI [9]; in Mogan Lake I-VI [14]. It is apparent that the age distribution in Kapulukaya Dam Lake is in good accordance with those found by Ömeroğlu [3] and Benzer and Benzer [14] at various locations (Table 2).

The gender ratio was found to be 33.84% for females and 66.16% for males (Table 2). The male: female ratio was found to be 1.78:1 for the general population. This ratio was found as 1.14:1 in Manyas Lake [3]; 1.12:1 in Işıklı Lake [4]; in Trasimeno Lake [6]; 1.10:1 in Apolyon (Uluabat) Lake [9]; 1.76:1 1.49:1 in Mogan Lake [14]. The climatic conditions prevailed during the study are reported to effect the sexual maturity, breeding, breeding time, egg development and egg hatching [21]. The values obtained from Kapulukaya Dam Lake are in good accordance with the values reported by Leronzoni et al. [6].

**Table 2.** The comparison of the mean lengths, growth parameters reported in literature

Authors		a	b	r <sup>2</sup>	L <sub>∞</sub> (cm)	K (year <sup>-1</sup> )	t <sub>0</sub> (year)	CF
Ömeroğlu (1996)	♀ FL	-	-	-	-	-	-	0.8-0.9
	♂ mm	-	-	-	-	-	-	0.8-0.9
İlhan (1999)	♀ FL	-	3.39	0.96	80.84	0.063	-4.353	1.111
	♂ cm	-	3.04	0.99	162.76	0.089	0.291	-
Lorenzoni et al. (2002)	♀ FL	-	-	-	-	-	-	-
	♂ cm	-	-	-	-	-	-	-
Çubuk et al. (2005)	♀ FL	-	3.23	-	191.8	0.041	-2.46	0.792
	♂ cm	-	-	-	-	-	-	-
Žiliukienė & Žiliukas (2010)	♀ L	6 10 <sup>-3</sup>	3.02	-	131.7	0.153	-0.0398	-
	♂ cm	-	-	-	101.12	0.140	-1.00	-
Abbasi et al. (2013)	♀ L	0.65 10 <sup>-6</sup>	3.02	-	-	-	-	-
	♂ cm	-	-	-	-	-	-	-
Milardi and Juntunen (2014)	♀ FL	1.03 10 <sup>-4</sup>	2.58	0.94	126.50	0.044	-0.654	-
	♂ cm	-	-	-	-	-	-	-
This study	♀ FL	4.5 10 <sup>-5</sup>	2.71	0.92	1678.9	-0.045	-4.25	0.793
	♂ mm	2.3 10 <sup>-4</sup>	2.44	0.92	803.18	-0.142	-3.09	0.802
	♀♂ mm	1.09 10 <sup>-4</sup>	2.56	0.91	2296.7	-0.029	-3.89	0.806

The age compositions reported by various workers are generally in good compliance with the value found in this study. However there are some differences with a few of them. This difference is largely due to the fishing tools used and the hunting pressure upon the fish. Even if the same nets with similar mesh sizes are used the growth rates in different location will differ and the age composition will exhibit a corresponding variation.

The length weight relations found for *Esox lucius* population in Kapulukaya Dam Lake by the authors and other relations determined by various workers at different locations are given in Table 2. The mean fork length found in this study is observed to be smaller than that found by many workers (Table 2). This difference can be attributed to biotic and abiotic factors at different locations such as ecological conditions, population size, food availability and genetic factors [22].

The b value for the female-male group was found as 2.5636. The length-weight parameters found by various workers are tabulated in Table 2. Lorenzoni et al. [6] found 3.04 for female+males; Çubuk et al. [1] found 3.23 for female+males; Žiliukienė and Žiliukas [10] found 3.02 for male and females and 3.00 for males in Irish Reservoir; Milardi and Juntunen [13] found 3.02 for male and females in Finland; Benzer and Benzer [14] found 2.58 for female+males. It is seen that the b values determined by different workers are generally bigger than the values determined in this study. The b value Le Cren equation of  $W = a \times L^b$  is regarded as the indicator of the feeding capacity of the related fish. If it is smaller than 3 it indicates the low feeding capacity [23].

The fact that the b value obtained for *Esox lucius* living in Kapulukaya Dam Lake is 2.7105 is the indication of the low feeding capacity of the fish. This is also verified by the lower condition value.

The age-length and age-weight relations found for *Esox lucius* living in Kapulukaya Dam Lake according to Von Bertalanffy is  $L_t = 1678.98 (1 - e^{-0.045(t + 4.25)})$  for females and  $L_t = 803.18 (1 - e^{-0.142(t + 3.09)})$  for males. Munro and Pauly [24] states that “K” value is the indicator of the growth performance of the species. The  $L_\infty$ , K and  $t_0$  values found by some researchers are shown in Table 3. The length-weight relations for the *Esox lucius* living in Kapulukaya Dam Lake were found as  $W = 0.00004532 \times L^{2.7105}$  for female,  $W = 0.00023207 \times L^{2.4372}$  for male and  $W = 0.00010908 \times L^{2.5636}$  for female+male.

Condition factor (CF) known as the feeding coefficient of fish gives valuable information on the effect of climatic conditions on gonad development, feeding condition and population density [25]. The condition value found for *Esox lucius* living in Kapulukaya Dam Lake was lower than those found for *Esox lucius* living in Işıklı Lake [4] (Table 2). The condition values found by Çubuk et al. [1] in Karamık Lake; Erdem et al. [9] in Işıklı Dam Lake (for female+males 0.90) are in parallel with our values (Table 2).

The condition values computed in this study is valid for the period when the study was carried out since it shows great variation with species, age, feeding habits and climatic conditions [25].



The condition factor gives important clues upon the effect feeding habits and population density of the fish on their growth and gonad development [26].

#### 4. CONCLUSION

The fact that there were no *Esox lucius* specimens encountered above VII. years of age is the indication of the hunting pressure on lower age fish. It is important that the economically important fish should be hunted after they reach to a certain maturity in order to give them enough time to breed. It is recommended that the fishing activities in Kapulukaya Dam Lake should be carried out in a controlled manner in order to increase the stocks.

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#### 6. REFERENCES

- [1] Çubuk H, Balık İ, Uysal R, Özkök R. Some biological characteristics and the stock size of the pike (*Esox lucius* L., 1758) population in Lake Karamık (Afyon, Turkey). Turk J Vet Anim Sci, 2005, 29, 1025-1031
- [2] Casselman JM, Lewis CA. Habitat requirements of northern pike (*Esox lucius*). Can. J. Fish. Aquat. Sci, 1996, 53,161-174, doi: 10.1139/f96-019
- [3] Ömeroğlu G. Growth rates and reproduction of pike (*Esox Lucius*, L. 1758) living in Manyas (Kuş) Lake, 1996, Gazi Ege Univ. Inst of Sci and Tech, Msc Thesis, Ankara, pp 39
- [4] İlhan A. Investigation of the bioecological characteristics of pike population (*Esox lucius* linnoeus, 1758) in Lake Işıklı. 1999, Ege Univ. Inst of Sci and Tech, Msc Thesis, İzmir, pp 47
- [5] Owens RW, Pronin NM. Age and growth of pike (*Esox lucius*) in Chivyrkui Bay, Lake Baikal. Journal of Great Lakes Research, 2000, 26(2), 164-173, doi: 10.1016/S0380-1330(00)70683-6

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- [6] Lorenzoni M, Corboli M, Dörr AJM, Mearelli M, Giovinazzo G. The Growth of pike (*Esox lucius* Linnaeus, 1758) in Lake Trasimeno (Umbria, Italy). 2002, Fisheries Research 1380, 1-8, doi: 10.1016/S0165-7836(02)00013-9
- [7] Özüluğ M. A Study on the fishes of Durusu (Terkos) lake basin and the biology of the pike (*Esox lucius* Linnaeus, 1758), 2003, İstanbul Univ. Inst of Sci and Tech. PhD Thesis, İstanbul, pp 89
- [8] Griffiths RW, Newlands NK, Noakes DLG, Beamish FWH. Northern pike (*Esox lucius*) growth and mortality in a northern Ontario River compared with that in lakes: influence of flow. 2004, Ecology of Freshwater Fish, 13(2), 136-144, doi: 10.1111/j.1600-0633.2004.00049.x
- [9] Erdem Ü, Atasoy E, Emre Y, Çelikleş S. Some biological characteristics of pike (*Esox Lucius* Linnaeus, 1758) in Lake Apolyont (Uluabat/Bursa-Turkey). 2007, Turkish Journal of Aquatic Life, 3-5(5.8), 413-418
- [10] Žiliukienė V, Žiliukas V. Growth of pike *Esox lucius* L. in Lake Rubikiai (Lithuania). 2010, Journal of Applied Ichthyology, 26(6), 898-903, doi: 10.1111/j.1439-0426.2010.01517.x
- [11] Abbasi M, Bani A, Moradinasab G, Mosavi Sabet SH. The comparison some of growth characteristic in pike (*Esox lucius* Linnaeus, 1758) from Anzali and Amirkelayeh wetlands. 2013, Journal of Applied Ichthyological Research 1(3), 49-62
- [12] Krainyuk VN, Asylbekova SZ. The growth of pike *Esox Lucius* L., 1758 (Esocidae) from K. Satpaev's Channel Reservoirs. 2014, Vestnik of Astrakhan State Technical University. Series: Fishing Industry, (3):19-28
- [13] Milardi M, Juntunen T. Variation in length, girth and weight of large northern pikes (*Esox lucius*) in Finland. 2014, In Annales Zoologici Fennici, 51(3), 335-339, doi: 10.5735/086.051.0305
- [14] Benzer S, Benzer R. Evaluation of growth in pike (*Esox lucius* L., 1758) using traditional methods and artificial neural networks. 2016, Applied Ecology and Environmental Research 14 (2), 543-554, doi: 10.15666/aeer/1402\_543554

- [15] DSİ. Kapulukaya Dam Lake Brochure. 1992, DSİ Press. Ankara pp 87
- [16] Lagler KF. Freshwater Fishery Biology. 1966, W.M.C. Brown Company Publishers, Dubuque, Iowa pp 421
- [17] Von Bertalanffy L. Quantitative laws in metabolism and growth. Quantitative laws in metabolism and growth. 1957, Quantitative Rev. Biology, 32,218-231, doi:10.1086/401873.
- [18] Le Cren ED. The Length-Weight Relationship and Seasonal Cycle in Gonad Weight and Condition in the Perc (*Perca fluviatilis*). 1951, Animal Ecology, 20(2): 201-219. doi: 10.2307/1540.
- [19] Schaeperclaus W. Lehrbuch de Teich- Wirtschaft. 1967, Paul Parey. Hamburg und Berlin. Pp 594
- [20] Nikolskii GW. Theory of fish population dynamics. 1980, Otto Koetz Science Publishers, Koenigstein. Pp 424
- [21] Hellawell JM. The autecology of the chub *Squalis cephalus* (L.) of at the River Luggan the aton liynfi. 1971, Freshwater Biology. 1: 29-60. doi: 10.1111/j.1365-2427.1971.tb01545.x
- [22] Koz'min AK. The biology of the pike, *Esox lucius*, from Lake Lacha. 1980, J. Ichthyol, 20, 44-48
- [23] Geldiay R, Balık S. Freshwater fishes of Turkey. 1988, Ege Univ Fac of Sci Public. No: 46, İzmir, pp 182-184
- [24] Munro JL, Pauly D. A simple method for comparing growth of fishes and invertebrates. 1983, ICLARM. Fishbyte, 1(1), 5-6
- [25] Ricker WE. Calcut et Interpredation des statistiques biologiques des population de poissons. 1980, Minister des Peches et des, Oceans. Fish Res. Board. Can. 191 pp 409
- [26] Weatherley AH. Growth and ecology of fish populations. 1972, Academic Press, London, pp 293

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