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A Preliminary Study on Growth Parameters and Mortality Rates of the Barbel (*Barbus tauricus escherichi* Steindachner, 1897) in Yeşildere Stream, Rize, Turkey

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Abstract: Growth parameters and mortality rates of the *Barbus tauricus escherichi* population inhabiting in Yeşildere Stream were investigated. In particular, age and size distributions, asymptotic growth, and mortality rates by age group classes were estimated. A total of 304 *B. t. escherichi* specimens were sampled between June 2001 and July 2002. The population consisted of 5 age classes (i.e. 0 to IV) with minimum and maximum sizes of 5 cm to 23 cm in total length. The mean growth parameters were determined as L_∞ = 26.63 cm, K = 0.274, and t_0 = -1.009 with the scale method and as L_∞ = 27.11 cm, K = 0.267, t_0 = -1.117, and Z = 1.06 with the Bhattacharya method.

Key Words: Barbel, *Barbus tauricus escherichi*, growth parameters, mortality rates, Yeşildere Stream, eastern Black Sea

Yeşildere (Rize-Türkiye)'de Yaşayan Bıyıklı Balığı (*Barbus tauricus escherichi* Steindachner, 1897)'ın Büyüme Parametreleri ve Mortalite Oranları

Özet: Bu araştırmada Yeşildere'de yaşayan *Barbus tauricus escherichi* (Bıyıklı Balık) populasyonunun bazı büyüme parametreleri ve ölüm oranları incelendi. Araştırma bölgesinden Haziran 2001-Temmuz 2002 yılları arasında toplam 304 adet balık yakalandı. Yakalanan bireylerin boyları en küçük 5 cm ve en büyük 23 cm, yaşları ise 0-IV arasında dağılım göstermektedir. Yaş tayini Bhattacharya ve pul yöntemleriyle yapılmıştır. Pullara göre büyüme parametreleri; L_∞ = 26,63 cm, K = 0,274, t_0 = -1,009, Bhattacharya'ya göre; büyüme parametreleri ve mortalite ise L_∞ = 27,11 cm, K = 0,267, t_0 = -1,117, Z = 1,06 olarak belirlenmiştir.

Anahtar Sözcükler: Barbus, *Barbus tauricus escherichi*, büyüme parametreleri, ölüm oranı, Yeşildere, Doğu Karadeniz

Introduction

The eastern Black Sea coast of Turkey has rich inland water resources, particularly in terms of streams and rivers, but fish species diversity is quite low. The icthyofauna is dominated by brown trout (*Salmo truta*) in upper, and *Leuciscus cephalus, Alburnoides bipunctatus*, and *Gobius platyrostris* in lower parts of the rivers. *B. t. escherichi* is a Cyprinid species quite common in the region (Kutrup, 1993; Turan, 2003). In addition to its significant ecological role in the food web, it is caught by local people using cast nets, simple traps, and lines.

The taxonomy and classification of *B. t. escherichi* have been extensively studied in Turkey, including the tributaries of the Çoruh River (Karaman, 1971; Kuru, 1975; Solak, 1978), the Sakarya basin (Erk'akan, 1983), some streams of the west and northwest parts of Turkey (Balık, 1979), and streams of the eastern Black Sea coast (Kutrup, 1993; Turan, 2003). Several researchers have investigated the ecology of this species in various streams as well, for instance Çoruh (Solak, 1977), the Kızılırmak river basin (Erk'akan and Akgül, 1986), Çoruh (Solak, 1989), Şana (Baysal and Kutrup, 1990), and Karadere

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(Kutrup and Baysal, 1994). However, studies on this species in the eastern Black Sea are limited to the few works above. Therefore, this preliminary study aimed to estimate growth parameters and mortality rates of the *B. t. escherichi* population inhabiting a typical small stream, Yeşildere Stream, in the northeastern Black Sea region of Turkey.

Materials and Methods

A total of 304 specimens were sampled throughout its zone range in Yeşildere Stream (Figure 1) using electroshock and cast nets between June 2001 and July 2002.

The specimens were transferred to the laboratory in a cooling box. Total lengths (cm) and weights (g) were measured and scale samples were taken from between the lateral line and dorsal fins for age readings. The length frequency distribution was prepared and the Bhattacharya method was used to estimate the age distribution and to check scale reading (Ricker, 1975; Gulland, 1983; FAO, 1988; King, 1995). The relationship between age and weight was determined using the equation $W = a.L^b$, where W is weight, L is total length, and a and b are regression coefficients. The Ford-Walford method was used to estimate the growth parameters. The length for any age was calculated by employing the von Bertalanffy equation $L_t = L_\infty\{1 - e^{-K(t - t_o)}\}$, where L_t is length at time t, L_∞ is maximum length, t is age, t_o is age when the length equals to 0 and K coefficient of development. The weight for any age was estimated with the equation $W_t = W_\infty \{1 - e^{-K(t - t_o)}\}^b$, where W_∞ is maximum weight and W_t is weight at time t. The instantaneous mortality ratios (Z) were designated by length to age transformations: $t = t_0 - 1/k.Ln(1 - 1/L_\infty)$. Natural and fishing mortalities were assessed employing the equations $LnM = -0.0152 - 0.279, LnL_\infty + 0.6543.LnK + 0.463.LnT$, and $F = Z - M$, respectively, where M: natural mortality, T: annual average water temperature, and F: fishing mortality (FAO, 1988; Gulland, 1988; Avşar, 1997). Water temperature in the sampling area was measured monthly using YSI model 85 (Handheld oxygen, Conductivity, Salinity, Temperature System and instrument accuracy = ±0.5%, Temperature = ±1% maximum). Student's t-test was employed for statistical comparisons (Sokal and Rohlf, 1936; Düzgüneş et al., 1983).

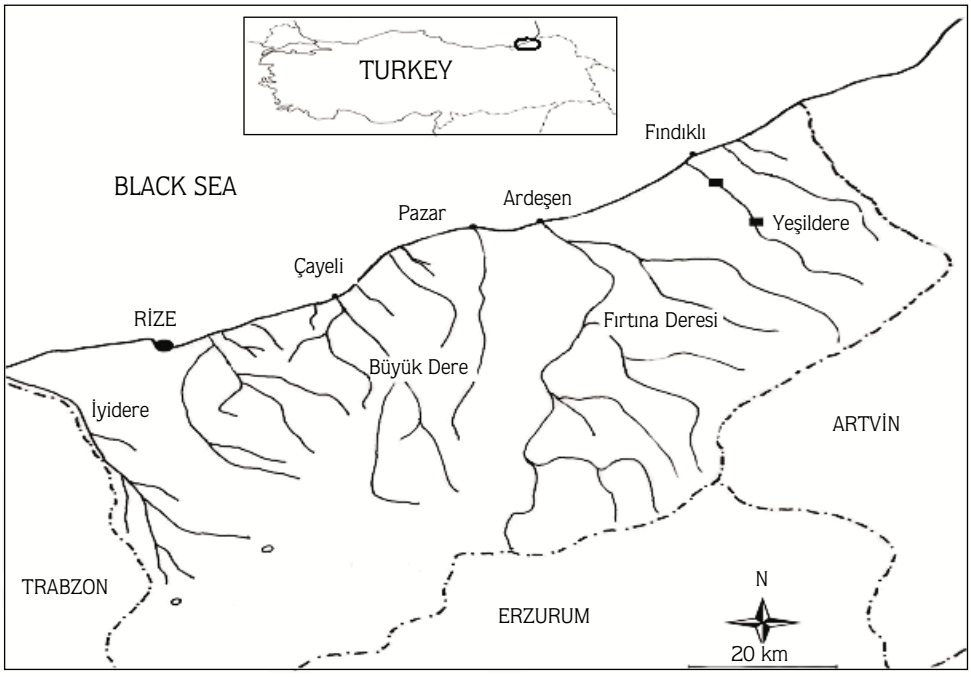

Figure 1. Study area.

Results

Total length of the specimens varied from 5 to 23 cm. The length-weight relationship was calculated and is presented in Figure 2.

The length frequency distributions indicated that the age composition varied between 0 and IV (Figure 3). The age readings based on the 2 methods (i.e. scale reading and the Bhattacharya method) were in agreement (Table 1). No significant differences (Student's t-test) were observed between measured and estimated (Bhattacharya) length and weight values. The relationships between age-weight and age-length were determined using the scale readings and the Bhattacharya method and are given in Figure 4 and Table 2.

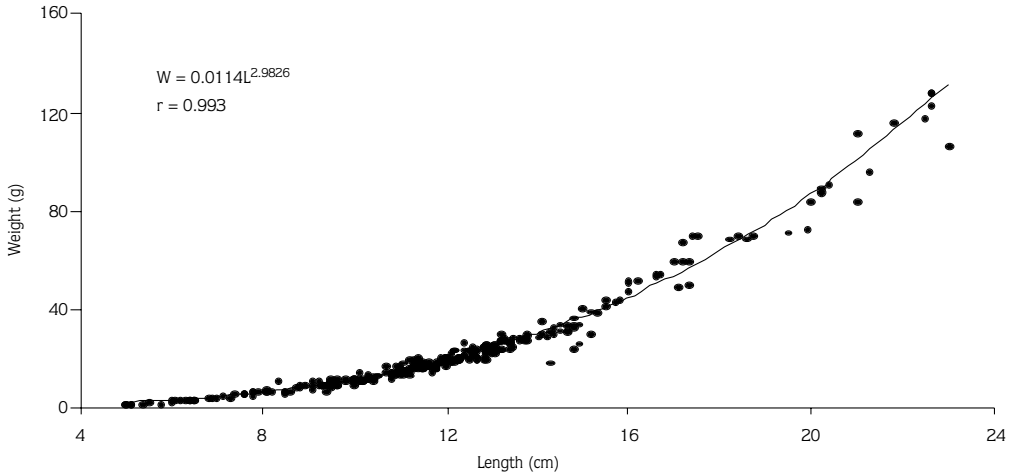

Figure 2. Length-weight relationship in *Barbus plebejus escherichi*.

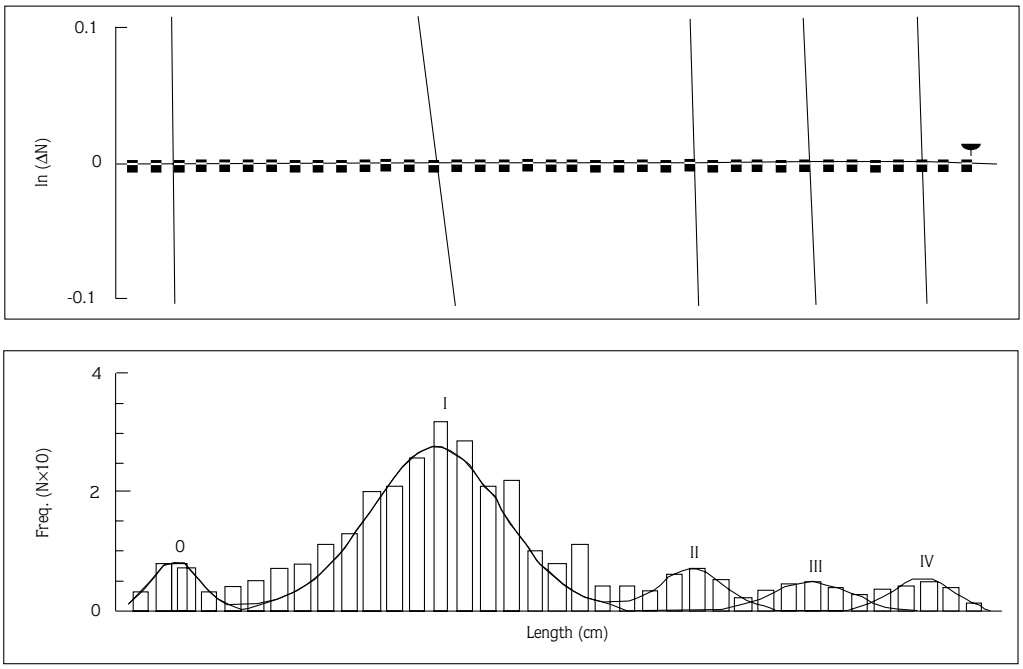

Figure 3. Year classes derived by the Bhattacharya method.

Table 1. Mean length and weight values for various ages.

Scales ± SE				Bhattacharya ± SE				
t	N	Length (cm)	Weight (g)	t	N	Length (cm)	Index of separation	Weight (g, $W = a * L^b$)
0	34	6.38 ± 0.126	2.83 ± 0.228	0	21	5.68 ± 0.116		2.02
1	181	11.12 ± 0.105	14.61 ± 0.378	1	194	11.01 ± 0.123	5.792	14.50
2	57	14.98 ± 0.185	35.83 ± 0.741	2	23	15.32 ± 0.128	5.382	38.81
3	24	18.93 ± 0.167	73.26 ± 2.705	3	18	18.66 ± 0.125	3.383	69.86
4	8	20.64 ± 0.257	94.58 ± 4.694	4	16	20.53 ± 0.159	3.358	92.90

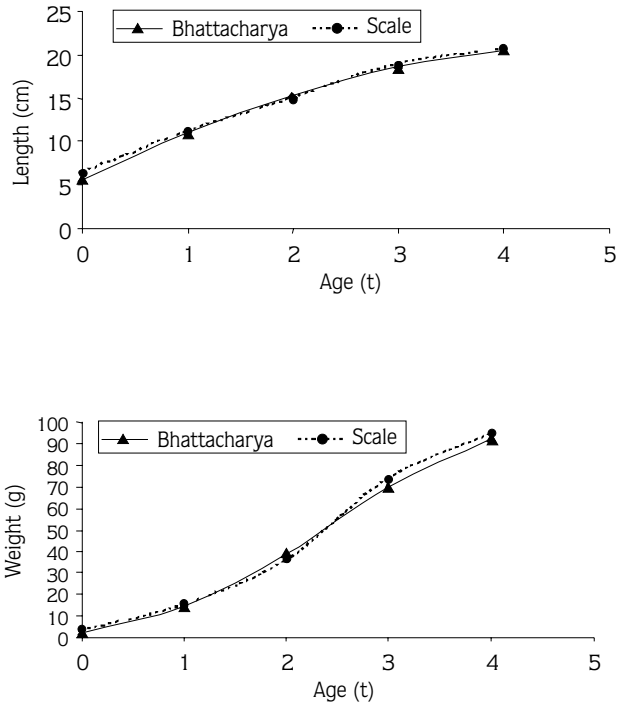

Figure 4. Age-weight and age-length relationships in *Barbus plebejus escherichi*.

Table 2. Growth parameters.

Parameter	Scales	Bhattacharya
L_∞	26.63	27.11
W_∞	203.3	214.46
K	0.274	0.267
t_o	-1.009	-1.117

The scale reading yielded equations of $L_t = 26.63 \{1 - e^{-0.274(t - (-1.009)}\}$ and $W_t = 203.3 \{1 - e^{-0.274(t - (-1.009)}\}^{2.982}$, while the equations based on Bhattacharya analysis were $L_t = 27.11\{1 - e^{-0.267(t - (-1.117)}\}$ and $W_t = 214.46 \{1 - e^{-0.267(t - (-1.117)}\}^{2.982}$. The instantaneous mortality rate was determined using age transformations from lengths. Length values were grouped (with 0.5 cm intervals) and the absolute ages (t) were calculated using the frequencies for each length group. The regression analysis was conducted for absolute ages and $Ln(N/\Delta t)$ of frequencies (Figure 5) and the equation was $Ln (N/\Delta t) = 5.70 – 1.06.t$. Here the total mortality rate Z is equal to -b, and so Z = 1.06. Natural mortality was M = 0.55 at the annual average temperature range of 4.5 to 21.8 ºC (annual mean of 11.5 ± 4.73 ºC), while fishing mortality was estimated from the equation F = Z - M as 0.51.

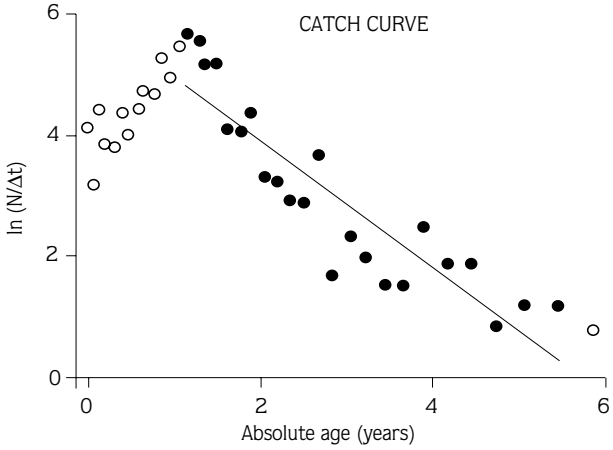

Figure 5. Total mortality rates versus absolute age.

Discussion

The size of *B. t. escherichi* in Yeşildere Stream ranged between 5 cm and 23 cm. Similar length values were reported from the rivers Kara and Şana in the region (Kutrup and Baysal, 1994). Length and weight are regarded as important growth criteria in the ecology of fish. In length-weight relationships, weight is the power of length (Ricker, 1975; Gulland, 1983; King, 1995). The correlation coefficient of length and weight was found to be 0.99. The value of b depends on ecological conditions (Ricker, 1975; King, 1995; Avşar, 1997). In this study, b was found to be 2.98, a value higher than the range of previously reported values (2.49-2.91) in many studies (Solak, 1977, 1989; Erk'akan, 1986; Baysal and Kutrup, 1990; Kutrup and Baysal, 1994; Bircan and Ergün, 1997; Yıldırım et al., 2001). The value of b, which is 2.98, was very close to the values obtained in other studies even though there are some differences in ecological conditions.

In the present study, the equation for the length-weight relationship was $W = 0.0114L^{2.9826}$ (Figure 2). The age distribution of samples varied between 0 and IV according to the Bhattacharya method and scale readings. Age group 0-I was dominant (Figure 2). Mean total lengths and weights coinciding with age classes estimated using the Bhattacharya method were compared with mean lengths and weights of age classes determined through scale reading, and Student's t results showed no significant differences ($P > 0.05$) (Table 1). Growth parameters estimated for each age group were compared with values reported by various authors (Table 3). Growth parameters obtained in the present study (Table 3) seem to be lower than those reported by various authors from different localities. These differences may have arisen from ecological differences and/or sampling.

Fishing mortality was 0.51 based on instantaneous and natural mortality rates. According to fisheries statistics (DIE, 1996-2001), there has been no fishing for this species in the area, but the results of this study indicated that some degree of fishing for this species has taken place. Fishing in all freshwaters is forbidden by Ministerial (Ministry of Agriculture and Rural Affairs) Circular. However, it is also known that illegal fishing by local people may have substantial effects on small stocks. This is in agreement with the mortality related results of the study.

In conclusion, *Barbus tauricus escherichi* in Yeşildere Stream exhibited similar growth (size) and age composition with other stocks in the region. Officially the stock is unexploited, but our study indicates some degree of fishing mortality in the stock ($F = 0.51$). Therefore, the structure of stocks in the region and fishing strategies must be determined before exploitation.

Table 3. Growth constants reported by various authors for *Barbus tauricus escherichi.*

Growth Constants					
a	b	L_∞	W_∞	K	References
0.0756	2.494	37.74	647.94	0.1254	Kutrup and Baysal (1994)
0.0192	2.8507	51.0619	1422.69	0.1937	Bircan and Ergün (1997)
0.0152	2.911	32.77	392.10	0.116	Yıldırım et al. (2001)
0.0114	2.9826	26.63	203.3	0.274	Present Study (Scale)
0.0114	2.9826	27.11	214.46	0.267	Present Study (Bhattacharya)

References

Avşar, D. 1997. Balıkçılık Biyolojisi ve Populasyon Dinamiği, No: 21, I. Basım, Baki Kitap ve Yayınevi, Adana.

Balık, S. 1979. Batı Anadolu Tatlısu Balıklarının Taksonomisi ve Ekolojik Özellikleri Üzerine Araştırmalar, Doktora Tezi, Ege Üniv. Fen Fak. İlmi Rap. Ser. 236: 1-61.

Baysal, A. and Kutrup, B. 1990. Determination of Some Growth Parameters of *Barbus Plebejus* (BON.1832) in The Şana Stream, X. Ulusal Biyoloji Kongresi, Atatürk Üniversitesi Fen-Edebiyat Fak. Biyoloji Bölümü, Erzurum.

Bircan. R. and Ergün, S. 1997. Bafra Altınkaya Barajı Gölündeki Bıyıklı Balığın (*Barbus plebejus escherichi,* Steindachner, 1897) bazı biyolojik özelliklinin incelenmesi, Doğa, Tr. Vet. ve Hay. Derg. 21: 65-72.

DİE, 2001-1996. Su Ürünleri İstatistikleri, Başbakanlık Devlet İstatistik Enstitüsü, Ankara.

Düzgüneş, O., Kesici, T. and Gürbüz, F. 1983. İstatistik Metodları I, Ankara Üniversitesi Ziraat Fakültesi Yayınları, Ankara.

Erk'akan, F. 1983. Sakarya Havzası Balıklarının Sistematiği ve Biyo-Ekolojisi Üzerine Araştırmalar, Doğa Tr. Vet. ve Hay. Derg. 7: 141-154.

Erk'akan, F. and Akgün, M., 1986. Kızılırmak Havzası ekonomik balık stoklarının incelenmesi, Doğa TU, Vet. ve Hay. Derg. 10: 239-250.

FAO, 1988. Introduction to Tropical Fish Stock Assessment, Fisheries Technical Paper, no: 306/1, Rome, 335 pp.

Gulland, J.A. 1983. Fish Stock Assessment: A Manual of Basic Methods, Wiley, New York.

Gulland, J.A. 1988. Fish Population Dynamics, the Implications for Management, Second Edition, Wiley, New York.

Karaman, M.S. 1971. Süsswasserfische der Türkei, 8, teil, Mitt. Hamburg. Zool. Mus. Inst. 67: 175-254.

King, M. 1995. Fisheries Biology Assessment and Management. Fishing News Books, UK.

Kuru, M. 1975. Dicle-Fırat, Kura-Aras, Van Gölü ve Karadeniz Havzası Tatlısularında Yaşayan Balıkların (Pisces) Sistematik ve Zoocoğrafik Yönden İncelenmesi, Doçentlik Tezi, Atatürk Üniversitesi Fen Fakültesi, Erzurum, 181pp.

Kutrup, B. 1993. Trabzon Yöresindeki Tatlısu Balıklarının Taksonomisi ve Ekolojik Özellikleri Üzerine Araştırmalar, Doktora Tezi, K.T.Ü. Fen Bilimleri Enstitüsü, Trabzon, 64pp.

Kutrup, B. and Baysal, A. 1994. Investigations of some growth features of *Barbus plebejus escherich* (STEINDACHNER, 1897) from the Kara stream, Turk. J. Zool. 18: 177-183.

Ricker, W.E. 1975. Computation and Interpretation of Biological Statistics of Fish populations. Second Edition, IDRC, Canada.

Solak, K. 1977. Çoruh-Aras Havzası, Caner ve Murzu Balıklarının (*Barbus* Türleri) dağılışında populasyon dinamiği üzerine araştırmalar, Ege Üniv. Fen Fak. Der., BI, 4: 361-374.

Solak, K. 1978. Çoruh ve Aras Havzasında yaşayan 3 *Barbus* türü, *Barbus plebejus* (BON.), *Barbus mursa* (GÜLD.), *Barbus capito* (GÜLD.), Doğa Bilim Dergisi. 11: 162-167.

Sokal, R.R. and Rohlf, F.J. 1936. Introduction to Biostatistics, Second Edition, W.H. Freeman and Company, New York.

Solak, K. 1989. Çoruh Havzasının bazı derelerinde yaşayan *Barbus plebejus escherichi* (STEINDACHNER,1897)'nin (Cyprinidae, Pisces) yaş-boy ve yaş-ağırlık ilişkileri, Doğa TU Zooloji Dergisi, 13: 39-46.

Turan, D. 2003. Rize ve Artvin Yöresinde Yaşayan Tatlısu Balıklarının Sistematik ve Ekolojik Yönden İncelenmesi, Doktora Tezi, Ege Üniv., Fen Bil. Enst. İzmir, 179 pp.

Yıldırım, A., Erdoğan, O. and Türkmen, M. 2001. On the age, growth and reproduction of the barbel, Barbus plebejus escherich (Steindachner, 1897) in the Oltu Stream of Çoruh River (Artvin Turkey), Turk. J. Zool., 25: 163-168.