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RESEARCH ARTICLE/ARAŞTIRMA MAKALESİ

Easternmost Locality Record and Morphological Data of *Cyrtopodion scabrum* (Heyden, 1827) (Squamata: Gekkonidae) in southeastern Anatolia, Turkey

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Abstract
The locality record of the Rough Bent-toed Gecko (*Cyrtopodion scabrum*) from the Silopi District of the Şırnak Province of Turkey was provided in the present study. The new locality record extended the distribution area of the species 40 km to the east. Data based on meristic pholidosis characters, metric measurements and color-patter features of the specimens from Silopi were given in detail and compared with data given in the previous literature.
Keywords: Rough Bent-toed Gecko, Pholidosis, Morphometric, Silopi, New locality

Introduction

Rough Bent-toed Gecko, *Cyrtopodion scabrum* (Heyden, 1827) is a widely distributed species of the *Cyrtopodion* genus, ranging from the African coast side of the Red Sea, through the Arabian Peninsula, Iraq, Syria, Jordan, Israel, southeastern Turkey, Iran, Azerbaijan, Afghanistan, Pakistan and localities in the Rajasthan Desert, and India (Leviton *et al.*, 1992; Dadashi *et al.*, 2009; Uetz *et al.*, 2013; Mohammed *et al.*, 2015). It was also introduced in Texas, United States of America (Werner *et al.*, 2010). It has been classified as LC (Least Concern) in the IUCN Red List since 2008 (Werner *et al.*, 2010).

Baran and Gruber (1982) aimed to clarify the relationship degrees of the species belonging to the family Gekkonidae in Turkey and they described the species, *Cyrtodactylus basoglui*. However, *Cyrtodactylus basoglui* was considered conspecific with *Cyrtopodion scabrum*. *Cyrtodactylus basoglui* is a synonym of *Cyrtopodion scabrum* (Werner *et al.*, 2010).

In Turkey, *C. scabrum* was recorded from Şanlıurfa (in the Harran, Siverek, Suruç, and Ceylanpınar districts), Mardin (in the Midyat and Nusaybin districts) and Şırnak (in the Cizre district) provinces (Baran & Gruber, 1982; Baran & Atatür, 1998; Sindaco *et al.*, 2000; Cihan *et al.*, 2003; Uğurtaş *et al.*, 2007; Baran *et al.*, 2013). Recently, the species has been reported from the Akçakale district in the Şanlıurfa Province (Çakmak, 2018).

The present study provides the easternmost locality record of *Cyrtopodion scabrum* in Turkey (Fig. 1) and all

pholidolial and other morphological characteristics belonging to two adult female individuals of the species are presented.

Material and Methods

Material: KZL-347/2019, 2 ♀♀, 04.26.2019, Cumhuriyet, Silopi, Şırnak, leg. U. BÜLBÜL, and Z. ASLAN. During a field study on 26th April 2019, 2 ♀♀ (The gekkonid lizards were sexed by sounding for the presence or absence of hemipenis pockets) individuals of *Crytopodion scabrum* were recorded from the Cumhuriyet Neighborhood, Silopi District of Şırnak Province (37°25′454″N, 42°25′585″E, 965 m a.s.l.).

The gekkonid lizards were caught on the walls of a garden around a house (Fig. 2). The garden consisted of mulberry, fig and vine trees. Because of their accidental discovery, we observed a small number of lizards. After the individuals were photographed in their natural habitat, they were anesthetized with MS 222. Then, 10% formaldehyde was injected to the specimens and they were stored in 70% ethanol. The collection number (KZL-347 for Silopi) was given to the specimens and they were placed at the Karadeniz Technical University, Biology Department, Zoology Research Laboratory.

We prepared the metric and meristic data, modifying the data obtained from the studies of Rastegar-Pouyani *et al.* (2010) and Çakmak (2018). We used a stereomicroscope to observe the morphological characters and a digital caliper to measure the morphometric characters to the nearest 0.01 mm. We obtained pholidolial features: supralabial scales (SL, left–right, posterior end defined by the last enlarged scale that touches infralabials at rear corner of mouth); infralabials (IL, left–right, posterior end defined by the posteriormost enlarged scales that contact the supralabials at the rear corner of the mouth); interorbital scales (IS, the number of scales between the eyes in the widest region); smooth scales across widest part of the belly (WB, number of scale rows around the trunk at midbody); trihedral tubercles of the dorsum (TTD, the number of trihedral tubercles across the widest part of the dorsum); trihedral tubercles (TT, the number

Figure 1. Map showing the localities of *Cyrtopodion scabrum* in Turkey. **1.** Şeyh Maksut Neighborhood, Şanlıurfa **2.** Şuayip District, Harran, Şanlıurfa **3.** Koyunluca Village, Harran, Şanlıurfa **4.** Tepedibi Village, Tektek Mountains, Şanlıurfa **5.** Osmanbey Campus, Şanlıurfa **6.** Akşemsettin Neighborhood, Şanlıurfa **7.** Devteşti Neighborhood, Süleymaniye, Şanlıurfa **8.** Osmanlı Neighborhood, Eyyübiye, Şanlıurfa **9.** Sınırgören, Akçakale, Şanlıurfa **10.** Ceylanpınar, Şanlıurfa; Suruç, Şanlıurfa, **11.** Akçatarla, Nusaybin, Mardin **12.** Nusaybin, Mardin **13.** Kızıltepe, Mardin **14.** Mardin **15.** Cizre, Şırnak **16.** Cumhuriyet Neighborhood, Silopi, Şırnak. The white colored star shows the new locality (Data from: Baran & Gruber, 1982; Baran & Atatür, 1998; Sindaco et al., 2000; Cihan et al., 2003; Uğurtaş et al., 2007; Baran et al., 2013; Çakmak, 2018).

of trihedral tubercles from behind the neck to a point just above the vent); subdigital lamellae under the 4th toe (SDL, left–right, number of 4th toe lamellae, from 1st lamella at the digit's cleft to the most distal lamella); transversal tubercles (TTMB, the number of transverse tubercles from the midbody); ventral scales (VEN, number of scales from below mental to the anterior border of the cloaca); number of the scales surrounding the nasal (SN, left-right, the scales surrounding the nasal, the number of the scales contacted by the rostral and supralabial); number of the scales between the nasal and eye (NE, left-right the number scales counted straight from the second nasal plate to the anterior part of the eye; number of the scales between the eye and tympanum (ET, left-right, the number of scales between the posterior part of the left eye and the anterior part of the tympanum opening, in the lateral part of the head); number of scales between upper labials (UL, the number of scales in single, between third upper labials); number of longitudinal dorsal tubercles (LDT, the longitudinal number of the dorsal tubercles); number of the surrounding dorsal tubercles (RDT, the mean number of scales around the five tubercles randomly selected from the dorsal); gularia (GLR, the number of the scales starting from the scales contacting the mental to the level of the posterior of the tympanum opening, in the ventral part of the head); number of the cloacal spines (CS, the spines lined symmetrically on both sides of the tail near the cloaca); number of the scales surrounding the postmental (SP, the number of the scales in contact with the postmentals).

The morphometric measurements in this study following: snout-vent length (SVL, from tip of snout to the anterior border of the cloaca); tail length (TL, from the posterior border of the cloacal opening to tip of tail); head width (HW, distance from left to right outer edge of the head at its widest point); head length (HL, from snout tip to the posterior border of tympanum); head depth (HD, dorsoventral distance from the top of head to the underside of the jaw at the transverse plane intersecting the angle of the jaws); fore limb length (FLL, from

Figure 2. A general view of the habitat of *Cyrtopodion scabrum* from Cumhuriyet, Silopi, Şırnak (Photo by Zeynep ASLAN).

shoulder joint to tip of fourth toe); hind limb length (HLL, from groin to tip of fourth toe), snout-eye length (SEL, from snout tip to the anterior border of the eye); eye-tympanum length (ETL, from the posterior border of the eye to the anterior border of tympanum); horizontal eye diameter (HEYED, the greatest diameter of horizontal eye); vertical eye diameter (VEYED, the greatest diameter of the vertical eye); horizontal ear diameter (HEARD, the greatest diameter of the horizontal tympanum) and the vertical ear diameter (VEARD, the greatest diameter of the vertical tympanum).

Results

We caught two adult female individuals between 4 and 5 p.m. on 26th April 2019. The temperature was about 17°C.

Pholidolial characteristics: The number of supralabial scales (left-right) was 10-10 in both specimens. 9-8 (left-right) infralabial scales were counted in both specimens. The number of lamellae under the 4th toe was 26-24 (left-right) in the first female specimen while it was 24-24 in the second one. The longitudinal tubercles on the dorsum were small and keeled. The number of scales (left-right) between the posterior part of the left eye and the anterior part of the ear opening, in the lateral part of the head was 18-18 in the first female specimen while it was 24-24 in the second one. The number of scales in contact with the postmentals was 10 in both specimens. The scales (left-right) surrounding the nasal, the scales contacted by rostral and supralabial was 1-1 in both specimens. The mean number of scales around the five tubercles randomly selected from the dorsal was 10.8 in the first female specimen while it was 9.6 in the second one.

Morphometric measurements: SVL was 36.68 mm and 34.38 mm for the first and second female individuals, respectively. Tail length was 88.33 mm and 80.05 mm, respectively. Head wide was 8.17 mm and 7.67 mm, respectively. Head length was respectively 13.33 mm and 11.07 mm, respectively. Horizontal eye diameter (left-right) was 2.70-2.73 in the first female specimen while it was 2.62-2.64 in the second one. Vertical ear diameter (left-right) was 1.36-1.33 in the first female specimen while it was 1.19-1.17 in the second one. The distance between the nostril and eye (left-right) was 3.12-3.74 in the first female specimen while it was 3.08-3.62 in the second one.

The metric and meristic characteristics of the collected specimens are given in Table 1.

Color-pattern: In the specimens of *C. scabrum*, the color of the back side was usually whitish. There were dark brown spots on the dorsum of the first female while these spots were light brown in the second female. The tubercles on the dorsal were white, brown and cream colors while they were white and brown colors in the second female. The ventral color was usually cream and white in both specimens. Dark brown colored bandings were observed in the tail of both specimens. The tubercles on the tail were white and light brown and the lower side of the tail had a white color in both specimens (Fig. 3).

Up to now the species has been reported from Şanlıurfa, Mardin and Şırnak (from the Cizre District) provinces of Turkey (Baran & Gruber, 1982; Baran & Atatür, 1998; Sindaco *et al.*, 2000; Cihan *et al.*, 2003; Uğurtaş *et al.*, 2007). In the present study, we reported the easternmost locality record of *C. scabrum* in Turkey. The findings of the present study indicate that the individuals of the species can be found in other provinces having suitable habitats in the Southeastern Anatolian region of Turkey.

Diagnostic characteristics of the species: longitudinal concavity in the frontal region of the head, usually 30 scales between the centers of the eyes, pupil vertical with anterior and posterior margins, two or three pairs of postmental shields, the first pair usually in contact behind the mental, clawed and slender digits, three or more rows (generally) of lateral scales on digits, a single series of smooth transverse subdigital lamellae, end of digit weakly or not at all laterally compressed, no fringes or denticulations on the lateral digital scales, distal two or three phalanges make an angle with the proximal portion of the digits and males with preanal and/or femoral pores; segmentation of tail pronounced (Leviton *et al*., 1992).
Morphological and morphometric data belonged to the specimens of Silopi were compared to those of the samples of *C. scabrum* observed in the studies of Anderson & Leviton (1969); Haas & Werner (1969); Baran & Gruber (1982); Rösler & Glaw (2009); Rastegar-Pouyani *et al.* (2010); Nazarov *et al*. (2011); Nazarov *et al*. (2012); Mohammed *et al*. (2015a); Mohammed *et al*. (2015b) and Çakmak (2018).

The numbers of SL, IL and TTMB were higher and the number of VEN was lower in the samples of Baran & Gruber (1982) when compared our data. The morphological and morphometric data belonged to the specimens from the Southeastern Anatolia populations in the study of Çakmak (2018) were also compared to our samples. RDT appeared lower while TL was higher in our two specimens. TT and UL were lower in only

one sample of the Silopi population. In addition, TL appeared higher while SEL and ETL were lower in our samples than in the specimens of Rösler & Glaw (2009). When we compared our data to the specimen of Rastegar-Pouyani et al. (2010), the different characteristics were only SDL (lower in Rastegar-Pouyani et al. 2010) and TTD (lower in one specimen of Silopi). TL was higher in the Silopi population than in those of the samples of *C. scabrum* observed in the studies of Nazarov *et al*. (2011); Nazarov *et al*. (2012);

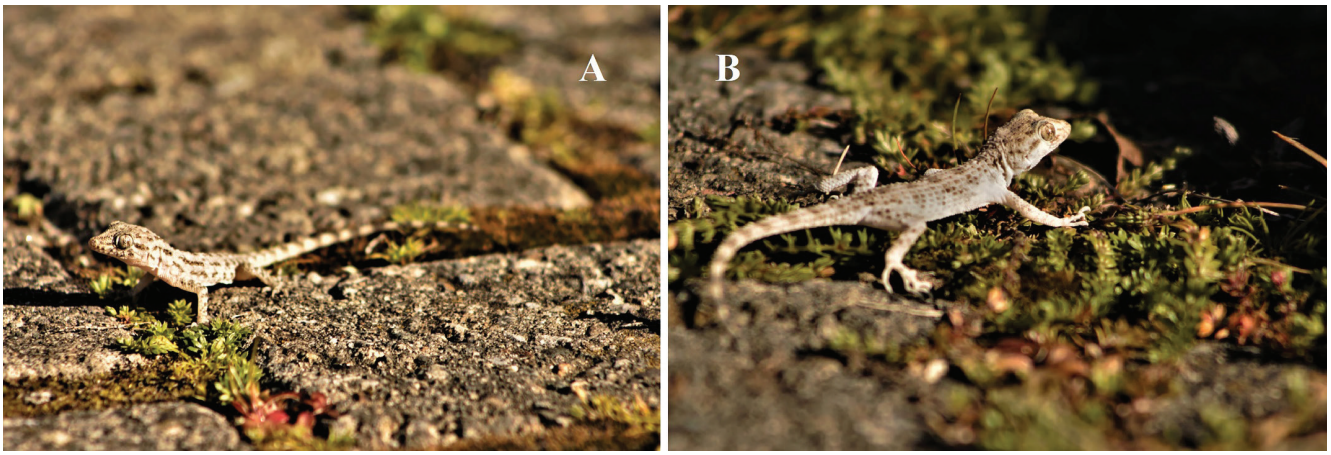

Figure 3. Two female specimens of *Cyrtopodion scabrum* in the studied population. **A.** The first female specimen, **B.** The second female specimen (Photo by Halime KOÇ).

Table 1. Descriptive statistics of some pholidolial characteristics and morphometric measurements of *Cyrtopodion scabrum* specimens collected from Silopi-Şırnak. L represents left and R represents right. For abbreviations see text.

Character	Rastegar-Pouyani et al. (2010)	Çakmak (2018)		This study	
	1 adult ♂♂	27 ♂♂ (min-max)	30 ♀♀ (min-max)	1st ♀♀	2nd ♀♀
SL (L-R)	9-9	9-11;9-11	8-11;9-11	10-10	10-10
IL (L-R)	9-9	7-9;7-9	7-10;7-10	9-9	8-8
IS	15	9-15	9-15	16	15
WB	20-21	-	-	21	20
TTD	13-14	-	-	14	13
TT	28-29	-	-	28	26
SDL (L-R)	20-21	22-25;22-26	22-26;22-28	26-24	24-24
TTMB	-	10-11	9-11	12	12
VEN	-	16-21	14-24	24	23
SN (L-R)	-	5-5	5-5	5-5	5-5
NE (L-R)	-	10-16;10-14	10-14;9-15	12-12	12-12
ET (L-R)	-	15-20;15-21	14-23;15-23	18-18	18-17
UL	-	14-19	14-19	14	13
LDT	-	10-11	9-11	12	11
RDT	-	13-16	12.5-17	10,8	9,6
GLR	-	34-45	33-43	38	38
CS	-	1-2	1-2	1	1
SP	-	9-16	9-16	10	10
SVL (mm)	44.6	31-51	31-55	36.68	34.38
TL (mm)	-	38-65	37-71	88.33	80.05
HW (mm)	8.2	6.45-9.72	5.49-11.62	8.17	7.67
HL (mm)	11.4	8.74-14.72	8.49-14.68	13.33	11.07
HD (mm)	6.5	3.57-7.23	3.38-7.96	6.09	5.11
FLL (mm)	21.3	-	-	21.04	20.02
HLL (mm)	28.4	-	-	28.11	27.03
SEL (L-R) (mm)	-	2.44-4.6;2.96-4.52	2.57-4.54;2.86-5.16	3.12-3.74	3.08-3.62
ETL (L-R) (mm)	-	2.8-4.51;2.74-4.57	2.79-4.98;2.54-4.95	3.98-3.96	3.20-3.17
HEYED (L-R) (mm)	-	2.26-3.76;2.46-3.69	2.22-3.61;2.28-3.82	2.70-2.73	2.62-2.64
VEYED (L-R) (mm)	-	1.53-3.09;2.09-3.06	1.98-3.36;1.4-3.35	2.04-2.02	1.98-1.96
HEARD (L-R) (mm)	-	0.18-1.7;0.17-1.72	0.25-1.94:0.18-1.7	0.64-0.62	0.59-0.57
VEARD (L-R) (mm)	-	0.34-1.38;0.42-2.03	0.5-2.18;0.36-2.09	1.36-1.33	1.19-1.17

Mohammed *et al*. (2015a); Mohammed *et al*. (2015b). Finally, our data appeared similar to those of the samples observed in the studies of Anderson & Leviton (1969) and Haas & Werner (1969).

We used a very low number of the specimens. Comprehensive observations, including more individuals are necessary to compare the Silopi population with other Anatolian populations. Future detailed surveys from Silopi to the east and north may reveal the new localities of the species in the Southeastern Anatolian region of Turkey.

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RESEARCH ARTICLE/ARAŞTIRMA MAKALESİ

Characterization and Potential Applications of Heterotrophic Bacteria Inhabit Nickel Rich Soils in Çanakkale, Turkey*

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Abstract
Microorganisms inhabit extreme environments such as high nickel rich soils are novel in terms of diversity and also valuable source of extracellular hydrolytic enzymes. The present study focused on isolation and characterization of heterotrophic bacteria from Nickel rich soils in Çanakkale, using culture dependent method and assessment of their heavy metal, antibiotic resistance and potential for production of some industrially important enzymes. Total 35 bacterial isolates were characterized morphologically, biochemically and these analysis of strains revealed that these strains were able to grow between 4-50 °C. These isolates also showed high heavy metal and antibiotic resistance and ability to produce one or more extracellular enzymes like amylase, protease, lipase and DNAse. Thus, the isolates from Ezine, Çanakkale could be potential candidates for industrial applications.

Keywords: Soil bacteria, Nickel, Heavy metal, Antimicrobial sensivity, Enzymatic activity

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Introduction

Heavy metals which are the most important pollutant sources in terms of soil pollution. They mixed and accumulated in soils led to many environmental and human health problems ranging from microbial activity, soil fertility, biodiversity and yield losses of products, food chain through to poisoning (Özay & Mammadov, 2013). Nickel (Ni) metal is one of these chemicals; it is classified by the Environmental Protection Agency (EPA), as one of 129 important pollutants and 14 important toxic heavy metals (EPA, 2002). In addition, nickel is considered to be one of the 25 important compounds which are poisonous to human health.

Ni-containing plants are called high-level metal accumulators (hyper accumulators). This term represents a concentration 100 times higher than the maximum expected for non-accumulating species grown in serpentines (Brooks, 2000). More than half *Alyssum* taxa of the Flora of Turkey, has high levels of heavy metal accumulation properties. Some of the regions in the Ezine district of Çanakkale are very important areas for the development of

the *Alyssum pinifolium* (Nyar, T.R. Dudley) plant. As a result of the soil analyzes performed by Esen (2016), the structure of the soil of the Ezine Road is fertile, the salinity 0.33 dS/m (without salt), the pH 7.52 (slightly alkaline), the lime 0.81 % (low), the organic matter 0.85 %. (low), phosphorus 3.99 kg/da (low), potassium 13.95 kg/da (low), calcium 810 ppm (low), magnesium 619 ppm (medium), sodium 399 ppm (high), iron 7.62 ppm (very high), copper 0.22 ppm (low), manganese 5.44 ppm (medium), zinc 0.17 ppm (low), and nickel 1702 mg/g (very high) was determined. In addition, the amount of nickel collected in the plant samples obtained from the *A. pinifolium* distribution areas was analyzed: 1781 mg/g in the Ezine road population (Esen, 2016).

It is possible to develop new technologies from these adapted organisms by reducing the amount of nickel in soil and water, especially by understanding the metabolic activities of nickel-related microorganisms. Therefore, it is important to know the microbial diversity in these areas. In this study, it was aimed to determine the bacterial diversity in nickel-containing *A. pinifolium* soils and to determine some biochemical properties, environmental requirements and antibiotic-heavy metal resistance and enzymatic activities of isolates that could be used in possible Ni bioremediation.

Material and Methods

Site description and sample collection

The region which covers about 3208 m^2 and found species of *A. pinifolium* in slope with serpentine soil (39º 52'N and 26º 19'E) by the highway where locate 6 km North away from Ezine district of Çanakkale province (Table 1). Appointed soil samples were collected from 10 cm depth of soil surface with the help of sterile spatula from different five locations that *A. pinifolium* exists and transferred into sterilized polythene bags and transported aseptically to laboratory.

Isolation and purification of bacterial isolates

10 g of collected soil samples were suspended in 90 g distilled water 0.90% and the suspension were made 10^{-5} fold serial dilution. 100 µL of each fold was transferred to appropriate growth medium. Nutrient Agar and Tryptic Soya Agar were used for bacterial isolation. The plates were incubated at 35 ± 2ºC for 24 h (Tamer et al., 1989). The colonies grown on the plates were purified by successive streaking on nutrient agar plates. Isolated bacterial strains were then stored at 4ºC in refrigerator for further study.

Biochemical characterization

The pure cultures were obtained. The appearance of colony such as shape, color was observed by magnifying lens (10X) with the simple strain technique after the growth of isolated strains. Gram staining process was performed according to the method determined by Bozkurt (2016). A series of basic biochemical tests were performed with oxidase, catalase, indole, citrate, voges proskauer (VP), methyl red (MR) test and Kilger's iron agar (KIA) test (Tamer et al., 1989).

Determination of physiological growth characteristics of isolates

Isolates transferred to calibrated medium for determining the appropriate growth requirement such as pH, temperature, salt, using carbon resource by using culture dependent method as described previously by Bozkurt (2016). The effect of pH on growth of isolates was tested with the pH range from 5.0 to 11.0. The temperature range for optimum growth was determined by incubating the isolates from 4 to 50ºC (Bozkurt, 2016). The effect of the salt on growth of isolates was tested with the salt range from 2.0 to 23.0% (Karaboz & Ozcan, 2005).

Table 1. Location, altitude and coordinates of soil samples.

Samples	Location	Altitude	Coordinates
I	Ezine/Çanakkale (Near of Araplar strait)	111 m	39.873416 N 26.323919 E
II	Sarımsaklı bridge, Kendirlik site	55 m	39.840276 N 26.320107 E
III	Araplar strait, Ahlatlı site	50 m	39.853860 N 26.318425 E
IV	Menderes Mountain	273 m	39.960355 N 26.374708 E
V	Ovacık, Küçük Uludağ	423 m	39.982499 N 26.416317 E

Antibiotic sensitivity testing

Susceptibility testing was performed by an agar diffusion method (Bauer et al., 1966), using Mueller–Hinton Agar (Oxoid) and 15 antibiotic discs: Sulfamethoxazole (SMZ100), Oxytetracycline (T30), Cephotaxime (CE30), Cefoxitin (CN30), Trimethaprim (TR10), Cephalothin (CH30), Chloramphenicol (C30), Kanamycin (K30), Furazolidone (FR50), Cefmetazole (CMZ30), Tobramycin (TB10), Erythromycin (E15), Ampicillin (A10), Gentamicin (G120), Amoxicillin (AX25). The isolates were determined to be sensitive to antibiotics according to the information supplied by the manufacturer (NCCLS, 2007). Reference strain of *Escherichia coli* ATCC 11230, were used as control organisms for verification of the antibacterial effect of the discs.

Determination of the MIC of heavy metals

The minimal inhibitory concentration (MIC) for each bacterial isolate for seven heavy metals was determined by using Mueller–Hinton Agar which is containing Cd^{2+}, Cr^{3+}, Cu^{2+}, Ni^{2+}, Mn^{2+}, Pb^{2+}, and Zn^{2+} at concentrations ranging from 100 to 12800 µg/mL. The metals were added as $CdCl_2.2H_2O$, $K_2Cr_2O_7$, $CuSO_4.5H_2O$, $Ni(CO)_4$, $MnCl_2.2H_2O$, $Pb(NO_3)_2$ and $ZnCl_2$. The isolates were considered resistant if the MIC values exceeded that of the *E. coli* K-12 strain which was used as the control (Matyar et al., 2008).

Screening of isolates for extracellular hydrolytic activities

All isolates were examined for their enzyme activity like DNase, lipase, protease and amylase by using standard methods (Sokol et al., 1979; Collins et al., 1989; Collins et al., 2003).

Results

A total of 35 bacteria were isolated from five stations soil samples. According to Gram staining reaction, 31 Gram positive and 4 Gram negative, rod shaped isolates were determined. 34 bacteria have endospore structure; 5 bacteria were found to be oxidase positive and 14 bacteria to be catalase positive. All to bacteria were found give results for indole test (+/-), 15 bacteria citrate tests were positive, 24 bacteria were tested for methyl red positive and 29 bacteria were tested for VP test positive (Table 2).

All isolates showed optimum growth in the temperature range of 20-37°C. 20 isolates at 4 °C; 9 isolates did not grow at 50 °C (Fig. 1). The optimum pH range for growth of all strains was observed 5.0 to 11.0, except 1T1 and 3T13 (at pH 9) and 4T30 (at pH 11) (Fig. 1). Isolates growth rate at different salt concentrations was examined; these rates were 100%, 80%, 25.71%, 31.42% at the salt concentration of 2%, 6%, 12%, 18%, respectively. There was no growth at the salt concentration of 23% (Fig. 2).

It was found that most effective antibiotic was G120 and about 94.28, 85.71, 82.85 and 80% of the isolates were resistant to CN30, A10, T30 and CMZ30, respectively (Fig. 3).

Results of heavy metal resistance of isolates were shown in Figure 4. The highest concentration of Cd^{2+}, Cr^{3+}, Cu^{2+}, Ni^{2+}, Mn^{2+}, Pb^{2+}, Zn^{2+} metals which observe the bacteria growth are 40%, 17.14%, 17.14%, 17.14%, 31.42%, 8.57%, 20%, respectively.

The isolates were tested for their ability to produce four industrially important hydrolytic enzymes (Table 3). Interestingly, it was noted that except 5N12 and 3N2, all other strains showed multi hydrolytic enzyme production ability. 28 isolates showed the ability to produce also 4 enzymes. 5 bacteria showed the ability to produce 3 enzymes and 2 bacteria just showed the ability to produce 1 enzyme (Table 3).

Discussion

Nowadays, the increasing industrialization rate in the world is threatening for the quality of abiotic resource such as soil, water and atmosphere. Contaminating of ecosystem and the amount of toxic and dangerous substance has been increased by using of industrial activities and the application of various chemicals (Eghomwanre et al., 2016). Toxic metals, including extremely basic metals, disrupt their biological structures and systems into reversible or irreversible compatibility, leading to the impaired organ function or ultimate death. The environment contains less amount of Ni which known heavy metal. Environmental pollution increase day by day because of the using of vast industrial of nickel containing material production includes recycling and disposal of them. By Ni mining or by various industrial processes, power plants or incinerators, rubber and plastic industries, nickel-cadmium battery industries and electroplating industries are caused of charging of Ni into the atmosphere. The widespread using or occupational exposure of Ni in various industries is definitely a matter of serious impact on human health.

There are many studies where new isolates with different isolates and conditions are adapted to different soils, such as

Table 2. Morphological features and biochemical characteristic of isolates (+: positive; -: negative; Y = yellow (acid), P = pink (alkaline), Black = H_2S)

Station	Isolate	Characteristics											
		Gram staining	Shape	Endospore	Oxidase	Catalase	Indole	Citrate	KIA			MR	VP
									Slant	Butt	Gas		
I	1N4	+	Rod	+	-	-	+/-	-	alkaline	acid	-	+	-
	1N5	+	Rod	+	-	+	+/-	-	alkaline	alkaline	-	+	+
	1N7	-	Rod	+	-	+	+/-	+	alkaline	acid	-	+	+
	1N18	+	Rod	-	+	+	+/-	+	alkaline	acid	-	+	+
	1T1	+	Rod	+	-	+	+/-	-	alkaline	acid	-	+	+
	1T2	+	Rod	+	+	-	+/-	-	alkaline	alkaline	-	+	+
	1T3	+	Rod	+	-	-	+/-	-	alkaline	acid	-	+	+
II	2N15	-	Rod	+	-	+	+/-	+	alkaline	acid	-	+	+
	2N19	+	Rod	+	-	-	+/-	-	alkaline	alkaline	-	+	+
	2T4	+	Rod	+	-	+	+/-	+	alkaline	acid	-	-	-
	2T6	+	Rod	+	-	+	+/-	-	alkaline	alkaline	-	+	+
	2T24	+	Rod	+	-	-	+/-	+	alkaline	acid	-	-	+
III	3N1	+	Rod	+	-	+	+/-	-	alkaline	acid	-	+	+
	3N2	-	Rod	+	-	+	+/-	+	alkaline	acid	-	+	+
	3N3	+	Rod	+	+	-	+/-	-	alkaline	alkaline	-	-	+
	3N17	+	Rod	+	+	-	+/-	-	alkaline	acid	-	-	-
	3T13	-	Rod	+	-	-	+/-	+	alkaline	alkaline	-	+	-
	3T14	+	Rod	+	-	-	+/-	+	alkaline	alkaline	-	+	+
IV	4N9	+	Rod	+	-	-	+/-	+	acid	alkaline	-	+	+
	4T9	+	Rod	+	-	+	+/-	-	acid	acid	-	+	-
	4T10	+	Rod	+	-	-	+/-	-	alkaline	acid	-	-	+
	4T12	+	Rod	+	-	+	+/-	-	alkaline	acid	-	+	-
	4T26	+	Rod	+	-	-	+/-	+	alkaline	acid	-	+	+
	4T27	+	Rod	+	-	+	+/-	-	alkaline	alkaline	-	-	-
	4T30	+	Rod	+	-	-	+/-	+	alkaline	acid	-	+	+
	4T31	+	Rod	+	+	-	+/-	+	alkaline	alkaline	-	-	-
	4T32	+	Rod	+	-	+	+/-	-	alkaline	alkaline	-	-	-
V	5N12	+	Rod	+	-	+	+/-	-	alkaline	acid	-	-	-
	5N13	-	Rod	+			+/-	-	alkaline	acid	-	-	-
	5N14	+	Rod	+	-	-	+/-	-	alkaline	acid	-	+	+
	5T15	+	Rod	+	-	-	+/-	+	alkaline	acid	-	-	-
	5T17	+	Rod	+	-	-	+/-	-	alkaline	alkaline	-	+	+
	5T19	+	Rod	+	-	-	+/-	-	alkaline	acid	-	+	-
	5T20	+	Rod	+	-	-	+/-	+	alkaline	alkaline	-	+	-
	5T28	+	Rod	+	-	-	+/-	+	alkaline	acid	-	+	-

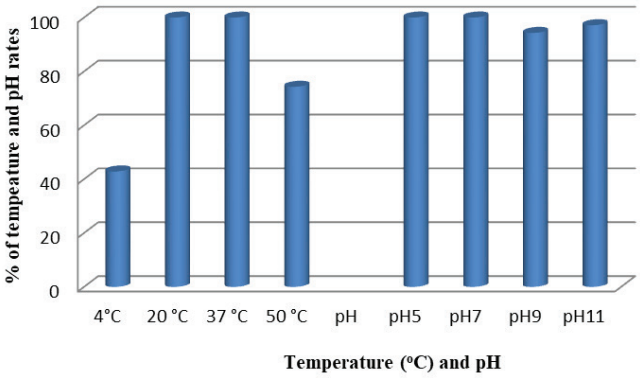

Figure 1. Percent of temperature and pH growth range of isolated soil bacteria.

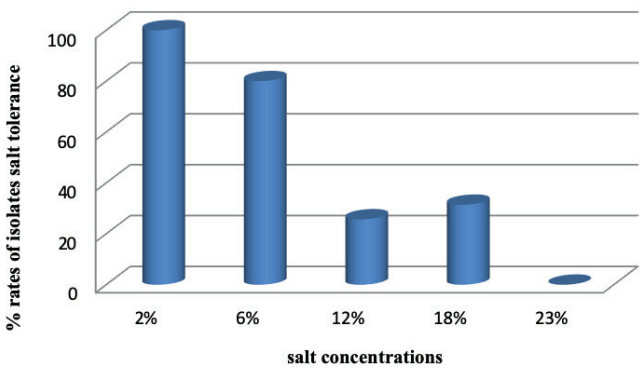

Figure 2. Percent of salt tolerance of isolated soil bacteria.

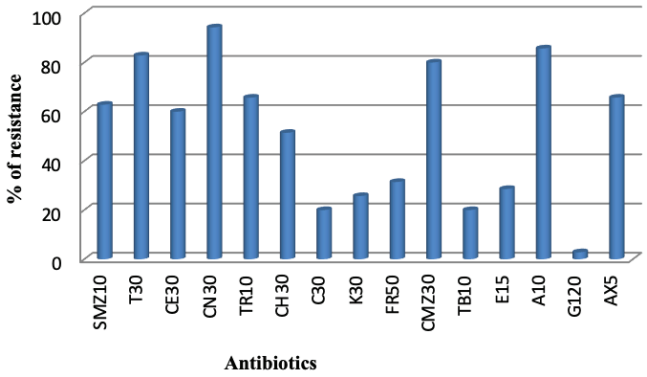

Figure 3. Percent of antibiotic resistance against isolated soil bacteria.

heavy metal chemicals or extreme physical conditions (Gülcan, 2006; Sevgi, 2007; Saraç et al., 2008; Dülger, 2012; Eghomwanre et al., 2016; Neelam et al., 2018).

Neha et al. (2015) isolated and identified heavy metal resistant bacteria from petroleum soil of Loni and found that the strains showed diverse metabolic pattern of carbon sources and other growth factors. They also showed tolerance to other heavy metals, such as copper, lead and nickel.

Eghomwanre et al. (2016) researched some selected bacteria that are from contaminated soils and sediments around Warri area of Delta State, for the tolerances of antibiotic resistance patterns and heavy metals such as Pb, Zn, Cd and Fe. The most resistant isolates were

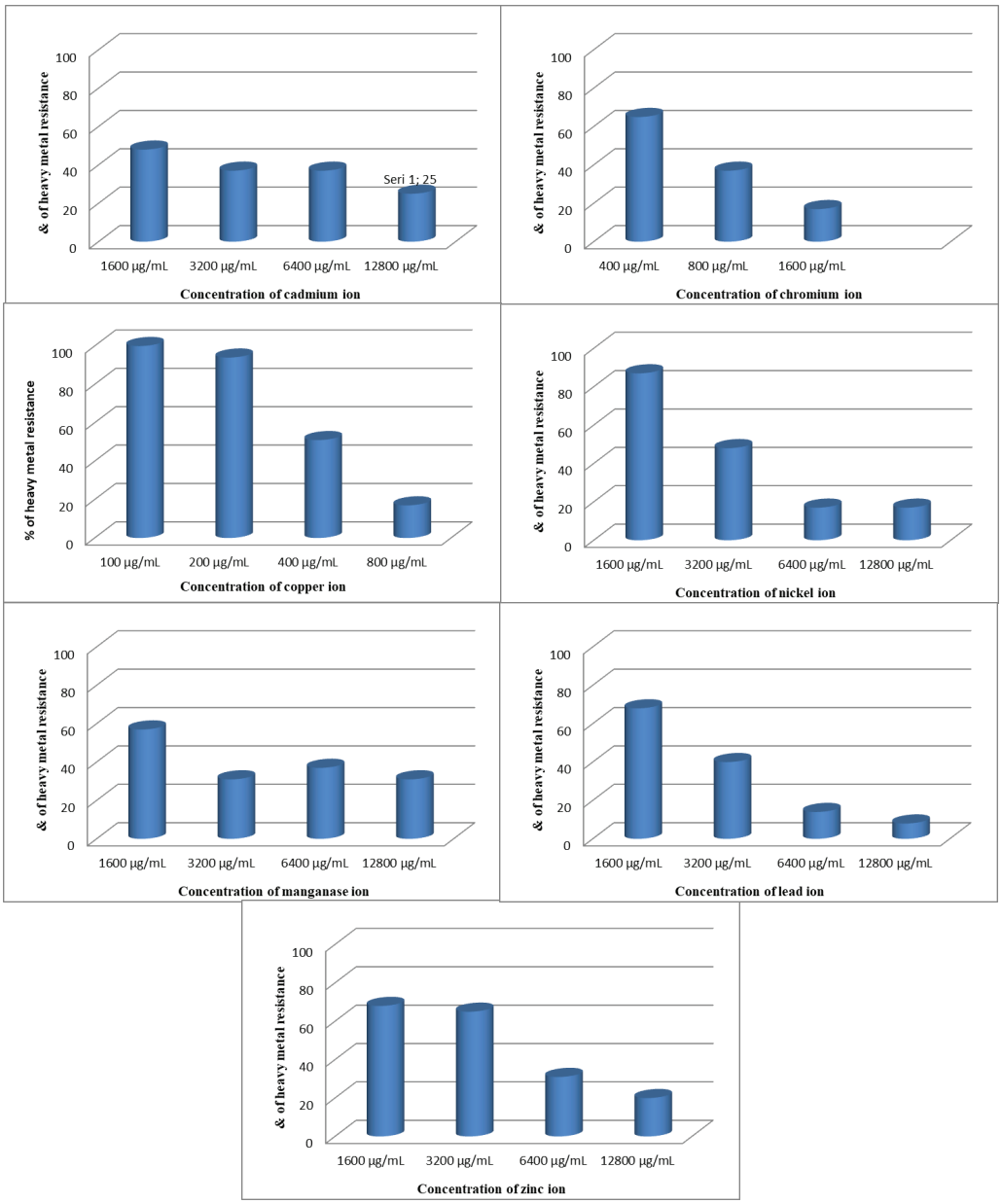

Figure 4. Percent of heavy metal resistance of isolated soil bacteria.

Table 3. Screening of industrially putative enzymes from isolated soil bacteria (+: positive; -: negative)

Isolates no	DNAse	Lipase	Protease	Amylase
1N4	+	+	+	+
1N5	+	+	-	+
1N7	+	+	+	+
1N18	+	+	+	+
1T1	-	+	+	+
1T2	+	+	+	+
1T3	+	+	+	+
2N15	+	+	+	+
2N19	+	+	+	+
2T4	+	+	+	+
2T6	+	+	+	+
2T24	-	+	+	+
3N1	+	+	+	+
3N2	-	-	-	+
3N3	+	+	+	+
3N17	+	+	+	+
3T13	+	+	+	+
3T14	+	+	+	+
4N9	+	+	+	+
4T9	+	+	+	+
4T10	+	+	+	+
4T12	+	+	+	+
4T26	+	+	+	+
4T27	+	+	+	+
4T30	-	+	+	+
4T31	+	+	+	+
4T32	+	+	+	+
5N12	-	-	-	+
5N13	-	+	+	+
5N14	+	+	+	+
5T15	+	+	+	+
5T17	+	+	+	+
5T19	+	+	+	+
5T20	+	+	+	+
5T28	+	+	+	+

Staphylococcus aureus, *Escherichia coli* and *Pseudomonas aeruginosa* from the experiment of multiple drug resistance on the bacterial isolates; while *Klebsiella mobilis* exhibited the least resistance. At different concentrations of Pb and Cd, all the bacterial isolates exhibited various degree of sensitivity; meanwhile the organisms showed abundant and moderate growth in the Fe and Zn even at higher concentrations. Our results show similarities with these studies. In the present study high degree of heavy metals resistance associated with multiple heavy metals was detected in Ni rich soil bacteria. These metal resistant bacteria can be utilized in bioremediation of metal contaminated environments. In addition to heavy metal resistance, our isolates have high antibiotic resistance and enzymatic activity. Inimitableness and characteristics of them could be used as agents of potential bioremediation for taking out the heavy metals from the environment and source of industrial enzymes. More studies are required to assess the heavy metal extraction ability of those isolates.

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RESEARCH ARTICLE/ARAŞTIRMA MAKALESİ

Food overlap between *Vimba vimba* (L., 1758) and *Scardinius erythrophthalmus* (L., 1758) in Büyükçekmece Reservoir (Turkey)

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Abstract
The feeding habits of two omnivorous fish species, *Vimba vimba* (L., 1758) and *Scardinius erythrophthalmus* (L., 1758) from the Büyükçekmece Reservoir (Turkey) were investigated through stomach content analyses. Samplings were carried out monthly to describe the dietary composition of two species and to assess whether it overlapped. The diet spectrum of *V. vimba* consisted of eight prey categories: Diptera, Insecta extremities, plants, Cladocera, Bivalvia, Ostracoda, Pisces and detritus. Detritus has the highest value in terms of modified index of relative importance and it was followed by Insecta. The diet composition of *S. erythrophthalmus* consisted of four prey categories: Insecta extremities, plants, Bivalvia and detritus. Plant has the highest value in terms of modified index of relative importance and it was followed by detritus. No dietary overlap was detected, except for the fish collected in spring. Fractional trophic level (TROPH) and its standard error (SE) were estimated as 2.62±0.25 for *V. vimba* and 2.45±0.19 for *S. erythrophthalmus*.
Keywords: Diet, freshwater fish, omnivorous, feeding, lake

Introduction

Studying trophic relationships among fishes is important for better understanding the role of fish in the food network, prey-predatory interactions, fish farming and biomanipulation processes. Additionally, investigations of diet in fish assemblages in a particular area allow understanding the ecological mechanisms by which a several number of species are able to coexist in the same community and the manner in which food is shared (Novakowski et al., 2008).

Shallow lakes with a high surface area relative to their volume tend to be productive because frequently mixing of external and internal nutrients from top to bottom enriches its productivity (Drake et al., 2011; Peel et al., 2019). Within this context, they constitute important habitats for fish assemblages with complex trophic interactions. Especially omnivorous fishes living in the shallow and productive lakes are able to consume alternative food sources and may show large diet modification (Blanco et al., 2003).

Büyükçekmece Reservoir is located in the northwest of Turkey, and is one of the special shallow lake ecosystems with its drastic change from past to present; while it was a lagoon connected with the Sea of Marmara in the past, its sea connection was blocked by a dam construction in 1985, and this lagoon became a freshwater lake over time (Özuluğ, 1999). The main freshwater inlet is the Stream Karasu; other sources are some small-scale streams and surface waters. In this

reservoir, the species composition has also shown a rapid alteration in parallel with the drastic change of the environmental conditions. Freshwater fish species living in the tributaries of the reservoir has become dominant in the lake over time. However, marine species such as *Pomatomus saltatrix* (L., 1766) and *Engraulis encrasicolus* (L., 1758) has eliminated from the lake. Recently, the invasive gibel carp, *Carassius gibelio* (Bloch, 1782) has been introduced into the lake in the early 1990s (Özuluğ, 1999) and has increased its population in time (Saç & Okgerman, 2015).

One paper investigated the diet of zooplanktivorous *Clupeonella cultriventris* (Nordmann, 1840) in the Büyükçekmece Reservoir (Saç, 2012). To the best of author's knowledge, there have been no other studies in the lake, which demonstrate and/or compare the feeding of native fish. This paper, therefore, attempts to evaluate, for the first time, the ontogenetic and seasonal dietary patterns of native *Vimba vimba* (L., 1758) and *Scardinius erythrophthalmus* (L., 1758) and to investigate whether there is a significant overlap between their diet composition in the Büyükçekmece Reservoir, where the environmental conditions and the fish fauna have dramatically changed over time.

Material and Methods

Fishes were collected monthly from March 2009 to February 2010 from the Büyükçekmece Reservoir using gillnets with different mesh sizes (10×10 mm, 20×20 mm, 30×30 mm, 40×40 mm and 50×50 mm). Gillnets were hauled parallel to shore and the sampling was conducted in darkness approximately on a 10-12 h timescale. Immediately after capture, alive fish specimens were killed with an overdose of clove oil and then transferred to the laboratory in cold conditions (portable freezer, -18°C) for further examinations. Fish samples were measured to the nearest 0.1 cm for fork length (FL) and total body weight (W) was weighed on a digital balance with a 0.01 g accuracy.

To determine the diet composition, fish were dissected and the digestive tracts were removed and fixed in a 4% formaldehyde solution before examinations. The prey items were identified to the lowest possible taxonomic level under a binocular microscope, thereafter dried at 80˚C (2–4 h) and weighted to the nearest 0.0001 g. The modified index of relative importance (MI%) of each food items were calculated according to Castriota et al. (2005) as follows:

$MI\% = [(F\% \times W\%)/\Sigma(F\% \times W\%)] \times 100$, where F% is the percentage of frequency of occurrence [(number of digestive tracks containing a food item/total number of digestive tracks with food)×100], and W% is the percentage gravimetric composition. The index was estimated for both length classes (6.0–8.9, 12.0–14.9, 15.0–17.9, 18.0–20.9, 21.0–23.9) and seasons in two fish species. According to the literature, an average interval of 3 cm can represent age classes for both species (Czerniejewski et al., 2011; Gürsoy Gaygusuz, 2018). Fractional trophic level (TROPH) and its standard error (SE) were estimated for each of the seasons and length classes, using the ACCESS stand-alone application TROPHLAB (Pauly et al., 2000).

Schoener' Index (a) was used to assess dietary overlap among length classes and seasons (Schoener, 1970) as follows; $a=1-0.5(\sum(P_{xi}-P_{yi}))$, where P_{xi} and P_{yi} are the points proportions of food category *i*, in the diets group *x* and group *y*. The index ranges from 0 (no overlap) to 1 (total overlap); the overlap value of $a \geq 0.6$ is considered to be biologically significant in terms of prey items consumed by groups *x* and *y* (Macpherson et al., 2010). Considering the low individual numbers corresponding to each length classes, the samples were gathered into three length classes (15.0–17.9, 18.0–20.9, 21.0–23.9 cm) for food overlap analysis. Where appropriate, data are presented as the mean ± SD (standard deviation).

Results

Diet of *V. vimba*

During the sampling period, a total of 258 *V. vimba* specimens were captured from the reservoir. The fork length of the specimens ranged from 6.4 to 24.4 cm (mean 16.5 ± 3.9 cm) and the body weight from 3.66 to 269.4 g (mean 76.0 ± 53.6 cm).

Of the total stomachs, 163 (63.2%) were empty. The diet spectrum of *V. vimba* consisted of eight prey categories: Diptera, Insecta extremities (unidentified), plants (terrestrial plant and algae), Cladocera, Bivalvia, Ostracoda, Pisces (eggs and larvae) and detritus. Detritus has the highest value in terms of modified index of relative importance (69.02%), the percentage gravimetric composition (56.0%) and the percentage of frequency of occurrence (64.06%), and it was followed by Insecta with the values of 24.96% (MI%), 25.95% (W%) and 50.0% (F%) (Table 1). The values of the index of relative importance (MI%) among length classes and seasons

were given in Table 2 and Table 3. In all seasons and length classes, the major foods of *V. vimba* were detritus. The diversity of food items in the diet of fish has increased with an increase in fish length. Fractional trophic level (TROPH) and its standard error (SE) were estimated as 2.62±0.25 and the values for each of the seasons and length classes were given in Table 2 and Table 3.

Diet of *S. erythrophthalmus*

A total of 305 *S. erythrophthalmus* specimens were collected from the reservoir. The FL of the specimens ranged from 6.2 to 24.8 cm (mean 16.5 ± 3.4 cm) and the W ranged from 4.04 to 344.0 g (mean 95.3 ± 58.6 cm).

Of the total stomachs, 244 (80.0%) were empty. The diet spectrum of the species consisted of four prey

Table 1. The values of the modified index of relative importance (MI%), the percentage gravimetric composition (W%), the percentage of frequency of occurrence (F%) and the trophic index for *V. vimba* and *S. erythrophthalmus* in the Büyükçekmece Reservoir.

***V. vimba* (n=65)**				***S. erythrophthalmus* (n=61)**			
Prey items	**MI (%)**	**W (%)**	**F (%)**	***Prey items***	**MI (%)**	**W (%)**	**F (%)**
Diptera	**0.50**	3.30	7.81	Insecta extremities	**1.75**	4.66	15.22
Insecta extremities	**24.96**	25.95	50.0	Plants	**61.70**	53.58	46.74
Plants	**1.45**	6.03	12.5	Bivalvia	**0.02**	0.42	2.17
Cladocera	**<0.01**	0.07	1.56	Detritus	**36.53**	41.34	35.87
Bivalvia	**4.07**	8.45	25.0				
Ostracoda	**<0.01**	0.03	4.69				
Pisces	**0.01**	0.17	1.56				
Detritus	**69.02**	56.0	64.06				
TROPH ± SE	**2.62±0.25**			**TROPH ± SE**	**2.45±0.19**		

Table 2. The values of the modified index of relative importance (MI%), the percentage gravimetric composition (W%), the percentage of frequency of occurrence (F%) and the trophic index among seasons for *V. vimba* in the Büyükçekmece Reservoir.

Prey items	**Spring (n=34)**			**Summer (n=5)**			**Autumn (n=18)**			**Winter (n=8)**		
	MI (%)	**W (%)**	**F (%)**	**MI (%)**	**W (%)**	**F (%)**	**MI (%)**	**W (%)**	**F (%)**	**MI (%)**	**W (%)**	**F (%)**
Diptera	**0.88**	3.97	11.76	**-**	-	-	**-**	-	-	**0.88**	6.36	12.5
Insecta extremities	**45.09**	32.44	73.53	**10.72**	13.61	40.0	**6.93**	16.57	22.22	**0.40**	2.91	12.5
Plants	**2.64**	7.92	17.65	**-**	-	-	**0.32**	3.05	5.56	**0.12**	0.86	12.5
Cladocera	**0.01**	0.11	2.94	**-**	-	-	**-**	-	-	**-**	-	-
Bivalvia	**1.61**	5.79	14.71	**25.65**	32.56	40.0	**14.12**	16.88	44.44	**0.05**	0.39	12.5
Ostracoda	**0.01**	0.04	0.36	**-**	-	-	**-**	-	-	**-**	-	-
Pisces	**-**	-	-	**-**	-	-	**0.09**	0.89	4.96	**-**	-	-
Detritus	**49.77**	49.73	52.94	**63.63**	53.84	60.0	**78.54**	62.60	66.67	**98.55**	89.48	100.0
Food category numbers	**7**			**3**			**5**			**5**		
TROPH ± SE	**2.50±0.25**			**2.52±0.23**			**2.41±0.22**			**2.12±0.12**		

Table 3. The values of the modified index of relative importance (MI%), the percentage gravimetric composition (W%), the percentage of frequency of occurrence (F%) and the trophic index among size groups for *V. vimba* in the Büyükçekmece Reservoir.

Prey items	**6.0–8.9 cm (n=4)**			**12.0–14.9 cm (n=16)**			**15.0–17.9 cm (n=16)**			**18.0–20.9 (n=13)**			**21.0–23.9 (n=16)**		
	MI (%)	**W (%)**	**F (%)**	**MI (%)**	**W (%)**	**F (%)**	**MI (%)**	**W (%)**	**F (%)**	**MI (%)**	**W (%)**	**F (%)**	**MI (%)**	**W (%)**	**F (%)**
Diptera	**-**	-	-	**-**	-	-	**-**	-	-	**0.19**	0.67	15.38	**2.63**	7.67	18.75
Insecta extremities	**-**	-	-	**28.77**	38.81	43.75	**9.59**	15.21	37.5	**73.85**	46.76	84.62	**13.19**	14.45	50.0
Plants	**-**	-	-	**1.75**	5.51	18.75	**0.01**	0.09	6.25	**-**	-	-	**5.95**	13.03	25.0
Cladocera	**-**	-	-	**0.06**	0.58	6.25	**-**	-	-	**-**	-	-	**-**	-	-
Bivalvia	**91.43**	21.95	25.0	**0.08**	0.37	12.5	**9.02**	14.30	37.5	**4.23**	14.72	15.38	**2.26**	3.97	31.25
Ostracoda	**-**	-	-	**0.07**	0.22	18.75	**-**	-	-	**-**	-	-	**-**	-	-
Pisces	**-**	-	-	**-**	-	-	**-**	-	-	**-**	-	-	**0.05**	0.41	6.25
Detritus	**8.57**	78.05	75.0	**69.27**	54.52	75.0	**81.38**	70.40	68.75	**21.73**	37.85	30.77	**75.92**	60.48	68.75
Food category numbers	**2**			**6**			**4**			**4**			**6**		
TROPH ± SE	**2.86±0.26**			**2.48±0.25**			**2.34±0.19**			**2.73±0.30**			**2.32±0.20**		

categories: Insecta extremities (unidentified), plants (terrestrial plant and algae), Bivalvia and detritus. Plant has the highest value in terms of modified index of relative importance (61.70%), the percentage gravimetric composition (53.58%) and the percentage of frequency of occurrence (46.74%), and it was followed by detritus with the values of 36.53% (MI%), 41.34% (W%) and 35.87% (F%) (Table 1). Table 4 and Table 5 show the values of the index of relative importance (MI%) for length classes and seasons. While detritus is the main food consumed by fish in the spring, the plant has become a primary food in all other seasons. The importance of plants in the diet of fish has increased with an increase in fish length. TROPH ± SE was estimated as 2.45±0.19 and the values for each of the seasons and length classes were given in Table 4 and Table 5. No significant overlap in food composition was observed except for the spring sample (Table 6).

Discussion

The results presented in this study are in agree with the previous studies which reported that the feeding of both of the species can be characterized as omnivorous (Ravera & Jamet, 1991; García-Berthou & Moreno-Amich, 2000; Okgerman et al., 2013). The high proportions of the empty stomachs for both species can be explained by the fact that the fish specimens remain alive for a while after being caught in gillnets and, the loss of dietary information due to post-capture digestion (Hammerschlag et al., 2010). Additionally, it may also be related to some factors such as the ability to obtain food from the environment, prey availability, nocturnal sampling, spatial or temporal behavior of fish and digestion rate (Labropoulou et al., 1998; Hammerschlag et al., 2010; Morote et al., 2010; El Qendouci et al., 2018).

Table 4. The values of the modified index of relative importance (MI%), the percentage gravimetric composition (W%), the percentage of frequency of occurrence (F%) and the trophic index among seasons for *S. erythrophthalmus* in the Büyükçekmece Reservoir.

Prey items	Spring (n=34)			Summer (n=5)			Autumn (n=18)			Winter (n=8)		
	MI (%)	W (%)	F (%)	MI (%)	W (%)	F (%)	MI (%)	W (%)	F (%)	MI (%)	W (%)	F (%)
Insecta extremities	**23.21**	29.74	41.38	**<0.01**	0.06	6.67	**-**	-	-	**<0.01**	<0.01	6.25
Plants	**2.47**	4.22	31.03	**94.88**	83.14	100.0	**95.84**	85.20	100.0	**59.69**	49.68	93.75
Bivalvia	**0.18**	2.70	3.45	**-**	-	-	**-**	-	-	**<0.01**	<0.01	6.25
Detritus	**74.14**	63.33	62.07	**5.11**	16.80	26.67	**4.16**	14.80	25.0	**40.31**	50.32	6.25
Food category numbers	**4**			**3**			**2**			**4**		
TROPH ± SE	**2.39±0.23**			**2.00±0.00**			**2.00±0.00**			**2.00±0.00**		

Table 5. The values of the modified index of relative importance (MI%), the percentage gravimetric composition (W%), the percentage of frequency of occurrence (F%) and the trophic index among size groups for *S. erythrophthalmus* in the Büyükçekmece Reservoir.

Prey items	6.0–8.9 cm (n=4)			12.0–14.9 cm (n=16)			15.0–17.9 cm (n=16)			18.0–20.9 (n=13)			21.0–23.9 (n=16)		
	MI (%)	W (%)	F (%)	MI (%)	W (%)	F (%)	MI (%)	W (%)	F (%)	MI (%)	W (%)	F (%)	MI (%)	W (%)	F (%)
Insecta extremities	**-**	-	-	**-**	-	-	**14.82**	21.06	33.33	**3.34**	7.06	30.77	**-**	-	-
Plants	**-**	-	-	**10.19**	18.49	50.0	**29.48**	26.18	53.33	**87.87**	74.35	76.92	**60.98**	55.12	93.33
Bivalvia	**100.0**	100.0	100.0	**-**	-	-	**-**	-	-	**<0.01**	0.01	7.69	**-**	-	-
Detritus	**-**	-	-	**89.81**	81.51	100.0	**55.70**	52.76	50.0	**8.79**	18.59	30.77	**39.02**	44.88	73.33
Food category numbers	**1**			**2**			**3**			**4**			**2**		
TROPH ± SE	**3.10±0.30**			**2.00±0.00**			**2.25±0.18**			**2.09±0.11**			**2.00±0.00**		

Table 6. The values of food overlap in different length classes and seasons between *V. vimba* and *S. erythrophthalmus* in the Büyükçekmece Reservoir.

Seasons	*Schoener' Index value (a)*	*Length classes (cm)*	*Schoener' Index value(a)*
Spring	0.76*	15.0–17.9	0.50
Summer	0.31	18.0–20.9	0.50
Autumn	0.04	21.0–23.9	0.50
Winter	0.40		

*: Significant; a>0.6

Although *V. vimba* migrates from the lake to the tributaries for spawning in spring (Hänfling et al., 2009), both the number of individuals caught and the variety of food were the highest in this season. Similar results were also found in the spring feeding of *S. erythrophthalmus*, which shows a relatively narrower food spectrum. However, a seasonal change in the food preference was observed for both species; *V. vimba* fed mainly detritus in other seasons, while *S. erythrophthalmus* preferred the plant as the main food type. The relatively high food variety in the diet of a fish during the spring months might be attributed to the requirement of reserves prior to spawning (both rapid replacement of body mass following winter and for high energy demand) and to the increase of prey availability in their environment (Všetičková et al., 2014). The food overlap is mainly related to the fact that both fish changed their food preferences in spring and consumed the same food categories substantially.

Okgerman et al. (2013) reported an ontogenetic shift in the feeding of *V. vimba* in the Sapanca Lake in which the ostracods were consumed by only juveniles whereas Bivalvia was mostly eaten by the adults. Similar results are obtained in the present study as ostracods were consumed by only 12.0-14.9 cm size group. Although food preferences in most length classes of *V. vimba* mainly on detritus, the occurrence of relatively larger-sized preys such as fish in the stomach of adult fish is related to the fact that fish typically consume larger food items as the mouth gape increases. The ontogenetic difference in diet can be attributed to the mouth gape limitation of young or adult individuals' prey type (Probst & Eckmann, 2009; Klein et al., 2016). According to Ravera & Jamet (1991), *S. erythrophthalmus* was considered omnivorous fish with an evident preference on the plant as food and this preference has increased with the age. A similar ontogenetic difference in food preference was also observed in the diet of *S. erythrophthalmus*; while the plant is the main food item for the adult fish, fish smaller than 18.0 cm mostly preferred the detritus as food. Ontogenetic shifts in the diets may also be related to changes in microhabitat use (Alcaraz & García-Berthou, 2007; Nunn et al., 2012). The different food preferences in the different length classes of these two fish resulted in no significant food overlap values ($a<0.6$).

In conclusion, the findings with the present study have documented for the first time a detailed dietary study on two native fish from a shallow reservoir area. The results showed that the seasonal change in the food preferences of *V. vimba* and *S. erythrophthalmus* were affected by seasonal variations in the food supply. However, the ontogenetic difference in feeding seems to have resulted in the dietary segregation of length classes in both of the species. More detailed studies on the trophic interactions in Büyükçekmece Reservoir will be critical in the potential future management options.

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DERLEME MAKALESİ/REVIEW ARTICLE

Afyonkarahisar Florasında Yer Alan Endemik Bitki Taksonlarının Morfolojik ve Fitokimyasal Özellikleri

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Öz

Afyonkarahisar, dağlık alanları ve bu dağlar arasındaki geniş alanları içeren bir coğrafyaya sahiptir. Dağlık alanlar volkanik oluşumludur ve yükseklikleri 1600-2600 m arasındadır. Şehrin batısında Akdeniz iklimi, doğusunda ise İç Anadolu'nun karasal iklimi görülmektedir. Afyonkarahisar'da çok sayıda göl bulunur. Jeomorfolojik özellikleri, iklimsel özellikleri, toprak ve hidrografik özellikleri gibi sebepler dolayısıyla sınırları içerisinde 2000 civarında bitki taksonu yayılış göstermektedir. Bu bitkilerden 330 takson Türkiye için endemiktir. Bu endemik taksonların 6'sı, *Cota fulvida* (Grierson) Holub, *Astragalus×afyonicus* (Ponert) Ponert, *Polygonum afyonicum* Leblebici & Gemici, *Sideritis akmanii* Aytac, Ekici&Donmez, *Thermopsis turcica* Kit Tan, Vural & Küçüködük ve *Verbascum afyonense* Hub.-Mor., yalnız Afyonkarahisar'da yetişen lokal endemik türlerdir. Bu çalışmada, lokal endemik türlerin, il sınırlarında yetiştikleri konumlarının, morfolojik özelliklerinin, biyolojik aktivite ve fitokimyasal içeriklerinin kapsamlı olarak derlenmesi amaçlanmıştır.

Anahtar Kelimeler: *Cota fulvida, Astragalus×afyonicus, Polygonum afyonicum, Sideritis akmanii, Thermopsis turcica,Verbascum afyonense*

Morphological and Phytochemical Properties of Endemic Plant Taxa in Afyonkarahisar Flora

Abstract

Afyonkarahisar has a geography that includes mountainous areas and large areas between these mountains. The mountainous areas are volcanic and have heights between 1600-2600 m. It is seen a Mediterranean climate to the west and the continental climate of Central Anatolia to the east. There are many lakes in Afyonkarahisar. Geomorphological features, climatic characteristics, soil and hydrographic features due to reasons such as the distribution of around 2000 plant species and sub-species shows. 330 species of this plant is endemic to Turkey. Six of the 330 endemic species, *Cota fulvida* (Grierson) Holub, *Astragalus×afyonicus* (Ponert) Ponert, *Polygonum afyonicum* Leblebici & Gemici, Sideritis akmanii Aytac, Ekici&Donmez, *Thermopsis turcica* Kit Tan, Vural &Küçüködük and *Verbascum afyonense* Hub.-Mor.,are local endemic species growing only in Afyonkarahisar. In this study, it is aimed to compile the location, morphological characteristics, biological activity and phytochemical contents of local endemic species in the province borders.

Keywords: *Cota fulvida, Astragalus×afyonicus, Polygonum afyonicum, Sideritis akmanii, Thermopsis turcica, Verbascum afyonense*

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Giriş

Türkiye, jeolojik ve jeomorfolojik durumu, engebeli topografyası ve yükseklik farklılıkları, zengin su kaynakları, üç fitocoğrafik bölgenin kesiştiği yerde bulunması, doğusu ve batısı arasında ekolojik farklılıkları olması sebebiyle, biyolojik çeşitlilik açısından zengin bir ülkedir (Malyer, 2011; Yeşilyurt vd., 2008; Bülbül & Aytaç, 2010). Türkiye sahip olduğu bitki türlerinin zenginliği açısından, dünyada önemli bir yere sahiptir. Kendisine komşu ülkeler ile kıyaslandığında bu fark daha net ortaya çıkmaktadır. Türkiye'de yaklaşık 9000 civarında bitki türü ve 12000 olan takson (tür, alttür ve varyete) bulunmaktadır. Yüzölçümü olarak Türkiye'nin 15 katı olan Avrupa kıtası florasında bulunan takson sayısı da yaklaşık 12000 dir. Türkiye, sahip olduğu tür çeşitliliği yanında, endemik tür açısından da zengindir. Türkiye'de yaklaşık olarak 4000 kadar yayılış gösterir (Akçiçek & Vural,2007).

Literatürde dünyanın farklı kıtalarında, aynı kıtanın farklı ülkelerinde ve bu ülkelerin farklı şehirlerinde hatta dağ, ova gibi belirli bölümleri kapsayan pek çok bitki örtüsü ve flora çalışması mevcuttur (Tarakçı vd., 2012). Afyonkarahisar'da da yapılan çok sayıda saha çalışması vardır. Baytop & Dökmeci (1978) Sultandağı'nda, Gemici (1990) Akdağ'da, Akçiçek & Vural (2003) Kumalar'da, Kurt (2002) ve Köse & Ocak (2004) Emirdağı'nda, Seçmen & Leblebici (1997) Eber Gölü ve Acıgöl'de floristik çalışma yapmışlardır. Kargıoğlu vd., (2007) Afyonkarahisar sınırlarında yayılış gösteren endemik bitkileri ve bunların tehlike kategorileri içeren çalışma yapmıştır.

Bu çalışma yalnız Afyonkarahisar'da yetişen endemik 6 türün, *Cota fulvida* (Grierson) Holub, *Astragalus ×afyonicus* (Ponert) Ponert, *Polygonum afyonicum* Leblebici & Gemici, *Sideritis akmanii* Aytac, Ekici & Donmez, *Thermopsis turcica* Kit Tan, Vural & Küçüködük ve *Verbascum afyonense* Hub.-Mor., morfolojik, kimyasal içerik, farmakolojik özelliklerinin kapsamlı olarak derlenmesi amacıyla yapılmıştır.

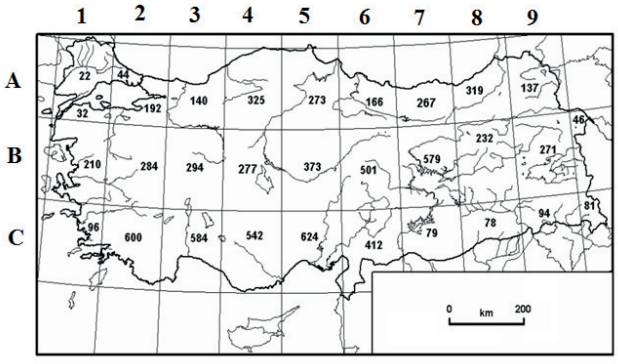
Afyonkarahisar'ın Bitki Zenginliği

Afyonkarahisar, 1034 m rakımda, 30° 32' doğu boylamı ile 38° 45' kuzey enleminin kesiştiği bölgede bulunmaktadır. Afyonkarahisar'ın, dağlık alanlar ve bu alanlar arasındaki geniş alanları kapsayan jeomorfolojik yapısı vardır. Dağlık alanlar volkanik oluşumludur ve yükseklikleri 1600-2600 m arasındadır. Dağların arasında tektonizma ve karstik kökenli ovalar bulunmaktadır. Dağlar arasındaki ovalar,yerleşim ve tarım için uygundur.Toprakları akarsular tarafından bölünmüş olup, plato şeklindedir. Alüvyal toprak dışında, hidromorfik alüvyal topraklar, kolüvyal topraklar, kahverengi orman toprakları, kireçsiz kahverengi orman toprakları, kestane renkli topraklar, kırmızı kestane renkli topraklar, kırmızı kahverengi Akdeniz toprakları, kahverengi topraklar, kireçsiz kahverengi topraklar, ırmak taşkın yatakları, çıplak kaya ve molozlar olmak üzere büyük toprak grupları görülür (Acar vd., 2012). Afyonkarahisar ili, iklimsel olarak farklı özellikler göstermektedir. İl, batısındaki Akdeniz iklimi ile doğusunda yer alan iç Anadolu'nun karasal iklimi arasında bir geçiş bölgesinde bulunmaktadır. İlde, yükseltinin ve rakımın fazla olması sebebiyle iç Anadolu iklimi (karasal iklim) etkilidir. Göller bakımından zengin bir şehirdir. İl sınırları içerisinde birçok göl bulunmaktadır. Bu göller daha çok ilin doğusunda ve güneybatısında yer almaktadır. Şehirdeki başlıca göller; Akşehir Gölü, Eber Gölü, Karamık Gölü ve Acı Göldür (Acar vd., 2012).

Afyonkarahisar ilinin temel bitki örtüsü bozkırdır. Bozkırın yanında orman toplulukları da bulunmaktadır. Ormanlık alanlar ilin batı ve güneybatısındaki yüksekliklerde bulunmaktadır. Düzlüklerde ise bozkırlar hâkimdir. Ormanların tahrip edilmesi sonucunda ilin ovalık alanları bozkır görünümünü almıştır. İlin batısı ve kuzey kesimlerin yüksek alanlarında karaçam ve ardıç ormanlıkları bulunmaktadır. Ovalarda step bitki örtüsünün yetişmektedir. İklim özelliklerine göre ovalarda, meşe ve karaçam yetişmesi gerekirken, antropojen etkiler nedeniyle, ovalarda step bitki örtüsü gelişmiştir (Ay, 2009)

Afyonkarahisar, Davis kareleme metoduna göre büyük çoğunluğu B3 karesinde olmakla birlikte, B2, C2 ve C3 karesinde yer almaktadır. Şekil 1 de Davis'in grid sistemi ve bu karelerde bulunan endemik bitki türlerinin sayıları gösterilmiştir (Davis, 1970).

Yapılan çalışmalar, il sınırları içerisinde 2000 civarında taksonun yayılış gösterdiğini bildirmişlerdir. Bu bitkilerden 330'unun Türkiye endemiği olduğu belirlenmiştir. Afyonkarahisar'da en fazla *Asteraceae* (Papatyagiller),



Şekil 1. Davis'in grid sistemi ve bu karelerde bulunan endemik bitki türlerinin sayıları

Tablo 1. Afyonkarahisar'da Yetişen Endemik Türler, Yöresel İsimler ve Tehlike Kategorileri

Bitki Adı	Yöresel İsmi	Tehlike Kategorisi (Kargıoğlu vd., 2007)
Cota fulvida (Grierson) Holub	Sultan Babuççа	DD (Veri yetersiz)
Astragalus×afyonicus (Ponert) Ponert	Afyon Geveni	EN (Tehlikede)
Polygonum afyonicum Leblebici & Gemici	Afyon Madımağı	EN (Tehlikede)
Sideritis akmanii Aytac, Ekici &Donmez	Dağ Çayı, Kuyruk Çayı	VU (Zarar görebilir)
Thermopsis turcica Kit Tan, Vural &Küçüködük	Eber Sarısı, Sarı Meyan	CR (Çok tehlikede)
Verbascum afyonense Hub.-Mor	Sığır kuyruğu	EN (Tehlikede)

DD: Data deficient, EN:Endangered, VU:Vulnerable, CR: Criticallyendangered

Fabaceae (Baklagiller), *Lamiaceae* (Ballababagiller), *Caryophyllaceae* (karanfilgiller) bitki familyaları ile *Verbascum* (Sığır kuyruğu) ve *Astragalus* (Geven) türleri yetişmektedir (Kargıoğlu vd., 2007). Bu 330 türün içerisinden de yalnız 6 türün Afyonkarahisar endemiği olduğu bildirilmiştir (Cenkci vd., 2012). Afyonkarahisar'da yetişen lokal endemik türler, yöresel isimleri ve tehlike kategorileri Tablo 1 de verilmiştir.

Cota fulvida (Grierson) Holub

Cota fulvida (Grierson) Holub, *Cota* (Asteraceae, Anthemideae) cinsi, dünya çapında, 49 tür (63 takson) ile temsil edilir. Türkiye'de ise 15 tür (22 takson) yetişmektedir ve bunlardan 9' u endemiktir. *Cota* üyeleri, özellikle Türkiye'nin Akdeniz ve İran-Turan fitocoğrafik bölgelerinde yaygındır (Özbek vd, 2011).

Cota fulvida, çok yıllık rizomlu bitkilerdir. Rizom, kahverengi- kirli beyaz fibrilli, 1-7 cm uzunluğundadır. Gövdesi 35 cm boyunda yumuşak ipeksi tüylüdür. Gövde, tek dallanmış ya da tabandan 1-3 gövdeli olabilmektedir. Gövdenin ilk yarısı yapraksızdır. İkinci yarısı yumuşak sapsız yapraklar taşır. 6-7 çiçek ve 7-8 meyve verebilen özelliktedir. Çiçek tablası konkav, altın sarısı renktedir. Dilsi çiçekleri bulunmamaktadır. Disk çiçekleri çift çatallı, 5 loblu, simetrik koronalı, sarı renktedir (Özbek, 2010).

Cota fulvida, Türkiye florasında B3 Afyon-Sultan dağlarının ağaç sınırının üst kısmında bulunan yeşil çayırlarla kaplı bölgede yetişmektedir. *C. fulvida* orman üst kısmından (kasnak meşesi-karaçam bölgelerinden)çayırlara geçişte yetişen bir habitatı bulunmaktadır. Çiçeklenmesi temmuz ayı sonu ile ağustos ayında gerçekleşirken, meyvelenmesi ağustos ayındadır. Dağınık olmayan bir popülasyona sahip *C. fulvida,*1800-1840 metreler arasında bulunur. Kumlu-killi-balçıklı toprak türlerinde yetişmektedir. 5,8 ile 6,5 arasında değişen toprak asitidesi gelişimi için idealdir (Arslan vd., 2015).

Cota fulvida türünün kimyasal bileşimini ve biyolojik potansiyelinin belirlendiği çalışmalar mevcuttur. Yapılan bir çalışmada, *C. fulvida*'nın esansiyel yağ asiti içeriği ile metanol ekstresi, 2,2-difenil-1-pikrilhidrazil (DPPH) radikal süpürme, Trolox eşdeğeri antioksidan kapasite (TEAC) ve β-karoten gibi farklı in vitro yöntemler kullanılarak antioksidan aktivite açısından değerlendirilmiştir. *C. fulvida*'nın organizmada diyet karbonhidratının sindirilmesinde anahtar enzim olarak bilinen pankreatik α-amilaza karşı inhibe edici ile tirozinaz enzimine karşı potansiyelin incelenmiştir. Bu çalışma, endemik *C. fulvida*'nın kimyası ve biyolojik aktivitelerine ilk katkı olarak dikkat çekicidir (Ozek vd., 2019).

Cota fulvida'nın esansiyel yağının kimyasal profili belirlenmiş, heksadekanoik asitin (%25,6) yağda temel yağ asidi olarak bulunmuştur. Hidrokarbonlu (%12,6) ve oksijenli (%15,9) monoterpenler, yağdaki diğer önemli grup olarak belirlenmişlerdir. Kafur (%6,1), sineol (%4,9) ve α-pinen (%3,0) gibi monoterpenleri ve karyofilenoksit (%5,3), humulen epoksit (%3,9) ve spatulenol (%2,4) gibi seskiterpenleri belirtilen miktarlarda içerdiği söylenmektedir. Türün yağı, çeşitli mono ve seskiterpen ve yağ asitleri bakımından zengindir, özütünün ise fenolik asitler, flavonoidler ve fenil propanoidleri içerdiği sonucuna varılmıştır. Ayrıca *C. fulvida*'nın, hücre hasarı, iltihaplanma, cilt hastalığı, nörodejeneratif problemler gibi çeşitli hastalıklarla mücadelede faydalı, ayrıca ucuz, güvenli ve doğal bitkisel ilaçların sağlanmasında faydalı olduğu düşünülen bir biyolojik aktif bileşen kaynağı olarak kabul edilebileceği de belirtilmiştir (Ozek vd., 2019)

Astragalus×afyonicus (Ponert) Ponert

Türkiye'de *Astragalus* cinsi 211 endemik takson ile temsil edilmektedir. Bu taksonların tamamı çok yıllıktır ve 64'u otsu, 33'ü bodur/cüce çalı, 27'si çalı, 7'si odunsu-ot ve 5'i yarı-çalı yaşam formundadır. 75 taksonun ise

durumu belirlenememiştir. Ülkemizde doğal olarak yetişen *Astragalus* türleri, hem hayvanlar için yem kaynağıdırlar, hem de erozyon kontrolünde etkilidirler (Akan vd., 2008).

Astragalus×afyonicus, çalı şeklinde 15-40 cm uzunluğunda gövdesi dallı bir türdür. Yılda yaklaşık 0,5-15 cm uzayabilmekte, birinci yılın sonunda 1-3,5 mm çapa ulaşmaktadır. Yaprakları 1-6,5 cm uzunluğunda düz, kalın, yataya yakın eğiktir. 4-8 parça yeşil, basık yaprakçık içermektedir. Yaprak ve yaprak sapı 0,2-1 mm tüy içerir. 2,5-9 cm uzunluğunda ve 2,5-5 cm genişliğinde, küresel veya silindirik 3-6 çiçekten oluşan bir çiçeklenmeye sahiptir. 13,5-20 mm uzunluğunda stamen, 15-21 mm ovaryuma sahiptir. Tohumları açık ya da koyu kahverengi, siyah nokta içermeyen eliptik/oval 2,5-3,5 mm uzunluğunda 2-2,5 mm genişliğindedir (Zarre-Mobarakeh, 2000).

Astragalus×afyonicus, yaprakçığının tüy örtüsüne göre diğer hibrit tür olan *Astragalus thracicus* subsp. *thracicus'*tan ayrılır. *Astragalus×afyonicus* da yaprakçığın alt tarafı yoğun tüylü, üst yüzeyi ise tüysüzdür. *Astragalus thracicus* subsp. *thracicus* ise tam tersi durum söz konusudur, yaprakçığın alt tarafı tüysüz, üst yüzeyi tüylüdür (Zarre-Mobarakeh, 2000).

***Polygonum afyonicum* Leblebici & Gemici**

Polygonum cinsi, tek yıllık otsu bitkiler ile 5 cm'ye kadar boylanabilen bitkileri, 3-4 m'ye kadar boylanabilen ve 20-30 m'ye kadar boylanabilen çok yıllık odunsu bitkileri içerir. Çiçekleri küçüktür ve yazın açmaktadır. Çiçekler pembe, beyaz veya yeşilimsi olup her bir sürgün veya yaprak boğumunda yoğun kümeler halindedir (Yeşilay, 2018). *Polygonum* L. cinsi, Türkiye'de 42 tür ile temsil edilir. Bu türlerin 13 tanesi endemiktir. Küçük olmaları, odunsu tabanlı ve uzun ömürlü oldukları için daha fazla yeni tür keşfedilmesi de olasıdır (Gemici & Tan, 2014; Keskin 2009).

Polygonum afyonicum, küçük çalı formundadır. Her biri başak şeklinde bir çiçeklenme ile sonuçlanan, çok uzun, ince, yerde sürgü şeklinde, 21-32 cm gövde uzunluğunu sahiptir. Kökleri dik, dallanmış, yaygın, tüylü veya tüysüz, nadiren dikenli ve belirgin şekilde şişkin nodüllere sahiptir. Dar eliptik, sapsız ve düz kenarlı yaprakları bulunmaktadır. Çiçeklenme dalların uçlarında toplanmış, her bitişik kümede 5-6 çiçek şeklindedir. Çiçekler, terminal veya aksillar, başaklı, genellikle demet şeklinde bazen de çiçek sapı ile gövde arasında tektir. Çiçekler biseksüel nadiren uniseksüel, 4-5 parçalıdır. Çiçek sapı eklemlidir. Çiçek yaprakları sap yapraklarından daha kısadır. Yapraklar değişkin şekilde, basit, kenarlar tam veya parçalı, uçları kesik veya eğiktir. 7-8 tane stamen bulunur. Tohum kapsülleri üçgenimsi veya bikonveks nadiren de bikonkavdır. Yaprak sapının gövdeye bağlandığı noktalardaki yaprakçıklar, genellikle gövde çevresinde zarsı bir kılıfla (okrea) çevrilidir. (Yeşilay, 2018; Güner vd., 2000). Dalları nispeten azdır. Üst dallar alt kısımlardan çok daha uzundur. Orman açıklıklarında 1500 m yükseklikte yetişmektedir (Gemici & Tan, 2014; Keskin, 2009).

***Sideritis akmanii* Aytac, Ekici & Donmez**

Sideritis, halk arasında dağ çayı, ada çayı olarak bilinen türdür. Eski çağlardan beri, virüslere bakterilere, mantarlara ve diyabete karşı etkilerinin olduğu düşünülmesi nedeniyle çayı yapılıp tüketilmektedir. İhracatı çok fazla olmasa da, yöresel olarak değerlendirilmektedir. Bilinçsizce ve fazlaca toplanılması ve hayvan otlatılması sebebiyle ile birçok türü yok olma tehlikesi ile karşı karşıya kalmıştır. Ekonomik öneme sahip olan *Sideritis* türlerinin, korumaya alınması önem arz etmektedir (Gümüşçü vd., 2011).

Sideritis akmanii, aromatik, açık yeşil renkli yapraklara sahip, otsu bir bitkidir. Alt yaprakları beyaz ipeksi tüylü, sapı 1-3 cm; yapraklarının ucu sivri ve uzundur. Alt tarafa doğru incelir ve kenarı birbirine kenetlenmiştir. Tepesinde mukronat yaprakları vardır ve yapraklar 0,5 mm ve sarımsı renktedir. Orta taraftaki yaprak sapları 0,5-2,5 cm dir ve bu yaprakların kenarı birbirine kenetlenmiştir. Üst yaprakları sapsız ve sivridir kenarları birbirine kenetlenmiştir. Basit çiçekleri ya da birkaç dalı vardır. Boyu 1 metreye kadar uzayabilmektedir (Gümüşçü vd., 2011).

Sideritis akmanii ile ilgili yapılan birkaç kimyasal içerik çalışması bulunmaktadır. Türün yapısında uçucu yağlar ve flavonları içerdiği, temel bileşenlerin ise linearol, isolineraol, sideroksol, foliol, isofoliol, sideridiol olduğu belirtilmiştir (Güzey, 2017).

Sideritis akmanii fitoterapik etkilerinin incelendiği, Coğuplugil (2019) tarafından yapılan tez çalışmasında, *S. akmanii*'nin yağlı diyet uygulanan denekler üzerindeki lipid profili değerlendirilmiştir. Yapılan tez çalışmasında *S.akmanii*'nin karaciğer fonksiyonel enzim (AST, ALT ve ALP) düzeylerinde düşüşe sebep olduğu belirlenmiştir. Ancak *S.akmanii*'nin karaciğer üzerindeki olası koruyucu etkilerinin daha net ortaya konulması için ileri çalışmalara ihtiyaç duyulduğundan bahsedilmektedir.

Güzey (2017) tarafından yapılan bir başka tez çalışmasında, *S. akmanii*'nin antioksidan kapasitesi belirlenmiştir. Çalışmada türün farklı çözücü ekstrelerinin total fenolik madde içeriği, DPPH radikal savıcı etkisi, total antioksidan kapasiteleri ve biyo element düzeyleri incelenmiştir. Türün metanol ekstresinin fenolik madde miktarının, aseton ekstresinden fazla olduğu belirtilmektedir. *S. akmanii*'nin, metanol ekstresinin

radikal savıcı etkisininde, aseton ekstresinden fazla olduğu görülmüştür. *S. akmanii*'nin, antioksidan enzim (SOD, GPx ve CAT) yapısına katılan elementleri içermesi, total fenolik madde içeriği, DPPH radikal savıcı etkisi ve total antioksidan kapasitesi nedeniyle fitoterapik çalışmalar için uygun bir tür olduğu belirtilmiştir.

***Thermopsis turcica* Kit Tan, Vural & Küçüködük**

Thermopsis turcica, endemik ve en dar yayılışlı bitki türlerinden biridir. *T. turcica, Fabaceae*(baklagiller) familyasının bir üyesidir. *Fabaceae* (baklagiller) familyası yaklaşık 650 cins, 18.000 kadar türe sahiptir. Bufamilyada ayrıca bakla, fasulye, nohut, mercimek gibi ekonomik değere sahip çok sayıda bitki türü bulunmaktadır. *T. turcica*'yı diğer baklagillerden ayıran en önemli özellik, bir çiçekten 3 meyve oluşturmasıdır. Bu özelliğe diğer baklagil türlerinden hiçbirinde rastlanmamıştır (Cenkci vd., 2012). *T. turcica,*çok yıllık, otsu ve uzun rizomlu bir bitkidir. Bitki boyu 30-89 cm kadar uzamaktadır. Dik gövdeli, dalları yapraklı, çizgili, tabanda kınlıdır. Kınlar yapraksı şekildedir. Yapraklar, beyaz, ipeksi tüylü, düz kenarlı, grimsi yeşil renktedir.

T. turcica, yapısında bulunan başlıca alkolidler, anagirin, termopsin, tursisin, tursindir. *Thermopsis* türlerinde alkaloid dışında, flavanoidler ve C vitamini bulunmaktadır (Özdemir vd., 2008). *T. turcica* ile yapılan çalışmalarla yok olma tehlikesiyle karşı karşıya olan türün, kallus oluşumu ve bitki doku kültürü yöntemleri ile çoğaltımı incelenmiştir (Cenkci vd., 2009). Ayrıca türün morfolojik (Davis vd., 1988; Sinan, 2002; Özdemir vd., 2008), anatomik (Sinan 2002; Özdemir vd., 2008) ve ekolojik (Sinan 2002) özellikleri üzerine de yapılan çalışmalar mevcuttur.

***Verbascum afyonense* Hub.-Mor.**

Dünyada yaklaşık 360 *Verbascum* türü bulunmaktadır. Türkiye en fazla çeşitliliğe sahip ülkedir. *Verbascum* (Scrophulariaceae) türleri, mukolitik etkileri nedeniyle, özellikle üst solunum yollarını rahatlatmak için sıklıkla kullanılır. Kurutulmuş *Verbascum* yaprakları ve çiçekleri, yağ özleri, alkollü tentürler, kapsülleri eczanelerde ve pazarlarda alternatif ilaç ürünleri olarak satılmaktadır (Akdemir vd., 2011; Kahraman vd., 2010; Luca, 2019; Süntar vd., 2010). Bazı *Verbascum* türlerinin tohumları içerdikleri saponinler yüzünden zehirli bir etki de göstermektedir. *Verbascum* bitkisinin çeşitli kültür formları, çiçeklerinin büyüklüğü, çiçek açma sürelerinin uzunluğu göz önünde bulundurularak Avrupa ve Kuzey Amerika'da park ve bahçe düzenlemelerinde yoğun olarak kullanılmaktadır (Çenil, 2007).

*Verbascum afyonense***,** iki yıllık, 60-80 cm boyunda bir türdür. Gövdesi, alt kısımda yünsü-örümcek ağımsı, dallanmış salgısız tüylü, üst kısımda basit, kısa ve salgısız tüylü yapıdadır. Gövde silindirik, üst kısımda bazen köşeli, nadiren az sayıda dallanmıştır. 10-20 × 3-6 cm boyutlarında, uç kısımları sivri taban yaprakları bulunur. Yaprak sapı 5-8 cm dir. Gövde yaprakları daha küçüktür ve kenarları tamdır. Çiçek sapı 10-25 mm uzunluğundadır. Kaliks 4-6 mm, korolla 20-25 mm çapında sarı renklidir. 5 adet stamen bulunur. Filamentlerden öndeki ikisi mor tüylü ve anterlere doğru çıplak, diğer üç filamentalt kısımda mor yukarı anterlere doğru beyaz tüylüdür. Kapsül, geniş, ovalimsi, 6-8×4-5 mm boyutlarında, salgılı/salgısız tüylü yapıdadır. Haziran ayında çiçeklenmektedir. Açıklık alanlar ve yol kenarlarında, 350 m. yükseklikte yetişmektedir (Çenil, 2007).

Sonuç

Bu çalışmada Afyonkarahisar'ın lokal endemik türleri *Cota fulvida* (Grierson) Holub*, Astragalus ×afyonicus* (Ponert) Ponert*, Polygonum afyonicum* Leblebici & Gemici*, Sideritis akmanii* Aytac, Ekici & Donmez*, Thermopsis turcica* Kit Tan, Vural & Küçüködük ve *Verbascum afyonense* Hub.-Mor taksonlarının bazı özellikleri ile ilgili temel bilgiler ilk kez derlenerek literatüre katkı sunulmuştur. Bu türlerin çoğu nesli tükenmekle karşı karşıyadır. Zarar görebilir, tehlikede ve çok tehlikede kategorilerinde yer almaktadır. Şehirleşme, tarım alanlarını genişletilmesi, aşırı otlatma, yurt dışı ihraç veya yurt içi kullanım dolayısıyla doğadan toplanması, tarımsal mücadele, ilaçlama ve yangın gibi bu türleri tehdit eden faktörler bulunmaktadır. Yalnız Afyonkarahisar'da yetişen bu endemik taksonların nesillerini devam ettirebilmesi için özel önlemlerin alınması oldukça önemlidir. Bu türler hakkında yapılacak bilgilendirmeler, koruma bilincinin geliştirilmesi önem arz etmektedir. Bu taksonlar üzerinde agronomik, fizyolojik ve biyoteknolojik araştırmalar yapılması gerekmektedir.

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SHORT COMMUNICATION/KISA BİLDİRİ

Length-Weight Relationships of two *Clupeonella* species (Clupeidae) from Northwestern Turkey

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Abstract
The length-weight relationships (LWRs) of *Clupeonella cultriventris* and *Clupeonella muhlisi* were analysed. Fish samples were collected gill nets (10 mm mesh sized) from the Büyükçekmece Reservoir and Küçükçekmece Lagoon April and June 2016. Samples from Durusu Reservoir and Uluabat Lake were obtained from Istanbul University Science Faculty Hydrobiology Museum. The values of parameter b in the LWR equations varied from 3.177 (Küçükçekmece Lake population) to 3.496 (Büyükçekmece Reservoir population) for *C. cultriventris* and 3.258 (Uluabat Lake) for *C. muhlisi*.
Keywords: Length-weight relationship, Clupeonella, Uluabat Lake, İstanbul

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Introduction

There are three species of genus *Clupeonella* in the Black Sea basin, *Clupeonella abrau* (Maliatsky, 1930), *Clupeonella cultriventris* (Nordmann, 1840) and *Clupeonaella muhlisi Neu, 1934* (Frose & Pauly, 2020). Two species *C. cultriventris* and *C. muhlisi* inhabit in Turkish fresh and brackish waters (Çiçek et al., 2015). All *Clupeonella* species are small in size and there are not any commercial value in Turkey. There are few studies on the length- weight relationships of *C. cultriventris* (Tarkan et al., 2006; Saç 2012; Meriç 1978). But there is not any information on the *C. muhlisi.*

The aim of this study was obtain information on length-weight relationships for these two species.

Materials and Methods

In this study all materials belong to Uluabat Lake, Büyükçekmece and Durusu Reservoirs and Küçükçekmece Lagoon. Uluabat Lake is a large and very shallow, it is connected via Susurluk River to Sea of Marmara. Büyükçekmece Reservoir was created in 1985 to supply fresh water for the city of İstanbul by cutting of the connection between Büyükçekmece Lagoon and the Sea of Marmara. Durusu Reservoir is located on Northwestern İstanbul near Black Sea. It was created in 1883. Küçükçekmece Lagoon is located along to northern Sea of Marmara coast.

Uluabat Lake, and Durusu Reservoir individuals were museum samples, Büyükçekmece Reservoir and Küçükçekmece Lagoon samples obtained from local

fishermen. Fish specimens were collected gill-nets (10 mm mesh sized) from the Büyükçekmece Reservoir and Küçükçekmece Lagoon April and June 2016, respectively. Captured specimens were killed with an overdose of anaesthesia (clove oil), fixed in 4% formaldehyde solution and stored in 70% ethanol. Samples from Durusu Reservoir and Uluabat Lake were borrowed from Istanbul University Science Faculty Hydrobiology Museum (IUSHM) fish collection.

All samples transferred to tap water from %70 ethanol. After 10 minutes samples were taken out of the water and the water on the samples was dried with filter paper. The dried fish samples were weight for total body weight (W) on a digital balance with 0.01 g and measured for standard length (SL) to the nearest 0.1 cm accuracy. The length-weight relationship (LWR) was computed by the following equation: $W=aL^b$, where W is the total weight (g), L is the SL length (cm), *a* is the regression intercept and, *b* is slope (Le Cren, 1951; Froese, 2006). The logarithmic transformation of this equation was performed as $\ln W=\ln a+b\ln SL$ and parameters *a* and *b* were computed by the regression analysis (King, 2007). To determine the growth type (isometric or allometric), 95% confidence limits (CI) of parameters *b* were calculated as follow: $95\%Cl=x\pm(t_{0.05}\times SE)$ (x: *b*; t: table value of t (*t*-test at 95% confidence); SE: standard error value of *b*).

Results

Material Examined:

Clupeonella cultriventris Figure 1-A, B, C: IUSHM 2020-1415, 10, 5.6-7.2 mm SL, Büyükçekmece Reservoir, 25.04.2016; IUSHM 2020-1416, 10, 4.9-7.6 mm SL, Durusu Reservoir, 06.06.2001; IUSHM 2020-1417, 18, 5.3-6.6 mm SL, Küçükçekmece Lagoon, 03.06.2016.

Clupeonella muhlisi Figure 1-D: IUSHM 2020-1418, 17, 4.8-5.6 mm SL, Uluabat Lake, 24.04.2006.

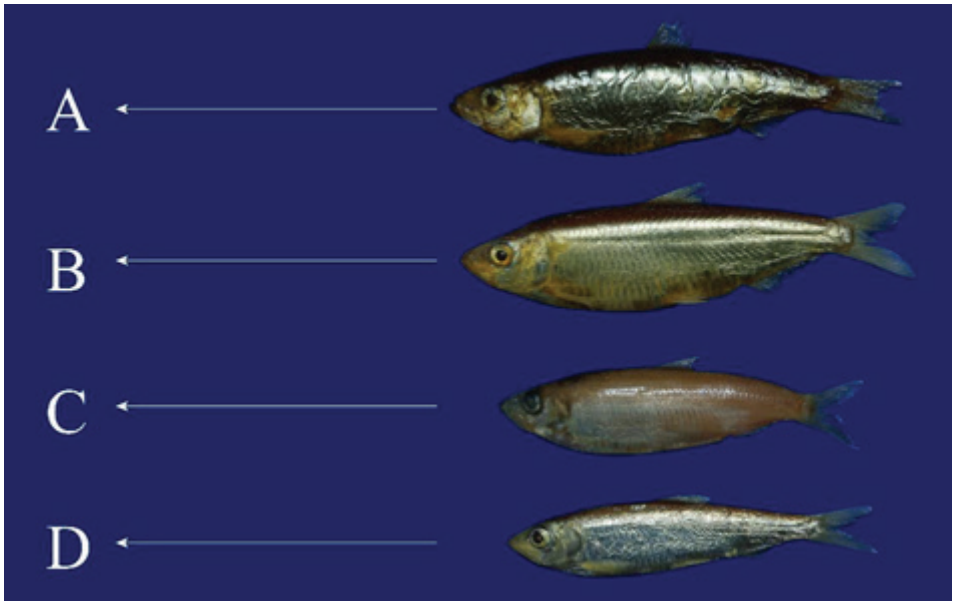

Figure 1. *Clupeonella cultriventris*: (A: Durusu Reservoir, B: Büyükçekmece Reservoir, C: Küçükçekmece Lagoon); *Clupeonella muhlisi*: D: Uluabat Lake.

Table 1. The descriptive statistics and estimated parameters of length-weight relationships of *Clupeonella cultriventris and Clupeonella muhlisi* populations living in the Uluabat Lake, Büyükçekmece and Durusu Reservoir and Küçükçekmece Lagoon (n: number of individuals, SL: Standard length (cm), W: body weight (g), Min: minimum, Max: maximum, *a:* intercept, *b*: slope, 95% CI: 95% confidence limit, r^2: coefficient correlation).

Species	Locality	n	SL	W	Regression Parameters		95% CL of a	95% CL of b	r^2
			Min.-Max.	Min.-Max.	a	b			
Clupeonella muhlisi	Uluabat Lake	17	4.8 – 5.6	1.22 – 2.14	0.007	3.258	0.002 – 0.028	2.441 – 4.075	0.812
Clupeonella cultriventris	Büyükçekmece Reservoir	10	5.6 – 7.2	2.04 – 5.63	0.005	3.496	0.001 – 0.041	2.374 – 4.618	0.903
	Durusu Reservoir	10	4.9 – 7.6	1.36 – 6.84	0.006	3.432	0.001 – 0.034	2.525 – 4.339	0.921
	Küçükçekmece Lagoon	18	5.3 – 6.6	2.06 – 4.62	0.011	3.177	0.003 – 0.040	2.456 – 3.897	0.857

Individual numbers (n), length and weight ranges, *a* and *b* values in the LWR equations, 95% confidence intervals of *b* values and r^2 values of these two *Clupeonella* fishes were given in Table 1.

The values of parameter *b* in the LWR equations varied from 3.177 (Küçükçekmece Lagoon population) to 3.496 (Büyükçekmece Reservoir population) for *C. cultriventris* and 3.258 for *C. muhlisi*. The correlation coefficient between length and weight (r^2) varied between 0.857 (Küçükçekmece Lagoon population) and 0.921 (Durusu Reservoir population) for *C. cultriventris* and 0.921 for *C. muhlisi* from Uluabat Lake.

Discussion

There are only three previous reports for length-weight relationships of *C.* cultriventris from Büyükçekmece Reservoir and Küçükçekmece Lagoon (Tarkan et al., 2006; Saç, 2012; Meriç 1978), but there are not any data for length- weight relationships of *C. muhlisi* (Frose & Pauly, 2020). The slope (b) of the length-weight relationships for all three *C. cultriventris* populations was within the expected range of 2.5–3.5 (Frose & Pauly, 2020). The slope (b) of the LW relationships was 2.7275 and 3.380 for Büyükçekmece Reservoir (Tarkan et al., 2006; Saç 2012), 3.4284 for Küçükçekmece Lagoon (Meriç, 1978).

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a) Turkish Book

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b) Book Translated into Turkish

Mucchielli, A. (1991). *Zihniyetler* [Mindsets] (A. Kotil, Trans.). İstanbul, Turkey: İletişim Yayınları.

c) Edited Book

Ören, T., Üney, T., & Çölkesen, R. (Eds.). (2006). *Türkiye bilişim ansiklopedisi* [Turkish Encyclopedia of Informatics]. İstanbul, Turkey: Papatya Yayıncılık.

d) Turkish Book with Multiple Authors

Tonta, Y., Bitirim, Y., & Sever, H. (2002). *Türkçe arama motorlarında performans değerlendirme* [Performance evaluation in Turkish search engines]. Ankara, Turkey: Total Bilişim.

e) Book in English

Kamien R., & Kamien A. (2014). *Music: An appreciation*. New York, NY: McGraw-Hill Education.

f) Chapter in an Edited Book

Bassett, C. (2006). Cultural studies and new media. In G. Hall & C. Birchall (Eds.), *New cultural studies: Adventures in theory* (pp. 220–237). Edinburgh, UK: Edinburgh University Press.

g) Chapter in an Edited Book in Turkish

Erkmen, T. (2012). Örgüt kültürü: Fonksiyonları, öğeleri, işletme yönetimi ve liderlikteki önemi [Organization culture: Its functions, elements and importance in leadership and business management]. In M. Zencirkıran (Ed.), Örgüt sosyolojisi [Organization sociology] (pp. 233–263). Bursa, Turkey: Dora Basım Yayın.

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American Psychological Association. (2009). *Publication manual of the American psychological association* (6th ed.). Washington, DC: Author.

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Mutlu, B., & Savaşer, S. (2007). Çocuğu ameliyat sonrası yoğun bakımda olan ebeveynlerde stres nedenleri ve azaltma girişimleri [Source and intervention reduction of stress for parents whose children are in intensive care unit after surgery]. *Istanbul University Florence Nightingale Journal of Nursing, 15*(60), 179–182.

b) English Article

de Cillia, R., Reisigl, M., & Wodak, R. (1999). The discursive construction of national identity. Discourse and Society, 10(2), 149–173. http://dx.doi.org/10.1177/0957926599010002002

c) Journal Article with DOI and More Than Seven Authors

Lal, H., Cunningham, A. L., Godeaux, O., Chlibek, R., Diez-Domingo, J., Hwang, S.-J. ... Heineman, T. C. (2015). Efficacy of an adjuvanted herpes zoster subunit vaccine in older adults. *New England Journal of Medicine, 372*, 2087–2096. http://dx.doi.org/10.1056/NEJMoa1501184

d) Journal Article from Web, without DOI

Sidani, S. (2003). Enhancing the evaluation of nursing care effectiveness. *Canadian Journal of Nursing Research, 35*(3), 26–38. Retrieved from http://cjnr.mcgill.ca

e) Journal Article wih DOI

Turner, S. J. (2010). Website statistics 2.0: Using Google Analytics to measure library website effectiveness. *Technical Services Quarterly, 27*, 261–278. http://dx.doi.org/10.1080/07317131003765910

f) Advance Online Publication

Smith, J. A. (2010). Citing advance online publication: A review. *Journal of Psychology*. Advance online publication. http://dx.doi.org/10.1037/a45d7867

g) Article in a Magazine

Henry, W. A., III. (1990, April 9). Making the grade in today's schools. Time, 135, 28–31.

Doctoral Dissertation, Master's Thesis, Presentation, Proceeding

a) Dissertation/Thesis from a Commercial Database

Van Brunt, D. (1997). *Networked consumer health information systems* (Doctoral dissertation). Available from ProQuest Dissertations and Theses database. (UMI No. 9943436)

b) Dissertation/Thesis from an Institutional Database

Yaylalı-Yıldız, B. (2014). *University campuses as places of potential publicness: Exploring the politicals, social and cultural practices in Ege University* (Doctoral dissertation). Retrieved from Retrieved from: http://library.iyte.edu.tr/tr/hizli-erisim/iyte-tez-portali

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Tonta, Y. A. (1992). *An analysis of search failures in online library catalogs* (Doctoral dissertation, University of California, Berkeley). Retrieved from http://yunus.hacettepe.edu.tr/~tonta/yayinlar /phd/ickapak.html

d) Dissertation/Thesis abstracted in Dissertations Abstracts International

Appelbaum, L. G. (2005). Three studies of human information processing: Texture amplification, motion representation, and figure-ground segregation. *Dissertation Abstracts International: Section B. Sciences and Engineering, 65*(10), 5428.

e) Symposium Contribution

Krinsky-McHale, S. J., Zigman, W. B., & Silverman, W. (2012, August). Are neuropsychiatric symptoms markers of prodromal Alzheimer's disease in adults with Down syndrome? In W. B. Zigman (Chair), *Predictors of mild cognitive impairment, dementia, and mortality in adults with Down syndrome*. Symposium conducted at the meeting of the American Psychological Association, Orlando, FL.

f) Conference Paper Abstract Retrieved Online

Liu, S. (2005, May). *Defending against business crises with the help of intelligent agent based early warning solutions*. Paper presented at the Seventh International Conference on Enterprise Information Systems, Miami, FL. Abstract retrieved from http://www.iceis.org/iceis2005/abstracts_2005.htm

g) Conference Paper - In Regularly Published Proceedings and Retrieved Online

Herculano-Houzel, S., Collins, C. E., Wong, P., Kaas, J. H., & Lent, R. (2008). The basic nonuniformity of the cerebral cortex. *Proceedings of the National Academy of Sciences, 105*, 12593–12598. http://dx.doi.org/10.1073/pnas.0805417105

h) Proceeding in Book Form

Parsons, O. A., Pryzwansky, W. B., Weinstein, D. J., & Wiens, A. N. (1995). Taxonomy for psychology. In J. N. Reich, H. Sands, & A. N. Wiens (Eds.), *Education and training beyond the doctoral degree: Proceedings of the American Psychological Association National Conference on Postdoctoral Education and Training in Psychology* (pp. 45–50). Washington, DC: American Psychological Association.

i) Paper Presentation

Nguyen, C. A. (2012, August). *Humor and deception in advertising: When laughter may not be the best medicine.* Paper presented at the meeting of the American Psychological Association, Orlando, FL.

Other Sources

a) Newspaper Article

Browne, R. (2010, March 21). This brainless patient is no dummy. *Sydney Morning Herald, 45*.

b) Newspaper Article with no Author

New drug appears to sharply cut risk of death from heart failure. (1993, July 15). *The Washington Post*, p. A12.

c) Web Page/Blog Post

Bordwell, D. (2013, June 18). David Koepp: Making the world movie-sized [Web log post]. Retrieved from http://www.davidbordwell.net/blog/page/27/

d) Online Encyclopedia/Dictionary

Ignition. (1989). *In Oxford English online dictionary* (2nd ed.). Retrieved from http://dictionary.oed.com

Marcoux, A. (2008). Business ethics. In E. N. Zalta (Ed.). *The Stanford encyclopedia of philosophy*. Retrieved from http://plato.stanford.edu/entries/ethics-business/

e) Podcast

Dunning, B. (Producer). (2011, January 12). *in Fact: Conspiracy theories* [Video podcast]. Retrieved from http://itunes.apple.com/

f) Single Episode in a Television Series

Egan, D. (Writer), & Alexander, J. (Director). (2005). Failure to communicate. [Television series episode]. In D. Shore (Executive producer), *House*; New York, NY: Fox Broadcasting.

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Fuchs, G. (2004). Light the menorah. On *Eight nights of Hanukkah* [CD]. Brick, NJ: Kid Kosher.

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