ACTA ZOOLOGICA BULGARICA
Acta zool. bulg., 63 (2), 2011: 179-185

Dynamics of Oligochaeta Fauna in Sazlidere Stream (Edirne, Turkey) with Relation to Environmental Factors

***Menekşe Taş*[1*], *Timur Kırgız*[2], *Naime Arslan*[3]**

[1] Trakya University, Institute of Natural Sciences, Biology Section, 22030 Edirne, Turkey
[2] Trakya University, Faculty of Science, Department of Biology, 22030, Edirne, Turkey
[3] Osmangazi University, Department of Biology, Faculty of Arts and Science, 26480, Eskişehir, Turkey

Abstract: This study was carried out in order to determine Oligochaeta fauna of Sazlidere Stream (Edirne, Turkey) and investigate their distribution between February 2007-December 2007. Samplings were collected in two monthly intervals at four different stations during a year. Oligochaeta individuals were identified on species level and a total of 14 species (*Tubifex tubifex* (Müller 1774)*, Limnodrilus hoffmeisteri* (Claparede1862), *L. udekemianus* (Claparede1862), *Potamothrix hammoniensis* (Michaelsen 1901) belonging to subfamily Tubificinae; *Chaetogaster diaphanus* (Gruithuisen1828), *Stylaria lacustris* (Linnaeus 1767), *Nais barbata* (Müller 1773),
N. bretscheri (Michaelsen 1899), *N. elinguis* (Piguet 1906), *Ophidonais serpentina* (Müller 1774), *Pristina longiseta* (Ehrenberg 1938), *Slavina appendiculata* (D'Ukem1855), *Dero digitata* (Müller 1773), *Aulophorus furcatus* (Müller 1774) belonging to family Naididae and immature tubificidae with hair setae were determined. All the species identified in Sazlidere Stream are new records for the stream. In addition, *C. diaphanus, N. barbata, N. bretscheri, O. serpentina, S. appendiculata, P. longiseta* are new recods for Oligochaeta fauna of Turkish Thrace. According to Shannon-Weiner diversity index, it was found that Sazlidere Stream has H'= 0.72 diversity values at average. According to Bray-Curtis Cluster analyse results, 1st and 2nd stations have showed the highest similarity in terms of Oligochaeta species and their number and it is observed that this similarity is related to 4th and 3rd station, respectively. Also, water sampling was done to determine some physical-chemical features of surface water (DO, BOD, SO_4^{-2}, PO_4^{-3}, NO^-_3-N, NO^-_2-N, Mg, Ca, Cl, Chlorophyll-a, suspended solid material, organic matter) and microbiological analysis (total bacteria, total coliform and *E. coli*). Furthermore, the relationships between oligochaeta species and physical-chemical features was analysed by one way ANOVA test.

Key words: Sazlidere Stream, Oligochaeta, fauna, physicochemical parameters

Introduction

Oligochaetes are a significant part of the zoobenthos in freshwater ecosystems. They are useful as water and sediment quality indicators and express different tolerance values for different conditions often indicating the type and degree of environmental pollution present. Moreover, Oligochaeta assemblages play an important role in monitoring and assesment of water quality (Goodnight & Whitley 1961).

In Turkey, the studies on freshwater Oligochaetes have been generally carried out in lakes. Also, all of them are related to either limnologic or faunistic content of the lakes. There is a small number studies carried on Oligochaetes in running waters of Turkey. Up to date, a total of 98 freshwater Oligochaeta species have been reported from Turkish inland waters (Arslan 2006). In running waters of Turkish Thrace,

*Corresponding author: menekseetas@hotmail.com

there are only two studies on Oligochaeta fauna (Kırgız *et al*. 2005; Çamur-Elipek *et al*. 2006).

Sazlidere Stream is located in the European part of Turkey, in Thrace Region. Before 1970s, waters of Sazlidere Stream were used for agricultural irrigation. Increasing industrial factories and their wastes damaged water quality of the stream. This results affected the agricultural production badly in the area (DSI 1984; Kırgız & Güher 1992; Özkan 1998).

As yet, there has been no study on Oligochaeta fauna and their relationships with physical-chemical parameters in Sazlidere Stream. The aim of the this study is to investigate the qualitative and quantative characteristics of Oligochaeta fauna in Sazlidere and their relationships with environmental conditions.

Material and Methods

Sazlidere stream constitutes the major part of part of Maritsa-Ergene Basin takes place in Edirne city (Turkish Thrace). The maximum depth is 80 cm, the streams lenght is 59 km and its average width 4-7 m. It is added to Maritsa (Meriç) River which is a boundary between Greece and Turkey (Fig. 1).

The study was performed between February 2007-December 2007 in two monthly intervals during a year. Sampling was carried out at four different sites

(Fig. 1). At each site, water samples were taken periyodically, when the time of sampling Oligochaeta.

Station 1: Köşençiftliği village. It is the first station of Sazlidere Stream. The substrate is composed of mud-clay and macrophytes.

Station 2: Sazlidere Bridge. The substrate is composed of mud-clay and macrophytes.

Station 3: Tayakadın village. This station is about 700 m away (after) from a textile factory. There is a factory producing paper materials at this location. The bottom has bad smelling mud-clay but macrophytes are absent.

Station 4: Karakasım village. This station is located the 6th km after the village. It has sandy and smelling bad bottom but macrophytes are absent.

Oligochaeta samples were collected using an Ekman Birge grab (15x15 cm) and sieved (1.19 mm, 0.595 mm, 0.297 mm mesh size). The samples were preserved in 4% formaldehyde when the field investigation and then carried in plastic bottles to the laboratory. The material was sorted under a binocular microscope and also transferred to 70% ethyl alcohol. Oligochaeta samples were examined by preparing temporary preparation with solution (using glycerine-water 1:5). These specimens, were identified by using Brinkhurst (1971, 1978), Brinkhurst & Jamieson (1971), Brinkhurst & Wetzel (1984), Kathman & Brinkhurst (1998), Milligian (1997), Sperber (1948, 1950), Timm (1999), Wetzel *et al*. (2000).

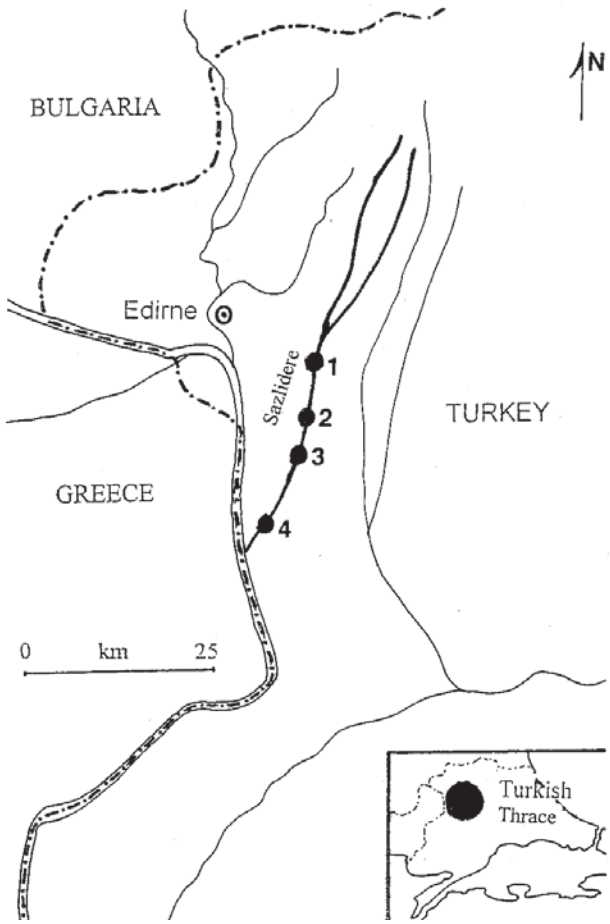

Fig. 1. Sampling Stations in Sazlidere Stream.

The species were also evaluated to their individual numbers and densities (%) to the sampling intervals and stations.

During sampling period, water temperature (using ordinary thermometer), pH (using pH meter), conductivity (using conductivitymeter), dissolved oxygen (using oxygenmeter) were measured while sampling. Furthermore, water samples taken by a Ruttner water sampler were carried to laboratory in bottles and dissolved oxygen (by classical Winkler

Method), SO_4^{-2}, PO_4^{-3}, NO_3^--N, NO_2^--N, CI, Mg, Ca, Chlorophyll-a, Suspended Solid Material, BOD were analysed (by classical titrimetric and spectrophotometric methods). In order to examine the total bacteria, fecal coliform and *E. coli*, water samples were taken into sterile bottles during the sampling period. All of them were kept at temperature 4 °C and were analysed within 24 h (APHA 1992; Özdemir & Eltem 2001).

Species diversity values were evaluated according to Shannon Wiener species diversity index (Krebs 1999). Also similarities of distribution of Oligochaeta species were determined according to Bray Curtis Similarity Index (Krebs 1999). The relationships between physical-chemical parameters and distribution of the species were evaluated by one way ANOVA in SPSS 9.0 for Windows.

Results

A total of 14 species and immature tubificidae with hair setae were determined (Table 1). *C. diaphanus, N. barbata, N. bretscheri, O. serpentina, S. appendiculata, P. longiseta* are new recods for Turkish Thrace. It was found that the number of Oligochaeta was 9139 ind./m^2 on average (Table 1).

When the total number of individual is taken into consideration it could be seen that station 4 has the highest values with 25 089 ind./m^2. It was followed by the station 1 (7267 ind./m^2), station 2 (2422 ind./m^2) and the station 3 (1778 ind./m^2).

L. hoffmeisteri, L. udekemianus, P. hammoniensis, *N. elinguis*, *O. serpentina* were observed all year throughout in each station (Table 1).

It was observed that *N. elinguis* has the highest abundance with 56.90% and it was followed by *P. hammoniensis* and *L. hoffmeisteri* (21.57% and 11.80%, respectively) (Table 1).

According to Shannon-Weiner diversity index, it was found that Sazlidere Stream has H'= 0.72 diversity values on average. The diversity values of the stations were determined as H'=1.16 for the first station, H'=0.88 for the second, H'= 0.46 for the third, H'= 0.41 for the forth.

In terms of Oligochaeta species and individual number at the stations, 1st and 2nd ones were found to have the highest similarity according to Bray-Curtis Cluster Analysis results. It is determined this similarity to continu to station 4 and subsequently to station 3 (Fig. 2).

The minimum, maximum and average values of the environmental parameters of Sazlidere Stream in the period of investigation are shown in Table 2. The results were compared by National Standards for Turkish inland waters (SKKY 2004) (Table 2).

The relationships between Oligochaeta species and physical-chemical parameters were evaluated by one way ANOVA. According to this, the abundance of *T. tubifex* showed positive correlations to pH, total hardness and organic matter ($p<0.05$); the abundance of *N. barbata* showed positive correlation to Chlorophyll-a ($p<0.05$); the abundance of *D. digitata* showed negative correlation to electrical conductivity ($p<0.05$). The abundance of *O. serpentina* showed a positive correlations to Mg, NO_2^--N and Cl^- ($p<0.05$); the abundance of *N. bretscheri*, *P. longiseta* and *S. appendiculata* showed positive correlations to NO_2^--N ($p<0.05$). The abundance of *N. elinguis* showed positive correlation to electirical conductivity and Mg ($p<0.05$); the abundance of *C. diaphanus* showed positive correlations to total hardness and *E. coli* ($p<0.05$); the abundance of *S. lacustris* showed positive correlations to Mg and *E. coli* ($p<0.05$). The abundance of *A. furcatus* showed positive correlations to NO_3^--N and Chlorophyll-a ($p<0.05$); the abundance of *L. hoffmeisteri* showed positive correlations to pH, DO, suspended solid material and *E. coli* ($p<0.05$); the abundance of *L. udekemianus* showed significant positive correlation to suspended solid material and organic matter ($p<0.05$); the abundance of *P. hammoniensis* showed significant positive correlations to DO and *E.coli* ($p<0.05$).

Discussion

Until the present, there has been no comprehensive study of Oligochaeta fauna in Sazlidere Stream. In the study performed by Çamur-Elipek *et al*. (2006), there were recorded *T. tubifex, L. hoffmeisteri, L. udekemianus, P. hammoniensis*, *S. lacustris, N. elinguis, D. digitata, A. furcatus* from Turkish Thrace. Although *C. diaphanus, N. barbata, N. bretscheri, O. serpentina, S. appendiculata, P. longiseta* have been recorded by Uzunov & Kapustina (1993) in Meriç River (Maritsa, Evros), these species are new records for Oligochaeta fauna of Turkish Thrace.

Table 1. Distribution of aquatic Oligochaetes in Sazlidere Stream (Edirne, Turkey).

	Stations				Months						Average	Abundance
	1st	2nd	3rd	4th	February	April	June	August	October	December		
Chaetogasterdiaphanus(Gruithuisen,1828)	0	0	52	0	0	67	11	0	0	0	13	0.14 %
Dero digitata (Müller, 1773)	24	8	0	0	0	0	0	0	48	0	8	0.09%
Aulophorus furcatus (Müller,1774)	0	0	0	22	0	0	0	30	0	0	5	0.05%
Nais barbata (Müller, 1773)	504	0	0	950	0	760	0	1422	0	0	364	4%
Nais bretscheri (Michaelsen, 1899)	0	12	0	0	0	18	0	0	0	0	3	0.03%
Nais elinguis (Piguet, 1906)	324	200	1444	18 827	355	2355	21 600	6744	100	22	5198	56.90%
Ophidonais serpentina (Müller, 1774)	555	89	126	0	133	806	164	33	0	22	193	2.11%
Slavina appendiculata (D'Ukem, 1855)	0	20	0	0	0	30	0	0	0	0	5	0.05%
Stylaria lacustris (Linnaeus, 1767)	0	12	40	0	0	44	33	0	0	0	13	0.14%
Pristina longiseta (Ehrenberg, 1938)	0	0	7	90	0	11	0	133	0	0	24	0.26%
Tubifex tubifex (Müller, 1774)	156	0	0	0	0	0	233	0	0	0	39	0.42%
Limnodrilus hoffmeisteri (Claparede,1862)	2790	840	52	634	1111	1100	500	1280	1080	1390	1078	11.80%
Limnodrilus udekemianus (Claparede,1862)	625	28	13	68	189	56	211	380	135	135	184	2.01%
Potamothrixhammoniensis(Michaelsen,1901)	2289	1213	44	4340	868	2528	256	4448	1422	2311	1972	21.57%
İmmature tubificidae with hair setae	0	0	0	158	0	0	170	0	70	0	40	0.43%
Total number of ind.	7267	2422	1778	25 089	2656	7775	23 178	14 470	2855	3880	9139	100%

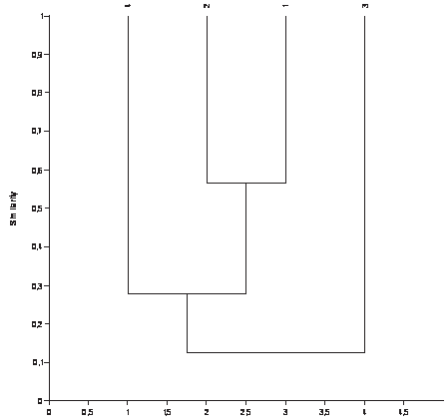

Fig. 2. Bray-Curtis dendogram of similarity of the stations in Sazlidere Stream with respect to Oligochaeta species.

The highest number of species was found at 2nd station (9 species), following by stations 1st, 3rd and 4th (8 species) (Table 1). *Slavina appendiculata* was found at 2nd station only. The 2nd station has a dense aquatic vegetation and clay-mud substratum structure.

Oligochaeta species composition and their distribution depend on many factors such as water temperature, physical-chemical features of water, sediments, bottom microflora and vegetation (Grigelis *et al*. 1981). It was reported that one of the most important factors determined distribution of Naididae is substratum type (Martinez Ansemil & Collado 1996). Our findings in 2nd station support this.

A total of four species (*L. hoffmeisteri*, *L. udekemianus*, *P. hammoniensis* and *N. elinguis*) were determined in each station. *L. hoffmeisteri* and *L. udekemianus* which are cosmopolitan species were found at especially organically enriched areas. Where the pollution increases, the number of these specimens increases (Timm 2003). The other dominant species *P. Hammoniensis*, is a freshwater euryhaline form, it has adapted to every kind of water. Especially it has known that one of characteristic species with organic polluted waters (Brinkhurst & Jamieson 1971). In June, there is an increase in *N. elinguis* density. Being a fairly tolerant species, *N. elinguis* reaches a high population density in especially algae included in running waters consisting nutrients (Arslan & Şahin 2003). The existence of these four species in all sampling stations have showed paralellism with the literature used.

In the study, average of bottom water temperature, pH, cloride, sulfate were found at normal levels. DO and BOD were found at fourth quality level in all stations. In terms of NO_2-N, 1st and 3rd stations were found at third quality level, at 2nd and 4th stations were found at fourth one, phosphate at 2nd, 3rd and at 4th stations were found at second quality level (Table 2).

As a result of microbiological parameters of total bacteria were found at 1st, 2nd and 4th stations between first and second quality levels, whereas at 3rd station was found between second and third ones. Furthermore, total coliform were found at all stations second quality level. *E. coli* was found very in high number at 4th station. These bacteria are known as intestinal origin microorganisms. This result indicates that the sewage system poures into Sazlidere Stream without purifying.

According to Bray-Curtis Similarity Index, 1st and 2nd stations are the most similar ones to each other while 4th and 3rd are the most different in terms of both Oligochaeta fauna and number of individuals. The structure of sediment in 1st and 2nd stations is similar to each other and these similarities may be explained with sediments of 1st and 2nd stations consisting of clay-mud.

Kırgız *et al.* (2005) have recorded a total of 8 species of Oligochaeta in Turkish segment of Tundzha River, while Elipek *et al.* (2006) have reported that benthic organisms of Tundzha River are composed of Oligochaeta 69% and 31 species.

If this study is compared to similar studies which are performed in Bulgarian part of Tundzha, Maritsa and Arda Rivers, a total of 47 oligochaeta species in Tundzha River, a total of 54 oligochaeta species in Maritsa River, and a total of 27 species in Arda River were recorded (Uzunov & Kapustina 1993).

Özkan (1998) has reported that dissolved oxygen and NO_3^--N of Sazlidere Stream is on third quality level, BOD is on first one, NO_2^--N is on fourth quality level. If present study is compared with findings of Özkan (1998) it is observed that the water quality of the stream has changed within last nine years. Increasing the number of industrial factories, urbanization, agricultural areas affect the quality of water in the stream.

Consequently, it is recomended that the stream should be monitored at regular intervals using both chemical and biological methods.

Table 2. Minimum, maximum and average values of physical-chemical parameters of Sazlidere Stream during the investigation (number in parantheses and roman numbers indicate average value and class of water quality, respectively). (D.O.: Dissolved Oxygen; BOD_5: Biological Oxygen Demand; SSM: Solid suspended material).

Parameters/Stations	1st	2nd	3rd	4th
pH	min.6.93-7.93max. average(7.71)	7.07-7.85 (7.52)	6.72-7.77 (7.41)	6.26-7.39 (7.07)
Conductivity (µS/cm)	0.65-1 (0.88)	0.66-0.92 (0.80)	0.81-1.01 (0.90)	0.7-0.98 (0.81)
Temperature (˚C)	8.5-23 (13.42)	6-24.5 (14.25)	6-25 (16.17)	7-24 (15.08)
D.O.(mg/L)	2.09-3.8 (2.95) IV	1.71-3.61 (2.66) IV	0.57-3.04 (2.12) IV	0.38-3.42 (1.62) IV
Mg^{+2}(mg/L)	20.82-42.61 (32.68)	19.85-33.41 (28.41)	6.29-34.86 (23.16)	7.26-50.36 (26.63)
Ca^{+2} (mg/L)	48.09-97.79 (73.34)	60.12-91.38 (73.34)	40.08-94.58 (77.22)	78.55-95.39 (85.23)
Total hardness (mg/L)	2-42 (27.90)	1.60-35 (25.60)	2-36.6 (25.30)	1-34 (25.33)
NO_3^{-1}N (mg/L)	0.17-3.92 (2.36)I	1.82-4.54 (3.43)I	0-3.46 (1.18)I	0-2.17 (0.69)I
NO_2^{-1}N (mg/L)	0-0.1 (0.03)III	0-0.19 (0.05)IV	0-0.09 (0.04)III	0-0.21 (0.07)IV
SO_4^{-2} (mg/L)	1.12-4.39 (2.36)I	0.91-3.26 (1.83)I	0-3.67 (2.39)I	1.31-2.72 (2.12)I
PO_4^{-3} (mg/ L)	0.01-0.04 (0.03)I	0.05-0.15 (0.09)II	0.04-0.39 (0.11)II	0.01-0.22 (0.10)II
Cl^{-1} (mg/L)	7.99-164.94 (58.14)I-II	8.99-122.9 (46.98)I-II	9.99-138.9 (50.48)I-II	8.99-112.9 (43.48)I-II
SSM (mg/L)	0.01-0.07 (0.04)	0.01-0.04 (0.03)	0.03-0.04 (0.04)	0.01-0.04 (0.03)
Chlorophyll-a (µg/L)	1.33-9.32 (4.29)	2.66-7.99 (4.96)	4.88-46.62 (13.76)	3.99-21.75 (10.80)
BOD_5 (mg/ L)	4-41 (21.83)IV	2-54 (23.33)IV	7-50 (25.33)IV	12-54 (33.17)IV
T. bacteria(cfu/mL)	0-2000 (200)	0-100 000 (25223)	0-350 000 (68000)	1000-100 000 (31 833)
T. coliform(cfu/mL)	0-1000 200	70-900 (350)	180-100000 (19530)	400-10000 (2950)
E. coli. (cfu/mL)	0-80 13.33	0-200 (46.67)	0-3000 (525)	0-10000 2533
Organic matter (mg/L)	2.99-11.97 (5.43)	0.52-2.94 (1.57)	0.01-1.29 (0.48)	0.84-5.07 (2.48)

Acknowledgements: We would like to thank to B. Çamur-Elipek and B. Öterler (Trakya University, Turkey) for their guidance during the study. We would also thank to Trakya Üniversitesi Su Ürünleri Uygulama and Araştırma Merkez Müdürlüğü.

This study was supported by the Research Fund of Trakya University (Project N 819). This paper is a part of Taş's MSc Thesis.

References

APHA-AWWA-WPCF 1992. Standard methods for the examination of water and wastewater. 18th edition. Washington DC., American Water Works Association and water Pollution Control Federation, 10-137.

Arslan N. 2006.Records of Aphanoneura and Aquatic Oligochaetes from Turkey. – *Fresenius Environmental Bulletin*, Vol. 15, **4**: 249-254.

Arslan N., Y. Şahin 2003. Nine New Naididae (Oligochaeta) Species for Sakarya River, Turkey. – *Turkish Journal of Zoology*, **27**: 27-38.

Brinkhurst R. O. 1971. A Guide for the Identification of British Aquatic Oligochaeta. Freshwater Biological Association, Scientific Publication No.22, 2nd edition, Toronto, 53 pp.

Brinkhurst R. O.1978. Limnofauna Europaea, IIIies J., Gustav Fisher Verlag, Stutgart, 139-147.

Brinkhurst, R. O., B. G. M. Jamieson 1971. Aquatic Oligochaeta of the World, Oliver & Boyd, Edinburg.

Brinkhurst R. O., M. Wetzel 1984. Aquatic Oligochaeta of the World: Supplement Can. Tech. Rep. Hydrogr. Ocean Sci., **44**: 1-101.

Çamur-Elipek B., N. Arslan, T. Kirgiz, B. Öterler 2006. Benthic macrofauna in Tunca River (Turkey) and their relationship with environmental variables. – *Acta hydrochim. hydrobiol*., **34**: 360-366.

Dsi. 1984. Su ürünleri Faaliyetleri Enerji ve Tabii Kay. Baş. DSİ Su İş. Gen. Müd. İşletme ve Bakım Dairesi Başk. DSİ Basın ve Foto-Film İşl. Müd. Mat., 67 p.

Goodnight, C. J., L. S. Whitley 1961. Oligochaetes are indicators of pollution. Pages 139-142. In: Proceedings of the 15th Industrial Waste Conference, 3-5 May 1960. Engineering Extension Service Bulletin Series No: 106. Purdue University, West Layafette, Indiana.

Grigelis A., O. Lenkaitis, Nainaite and E. Zukaite 1981. Peculiarities of Distribution of Cold-Stenotherm Hydrobionts in Lakes of the National Park of the Lithuanian SSR. – *Verh. Int.Ver. Limnol*., **21**: 501-503.

Kathman R. D., R. O. Brinkhurst 1998. Guide to the Freshwater Oligochaetes of North America, Aquatic Resources Center, Tennessee, USA, 264 p.

Kirgiz T., B. Çamur-Elipek, N. Arslan 2005. Preliminary study of Enchytraeidae (Oligochaeta) in Tunca River (Thrace, Turkey). – *Proc. Estonian Acad. Sci. Biol. Ecol.* **54** (4): 310-314.

Kirgiz T., H. Güher 1992. Trakya Bölgesinde Sazlıdere ve Çorlu Derelerinin Bentik Faunası Üzerinde Kirliliğin Etkileri. II Uluslararası Ekoloji ve Çevre Sorunları Sempozyumu, 5-7 Kasım, Ankara, 83-92.

Krebs C. J. 1999. Ecological Methodology, Addison Wesley Longman, Inc., Menlo Park, California, 620 pp.

Martinez-Ansemil E., R. Collado 1996. Distribution patterns of aquatic Oligochaetes inhabiting water sources in the Northwestern Iberian Peninsula. – *Hydrobiologia*, **334**: 73-83.

Milligian R. M. 1997. Identification Manual for The Aquatic Oligochaeta of Florida Volume I, Freshwater Oligochaetes. State of Florida Department of Environmental Protection Tallahassee, Florida, 187 p.

Özdemir G., R. Eltem 2001. Su ve Atık Suların Mikrobiyolojik İncelenmesi ve Arıtım Uygulamaları, Ege Üniversitesi Fen Fakültesi Kitaplar Serisi No: 167, 214 p.

Özkan N. 1998. Maritsave Ergene Nehirleriyle Bazı Kollarında Chironomidae (Diptera) Larvalarının Dinamiği, Trakya Üniversitesi Fen Bilimleri Enstitüsü 143 p. (Doktora Tezi).

Skky. 2004. Su Kirliliği Kontrol Yönetmeliği, Yayımlandığı Resmi Gazete, 31 Aralık Cuma 2004, Sayı: 25687.

Sperber C. 1948. A Taxonomical Study of the Naididae. Zool. Bidr. Uppsala, **28**: 296.

Sperber C. 1950. A Guide for the Determination European Naididae. Zool. Bidr, Uppsala, **29**: 45-78.

Timm T. 1999. A Guide to the Estonian Annelida. Naturnalist's Handbooks 1, Tart-Tallin, 208 pp.

Timm T. 2003. Veldhuijzen Van Zanten, H.H. Freshwater Oligochaeta of North-West Europe.

Uzunov Y., L. Kapustina 1993. Current rewiev on Oligochaeta from macrozoobenthic communities of Bulgarian Rivers. Lauterbirnia, 13: 73-83 (1993).

Wetzel M. J., R. D. Kathman, S. V. Fend, K. A. Coates 2000. Taxonomy, Systematics and Ecology of Freshwater Oligochaeta. Workbook Prepared for North American Benthological Society Technical Workshop, 48th Annual Meeting, Keystone Resort, CO. 120 p.

Received: 09.12.2010
Accepted: 03.06.2011