E.Ü. Su Ürünleri Dergisi 2005
E.U. Journal of Fisheries & Aquatic Sciences 2005
Cilt/Volume 22, Sayı/Issue (1-2): 165–172

ISSN 1300 - 1590
http://jfas.ege.edu.tr/

The Oligochaeta (Annelida) Fauna of the Inland Waters in the Lake District (Turkey)*

*Seray Yıldız, Süleyman Balık

Ege University, Faculty of Fisheries, Department of Hydrobiology, 35100, Bornova, Izmir, Turkey
**E mail: syildiz@sufak.ege.edu.tr*

Özet: *Göller Bölgesi (Türkiye) içsularının Oligochaeta (Annelida) faunası.* Göller Bölgesi içsularında dağılım gösteren Oligochaeta faunasının belirlenmesi amacıyla Haziran 1999-Kasım 2000 tarihleri arasında 75 istasyondan (30 kaynak, 21 göl, bir gölet, 12 baraj gölü, 7 akarsu, 3 kanal, bir mağara) toplam 237 bentik örnek alınmıştır. Araştırma sonucunda, 24'ü Tubificidae, 14'ü Naididae, 3'ü Enchytraeidae, 2'si Lumbriculidae, 1'i Lumbricidae, 1'i Haplotaxidae ve 1'i Glossoscolecidae familyalarına ait olmak üzere toplam 46 tür tespit edilmiştir. Tespit edilen türlerden, *Henlea nasuta, Tubifex tubifex f. bergi, Limnodrilus hoffmeisteri f. parvus, Ilyodrilus frantzi* ve *Spirosperma nikolskyi* Türkiye Oligochaeta Faunası için ilk kayıt niteliğindedir.

Anahtar Kelimeler: Oligochaeta Fauna, Göller Bölgesi, Türkiye.

Abstract: A total of 237 benthic samples was collected from 75 stations (30 springs, 21 lakes, one pond, 12 reservoirs, 7 flowing streams, 3 canals, one cave) between June 1999 - November 2000 and evaluated in order to determine the distribution of oligochaete fauna in inland waters of Lake District, Turkey. As a result of the study, a total of 46 species was determined, comprising 2 species from Lumbriculidae, 1 species from Haplotaxidae, 3 species from Enchytraeidae, 24 species from Tubificidae, 14 species from Naididae, 1 species from Lumbricidae and 1 species from Glossoscolecidae. Among these, *Henlea nasuta, Mesenchytraeus armatus, Tubifex tubifex f. bergi, Limnodrilus hoffmeisteri f. parvus, Ilyodrilus frantzi, Spirosperma nikolskyi* are new records for the inland water fauna of Turkey.

Key Words: Oligochaeta fauna, Lake District, Turkey.

**Doktora tez çalışmasıdır.*

Introduction

Anatolia is a passage among the Eremial, Boreal and Mid-Europe elements in addition to being a centre for a number of living species to evolve and distribute. It is one of the most important zoogeographical parts of the Palearctic Region with its inland sources and paleogeographical and hydrogeographical properties of these sources (Demirsoy 1999). Anatolia is a very interesting region with its big and different inland sources as well as diversity of organisms' distributing in these ecosystems. Thus, there is a significant increase in studies to determine hydrobiological properties of lentic and lotic systems.

The Lake District of south-western of Turkey is surrounded to the south by the western ranges of the Taurus Mountains, uplifting of which formed Antalya Bay in the south and the region in the north shifted northwards. Its topography is composed of narrow and long mountain ranges surrounding depression areas most of which have changed into lakes. These lakes are in a line parallel to Lake Eğirdir. The altitude is relatively high, decreasing slightly in depression areas like Burdur and Eğirdir.

Sözen and Yigit (1996) reported the benthic fauna and some limnological properties of the Lake Aksehir that Chironomidae larvae represented 51.55% of benthic fauna in the lake, Oligochaeta samples 45.97% and other benthic invertebrate groups 2.48%. Tubificidae, a family of Oligochaeta was reported while the species were left at the level of genus.

Kazanci *et al.,* (1998) didn't report Oligochaeta in benthic faunas of the Lakes Burdur and Acigöl (Denizli) in a study on limnology, environmental quality and biological diversity of these 2 lakes.

Kazanci *et al.,* (1999) reported members of Lumbriculidae family in Egirdir, Bafa and Eber Lakes and Büyük Menderes Delta in a study on limnology, environmental quality and biological diversity of these water bodies, but they didn't perform detailed species description. Naididae were found in the Lake Gebekirse only, but without any species description.

The aim of this study is a contribution to the Oligochaeta fauna of Lake District and thereby to biological diversity of our country.

Materials and Methods

237 samples from a total of 75 stations were taken at different dates (11-15.06.1999; 06-09.09.1999; 06-10.12.1999; 08-11.05.2000; 15-18.07.2000; 31.07-03.08.2000; 20-23.11.2000) in the Lake District. The stations included of 21 lakes, 12 dams, 30 underground water sources, 7 streams, 3 canals, one pond and one cave (Figure 1).

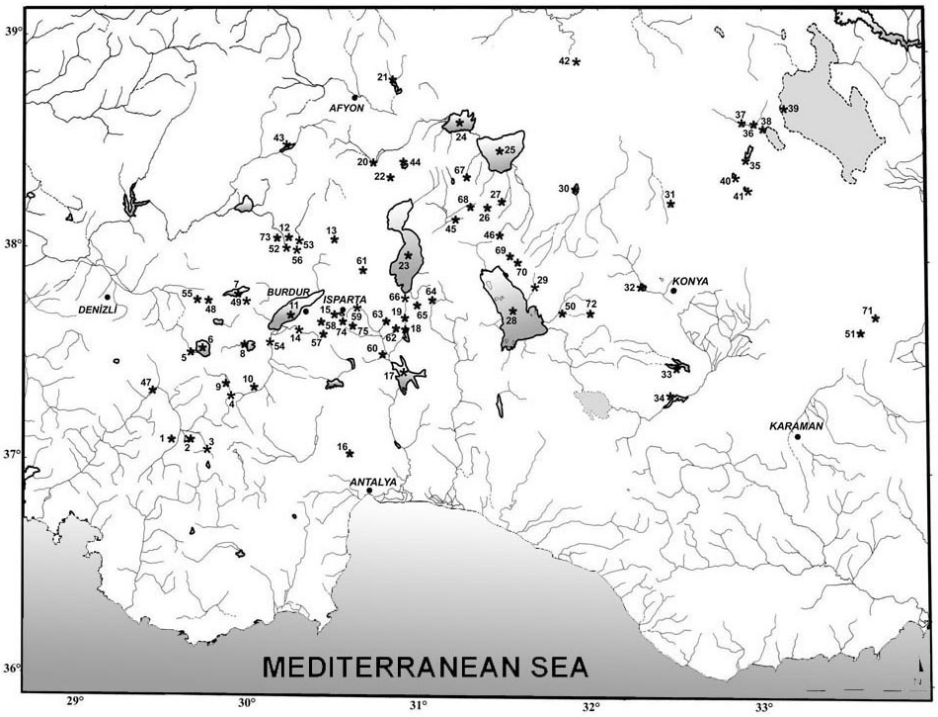

Figure 1. Map of Lake District in Turkey.

1. Yaprakli Dam
2. Gölhisar Lake
3. Kızıllar Çavdır Dam
4. Kırkpınar Springs
5. Salda Creek
6. Salda Lake
7. Acıgöl Lake (Denizli)
8. Yarışlı Lake
9. Karamanlı Dam
10. Karataş Lake
11. Burdur Llake
12. The .Sources of the River B. Menderes (İncirli Springs.-Dinar- Afyon)
13. Uluborlu Dam
14. İnsuyu Cave
15. Gölcük Lake (Isparta)
16. Kırkgöz Springs (Antalya)
17. Karacaören-I Dam (Çandır-Isparta)
18. Kovada Lake (Isparta)
19. Kovada Channel (Isparta)
20. Selevir Dam (Afyon)
21. Seyitler-Gebiciler Dam
22. Karamık Bataklığı Springs (Dinar-Afyon)
23. Eğirdir Lake
24. Eber Lake
25. Akşehir Lake
26. Sultan Mountains Çeşme Basin (Afyon)
27. The Creek created by snow waters of Akşehir on The Sultan Mountains
28. Beyşehir Lake
29. The Srping on road-fork between Beyşehir - İmrenler (Beyşehir- Konya)
30. Çavuşçu Lake
31. Başhüyük Pond
32. Altınapa Dam
33. May Dam
34. Apa Dam
35. Bolluk Lake
36. Pınarbaşı Springs (Cihanbeyli–Konya)
37. İnsuyu Channel (Cihanbeyli–Konya)
38. Tersakan Lake (Konya)
39. Tuz Lake
40. Köpek Lake (Kulu-Konya)
41. Düden Lake (Kulu-Konya)
42. Bademli Dam (Burdur)
43. Örenler–Akharım Dam (Afyon)
44. Karamık Marshy Area
45. The Creek on the intersection among Yalvaç-Isparta-Akşehir
46. The Waetrin canal on entrance of the County Göksöğüt
47. Dalaman River-Çamköy
48. Gemiş County-Pınar-Çardak (Denizli)
49.Aşağı Akpınar Place- II. Spring- Çardak (Denizli)
50. The Creek between Beyşehir-Konya (Konya)
51. Meke Saltpan (Karapınar-Konya)
52. B.Menderes Eldere-Pınarbaşı Springs-Dinar (Afyon
53. B.Menderes Su Çıkan Dinar İçi Springs-Dinar (Afyon
54. The Creek Karaçal (Burdur)
55. Çaltı (Kurugöl) Lake–Çardak (Afyon)
56. B. Menderes Düden Springsı-Dinar (Afyon)
57. Taşkapı-Çatak-Beldibi (Burdur)
58. Gökçebağ Dam-Pınargözü Springs (Gelincik-Isparta)
59. Pınarbaşı Springs-Sav (Isparta)
60. Gökböğet Springs-The Village Aşağı Gökdere -(Eğirdir-Isparta)
61. Kısık Spring-Atabey (Isparta)
62. Kocapınar Spring. - The Village Yukarı Gökdere
63. Su Gözü Spring- The Village Çukur (Eğirdir-Isparta)
64. Zindan River- Front of Zindan Cave (Aksu-Isparta)
65. Akdoğan Spring (Akdoğan-Isparta)
66. Pınar Pazarı (Eğirdir-Isparta)
67. Hisarardı Spring (Yalvaç-Isparta)
68. Su Gözü Spring–Bağkonak (Yalvaç-Isparta)
69. Fele Spring–The Village Fele (Yalvaç-Isparta)
70. Başpınar–Köprüköy (Şarkikaraağaç-Isparta)
71. Acıgöl Lake (Karapınar-Konya)
72. The Starting point of Gölyaka –spring (Beyşehir-Konya)
73. Kocapınar Spring–Karakuyu Pond (Dinar-Afyon)
74. Milas Spring (Yakaören-Isparta)
75. Starting point of Milas Spring – The way Gölcük (Isparta)

Hand dip-nets were used for shore samplings in streams and standing waters; and Ekman-Birge grab (15x15 cm) in open water of lakes, ponds and dams.

Depth, water temperature, dissolved oxygen values, pH, salinity, electrical conductivity and alkalinity as well as altitude and coordinates were determined on the most stations. Some other physical and chemical analyses were carried out in the laboratory (Table 1).

Table 1. Some phsyco-chemical parameters of stations. (D.O.:Dissolved Oxygen) * Could not measure.

STATIONS	PHYSICO-CHEMICAL PROPERTIES									
	Depth(m)	Temperature (°C)	Transparency(m)	pH	D.O. (mg/l)	Saturation (%)	C (µS- 25°C)	CaCO3 (meq/l)	Salinity (‰)	Alkalinity meq/l)
Yaprakli Dam	26	13.4	2.7	8.28	7.2	74	308.2	*	0.033	4.2
Gölhisar Lake	1.7	28	0.4	8.61	7.1	114	798	*	0.056	7.0
Kizillar-Çavdir Dam	29	12.7	3.8	8.36	7.6	75	299.8	*	0.045	4.8
Kirkpinar Springs- (Tefenni)	*	22.9	*	7.75	7.6	101	468	*	0.022	4.8
Salda Creek	*	21.2	*	8.55	6.7	87	800	*	0.056	10.2
Salda Lake	45.5	22.7	8.5	9.45	7	96	*	*	1.114	30.6
Acigöl Lake	0.4	10.6	*	7.75	13.25	100.4	1033	510	0.265	2.6
Springs of Yarisli Lake	*	16.2	*	8.15	8.93	87.3	260	130	0.111	3.8
Karamanli Dam-(Burdur)	15.4	10.5	1.7	8.83	9.3	84	428.1	*	0.033	6.8
Karatas Lake	1	23	0.1	8.83	5.6	75	585	*	0.067	6.4
Burdur Lake	7.8	5.7	4	9.26	8.74	72.1	*	1277	5.708	19.8
Incirli Springs- (Dinar)	*	16.0	*	7.32	3.3	34	*	*	0.084	3.0
Uluborlu Dam- (Isparta)	23	11.2	1.6	7.15	8.8	92	327.7	*	*	*
Insuyu Cave-(Burdur)	*	*	*	*	*	*	*	*	*	*
Gölcük Lake - (Isparta)	25	19.1	6.4	7.92	5.7	71	180	90	0.084	1.6
Kirkgöz Göleti	2.5	19.7	2.5	7.01	5.4	66	663	*	0.056	7.4
Karacaören 1 Dam- (Çandir)	14.7	24.6	3.2	7.65	6.4	80	226	110	0.084	1.4
Kovada Lake	2.0	23.5	2.0	8.9	7.2	94	191	90	0.070	1.4
Kovada Channel (Kizilçubuk Location)	2.0	23.9	*	8.1	5.3	68	291	140	*	*
Selevir Dam-(Afyon)	15.2	9.7	2.3	8.45	9.5	85	176.2	*	0.022	2.6
Seyitler-Gebiciler Dam-(Afyon)	15	11.8	1	8.72	10.5	93	239.7	*	0.033	3.4
Springs of Karamik Marshy Area (Çayiryazi- Dinar)	*	13	*	8.3	5.6	60.1	265	130	0.056	1.8
Egirdir Lake 1. sta. (Bağören village)	7.5	20.6	7.5	8.4	6.2	76	265	130	0.056	2.6
Egirdir Lake 2. sta. (Boyali village)	5.0	19.9	5.0	8.2	5.8	71	253	120	0.070	2.4
Egirdir Lake 3. sta. (Senirkent)	4.7	20.7	4.7	8.0	6.0	72	254	120	0.070	2.8
Egirdir Lake 4. sta. (Yalvaç)	5.1	20.4	5.1	8.0	5.7	70	291	140	0.070	2.4
Egirdir Lake 5. sta. (Port)	7.0	20.5	4.2	8.4	5.7	63	270	150	0.070	2.0
Egirdir Lake 6. sta.(island)	8.7	20.5	3.2	8.2	5.8	63	260	142	0.070	1.8
Egirdir Lake- Yenice Village(from coast)	1.9	13.3	1.9	7.69	7.09	71.7	330	160	0.056	2.6
Egirdir Lake- (Karkin Village)	5.8	20	5.8	8.68	6.8	86	295	170	*	*
Eber Lake – (Bolvadin)	0.8	5	0.4	9.32	2.3	18	1571	780	0.961	3.6
Aksehir Lake- (Gölçayir)	1.4	21	0.1	9.39	6.6	81	7890	*	1.949	26.4
Karsuyu Creek	*	13.0	*	8.71	6.3	81	*	*	0.084	3.0
Beysehir Lake 1. sta. (Tolca village)	3.1	20.8	1.9	8.2	5.6	74	253	120	0.070	1.6
Beysehir Lake 2. sta. (Kusluca village)	3.0	20.6	1.4	8.0	5.3	63	246	120	0.070	1.6
Beysehir Lake 3. sta. (Gölkasi village)	4.7	19.3	3.0	8.1	5.5	68	230	110	0.070	1.6
Beysehir Lake 4. sta. (Karadiken village)	6.3	20.2	1.7	8.0	5.0	58	250	120	0.070	1.8
Beysehir Lake 5. sta. (Cemeller village)	5.2	23.5	5.2	7.6	4.6	58	270	130	0.070	1.4
Beysehir Lake 6. sta. (Gölyaka village)	5.8	23.7	4.5	7.8	5.3	67	263	160	0.070	1.6
Beysehir Lake 7. sta. (Gedikli village)	3.1	22.0	2.5	8.5	6.3	78	217	110	0.070	1.6
Beysehir Lake 8. sta. (Çiftlikköy village)	4.2	15.0	3.3	8.58	7.2	81	283	140	0.056	2.4
Beysehir Lake 9. sta. (Tolca village)	*	21.0	*	8.5	8.4	107	278	140	0.056	2.6
Beysehir Lake 10. sta. (Akburun)	2.4	21.3	2.4	8.96	6.1	78	274.4	*	0.056	2.6
Beysehir Imrenler Springs	*	19.9	*	7.68	4.1	58	583	*	0.056	5.8
Çavusçu Lake-(Ilgin)	1.2	24	0.2	8.88	6.55	87.8	279	140	0.111	3.0
Bashüyük Pond- (Sarayönü)	*	21.7	*	9.19	10.3	139	643	320	0.195	3.0
May Dam-(Konya)	*	7.6	2.2	9.05	13.3	115	167.6	*	0.033	2.4
Apa Dam-(Konya)	3.1	11.6	2.3	9.02	10.7	105	264.2	*	0.056	3.4
Bolluk Lake- (Cihanbeyli)	*	14.9	*	8.59	3.0	35	*	*	48.452	13.0
Insuyu Springs-(Cihanbeyli)	*	15.9	*	7.83	8.7	101	414	210	0.084	2.2
Insuyu Channel-(Cihanbeyli)	*	18.7	*	8.24	7.6	98	1026	650	0.223	2.8

Table 1. Continued

Tersakan Lake	*	15.0	*	8.95	5.1	54	*	*	49.844	9.0
Tuz Lake	*	21.5	*	7.48	6.9	80	*	*	45.667	2.0
Düden Lake	*	22.8	*	9.67	12.0	140	*	7650	0.418	24.2
Bademli Dam	6.1	9.5	1.4	8.4	8.4	69	269.3	*	0.033	3.8
Örenler-Akharim Dam- (Afyon)	*	9.3	*	8.49	8.8	91	148	*	0.033	2.8
Karamik Marshy Area- (Afyon)	2	25	1.3	8.1	2.28	*	1670	850	0.557	10.2
The Creek on the intersection among Yalvaç, Isparta and Aksehir	*	16.7	*	7.5	5.3	65	469	580	0.070	2.8
The Watering Canal on Entrance of the County Göksögüt	*	*	*	*	*	*	*	*	*	*
Dalaman River-Çamköy	*	18.2	*	8.46	8.2	*	476	270	*	*
Gemis County-Pinar-Çardak (Denizli)	*	19	*	7.38	3.85	43.6	1048	520	0.167	3.2
Asagi Akpinar Place-II.Spring-Çardak (Denizli)	*	19	*	7.29	3.02	34.9	1042	520	*	*
Meke Saltpan (Karapinar-Konya)	1.5	8.6	1.5	8.37	8.25	73.9	*	*	49.009	6.0
Eldere-Pinarbasi Springs-Büyük Menderes-Dinar (Afyon))	*	14.4	*	7.75	6.2	71	268	160	0.084	3.8
Büyük Menderes Su Çikan Springs in Dinar (Afyon)	*	21	*	7.45	4.6	58	417	180	0.084	4.4
Çalti (Kurugöl) Lake–Çardak (Afyon)	*	25	*	7.95	4.03	52.5	912	450	0.111	4.8
B. Menderes Düden Springs-Dinar (Afyon)	*	20.3	*	7.38	6.3	81	524	*	0.028	5.0
Gökçebag Dam-Pinargözü Springs (Gelincik-Isparta)	*	16.1	*	7.79	7.3	90	324.1	*	0.084	4.6
Pinarbasi Springs-Sav (Isparta)	*	13.1	*	8.15	8.8	88	138.2	*	0.084	2.2
Gökböget Springs-Asagi Gökdere Village-(Egirdir-Isparta)	*	18.9	*	8.45	7.3	83	262.7	*	0.084	3.4
Kisik Membasi-Atabey (Isparta)	*	17.6	*	8.4	7.3	89	241.4	*	0.084	3.2
Kocapinar Springs-Yukari Gökdere Village- (Egirdir-Isparta)	*	10.8	*	7.65	7.4	90	227.5	*	0.084	3.4
Su Gözü Springs-Çukur Village (Egirdir-Isparta)	*	15.3	*	7.69	7.8	89	240.7	*	0.111	3.2
Zindan Creek-Front of Zindan Cave (Aksu-Isparta)	*	16.7	*	8.33	7.8	91	204.8	*	0.084	2.8
Akdogan Spring (Akdogan-Isparta)	*	13.8	*	8.09	9.5	103	298.4	*	0.084	3.0
Pinar Pazari (Egirdir-Isparta)	*	14.2	*	7.3	4.5	52	511	*	0.111	6.2
Hisarardi Spring (Yalvaç-Isparta)	*	*	*	*	*	*	*	*	0.111	3.2
Su Gözü Spring–Bagkonak (Yalvaç-Isparta)	*	12.3	*	7.94	8.4	92	202.5	*	0.084	2.8
Fele Spring–Fele Village (Yalvaç-Isparta)	*	14.6	*	7.24	6.6	74	477	*	0.111	6.4
Baspinar–Köprüköy (Şarkikaraagaç-Isparta)	*	22.7	*	7.28	3.6	51	573	*	0.111	5.0
Acigöl Lake (Karapinar-Konya)	35.7	9	5	8.2	2.01	21.9	*	*	49.733	6.0
The Starting point of Gölyaka Spring (Beysehir–Konya)	*	*	*	*	*	*	*	*	*	*
Kocapinar Springs – Karakuyu Pond (Dinar-Afyon)	*	12	*	7.57	6.44	66.9	277	140	0.084	2.2

Oligochaeta were collected by sieving the samples of sediment on a sieve with a mesh size of 500 m, fixing the residue in 4% formaldehyde. Fixed material was again sieved on a sieve of 500 µm; the worms were sorted out under binocular microscope and preserved in 70% alcohol. The worms were made transparent using Amman's Lactophenol solution.

Keys by Brinkhurst (1971), Brinkhurst and Jamieson (1971), Brinkhurst and Wetzel (1984), Kathman and Brinkhurst (1998), Nielsen and Christensen (1959), Sperber (1948, 1950) and Timm (1999) were used for species identification, and information from Wetzel *et al.,* (2000) was used for some additional ecological information.

Results

As a result of the study, 46 species of Oligochaeta were found. These species belonged to 3 orders, 7 families and 24 genera. The order of Tubificida was represented by 43 species. Lumbriculida by two and Haplotaxida by one species.

Tubificidae was the most diverse family with 24 species. Naididae was represented with 14, Enchytraeidae with three, Lumbriculidae with two, and Haplotaxidae, Lumbricidae and Glossoscolecidae each with only one species.

In regard to distribution of species (Tables 2 – 4); station 28 was the station represented by the most diverse organisms (21 species). Following this were station 23 (20 species), 30 and 37 (each of them represented by 16 species) and the others. The stations 14, 23, 53, 58 and 64 were represented by only one species. No Oligochaeta taxon was observed in stations 3, 7, 27, 31, 32, 33, 35, 38, 39, 40, 41, 42, 44, 46, 49, 54, 55, 59, 65, 66 and 71.

The most common species observed in the stations during the sampling were *T. tubifex* (33 stations), *L. hoffmeisteri* (26), *P. hammoniensis* (18), *L. hoffmeisteri f. parvus, L. udekemianus* (16), *P.deserticola* (12), *I. templetoni* (11) and *P. bavaricus* (10) (Tables 2– 4).

T. tubifex, L. hoffmeisteri f. parvus, L. udekemianus*, P. deserticola, P. hammoniensis* and *C. lacuum* were of wider valence and found in all habitats, indicating that these species might be adapted to every environmental setting. Following these, *L. variegatus, T. tubifex f. bergi, P. bavaricus, P. bedoti, I. templetoni, I. frantzi, O. serpentina, S. Lacustris* and *D. digitata* (in 4 habitats); *T. nerthus, L. profundicola, S. nikolskyi, A. pluriseta* and *E. tetraedra türleri* (in 3 habitats), *T. slovenica, H. gordioides, H. nasuta, M. armatus, T. ignotus, H. speciosus, N. communis, N. pardalis, N. elinguis, N. barbata, N. pseudoptusa* and *S. fossularis* (in 2 habitats) and *H. ventriculosa, P. albicola, P. heuscheri, S. ferox, A. pigueti, P. frici, N. variabilis* and *P. acuminata* (in only 1 habitat). *D. obtusa* and *P. osborni* were found to exist in only habitats of macrophyte vegetation (Table 5).

Table 2. Distribution of species determined by stations in the lakes.

Species	Stations (Lakes)											
	2	6	10	11	15	18	23	24	25	28	30	51
Lumbriculus variegatus (Müller, 1774)	-	-	-	-	-	-	+	-	-	+	-	-
Tubifex tubifex (Müller,1774)	+	+	+	-	+	+	+	+	+	+	+	-
T. tubifex f. bergi (Müller,1774)	-	-	-	+	-	-	+	-	-	+	-	-
T. ignotus (Stolc, 1886)	-	-	-	-	-	-	-	-	-	-	+	-
T.nerthus Michaelsen, 1908	-	-	-	-	+	-	+	-	-	+	-	-
T. montanus Kowalewski,1919	+	-	-	-	-	-	-	-	-	-	-	-
Limnodrilus hoffmeisteri Claparede,1862	+	-	-	-	-	+	+	-	-	+	+	-
L. hoffmeisteri f. parvus Southern, 1909	-	-	-	-	-	-	+	-	-	+	-	-
L. udekemianus Claparede,1862	+	-	-	-	-	-	+	-	-	+	+	-
L profundicola (Verrill, 1871)	-	-	-	-	-	+	-	-	-	+	-	-
Psammoryctides albicola (Michaelsen, 1901)	-	-	-	-	-	-	-	-	-	-	+	-
P.deserticola (Grimm,1877)	-	-	-	-	+	-	+	-	-	+	+	-
Potamothrix heuscheri (Bretscher, 1900)	-	-	-	-	-	-	+	-	-	+	-	-
P. hammoniensis (Michaelsen,1901)	+	+	+	-	+	+	+	+	-	+	+	-
P. bavaricus (Öschmann, 1913)	+	-	-	-	+	-	+	-	-	+	+	-
Potamothrix bedoti (Piguet, 1913)	+	-	-	-	-	+	+	+	-	-	+	-
Ilyodrilus templetoni (Southern,1909)	+	-	-	-	-	-	+	-	-	-	+	-
Ilyodrilus frantzi Brinkhurst, 1965	-	-	-	-	-	-	+	-	-	-	-	-
Haber speciosus (Hrabe,1931)	-	-	-	-	+	-	-	-	-	+	-	-
Spirosperma ferox (Eisen,1879)	+	-	-	+	-	-	-	-	-	+	+	-
S. nikolskyi Lastockin and Sokolskaya, 1953	-	-	-	-	-	-	+	-	-	-	-	-
Aulodrilus pluriseta (Piguet, 1906)	-	-	+	-	-	-	+	-	-	+	-	-
A. pigueti Kowalewski, 1914	-	-	-	-	-	-	-	-	-	-	+	-
Ophidonais serpentina (Müller, 1773)	-	-	+	-	-	-	+	-	-	-	+	-
Nais communis Piguet, 1906	-	-	+	-	-	-	-	-	-	+	-	-
N. variabilis Piguet, 1906	-	-	+	-	-	-	-	-	-	-	+	-
N. pardalis Piguet, 1906	-	-	+	-	-	-	-	-	-	-	-	-
N. elinguis Müller,1773	-	-	+	-	-	-	-	-	-	-	-	-
Stylaria lacustris (Linnaeus, 1767)	-	-	-	-	+	-	+	+	-	+	+	-
Dero digitata (Müller,1773)	-	-	-	-	-	+	-	-	-	+	-	-
D. obtusa d'Udekem,1855	-	-	-	-	-	-	-	-	-	-	+	-
Pristinella acuminata Liang,1958	-	-	-	-	-	-	+	-	-	-	-	-
Eiseniella tetraedra (Savigny,1826)	-	-	-	-	-	-	-	-	-	+	-	-
Criodrilus lacuum Hoffmeister,1845	-	-	-	-	-	+	+	-	-	+	-	-

Table 3. Distribution of species determined by stations in the springs.

Species	Stations (Springs)																									
	4	8	12	16	22	26	29	36	48	52	53	56	57	58	60	61	62	63	67	68	69	70	72	73	74	75
Lumbriculus variegatus (Müller, 1774)	-	+	-	-	+	+	-	-	-	-	-	-	+	+	-	-	-	+	-	-	-	-	-	-	-	-
Tatriella slovenica Hrabe, 1936	-	-	-	-	-	-	-	-	-	-	-	+	-	-	-	-	-	-	-	-	-	-	-	+	-	-
Haplotaxis gordioides (Hartmann, 1821)	-	-	-	+	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	+	-	-	-	-	-	-
Henlea ventriculosa (Udekem, 1854)	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	+	-	-	-	-	-	+	-
Mesenchytraeus armatus Levinsen, 1884	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	+	-	-	-	-	-	-	-	-	-	-
Tubifex tubifex (Müller, 1774)	+	-	+	-	-	+	-	-	+	+	+	-	+	-	-	-	-	-	-	-	+	+	+	+	-	-
T. tubifex f. bergi (Müller, 1774)	-	+	-	+	-	-	-	-	-	-	-	-	-	-	-	-	-	+	-	-	+	-	+	+	-	-
T. ignotus (Stolc, 1886)	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	+	-	-
T.nerthus Michaelsen, 1908	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	+	-	-	-	-
Limnodrilus hoffmeisteri Claparede,1862	-	-	-	+	-	-	+	+	+	+	-	-	-	-	+	-	-	+	-	-	+	-	-	+	-	-
L. hoffmeisteri f. parvus Southern, 1909	-	+	+	-	-	-	-	+	-	+	-	-	-	-	+	-	+	+	-	-	+	-	-	+	-	-
L.udekemianus Claparede,1862	-	+	+	+	-	-	+	-	-	-	-	-	-	-	-	-	-	-	-	-	+	+	-	+	-	-
Psammoryctides albicola (Michaelsen, 1901)	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	+	-	-
P.deserticola (Grimm,1877)	-	-	-	+	+	-	-	-	+	+	-	-	-	-	-	-	-	-	-	-	-	-	+	+	-	-
Potamothrix heuscheri (Bretscher, 1900)	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	+	-	-
P.hammoniensis (Michaelsen,1901)	+	+	-	-	-	-	-	-	+	-	-	-	-	-	-	-	-	-	-	-	-	+	-	-	-	-
P. bavaricus (Öschmann, 1913)	-	-	-	+	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	+	+	-	-	-	-
Potamothrix bedoti (Piguet, 1913)	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	+	-	-	-	-	-
Ilyodrilus templetoni (Southern,1909)	-	-	-	+	-	-	-	-	-	+	-	-	+	-	+	-	-	-	+	-	+	+	-	+	-	-
I. frantzi Brinkhurst, 1965	-	-	-	-	+	-	+	-	-	-	-	-	-	-	-	-	+	-	-	-	-	-	-	-	-	-
Quistadrilus multisetosus (Smith, 1900)	-	-	-	-	+	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Spirosperma nikolskyi Lastockin and Sokolskaya, 1953	-	-	-	-	-	-	-	-	-	+	-	+	-	-	-	-	-	-	-	-	-	-	-	+	-	-

Table 3. Continued																										
Aulodrilus pluriseta (Piguet, 1906)	-	-	-	-	-	-	-	-	-	-	-	-	-	+	-	-	-	-	-	-	-	-	-	+	+	-	-
Ophidonais serpentina (Müller, 1773)	-	-	-	-	+	-	-	-	+	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Nais communis Piguet, 1906	-	+	-	+	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	+
N. variabilis Piguet, 1906	-	-	-	-	+	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
N. pardalis Piguet, 1906	-	-	-	-	-	-	+	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
N. elinguis Müller,1773	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	+	-	+
N. barbata Müller,1773	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	+	-	-
N.pseudoptusa Piguet, 1906	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	+	-	-
Stylaria lacustris (Linnaeus, 1767)	-	-	-	-	-	-	+	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Stylaria fossularis Leidy, 1852	-	-	-	-	-	-	+	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Dero digitata (Müller,1773)	-	-	-	-	-	-	+	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Pristinella osborni (Walton,1906)	-	+	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Eiseniella tetraedra (Savigny,1826)	-	-	-	-	-	-	-	-	-	-	-	-	+	-	+	+	-	-	-	+	-	-	-	-	-	-	-
Criodrilus lacuum Hoffmeister,1845	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	+	-	-	-	-	-	-	+	+

Table 4. Distribution of species determined in the dams and channels.

Species	Stations															
	The Dams								The Channels							
	1	9	13	17	20	21	34	43	5	14	19	37	45	47	50	64
Tubifex tubifex	+	+	+	+	+	+	+	+	+	+	+	-	-	+	-	-
T. ignotus	+	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
T.nerthus	-	-	-	-	-	-	+	-	-	-	-	-	-	-	-	-
Limnodrilus hoffmeisteri	+	+	+	+	-	+	+	+	-	-	+	+	+	+	+	-
L. hoffmeisteri f. parvus	-	-	-	-	-	-	-	-	-	-	+	+	-	+	+	+
L. udekemianus	-	-	-	-	-	-	+	+	-	-	+	+	-	+	-	-
L. profundicola	-	-	-	+	-	+	-	-	-	-	-	+	-	-	-	-
Potamothrix hammoniensis	-	+	-	-	+	+	-	-	+	-	+	-	-	-	-	-
P. bavaricus	-	-	-	+	-	-	-	-	-	-	+	-	-	-	-	-
P. bedoti	-	-	-	-	+	+	-	-	-	-	+	-	-	-	-	-
Psammoryctides deserticola	-	-	-	-	-	-	-	-	-	-	-	+	-	+	-	-
Haber speciosus	-	-	-	-	-	+	-	-	-	-	-	-	-	-	-	-
Ophidonais serpentina	-	-	-	-	-	-	+	-	-	-	-	-	-	-	-	-
Dero digitata	+	-	-	+	-	+	+	+	-	-	-	-	-	-	-	-
Paranais frici Hrabe, 1941	-	-	-	-	-	-	-	-	-	-	-	-	-	-	+	-
Nais variabilis	-	-	-	-	-	-	-	-	-	-	-	-	-	-	+	-
Henlea nasuta (Eisen,1878)	-	-	-	-	-	-	-	-	-	-	-	-	+	-	-	-
Eiseniella tetraedra	-	-	-	-	-	-	-	-	-	-	+	-	-	-	-	-

Table 5. Distribution of the species determined by the habitats (MV= Macrophyte vegetation).

Species	Habitats					Species	Habitats				
	Mud	Detritus	Stone	Sand	Gravel		Mud	Detritus	Stone	Sand	Gravel
Lumbriculus variegatus		+MV	+	+	+	*Quistadrilus multisetosus*		MV			
Tatriella slovenica		+MV	+			*Spirosperma ferox*	+	MV			
Haplotaxis gordioides		+MV	+			*S. nikolskyi*		+MV	+	+	
Henlea nasuta	+		+			*Aulodrilus pluriseta*		+MV	+	+	
H. ventriculosa	+					*A. pigueti*		+			
Mesenchytraeus armatus			+	+		*Paranais frici*		MV		+	
Tubifex tubifex	+	+MV	+	+	+	*Ophidonais serpentina*	+	+MV		+	+
T. tubifex f. bergi		+MV	+	+	+	*Nais communis*		+MV		+	
T. ignotus		+	+			*N. variabilis*		MV		+ (few)	
T. nerthus	+	MV	+	+		*N. pardalis*	+	MV		+	
T. montanus						*N. elinguis*		+MV	+		
Limnodrilus hoffmeisteri	+	+MV	+	+	+	*N. barbata*		+	+		
L.hoffmeisteri f. parvus	+	+MV	+	+	+	*N. pseudoptusa*		+	+		
L. udekemianus	+	+MV	+	+	+	*Stylaria lacustris*	+	+MV		+	+
L. profundicola	+	MV	+	+		*S. fossularis*	+			+	
Psammoryctides albicola		MV			+	*Dero digitata*	+	+MV	+	+	
P. deserticola	+	+MV	+	+	+	*D. obtusa*		MV			
Potamothrix heuscheri		MV		+		*Pristinella osborni*		MV			
P. hammoniensis	+	+MV	+	+	+	*P. acuminata*	+				
P. bavaricus	+	+MV	+	+		*Eiseniella tetraedra*		+MV	+	+	
P. bedoti	+	+MV	+	+		*Criodrilus lacuum*	+	+MV	+	+	+
Ilyodrilus templetoni	+	+MV	+	+							
I. frantzi	+	+MV		+	+						
Haber speciosus	+	+MV									

In regard to depth at which the species were found, the depth range was between 0.8 and 45.5 meters. Additionally, some species were found only on the coast or only in the underground springs. *T. tubifex* and *Potamothrix hammoniensis* reached the deepest point. Following these were *L. hoffmeisteri* (26 m), *T. nerthus* and *P. bavaricus* (25 m), *H. speciosus* (23 m), *D. digitata* (20 m), *P. bedoti* (15 m), *P. deserticola* and *S. lacustris* (12 m).

Morphometric, biological and ecological characteristics and the distribution of Oligochaeta species specified as new records for the inland water fauna of Turkey are as follows; (L: Total length, S: Number of segments):

T. tubifex f. *bergi* (Müller, 1774)

Morphometric Characteristics: L= 20 mm, S = 50 (Figures 2 a; 3 b, c, d)

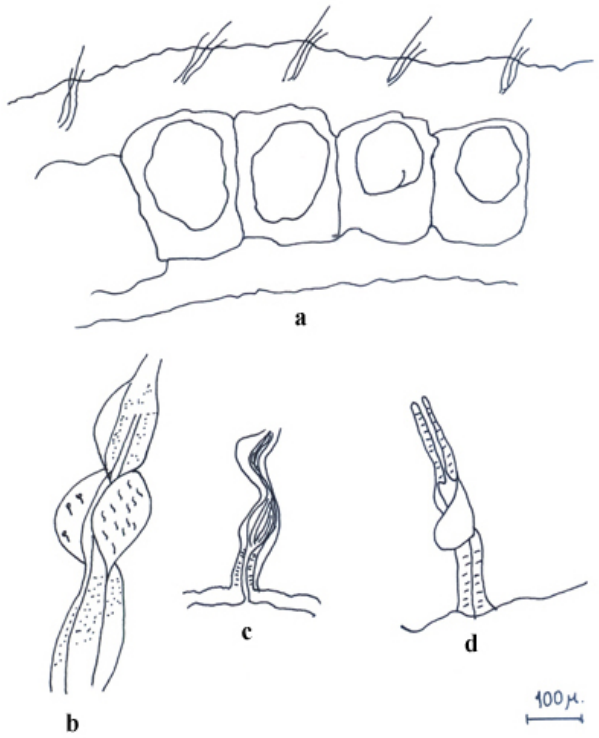

Figure 2. Some characteristics of new records. a) *Tubifex tubifex* f. *bergi* – anterior part of the body (hair setae few). b) *Henlea nasuta* VII.-VIII. and IX. segments (two intestinal diverticula in VIII). c) *Henlea nasuta* spermatheca. d) *Mesenchytraeus armatus* spermatheca.

After 11 days at pH 5, *Tubifex tubifex* begins to lose their hair and pectinate setae and resemble *Tubifex tubifex* forma *bergi,* which has sparse hair setae and few pectinations.

World Distribution: Cosmopolitan.

Ecology: A freshwater form. This species is highly tolerant to organically enriched habitats.

Limnodrilus hoffmeisteri f. *parvus* Southern, 1909

Morphometric Characteristics: L= 25 mm, S= 60 (Figures 3 a)

Limnodrilus hoffmeisteri that has specimens with setae having upper teeth thinner and shorter than the lower teeth in II-VI, becoming subequal in the mid section and posterior with the upper teeth thinner and equal to or slightly shorter than the lower are considered to be *Limnodrilus hoffmeisteri* forma *parvus.* The penis sheaths are like those for *L. hoffmeisteri*.

World Distribution: Cosmopolitan.

Ecology: The most common tubificid in many habitats, especially in polluted sites.

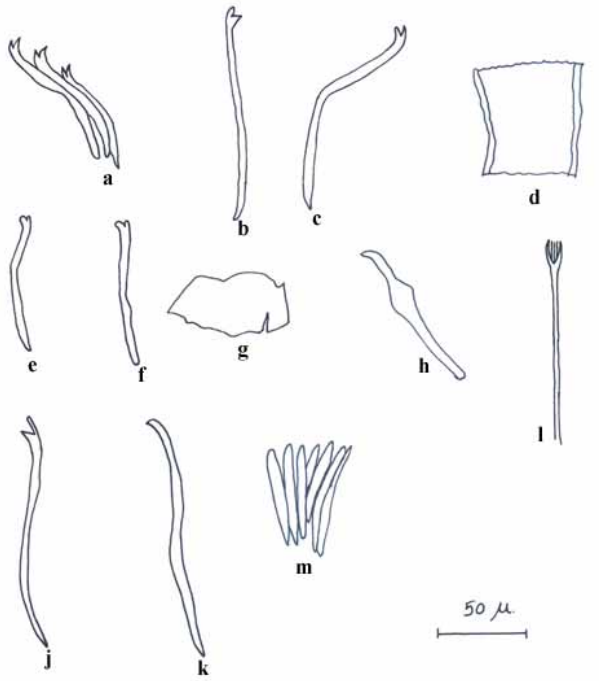

Figure 3. Some characteristics of new records. a) *Limnodrilus hoffmeisteri* f. *parvus* (ventral setae of V) b)*Tubifex tubifex* f. *bergi* (dorsal setae) c) *Tubifex tubifex* f. *bergi* (ventral setae) d) *Tubifex tubifex* f. *bergi* (penis sheath) e) *Ilyodrilus frantzi* (anterior ventral setae of II.) f) *Ilyodrilus frantzi* (anterior ventral setae of III.) g) *Ilyodrilus frantzi* (penis sheath) h) *Mesenchytraeus armatus* (setae) ı) *Spirosperma nikolskyi* (lyre type dorsal setae) j) *Spirosperma nikolskyi* (anterior ventral setae) k) *Spirosperma nikolskyi* (simple pointed setae) m) *Henlea nasuta* (bundle of setae).

Ilyodrilus frantzi Brinkhurst, 1965

Morphometric Characteristics: L= 15 mm, S= 65 (Figures 3 e, f, g)

Limnodrilus hoffmeisteri that has specimens with setae having upper teeth thinner and shorter than the lower teeth in II-VI, becoming subequal in the mid section and posterior with the upper teeth thinner and equal to or slightly shorter than the lower are considered to be *Limnodrilus hoffmeisteri* forma *parvus.* The penis sheaths are like those for *L. hoffmeisteri*.

World Distribution: British Columbia to California, estuaries.

Ecology: It is found both freshwater and brackish water localities.

Spirosperma nikolskyi Lastockin and Sokolskaya, 1953

Morphometric Characteristics: L= 20 mm, S= 69 (Figure 3 ı, j and k)

Body wall papillate, prostomium and I. segment retractile. Dorsal bundles with 2-4 hair setae and 2-4 hair-like setae with fine bifid to pectinate tips. Ventral bundles of II-IV with 1-2 seta, either simple pointed, bifid, or both; the rest bifid

with the upper teeth longer and thinner than the lower, sometimes with an additional spine; posterior ventral setae single with a broad lower tooth.
World Distribution: Widespread.
Ecology: May be abundant in cold, oligotrophic profundal regions.
Henlea nasuta (Eisen, 1878)
Morphometric Characteristics: L= 16 mm, S= 53 (Figure 2 b, c; 3 m)

Medium sized to large species. Color yellowish-grayish. Each segment has 8-10 rows of irregularly shaped cutaneous glands. Two intestinal diverticula in VIII, not coalescent with oesophagus. Setae by 3-8 in dorsal and by 4-8 in ventral bundles.
World Distribution: Europe, Estonia.
Ecology: In soil, also in freshwater near the shore.
Mesenchytraeus armatus Levinsen, 1884
Morphometric Characteristics: L= 10 mm, S= 55 (Figure 2 d; 3 h)

Medium sized 10-20 mm. Color grayish to brownish. Setae 2-12 per bundle, 80 µm long; as exclusion, giant setae, usually single, up to 12 µm thick, in place of dorsal bundles in V-VII or V-VIII.
World Distribution: Denmark, Deutschland, Poland, Switzerland, Eire.
Ecology: In wet soil, also in freshwater near the shore.

Discussion and Conclusion

The family Tubificidae, with origins in the northern temperate zone (Timm, 1980), was represented with the greatest number of species in this study. Its most diverse group was the genus *Tubifex,* with 5 species. Another genus, *Limnodrilus* was represented with 3 species and 1 sub-species.
The second diverse family in the present study was Naididae family with 15 species belonging to 7 genera. Among them, genus *Nais* was represented with 6 species.

T. tubifex, which was a dominant species in the study, was encountered at the deepest points, up to 45.5 m. It is known from big and oligotrophic lakes together with other oxyphilous species like *Spirosperma ferox* (Timm 1996). Similar to our study, it was found in the lakes of Gölhisar, Çavusçu and Beysehir together with the latter species. *T. tubifex* lives also in smaller oligotrophic lakes as the only species in deep profundal where oxygen concentration is very low. For instance, it inhabited alone the Lake Aksehir, in our study.

Q. multisetosus, found only in the stations of underground springs, was seen in macrophytic settings. This station is the spring of Karamik Marsh with eutrophic characteristics. It is natural for this species to exist in such a setting. The species is accompanied here by *Lumbriculus variegatus, Psammoryctides deserticola, Ilyodrilus frantzi, Ophidonais serpentina* and *Nais variabilis*.

This study contributed to the known biological diversity in our country. *Henlea nasuta, Mesenchytraeus armatus, Tubifex tubifex f. bergi, Limnodrilus hoffmeisteri f. parvus, Ilyodrilus frantzi* and *Spirosperma nikolskyi* are recorded for the first time in Turkey.

Acknowledgements

This project has been supported by The Fund of Scientific Research of Ege University (Project: 1999/SUF/001) and The Scientific and Technical Research Council of Turkey (TUBITAK Project: 199/Y/071). We are deeply grateful to them for their support. We, also, would kindly like to thank Mesut KAPTAN for his invaluable support and help on technical issues.

References

Brinkhurst, R. O. 1971. A Guide for the Identification of British Aquatic Oligochaeta, Freshwater Biological Association Scientific Publication 22: 55 pp.
Brinkhurst, R. O., B.G.M., Jamieson. 1971. Aquatic Oligochaeta of the World, University of Toronto, 860 pp.
Brinkhurst, R. O., M. J. Wetzel. 1984. Aquatic Oligochaeta of the World: Supplement a Catalogue of New Freshwater Species, Descriptions and Revisions, No: 44, Canadian Technical Report of Hydrography and Ocean Sciences, Canada, 101 pp.
Demirsoy, A., 1999. General and Zoogeography of Turkey "Animal Geography", (in turkish). Second Edition, Ankara, 965 pp.
Kathman, R.D., R.O. Brinkhurst. 1998. Guide to the Freshwater Oligochaetes of North America, Aquatic Resources Center, Tennessee, USA, 264 pp.
Kazanci, N., S. Girgin, M. Dugel, D. Oguzkurt. 1998. Limnology of Burdur Lake and Acıgöl. The quality of Environment and Biological Diversity (in turkish). Turkey Freshwaters Researces Series: III, Ankara, 117 s.
Kazanci, N., S. Girgin., M. Dugel., D.Oguzkurt., B.Mutlu., S. Dere., M. Barlas., M. Ozçelik., 1999. Lakes of Köyceğiz, Beysehir, Egirdir, Aksehir, Eber, Çorak, Kovada, Yarisli, Bafa, Salda, Karatas, Çavuscu, Deltas of Küçük and Büyük Menderes, Güllük Marshy Place, The Limnology of Karamuk Bog, The quality of Environment and Biological Diversity (in turkish). Turkey Freshwaters Researces Series: IV, 371 s.
Nielsen, C.O., B. Christensen., 1959. The Enchytraeidae Critical Revision and Taxonomy of European Species, (Studies on Enchytreidae VII). Naturhıstorısk Museum-Aarhus, 160 pp.
Sozen, M., S. Yigit. 1996. The Benthic Fauna of Lake Aksehir (Konya) and Some Limnological Characteristics (in turkish). Tr. J. of Zoology 23 (1999) Ek Sayı 3, 829-847.
Sperber, C., 1948. A Taxonomical Study of the Naididae. Zoology, Bidrag, Uppsala Bd, 28, 1-296.
Sperber, C., 1950. A Guide for the Determination of European Naididae, Zoology, Bidrag, Uppsala Bd, 29, 45-78.
Timm, T., 1980. Distribution of Aquatic Oligochaetes. In R. O. Brinkhurst & D.G. Cook Eds, Aquatic oligochaeta Biology, plenum press, New York, 55-77.
Timm, T., 1996. *Tubifex tubifex* (Müller, 1774) (Oligochaeta, Tubificidae) in the Profundal of Estonian Lakes, Int. Revue ges. Hydrobiologia. 81.4. 589-596.
Timm, T., 1999. A Guide to the Estonian Annelida. Naturalist's Handbooks 1, Estonian Academy Publishers, Tartu- Tallinn, 208 pp.
Wetzel, M.J., R.D. Kathman., S. Fend., K.A. Coates., 2000. Taxonomy, Systematic and Ecology of Freshwater Oligochaeta. Workbook Prepared for North American Benthological Society Technical Information Workshop, 48th Annual Meeting, Keystone Resort, CO. 120 pp.