

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

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**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.

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## 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 Akşehir 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.

Kazancı *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.

Kazancı *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).

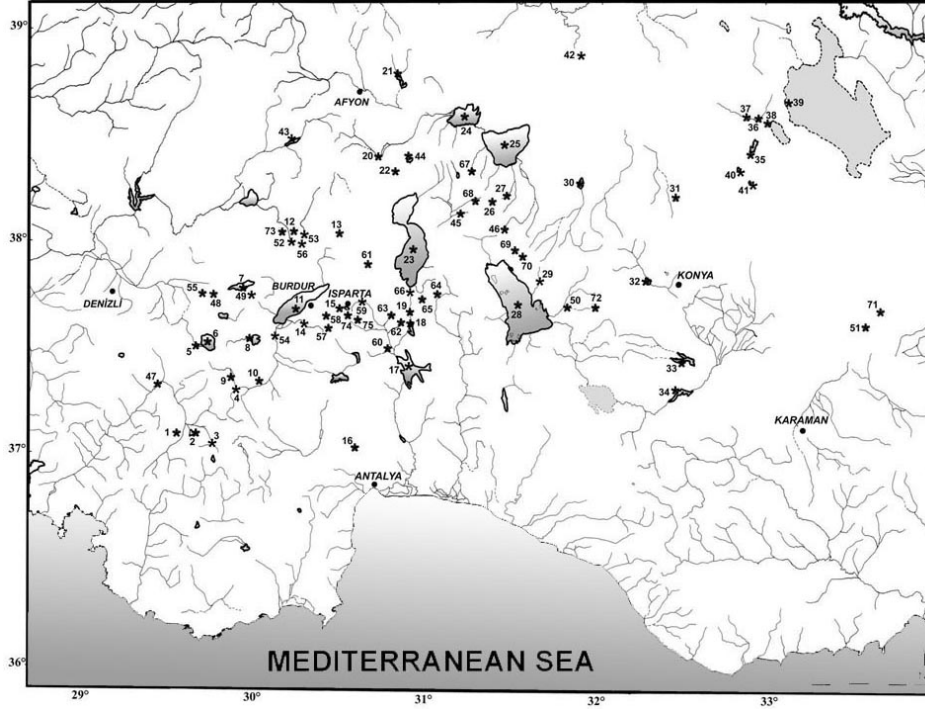


Figure 1. Map of Lake District in Turkey.

1. Yapraklı 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 Lake
12. The Sources of the River B. Menderes (İncirli Springs.-Dinar- Afyon)
13. Uluborlu Dam
14. İnsuyu Cave
15. Gölçük 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 Spring 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. Gökboğaz 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 (Şarkıkaraağaç-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 Gölçük (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 physico-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)
Yapraklı Dam	26	13.4	2.7	8.28	7.2	74	308.2	*	0.033	4.2
Göhlisar Lake	1.7	28	0.4	8.61	7.1	114	798	*	0.056	7.0
Kizillar-Çavdır Dam	29	12.7	3.8	8.36	7.6	75	299.8	*	0.045	4.8
Kirkpınar 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 Yarıslı Lake	*	16.2	*	8.15	8.93	87.3	260	130	0.111	3.8
Karamanlı 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
İncirli 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	*	*	*
İnsuyu 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- (Çandır)	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 (Kızılcubuk 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
Eğirdir Lake 1. sta. (Bağören village)	7.5	20.6	7.5	8.4	6.2	76	265	130	0.056	2.6
Eğirdir Lake 2. sta. (Boyalı village)	5.0	19.9	5.0	8.2	5.8	71	253	120	0.070	2.4
Eğirdir Lake 3. sta. (Senirkent)	4.7	20.7	4.7	8.0	6.0	72	254	120	0.070	2.8
Eğirdir Lake 4. sta. (Yalvaç)	5.1	20.4	5.1	8.0	5.7	70	291	140	0.070	2.4
Eğirdir Lake 5. sta. (Port)	7.0	20.5	4.2	8.4	5.7	63	270	150	0.070	2.0
Eğirdir Lake 6. sta. (island)	8.7	20.5	3.2	8.2	5.8	63	260	142	0.070	1.8
Eğirdir Lake- Yenice Village(from coast)	1.9	13.3	1.9	7.69	7.09	71.7	330	160	0.056	2.6
Eğirdir 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- (Gölçayır)	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
Beyşehir Lake 1. sta. (Tolca village)	3.1	20.8	1.9	8.2	5.6	74	253	120	0.070	1.6
Beyşehir Lake 2. sta. (Kusluca village)	3.0	20.6	1.4	8.0	5.3	63	246	120	0.070	1.6
Beyşehir Lake 3. sta. (Gölkasi village)	4.7	19.3	3.0	8.1	5.5	68	230	110	0.070	1.6
Beyşehir Lake 4. sta. (Karadiken village)	6.3	20.2	1.7	8.0	5.0	58	250	120	0.070	1.8
Beyşehir Lake 5. sta. (Cemeller village)	5.2	23.5	5.2	7.6	4.6	58	270	130	0.070	1.4
Beyşehir Lake 6. sta. (Gölyaka village)	5.8	23.7	4.5	7.8	5.3	67	263	160	0.070	1.6
Beyşehir Lake 7. sta. (Gedikli village)	3.1	22.0	2.5	8.5	6.3	78	217	110	0.070	1.6
Beyşehir Lake 8. sta. (Çiftlikköy village)	4.2	15.0	3.3	8.58	7.2	81	283	140	0.056	2.4
Beyşehir Lake 9. sta. (Tolca village)	*	21.0	*	8.5	8.4	107	278	140	0.056	2.6
Beyşehir Lake 10. sta. (Akburun)	2.4	21.3	2.4	8.96	6.1	78	274.4	*	0.056	2.6
Beyşehir İmrenler Springs	*	19.9	*	7.68	4.1	58	583	*	0.056	5.8
Çavuşçu Lake-(Ilgın)	1.2	24	0.2	8.88	6.55	87.8	279	140	0.111	3.0
Başhüyük 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
İnsuyu Springs-(Cihanbeyli)	*	15.9	*	7.83	8.7	101	414	210	0.084	2.2
İnsuyu 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
Orenler-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 Akşehir	*	16.7	*	7.5	5.3	65	469	580	0.070	2.8
The Watering Canal on Entrance of the County Göksöğüt	*	*	*	*	*	*	*	*	*	*
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
Asağı Akpınar Place-II.Spring-Çardak (Denizli)	*	19	*	7.29	3.02	34.9	1042	520	*	*
Meke Saltpan (Karapınar-Konya)	1.5	8.6	1.5	8.37	8.25	73.9	*	*	49.009	6.0
Eldere-Pınarbaşı Springs-Büyük Menderes-Dinar (Afyon)	*	14.4	*	7.75	6.2	71	268	160	0.084	3.8
Büyük Menderes Su Çıkan Springs in Dinar (Afyon)	*	21	*	7.45	4.6	58	417	180	0.084	4.4
Çaltı (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
Gökçebağ Dam-Pınargözü Springs (Gelincik-Isparta)	*	16.1	*	7.79	7.3	90	324.1	*	0.084	4.6
Pınarbaşı Springs-Sav (Isparta)	*	13.1	*	8.15	8.8	88	138.2	*	0.084	2.2
Gökböğüt Springs-Asağı 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
Kocapınar Springs-Yukarı 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
Pınar Pazarı (Egirdir-Isparta)	*	14.2	*	7.3	4.5	52	511	*	0.111	6.2
Hisarardı Spring (Yalvaç-Isparta)	*	*	*	*	*	*	*	*	0.111	3.2
Su Gözü Spring-Bağkonak (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
Baspınar-Köprüköy (Şarkikaraağaç-Isparta)	*	22.7	*	7.28	3.6	51	573	*	0.111	5.0
Acıgöl Lake (Karapınar-Konya)	35.7	9	5	8.2	2.01	21.9	*	*	49.733	6.0
The Starting point of Gölyaka Spring (Beyşehir-Konya)	*	*	*	*	*	*	*	*	*	*
Kocapınar 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 µm, 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. plurisetia* 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
<i>Lumbriculus variegatus</i> (Müller, 1774)	-	-	-	-	-	-	+	-	-	+	-	-
<i>Tubifex tubifex</i> (Müller, 1774)	+	+	+	-	+	+	+	+	+	+	+	-
<i>T. tubifex f. bergi</i> (Müller, 1774)	-	-	-	+	-	-	+	-	-	+	-	-
<i>T. ignotus</i> (Stolc, 1886)	-	-	-	-	-	-	-	-	-	-	+	-
<i>T. nerthus</i> Michaelsen, 1908	-	-	-	-	+	-	+	-	-	+	-	-
<i>T. montanus</i> Kowalewski, 1919	+	-	-	-	-	-	-	-	-	-	-	-
<i>Limnodrilus hoffmeisteri</i> Claparede, 1862	+	-	-	-	-	+	+	-	-	+	+	-
<i>L. hoffmeisteri f. parvus</i> Southern, 1909	-	-	-	-	-	-	+	-	-	+	-	-
<i>L. udekemianus</i> Claparede, 1862	+	-	-	-	-	-	+	-	-	+	+	-
<i>L. profundicola</i> (Verrill, 1871)	-	-	-	-	-	+	-	-	-	+	-	-
<i>Psammoryctides albicola</i> (Michaelsen, 1901)	-	-	-	-	-	-	-	-	-	-	+	-
<i>P. deserticola</i> (Grimm, 1877)	-	-	-	-	+	-	+	-	-	+	+	-
<i>Potamothenis heuscheri</i> (Bretscher, 1900)	-	-	-	-	-	-	+	-	-	+	+	-
<i>P. hammoniensis</i> (Michaelsen, 1901)	+	+	+	-	+	+	+	+	-	+	+	-
<i>P. bavaricus</i> (Öschmann, 1913)	+	-	-	-	+	-	+	-	-	+	+	-
<i>Potamothenis bedoti</i> (Piguet, 1913)	+	-	-	-	-	+	+	+	-	-	+	-
<i>Ilyodrilus templetoni</i> (Southern, 1909)	+	-	-	-	-	-	+	-	-	-	+	-
<i>Ilyodrilus frantzi</i> Brinkhurst, 1965	-	-	-	-	-	-	+	-	-	-	-	-
<i>Haber speciosus</i> (Hrabe, 1931)	-	-	-	-	+	-	-	-	-	+	-	-
<i>Spirosperma ferox</i> (Eisen, 1879)	+	-	-	+	-	-	-	-	-	+	+	-
<i>S. nikolskyi</i> Lastockin and Sokolskaya, 1953	-	-	-	-	-	-	+	-	-	-	-	-
<i>Aulodrilus plurisetus</i> (Piguet, 1906)	-	-	+	-	-	-	+	-	-	+	-	-
<i>A. pigueti</i> Kowalewski, 1914	-	-	-	-	-	-	-	-	-	-	+	-
<i>Ophidonais serpentina</i> (Müller, 1773)	-	-	+	-	-	-	+	-	-	-	+	-
<i>Nais communis</i> Piguet, 1906	-	-	+	-	-	-	-	-	-	+	-	-
<i>N. variabilis</i> Piguet, 1906	-	-	+	-	-	-	-	-	-	-	+	-
<i>N. pardalis</i> Piguet, 1906	-	-	+	-	-	-	-	-	-	-	-	-
<i>N. elinguis</i> Müller, 1773	-	-	+	-	-	-	-	-	-	-	-	-
<i>Stylaria lacustris</i> (Linnaeus, 1767)	-	-	-	-	+	-	+	+	-	+	+	-
<i>Dero digitata</i> (Müller, 1773)	-	-	-	-	-	+	-	-	-	+	-	-
<i>D. obtusa</i> d'Udekem, 1855	-	-	-	-	-	-	-	-	-	-	+	-
<i>Pristinella acuminata</i> Liang, 1958	-	-	-	-	-	-	+	-	-	-	-	-
<i>Eiseniella tetraedra</i> (Savigny, 1826)	-	-	-	-	-	-	-	-	-	+	-	-
<i>Crödriulus lacuum</i> 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
<i>Lumbriculus variegatus</i> (Müller, 1774)	-	+	-	-	+	+	-	-	-	-	-	-	+	+	-	-	-	+	-	-	-	-	-	-	-	-
<i>Tatriella slovenica</i> Hrabe, 1936	-	-	-	-	-	-	-	-	-	-	-	+	-	-	-	-	-	-	-	-	-	-	-	+	-	-
<i>Haplotaxis gordioides</i> (Hartmann, 1821)	-	-	-	+	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	+	-	-	-	-	-	-
<i>Henlea ventriculosa</i> (Udekem, 1854)	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	+	-	-	-	-	-	+
<i>Mesenchytraeus armatus</i> Levinsen, 1884	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	+	-	-	-	-	-	-	-	-	-
<i>Tubifex tubifex</i> (Müller, 1774)	+	-	+	-	-	+	-	-	+	+	+	-	+	-	-	-	-	-	-	-	+	+	+	+	-	-
<i>T. tubifex f. bergi</i> (Müller, 1774)	-	+	-	+	-	-	-	-	-	-	-	-	-	-	-	-	-	+	-	-	+	-	+	+	-	-
<i>T. ignotus</i> (Stolc, 1886)	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	+	-	-
<i>T. nerthus</i> Michaelsen, 1908	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	+	-	-	-	-
<i>Limnodrilus hoffmeisteri</i> Claparede, 1862	-	-	-	+	-	-	+	+	+	+	-	-	-	-	+	-	-	+	-	-	+	-	+	-	+	-
<i>L. hoffmeisteri f. parvus</i> Southern, 1909	-	+	+	-	-	-	+	-	+	-	-	-	-	-	+	+	+	-	-	+	-	-	+	-	-	-
<i>L. udekemianus</i> Claparede, 1862	-	+	+	+	-	-	+	-	-	-	-	-	-	-	-	-	-	-	-	-	+	+	-	+	-	-
<i>Psammoryctides albicola</i> (Michaelsen, 1901)	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	+	-	-
<i>P. deserticola</i> (Grimm, 1877)	-	-	-	+	+	-	-	-	+	+	-	-	-	-	-	-	-	-	-	-	-	-	+	+	-	-
<i>Potamothenis heuscheri</i> (Bretscher, 1900)	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	+	-	-
<i>P. hammoniensis</i> (Michaelsen, 1901)	+	+	-	-	-	-	-	-	+	-	-	-	-	-	-	-	-	-	-	-	-	+	-	-	-	-
<i>P. bavaricus</i> (Öschmann, 1913)	-	-	-	+	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	+	+	-	-	-
<i>Potamothenis bedoti</i> (Piguet, 1913)	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	+	-	-	-	-
<i>Ilyodrilus templetoni</i> (Southern, 1909)	-	-	-	+	-	-	-	-	-	+	-	-	+	-	+	-	-	+	-	-	+	+	-	+	-	-
<i>I. frantzi</i> Brinkhurst, 1965	-	-	-	-	+	-	+	-	-	-	-	-	-	-	-	-	-	+	-	-	-	-	-	-	-	-
<i>Quistadrilus multisetosus</i> (Smith, 1900)	-	-	-	-	+	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
<i>Spirosperma nikolskyi</i> Lastockin and Sokolskaya, 1953	-	-	-	-	-	-	-	-	+	+	-	-	-	-	-	-	-	-	-	-	-	-	-	+	-	-



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)

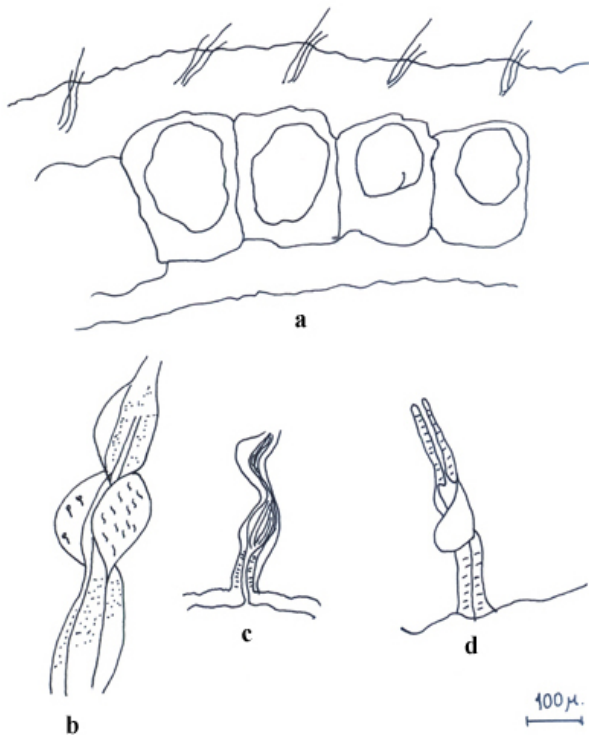


Figure 2. Some characteristics of new records. a) *Tubifex tubifex* f. *bergi* – anterior part of the body (hair setae few). b) *Henlea nasuta* VII-VIII. and IX. segments (two intestinal diverticula in VIII). c) *Henlea nasuta* spermatheca. d) *Mesenchytraeus armatus* spermatheca.

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.

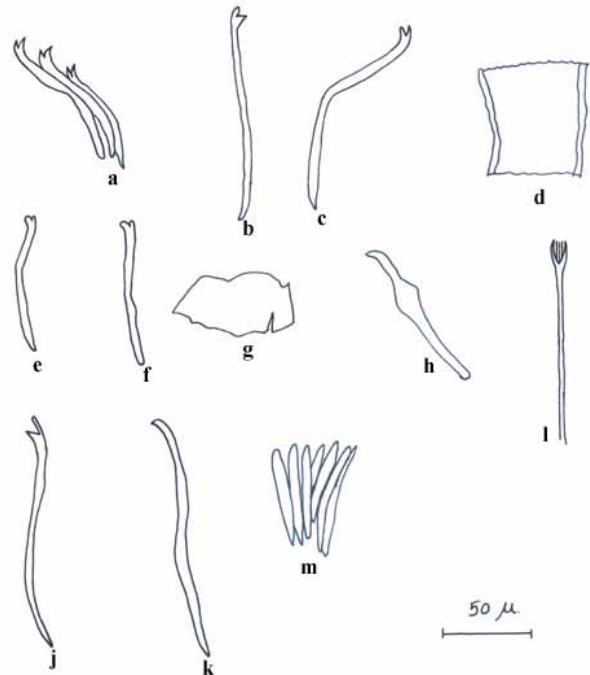


Figure 3. Some characteristics of new records. a) *Limnodrilus hoffmeisteri* f. *parvus* (ventral setae of V) b) *Tubifex tubifex* f. *bergi* (dorsal setae) c) *Tubifex tubifex* f. *bergi* (ventral setae) d) *Tubifex tubifex* f. *bergi* (penis sheath) e) *Ilyodrilus frantzi* (anterior ventral setae of II.) f) *Ilyodrilus frantzi* (anterior ventral setae of III.) g) *Ilyodrilus frantzi* (penis sheath) h) *Mesenchytraeus armatus* (setae) i) *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 i, 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, Çavuşçu and Beyşehir 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 Akşehir, 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.

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