Journal of Entomology and Zoology Studies

Available online at www.entomoljournal.com

JEZS Journal of Entomology and Zoology Studies

ISSN 2320-7078
JEZS 2014; 2 (5): 182-192
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Received: 23-09-2014
Accepted: 06-10-2014

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Species composition and distribution of ostracods (Crustacea, Ostracoda) in some lakes and lagoons (Kocaeli and Sakarya, Turkey)

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Abstract
In the present study the community structure and diversity of ostracods were investigated seasonally in the water of the nine wetlands located in Sakarya and Kocaeli Province during September 2009-January 2010. As a result of the qualitative study, totally of 24 taxa belonging to 20 genera were recorded in nine wetlands. Among the ostracods species found at wetlands, Cosmopolitan species *Darwinula stevensoni* (8 wetlands) *Cypria ophthalmica* (8 wetlands) and *Cypridopsis vidua* (8 wetlands) were the most common species (88.8%) in nine wetlands, whereas, five species of ostracods (*Candonopsis kingsleii*, *Tonnacypris lutaria*, *Potamocypris variegata*, *Sarscypridopsis aculeata* and *Plesiocypridopsis newtoni*) were found only in one wetland. According to the Shannon-Weaver diversity index (H') the highest diversity values determined in the Lake Kanlıgöl (3.378) and Lake Kamış (3.38), whereas, the lowest values of the Shannon-Weaver diversity index (H') was determined in Dalyan Lagoon (0.86).

Keywords: Ostracoda, Lakes, Lagoons, Distribution, Ecology

1. Introduction

Ostracods are likely the common group of microbenthic fauna in aquatic ecosystems. Ostracods (Crustacea) are bivalved crustaceans with adults being typically 0.5 to 3.0 mm long. Ostracods are environmentally and geographically diverse, and are often abundant in almost all aquatic and in some terrestrial habitats [1, 2, 3, 4]. Ostracods have been accepted as ecological and palaeoecological indicators [2, 5, 6, 7, 8, 9]. Many freshwater ostracods live among the macrophytes in the littoral and sublittoral zones of lakes for feed and shelter. The benthic ostracods play a role of converting phytoplankton to food for fish and other aquatic animals. Also ostracods are an important nutritional source for fish species. Freshwater ostracods (Crustacea, Ostracoda) are sensitive to environmental conditions, and are widely used as biological indicators for past and present environmental changes [2, 10, 11, 12, 13, 14]. Wetlands have been important habitat for many species. Only about 1% of the world surface is occupied by the wetlands. Wetlands provides a habitat for about 20% of the world's species [15]. 1.3 million ha. of its historic wetlands over the past 60 years has lost at least in Turkey, mostly due to human impacts [16, 17]. Eutrophication, altered surface and subsurface flows and exceedingly high sedimentation rates will be major threats to wetlands of Turkey [18]. Although it be neglected for state authorities, ongoing since long time uncontrolled and high population growth rate of the Turkey is major threat to future of wetlands.

Preliminary researches on the Ostracoda species, which lives in the inland water of Turkey, were performed by Schäfer [19] and Hartmann [20]. Altınsaçlı and Griffiths [21] presented a checklist of the non-marine Ostracoda fauna from Turkey.

There are publications containing floristic information about adjacent wetlands [22, 23, 24, 25, 26]. There are publications containing faunistic and floristic information about adjacent wetlands [23, 24, 25, 26, 27, 28, 29, 30, 31]. A compulsory condition determination must be made for recent ostracods studies, unfortunately, some recent studies published on the freshwater ostracods has been presented as a detailed ecological and faunistic studies although they only a preliminary and time limited studies.

The aims of this study are to document ostracod species composition in the lakes and some lagoons of the Sakarya and Kocaeli Provinces, to evaluate ecological characteristics of

ostracod species, to determine to microhabitat preferences of species and to contribute to the knowledge of ostracod diversity and ecology.

2. Material and Methods

2.1 Site description

Lake Saklıgöl: Lake Saklıgöl (41°07' 25.81"N 29°55' 19.27"E) is a karstic freshwater lake situated in in the north-western part of Kandıra District (Kocaeli Province**)**, at an altitude of 77 m a.s.l. (Fig. 1) [26]. It is a mesotrophic lake, with a mean depth of 1.5 m, maximum depth of 4 m and surface area of 3.9 ha. [26]. The lake is fed by underground water source and rain water falling into a depression with no surface inlet or outlet. The only outlet of the lake water is via discharge through a karst aquifer. The codes of abbreviated names for each species were coded beside species names and these codes were used in next sentences. Eleven macrophyte species were identified by Altınsaçlı *et al.* [26].

Lake Sarıcagelin: Lake Sarıcagelin (41° 07' 58.17"N 30° 00' 51.35" E) is a karstic freshwater lake situated in the Upper Cretaceous–Paleocene limestones in the northwestern part of Kandıra District (Kocaeli Province), at an altitude of 26 m a.s.l. (Fig. 1) [26]. The lake basin was formed by dissolved carbonated rocks. It is a mesotrophic lake, with a mean depth of 1 m, maximum depth of 3 m and surface area of 1.6 ha [26]. The lake is fed by an underground water source and by rain water falling into a depression with no surface inlet or outlet. The only outlet of the lake water is via discharge through a karst aquifer. Seven macrophyte species were identified by Altınsaçlı *et al.* [26].

Sarısu Lagoon: Sarısu Lagoon is located in the northern part of Kandıra District (Kocaeli Province) (41° 08' 17.77"N 30° 09' 01.14"E), at an altitude of 0 m (Fig. 1) [26]. Like many other lagoonal lakes, Lake Sarısu is situated on a sandy shore. This semi-enclosed water body is separated from the open sea by a sandy barrier [26]. Sarısu lagoon is formed in a depression behind the coastal dunes. It is a mesotrophic and oligo-mesosaline lagoon, with a mean depth of 1 m, maximum depth of 2.8 m and surface area of 1.94 ha [26]. It is fed by the rain water, a small freshwater stream and Sarısu Creek [26]. Its only temporary outlet is in the east. Fifteen macrophyte species were identified by Altınsaçlı *et al.* [26].

Lake Akçagöl: Lake Akçagöl is small lake located in the southern part of Karasu District (Adapazarı Province) (41° 03' 56.3" N 30° 48' 59.5" E), at an altitude of 58 m a.s.l. (Fig. 1) [25]. It is a freshwater lake, eutrophic and with a mean depth of 2 m, maximum depth of 3 m and surface area of 1.3 ha [25]. The lake fed by underground water and rain water, and lake has no inlet and outlet [25]. Sixteen macrophyte species were identified by Altınsaçlı *et al.* [25].

Lake Küçükboğaz (Lagoon): Lake Küçükboğaz is located in the eastern part of the district of Karasu (Adapazarı Province) (41°05' 07.0" N 30°44' 41.5" E), at an altitude of 2 m a.s.l. (Fig. 1) [25]. It is mesotrophic, with a mean depth of 2 m, maximum depth of 3 m and surface area of 50 ha [25]. The eastern and southern parts of the lake are freshwater, whereas the transitional freshwater-brackish water zones are in the northern part of lake [25]. The lagoon is fed principally by several small creeks and rain water. Lake has only one temporary outlet in the north [25]. Sixteen macrophyte species were identified by Altınsaçlı *et al.* [25].

Lake Akgöl: Lake Akgöl is located in the eastern part of the Karasu District (Adapazarı Province) (41° 03' 57.7" N 30° 49' 01.1" E) at an altitude of 2 m a.s.l. (Fig. 1) [25]. It is an eutrophic lake, with a mean depth of 2 m, maximum depth of 5 m, and surface area of 4.2 ha [25]. Lake has an outlet. Sixteen macrophyte species were identified by Altınsaçlı *et al.* [25].

Dalyan Lagoon: Dalyan Lagoon is located in the eastern part of the Karasu town (Adapazarı Province) (41° 04' 58.6" N 30° 47' 12.4" E), at an altitude of 4 m a.s.l. (Fig. 1) [25]. It is a mesotrophic lake, with a mean depth of 1 m, maximum depth of 1.5 m and surface area of 0.6 ha [25]. The lake fed by underground water and rain water, and has no inlet and no outlet. The lake is surrounded by little sand hills [25]. Sixteen macrophyte species were identified by Altınsaçlı *et al.* [25].

Lake Kanlıgöl: Lake Kanlıgöl is located in the northern east part of the Kaynarca District (Adapazarı Province) (41° 09' 55.7" N 30° 22' 39.6" E) at an altitude of 4 m a.s.l. (Fig. 1). It is a eutrophic lake, with a mean depth of 1 m, maximum depth of 1.5 m, and surface area of 20 ha. Seventeen macrophyte species (*Phragmites australis* (Cav.) Trin.ex Steud., *Typha angustifolia* L., *Typha latifolia* L., *Salvinia natans* (L.) All., *Nasturtium officinale* R. Br., *Alisma plantago-aquatica* L., *Ceratophyllum demersum* L., *Myriophyllum spicatum* L., *Juncus effusus* L., *Juncus littoralis* C.A. Mey., *Juncus maritimus* Lam., *Iris pseudacorus* L., *Mentha aquatica* L., *Lemna minor* L., *Utricularia vulgaris* L., *Nymphaea alba* L., *Potamogeton crispus* L.) were identified during present study in Lake Kamış by Altınsaçlı (unpublished data).

Lake Kamış: Lake Kamış is located in the northern east part of the Kaynarca District (Adapazarı Province**)** (41° 10' 05.8" N 30° 21' 29.5" E) at an altitude of 2 m a.s.l. (Fig. 1). It is a eutrophic lake, with a mean depth of 1 m, maximum depth of 2m, and surface area of 92 ha. Twenty macrophyte species (*Phragmites australis* (Cav.) Trin.ex Steud., *Sparganium erectum* L., *Typha latifolia* L., *Salvinia natans* (L.) All., *Nasturtium officinale* R. Br., *Alisma plantago-aquatica* L., *Ceratophyllum demersum* L., *Myriophyllum spicatum* L., *Juncus effusus* L., *Juncus littoralis* C.A. Mey., *Juncus maritimus* Lam., *Iris pseudacorus* L., *Mentha aquatica* L., *Lemna minor* L., *Utricularia vulgaris* L., *Potamogeton crispus* L. *Potamogeton natans* L.,*Nymphaea alba* L., *Nuphar lutea* (L.) Sm., *Trapa natans* L.) were identified during present study in Lake Kamış by Altınsaçlı (unpublished data).

Excluding ostracods, other animal species found during this study in the wetlands are shown in Table 1.

Table 1: Other animal species found in studied wetlands

SPECIES	Lake Saklıgöl	Lake Sarıcagelin	Sarısu Lagoon	Lake Akçagöl	Lake Küçükboğaz	Lake Akgöl	Dalyan Lagoon	Lake Kanlıgöl	Lake Kamış
Cyprinus carpio L. 1758	*	*		*	*	*		*	*
Cyprinus carpio subsp. carpio L. 1758		*		*					
Esox lucius L. 1758				*	*	*		*	*
Scardinius erythrophthalmus (Linnaeus, 1758)	*			*	*	*		*	*
Carassius gibelio (Bloch, 1782)	*	*		*	*			*	*
Gasterosteus aculeatus L. 1758			*						
Gambusia affinis (Baird & Girard 1853)		*							
Siluris glanis (Linnaeus, 1758)					*				
Natrix tessellata Laurenti, 1768	*	*	*	*	*	*		*	*
Natrix natrix (Linnaeus, 1758)	*	*	*	*	*	*		*	*
Mauremys caspica Pritchard, 1966	*	*	*	*	*	*	*	*	*
Mauremys caspica rivulata Gruber & Fuchs 1977	*	*	*	*	*	*	*	*	*
Astacus leptodactylus Eschscholtz, 1823	*	*	*	*	*	*		*	*
Dreissena polymorpha (Pallas, 1771)			*				*		
Cerastoderma glaucum (Bruguière, 1789)			*				*		
Anodonta cygnea (L. 1758),				*					
Viviparus viviparus (L. 1758)	*	*	*	*					
Physella acuta (Draparnaud 1805)	*	*		*					
Planorbis (L. 1758)	*	*		*					
Physa fontinalis (L. 1758)	*	*		*					
Bithynia tentaculata (Linnaeus, 1758)	*	*		*					
Hirudo medicinalis L. 1758	*	*		*	*	*		*	*
Hirudo verbena Carena 1820								*	*
Fulica atra L. 1758	*	*	*	*	*	*		*	*
Cygnus olor Gmelin 1887	*				*	*			*

Climate of Marmara bears common traits both of the Mediterranean climate (mild and rainy winters, warm and dry summer) and Black Sea climate (wet, humid, rainy in all season).

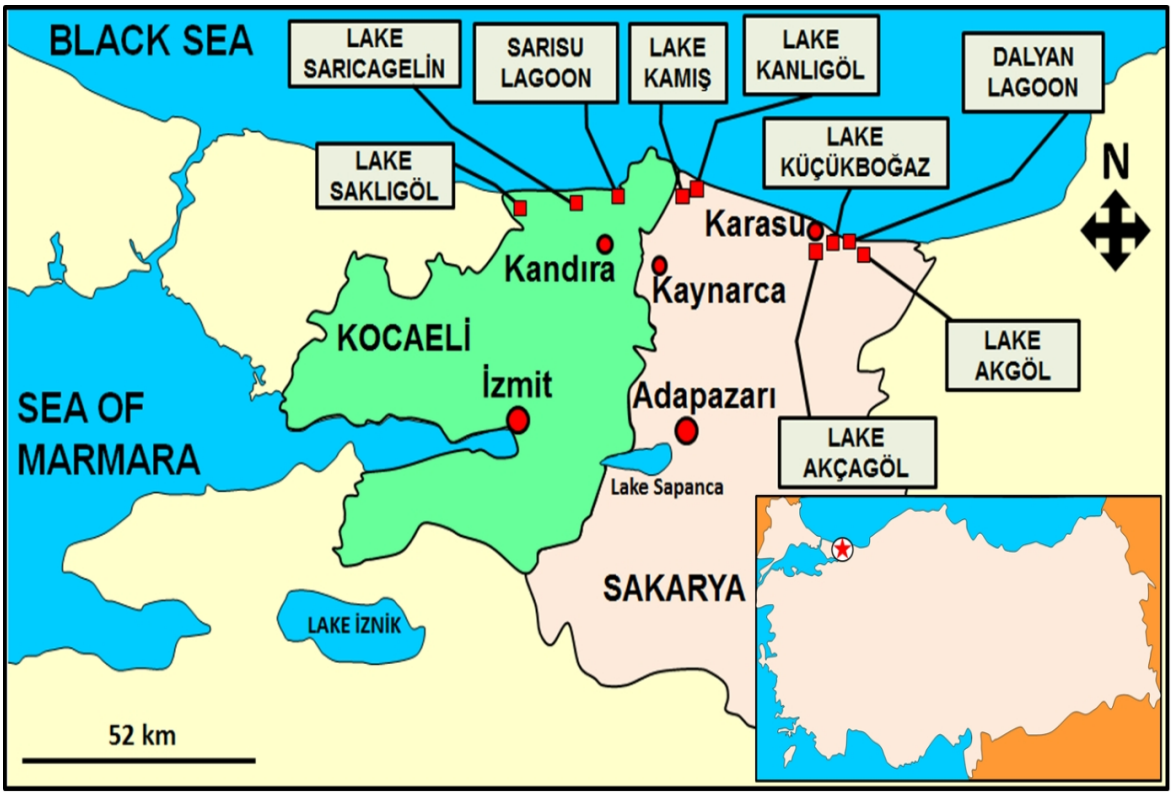

Fig 1: Sampling sites in Sakarya and Kocaeli Provinces

2.2 Sampling

Between September 2009 and August 2010, ostracods were collected from 9 wetland sites in at least two different aquatic habitats (littoral zone of lakes and lagoons) in two counties (Kaynarca and Karasu) of Sakarya and one county (Kandıra) of Kocaeli. Five physicochemical variables commonly used were measured monthly from September 2009 to August 2010: dissolved oxygen (DO), pH, water temperature (Tem.), electrical conductivity (EC) and salinity (Sal.). Table 2 presents values of each physicochemical parameter for each of the different wetlands. Two hundred milliliter of sediment (with submerged aquatic plants) were collected from a depth of 10 to 60 cm (ca. 1 m^2 of area) using a standard hand net (250 µm mesh size) and fixed in 4% formaldehyde in situ. In

the laboratory, ostracods were separated from sediment using four standardized sieves: 2.0, 1.5, 0.5, and 0.25 mm mesh size. Samples were stored in 1:1 70 % ethanol:glycerine and species were identified using both soft part sand carapace-based characters using standard keys [2, 32, 33]. with systematic nomenclature following and Meisch [2] and Hartmann & Puri [34]. Permanent and temporary soft part preparations were made with Canada balsam and lactophenol. Seasonal individual numbers of ostracod species are shown in table 3. **5.**

2.3 Statistical Analyses

Sorensen's Similarity Quotient (QS) [35], i.e. the species similarity based on the presence or absence of species, was used to determine the degree of similarity of ostracod species collected from the nine wetlands: QS = 2C/(A+B), where A and B are the number of species from each sample, and C is the number of common species. The (log2) Shannon-Weaver diversity index (H') [36]. was calculated for each sample based on number of individuals of each ostracod species found. Binary (presence–absence) data was used to show relationships among species using the Bray Curtis similarity coefficient and non-weighted pair group mean averages (here after UPGMA) analysis provided by the program Multivariate Statistical Package Version 3.1 [37]. We used numbers of individuals in Spearman Rank Correlation analysis along with two-tailed significance of bivariate correlations to determine the correlations among the species, environmental variables and both [38]. Significant results were determined at 0.01 and/or 0.05 critical levels.

3. Results

8147 individuals belonging to 20 genera and 24 taxa (*Darwinula stevensoni* (Brady & Robertson, 1870, *Cypria ophthalmica* (Jurine, 1820), *Physocypria kraepelini* G.W. Müller, 1903, *Ilyocypris biplicata* (Koch, 1838), *Ilyocypris bradyi* Sars, 1890, *Notodromas monacha* (O.F. Müller, 1776), *Candona neglecta* Sars, 1887, *Pseudocandona compressa* (Koch, 1838), *Pseudocandona marchica* (Hartwig, 1899), *Pseudocandona rostrata* (Brady & Norman, 1889), *Fabaeformiscandona fabaeformis* (Fischer, 1851), *Candonopsis kingsleii* (Brady & Robertson, 1870), *Eucypris virens* (Jurine, 1820), *Tonnacypris lutaria* (Koch, 1838), *Heterocypris incongruens* (Ramdohr, 1808), *Heterocypris salina* (Brady, 1868), *Cypridopsis vidua* (O.F. Müller, 1776), *Potamocypris variegata* (Brady & Norman, 1889), *Sarscypridopsis aculeata* (Costa, 1847), *Plesiocypridopsis newtoni* (Brady & Robertson, 1870), *Cyprideis torosa* (Jones, 1850), *Loxoconcha (Loxocaspia) immodulata* (Stepanaitys, 1958), *Limnocythere inopinata* (Baird, 1843), *Metacypris cordata* Brady & Robertson 1870) were collected from the nine sampled sites (See Table 3). Individual numbers of 24 ostracod species collected from nine wetlands are shown in Table 3. The values of eight physicochemical variables measured in ten wetlands from September 2009 (Sept. 2009) to August 2010 (Aug.2010) (Table 2).

Table 2: Physicochemical variables measured in thewetlands during September 2009 to August 2010. Abbreviations (Tem.= Water temperature (°C), DO = Dissolved oxygen (mg/L), pH, Sal.= Salinity (‰), EC= Electrical Conductivity (µS/cm))

WETLANDS	KARACAKÖY CREEK					LAKE SAKLIGÖL					SARISU LAGOON					DALYAN LAGOON					LAKE SARICAGELİN				
Sampling Date	Tem.	pH	Sal.	DO	EC	Tem.	pH	Sal	DO	EC	Tem.	pH	Sal	DO	EC	Tem.	pH	Sal.	DO	EC	Tem.	pH	Sal.	DO	EC
Sept. 2009	21	7.6	0.0	5.7	510	21	8.2	0.2	8.3	273	24	7.6	3.5	5.1	5610	26	9.0	6.8	5.9	9240	21	7.7	0.0	7.5	227
Oct. 2009	20	7.5	0.0	5.9	480	20	7.6	0.1	8.3	244	22	7.8	3.0	5.5	4100	26	8.3	4.5	5.4	7.25	24	8.2	0.0	6.0	236
Nov. 2009	18	7.3	0.0	6.2	430	17	8.0	0.1	8.3	232	23	7.6	2.7	5.5	3650	26	8.3	3.5	5.3	6100	22	7.8	0.0	6.5	242
Dec. 2009	13	7.4	0.0	6.7	412	14	7.7	0.1	8.3	238	20	7.8	2.4	5.5	3400	26	8.3	3.5	6.4	5730	12	8.1	0.0	5.9	251
Jan. 2010	11	7.2	0.0	6.7	402	12	7.9	0.1	8.3	228	12	8.0	2.0	5.4	2700	26	8.3	3.4	5.6	5160	10	8.9	0.0	5.6	183
Feb. 2010	13	7.4	0.0	6.5	410	10	8.3	0.1	8.3	230	13	7.9	1.5	5.2	2200	28	8.7	4.5	7.2	7220	13	8.9	0.0	6.2	180
Mar. 2010	12	7.6	0.0	6.3	398	12	8.0	0.1	8.3	241	14	7.8	0.9	5.6	1800	27	8.2	4.6	6.5	7810	16	9.2	0.0	7.0	187
Apr. 2010	16	7.5	0.0	6.8	425	14	7.9	0.1	8.3	229	20	8.3	0.9	5.3	1820	26	8.6	6.4	7.1	11110	18	8.9	0.0	6.8	165
May. 2010	24	7.7	0.0	6.5	502	22	8.1	0.2	8.2	450	28	8.2	0.7	5.4	1650	24	8.9	6.8	6.8	11400	22	9.0	0.0	6.5	150
Jun. 2010	27	7.7	0.0	6.8	512	26	8.4	0.3	6.5	820	26	8.3	3.4	5.6	6100	26	9.1	10.9	6.8	18110	29	10.3	0.0	6.1	189
Jul. 2010	26	7.9	0.0	6.9	511	26	8.9	0.6	6.7	1377	28	8.7	4.5	7.2	8220	29	9.5	7.8	6.3	14200	27	10.4	0.0	6.5	203
Aug. 2010	25	7.9	0.0	6.7	519	27	8.8	0.3	6.8	780	27	8.2	4.6	6.5	8750	29	9.5	7.8	6.0	12240	26	10.0	0.0	6.8	232
Maximum	27	7.9	0.0	6.9	519	27	8.9	0.6	8.3	1377	28	8.7	4.6	7.2	8750	29	9.5	10.9	7.2	18110	29	10.4	0.0	7.5	251
Minimum	11	7.2	0.0	5.7	398	10	7.6	0.1	6.5	228	12	7.6	0.7	5.1	1650	24	8.2	3.4	5.3	5160	10	7.7	0.0	5.6	150
Mean	18.8	7.55	0.0	6.45	459	18.4	8.1	0.2	7.8	496	21.2	8.0	2.5	5.7	4314	26.5	8.7	6.0	6.2	9917	19.9	8.9	0.0	6.46	203
WETLANDS	LAKE KÜÇÜKBOĞAZ					LAKE AKÇAGÖL					LAKE KANLIGÖL					LAKE KAMIŞ					LAKE AKGÖL				
Sampling Date	Tem.	pH	Sal.	DO	EC	Tem.	pH	Sal	DO	EC	Tem	pH	Sal	DO	EC.	Tem.	pH	Sal.	DO	EC	Tem.	pH	Sal.	DO	EC
Sept. 2009	22	8.1	0.1	6.3	221	21	8.1	0.0	5.9	323	23	7.6	0.0	6.7	400	20	7.3	0.0	6.2	500	21	7.8	0.0	6.4	640
Oct. 2009	22	8.0	0.1	6.7	220	20	7.8	0.0	6.3	285	23	7.8	0.0	6.8	472	21	7.6	0.0	6.6	472	19	8.7	0.0	6.0	670
Nov. 2009	16	7.7	0.1	6.6	217	17	8.3	0.0	6.5	279	17	7.6	0.0	6.7	404	16	7.5	0.0	6.5	404	16	8.1	0.0	5.5	665
Dec. 2009	15	7.5	0.1	6.3	214	14	8.0	0.0	6.7	289	14	7.5	0.0	6.4	411	13	7.6	0.0	6.4	411	14	8.1	0.0	5.7	695
Jan. 2010	12	7.8	0.1	7.1	212	12	7.8	0.0	6.5	256	13	7.7	0.0	6.7	410	11	7.5	0.0	6.8	420	11	7.9	0.0	6.3	620
Feb. 2010	12	8.2	0.1	7.5	210	13	7.9	0.0	6.6	262	12	7.8	0.0	7.0	410	13	7.7	0.0	7.0	430	11	8.2	0.0	6.4	695
Mar. 2010	14	8.3	0.1	7.6	212	14	7.9	0.0	6.3	290	14	7.7	0.0	7.5	406	12	7.7	0.0	7.3	406	12	8.4	0.0	6.5	671
Apr. 2010	16	8.5	0.2	6.9	1478	15	8.2	0.0	6.7	311	16	7.9	0.0	6.6	420	15	7.5	0.0	6.6	420	14	8.3	0.0	6.0	694
May. 2010	24	8.7	2.1	7.6	4160	28	8.2	0.0	6.9	311	24	8.0	0.0	6.8	490	23	8.0	0.0	6.8	490	22	8.4	0.1	5.4	713
Jun. 2010	26	9.1	0.4	7.2	1246	26	9.0	0.0	6.0	351	28	8.2	0.0	7.1	430	27	7.6	0.0	7.2	520	25	8.8	0.1	5.4	720
Jul. 2010	27	9.2	0.4	7.4	3255	27	9.3	0.0	5.9	358	28	7.9	0.0	7.3	427	28	7.8	0.0	7.1	524	27	8.5	0.1	5.1	711
Aug. 2010	28	8.9	0.3	6.5	2980	26	8.5	0.0	6.1	354	27	7.6	0.0	6.9	411	27	7.8	0.0	6.8	516	27	8.3	0.0	5.0	657
Maximum	28	9.2	2.1	7.6	4160	28	9.3	0.0	6.9	358	28	8.2	0.0	7.5	490	28	8	0.0	7.3	524	27	8.8	0.1	6.5	720
Minimum	12	7.5	0.1	6.3	210	12	7.8	0.0	5.9	256	12	7.5	0.0	6.4	400	11	7.3	0.0	6.2	404	11	7.8	0.0	5	620
Mean	19.5	8.3	0.45	6.9	1356	19.5	8.2	0.0	6.37	305	19.9	7.7	0.0	6.8	427	18.9	7.6	0.0	6.7	460	18.3	8.2	0.0	5.8	677

Table 3: List and total individual numbers of ostracod taxa collected in the wetlands during September 2009 to August 2010.

Species	Lake Saklıgöl	Sarısu Lagoon	Lake Sarıcagelin	Dalyan Lagoon	Lake Küçükboğaz	Lake Akçagöl	Lake Kanlıgöl	Lake Kamış	Lake Akgöl	Total individual number of each species	Percent Frequency (%)
Darwinula stevensoni	176	88	130		95	42	132	146	91	900	11.4
Cypria ophthalmica	262	55	99		148	56	169	153	110	1052	12.9
Physocypria kraepelini			34				20	36	25	115	1.4
Ilyocypris biplicata	87	89	47				77	92	38	430	5.3
Ilyocypris bradyi					72		67	77		216	2.6
Notodromas monacha						8	19	29		56	0.6
Candona neglecta		19			95	38	95	113	67	427	5.2
Pseudocandona compressa		25							33	58	0.7
Pseudocandona marchica		20				30	63	75	48	236	2.9
Pseudocandona rostrata					20		19	32		71	0.9
Fabaeformiscandona fabaeformis		62			45	41	58	75	52	333	4.1
Candonopsis kingsleii									44	44	0.5
Tonnacypris lutaria								31		31	0.4
Eucypris virens							38	48		86	1
Heterocypris incongruens					86		73	125		284	3.5
Heterocypris salina		197		271	121	37				626	7.7
Cypridopsis vidua	203	84	183		166	80	150	186	139	1191	14.6
Potamocypris variegata			88							88	1
Sarscypridopsis aculeata					36					36	0.5
Plesiocypridopsis newtoni					48					48	0.6
Cyprideis torosa		265		450	88					803	9.8
Loxoconcha immodulata						4	65	130		199	2.4
Limnocythere inopinata	372	80	207		117					776	9.5
Metacypris cordata						7	8	20	6	41	0.5
Total individual number of ostracods in wetlands	1100	984	788	721	1137	343	1053	1368	653	8147	100

During the present study, five cosmopolitan species (*D. stevensoni, C. ophthalmica, H. salina, S. aculeata, C. vidua*) were found. Five cosmopolitan species are significant contribution to species diversity. All of the species during the present study had been determined from Turkey, and within the geographical region and sub-regions located of Turkey [2].

The results from the species-clustering analysis (UPGMA) revealed three major clustering groups (Fig 2). The first group consisted in brackish (oligosaline) lagoon (Dalyan Lagoon). Second group comprised from slightly brackish (oligosaline)-freshwater coastal lakes and lagoons located in the Black Sea coastline (mentioned lagoons are fed by freshwater of rainwater and creeks) Three major clustering groups are includes karstic freshwater lakes (Lake Sarıcagelin and Lake Saklıgöl).

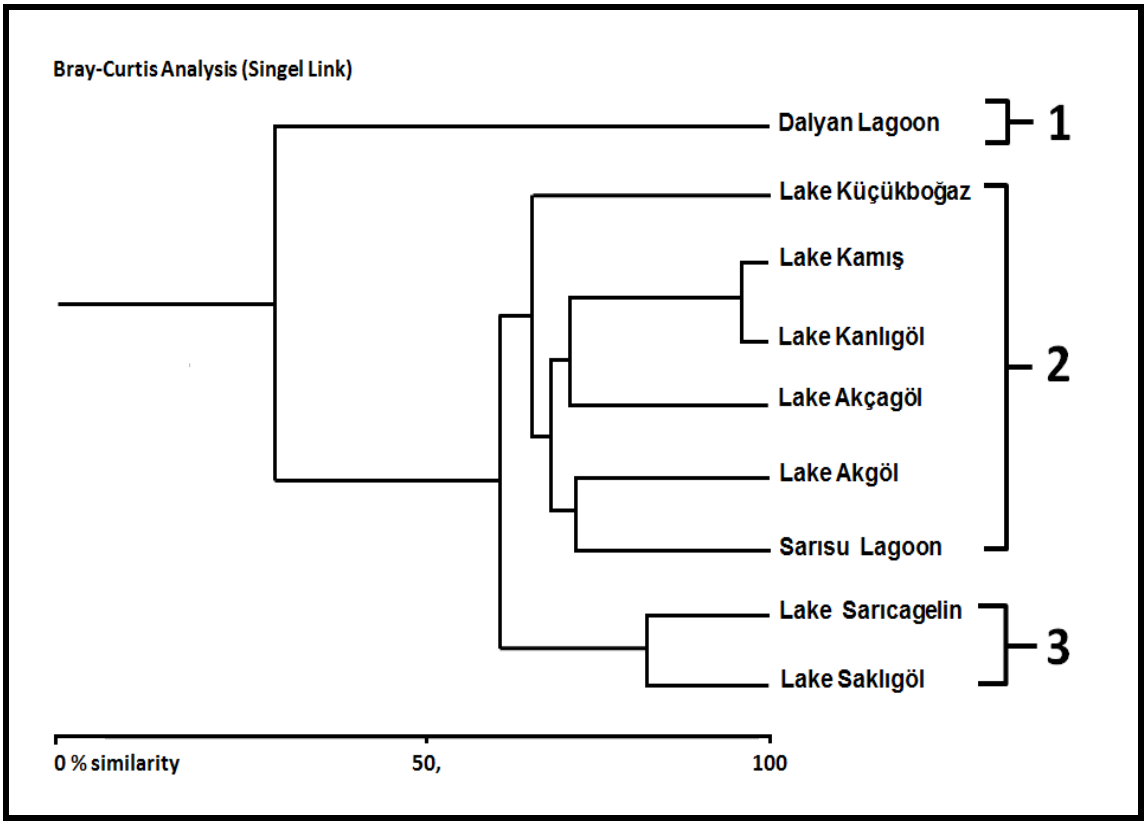

Fig 2: An analysis of Unweighted Pair-Group Mean Averages (UPGMA) shows the clustering relationships of ostracod fauna among wetlands.

Results of Sorensen's Similarity Coefficient analysis results are shown in table 4.

Table 4: Percent similarities among the wetlands, calculated using the estimates of the Sorenson Index. (* The highest similarity scores).

Name of Wetlands	Lake Saklıgöl	Sarısu Lagoon	Lake Sarıcagelin	Dalyan Lagoon	Lake Küçükboğaz	Lake Akçagöl	Lake Kanlıgöl	Lake Kamış	Lake Akgöl
Lake Saklıgöl	100	62.5	66.6*	0	44.4	40	40	38	50
Sarısu Lagoon	62.5	100	55.5	30.7*	66.6*	66.6	53.8	51.8	72.7*
Lake Sarıcagelin	66.6*	55.5	100	0	30	35.2	45.4	43.4	55.5
Dalyan Lagoon	0	30.7	0	100	26,60	26.6	0	0	0
Lake Küçükboğaz	44.4	66.6	30	26.6	100	52,1	50	55.1	41.6
Lake Akçagöl	40	66.6	35.2	16.6	52.1	100	72	69.2	66,6
Lake Kanlıgöl	40	53.8	45.4	0	50	72*	100	96.7*	61.5
Lake Kamış	38	51.8	43.4	0	55.1	69.2	96.7*	100	66.6
Lake Akgöl	50	72.7*	55.5	0	41.6	66.6	61.5	66.6	100

According to the results of the Sorenson Similarity Index, the greatest similarity (96.7 %) was found between Lake Kanlıgöl and Lake Kamış while the lowest similarity (0 %) occurred between Dalyan Lagoon and other lakes (see Table 4).Species diversity values of the wetlands according to Shannon Wiener diversity index are shown in Fig 3. Higher values of Shannon's index (H') indicate of greater species diversity.

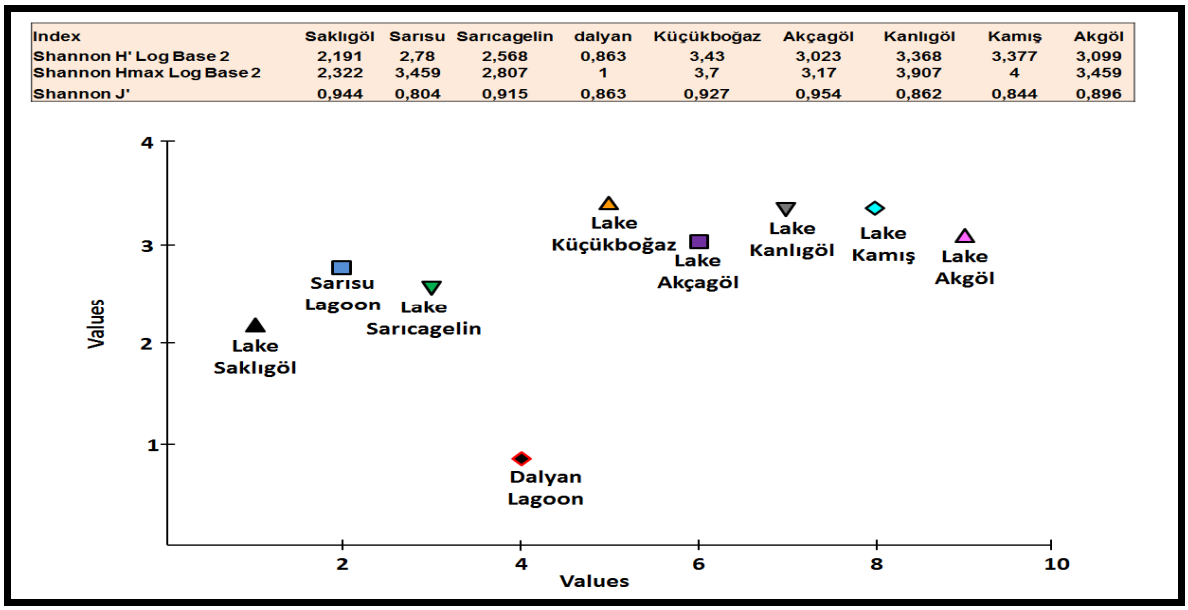

Fig 3: Shannon-Weaver similarity index (H') values of the wetlands in Sakarya and Kocaeli Provinces.

According to the Shannon-Weaver diversity index (H') values (Fig 3) suggested high diversity values for the Kanlıgöl (3.37) and Lake Kamış (3.38), whereas values of the Shannon-Weaver diversity index (H') were the lowest for Dalyan Lagoon (0.86) (Fig 3). Seasonal Shannon-Weaver diversity index (H') values of the wetlands are shown in Fig 4.

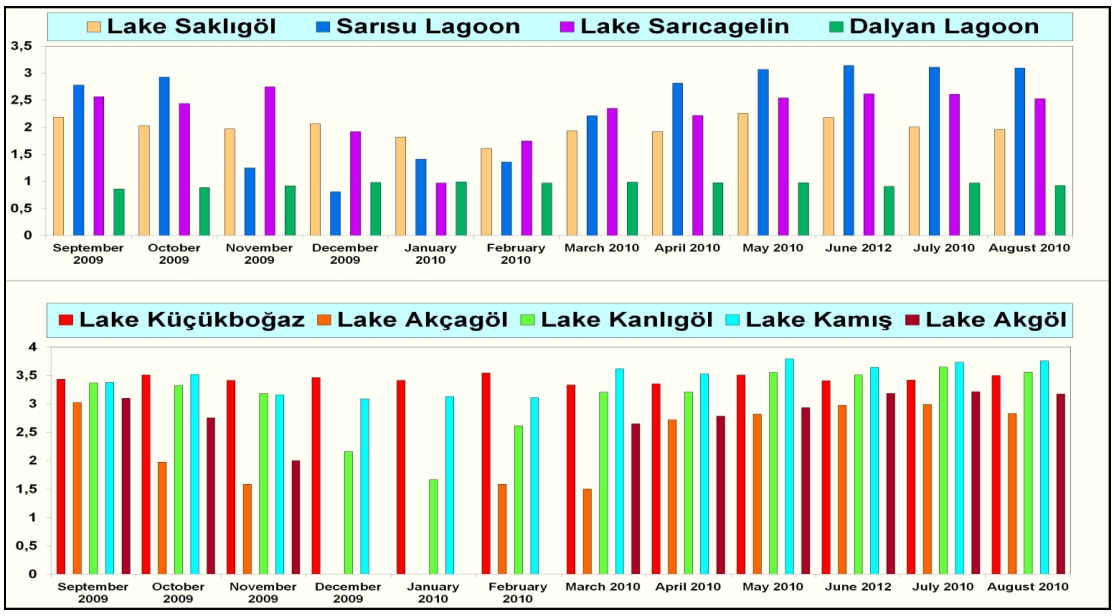

Fig 4: Seasonal Shannon-Weaver diversity index (H') values of the wetlands during September 2009 to August 2010

In the present study, the lowest (1.61) and the highest (2.26) Shannon Wiener index (H') values recorded during winter and spring, respectively at Lake Saklıgöl. The lowest winter (0.81) and the highest (3.14) Shannon Wiener index (H') values recorded during winter and summer, respectively at Sarısu Lagoon. The lowest (0.97) and the highest (2.81) Shannon Wiener index (H') values recorded during winter and autumn, respectively at Lake Sarıcagelin. The lowest (0.86) and the highest (0.98) Shannon Wiener index (H') values recorded during autumn and winter, respectively at Dalyan Lagoon. The lowest (3.33) and the highest (3.53) Shannon Wiener index (H') values recorded during winter and early spring, respectively at Lake Küçükboğaz. The lowest (0.0) and the highest (3.02) Shannon Wiener index (H') values record during winter and early autumn, respectively at Lake Akçagöl. The lowest (1.6) and the highest (3.63) Shannon Wiener index (H') values recorded during winter and summer, respectively at Lake Kanlıgöl. The lowest (3.08) and the highest (3.79) Shannon Wiener index (H') values recorded during winter and summer, respectively at Lake Kamış. The lowest (0.0) and the highest (3.18) Shannon Wiener index (H') values recorded during late autumn and winter and summer, respectively at Lake Akgöl. In terms of species diversity has the lowest to Shannon-Weaver diversity indices in the late autumn and winter months in nine wetlands

All ostracods species were significantly positive correlated with each other in Lake Saklıgöl. The most strong positive correlation was observed between *C. vidua* and *I. bradyi* (r= 0.910, P < 0.01). Except dissolved oxygen, the positive correlation was observed between all other environmental variables.The most positive correlation was observed between salinity and electrical conductivity (r= 0.893) while most strong negative correlation was observed between salinity and dissolved oxygen (r= -0.902).

All ostracods species were significantly positive correlated with each other in Lake Küçükboğaz. The most strong positive correlation was observed between *H. salina* and *C. neglecta* (r = 0.975, P < 0.01). Except relation between electrical conductivity and dissolved oxygen, electrical conductivity and temperature, positive correlations were observed between all environmental variables in Lake Küçükboğaz. The most positive correlation was observed between salinity and pH (r= 0,848, P < 0.01) while weak negative correlation was observed between temparature and dissolved oxygen (r= -0,132).

All ostracods species were significantly positive correlated with each other in Lake Akçagöl. The most strong positive correlation was observed between *D. stevensoni* sand *C. neglecta* (r = 0.991, P < 0.01). The most weak positive correlation was observed between *N. monacha* and *L. immodulata* (r= 0,441). The most positive correlation was observed between temparature and conductivity (r= 0,798, P < 0.01) while weak negative correlation was observed between pH and dissolved oxygen (r= --0,340).

All ostracods species were significantly positive correlated with each other in Sarısu Lagoon. The most strong positive correlation was observed between *L. inopinata* and *P. compressa* (r = 0. 992, P < 0.01). The most weak positive correlation was observed between *P. marchica* and *H. salina* (r = 0.651, P< 0.05). The positive correlation was observed between all environmental variables in Sarısu Lagoon. The most positive correlation was observed between salinity and conductivity (r= 0.991, P < 0.01) while weak positive correlation was observed between pH and electrical conductivity (r= -0.135).

All ostracods species were significantly positive correlated with each other in Lake Sarıcagelin. The most strong positive correlation was observed between *C. ophthalmica* and *D. stevensoni* (r= 0. 993, P < 0.01). The most weak positive correlation was observed between *C. ophthalmica* and *L. inopinata* (r= 0,848, P< 0.01). The most positive correlation was observed between pH and temperature (r= 0.494) while weak positive correlation was observed between pH and dissolved oxygen (r= -0.057). The most negative correlation was observed between electrical conductivity and pH (r= -0,380) while weak negative correlation was observed between electrical conductivity and dissolved oxygen (r= -0.152).

Two ostracods species were positive correlated in Dalyan Lagoon. The most strong positive correlation was observed between *C. torosa* and *H. salina* (r = 0.910, P < 0.01). The positive correlation was observed between all environmental variables in Dalyan Lagoon. The most positive correlation was observed between salinity and electrical conductivity (r= 0,982, P < 0.01) while weak positive correlation was observed between temperature and dissolved oxygen (r= 0,067).

All ostracods species were strongly positive correlated with each other ostracod in species in Lake Kamış. The most strong positive correlation was observed between *F. fabaeformis* and *I. bradyi* (r = 0. 993, P < 0.01). The positive correlation was observed between all environmental variables in Lake Kamış. The most positive correlation was observed between temperature and electrical conductivity (r= 0, 822, P < 0.01) while weak positive correlation was observed between temperature and dissolved oxygen (r= 0,127).

All ostracods species were strongly positive correlated with each other ostracod in species in Lake Kanlıgöl. The most strong positive correlation was observed between *H. incongruens* and *C. vidua* (r = 0,975, P < 0.01). The positive correlation was observed between all environmental variables in Lake Kamış. The most positive correlation was observed between pH and electrical conductivity (r= 0,703, P < 0.01) while weak positive correlation was observed between electrical conductivity and dissolved oxygen (r= 0,159).

All ostracods species were strongly positive correlated with each other ostracod in species in Lake Akgöl. The most strong positive correlation was observed between *C. neglecta* and I. *biplicata* (r = 0,987, P < 0.01). The most positive correlation was observed between electrical conductivity and salinity (r= 0,754, P < 0.01) while weak positive correlation was observed between electrical conductivity and temperature (r= 0,271) in Lake Akgöl. The most negative correlation was observed between temperature and dissolved oxygen (r= -0,802, P <0.01) while weak negative correlation was observed between electrical conductivity and dissolved oxygen (r= -0,361).

4. Discussion

Faunistic studies on ostracods were performed in wetlands that with regard to similar climate, conditions and geographical characteristics [24, 27, 28, 29, 30, 31, 39]

In another study, a total of 19 ostracod species (*Ilyocypris bradyi, I. gibba* (Ramdohr, 1808), *C. neglecta, Pseudocandona compressa, P. marchica, Eucypris mareotica* (Fischer, 1855), *Cypris pubera* O.F. Müller, 1776, *H. incongruens, C. vidua, Cypridopsis parva* G.W. Müller, 1900 Syn.: *Cypridopsis vidua, Cypridopsis newtoni* Brady & Robertson, 1870 Syn.: *P. newtoni* (Brady & Robertson, 1870), *C. ophthalmica, Physocypria kliei* Schäfer, 1934 Syn.: *Physocypria kraepelini, Cyprideis sorbyana* (Jones, 1857) Blake, 1933, *L. immodulata, Tyrrhenocythere amnicola* (Sars, 1887*), Leptocythere rara* (Mueller, 1894) Ruggieri, 1953, *D. stevensoni, C. torosa*) were recorded in Lake Terkos (Durusu)

by Altınsaçlı & Yılmam [27].

Ten ostracod species (*C. ophthalmica, E. virens, C. parva, C. vidua, P. newtoni*, *Potamocypris unicaudata* Schäfer, 1943, *P. variegata, P. villosa* (Jurine, 1820), *P. zschokkei* (Kaufmann, 1900), *L. inopinata*) were determined in the Ömerli Dam [29].

One ostracod species *(M. cordata*) was determined by Altınsaçlı *et al.* [39].

A total of 24 ostracod species were determined in the Lake Hamam, Lake Pedina, Mert Lagoon, Erikli Lagoon, and Saka Lagoon by Altınsaçlı [30]. Thirteen ostracod species (*C. neglecta, Pseudocandona hartwigi* (G. W. Müller, 1900), *P. marchica, C. ophthalmica, P. kraepelini, H. salina, C. vidua, L. inopinata*, *Limnocythere stationis* Vávra, 1891, *Callistocythere diffusa* (Mueller, 1894) Morkhoven, 1963, *Pontocythere baceseoi* (Caraion, 1960) Caraion, 1967, *Urocythereis margaritifera* (Mueller, 1894) Ruggieri, 1950, *C. torosa*) were determined in the Erikli Lagoon [30]. Twelve species (*C. neglecta, F. fabaeformis, P. compressa, Pseudocandona hartwigi* (G.W. Müller, 1900), *P. marchica, Candonopsis kingsleii, P. kraepelini, I. biplicata, E. virens, H. incongruens, Cyprinotus inaequivalvis* Bronshtein, 1928) Syn.: *Heterocypris salina, C. vidua*) were determined in the Lake Hamam [30]. Fourteen species (*C. neglecta, P. marchica, C. kingsleii, P. kraepelini, I. biplicata, Ilyocypris monstrifica* (Norman, 1862), *Cypris bispinosa* Lucas, 1849, *E. virens, Psychrodromus olivaceus* (Brady & Norman, 1889), *H. incongruens, H. salina, C. vidua, C. torosa, C. diffusa*) were determined in the Mert Lagoon. Ten species (*C. neglecta, F. fabaeformis, P. compressa, C. kingsleii, P. marchica, P. kraepelini, I. biplicata, Eucypris inflata* Sars, 1903 Syn.: *Eucypris mareotica* (Fischer, 1855), *H. incongruens, C. vidua*) were determined in the Lake Pedina [30].Lagoon. 4 species (*C. neglecta, E. inflata, H. salina, C. vidua*) were determined in the Saka Lagoon by Altınsaçlı [30].

Fifty-two ostracod species were determined from 63 wetlands [31].The above-mentioned this study [31]: eight ostracod species (*D. stevensoni, C. neglecta, F. fabaeformis, C. ophthalmica, I. biplicata, H. salina, C. vidua* and *C. torosa)* in Lake Küçükboğaz, twelve ostracod species (*C. ophthalmica, I. biplicata, I. bradyi, N. monacha, C. neglecta, P. marchica, F. fabaeformis, C. kingsleii, E. virens, C. vidua, Paralimnocythere psammophila* (Flössner, 1965) and *T. lutaria*) in Lake Acarlar, ten ostracod species (*D. stevensoni, C. neglecta, P. marchica, C. ophthalmica, P. kraepelini, H. incongruens, C. vidua, L. inopinata, Tyrrhenocythere donetziensis* (Dubowsky, 1926), *L. immodulata*) in Lake Büyük Akgöl, five ostracod species (*D. stevensoni, C. neglecta, P. marchica, C. ophthalmica, C. vidua*) in Lake Küçük Akgöl, thirteen ostracod species (*D. stevensoni, C. neglecta, F. fabaeformis, P. marchica, C. kingsleii, P. kraepelini, C. ophthalmica, I. biplicata, C. vidua, L inopinata, P. psammophila, T. donetziensis, L. immodulata*) in Lake Taşkısığı were determined.

Twenty-six ostracod species (*D. stevensoni, C. neglecta, F. fabaeformis, P. marchica, C. kingsleii, P. kraepelini, C. ophthalmica, Cyclocypris ovum* (Jurine, 1820), *N. monacha, I. biplicata, I. bradyi, Dolerocypris sinensis* Sars, 1903, *E. inflata, Eucypris lilljeborgi* (G.W. Müller, 1900), *E. virens, P. zenkeri, T. lutaria, P. olivaceus, H. incongruens, H. salina, C. vidua, P. newtoni, L. inopinata, C. torosa, L. immodulata, T. donetziensis*) were determined in Lake Poyrazlar by Altınsaçlı [24].

In another studies performed in adjacent area on ostracods was carried out in and Sakarya River Basin and Lake Sapanca [23, 28]. Sixteen ostracod species (*I. biplicata, I. gibba, I. bradyi, Ilyocypris decipiens* Masi, 1905, *C. neglecta, C. ophthalmica, E. virens, Prionocypris zenkeri* (Chyzer & Toth, 1858), *H. incongruens, C. inaequivalvis, Herpetocypris chevreuxi* (Sars, 1896), *P. olivaceus, C. vidua, Potamocypris villosa* (Jurine, 1820), *Potamocypris zschokkei* (Kaufmann, 1900), *T. donetziensis*) were determined in Sakarya River and its arms by Gülen & Altınsaçlı [23].

Twenty five ostracod species (*I. gibba, I. biplicata, I. decipiens, C. neglecta, P. marchica, Cryptocandona vavrai* Kaufmann, 1900, *C. vidua, F. fabaeformis, Candona angulata* G.W. Müller, 1900, *C. kingsleii, C. ophthalmica, C. pubera, C. bispinosa, E. virens, T. lutaria, E. lilljeborgi, D. sinensis, H. salina, H. incongruens, H. chevreuxi, P. olivaceus, C. vidua, D. stevensoni, T. donetziensis, L. immodulata*) were determined in Lake Sapanca by Altınsaçlı [28]. Concurrent studies were performed in different adjacent wetlands during present study. Seven ostracod species (*D. stevensoni, C. ophthalmica, C. neglecta, P. marchica, F. fabaeformis, H. salina, C. vidua*) were determined in unnamed shallow wetland (41° 03’ 42.4’’ N 30° 46’ 42.4’’E) close by Karasu village. Nine ostracod species *(D. stevensoni, C. ophthalmica, I. biplicata, C. neglecta, F. fabaeformis, H. salina, C. vidua, L. inopinata, C. torosa*) were determined in Sarısu Creek (41° 07’ 57.4’’ N 30° 09’ 17.2’’E). Ten ostracod species (*D. stevensoni, C. ophthalmica, I. biplicata, C. neglecta, P. compressa, P. marchica, F. fabaeformis, H. salina, C. vidua, L. inopinata*) were determined in Lake Sülüklü (41° 03’ 42.4’’ N 30° 46’ 42.4’’E). Many quarries naturally fill with water after abandonment and become lakes to. Such a lake was formed close by Sarısu Creek. Four ostracod species (*C. ophthalmica, H. incongruens, C. vidua, I. biplicata*) were determined in this lake (41° 08’ 01.7’’ N 30° 09’ 14.2’’E). Eight ostracod species (*D. stevensoni, C. ophthalmica, I. biplicata, C. neglecta, F. fabaeformis, H. salina, C. vidua, L. inopinata, C. torosa*) were determined in Seyrek Creek (41° 07’ 58.1’’ N 30° 05’ 56.4’’E). Eight ostracod species (*D. stevensoni, C. ophthalmica, I. biplicata, C. neglecta, F. fabaeformis, H. salina, C. vidua, L. inopinata)* were determined in Bağırganlı Creek (41° 07’ 57.4’’ N 30° 01’ 07.7’’E). Five ostracod species (*C. ophthalmica, I. biplicata, H. salina, C. vidua, L. inopinata*) were determined in Karacaköy Creek (41° 09’ 21.0’’ N 29° 46’ 41.2’’E). *Tyrrhenocythere donetziensis* was determined in Sakaryabaşı Spring pond (39° 21’ 16.7’’ N 31° 03’ 21.3’’E). Twenty-six ostracod species (*D. stevensoni, C. neglecta, F. fabaeformis, P. marchica, C. kingsleii, P. kraepelini, C. ophthalmica, C. pubera, N. monacha, I. biplicata, D. sinensis, E. inflata, E. lilljeborgi, E. virens, P. zenkeri, T. lutaria, P. olivaceus, H. incongruens, H. salina, C. vidua, P. villosa, P. newtoni, L. inopinata, C. torosa, L. inopinata, T. donetziensis*) were determined in Mollaköy Ponds (Mollaköy, Arifiye, Sakarya). Three ostracod species (*C. torosa, H. salina, Loxoconcha elliptica* Brady, 1868) were determined in Hersek Lagoon (40° 43’ 02.6’’ N 29° 31’ 02.1’’E) as Mischke *et al.* [40].

This survey includes freshwater (0 ppt), oligosaline (<0.5ppt) and mesosaline (<5 ppt) wetlands (Fig 1). Some ostracod species can grow and reproduce normally in freshwater and low brackish water. Salinity is an effective barrier to freshwater ostracods. Results showed salinity levels were below 0.5 ‰ at Saklıgöl, Sarıcagelin, Kamış, Kanlıgöl, Akçagöl, Akgöl and Saklıgöl Lakes (see Table 1). According to classification of Brackish [41], Sarısu Lagoon is mesosaline (average salinity values 2.5 ‰) wetlands. Dalyan Lagoon is mesosaline (average salinity values 6 ‰). Sarısu lagoon is fed by the rain water, several small freshwater streams and Sarısu

Creek in the all seasons. Its only temporary outlet is in the east. The closed outlet of lagoon opens with a dipper dredger by the local administration in summer months. Thus, waters of lagoon flow to the Black Sea. For this reason, the lagoon may become much more saline during in the summer months than the spring and winter months. Eleven ostracod species (*D. stevensoni, C. ophthalmica, I. biplicata, C. neglecta, P. compressa, P. marchica, F. fabaeformis, H. salina, C. vidua, C. torosa, L. inopinata*) were found in Sarısu Lagoon. Four of these species (*F. fabaeformis, H. salina, C. vidua, C. torosa*) were determined in oligo-mesosaline water of Lake Bafa [42]. Two ostracod species (*H. salina, C. torosa*) were found in Dalyan Lagoon. *C. torosa* is accompanies to the *H. salina* in the coastal lagoons. *H. salina* and *C. torosa* can be found different levels of the salinity and alkalinity.

Except *C. torosa* and *H. salina*, the all other ostracods were found in lower salinity levels waters of Sarısu lagoon due to excessive freshwater input to lagoon. Also, except *C. torosa, S. aculeata* and *H. salina*, all ostracod species were found in the freshwaters of the Lake Küçükboğaz.

Major sections of determined ostracod species in this present study are tolerant of harsh conditions such as salinity, pollution, eutrophication, low oxygenation and high pH levels.

The present studies were performed three brackish water habitats (Dalyan Lagoon, Sarısu Lagoon and Lake Küçükboğaz) and other six freshwater habitats. Brackish water conditions has been determined in only a small section of the Lake Küçükboğaz that it connects to the Black Sea, because, input of freshwater into the lake are higher from input of brackish water. Therefore, a large part of the lake shows typical freshwater characteristics with regard to floristic and faunistic composition.

Air temperature and precipitation are considered two external environmental factors determining of water temperatures, water levels and ion concentrations in seasonal scales. Therefore, temperature is generally main factor controlling life cycles of ostracods species. According to results of this study, individual numbers of ostracod species usually reached peak numbers in warm seasons and only occasionally in late autumn.

Substrate types are effect to absence of preference of ostracod species. Lakes Sarıcagelin, Saklıgöl and Akçagöl lakes are formed in karst depression. Material were collected from sandy substrate of Lake Saklıgöl, muddy sandy substrate of Lake Sarıcagelin, muddy-sandy substrate of Lake Akçagöl, sandy and sandy muddy of Sarısu Lagoon, sandy substrate of Dalyan Lagoon, sandy and sandy muddy substrate of Lake Küçükboğaz, sandy muddy substrate of Lake Kanlıgöl, muddy-sandy substrate of Lake Kamış and muddy-sandy substrate of Akgöl.All species have been found suitable substrates for their lives in present study such as thoroughly described in the publication cited [2].

The ostracod *C. vidua* prefers periphyton growing on *Chara fragilis* Desvaux to other feeding substrates [43]. Also, this species were found in periphyton of *Chara vulgaris* Linnaeus 1753 (Lake Saklıgöl, Sarısu Lagoon, Karacaköy Creek and Lake Sarısu) and *Nitellopsis obtusa* (N.A.Desvaux) J. Groves 1919 (Lake Sarıcagelin).

C. vidua, C. neglecta, C. ophthalmica, P. kraepelini, D. stevensoni, L. inopinata, H. incongruens and *H. salina* are eurytopic taxa. Also, their occurrences were reported in nutrient-rich, eutrophic and polluted waters [21, 31]. *C. torosa* is a typically euryhaline species [2]. Smooth forms of *C. torosa* seen at salinities >5‰ [2]. Therefore, the smooth specimens (*Cyprideis torosa* forma *littoralis*) and noded specimens (*Cyprideis torosa* forma *torosa*) of *C. torosa* were determined in Dalyan Lagoon, whereas, only noded specimens of *C. torosa* were determined Lake Küçükboğaz and Sarısu Lagoon. *C. torosa* were determined coastal lagoons [31] and inland saline water [44].

P. kraepelini were found in many aquatic ecosystems of Turkey [30, 31]. Except Dalyan lagoon, *C. ophthalmica* was found in other eight wetlands. *H. salina* can tolerate salinities up to 20‰ [2]. Cosmopolitan species tolerant to brackish water conditions and eutrophication [2]. Dalyan lagoon is fed with rain water, and water losses due evaporation, therefore lagoon has to harsh conditions for inhabitant organism. Hence, salinity tolerant species *H. salina* and *C. torosa* can survive in harsh conditions such as Dalyan Lagoon.

Brackish waters are preferred by *S. aculeata* and *H. salina* [2]. In spite of that, these two species can live in pure freshwaters [2]. Also, *H. salina* and *S. aculeata* were found in both freshwater and brackish water in present study.

I. biplicata has been synonymized with *Ilyocypris gibba* [2]. We were determined non noded form (*Ilyocypris* forma *biplicata*) of *I. biplicata*

The most dominant species were *C. ophthalmica* in Lake Saklıgöl (262 specimens, 23.8 %) and Kanlıgöl (169 specimens, 16 %). The most dominant species were *C. vidua* in Lake Küçükboğaz (166 specimens, 14.5 %), Lake Akçagöl (80 specimens, 23.3 %), Lake kamış (186 specimens, 12.2 %) and Lake Akgöl (139 specimens, 21.2 %). The most dominant species were *C. torosa* in Sarısu Lagoon (265 specimens, 33.6 %) and Dalyan Lagoon (450 specimens, 62.4 %).

The most common genus was *Pseudocandona* (*P. compressa, P. marchica, P. rostrata*) at the nine wetlands. Among all samples, *C. vidua* dominated the ostracods by a relative abundance of 14.61% (1191 individual), followed by *C. ophthalmica* (12.9 %, 1052 individual) and *D. stevensoni* (11.4 %, 900 individual). These wetlands must be carefully monitored for protection of ecological balance due to determining of cosmopolitan or ecological plasticity wide range ostracod species in present study. Cosmopolitan species *C. vidua* has tolerance to low oxygenated waters [2]. *D. stevensoni* is cosmopolitan and ubiquitous [45].

Loxoconcha immodulata (Stepanaitys, 1958) reported in the Lake Poyrazlar [24], Lake Terkos [27], Black Sea [46], Lake Taşkısığı and Büyük Akgöl [31], Aral Sea [47], Lake Sapanca [28, 48] and Mollaköy Ponds (Mollaköy, Arifiye, Sakarya) during in these studies. These results show that *L. inopinata* are common species in brackish and freshwater habitats located in the Pontocaspian region (Caspian Sea, Azov Sea, Black Sea and Aral Sea).

N. monacha lives in both permanent and temporary water bodies, and prefers shallow water with rich vegetation such as ponds and littoral of lakes [49]. *N. monacha* has a Holarctic distribution [2]. *N. monacha* prefers dense submerged emergent macrophytes belt for habitat [50] as well as lakes Kamış and Kanlıgöl.

D. stevensoni is considered with a cosmopolitan species [51, 52]. Euryhaline benthic ostracod *D. stevensoni* was reported in the coastal lagoons [53, 54, 55].

L. inopinata and *H. incongruens* are typical inhabitants of still water bodies. *L. inopinata* can tolerate high alkalinities [56] as in lakes Sarıcagelin and Saklıgöl

C. neglecta has worldwide geographical distribution and wide tolerance to environmental conditions [2] Also, accuracy of above mentioned information about of *C. neglecta* are confirm due to known presence of *C. neglecta* in very different kinds habitats of Turkey [21, 31]

Result of this study showed that these 24 species have been previously reported alive from different wetlands such as lagoons, lakes, ponds, swamp, hot springs, creeks, rivers and dams of the world and Turkey where in different levels of ecological variables and in similar habitats by many researcher.

This study has shown that, the presence, absence, distribution and composition of the ostracod species in nine wetlands related to the structure of substrates, changes of physical and chemical variables, macrophyte composition and geomorphological origin of wetlands and levels of salinity.

5. Conclusions

Finally, we are summarized our findings on Ostracoda fauna of nine wetlands as follows:

1. We collected 8147 ostracod specimens from the nine wetlands and identified them into 24 species.
2. Five cosmopolitan ostracod species (*D. stevensoni, C. ophthalmica, H. salina, S. aculeata, C. vidua*) of the total 24 were found in nine wetlands. At least five cosmopolitan species from nine wetlands had an important contribution to local diversity.
3. All ostracods species were significantly positive correlated with each other.
4. Sampling wetlands according to ostracod species assemblage were clustered into three groups (1. Lagoon, 2. Coastal lakes and lagoons, 3. Typical Karstic lakes).
5. The ostracod abundance and diversity increases in warm period from late spring and early autumn
6. We found the highest diversity in May mean diversity of 3.79 in lake Kamış.

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