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Assessments on diversity, spatiotemporal distribution and ecology of the living ostracod species (Crustacea) in oligo-hypersaline coastal wetland of Bargilya (Milas, Muğla, Turkey)

Selçuk Altınsaçlı, Ferda Perçin-Paçal, Songül Altınsaçlı

Abstract
This study aims to understand the ecology of the Ostracoda species obtained from the Bargilya wetland (Milas, Muğla, Turkey). This environmental impact study investigates the distribution and occurrence of ostracods in the wetland in 2008. Consequently, thirteen taxa belonging to 7 genera were recorded from eight sampling sites. UPGMA clustering analysis separated seven ostracod species into three groups based on their ecology and spatiotemporal requirements: brackish-marine species *Cyprideis torosa*, and *Loxoconcha elliptica* are in the first group; marine-brackish ten species in the second group are in the second group; continental brackish species, *Heterocypris salina*, is in the third group. Statistical analysis results show that statistically significant relationships were observed between biotic parameters (species abundance, richness and diversity) and environmental variables. Results also suggest that existence of salinity level different zones in the Bargilya wetland is one of the important factor influencing of ostracod species diversity and distribution.

Keywords: Bargilya, ecology, fauna, habitat preferences, ostracoda, saltpan

1. Introduction

Lagoons, saltpans, and saltmarshes are ecologically sensitive ecosystems within coastal areas. The Bargilya wetland in Turkey is one of important ecosystems. The Bargilya wetland is situated at the southern coast of Aegean Sea, and it consists of three sections: Metruk Tuzla (former Saltpan), Bargilya Cove and Kocadere (Mazı) Creek (Fig. 1).

Throughout the world, coastal areas are major destinations for tourism. Changes in the size, composition, and distribution of human populations affect these coastal regions by changing land use and land cover. Fishing, the destruction of forests, and pollution and sedimentation from human activities can all affect the coastal environment. Tourism dominates the economy of the coastal regions of Aegean, where many areas are becoming increasingly urban. The urbanization of Aegean coasts brings with it coastal development (including demands for fresh water and sewage treatment) and damage to coastal ecosystems [1].

Crustaceans are an extreme diverse group of animals that have adapted to very different and, sometimes, to extreme environments [2]. The Ostracoda (Crustacea) have become a very successful inhabitant of every aquatic habitat. They are an important component of the benthos of lotic and lentic brackish, freshwater, and marine habitats. Fossil ostracods in sediments indicate the past fauna of wetlands, and therefore represent a potentially useful tool for reconstructing wetland ecology and paleoecology.

The composition of ostracod population density and diversity varies both spatiotemporal and depending on a range of environmental factors (e.g. anthropogenic impacts, salinity, water depth, water temperature, sediment grain size). The distribution of ostracod species is primarily controlled by salinity, temperature, oxygen availability, and substrate type [3]. Habitat type, water level and depth, the chemical composition of water, the presence and absence of plant species, and the competition and predation for food also affect the distribution of ostracods [4, 5].

The coastal lagoons of the Aegean Sea coast have a rich biodiversity (Kevrekidis 1997, 2004 [6, 7, 8]. However, there are inadequate Ostracoda data for Turkish lagoons and coastal wetlands. Marine and brackish water ostracod species have been recorded from the South Aegean and

Mediterranean Sea coasts of Turkey by Nazik *et al.* [9], Şafak [10], Altınsaçlı [11, 12], Ertekin & Tunoğlu [13], Akıncı [14], Bergin *et al.* [15], Meriç *et al.* [16], Perçin-Paçal [17] and Altınsaçlı *et al.* [18].

An updated checklist of the marine and coastal waters ostracod species of Turkey are presented by Perçin-Paçal *et al.* [19].This updated checklist contains total 382 ostracod species (326 from marine and 56 from coastal brackish waters) which have determined from Turkey [19].

The objectives of this study are to: (1) describe the diversity and distribution of ostracods found in the Bargilya wetland (Metruk Tuzla, Bargil Cove and Kocadere Creek) in the village district of Boğaziçi in the Milas area of Muğla Province in southwestern Turkey; (2) describe the impact of anthropogenic and agricultural activities on two of the Bargilya wetland; (3) ascertain the ecological characteristics of ostracods found in the study area; (4) examine whether establishing coastal wetlands provides any benefits for aquatic biodiversity; and (5) discuss the conservation status of the study area.

2. Materials and Methods

The Bargilya wetland (covers 590 ha) is located in the Güllük Bay (Aegean Sea) coastal area, SW Turkey (Figure 1, 2). Former saltpan (Metruk Tuzla) (37°11''04.56" N 27°35'' 12.86" E) is a shallow coastal lagoon (maximum depth: 1.5 m; average depth of 45 cm, elevation: sea level; surface area 311 ha) located in the southern part of the Bargilya wetland (Fig. 1, Fig. 2).

Bargilya wetland is surrounded by hills along the North, West and South margins. The Bargilya saltpan is connected to the sea by three channels with an extension of 7 m, 1, 5 m width and 1 m depth. Flow direction of the water in the connection channels between saltpan and Bargil cove is changed according to seasons. Former saltpan is separated by the road built on the embankment from the Bargil cove.

Water salinity of former saltpan is much higher than that of the adjacent eastern Aegean Sea; therefore, it is considered as a hyper-saline lagoon. Also, the influence of the hypersaline waters of saltpan, the waters in the southern region of Bargil cove are also more saline than mouth of the Bargil cove.

Metruk Tuzla is a protected area and an important bird area (IBA) about 22 km southwest of the Milas municipality district (Muğla Province, Turkey).

Positioned on Bargil (Ülelibük) Cove on the coast of Güllük Bay (Aegean Sea), this shallow, former saltpan nowadays occupies an approximate surface area of 310 ha. Metruk Tuzla is called Bükgöl (Cove Lake) by the local people. Bargil Cove is a small (272 ha) but relatively deep (> 1.5 m) cove in Güllük Bay (Aegean Sea). The mouth of Kocadere Creek, where other work areas are located, covers an area of 7.2 hectares (Fig. 1).

Figure 1 shows a map of the area designed according to water salinity and, the focus of this paper, the spatial distribution of ostracod species. The wetland area and surrounding waters consist of three different sections with different salinities, including the mouth of Kocadere Creek, Bargil (Vargil or Ülelibük) Cove, and Metruk Tuzla. In the past, sediments from Kocadere Creek was transported by small creeks to Bargil Cove, and over time sedimentation filled some parts of this little cove, making the Boğaziçi village coast shallow, like Metruk Tuzla.

The Bargilya wetland region has a typical Mediterranean climate, with dry and hot summers and mild winters with high precipitation (Fig. 3).

Metruk Tuzla itself is surrounded by hills covered with olive groves, Aleppo pines (*Pinus halepensis*), and tamarisk trees. The shallow parts of the wetland dry out in summer and are covered with samphire. The shallow coastline of Bargil (Ülelibük) Cove and Metruk Tuzla is covered with glasswort species of the genus *Salicornia.*

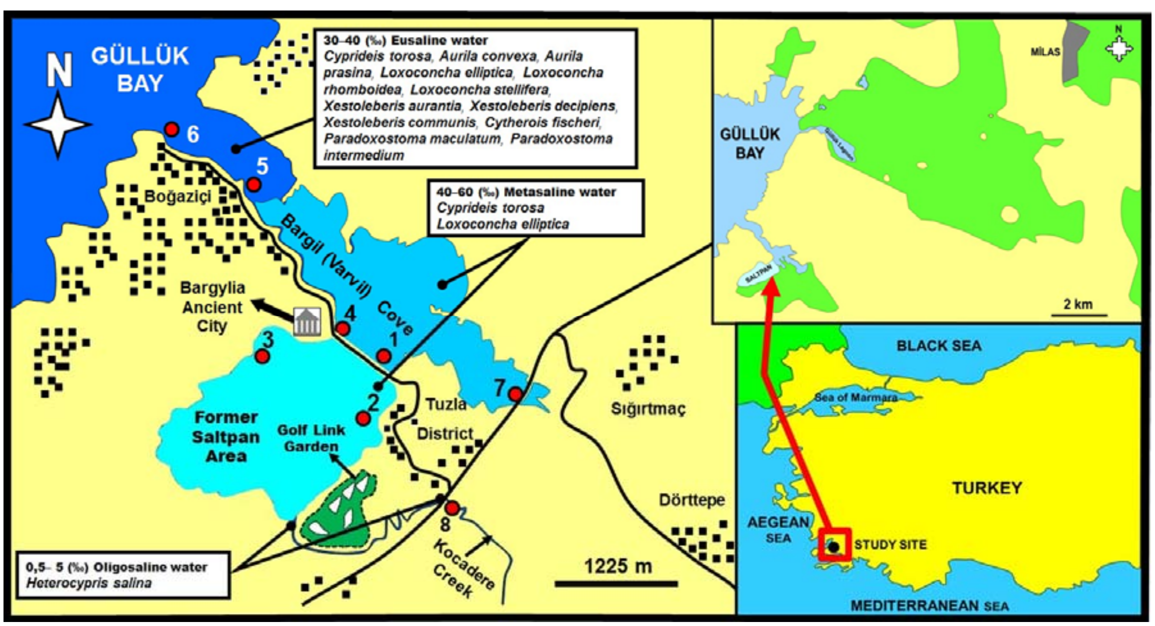

Fig 1: Location of Bargilya wetland, with water salinity classification, sampling localities, and spatial distribution of ostracod species according to salinity zonation.

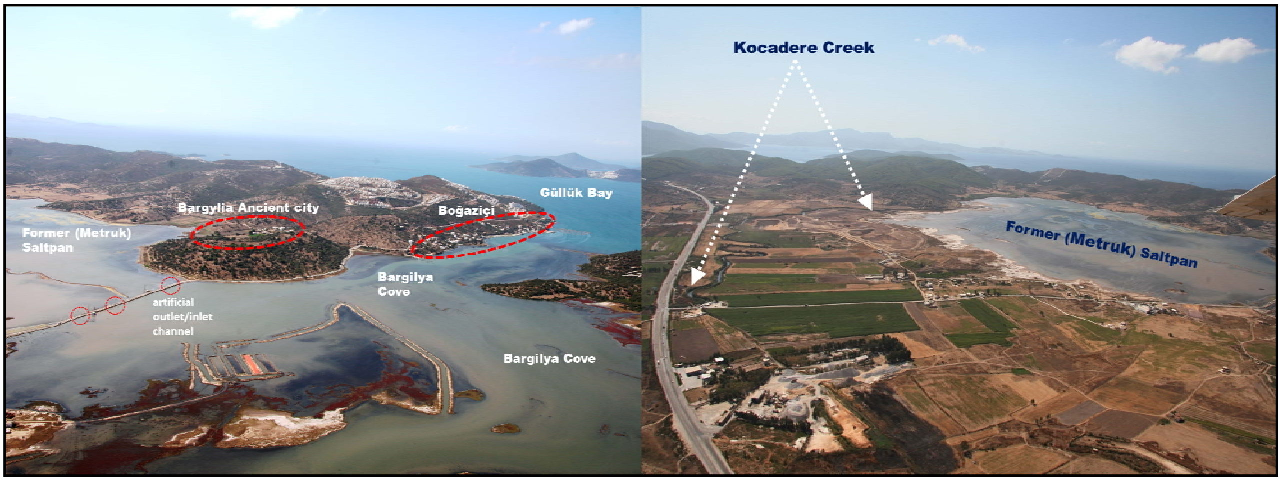

Fig 2: Photographs of the Bargilya wetland (Former salt pan, Bargilya Cove and Kocadere Creek

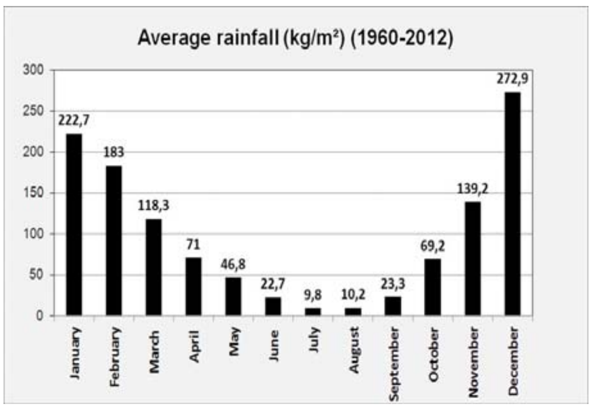

Fig 3: Monthly average rainfall data of Muğla province 1960-2012 (Turkish State Meteorological Service (TSMS) 2014 [20].

Historically, small Carian coastal city Bargilya was considered a strategic point for settlement from the 4th century BC. The coastal city lost its importance, however, and became deserted. In Turkey, salt is produced from four different sources: in seas, lakes, springs, and outcroppings. Metruk Tuzla is very close to a natural area used as a saltpan centuries ago. The Metruk Tuzla saltpan is connected to Güllük Bay and was established during the Ottoman Empire period. One of the most important Ottoman travelers, Evliya Çelebi [21], noted the taste of the salt produced in Tuzla in the 17th century, and wrote that the salt obtained there was not only consumed in Anatolia but also exported to France. Salt production in Tuzla ended in the early 19th century.

Less than one meter deep, the waters of Metruk Tuzla, rich in fish and algae, provide vital nourishment to migratory birds on their long migratory journeys. Indeed, the Bargilya wetland is known as one of the most important natural reserves for migratory birds and wild fowl species. Blue-green and red algae, diatoms, larval and adult forms of small insects, crustaceans, molluscs, and small fishes make up the main diet of flamingos. The wetland area is a very important feeding ground especially for the *Phoenicopterus ruber roseus* (Greater Flamingo) Pallas 1811. Artesian wells located around in the wetlands are fed by the shallow subsurface aquifers. Unfortunately, these important water sources are abused by cottage sites since long time by the high consumption way. A golf club recently built on the edge of the wetlands uses groundwater intensely for grass irrigation. Agricultural activities in the area include cotton and olive cultivation. A causeway separates Metruk Tuzla from the Bargil cove. The Bargil cove and Metruk Tuzla are interconnected with three channels that built under the road. Although the water level decreases with the summer and fall evaporation, the inward flowing seawater from these channels prevent from drying up of the Metruk Tuzla. Occasionally, the effect of the water flow from Metruk Tuzla to the nearby village, Boğaziçi, combined with evaporation, increases the salinity of the wetland. Seven physicochemical variables commonly used in studies of brackish, marine, and hypersaline water habitats were measured monthly from January 2008 to December 2008: The water redox potential (Eh [Mv]), pH, percentage of oxygen saturation (Sat %), dissolved oxygen (DO [mg/L]), electrical conductivity (EC [µS/cm]), salinity (S[‰]), and water (T[w]) temperature (ºC) were measured *in situ* using electronic probes (WTW 340i multimeter) at each sampling sites of the Bargilya wetland (Fig. 1). The physicochemical characteristics recorded are shown in Table 1. Mean values and standard deviations of environmental parameters, and ostracod specimen numbers of all stations are shown in Table 2.

Table 1: Data collected from eight sampling sites. The species name abbreviations as follows: CT: *Cyprideis torosa*, AC: *Aurila convexa*, AP: *Aurila prasina*, LE: *Loxoconcha elliptica*, LR: *Loxoconcha rhomboidea*, LS: *Loxoconcha stellifera*, XA: *Xestoleberis aurantia*, XD: *Xestoleberis* decipiens, XC: *Xestoleberis* communis, CF: *Cytherois fischeri*, PM: *Paradoxostoma maculatum*, PI: *Paradoxostoma intermedium*, and HS: *Heterocypris salina*. St. no. = number of the sampling site. Water parameters measured included water redox potential (Eh), pH, percentage oxygen saturation (SAT %), dissolved oxygen (DO [mg/L]), electrical conductivity (EC [mS/cm]), salinity (SAL [‰]) and water temperature (T[w])

St. No/Dates	T(w)	pH	Eh	SAL	EC	DO	SAT	CT	AC	AP	LE	LR	LS	XA	XD	XC	CF	PM	PI	HS
St.1 12.01.08	19	8.6	-92	39.5	50	8.4	106	18	0	0	10	0	0	0	0	0	0	0	0	0
St.1 22.02.08	19	8.6	-97	39.8	51	8.5	106	56	0	0	19	0	0	0	0	0	0	0	0	0
St.1 22.03.08	21	8.7	-98	40.8	63	8.5	107	98	0	0	56	0	0	0	0	0	0	0	0	0

St.1 27.04.08	21	8.7	-98	41.5	67	8.7	105	181	0	0	66	0	0	0	0	0	0	0	0	0
St.1 07.05.08	23	8.6	-100	42.7	69	7.5	86	222	0	0	72	0	0	0	0	0	0	0	0	0
St.1 15.06.08	27	8.7	-101	42.2	69	7.5	87	590	0	0	176	0	0	0	0	0	0	0	0	0
St.1 27.07.08	30	8.7	-104	42.0	68	7.5	88	641	0	0	178	0	0	0	0	0	0	0	0	0
St.1 11.08.08	30	8.7	-108	42.0	69	7.6	98	235	0	0	171	0	0	0	0	0	0	0	0	0
St.1 24.09.08	29	8.7	-94	41.7	68	8	98	171	0	0	165	0	0	0	0	0	0	0	0	0
St.1 01.10.08	28	8.9	-94	46.8	68	8.4	108	154	0	0	144	0	0	0	0	0	0	0	0	0
St.1 09.11.08	23	8.7	-94	41.2	67	8.3	103	49	0	0	38	0	0	0	0	0	0	0	0	0
St.1 14.12.08	20	8.6	-93	40.2	64.1	8.1	104	21	0	0	17	0	0	0	0	0	0	0	0	0
St.2 12.01.08	18	8.3	-114	47.8	54	8.1	102	29	0	0	25	0	0	0	0	0	0	0	0	0
St.2 22.02.08	20	8.4	-115	46.2	54	8.2	103	52	0	0	39	0	0	0	0	0	0	0	0	0
St.2 22.03.08	21	8.6	-116	46.7	65	8.3	106	69	0	0	58	0	0	0	0	0	0	0	0	0
St.2 27.04.08	21	8.7	-116	48.5	65	8.5	108	268	0	0	112	0	0	0	0	0	0	0	0	0
St.2 07.05.08	24	9.2	-116	52.2	75	7.4	99	312	0	0	135	0	0	0	0	0	0	0	0	0
St. 2 15.06.08	27	8.8	-110	59.4	78	7.5	99	908	0	0	198	0	0	0	0	0	0	0	0	0
St.2 27.07.08	30	8.8	-104	61.1	87	8.8	121	979	0	0	335	0	0	0	0	0	0	0	0	0
St.2 11.08.08	31	8.8	-106	62.4	86.9	8.9	125	315	0	0	310	0	0	0	0	0	0	0	0	0
St.2 24.09.08	29	8.9	-113	61.5	87	8.9	127	211	0	0	154	0	0	0	0	0	0	0	0	0
St.2 01.10.08	28	9.3	-116	57.4	77	9.1	107	178	0	0	141	0	0	0	0	0	0	0	0	0
St.2 09.11.08	24	9.1	-114	57.4	77	8.7	106	100	0	0	120	0	0	0	0	0	0	0	0	0
St.2 14.12.08	21	8.7	-113	59.1	71	8.6	107	78	0	0	56	0	0	0	0	0	0	0	0	0

St. No/Dates	T(w)	pH	Eh	SAL	EC	DO	SAT	CT	AC	AP	LE	LR	LS	XA	XD	XC	CF	PM	PI	HS
St.3 12.01.08	19	8.6	-115	47.8	50	8.4	106	35	0	0	27	0	0	0	0	0	0	0	0	0
St.3 22.02.08	20	8.7	-116	46.2	51	8.5	106	40	0	0	43	0	0	0	0	0	0	0	0	0
St.3 22.03.08	22	8.6	-116	46.7	63	8.5	107	79	0	0	61	0	0	0	0	0	0	0	0	0
St.3 27.04.08	22	8.7	-115	48.5	67	8.7	105	245	0	0	120	0	0	0	0	0	0	0	0	0
St.3 09.05.08	24	8.9	-115	53.1	76	7.3	98	320	0	0	149	0	0	0	0	0	0	0	0	0
St.3 17.06.08	27	8.7	-109	58.2	77	7.5	98	1112	0	0	234	0	0	0	0	0	0	0	0	0
St.3 27.07.08	30	8.8	-103	58.7	78	8.7	119	1116	0	0	320	0	0	0	0	0	0	0	0	0
St.3 13.08.08	30	8.7	-104	59.8	80	8.8	122	381	0	0	317	0	0	0	0	0	0	0	0	0
St.3 29.09.08	28	8.8	-113	60.1	83	8.9	124	230	0	0	134	0	0	0	0	0	0	0	0	0
St.3 01.10.08	26	9.2	-115	57.8	78	9.1	126	198	0	0	123	0	0	0	0	0	0	0	0	0
St.3 09.11.08	24	8.6	-115	57.5	78	8.7	106	98	0	0	101	0	0	0	0	0	0	0	0	0
St.3 14.12.08	21	8.6	-115	56.3	72	8.7	105	80	0	0	56	0	0	0	0	0	0	0	0	0
St.4 12.01.08	19	8.5	-93	39.4	49	8.3	105	20	0	0	16	0	0	0	0	0	0	0	0	0
St.4 22.02.08	19	8.5	-96	39.5	50	8.4	105	52	0	0	25	0	0	0	0	0	0	0	0	0
St.4 22.03.08	21	8.6	-97	39.5	60	8.4	106	100	0	0	67	0	0	0	0	0	0	0	0	0
St.4 27.04.08	21	8.6	-97	39.7	65	8.6	107	222	0	0	72	0	0	0	0	0	0	0	0	0
St.4 07.05.08	24	8.6	-97	40.1	62	7.4	94	230	0	0	81	0	0	0	0	0	0	0	0	0
St.4 15.06.08	28	8.7	-101	40.5	62	7.4	94	573	0	0	182	0	0	0	0	0	0	0	0	0
St.4 27.07.08	31	8.9	-104	40.1	62	7.5	95	735	0	0	200	0	0	0	0	0	0	0	0	0
St.4 11.08.08	30	8.8	-106	40.1	62	7.6	96	235	0	0	175	0	0	0	0	0	0	0	0	0
St.4 24.09.08	29	8.6	-105	41.2	63	7.9	98	162	0	0	129	0	0	0	0	0	0	0	0	0
St.4 01.10.08	28	8.9	-108	41.3	67	8.4	104	148	0	0	98	0	0	0	0	0	0	0	0	0
St.4 09.11.08	21	8.6	-98	39.5	49	8.4	102	56	0	0	36	0	0	0	0	0	0	0	0	0
St.4 14.12.08	20	8.7	-97	39.5	49	8.4	101	31	0	0	22	0	0	0	0	0	0	0	0	0

St. No/Dates	T(w)	pH	Eh	SAL	EC	DO	SAT	CT	AC	AP	LE	LR	LS	XA	XD	XC	CF	PM	PI	HS
St.5 12.01.08	18	8.4	-92	38	61	7.5	86	2	2	2	1	1	1	2	2	1	1	1	1	0
St.5 22.02.08	19	8.4	-93	38	61	7.5	87	3	2	2	3	1	1	2	2	2	1	2	2	0
St.5 22.03.08	21	8.4	-99	38.1	61	7.5	87	6	3	2	4	2	2	2	2	3	2	1	1	0
St.5 27.04.08	21	8.4	-99	38.1	61	7.6	87	8	5	3	5	2	2	3	2	3	2	3	2	0
St.5 07.05.08	23	8.5	-97	38.2	51	6.9	58	11	4	6	6	3	3	3	3	3	1	3	3	0
St.5 15.06.08	27	8.7	-99	38.3	59	7.8	91	9	3	3	6	5	2	2	2	2	0	2	1	0
St.5 27.07.08	30	8.8	-105	38.3	59	7.2	91	8	2	3	3	4	2	2	2	1	0	2	1	0
St.5 11.08.08	30	8.8	-105	38.7	62	7.7	84	6	2	3	3	2	2	2	2	1	0	1	1	0
St.5 24.09.08	27	8.5	-97	39.2	62	7.7	83	3	2	2	4	1	2	2	2	3	1	1	1	0
St.5 01.10.08	27	8.5	-91	39.9	66	5.7	70	4	1	2	3	1	1	3	2	3	1	3	2	0
St.5 09.11.08	21	8.5	-91	38.2	61	7.4	88	4	2	1	2	3	2	2	2	3	1	1	1	0
St.5 14.12.08	20	8.5	-91	38.2	62	7.4	87	4	1	1	1	1	1	3	2	3	1	3	2	0
St.6 12.01.08	18	8.5	-91	37.2	56	7.3	80	1	1	1	1	1	1	1	1	1	1	3	1	0
St.6 22.02.08	19	8.5	-92	37.3	56	7.3	81	1	1	1	1	1	1	2	2	3	1	1	1	0
St.6 22.03.08	21	8.5	-94	37.3	56	7.3	81	2	1	1	2	2	1	1	1	1	1	3	1	0
St.6 27.04.08	21	8.5	-97	37.3	56	7.4	82	2	3	3	3	2	2	2	2	1	1	1	1	0
St.6 07.05.08	23	8.6	-99	37.3	56	7.4	92	3	6	7	4	4	4	4	3	1	2	3	2	0
St.6 15.06.08	26	8.6	-99	37.5	57	7.3	91	4	3	5	5	5	3	4	3	1	3	2	1	0

St.6 27.07.08	27	8.7	105	37.9	57	7.7	90	3	2	2	4	3	2	2	2	1	2	2	1	0
St.6 11.08.08	28	87	-105	37.8	57	7.7	91	4	2	2	2	2	3	2	3	1	2	1	1	0
St.6 24.09.08	26	8.6	-98	37.9	59	7.7	82	2	1	2	3	3	2	3	2	1	1	2	1	0
St.6 01.10.08	25	8.5	-93	38.1	60	6.7	70	2	3	4	2	4	2	3	2	1	1	3	1	0
St.6 09.11.08	21	8.5	-91	38.1	60	7.4	83	1	2	1	2	3	2	2	2	1	1	1	1	0
St.6 14.12.08	20	8.5	-91	37.5	56	7.4	83	1	1	1	1	1	1	1	1	1	1	1	1	0

St.No/Dates	T(w)	pH	Eh	SAL	EC	DO	SAT	CT	AC	AP	LE	LR	LS	XA	XD	XC	CF	PM	PI	HS
St.7 12.01.08	19	8.6	-92	39.5	50	5.6	60	18	0	0	16	0	0	0	0	0	0	0	0	0
St.7 22.02.08	19	8.6	-97	39.8	51	5.7	61	49	0	0	27	0	0	0	0	0	0	0	0	0
St.7 22.03.08	21	8.7	-98	40.8	63	5.7	62	100	0	0	58	0	0	0	0	0	0	0	0	0
St.7 27.04.08	21	8.7	-98	41.5	67	5.8	63	222	0	0	72	0	0	0	0	0	0	0	0	0
St.7 07.05.08	25	8.4	-86	52.2	74	5.9	76	214	0	0	73	0	0	0	0	0	0	0	0	0
St.7 15.06.08	29	8.7	-97	55.4	79	5.9	76	572	0	0	168	0	0	0	0	0	0	0	0	0
St.7 27.07.08	32	8.8	-101	55.5	79	6	77	629	0	0	160	0	0	0	0	0	0	0	0	0
St.7 11.08.08	32	8.8	-99	55.6	80	6	77	242	0	0	145	0	0	0	0	0	0	0	0	0
St.7 24.09.08	29	8.6	-96	56.4	81	5.3	77	165	0	0	124	0	0	0	0	0	0	0	0	0
St.7 01.10.08	25	8.4	-86	57.6	83	5.4	78	163	0	0	98	0	0	0	0	0	0	0	0	0
St.7 09.11.08	23	8.7	-94	41.2	67	5.6	61	61	0	0	29	0	0	0	0	0	0	0	0	0
St.7 14.12.08	20	8.6	-93	40.2	64.1	5.7	62	26	0	0	18	0	0	0	0	0	0	0	0	0
St.8 12.01.08	13	8.6	-90	0.5	1.43	5.8	54	0	0	0	0	0	0	0	0	0	0	0	0	10
St.8 22.02.08	14	8.6	-90	0.5	1.43	5.8	54	0	0	0	0	0	0	0	0	0	0	0	0	13
St.8 22.03.08	15	8.6	-90	0.5	1.43	5.8	54	0	0	0	0	0	0	0	0	0	0	0	0	17
St.8 27.04.08	15	8.6	-90	0.5	1.43	5.8	54	0	0	0	0	0	0	0	0	0	0	0	0	25
St.8 07.05.08	20	8.6	-90	0.5	1.43	5.9	55	0	0	0	0	0	0	0	0	0	0	0	0	35
St.8 15.06.08	26	8.2	-109	1.1	2.1	5.9	55	0	0	0	0	0	0	0	0	0	0	0	0	22
St.8 27.07.08	28	8.3	-110	1.8	2.5	5.3	68	0	0	0	0	0	0	0	0	0	0	0	0	19
St.8 11.08.08	29	8.3	-112	2.3	4.2	7.3	123	0	0	0	0	0	0	0	0	0	0	0	0	14
St.8 24.09.08	24	8.2	-114	2.4	4.5	7.4	125	0	0	0	0	0	0	0	0	0	0	0	0	12
St.8 01.10.08	23	9.1	-116	2.7	4.9	5.9	58	0	0	0	0	0	0	0	0	0	0	0	0	13
St.8 09.11.08	15	8.6	-93	0.5	1.41	5.9	57	0	0	0	0	0	0	0	0	0	0	0	0	22
St.8 14.12.08	14	8.6	-92	0.5	1.42	5.9	55	0	0	0	0	0	0	0	0	0	0	0	0	12

Table 2: Mean values ± standard deviations of environmental parameters measured at eight sampling sites located in the Bargilya wetland, and ostracod specimen numbers in all stations (SNS = specimen number in station; TSN = total specimen numbers in all stations, all other Abbreviations same with table 1).

	St. 1 Mean ± SD	St. 2 Mean ± SD	St. 3 Mean ± SD	St. 4 Mean ± SD	St. 5 Mean ± SD	St. 6 Mean ± SD	St. 7 Mean ± SD	St. 8 Mean ± SD	
T(w)	24±4	25±4	24±4	24±4	24±4	23±3	25±5	20±6	
pH	8.7±0.1	8.8±0.3	8,7±0.2	8,7±0.1	8.6±0.1	8,6±0.1	8.6±0.1	8.5±0.2	
Eh	98±5	113±4	113±5	100±5	97±5	96±5	95±5	100±11	
SAL.	41.7±1.9	54.7±6.1	54.2±5.4	40.0±0.7	38.4±0.6	37.6±0.3	48.0±7.9	1.2±0.9	
EC	64.6±6.9	73±11	71±11	58±7	61±3	57±1	70.5±11.6	2.4±1.4	
DO	8.1±0.5	8.4±0.5	8.5±0.5	8.0±0.4	7.3±0.6	7.4±0.3	5.7±0.2	6.1±0.6	
SAT	100±8	109±10	110±10	101±5	83±10	84±6	69±8	68±27	
	St. 1	**St. 2**	**St. 3**	**St. 4**	**St. 5**	**St. 6**	**St. 7**	**St. 8**	**SNS**
CT	2436	3499	3934	2564	68	26	2461	0	14988
AC	0	0	0	0	29	26	0	0	55
AP	0	0	0	0	30	30	0	0	60
LE	1112	1683	1685	1103	41	30	988	0	6642
LR	0	0	0	0	26	31	0	0	57
LS	0	0	0	0	21	24	0	0	45
XA	0	0	0	0	28	27	0	0	55
XD	0	0	0	0	25	24	0	0	49
XC	0	0	0	0	28	14	0	0	42
CF	0	0	0	0	11	17	0	0	28
PM	0	0	0	0	23	23	0	0	46
PI	0	0	0	0	18	13	0	0	31
HS	0	0	0	0	0	0	0	214	214
TSN	3548	5182	5619	3667	348	285	3449	214	22312

The coordinates, type of substrate, sampling site depth, and Secchi depth water transparency values for each sampling site in the wetland are shown in Table 3. Coordinates of the sampling sites were obtained with a Garmin Etrex GPS, while water transparency was determined with a 25 cm diameter Secchi disc.

Table 3: Coordinates, type of substrate, sampling site depth, and Secchi depth water transparency values of each sampling sites in the Bargilya wetland.

Site Number	Coordinates		Secchi depth (cm)	Depth (cm)	Substrates
	Latitude N	Longitude E			
1	37° 11' 24.8"	27° 35' 53.2"	Bottom	55	Muddy sand
2	37° 11' 09.1"	27° 35' 56.6"	Bottom	50	Muddy sand
3	37° 11' 24.6"	27° 35' 01.2"	Bottom	50	Muddy sand
4	37° 11' 37.1"	27° 35' 35.4"	Bottom	50	Muddy sand
5	37° 12' 18.9"	27° 34' 55.3"	Bottom	55	Sand
6	37° 12' 33.3"	27° 34' 30.3"	Bottom	100	Sand
7	37° 11' 18.3"	27° 36' 55.1"	Bottom	40	Muddy sand
8	37° 10' 37.0"	27° 36' 26.5"	Bottom	40	Muddy sand

Adult individuals of living ostracod species on the surface sediments and plants were collected from the shallow littoral zone (<1 m) using with a hand net (250 µm mesh size) at each sites.

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 the collected samples were kept in polyethylene jars (250 ml bottles) containing 4% formaldehyde solution and fixed *in situ*.

In the laboratory, samples were washed with pressurized tap water, and separated from sediment using four standardized sieves (2.0, 1.5, 0.5, 0.25 mm mesh size, respectively). Subsequently, specimens were preserved in 70% ethanol and glycerine (1:1 ratio) and the retained material transferred to a Petri dish. Ostracod dissections were prepared following Namiotko *et al.* [22].

The number of adult individuals belonging to each identified ostracod species was counted under a stereomicroscope. Also, the juvenile stages of each ostracod species observed in all sampling sites. Specimens were determined using the taxonomic publications by Bronshtein [23], Mordukhai-Boltovskoi [24], Barbeito-Gonzales [25], Hartmann and Puri [26], Bonaduce *et al.* [27], Breman [28], Athersuch *et al.* [29], Yassini [30], Stambolidis [31], Meisch [32] and Karanovic [33].

Various invertebrate and vertebrate animal species other than ostracod species were identified to the lowest possible taxon (Table 4). These data were not used for statistical analysis. List of identified species (except ostracods) in Bargilya wetland was given in present study. Determined species list in the Bargilya wetland is presented only for emphasize to biological importance of this wetland.

Correlations between species, environmental variables, and species and environmental variables were analyzed by a two-tailed nonparametric Spearman Correlation analysis performed with the SPSS 10.0 software program [34]. Significant results were determined at 0.01 and/or 0.05 critical levels.

Classification of ostracod species and sampling sites were achieved using the Bray-Curtis similarity coefficient to construct dendrograms. Species richness and diversity of sampling sites were calculated using the Shannon–Weaver diversity index.

Table 4: Species list of other faunal and floral components from the Bargilya wetland.

Other floral and faunal components of Metruk Tuzla (Former Saltpan), Bargil Cove and Kocadere Creek Mouth	
FAUNA	*Liza ramada* (Risso, 1826)
POLYCHAETA	*Liza saliens* (Risso, 1810)
Hediste diversicolor (O.F. Müller, 1776)	*Mugil cephalus* (Linneaus, 1758)
Heteromastus filiformis (Claparède, 1864)	*Solea solea* (Linneaus, 1758)
Perinereis cultrifera (Grube, 1840)	*Diplodus annularis* Linnaeus, 1758
CRUSTACEA	*Sarpa salpa* (Linnaeus, 1758).
Mysidacea	**REPTILIA**
Amphipoda	*Emys orbicularis* (Linnaeus, 1758)
Corophium orientale Schellenberg, 1928	*Natrix natrix*, (Linnaeus, 1758)
Gammarus aequicauda (Martynov, 1931)	**AVES**
Gammarus crinicornis Stock, 1966	*Pelecanus onocrotalus* L. 1758
Gammarus subtypicus Stock, 1966	*Pelecanus crispus* Bruch, 1832
Idotea baltica (Pallas, 1772)	*Anas strepera* L. 1758
Tanaidecea	*Anas platyrhynchos* L. 1758
Leptochelia savignyi (Krøyer, 1842)	*Netta rufina* (Pallas, 1773)
Tanais cavolini Milne-Edwards, 1829	*Fulica atra* L. 1758
Tanais filiformis Lilljeborg, 1864	*Egretta alba* L. 1758
Decapoda	*Egretta garzetta* (L. 1776)
Upogebia pusilla Petanga, 1792	*Anser anser* L. 1758
Carcinus aestuarii Nardo, 1847	*Phoenicopterus ruber* L. 1758
MOLLUSCA	*Porzana sp.*
Bivalvia	*Glareola pratincola* L. 1766
Cerastoderma glaucum (Poiret, 1789)	*Phalacrocorax pygmeus* Pallas, 1773
Abra ovata (Philippi, 1846)	*Phalacrocorax carbo* (L. 1758)
Gastropoda	*Ardea cinerea* L. 1758
Bittium reticulatum (da Costa, 1778)	**FLORA**
Theodoxus fluviatilis (Linnaeus, 1758)	*Juncus littoralis* C.A.Mey.
Pirenella conica (Blainville, 1829)	*Enteromorpha sp.*
Cerithium vulgatum Bruguière, 1792	*Phragmites australis* (Cav.) Trin. ex Steudel
Hydrobia acuta (Draparnaud, 1805)	*Potamogeton pectinatus* L.
Hydrobia ventrosa (Montagu, 1803)	*Ruppia maritima* L.
Myosotella myosotis (Draparnaud, 1801)	*Polygonum amphibium* L
Nassarius reticulatus (Linnaeus, 1758)	*Tamarix hampeana* L.
PISCES	*Salicornia sp.*
Chelon labrosus (Risso, 1826)	

Binary (presence–absence) data were used to show relationships among species by means of a Bray–Curtis UPGMA (Unweighted Pair Group method with Arithmetic Mean) analysis as provided by the Multivariate Statistical Package (MVSP) program, version 3.1 [35]. Relationships between ostracod assemblages in sampling sites were examined using UPGMA hierarchical clustering based on the Bray–Curtis similarity coefficient MVSP, version 3.1 [35]. A Bray–Curtis cluster analysis was used to obtain the species–sampling sites and sampling sites–species similarity for Bargilya wetland (with log (x+1) transformation performed before the analysis) [36]. The Shannon–Weaver index, which combines information on species richness (number of species) and how individuals are distributed among species, was calculated. A living ostracod species database of seasonal samples from the eight Bargilya wetland sampling sites was calculated by means of the (log2) Shannon–Weaver index (H) [37].

Canonical correspondence analysis (CCA), a gradient analysis technique, was used to examine the relationship between environmental variables and species. Faunistic and environmental data were analyzed by CCA [38, 39]. In the ordination procedure, four physicochemical variables were used. Variables affecting species distribution were, in order of importance according to the CCA: redox potential, pH, percentage of oxygen saturation, dissolved oxygen, electrical conductivity, salinity, and water temperature.

3. Results

A total of 22312 ostracod specimens, consisting of 13 species from seven genera and six families, were identified from the eight sites in the Bargilya wetland (including Metruk Tuzla, Bargil Cove, and mouth of Kocadere Creek). The 13 species were: *Heterocypris salina* (Brady, 1868), *Cyprideis torosa* (Jones, 1850), *Aurila convexa* (Baird, 1850), *Aurila prasina* (Barbeito-Gonzalez, 1971), *Loxoconcha elliptica* (Brady, 1868), *Loxoconcha rhomboidea* (Fischer, 1855), *Loxoconcha stellifera* (Müller, 1894), *Xestoleberis aurantia* (Baird, 1838), *Xestoleberis decipiens* (Müller, 1894), *Xestoleberis communis* (Müller, 1894), *Cytherois fischeri* (Sars, 1866), *Paradoxostoma maculatum* (Müller, 1894), and *Paradoxostoma intermedium* (Müller, 1894). Taxonomy follows the classification scheme of Athersuch *et al.* and Meisch [29, 32].

Ostracod species with their code and frequency and sites where they were collected in the Bargilya wetland are shown in Table 5. Ostracod assemblage, sampling sites, and ecological characteristics of ostracod species determined in the Bargilya wetland are shown in Table 6. *Cyprideis torosa* was the dominant species at sampling sites 1, 2, 3, 4 and 7, with muddy sand sediments, and at sampling site 5, with sandy sediment. *Aurila prasina* was observed as the dominant species at sandy sediment sampling site 6, and *Heterocypris salina* at muddy sand sediment sampling site 8. The highest salinity concentration found in the Bargilya wetland was 62.4‰ at sampling site 2, in the Tuzla (meaning “salt”) part of the study area, in August. Salinity levels of this shallow area are subject to the effects of evaporation during the summer and early autumn months. The lowest salinity level (0.5‰) was recorded at sampling site 8, which has a high freshwater input.

Table 5: Ostracod species, showing name, code, frequency and collection site details. Frequency (%) indicates the relative abundance per sample (or the total numbers of occurrences using presence–absence data). An asterisk (*) marks the two most frequently occurring species (accounting for more than 96.95% of total species occurrence).

Species	Code	Sites	Specimen number (n)	F (%)
Cyprideis torosa *	CT	1, 2, 3, 4, 5, 6, 7	14988	67,17
Loxoconcha elliptica *	LE	1, 2, 3, 4, 5, 6, 7	6642	29,78
Heterocypris salina	HS	8	214	0,957
Aurila prasina	AP	5, 6	60	0,268
Loxoconcha rhomboidea	LR	5, 6	57	0,255
Xestoleberis aurantia	XA	5, 6	55	0,246
Aurila convexa	AC	5, 6	55	0,246
Xestoleberis decipiens	XD	5, 6	49	0,22
Paradoxostoma maculatum	PM	5, 6	46	0,207
Loxoconcha stellifera	LS	5, 6	45	0,201
Xestoleberis communis	XC	5, 6	42	0,188
Paradoxostoma intermedium	PI	5, 6	31	0,138
Cytherois fischeri	CF	5, 6	28	0,124
		Total	22312	100

Table 6: Ostracod assemblage, sampling sites, and ecological characteristics of ostracod species.

Ostracod Species	Sampling Sites	Ecology
		Group I
Aurila convexa *Aurila prasina* *Paradoxostoma maculatum* *Paradoxostoma intermedium* *Xestoleberis aurantia* *Xestoleberis decipiens* *Xestoleberis communis*	5, 6 5, 6 5, 6 5, 6 5, 6 5, 6 5, 6	Marine, phytal, littoral and shallow sublittoral, polyhalineeuhaline species living on sandy substrate, frequently with marine algae, algal debris (Wagner [40], Schornikov [41], Athersuch *et al.* [29] and Lachenal [42])
		Group II
Loxoconcha elliptica *Loxoconcha rhomboidea* *Loxoconcha stellifera* *Cytherois fischeri* *Cyprideis torosa*	1, 2, 3, 4, 5, 6, 7 5, 6 5, 6 5, 6 1, 2, 3, 4, 5, 6, 7	Oligo-mesohaline exceptionally also polyhaline. These species prefer muddy, sandy or sandy mud subtrates with plants. *Cyprideis torosa* can survive Marine brackish littoral species substrate (150‰ while *Loxoconcha elliptica* range from 0.5 to 30‰ whereas *L. elliptica* tolerates high salinities (up to 65‰) in the Mediterranean saltpan and found along with *C. torosa* (Wagner [40], Ascoli [43], Zaninetti [44, 45], Neale [46], Athersuch *et al.* [29], Lachenal [42], Meisch [32], Altınsaçlı [11], Altınsaçlı [12] and Altınsaçlı *et al.* [47])
		Group III
Heterocypris salina	8	Brackish continental shallow water species (salinity range: from the fresh to oligo-mesohaline exceptionally also euryhaline (or halophylous) living on muddy subtrates (Bronshtein [23], Wagner [40], Ascoli [43], Neale [46], Anadón *et al.* [48], Forester [49], Meisch [32], Altınsaçlı [12] and Altınsaçlı *et al.* [47])

This low salinity level (in January, February, March, April, May, June, July, November and December) was due to freshwater flow from Kocadere Creek. In subsequent months the salinity level at this sampling site increased. Electrical conductivity, which increased and decreased parallel to salinity, was lowest (1.41 mS/cm) and highest (86.9 mS/cm) at the sites 8 and 2, in November and August, respectively) (Table 1). The Bargilya wetland is alkaline. The pH level was highest at sampling site 2 (pH 9.3), in January, and lowest also at sampling site 8 (pH 8.2), in September and June. The maximum (site 2 and 3) and minimum levels of dissolved oxygen were observed at sampling sites 7 and 8. Sampling sites 7 and 8 are thought by farmers to be fed by artesian well water. This sampling site has the highest freshwater input and was thick with macrophytes at the time of the study. The dissolved oxygen level is highest during the summer and autumn because of the freshwater input and photosynthesis, and decreases in the autumn with the death of macrophytes and low freshwater input (Table 1).

Surface water temperature in the study area was mainly characterized by temporal variability, with the lowest value recorded in January (13 ºC at sampling site 8) and the highest in August (32ºC at sampling sites 7 and 8). The seasonal fluctuations of ostracod specimen numbers recorded at the sampling sites of Bargilya wetland is shown in Fig. 4. Individual numbers of the *C. torosa* and *L. elliptica* populations increase in spring and summer seasons and decrease through the winter and autumn. With the exception of *C. torosa*, *L. elliptica*, and *H. salina,* individual species numbers were fairly stable. Sampling sites 5 and 6 have a strong marine influence, without significant freshwater input, and thus demonstrate more stable physicochemical conditions than other sampling sites in the Bargilya wetland. The *C. torosa* and *L. elliptica* populations at these sampling sites were also stable, as at the other sampling sites (and similar to the other marine populations). At sampling site 8, the numbers of *H. salina* increased in the spring and decreased in the summer; at the end of autumn, with the onset of rains, the population of this species increased again.

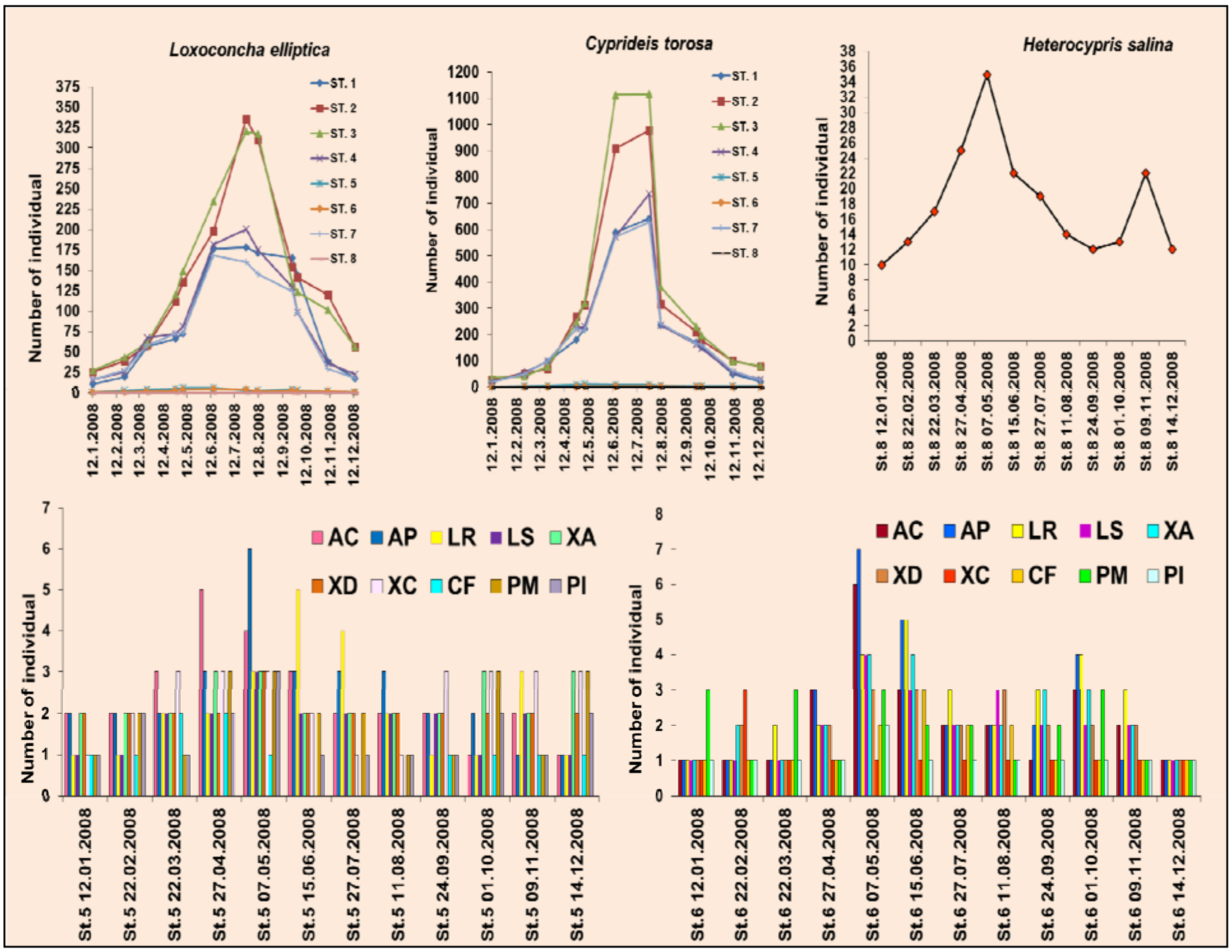

Fig 4: Seasonal fluctuation of ostracod specimen numbers recorded at the Bargilya wetland sampling sites.

The relationships between ostracod site assemblages were examined using UPGMA hierarchical clustering based on square metre and Bray–Curtis similarity coefficient. To produce the UPGMA dendrogram, obtained on the basis of the Bray–Curtis similarity (%) matrix among ostracod assemblages from the sampling sites at the Bargilya wetland. A Bray– Curtis similarity matrix for the ostracoda species according to sampling site is shown in Fig. 5. Based on species occurrence, UPGMA was able to cluster 13 species into three groups; with two brackish-marine species (*C. torosa*, *L. elliptica*) in the first group, ten marine species (*A. convexa, A. prasina, L. rhomboidea, L. stellifera, X. aurantia, X. decipiens, X. communis, C. fischeri, P. maculatum, P. intermedium*) in the second group, and one (*H. salina*) in the third group (Fig. 5). Another important finding is that, *C. fischeri* is clearly a marine-brackish water ostracod species and not only a marine ostracod. The UPGMA dendrogram shows the eight sampling sites in the Bargilya wetland clustered into three main groups (Fig. 6.). The sampling sites at which the first group of species were identified included two typical metahypersaline water sampling sites (1, 2, 3, 4, 7), while the second group included two marine sampling sites (5, 6), and the third group a brackish water sampling site (8). There was no similarity between Sampling sites 1–7 and sampling site 8.

The similarity percentage between sampling sites 1, 2, 3, 4, and 7 with sampling sites 5 and 6 was 28%.

According to the Shannon–Weaver index, the highest level of diversity was found at sampling site 6 (3.585) and the lowest at sampling site 8 (0) (Table 7). For all sampling sites, the highest diversity was found in the all season in sampling site 5 and 6. Also, at the fifth and sixth sampling sites (with the marine environment), the diversity value was highest in February (3.501 in sampling site 5) and December (3.585 in sampling site 6). The biodiversity at sampling sites 5 and 6 representing the marine habitat was the highest.

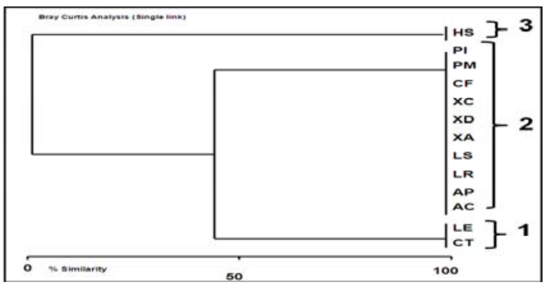

Fig 5: UPGMA dendrogram showings three clustering groups (I–III), three main species group for the thirteen most abundant ostracod species in the Bargilya wetland.

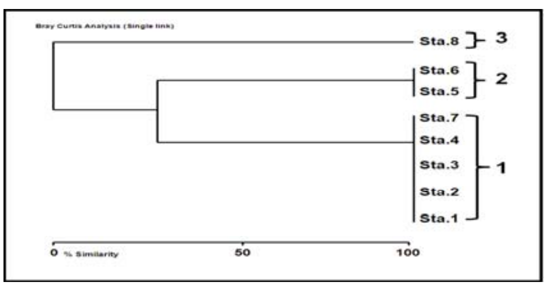

Fig 6: The UPGMA dendrogram shows that eight sampling sites in the Bargilya wetland in terms of similarity are clustered in three main groups (I–III).

Determined biodiversity values in the sampling sites 1, 2, 3, 4 and 7 are very close to each other, because these sampling sites are representing by the only two euryhaline ostracod species (*Cyprideis torosa* and *Loxoxconcha elliptica*). Sampling site 8 represented the fresh-brackish water transition, where *H. salina*, which prefers brackish continental water, was observed. The Shannon–Weaver index was very low at sampling site 8, because only one species was observed at this sampling site. *H. salina*, which was absent in all other sites.

H. salina, *C. torosa*, and *L. elliptica* had high negative correlations with one another. *H. salina* had a strong negative correlation with all other species identified. There was a high positive correlation among all other species (Except *H. salina*). Even though *Cyprideis fischeri* has adapted to harsh conditions, it had a high negative correlation with *C. torosa* and a low negative correlation with *L. elliptica* in this wetland. Spearman correlation analysis results are shown for the Bargilya wetland in Table 8.

However, when the Spearman rank correlation values are compared with that of values of other species, except *H. salina*, *C. torosa* and *L. elliptica, C. fischeri* shows a strong positive correlation with all other species. This is because *C. fischeri* has not found the hypersaline environment of Metruk Tuzla, where both C. *torosa* and *L. elliptica* are found, despite the fact that this species has been detected together with *C. torosa* and *L. elliptica* in many other oligo-mesohaline wetlands [11, 12, 18, 19, 47].

Spearman rank correlation results indicate that there were positive correlations between temperature, salinity, electrical conductivity, pH, dissolved oxygen and saturation. There were negative correlation between redox potential and all other physicochemical variables. Except redox potential, there are positive correlation between all other physicochemical variables and *C. torosa* and *L. elliptica.* Except *C. torosa* and *L. elliptica*, there are negative correlation between all other physicochemical variables and other species. Except redox potential, there are positive correlation between all other physicochemical variables and *C. torosa* and *L. elliptica.*

Table 7: Table of Shannon Weaver index (H"log2) values for all sampling stations.

Sampling Date/Site	St 1	St. 2	St. 3	St. 4	St. 5	St. 6	St.7	St. 8
January 08	0,940	0,996	0,988	0,991	3,499	3,468	0,998	0
February 08	0.817	0.985	0.999	0.909	3.501	3.453	0.939	0
March 08	0.946	0.995	0.988	0.972	3.406	3.455	0.948	0
April 08	0.837	0.875	0.914	0.803	3.416	3.469	0.803	0
May 08	0.803	0.884	0.902	0.827	3.363	3.440	0.818	0
June 08	0.778	0.678	0.666	0.797	3.178	3.443	0.773	0
July 08	0.755	0.819	0.765	0.749	3.190	3.489	0.727	0
August 08	0.982	1	0.994	0.984	3.243	3.463	0.954	0
September 08	1	0.982	0.949	0.991	3.439	3.469	0.985	0
October 08	0.999	0.990	0.960	0.97	3.430	3.441	0.955	0
November 08	0.988	0.994	1	0.966	3.439	3.471	0.907	0
December 08	0.992	0.980	0.977	0.979	3.382	3.585	0.976	0
Maximum	1	1	1	0.991	3.501	3.585	0.985	0
Minimum	0.755	0.678	0.666	0.749	3.178	3.44	0.727	0
Number of species (n)	2	2	2	2	12	12	2	1

Table 8: Spearman correlation analyses for seven environmental variables with 13 species studied (Codes as for Table 1) **(*, **** significant levels at **0.05** and **0.01** levels, respectively).

	T(w)	pH	EH	SAL	EC	DO	SAT	CT	AC	AP	LE	LR	LS	XA	XD	XC	CF	PM	PI	HS
T(w)	1																			
pH	0.450**	1																		
EH	-0.422**	-0.359**	1																	
SAL	0.458**	0.469**	-0.489**	1																
EC	0.576**	0.474**	-0.278**	0.839**	1															
DO	0.170	0.332**	-0.515**	0.509**	0.333**	1														
SAT	0.250*	0.295**	-0.575**	0.559**	0.371**	0.885**	1													
CT	0.537**	0.542**	-0.410**	0.871**	0.774**	0.424**	0.474**	1												
AC	-0.028	-0.236*	0.258*	-0.485**	-0.230*	-0.174	-0.280**	-0.485**	1											
AP	-0.008	-0.229*	0.250*	-0.482**	-0.229*	-0.180	-0.284**	-0.484**	0.995**	1										
LE	0.582**	0.528**	-0.435**	0.890**	0.781**	0.472**	0.513**	0.976**	-0.481**	-0.480**	1									
LR	-0.009	-0.200	0.255*	-0.485**	-0.235*	-0.180	-0.277**	-0.487**	0.990**	0.990**	-0.484**	1								
LS	-0.007	-0.204*	0.249*	-0.486**	-0.233*	-0.173	-0.279**	-0.486**	0.994**	0.993**	-0.483**	0.994**	1							
XA	-0.027	-0.223*	0.276**	-0.481**	-0.222*	-0.189	-0.286**	-0.488**	0.987**	0.991**	-0.487**	0.986**	0.989**	1						
XD	-0.023	-0.209*	0.265**	-0.485**	-0.228*	-0.180	-0.282**	-0.488**	0.992**	0.992**	-0.488**	0.988**	0.996**	0.994**	1					
XC	-0.056	-0.233*	0.299**	-0.476**	-0.217*	-0.186	-0.292**	-0.488**	0.978**	0.974**	-0.492**	0.970**	0.975**	0.983**	0.983**	1				
CF	-0.120	-0.296**	0.304**	-0.473**	-0.217*	-0.181	-0.271**	-0.474**	0.902**	0.887**	-0.461**	0.885**	0.903**	0.915**	0.912**	0.908**	1			
PM	-0.047	-0.236*	0.289**	-0.485**	-0.228*	-0.199	-0.293**	-0.491**	0.978**	0.982**	-0.491**	0.980**	0.976**	0.987**	0.980**	0.979**	0.907**	1		
PI	-0.054	-0.237*	0.293**	-0.483**	-0.224*	-0.192	-0.292**	-0.491**	0.984**	0.985**	-0.492**	0.977**	0.981**	0.991**	0.989**	0.991**	0.915**	0.992**	1	
HS	-0.243*	-0.247*	0.144	-0.572**	-.0572**	-0.429**	-0.389**	-0.572**	-0.215*	-0.215*	-0.572**	-0.215*	-0.215*	-0.215*	-0.216*	-0.215*	-0.198	-0.215*	-0.216*	1

Canonical correspondence analyses (CCA) seek patterns of data structure from a matrix of faunistic records correlated to a set of variables. The length of the arrow is proportional to the importance of the explanatory variable in the ordination, and arrow direction indicates positive and negative correlations. The relationship between the physicochemical variables and the species composition of the Bargilya wetland is illustrated by the CCA biplot in Fig 7.

The CCA results for the three taxonomic levels are summarized in Table 9. The length of the arrows in the CCA (Fig. 7) ordination diagram indicates the strength of environmental variables (long arrows show increased effect). Electrical conductivity, pH, Eh, and salinity were found to be effective environmental variables.

At the center of the ordination diagram, *C. torosa* and *L. elliptica* show the widest range of tolerance to the fluctuations of such variables. These two are euryhaline species, and show extremely high tolerance to the physicochemical dynamics of the environments where they occur. *C. torosa* has a strong positive correlation with temperature, pH, salinity, and dissolved oxygen, and a low positive correlation with saturation.

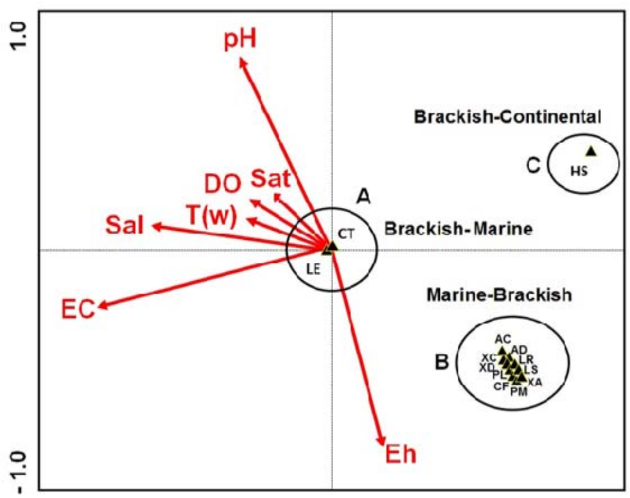

Fig 7: CCA diagram showing relationships between 13 species (triangular) and seven selected environmental variables (EC: Electrical Conductivity, DO: Dissolved oxygen, Temp.: Water temperature, pH, Sal: Salinity and Sat: Oxygen saturation

Table 9: Main results of the CCA

Axis	Axis 1	Axes 2	Axes 3	Axes 4	Total inertia
Eigenvalues	0.455	0.054	0.013	0.001	1.85
Species-environment correlations	0.698	0.268	0.392	0.173	
Cumulative percentage variance					
of species data	24.60	27.50	28.20	28.20	
of species-environment relation	87.0	97.3	99.8	99.9	
Sum of all eigenvalues					1.85
Sum of all canonical eigenvalues					0.524

There is a strong negative correlation with the redox potential of this species. *L. elliptica* has a strong positive correlation with temperature, pH, salinity, dissolved oxygen, conductivity, and saturation, and a strong negative correlation with the redox potential. *H. salina* has a strong negative correlation with temperature, pH, salinity, conductivity, dissolved oxygen, oxygen saturation and a weak positive correlation with EH.

The first axis of CCA explains 69.8% (Table 8) of the variation between environmental variables and ostracod species. The euryhaline taxa, *C. torosa* and *L. elliptica*, plot in the center of the ordination diagram, reflecting their tolerance of environmental fluctuations. *C. torosa* has a strong positive relationship with temperature, pH, salinity, conductivity, and dissolved oxygen, saturation and a strong negative relationship with redox potential (Table 8).

Gasse *et al.* [50] classified saline lakes according to values: into freshwater (0–0.5 ‰), oligosaline lakes (0.5–5 ‰), mesosaline lakes (5–15 ‰), polysaline lakes (15–30 ‰), eusaline lakes (30–40 ‰), metasaline lakes (40–70 ‰) and hypersaline lakes (> 70 ‰). On this basis, the near section of Bargil Cove in Güllük Bay was eusaline, that of the Metruk Tuzla saltpan was eusaline–metasaline (hypersaline), and the mouth of Kocadere Creek was oligosaline (β-Oligosaline) (Table 10, Fig. 1).

Table 10: Salinity classification of sampling sites and species composition according to Gasse *et al.* [50], a moderated version of the Venice System [51].

Salinity (‰) Classification of Gasse et. al. (1987)	Sampling sites	Species Code	Salinity (‰) Classification of Venice System (1958)	Sampling sites	Species Code
0-0.5 Freshwater			0 – 0.5 Freshwater		
0.5– 5 Oligosaline water	8	HS	>0.5 β- Oligosaline water	8	HS
5–20 Mesosaline water			>3 α- Oligosaline water		
20–30 Polysaline water			>5 β- Mesosaline water		
30–40 Eusaline water	5, 6	CT, LE, AC, AP, LR, LS, XA, XD, XC, CF, PM, PI	>10 α- Mesosaline water		
40–60 Metasaline water	1, 4, 7	CT, LE	>18 Polysaline water		
70-200 Hypersaline water	2, 3	CT, LE	>30 Eusaline water	5, 6	CT, LE, AC, AP, LR, LS, XA, XD, XC, CF, PM, PI
			>40 Hypersaline water	1, 2, 3, 4, 7	CT, LE

The unconstrained cluster analysis of ostracod species resulted in three main groups (A, B, and C). Group A included the most abundant brackish water and the euryhaline species *C. torosa* and the brackish euryhaline and phytophilous species *L. elliptica*. Group B included marine species together with the less abundant brackish species *C. torosa* and *L. elliptica*. Group C included the continental brackish and freshwater species and halotolerant species, *H. salina* (Fig. 5). The total of 13 ostracod species identified are presented as a marine species assemblage (composed mainly of *A. convexa, A. prasina*, *X. aurantia, X. communis X. decipiens*, *P. maculatum*, *P. intermedium*), a marine brackish species assemblage (*C. torosa, L. elliptica, C. fischeri*), and a brackish-continental species assemblage (*H. salina*) (Table 10, Fig. 1). *C. torosa* and *L. elliptica* the low suspended sediment and algal density in the water column of the shallow Metruk Tuzla and Bargil Cove lead to high Secchi disc depth. We were presented photographs of the most common species (*Cyprideis torosa* and *Loxoconcha elliptica*) in Fig. 8.

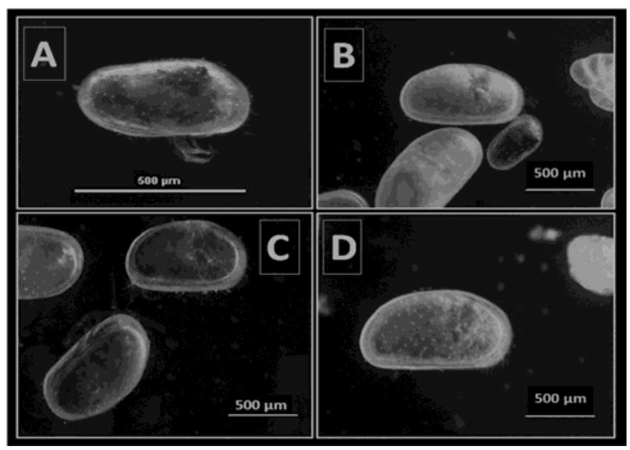

Fig 8: A: *Loxoconcha elliptica*, **B:** *Cyprideis torosa* and *Loxoconcha elliptica*, **C-D:** *Cyprideis torosa*

4. Discussion

The large majority of *Cyprideis* species inhabit brackish (oligo-mesosaline) environments [52]. They tolerate a wide range of salinity including meso-meta-hypersaline environments, marine lagoons, salt marshes, and brackish marine estuaries and can even be found in sulphate-rich fresh water lakes. The presence and shell morphology in the less saline environments of *Cyprideis torosa* plays a key role in the identification and classification of brackish water conditions. It is a member of the brackish biocoenosis in European coastal waters and is often very abundant in hypo- as well as in

It is a member of the brackish biocoenosis in European coastal waters and is often very abundant in hypo- as well as in hypersaline waters (Meisch, 2000 [32]. Also, it is important indicator species for determination of changes of salinity in saline and brackish water environments. It is also used as a salinity paleoindicator, in ecology and Paleoecology [53-59], in morphometric variability and ornamentation [54, 60-66], and in genetics [67, 68], geochemistry [69-73], and physiology [74, 75]. *C. torosa* develops phenotypic tubercles on one or both valves when moving to less saline environments [52, 76, 77].

In marine waters of very low salinity (< 5%), it develops nodes at certain places on the shell [53, 78]. The presence of nodes is used widely in paleontology as an indicator of brackish water environments. It is tolerant of high salinities (up to 65%) in Mediterranean saltpan environments [44, 45], where it is found together with *L. elliptica*. In this study, shells of *C. torosa* clearly predominate in taphocoenosis.

Cyprideis torosa shells belonging only to the smooth form (*C. torosa* forma *littoralis*) were recorded in the sediments of the Bargilya wetlands. It is well known that *Cyprideis torosa* forms nodes on its valves under oligohaline conditions. Those with noded shells (*C. torosa* forma *torosa*) were not found, presumably because of salinity concentrations of >5‰ at Sampling sites 1–7, in the metasaline and hypersaline conditions of Metruk Tuzla. This study produced results which corroborate the findings of other studies [52, 53, 76, 77, 78]. *Cyprideis torosa* has been recorded previously from oligosaline and hypersaline coastal wetlands of Turkey examined by Altınsaçlı [11] and Altınsaçlı *et al.* [47]. Although *C. torosa* prefers oligosaline and hypersaline waters, it was also found in pure freshwater spring when fed by the hypersaline Lake Acıgöl [79]. It prefers a mud or sandy-mud substrate. On soft mud with organic detritus, mass development can occur [32]. Living specimens (Adult and juvenile) and subfossil valves of *C. torosa* were found in the sandy-mud substrates of Metruk Tuzla in this study. In the anomalohaline waters that constitute the typical habitat of *C. torosa*, salinity levels fluctuate because of precipitation and evaporation cycles. In Metruk Tuzla however, Because of the dominance of evaporation over precipitation, salinity levels are more constant. Drainage channels available in between the Bargilya cove and Former Saltpan prevents fall of water level in former saltpan. Therefore, despite to strongly evaporation, the salinity level is slightly rises in dry and hot period in Metruk Tuzla. In this study, *C. torosa* was found in seven locations (sampling sites 1–7) and was dominant in five of these with sandy mud sediments (1–4 and 7). The ostracod assemblage is almost completely dominated by this species, with *L. elliptica* present in the biocoenosis and taphocoenosis of sampling sites 1–4 and 7. This latter species also has a wide distribution in the coastal water of the Aegean Sea [14, 25, 80]. *Cyprideis torosa* is widespread in lagoons and estuaries around the margins of the Mediterranean Sea [32, 58, 81].When we compare the results of this study with others [11, 47, 79], where *C. torosa* is detected, it can be seen that the Metruk Tuzla section of the Bargilya wetland is a suitable living area for euryhaline species such as *L. elliptica* and *C. torosa*, because it is rich in organic detritus, mud, and algal debris, and has a high salinity level, and also because only a very few types of predator organisms can survive in these environments. By evolving to tolerate extreme conditions that few other species can endure, these two species have gained an advantage over others. Also, Altınsaçlı [11] was repeatedly observed absolute abundance of *C. torosa* as higher than that of L. elliptica. The flat-shelled population form of *C. torosa* was dominant in Metruk Tuzla and Bargil Cove. The number of female *C. torosa* was also higher among the bisexual population in this study. Only a few individuals of *C. torosa* and *L. elliptica* were detected in the sandy and detritus-poor substrates of sampling sites 5 and 6. These are clearly less favorable environments - which restricts the abundance of these two species. The numbers of *C. torosa* vary between a minimum of 20.000 to 40.000 individuals/m^2 and a maximum of 1.8 million individuals (including adult and juvenile forms)/m^2 [82]. The 14988 living individual of *C. torosa* were detected at sampling sites 1–7 in Bargilya wetlands (12433 individual were only collected from 1-4 stations). It is apparent that 67% of all ostracods recorded from Bargilya wetland is belongs to *Cyprideis torosa*. These results indicate that brackish water and hypersaline habitats are most probably supported life of large populations of euryhaline species such as *C. torosa*, also, this characteristic of this species has been confirmed by with similar findings of many other studies. *Cyprideis torosa* produces eggs all year round and exhibits a bivoltine reproductive pattern [83]. The first generation, starting from eggs produced in spring, attains adult size after a mean time of 154 days, whiles the second generation, starting in autumn, develops more slowly, attaining adulthood after an average 196 days [83]. In the present study, the species abundance reached a maximum in the summer in the Bargilya wetland (Table 1, Fig. 4), as found also by Mezquita *et al.* [83]. Found in brackish waters and tolerating oligosaline to hypersaline conditions, *C. torosa* determined the euhaline condition at Sampling sites 5, 6 and 7, and metasaline– hypersaline conditions at Sampling sites 1–4 and 7. Aligned with this, it was also observed here that *C. torosa* had high population numbers at shallow water sampling sites.

Loxoconcha elliptica is another frequent and ubiquitous species found in brackish coastal waters (mesohaline) with a salt concentration of 18–30‰. It thrives at relatively shallow depths (20 m or less) in lagoons, gulfs, estuaries, river mouths, and tidal plains, tolerates a wide range of salinities and is commonly associated with algae and mud [11, 12, 27, 29, 47, 63, 84-87]. *Loxoconcha elliptica* begins reproduction in spring, producing two or three generations in the summer, leaving the large juveniles of the last generation to survive the next winter [29]. In this study, abundance was highest in the summer in both lagoons (Table 1, Fig. 4). Again, the present data corroborates to the findings of Athersuch *et al.* [29]. At sampling site 8, physicochemical conditions and the hydrological regime were not suitable for this species, because of the high flow rate of Kocadere Creek in the winter. Given their tolerance of a wide range of conditions, the presence of *Cyprideis torosa* and *L. elliptica* at sampling sites 1–7 was not surprising. *Cyprideis torosa* and *Loxoxconcha elliptica* fossil shells and live individuals were found in large numbers at sampling sites 1 and 2. At these sampling sites, these two species were the most dominant types of biocoenosis; taphocoenosis was also present, in assemblages with abundant gastropod shells.

Cytherois fischeri is a euryhaline species like *L. elliptica* and *C. torosa* [81, 88, 89, 90, 91]. This species was dominant at sampling sites 1–4 and 7 (after *C. torosa*) but had very few individuals in the marine conditions of sampling sites 5 and 6. Generally, *C. torosa* is found in across a wide range of muddy and detritus-rich substrate habitats [12, 17, 47], but much less abundant in sandy and detritus-poor conditions [11, 79]. Again, this study produced results which corroborate the findings of a great deal of the previous work of Altınsaçlı [11], Altınsaçlı [12], Perçin-Paçal *et al.* [17] and Altınsaçlı *et al.* [18], Altınsaçlı *et al.* [47], Altınsaçlı & Mezquita [79].

Heterocypris salina is a typical non-marine species. It is abundant in small, slightly brackish, coastal water bodies of the Baltic and North Sea and small inland water bodies, and generally occurs where salinity is < 10 ‰ [32]. It frequently coexists with other halophilic ostracods. It also occurs in pure freshwater habitats [32]. According to Janz *et al.* [92], the species is indicative of a high salt content in limnic waters and occurs frequently in brackish water. Pipik [93] considers *H. salina* a halobiont species, living in springs and pools with a muddy substrate. In Turkey, it has been reported in continental brackish and freshwater environments [11, 12, 47, 94, 95, 47], including Kocadere Creek, where there is a freshwater input.

In Metruk Tuzla, where the creek water enters and NaCl salinization occurs, *H. salina* (shells or live individuals) was not detected. In fact, it would not be possible for this species to survive at these marine environment locations. The small number of individuals in the Kocadere population shows that this type tolerates $NaSO_4$ salinity found in internal waters rather than marine-based NaCl salinity. In addition to preferring "brackish" water, *H. Salina* can survive in pure freshwater conditions [11]. Like *C. torosa*, it can also be used as an indicator of mild salinity in continental waters. The *Heterocypris salina* individuals found in the Kocadere Creek waters were darker in color than the lighter-hued specimens found by Altınsaçlı [11] in fresh water. It has also been observed that this species shows body size and color differences which appear to correlate with differences in salinity along the fresh-saline chemical gradient (Altınsaçlı, unpublished data). This study has shown *H. salina* existing in the muddy substrata at sampling site 8, where *Polygonum amphibium* L. and *Phragmites australis* (Cav.) Trin. ex Steud. are the dominant macrophyte species. While all other ostracod species except for *H. salina* were found, at sampling sites 5 and 6, at sampling site 8, only *H. salina* was detected.

Ammonia tepida (Cushman, 1923) is foraminiferal species also commonly found in brackish and hypersaline coastal wetlands and was present in the Bargilya wetland together with *C. torosa* and *L. elliptica*. Also, another species except *Ammonia tepida* (*Adelosina mediterranensis* (Le Calvez, J. and Y., 1958), *Adelosina cliarensis* (Heron-Allen & Earland, 1930); *Adelosina carinata-striata* Wiesner, 1923, *Spiroloculina ornata* d'Orbigny, 1839, *Quinqueloculina seminulum* (Linnaeus, 1758), *Quinqueloculina disparili* d'Orbigny, 1826, *Porosononion subgronosum* (Egger), *Elphidium complanatum* (d'Orbigny, 1839), *Elphidium crispum* (Linnaeus, 1758), *Ammonia compacta* (Hofker, 1969), *Haynesina depressula* (Walker & Jacob, 1798)) of benthic foraminifers were determined in former saltpan part of Bargilya wetlands.

Xestoleberis communis was encountered at two sampling sites (5 and 6), and was found to be dominant in phytal and sand sediments. This species has been observed as a dominant species widely distributed around the Mediterranean Sea [14, 17, 25], and is usually encountered on sandy sediment [28]. This study produced results which corroborate the findings of Breman [28].

Aurila convexa is known as a cosmopolitan Mediterranean species [27], also recorded in the North Aegean Sea [31]. It has been encountered in brackish water systems as a polyhaline species, which has been confirmed by reports from the Black Sea [41, 96]. It lives in the littoral and sublittoral zone of most coasts in Turkey [17, 19].

Barbeito-Gonzales discovered *Loxoconcha stellifera* in up to 4 m water depth [25], and Stambolidis [31] found it in 3.5–33 m on a muddy and sandy substrate. This also lives in the littoral and sublittoral zones of most Turkish coasts [17, 19].

The recent identified species *Loxoconcha rhomboidea* lives in the Mediterranean from 1–57 m water depth [97]. It is a common marine and phytal species, and it has been widely found in littoral and sublittoral zones of seas of Turkey. [17, 19, 29]. All the species (except for *C. torosa* and *L. elliptica*) found at the 5th and 6th sampling sites are phytal and littoral marine species, and generally have low population numbers.

The results show that, other than *H. salina*, all other ostracod species are common constituents of the phytal habitat of Bargil Cove. In terms of marine studies, it is known that these species have low population numbers per unit area [17]. When we consider the size and physicochemical character of the marine environment, which is more stable than that of inland saline and fresh waters, it can be better understood why these species should exist in low numbers. In this study area, sampling sites 5 and 6 had the most stable habitats and least changeable variables. Thus, they were richer in species diversity. For the other sampling sites, the fast changing physical characteristics of the water allowed only species with high ecological tolerance limits to flourish. This seems to be the main reason for the limited species diversity at these other sampling sites.

At the mouth of Bargil Cove (Sampling sites 5 and 6), the most common species were a mixture of open-marine, stenohaline forms such as *Aurila convexa*, *Aurila prasina*, *Loxoconcha rhomboidea*, *Loxoconcha stellifera*, *Xestoleberis aurantia*, *Xestoleberis decipiens*, *Xestoleberis communis*, *Paradoxostoma maculatum*, and *Paradoxostoma intermedium*, together with euryhaline, brackish water forms, including *Cyprideis torosa*, *Loxoconcha elliptica*, and *Cytherois fischeri*. *Aurila prasina* and *X. communis* are marine polyhaline, euhaline species living on fine-grained substrates, frequently with *Posidonia oceanica* (L.) Delile, 1813. *Xestoleberis aurantia*, *Loxoconcha elliptica* and *Cyprideis torosa* are a marine brackish littoral species. *X. aurantia* has been found in freshwater and low oligohaline shallow water environments with sporadic influence of marine water [98]. This species has also been found as a euryhaline species in northeast England [99].

In this instance, the other ostracod species are less abundant than *L. elliptica*, *C. torosa*, and *H. salina*, despite their frequent occurrence in marine littoral environments. The reason for this relative scarcity is the fluctuating physicochemical conditions of lagoons, saltpan and estuaries compared to more stable marine environments.

The ostracod assemblages of the saltpan section are clearly dominated by *C. torosa* (69%), with *L. elliptica* (31%) as a secondary component. A similar pattern is found in the middle and the inner sections (sampling site 7) of Bargil Cove (*C. torosa*- 71, 1 % of the sample, *L. elliptica* – 28,9%). Assemblages at the mouth of the Bargil Cove are more diverse: *C. torosa* (15%), *L. elliptica* (11%), *A. prasina* (9%), *L. rhomboidea* (9%), *X. aurantia* (9%), *A. convexa* (9%), *X. decipiens* (8%), *L. stellifera* (7%), *P. maculatum* (7%), *X. communis* (7%), *P. intermedium* (5%) and *C. fischeri* (4%). Three marine brackish water species (*C. torosa* (15%), *L. elliptica* (11%) and *C. fischeri* (4%) were found at sampling sites 5 and 6, but their abundance was low in this section of the wetland, because they prefer brackish rather than marine habitats. The ostracod assemblages in Kocadere Creek mouth are totally dominated by *H. salina* (100%). Upper sections of Kocadere creek is generally dry in late spring, summer, and early autumn, but, the mouth section of the Kocadere Creek (1.5 km) is not dry in summer and autumn. Metruk Tuzla (a former saltpan) is fed by freshwater from Kocadere Creek in the winter period. The mouth of Kocadere Creek contains brackish (oligosaline) water throughout this season. Thus, the non-marine (brackish, continental, shallow water) species *H. salina* was found in Kocadere Creek.

Being shallow, Metruk Tuzla is an important feeding and breeding, habitat for the Greater Flamingo (*Phoenicopterus ruber* L.). *Cyprideis torosa* and *L. elliptica* (as many other benthic invertebrate organisms living in the Metruk Tuzla) are the most important nutritional source for this species. Protection of this wetland in the future will secure the survival of the flamingo. The same conservation need is also apparent at Kocadere Creek, which feeds the Bargilya saline and is an important feeding and breeding site for the *Emys orbicularis* (L.) (European Pond Turtle).

The Mediterranean Green Crab (*Carcinus aestuarii* Nardo, 1847) is widely distributed in the Levantine Sea coast of Turkey, the Aegean Sea, the Turkish Straits system, and the Black Sea [100]. *Carcinus aestuarii* populations show a tolerance to environmental changes [101]. Therefore, *Carcinus aestuarii* was commonly found in this study.

During the rainy periods, the waters of Kocadere Creek accumulate behind the Mumcular Dam, (constructed in 1989). Therefore, in non-rainfall periods, the creek always remains dry. For this reason, sediment accumulation has declined compared to the past. Although Bargil Cove was part of the deep bay of the Gulf of Güllük until the Carian period (until 540 BC), it has gradually turned into a shallow bay through sediment deposition from Kocadere Creek. Commercial and military vessels with their smaller dimensions used to be able to put in at the port of the ancient city, which is not the case today. This reveals the pace of environmental change brought about by human activities during the last 2000 years of the Holocene Period.

A wide range of ecological and human crises result from inadequate access to and the inappropriate management of freshwater resources. Some of the rainwater is filtered from alluvial land around Metruk Tuzla and stored in the underground layer. There are a large number of artesian wells around Metruk Tuzla. The brackish underground water is pumped from a depth of 40–70 m for domestic use in the cottage sites and irrigation of golf courses. Excessive quantities of water have been extracted from groundwater quantities to satisfy the demand of the newly developed settlements, lowering the water table and resulting in seawater intrusion in most of the coastal aquifers. Groundwater salinity was study for this reason between 1996 and 2013 (Altınsaçlı unpublished data). Because of the overuse of underground waters, along with a decrease in precipitation in the basin, the salinity level has increased from 1‰ (1996) to 7.5% (2013) in the 40–70 meter-deep artesian well samples. This is a clear indication of seawater intrusion.

Another effect of tourist development is the increase of bacteria (group Gamma Protobacteria) in Güllük Bay [1]. It is accepted that domestic wastewaters are the source of this bacteriological pollution in Güllük Bay [1]. In recent years, the many cottage sites were built around the Bargylia wetland. Also, sewage treatment systems in many of them are inadequate. In summer period, determination of the presence of many dead crabs in the Bargil cove and saltpan, algal growth and dense sewage odor in the former saltpan and the inner portions of Bargil cove are typical evidences of the pollution for the human origin.

The results of our study indicate that Metruk Tuzla comprises an interesting and probably fragile system that needs further study and a scientific management plan in order to avoid environmental degradation. Although previous ostracod monitoring data are lacking, it will be important to maintain a monitoring programme to prevent further deterioration of these valuable ecosystems. Preventing unplanned development, lacking infrastructure, around the lagoon will be extremely important if eutrophication and pollution are to be avoided. The rapid increase in construction and human settlements in this area will lead to significant environmental and ecological problems. Even though general awareness of environmental problems has grown, history shows that paying insufficient attention to the sensitivity of fragile, natural ecosystems will result in increasing degradation of these special habitats.

5. Conclusions

Most probably, composed shoaling in Bargil cove could have played a significant role in the loss of importance of Bargylia ancient city Harbor, and be abandoned of this city. This study provides baseline data for future work on ecologically important lagoonal ostracods. A total of 7 genera and 13 ostracod species were identified from 8 locations in the Bargilya wetland. Determining of the presence of juvenile stages of each ostracod species in all sampling sites have been proved to autochthonous character of the ostracod assemblages. Analysis of the assemblages of the Bargilya wetland revealed a significant relationship between species composition and environmental conditions. A distinct increase in the number of ostracods specimens was observed in early spring and summer. Spatially, the highest levels of species richness occurred at sampling site 5 and 6 (within the transition zone of Bargilya Cove to Güllük Bay). Salinity was the most important factor influencing ostracod assemblages. A noticeable decrease in species richness was found at sampling sites 1, 2, 3 and 4 with high salinity. These locations were characterized by a high abundance of few species.

The variety and abundance of ostracods changed little over the seasons.

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