ABANT IZZET BAYSAL UNIVERSITY

THE GRADUATE SCHOOL OF NATURAL AND APPLIED SCIENCES

DEPARTMENT OF BIOLOGY

ECOLOGY AND SEASONAL DISTRIBUTION OF OSTRACODA (CRUSTACEA) IN SEBEN TAŞLIYAYLA LAKELET (BOLU, TURKEY)

MASTER OF SCIENCE

MERİÇ TANYERİ

BOLU, JULY 2016

APPROVAL OF THE THESIS

ECOLOGY AND SEASONAL DISTRIBUTION OF OSTRACODA (CRUSTACEA) IN SEBEN TAŞLIYAYLA LAKELET (BOLU, TURKEY) submitted by **MERİÇ TANYERİ** in partial fulfillment of the requirements for the degree of Master of Science in **Department of Biology, Abant İzzet Baysal University** by,

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To my family

DECLARATION

I hereby declare that all information in this document has been obtained and presented in accordance with academic rules and ethical conduct. I also declare that, as required by these rules and conduct, I have fully cited and referenced all material and results that are not original to this work.

Meriç TANYERİ

ABSTRACT

ECOLOGY AND SEASONAL DISTRIBUTION OF OSTRACODA (CRUSTACEA) IN SEBEN TAŞLIYAYLA LAKELET (BOLU, TURKEY)
MSC THESIS
MERİÇ TANYERİ
ABANT IZZET BAYSAL UNIVERSITY GRADUATE SCHOOL OF NATURAL AND APPLIED SCIENCES
DEPARTMENT OF BIOLOGY
(SUPERVISOR: PROF. DR. OKAN KÜLKÖYLÜOĞLU)

BOLU, JULY 2016

ABSTRACT;
In order to understand seasonal distribution and ecology of non-marine ostracod species, 15 stations around Seben - Taşlıyayla Lakelet (reservoir) were monthly visited between August 2013 and September 2014. Accordingly, total of eight species (*Candona weltneri*, *Cypridopsis vidua*, *Herpetocypris chevreuxi*, *Heterocypris salina*, *Heterocypris incongruens*, *Limnocythere inopinata*, *Potamocypris variegata*, *Koencypris ornata*) were reported. The most common species *C. vidua* collected from almost all stations showed wide ranges of dissolved oxygen (DO) (4.53-9.47 mg/L), pH (7.53-9.47), water temperature (Tw) (6-27.3 °C), total dissolved solid (TDS) (0.0235-0.1021 mg/L) and electrical conductivity (74.4-127.4 µS/cm) while *H. chevreuxi, L. inopinata, H. salina, P. variegata* and *H. incongruens* displayed the lowest TDS values. According to Ostracod Watch Model (OWM), several species exhibited a clear seasonal distribution; for example, *C. vidua* was common from June to December when *C. weltneri* was only found in March. Species richness was highest in autumn season with seven species. Regression models revealed significantly positive correlation between air and water temperature ($P<0.01$). Among the species, six are cosmoecious species, having high levels of tolerances to different environmental variables and with wide geographical ranges. Accordingly, the ratio between numbers of noncosmopolitan to cosmopolitan species or so called “pseudorichness ratio” was 0.33, suggesting the reservior is in the early succession stage.

KEYWORDS: Ostracod Watch Model, Succession, Pseudorichness, Seasonal Distribution, Water temperature**.**

ÖZET

SEBEN TAŞLIYAYLA GÖLETİ (BOLU, TÜRKİYE) OSTRAKODA (CRUSTACEA) FAUNASININ MEVSİMSEL DAĞILIMI VE EKOLOJİK ÖZELLİKLERİ
YÜKSEK LİSANS TEZİ
MERİÇ TANYERİ
ABANT İZZET BAYSAL ÜNİVERSİTESİ FEN BİLİMLERİ ENSTİTÜSÜ BİYOLOJİ ANABİLİM DALI
(TEZ DANIŞMANI: PROF. DR. OKAN KÜLKÖYLÜOĞLU)

BOLU, TEMMUZ - 2016

ÖZET;
Denizel olmayan ostracod türlerinin mevsimsel dağılımı ve ekolojilerini anlamak için Seben – Taşlıyayla göletinde (barajında) Ağustos 2013 ve Eylül 2014 tarihleri arasında 15 istasyon aylık olarak ziyaret edilmiştir. Buna göre toplamda sekiz tür (*Candona weltneri*, *Cypridopsis vidua*, *Herpetocypris chevreuxi*, *Heterocypris salina*, *Heterocypris incongruens*, *Limnocythere inopinata*, *Potamocypris variegata*, *Koencypris ornata*) rapor edilmiştir. Hemen her istasyonda en sık rastlanan tür olan *C. vidua* çözünmüş oksijen (DO) (4.53-9.47 mg/L), pH (7.53-9.47), su sıcaklığı (Tw) (6-27.3 °C), toplam çözünmüş katı (TDS) (0.0235-0.1021 mg/L) ve elektriksel iletkenlik (EC) (74.4-127.4 µS/cm) bakımından geniş aralığa sahip iken *H. chevreuxi, L. inopinata, H. salina, P. variegata* ve *H. incongruens* en düşük toplam çözünmüş madde (TDS) değerine sahiptir. Ostracod Saat Modeli (OWM)'ne göre, birçok tür net bir mevsimsel dağılım sergilemektedir; örneğin *C. vidua* Haziran ayından aralık ayına kadar yaygın iken *C. weltneri* sadece Mart ayında bulunmuştur. Yedi tür ile tür zenginliği en fazla Sonbahar mevsimindedir. Regresyon modelleri hava ve su sıcaklığı arasındaki kuvvetli ($P<0.01$) korelasyon'u ortaya koymuştur. Türler arasında, altı "Kosmoşius" tür çevresel değişkenlere yüksek tolerans ve geniş coğrafik aralığa sahiptir. Buna göre kozmopolit olmayan ve kozmopolit olan türler arasındaki oranın ("Sahte Zenginlik oranı" da denir) 0.33 olması, barajın erken süksesyon basamağında olduğunu akla getirmektedir.

ANAHTAR KELİMELER: Ostracod Saat Modeli (OWM), Süksesyon, Sahte Zenginlik, Mevsimsel dağılım, Su sıcaklığı.

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LIST OF ABBREVIATIONS AND SYMBOLS

A1	**:** Antennule
A2	**:** Antenna
Md	**:** Mandible
Mx1	**:** Maxillule
T1	**:** First thoracopod
T2	**:** Second thoracopod
T3	**:** Third thoracopod
DO	**:** Dissolved Oxygen
%DO	**:** Percentage Dissolved Oxygen
EC	**:** Electrical conductivity
Spec.EC	**:** Spesific electrical conductivity
TDS	**:** Total dissolved solid
ORP	**:** Oxidation reduction potential
Atm.press	**:** Atmospheric pressure
St	**:** Station

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1. INTRODUCTION

Aquatic bodies are important for continuous ecosystems. Most of the organisms need to water for live and reproduce. Also these aquatic ecosystems are effective on climate (O'Reilly et al., 2015). Lakelets and reserviors are also important sources for human activities as cleaning, drinking and agricultural usage. From engineering perspective almost every aquatic system can be transformed a lakelet or reservoir and serve the human usage. In contrast, from ecological perspective reservoirs not only effect on local geography and climate but also water quality and biodiversiy of ecosystem (Palacios-Fest and Dettman, 2001; Özdoğan and Salvucci, 2004; Yılmaz and Külköylüoğlu, 2006). Such systems are most effected places by anthropogenic factors (Beklioğlu et al., 2003). Eventually, species quantity and quality of man-made lakes are possibly changed comparing to the natural aquatic systems. In Turkey, there are more than 120 natural lakes while 706 man made reserviors builded (DSİ, 2016).

1.1 Ostracoda

Ostracods are small (0.3 - 5 mm) bivalved invertebrates as a class under phylum Arthropoda and subphylum Crustacea (Meisch, 2000). Because of the bivalve characteristics, they have been well documented in fossil records from Cambrian to date. Ostracods can be found nearly all kind of aquatic habitats like oceans, seas, lakes, rivers, dams, springs, ponds, pools, underground waters, cave waters, water bodies etc. They can also live in benthic, semi terrestrial and deep waters (Horne, 2004). Some of the species prefers mainly special water types, sensitive to biotic and abiotic changes (climatic parameters, vegetation, chemical component, etc.). Since each species has species-specific conditions. They can be used as indicator species (Külköylüoğlu and Vinyard, 2000; Mezquita et al., 2001; Külköylüoğlu, 2004; Külköylüoğlu and Dügel, 2004).

1.1.1 Morphology of Ostracoda

Ostracods have two dorsally connected valves with hinge structure which protect soft body parts (Figure 1.1). The carapace generally covers the whole body and appendages (pair of limbs) or the free valve margins closure tightly. A few tips of the limbs, antenna, antennules, walking legs and uropods extend from the open valves (Meisch, 2000).

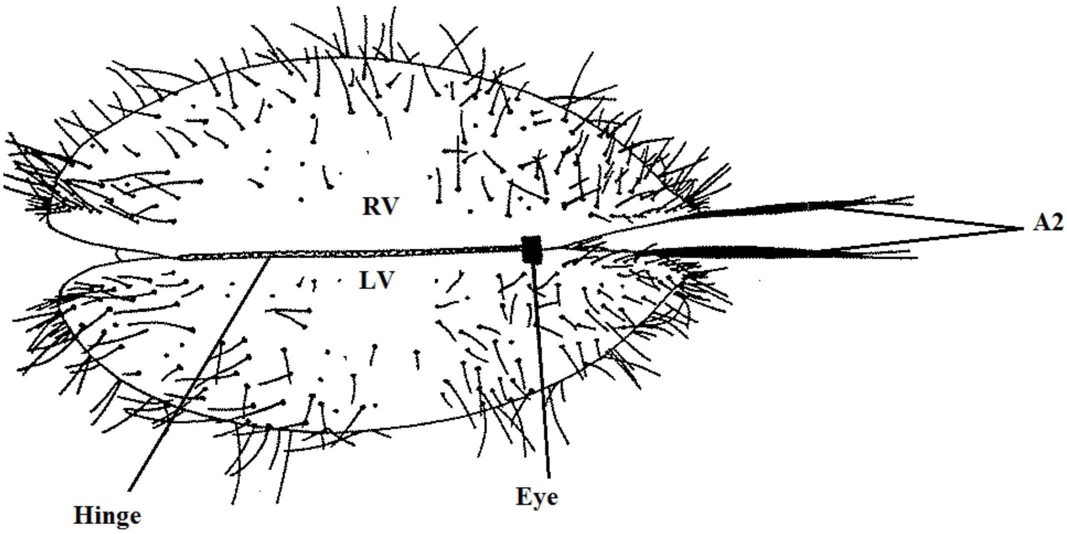

Figure 1.1. Dorsal view of Ostracoda (♀) (*Pseudocandona compressa)* (adapted from Sywula 1974, in Meisch, 2000), (RV- right valve, LV- left valve).

The opening and closing function of the valves are controlled by thick powerful bundle of adductor muscles. These muscle scars are important taxonomic characters at superfamily and family levels. The valve surface usually dense or less covered with pits and pores. Some of the species (e.g., *Cyprideis torosa)* shows different nodding compositions according to environmental differences (Keyser, 2005; Ruiz et al., 2013). Also, eye structures are different between orders. While the order Myocopida has compound eyes, orders Podocopida, Platycopida, Palaecopida and Halocyprida have dark spot like “Nauplius” eyes, located dorsally (Ikeya et al., 2005).

Ostracods have eight moulting stages until adult form. In the adult form there are paired appendages named as antennule (A1), antenna (A2), mandible (Md), maxillule (Mx1), first thoracopod (T1), second thoracopod (T2), third thoracopod

(T3) (Figure 1.2.), and coppulatory organ and uropod (Meisch, 2000; Martens 2003). Antennule includes mainly sensory organs and some locomotory functions as antenna, mainly has long natatory setae in swimming forms. First thoracopod (T1) shows variation of their shape and function at different species as walking leg (Cytheroidea), palp like endopod and a vibratory plate (Darwinuloidea and Cypridoidea) or like male Cypridoids transformed to clasping organ, used while copulation. Second thoracopod (T2) as a pair of walking legs representative for order Podocopida with only one seta. For the males of Platycopida the endopod transform to clasping organ. Also, cleaning leg (T3) shows variation like walking leg in Darwinuloidea and cleaning leg in Cypridoidea. The known function of this appendage is cleaning the posterior space so it is called as "cleaning leg".

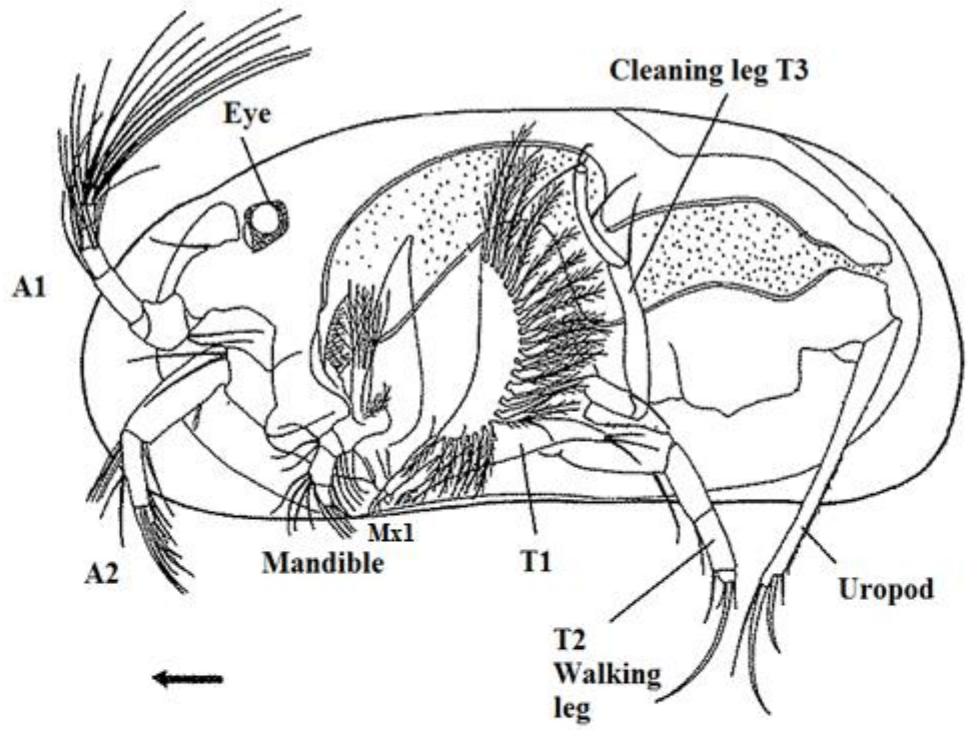

Figure 1.2. Internal view of Ostracoda (♀) (*Herpetocypris reptans*) (Rome, 1974, in Meisch, 2007).

1.1.2 Ecology of Ostracoda

Ostracods can be found in almost all aquatic habitats. They are reported from shallow shorelines to deepest oceans, crater lakes to desert oasis, irrigation canals to throughs, temporary or permanent ponds, springs, lakes, dams etc. (Delorme, 1991; Meisch, 2000). Also, they can be distributed by passive or active modes of dispersion. The active distribution take, place by organisms themselves, passive distribution can be done by ostracods or their strong eggs by wind (Mckenzie, 1971), insects (Fryer 1953), guts of fishes (Kornicker and Sohn, 1971) or birds (De Deckker, 1977). Because of the high tolerance ranges to abiotic conditions of some species, their geographical distribution ranges are so wide. On the other hand, some species with limited ranges can be used as bioindicator species to determine the water quality/conditions and temporal changes in the environment caused by climatic and anthropogenic events (Mezquita et al., 2001; Külköylüoğlu, 2004; Külköylüoğlu and Dügel, 2004). Using ostracods as bioindicator require a deep knowledge of their ecological preferences. The fossilized carapace which is made mostly of Calcium-Carbonate form, provides predictions about past conditions as well (Tuncer and Tunoğlu, 2014; Tunoğlu et al., 2014). In such a way, reconstruction of past history can be made for any particular area. Some cosmopolitan ostracod species has wide distribution and high survival abilities in different water bodies. On the other hand, cosmopolitan species cause a phenomenon named as "pseudorichness" that can be described as the high density of the cosmopolitan species from non-cosmopolitans in an area (Külköylüoğlu, 2004). Most of the individual species density shows differences, and these specialities also used to determine past, future and present condition of that particular habitat (Külköylüoğlu, 2003). They can live as prey, predator, herbivore, detrivore, carnivore or omnivore and reproduce both sexually or asexually (Meisch 2000). Some of the cytheroid ostracods live as symbiont, commercial or ectoparasit on hypogean isopodas' appendages (Hobbs and Peters, 1997). Those specialities provide wide diversity and survival abilities to ostracods.

Succession is a general meaning of changes on an area, habitat type or species composition (Connell et al., 1977). According to this study, succession can be classified into two main classes: i) Early (primary) succession; a disturbance opens relatively large area or releases the resources for those species colonise the area after that first comers. After that the area can be available for other species. ii) Secondary succession; that occurs after big and critical changes (or maybe called “disturbance”) on the habitat by means of natural or artificial impacts or events such as fire, earthquake, volcanic eruption etc. Following that events, the primary conditions are disturbed and the habitat begins to regenerate. After that some of the species re-colonize the area. The idea of succession in nonmarine ostracods was first used in a small spring by Külköylüoğlu in 2007. After that study, this is the second attempt to see ostracod succession in a newly developed reservoir.

1.1.3 Some of the Freshwater Ostracoda researches in Turkey

Ostracod studies in Turkey rooted by outlander ostracodologists H. W. Schäfer (1952) and Hartman (1964). After these researches, Prof. Dr. Dinçer Gülen between 1965 and 1971, studied on hot springs of Turkey and began to report new ostracod species for literature. Gülen studied in Eskişehir, Kütahya and İzmir between 1971 and 1975, and reported 22 species (11 of them new for Turkey) (Gülen, 1977). Following these studies, Gülen (1984, 1985) work included west Anatolian freshwaters and Mersin, Adana, Antakya, Çankırı, Çorum, Amasya, Tokat, Sivas, Kayseri, Nevşehir and Konya. Almost all of these works were based on taxonomic and faunistic determining to understand nonmarine ostracod geographical in Turkey. Inland freshwater ostracod studies trends from taxonomical to ecological and distributional studies through time. Altınsaçlı (1988) from Bergama, Altınsaçlı and Kubanç (1990) from Ayvalık, Külköylüoğlu et al. (1993) in Küçükçekmece and Külköylüoğlu et al. (1995) in Lake Büyükçekmece, Asırlıgil (1995), Kubanç (1995), Kılıç (1997) are also some of the good examples for taxonomical and faunastic studies. Also, Külköylüoğlu (1998) in Lake Şamlar, Yılmaz and Külköylüoğlu (2006) in Lake Aladağ (Bolu), Sarı (2007) in Bolu region Karakaş-Sarı and Külköylüoğlu (2008) in rheocrene springs from Bolu, Balcı (2008) in Lake Sünnet are important examples for ecological and taxonomical studies supported with statistical analyses. Additionally, Külköylüoğlu (2003), Külköylüoğlu (2004), Külköylüoğlu and Dügel (2004) are other additional studies supported with stastical analyses. Most of these early studies on ostracods have been done in freshwater ostracods and generally show efforts of one-time sampling and not include monthly or seasonal sampling. There are a few long-term, monthly sampling efforts (e.g. see Külköylüoğlu and Dügel, 2004; Koşal Şahin, 2005; Külköylüoğlu, 2005a, b; Külköylüoğlu and Yılmaz, 2006; Külköylüoğlu et al., 2007). On the other hand, there were also different studies at literature like, Akdemir (2008) from Maar and Sinkhole lakes of Konya and Yavuzatmaca et al. (2012) in cave sourced freshwater in Western Black Sea region of Turkey. Also the last studies showed that there was 143 reported nonmarine ostracod species belonging to 49 genera in 18 subfamilies in 10 families, from Turkey (Külköylüoğlu et al., 2015).

1.2 Terminology

The used terminology inside the thesis was given below. The following definitions were adapted from Hartmann and Hiller (1977) (in Meisch, 2000).

Coldstenothermal:	species linked to permanently cold waters;
Oligothermophilic:	prefering cold waters; species mainly found in cold waters;
Mesothermophilic:	intermediate between the first two categories;
Polythermophilic:	prefering warm waters; species mainly found in warm waters;
Oligotitanophilic:	mainly occorring at 0-18 mg Ca/L;
Mesotitanophilic:	mainly occorring at 18-72 mg Ca/L;
Polytitanophilic:	mainly occorring at >72 mg Ca/L;
Titanoeuryplastic:	occuring indefferently in all three Ca ranges;
Limnethic range:	< ± 0.5‰ total salt content;
Oligohaline range:	± 0.5‰ - ± 5‰;
Mesohaline range:	± 5 - 18‰;
Rheophobic:	occuring in stagnant waters only;
Oligorheophilic:	occuring in the turbulent littoral are of lakes, and/or sometimes in flowing waters;
Mesorheophilic:	frequently found in flowing waters;
Polyrheophilic:	mainly found in flowing wates;
Rheoeuryplastic:	found in both stagnant and flowing waters;
Stenochronal:	found in limited period during year;
Eurychronal:	found almost all year.

2. AIMS OF THE STUDY

The aim of this study is to understand monthly distribution of the ostracod species in a newly established Seben-Taşlıyayla reservoir (Bolu, Turkey) along with their ecological preferences. Also climatic data and extra samplings are also provided within the study to understand the limnoecological characteristics of the reservoir. Notwithstanding the aim, the hypotheses are described as:

H_0 1: There are no differences among the stations based on ostracod species distribution.

Rationality: Species distribution among the stations is not assumed different because of the same water quality of the reservoir. This distribution of the species must be equal if the species composition of the reservoir well developed and fixed.

H_0 2: There are no seasonal differences on the distribution of ostracods in the study area.

Rationality: There may not be any differences for seasonality on ostracod distribution if they prefer special conditions for living on an area. The seasonal differences are caused by climatic changes but the other conditions like food and nutrition may be effective on species occurrence. Since the present study does not cover biotic conditions and limited with those variables measured *in situ*, it is assumed that seasonality might be better factor for species occurrence.

3. MATERIALS AND METHODS

3.1 Site description

"Taşlıyayla" (Seben) lakelet (reservoir) (40˚ 30′ 57″ N, 31˚ 38′ 32″ E) is located about 22 km South of Bolu province at 1450 m of elevation. The lakelet covers about 8.33 km^2 of surface area with the volume of 44 x 10^6 m^3 (Figure 3.1), where maximum depth is about 12 m (BİÖİ 2003). The maximum length, nearly 5 km while the width 2.6 km. There are seven plateaus around the reservoir.

Some plateaus around the reservoir are as: Ayman on the north east, Solaklar on the south east, Nimetli, Alpagut and Dedeler on the south, Demirciler and Çavuşlar on the west side of the reservoir. The building of the reservoir was began in 2005 and finished in 2008. Water level of the reservoir become reaches full levels after 2009. Before the dam, the area was mostly covered by bogy structure which was used to dry out during summer (BİÖİ 2003). The lake is mainly fed by Aladağ stream, few springs, snow and rain water. Also the reservoir opens for anthropogenic effects.

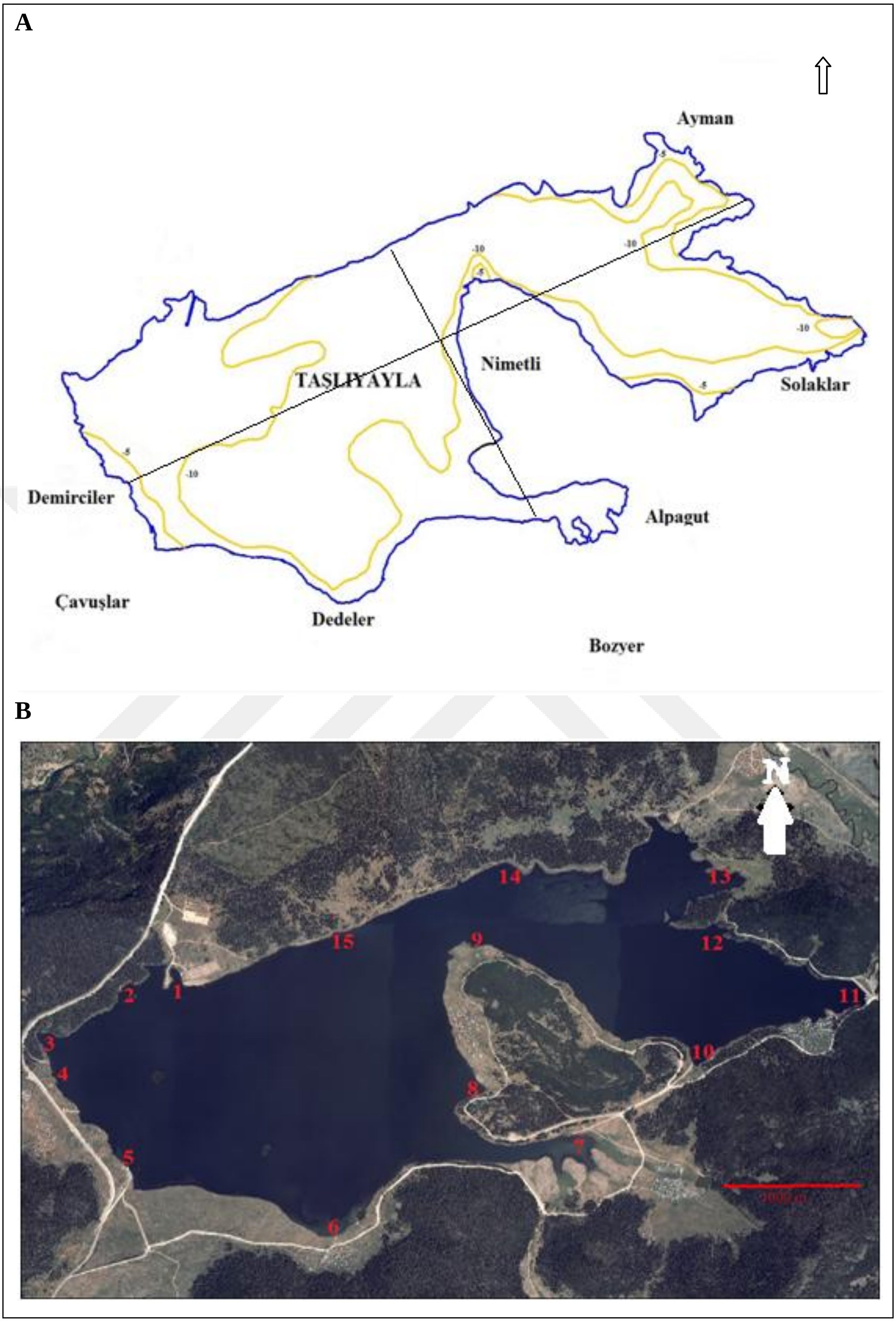

Figure 3.1. A) Counturline (depth) ranges and B) sampling sites on Seben-Taşlıyayla reservoir. (A, redrawn from General Command of Mapping 25000:1 templates; B, modified from satelite maps).

3.2 Methodology

Materials were collected monthly from August 2013 to September 2014 at randomly selected 15 stations around the littoral zone of the reservoir. Also, additional samples were collected from two other stations outside of the reservoir area. The "station 16" is located 6 km north of the reservoir and 450 m south west of Kızık plateau. The stream originated from Kartalkaya Mountain is mixed with Aladağ stream is the main source of the reservoir. Another additional station (St-17) has 63 m length 52 m width and located 150 m east of the reservoir. The station is connected with very thin canal and leaks rarely to the reservoir. In January 2014 no sample was collected because of the ice coverage. Geographical coordinates and elevation were determined with a Geographical Positioning System (Garmin E-trex VISTA H). Nine major environmental variables (pH, Dissolved Oxygen (DO, mg/L), percent oxygen saturation (%DO, mg/L), electrical conductivity (EC, µs/cm), specific electrical conductivity (Spec. Ec., µs/cm), Salinity (ppt.), water temperature (T°C), total dissolved solid (TDS, mg/L), Atmospheric pressure (mm Hg)) were measured before sampling with YSI Professional Plus for avoiding from "pseudoreplication" (Hurlbert, 1984). Wind (m/s), moisture (%) and air temperature (°C) were measured with Testo 410-2 model anemometer.

Ostracod samples collected with standard hand net (200µm mesh size) from the littoral zone of stations at $1m^2$ of area. All samples were fixed with 70 % ethanol *in situ* in 250 ml plastic jars. In laboratory, samples were filtered under the tap water with four standard sized sieves (0.25; 0.50; 1.00; 1.5 mm of mesh size) to clear up dust particles and stored into ethanol. Ostracods were identified based on soft body parts and carapace structures. The identification was done under the light microscope (Olympus BX-51). Identification and taxonomic classification were followed from taxonomic key of Meisch (2000). Samples were saved in lactophenol solution for permanent slides and were housed at Abant İzzet Baysal University Limnology Laboratory of the Biology Department. The species' single valves and carapace samples photographed under the JEOL JSM-6390LV model Scanning Electron Microscopy (SEM) with JEOL Sem control User interface program Version 8.25. Before SEM photography, the samples were coated with gold under 4mA for 220 second with COXEM KIC-IA model ION- COATER.

3.3 Statistical analyses

IBM SPSS Statistics programme version 21 was used for the analyses of variances for monthly mean water and air temperatures to understand if there is any difference between the variances of the water and air temperatures. A nonparametric Spearman Rank Correlation analyses was used to understand the relation between environmental variables and some species. Species were selected from mostly occurrence of live adults identified from the reservoir, subfossils and juveniles were not included to the analyses. Ostracod Watch Model (OWM) was used to show seasonal distribution of the species according to the in monthly and seasonal occurence (Külköylüoğlu, 1998). Regression analyses were used to show the affect of air temperature on the water temperature and try to create an equation to predict water temperature of the reservoir with using air temperature, during the study period by means of following equetion:

"Predicted variable (dependent variable) = Slope * Independent variable + intercept"

Where dependent varieble represents water temperature, independent variable is air temperature. The mean values of the data were used during the analyses. Species minimum and maximum values were estimeted to environmental variable shown for understand the ranges and limiting conditions. Additionally, annual climatic variables of both Seben and Bolu were used to show the differences after the reservoir conditions by using the graphs of Excel (Microsoft). With using the data of climate was generally taken from Turkish State Metorological Service. During the study period, the climatic data were used along with our measurements. *Heterocypris salina* and *H. incongruens* were not used most of the analyses because of their low individual numbers.

4. RESULTS

In Taşlıyayla (Seben) reservoir, 19 taxa (10 living (*Candona weltneri*, *Candona* sp., *Cypridopsis vidua*, *Herpetocypris chevreuxi*, *Heterocypris salina*, *Heterocypris incongruens*, *Limnocythere inopinata*, *Potamocypris variegata*, *Potamocypris* sp., *Koencypris ornata*) 9 subfossil (*Cypridopsis* sp., *Herpetocypris* sp., *Heterocypris* sp., *Ilyocypris* sp., *Isocypris* sp., *Limnocythere* sp., *Prionocypris zenkeri*, *Cavernocypris* sp., *Zonocypris* sp.)) were reported (Appendix A, B). Most abundantly detected species *Cypridopsis vidua* showed wide seasonal broad ecological ranges. While the *C. vidua* showed wide ranges of pH (7.53 – 9.47), DO (4.57 – 14.77 mg/L), Tw (6 – 27.3 °C) and TDS (0.0235 – 0.1021mg/L), *Limnocythere inopinata* displayed a wide range for ORP (1 – 283 mV) during this study. On the other hand, there are 6 living taxa *(Candona neglecta*, *Cyclocypris globosa*, *Cyclocypris* sp., *Cypria* sp., *Cypridopsis vidua*, *Potamocypris variegata*) reported from 16th station a pool located 6 km north from the reservoir. Also, three other living species (*C. globosa*, *Stenocypria fischeri*, *C. vidua*) were reported from second additional station located 150m east from the reservoir. All of the detected taxa reported belong to 3 superfamily, 5 family, 10 subfamily and 16 genus. All of the species collected from Seben-Taşlıyayla reservoir are new reports for the area.

4.1 Systematic Description

PHYLUM:	Arthropoda
SUBPHYLUM:	Crustacea Pennant, 1777
CLASS:	Ostracoda Latreille, 1806
SUBCLASS:	Podacopa Müller, 1894
ORDER:	Podacopida Sars, 1866
SUBORDER:	Podocopina Sars, 1866
INFRAORDER:	Cypridocopina Sohn, 1988
SUPERFAMILY:	Cypridoidea s. str. Braid, 1845
FAMILY:	Candonidae Kaufmann, 1900

SUBFAMILY: Candoninae Kaufmann, 1900

GENUS: *Candona* s. str. Braid, 1845

Candona neglecta Sars, 1887

Candona weltneri Hartwig, 1899

Candona sp.

SUBFAMILY: Cyclocypridinae Kaufmann, 1900

GENUS: *Cyclocypris* Brady and Norman, 1889

Cyclocypris globosa (Sars, 1863)

Cyclocypris sp.

GENUS: *Cypria* Zenker, 1854

Cypria sp.

FAMILY: Cyprididae Braid, 1845

SUBFAMILY: Cypridopsinae Kaufmann, 1900

GENUS: *Cypridopsis* Brady, 1867

Cypridopsis vidua (O.F. Müller, 1776)

Cypridopsis sp.

GENUS: *Cavernocypris* Hartmann, 1964

Cavernocypris sp.

GENUS: *Potamocypris* Brady, 1870

Potamocypris variegata (Brady and Norman, 1889)

Potamocypris sp.

SUBFAMILY: Eucypridinae Broinshtein, 1947

GENUS: *Eucypris* Vavra, 1891

Eucypris sp.

GENUS: *Koencypris* Meisch, 2000

Koencypris ornata (O. F. Müller, 1776)

GENUS: *Prionocypris* Brady and Norman, 1896

Prionocypris zenkeri (Chyzer and Toth, 1858)

SUBFAMILY: Herpetocypridinae Kaufmann, 1900

GENUS: *Herpetocypris* Brady and Norman, 1889

Herpetocypris chevreuxi (Sars, 1896)

Herpetocypris sp.

GENUS: *Stenocypria* G. W. Müller, 1901

Stenocypria fischeri (Lilljeborg, 1883)

SUBFAMILY: Cprinotinae Bronshtein, 1947

GENUS: *Heterocypris* Claus, 1892

Heterocypris incongruens (Ramdohr, 1808)

Heterocypris cf. *barbara* (Gautheir and Brehm, 1928)

Heterocypris salina (Brady, 1868)

Heterocypris sp.

FAMILY: Ilyocyprididae Kaufmann, 1900

SUBFAMILY: Ilyocypridinae Kaufmann, 1900

GENUS: *Ilocypris* Brady and Norman, 1889

Ilyocypris sp.

SUBFAMILY: Isocypridinae Rome, 1965

GENUS: *Isocypris* G. W. Müller, 1908

Isocypris sp.

SUPERFAMILY: Cythereoidea Braid, 1850

FAMILY: Limnocytheridae Klie, 1938

SUBFAMILY: Limnocytherinae Klie, 1938

GENUS: *Limnocythere* s. str. Brady, 1867

Limnocythere inopinata (Baird, 1843)

Limnocythere sp.

SUPERFAMILY: Cypridacea Baird, 1845

FAMILY: Cyprididae Baird, 1845

SUBFAMILY: Cypridinae Baird, 1845

GENUS: *Zonocypris* G. W. Müller, 1898

Zonocypris sp.

4.2 Ecological Results

Table 4.1 and Figure 4.1 show monthly and seasonal species and individual distribution in the reservoir, respectively. During the sampling period of three month (February, April and May), no living adult species was found from the reservior. According to the Table 4.1., *C. vidua* was the most commonly seen species, except March to May. In February, species was not found from the reservoir but collected from station 16. Most of the abundant species generally increased population from August to October while *C. weltneri* was seen only in March with five individuals.

Table 4.1. Monthly (A) and seasonal (B) numbers of species and individuals.

Species codes: *Candona weltneri*, Cw; *Cypridopsis vidua*, *Cv; Herpetocypris chevreuxi*, Hc; *Heterocypris salina*, Hs; *Heterocypris incongruens*, Hi, *Limnocythere inopinata*, Li; *Potamocypris variegata*, Pv; *Koencypris ornata*, Ko.

A								
Months	**Cw**	**Cv**	**Hc**	**Hs**	**Hi**	**Li**	**Pv**	**Ko**
Aug. 13		313						
Sep. 13		64			1	3	3	
Oct. 13		45	1			284	69	
Nov. 13		11				16	54	2
Dec. 13		1						
Feb. 14								
Mar. 14	5							
Apr. 14								
May.14								
Jun.14		2						
Jul.14		2						
Aug. 14		12						
Sep. 14		16	1	1				

B	
Seasons	**Species Number**
Summer	1
Autumn	7
Winter	1
Spring	1

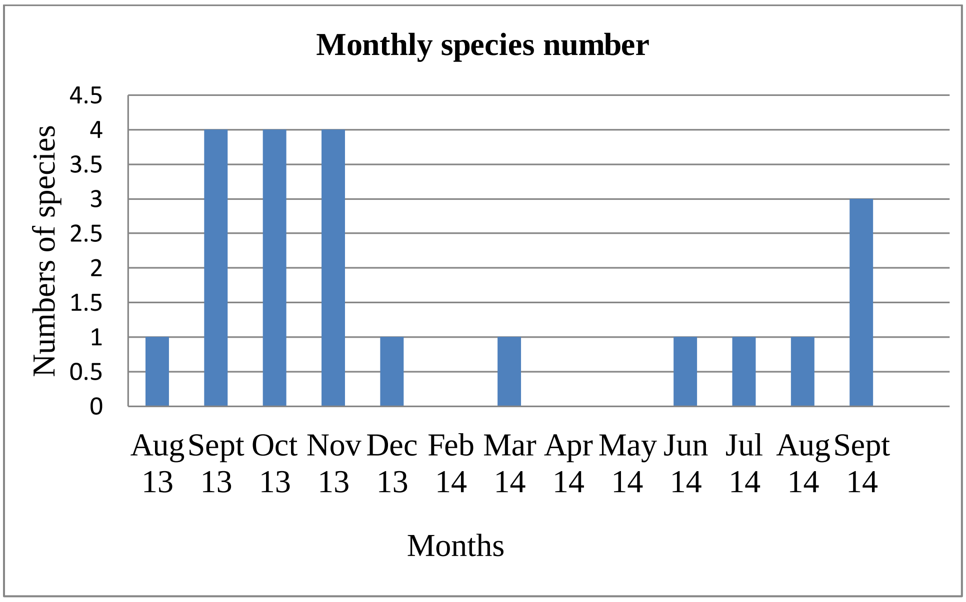

Figure 4.1. Numbers of species per month in the study area. Note that species were not found in February, April and May of 2014.

Ostracod Watch Models (OWM) shows monthly distribution of the species. The angle between two arrows refers to the time that species was collected (Figure 4.2). The models circular chart refers the months of the year. The time began with the January as the first month of the year. According to the model *H. incongruens*, *H. salina*, *C. weltneri* and *K. ornata* appear once in a year while *H. chevreuxi* was seen in October 2013 and September 2014.

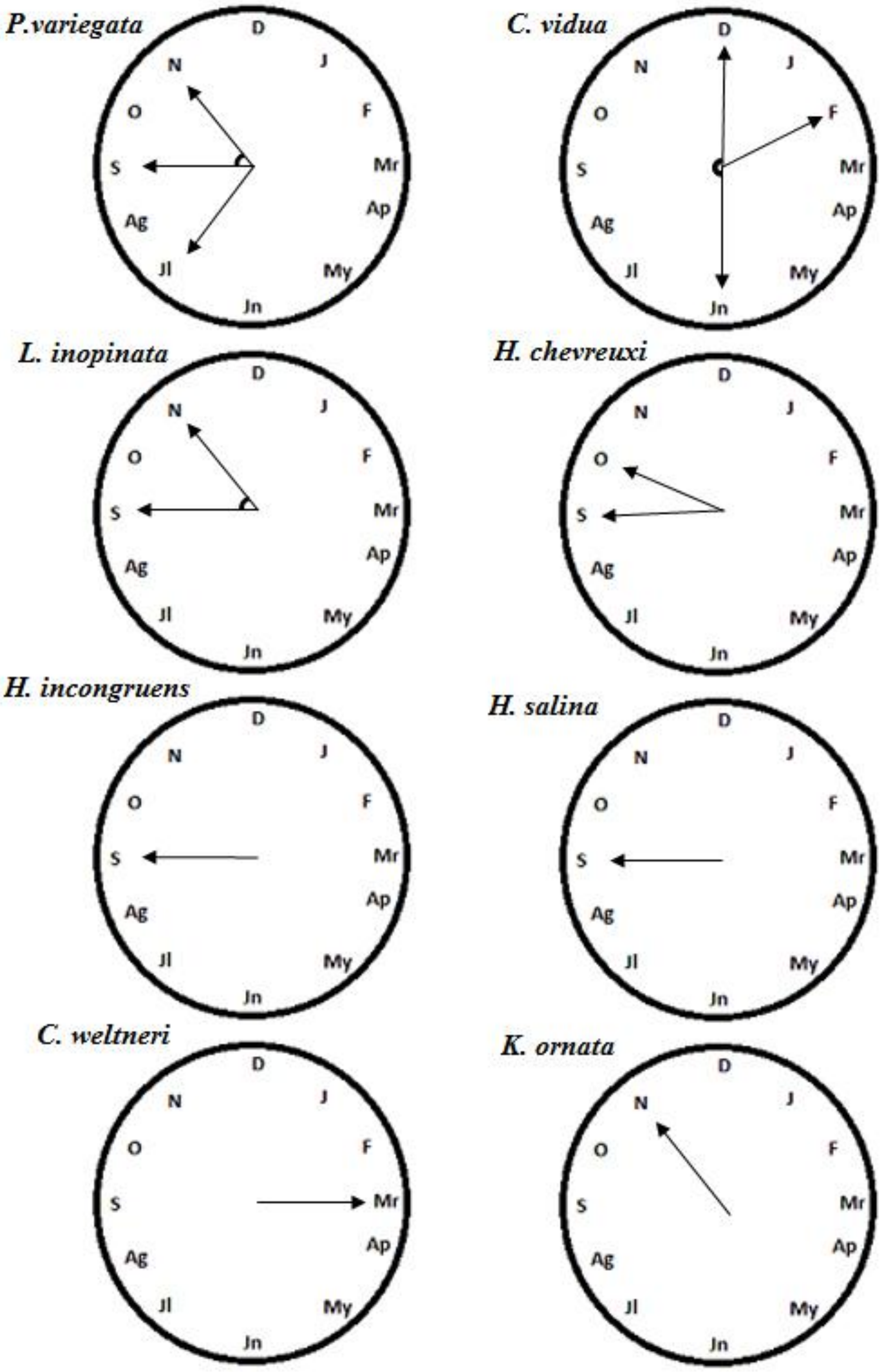

Figure 4.2. Ostracod Watch Model (OWM) represents seasonal distribution of eight species.

The observed species ranges (minimum, maximum) for some physicochemical variables of the reservoir water given below (Table 4.2), where *C. weltneri*, *H. salina* and *H. incongruens* ranges are not shown because they were seen once with living adult individuals during this study.

Table 4.2. Observed ranges of living adult species and individuals.(Abbreviations: DO dissolved oxygen(mg/L), EC electrical conductivity of water (µs/cm), Tw water temperature, TDS total dissolved solids in water(mg/L).

Cypridopsis vidua	pH	DO	EC	Tw	TDS
Min	7.53	4.57	74.4	6.0	0.023
Max	9.47	14.77	127.4	27.3	0.102
Limnocythere inopinata					
Min	7.92	6.64	82.5	10	0.071
Max	8.52	10.48	105.2	19.3	0.076
Potamocypris variegata					
Min	7.92	6.64	80.9	10	0.068
Max	8.66	12.85	105.2	19.3	0.076
Herpetocypris chevreuxi					
Min	8.02	8.48	89.9	12.3	0.076
Max	8.97	10.09	121.2	23.6	0.080
Koencypris ornata					
Min	7.58	9.37	82.1	10.5	0.072
Max	7.86	9.46	82.5	11.1	0.074
Candona weltneri					
	7.65	15.68	54.4	6.2	0.053
Heterocypris salina					
	8.27	7.91	111.5	22.8	0.076
Heterocypris incongruens					
	9.11	10.19	103.8	22.7	0.071

Table 4.3. Monthly average, minimum and maximum values of environmental variables. (Abbreviations: Moist.%, percentage moisture in the air; wind, wind speed; DO (%), dissolved oxygen; (Spec.) EC, electrical conductivity of water (at 25 ºC); Sal, salinity (ppt); T w, water temperature; Ta, air temperature; TDS, total dissolved solid; Atm.Pres., atmospherical pressure.)

Date		Moist. %	Wind	pH	DO	%DO	EC	Spec.EC	Sal	Tw	Ta	TDS	AtmP
8.13	Mean	44,86	12,49	7,93	6,60	75,74	101,71			22,12	24,16		646,04
	min	32,40	3,00	7,41	5,57	61,00	96,00			19,80	20,60		644,10
	max	58,00	46,20	8,17	7,20	85,30	108,60			24,30	28,10		664,20
9.13	Mean	39,61	11,98	8,46	8,28	85,07	104,17	110,27	0,05	19,64	19,74	0,07	645,06
	min	31,30	3,50	7,75	4,04	7,17	97,40	10,86	0,05	15,10	14,70	0,02	643,90
	max	51,70	23,50	9,47	11,28	123,10	135,90	167,70	0,08	23,10	28,30	0,11	653,30
10.13	Mean	21,55	7,44	8,32	9,90	98,26	90,98	112,88	0,05	14,95	20,91	0,07	646,26
	min	14,50	2,90	6,44	8,02	80,10	83,70	93,70	0,04	10,70	17,40	0,06	645,10
	max	34,10	14,20	9,47	12,40	133,30	100,60	119,10	0,06	19,60	25,50	0,08	654,40
11.13	Mean	34,73	11,48	8,06	10,17	94,68	87,04	115,64	0,05	12,69	16,47	0,07	642,86
	min	22,10	3,00	7,51	6,44	63,60	80,90	105,30	0,05	9,60	12,90	0,05	641,40
	max	48,90	25,20	9,47	13,04	133,30	127,40	157,50	0,07	21,00	25,50	0,10	654,40
12.13	Mean	32,13	8,79	7,91	14,87	116,29	72,96	117,87	0,06	5,03	5,84	0,08	639,51
	min	25,30	2,40	7,74	14,13	110,70	69,70	115,50	0,05	2,80	3,20	0,08	639,00
	max	35,70	15,80	8,37	15,85	121,70	76,50	125,60	0,06	7,00	9,90	0,08	640,00
2.14	Mean	64,17	5,49	7,70	14,35	113,37	69,65	108,43	0,05	4,13	8,49	0,07	640,69
	min	53,70	-	7,44	2,90	83,10	37,90	53,10	0,03	1,80	4,80	0,04	639,70
	max	79,10	10,20	7,98	20,40	148,10	113,50	178,70	0,08	5,90	13,60	0,12	649,00
3.14	Mean	73,09	6,23	7,74	16,36	134,92	63,92	101,43	0,05	5,85	8,26	0,06	638,79
	min	53,40	1,50	7,44	14,00	113,50	40,80	66,10	0,02	5,10	5,50	0,04	637,70
	max	94,50	13,70	8,32	20,49	184,20	78,20	122,50	0,06	6,40	12,80	0,08	647,80
4.14	Mean	31,18	7,13	8,30	14,07	133,49	80,02	108,45	0,05	11,40	18,82	0,07	638,64
	min	23,10	1,80	8,00	4,16	112,20	68,00	86,80	0,04	9,50	13,40	0,06	636,70
	max	40,50	23,90	8,62	16,73	151,30	87,70	116,80	0,05	14,30	21,60	0,08	646,40
5.14	Mean	53,34	5,27	8,18	12,73	121,47	83,54	106,50	0,08	13,56	16,44	0,07	643,34
	min	38,90	1,80	7,75	10,00	94,80	69,90	86,10	0,04	10,70	12,60	0,06	638,30
	max	75,10	14,30	8,66	15,01	144,70	91,40	118,60	0,60	16,50	24,60	0,08	652,70
6.14	Mean	42,54	8,69	8,04	10,98	74,49	95,78	111,09	0,05	18,05	20,26	0,07	641,79
	min	33,50	1,70	4,46	5,91	6,37	73,40	87,80	0,04	15,90	16,30	0,06	640,40
	max	52,40	15,20	8,73	65,60	107,90	175,20	207,40	0,10	19,90	23,90	0,14	650,20
7.14	Mean	40,85	4,82	8,52	6,41	73,11	97,35	103,68	0,05	21,75	25,76	0,07	642,94
	min	35,10	1,80	7,95	5,15	52,10	66,70	80,00	0,04	16,30	21,30	0,05	641,70
	max	47,50	10,20	9,28	9,05	106,30	107,30	118,90	0,06	26,00	32,70	0,08	651,00
8.14	Mean	33,93	8,09	7,91	5,07	61,14	111,48	111,80	0,05	24,82	26,39	0,07	638,99
	min	26,50	1,70	6,99	1,25	12,70	90,00	105,20	0,05	17,50	24,20	0,07	637,60
	max	41,60	17,90	8,79	7,16	87,50	133,70	138,40	0,06	28,10	29,20	0,09	647,20
9.14	Mean	48,48	4,63	8,39	8,00	93,98	116,43	121,65	0,05	23,11	26,02	0,08	640,61
	min	34,02	-	7,19	2,28	22,40	101,20	100,00	0,05	16,80	22,00	0,07	639,10
	max	66,80	10,80	9,36	12,69	156,70	180,70	215,70	0,10	25,70	31,30	0,14	649,70

Table 4.4. Mean, minimum and maximum measured values per station (Abbreviations see Table 4.1 and 4.3).

	Station	Moisture %	Wind	Ta	pH	DO	EC	Sal	Tw	TDS	Species code
Mean	1	47.15	9.40	16.51	8.35	14.81	97.95	0.10	13.81	0.081	Cv, Hc
min	1	34.10	1.90	4.80	7.98	4.64	54.50	0.05	2.80	0.056	
max	1	75.10	19.70	28.50	9.08	65.60	175.20	0.06	25.90	0.135	
Mean	2	44.29	5.13	17.91	8.10	10.31	90.18	0.05	15.08	0.069	Cv
min	2	25.20	0	4.90	7.44	6.39	69.80	0.05	4.20	0.023	
max	2	90.50	12.14	28.00	8.93	14.80	112.50	0.06	24.90	0.077	
Mean	3	43.20	5.74	18.21	7.74	9.41	86.40	0.05	14.26	0.070	Cv, Hs, Ko
min	3	20.40	0	4.70	4.46	2.90	37.90	0.03	1.80	0.045	
max	3	94.50	15.80	27.10	8.47	19.20	111.50	0.06	23.10	0.077	
Mean	4	42.56	6.32	18.29	8.12	10.96	86.98	0.05	14.86	0.070	Cv,Pv
min	4	16.20	2.10	3.20	7.45	5.30	56.60	0.04	3.50	0.061	
max	4	92.40	13.70	29.20	8.73	16.73	109.40	0.05	24.00	0.075	
Mean	5	44.77	12.84	17.91	8.11	10.29	93.32	0.05	15.11	0.075	Cv, Li, Pv
min	5	17.30	1.90	6.10	7.50	3.99	73.20	0.05	4.20	0.066	
max	5	78.50	46.20	26.10	8.77	20.49	122.10	0.06	25.60	0.082	
Mean	6	45.62	9.45	18.15	8.18	11.27	87.15	0.05	15.83	0.068	Cv, Li, Pv
min	6	22.10	1.80	4.30	7.65	5.21	41.20	0.03	4.40	0.043	
max	6	92.20	21.70	26.30	9.13	18.03	112.40	0.06	26.90	0.077	
Mean	7	44.93	11.45	17.38	8.51	11.77	92.27	0.05	17.58	0.067	Cv,Cw
min	7	22.30	3.00	3.90	7.65	4.79	54.40	0.04	3.00	0.053	
max	7	68.60	23.90	27.60	9.47	20.40	114.30	0.05	28.10	0.073	
Mean	8	39.89	7.43	19.37	8.29	10.69	92.83	0.05	16.79	0.072	Cv,Pv
min	8	18.30	1.50	9.90	7.74	5.32	71.80	0.05	5.20	0.067	
max	8	62.70	18.30	27.10	9.43	15.37	113.10	0.05	27.30	0.075	

Table 4.4. (Cont'd)

	Station	Moist %	Wind	Ta	pH	DO	EC	Sal	Tw	TDS	Species code
Mean	9	44.04	7.86	18.138	8.17	10.56	87.938	0.05	14.43	0.072	Cv
min	9	14.50	2.40	3.7	7.58	5.87	70.5	0.05	4.60	0.065	
max	9	79.10	23.50	31.3	8.64	17.63	108.8	0.06	23.60	0.076	
Mean	10	42.65	9.91	18.454	8.33	11.03	89.300	0.05	16.25	0.069	Cv
min	10	17.90	1.80	7.4	7.64	5.82	56.3	0.04	5.20	0.053	
max	10	65.40	20.20	25.5	9.47	17.50	115.1	0.05	26.60	0.076	
Mean	11	39.97	8.53	18.031	8.05	9.75	87.754	0.05	14.41	0.072	Cv
min	11	15.30	2.00	4.2	7.58	4.04	67.8	0.05	4.10	0.065	
max	11	62.30	22.30	26.2	8.54	14.81	108.1	0.05	23.60	0.076	
Mean	12	40.25	5.29	19.108	8.18	10.76	87.754	0.05	16.80	0.069	Cv,Hi
min	12	20.20	1.70	6.2	7.62	5.66	59.6	0.04	3.90	0.061	
max	12	65.20	15.20	29.4	9.11	16.70	110.9	0.05	26.80	0.075	
Mean	13	39.39	4.81	19.962	8.14	10.34	90.208	0.05	15.50	0.072	Cv,Hc, Ko
min	13	22.20	1.50	5.6	7.58	5.25	72.5	0.05	5.50	0.065	
max	13	74.20	11.90	32.7	8.97	15.88	121.2	0.06	24.40	0.080	
Mean	14	40.84	7.85	18.469	8.04	9.36	87.585	0.05	15.36	0.070	
min	14	24.50	2.10	6.1	7.51	3.48	40.8	0.03	3.40	0.045	
max	14	66.70	25.20	28.4	8.67	9.19	109	0.06	23.50	0.077	
Mean	15	41.80	7.20	18.138	7.98	9.19	97.277	0.05	15.31	0.078	Cv
min	15	21.90	2.10	5.2	7.44	4.01	40.8	0.02	5.30	0.042	
max	15	73.80	21.20	28.7	8.44	74.2	127.4	0.08	27.00	0.116	

Table 4.3 and 4.4 show monthly and average, highest and lowest values of station measured in Seben-Taşlıyayla reservoir. Only living adult species were given on Table 4.4. There was no living adult individual from St-14 but there were one juvenile, one valve and one carapace of *C. vidua*, one valve of *Eucypris* sp., and one valve of *Ilyocypris* sp..

While living individuals of *C. neglecta*, *Cyclocypris globosa*, *Cypridopsis vidua*, *Potamocypris variegata Cyclocypris* sp., *Cypria* sp. and *Eucypris* sp., valves of *Candona* sp. and *Cavernocypris* sp. were found in St-16 (additional station), living individuals of *Cyclocypris globosa*, *Cypridopsis vidua*, *Heterocypris* cf. *barbara* and *Stenocypria fischeri* were reported from St-17 (another additional station outside of the reservoir). All variables and species data was shown at Appendix B.

Monthly water and air temperature average values of all stations on Taşlıyayla reservoir is shown with Figure 4.3. Linear lines represent increasing trend in water and air temperatures. Besides, a positive strong relationship between water and air temperature (P<0. 01) was found during the study period (Table 4.6).

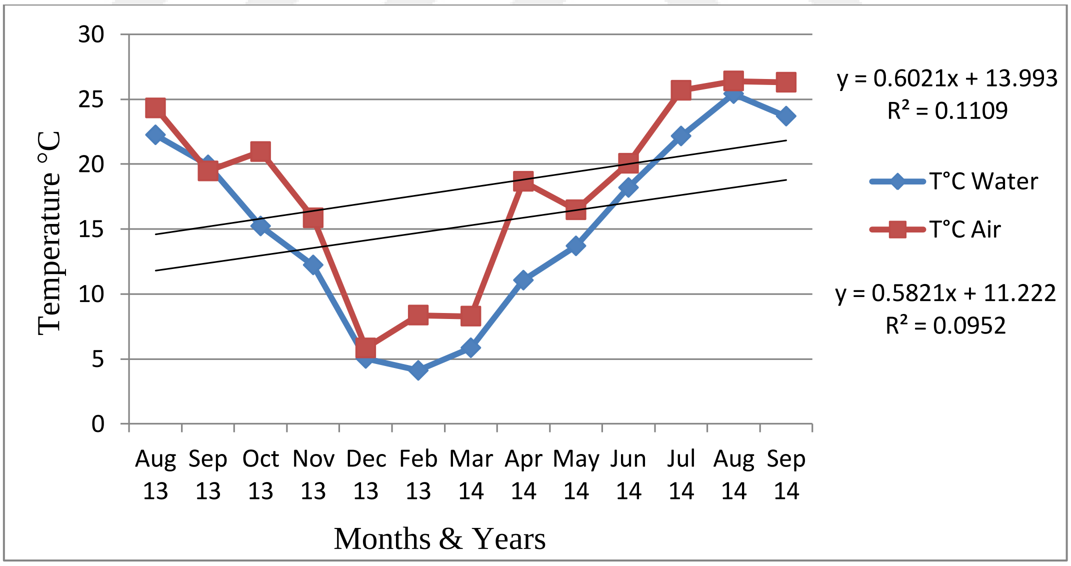

Figure 4.3. Monthly air and water temperature fluctuations in the study area.

The result, between regression and correlation mostly supported the strong relationship between air temperature (Ta) and water temperature (Tw) (Table 4.5). Accordingly, the following equetion may be designed:

“0.999 * independent (Ta) + (-2.886) = dependent (Tw)” for this study.

Table 4.5 Regression coefficent model values of air and water temperatures.

Coefficients[a]

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.
		B	Std. Error	Beta		
1	(Constant)	-2.886	1.771		-1.630	.131
	Ta	.999	.091	.957	10.952	.000

a. Dependent Variable: Tw

Correlation analyses revealed that dissolved oxygen shows strong negative correlation (P<0.01) with electrical conductivity of water, water and air temperature while the pH shows positive significant correlation (P<0.05) with electrical conductivity of water, water and air temperature. On the other hand, electrical conductivity exhibited strong positive relation with water and air temperature (Table 4.6). Some of the variables and species show 1.00 or -1.00 corelation that could be caused variable numbers not enough to correlate significantly. Because of that this values were disregarded.

Table 4.6. Spearman correlation analyses (for abbreviations to see Table 4.1 and Table 4.2)

		pH	Do	EC	Sal	Tw	Ta	TDS	AtmP	Moist	Wind	Cv	Li	Pv
pH	**Coeff.**	1.0												
	Sig.	.												
	N	13												
Do	**Coeff.**	-,434	1,000											
	Sig.	,138	.											
	N	13	13											
EC	**Coeff.**	,626*	-,830**	1,000										
	Sig.	,022	,000	.										
	N	13	13	13										
Sal	**Coeff.**	,141	-,285	,267	1,000									
	Sig.	,663	,370	,401	.									
	N	12	12	12	12									
Tw	**Coeff.**	,582*	-,863**	,956**	,221	1,000								
	Sig.	,037	,000	,000	,489	.								
	N	13	13	13	12	13								
Ta	**Coeff.**	,632*	-,874**	,890**	,091	,940**	1,000							
	Sig.	,021	,000	,000	,778	,000	.							
	N	13	13	13	12	13	13							
TDS	**Coeff.**	-,021	-,168	,182	,464	-,021	,035	1,000						
	Sig.	,948	,602	,572	,129	,948	,914	.						
	N	12	12	12	12	12	12	12						
AtmP	**Coeff.**	,352	-,434	,352	,239	,302	,269	-,035	1,000					
	Sig.	,239	,138	,239	,454	,316	,374	,914	.					
	N	13	13	13	12	13	13	12	13					
Moist	**Coeff.**	-,308	,176	-,165	-,116	-,082	-,170	-,531	-,099	1,000				
	Sig.	,306	,566	,590	,720	,789	,578	,075	,748	.				
	N	13	13	13	12	13	13	12	13	13				
Wind	**Coeff.**	-,275	-,082	,209	,032	,115	-,044	,406	,247	-,346	1,000			
	Sig.	,364	,789	,494	,922	,707	,887	,191	,415	,247	.			
	N	13	13	13	12	13	13	12	13	13	13			
Cv	**Coeff.**	,340	-,468	,626	-,481	,565	,486	-,184	,596	,000	,359	1,0		
	Sig.	,336	,172	,053	,190	,089	,154	,635	,069	1,00	,309	.		
	N	10	10	10	9	10	10	9	10	10	10	10		
Li	**Coef.**	-,50	-1,0**	-,500	,500	-,500	,500	,500	,500	-1,0**	-1,0**	-,50	1,00	1,0**
	Sig.	,667	.	,667	,667	,667	,667	,667	,667	.	.	,667	.	.
	N	3	3	3	3	3	3	3	3	3	3	3	3	3
Pv	**Coeff.**	-,800	,200	-,600	,000	-,800	-,400	,800	,400	-1,0**	,200	,40	1**	1,00
	Sig.	,200	,800	,400	1,00	,200	,600	,200	,600	.	,800	,60	.	.
	N	4	4	4	4	4	4	4	4	4	4	4	3	4

* Correlation is significant at the 0.05 level (2- tailed)

** Correlation is significant at the 0.01 level (2- tailed)

Figure 4.4 showed fluctuation in air temperature and moisture changes in Bolu and Seben province (The values taken from Turkish State Metorological Service). Beginning from 2007, there has not been any effective changes according to graphs. On the other hand, after 2009 moisture of Seben looks like differences than before like the moisture changes between seasons became lesser than before.

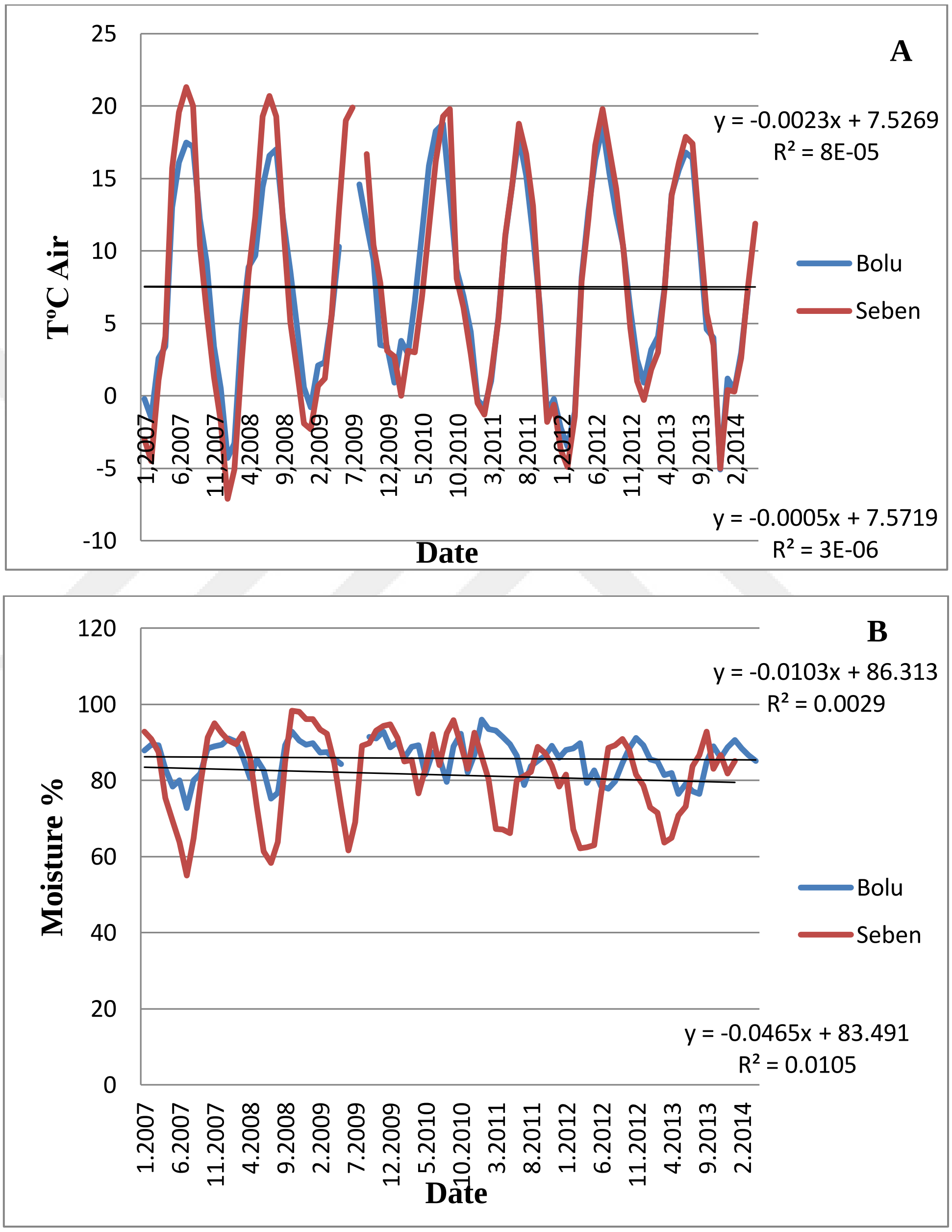

Figure 4.4. Annual A) air temperature (°C) and B) moisture (%) values of Bolu and Seben.

5. DISCUSSION

Air temperature of the earth increases rapidly and human activities accelerate its speed, which is called as global warming. Temperature in lacustrine environments trend to increase with in/direct effect of climatic warming. Our regression result supports the linear relationship between air and water temperatures that was proposed by Kothandaramans and Evans (1972). Also, Morril et al. (2005) noticed that every 1 ºC change in air temperature affect water temperature from 0.6 to 0.8 ºC rise on streams. More recent study on global state indicated that lakes summertime surface temperatures show a rising trend by mean 0.34°C decade (O'Reilly et al., 2015). A similar increase trend was also seen in our study (Figure 4.3). On the other hand, our water temperature measurements were taken from littoral zone of the reservoir with a maximum 1 m depth and before midday. This is because of that an unusual strongness (0.999) effect of air temperature was found on littoral water temperatures (Table 4.5). As seen above mentioned information, this relation shows differences that may be due to the effect of the other variables and regional conditions as well, some of the chemical and physical conditions (Piccolroaz et al., 2013). For future studies, the relationship between air and water temperature could be explain more affectively with using more variables and long period measurements. However, if we look at the Figure 4.4, the ranges of moisture in Seben province began to show less fluctuation after 2009. This time corresponds to the reaching of reservoir to almost full level. All of these changes' results will be seen on species composition. For long period maybe we can see extinctions for species which are more sensitive to environmental changes. And that's how we can explain that most of the reported species from the area show cosmopolitan characteristic.

According to the result of Spearman Correlation analyses, there was no significant relationship between seven environmental variables with three most common species. Also *C. vidua* showed a positive relation with pH in Gölköy a man-made reservoir similar to study area but unlike our results (Külköylüoğlu, 2005). We found that dissolved oxygen negatively and strongly correlated ($P<0.01$) to air (r = -

0.874) and water (r = -0.836) temperature, similar results were also observed in Lake Gölcük where the correlation was negative and strong (r =-0.678 for Ta, r = -0.591 for Tw) (Külköylüoğlu and Dügel, 2004). Additionally, at the same study of Külköylüoğlu and Dügel, to have the strong and possitive realtionship between air and water temperature, clearly supports our results. Additionally, there were strong negative relationship between electrical conductivity of water and dissolved oxygen ($P<0.01$, r = -0.830). Findings of Külköylüoğlu and Yılmaz (2006) support our result with a study done near location, Lake Aladağ.

Newly developed environments generally have low species composition. According to Connell and Slatyer (1977) the environment firstly hosted by only few species because of the unavailability of the environment for most other species. If we lookout a newly developed freshwater ecosystem (like this one), their chemical and physical compositions should require some time to be available for other species. That kind of environments firstly colonized by cosmopolitan species that have usually wide ecological distribution and ranges (Külköylüoğlu, 2009). On the other hand, these cosmopolitan species create richness in aquatic system; this concept is known as "pseudorichness" (Külköylüoğlu et al., 2007). Application of this concept revealed high levels of pseudorichness ratio (noncosmopolitan / cosmopolitan = 0.33) in Taşlıyayla reservoir. The natural and man made lakes show differences in species richness according to this concept. Lake Aladağ is one of the man made lakes (Yılmaz and Külköylüoğlu, 2006), where there were seven species (six of them were cosmopolitan) with high pseudorichness (0.17). Other two dams from Bolu also show similar results. While Gölköy dam had 0.22 of pseudorichness ratio with 11 species (nine of them cosmopolitan), at Gölcük dam this ratio was 0.2 with six species (five of them cosmopolitan) (Külköylüoğlu, 2005a; Külköylüoğlu and Dügel, 2004, respectively). Conversely, the natural lakes like Lake Çubuk (Külköylüoğlu et al., 2014) and Lake Sünnet (Külköylüoğlu et al., 2010) had higher richness than the man-made ones (0.89 and 0.80 pseudorichness ratios, respectively) (Külköylüoğlu, 2013). These also show that the species quality of natural lakes are better than man-made lakes (Appendix C). Moreover, average species number per station of the reservoir was also low comparing to the other studies in the province. For example, the average species number per station was 4.7 in Lake Abant, 4.6 in Lake Gölköy and 4.14 in Lake Aladağ. There was only 1.73 species per station in Taşlıyayla reservoir. Also, all the stations include at least one cosmopolitan species and the highest species number was 3 at one station could be the cause of this poorness (Table 4.4). According to the results, it is not wrong to say that the reservoir is in the early succession stage. This indicates that the reservior needs more time to have better conditions for ostracod fauna.

5.1 Species-specific data on ostracods

Species- specific informations about living adult individuals collected from the study area was given below.

5.1.1 *Candona weltneri* Hartwig, 1899

According to Martens and Savatenalinton (2011), *C. weltneri* shows Palearctic and Nearctic distribution. Generally, reported from littoral and profundal zone of the lakes, ponds, permanent and temporary small waters, swamps, oxbows, and ditches. Also, it was classified as winter form due to occurrence of adult individuals in winter season (Meisch, 2000). Reported from Britain (Freyer, 1993), Germany, Netherlands (Redeke and Den Dulk, 1940), Belgium (Martens and Dumont, 1984), Hungary (Meisch and Forro, 1998), Czech Republic (Absolon, 1978) and Turkey (Sarı and Külköylüoğlu, 2009). Also, it was reported from Lake Fehér (Hungary) from the part of reedbeds treated by waste water (Kiss et al., 2014).

However, Rosetti et al. (2004) pointed that, *C. weltneri* occured almost all the time during sampling period except winter season. They collected samples in April, June, August and October from shallow oxbow (Castlefracon), in channels with flowing waters with *C. vidua* and from a pond (Gerre Gavazzi) mostly fed by ground water with high sedimentation rate at the Parco Oglio sud at North Italy. Kiss et al. (2015) collected the species from oxbow when the water level was very low. Likewise, Nagorskaya and Keyser (2005) underlined to preference of the species in small water bodies with swampy or boggy bottom. The habitat preferences also reported as sediment surface covered with high vegetation at Lake Fehe’r (Hungary) (Kiss, 2007). Also from Kahramanmaraş province the reported in Aksu stream in

July (Külköylüoğlu et al., 2012b). While the studies in Poland and Bolu (Turkey) reported the species in summer, *C. weltneri* was reported in early Spring (March) (Sarı and Külköylüoğlu, 2009; Szlauer-Lukaszewska, 2014). In Taşlıyayla we found the species once in March, corresponding to the literature.

Ecological characterization: cold stenothermal, oligorheophilic, titanoeuryplastic, oligohalophilic (Meisch 2000), stenochronal.

5.1.2 *Cypridopsis vidua* (O. F. Müller, 1776)

According to Martens and Savatenalinton checklist (2011) *C. vidua* shows distribution in Afrotropical, Nearctic, Neotropical, Palaearctic, Pacific region and oceanic islands distribution. This cosmopolitan species (or as called cosmoecious) has wide distribution in large and small, permanent and temporal aquatic bodies such as ponds, littoral zones of lakes, slow river pools, temporary ponds, springs, wells and interstitial habitats. According to Mbahinzireki et al. (1991) this animal prefers shady areas with rich vegetation. The species has well developed A2 notatory setae which provide swimming ability to the species. Also living specimens reported from the rectum of a frog (Lowndes, 1930). *Cypridopsis vidua* is very active swimmer reported to decrease motility with the presence of fish *Abramis brama* (Roca et al., 1993). The species has wide tolerance in low salinity levels, preferring well oxygenated waters (Meisch, 2000). In the laboratory conditions, it was survived only few days at oxygen tensions of 0.1mg/L (Danielopol, 1991).

According to Külköylüoğlu and Yılmaz (2006), *C. vidua* was collected in October and December from helocrene spring. Also, occurrence of the species continued from July to November, in two man-made reservoirs (Lake Gölköy and Yumrukaya) (Külköylüoğlu, 2005a, b). When we look at the monthly distribution of the species in Lake Abant, its occurrence began from April to November (Dügel et al., 2008). Our results are supported by most of the past studies with the occurrence of *C. vidua* from June to December through February. In January, the species was not collected from the reservoir because of the ice coverage. Accounting all data, *C. vidua* can be seen all year around. Its wide distribution can be related to its wide range of tolerances (Külköylüoğlu, 2000).

Some ranges of *C. vidua* in literature given as; pH (5.20 – 12) (Delorme, 1991), water temperature (3.8 – 36 ºC) (Külköylüoğlu and Yılmaz, 2006; Bronshtein, 1947), dissolved oxygen (1.44 – 19 mg/L) (Green, 1994; Külköylüoğlu, 2004), electrical conductivity (37 – 7410 µS/cm) (Meisch et. al. 2007; Meisch and Broodbaker, 1993, respectively). As a result, our measured ranges do not show differences from the literature.

Ecological characterization: polythermophilic, mesotermophilic, titanoeuryplastic (Hiller, 1972), phytophilic (Roca and Danielopol, 1991), and oligohalophilic (Meisch, 2000), eurychronal.

5.1.3 *Herpetocypris chevreuxi* (Sars, 1896)

Herpetocypris chevreuxi shows Nearctic, Neotropical, Palearctic regional distribution (Martens and Savatenalinton, 2011). It prefers slightly saline waters, small stagnant water bodies, the littoral zone of lakes, swamps, pools of streams and rivers. The species is good swimmer and shows “cosmoecious” characteristics (Külköylüoğlu et al., 2013). It was often detected with a few other halophilic ostracods such as *Candona angulata*, *Heterocypris salina*, *Sarscypridopsis aculeata*, *Potamocypris unicaudata* and *Cyprideis torosa.* The species generally occurs in pure freshwater (Meisch, 2000). On the other hand, it was collected from sulfidic (H_2S) springs at the enterance of Grotta del Fiume cave in Northern Italy (Rosetti et al., 2004). It was reported from various sedimentation types like stone, sandy, muddy and silt (Külköylüoğlu and Vinyard, 2000; Meisch, 2000; Pieri et al., 2006).

Herpetocypris chevreuxi was reported in May of 2000 and 2002 from Lake Aladağ (a man-made reservoir) and Lake Abant (a natural lake) (Külköylüoğlu, 2004; Dügel et al., 2008, respectively). On the other hand, in a study done near to Gölköy (Bolu) region, *H. chevreuxi* reported from a rheocrene spring (Çetinbey) in May and from October to November (Sarı, 2008). At the present study, *H. chevreuxi* was collected October and September with different years. According to this literature, the species shows seasonal distribution from summer to spring seasons. With the present study this range can be reached to early autumn.

Up to now, the species has been reported from different ranges of water temperature (5.7 – 33.9 ºC) (Külköylüoğlu and Vinyard, 2000; Sarı, 2007), electrical conductivity (74.7 – 1475 µS/cm) (Yılmaz, 2014; Sarı, 2007), pH (6.3 – 9.3) (Fernandes Martins et al., 2010; Dügel et al., 2008), dissolved oxygen (2.11 – 17 mg/L) (Sarı and Külköylüoğlu, 2008; Rosetti et al., 2008), TDS (0.08 – 958.75 mg/L) (present study; Sarı, 2007, respectively). In a conclusion of this proof, our measured ranges correspond with the literature, except TDS values.

Ecological characterization: oligohalophilic, oligorheophilic, stenochronal

5.1.4 *Heterocypris salina* (Brady, 1868)

According to Martens and Savatenalinton (2011), *H. salina* shows Nearctic, Neotropical and Palearctic regional distribution. It prefers small and slightly saline coastal and inland water bodies where the species can often be found with other halophilic ostracods, such as *Herpetocypris chevreuxi*. This species is a good swimmer and reported as cosmopolitan species in both stagnant and temporary waters (Malmqvist et al., 1997; Van der Meeren et al., 2010), while it is also called cosmoecious species (Külköylüoğlu, 2013). The species successfully survived within pure freshwater conditions in controlled environment for several years (Diebel and Pietrzeniku, 1975).

When we look at the monthly distribution of the *H. salina*, it has been generally reported in summer season (Sarı and Külköylüoğlu, 2009; Szlauer-Lukaszewska, 2014). Besides, it was reported in June from Gavur Lake (Kahramanmaraş province, Turkey). On the other hand, Akdemir and Külköylüoğlu (2006) reported it in August from a brackish Lake (Acıgöl) from Erzincan region. Conjointly, another report came from Istranca Stream (Turkey) in July 2004 (Özuluğ, 2011). We found *H. salina* in September 2014.

Additionally, some of the reported ranges of the species; water temperature (3.7 – 34 ºC) (Mezquita et al., 2001; Meisch, 2000), electrical conductivity (15.94 – 10050 µS/cm) (Uçak et al., 2014; Rasouli et al., 2014), pH (6.05 – 9.9) (Yılmaz, 2014; Van der Mereen et al., 2010), dissolved oxygen (0 – 18.84 mg/L) (Ruiz et al., 2013; Uçak et al., 2014) TDS (0.07 – 20034 mg/L) (present study; Van der Mereen et al., 2010, respectively). As a conclusion, our measured ranges is included in the literature except TDS.

Ecological characterization: thermoeuryplastic, meso-polyrheophilic, meso-polytitanophilic (Vesper, 1975) and mesohalophilic (Meisch, 2000), stenochronal.

5.1.5 *Heterocypris incongruens* (Ramdohr, 1808)

According to Martens and Savatenalinton (2011), *H. incongruens* shows Afrotropical, Australasian, Nearctic, Neotropical, Oriental, Palearctic, Pacific region and Oceanic islands distribution. It prefers shallow seasonal pools rain puddles, water butts, troughs, fountains, tree cavities and small permanent water bodies, clayey and lacks any macrophytes substrates. It is good swimmer and reported as "cosmoecious" (Külköylüoğlu et al., 2013). Also, it has been reported in some areas of brooks and rivers, rice fields, springs and underground waters. The species colonizes strongly eutrophic ponds with low oxygen content, and even from those highly polluted with organic materials from waterfowl (Meisch, 2000). The species tolerates salinity ranges and sometimes found with *H. salina* and prefers slightly brackish waters. Both species collected from the swimming pool of the spa at Hermannsbad (Poland), where the mean temperature was 22 Cº, salinity 20‰, pH 8, O_2 content < 1 cm^3/L (Pax, 1942). Also Ganning (1971) was reported the salinity tolerances of the species in laboratory cultures as a salt content of 1-5‰. Half of the population was tolerate the condition 20 days or more.

From near to Lake Yeniçağa, samples were collected from newly devoloped rheocrene spring, *H. incongruens* was one of the first colonizing species appeared in June, July, October and November (Külköylüoğlu, 2009). Also according to Külköylüoğlu (2004), the species was detected in May from Lake Aladağ, open to human affect. Besides, from April to December, the wide distribution of the species was reported (Külköylüoğlu, 2005b). In the present study, *H. incongruens* was seen only September in the reservoir. The first colonizing species will be cosmopolitan species, not surprising result because of the reservoir is a newly developed area (Külköylüoğlu, 2009).

Furthermore, some ranges of environmental variables of the species as; water temperature (3.7 – 33.9 ºC) (Mezquita et al., 2001; Yavuzatmaca, 2015), electrical conductivity (11.04 – 10050 µS/cm) (Uçak et al., 2014; Rasouli et al., 2013), dissolved oxygen (0.28 – 20 mg/L) (Yılmaz, 2014; Külköylüoğlu et al., 2013), TDS (0.07 – 20034 mg/L) (present study; Van der Mereen et al., 2010, respectively). Sequentially, the given ranges cover our measurments, except TDS values.

Ecological characterization: mesothermophilic, mesorheophilic, titanoeuryplastic (Hartman and Hiller, 1977) and oligohalophilic (Meisch, 2000), eurychronal.

5.1.6 *Limnocythere inopinata* (Baird, 1843)

According to Martens and Savatenalinton (2011), *L. inopinata* shows Afrotropical, Nearctic, Palearctic regional distribution. It prefers ponds, swamps, ditches, lakes, pools of brooks and rivers and rice fields. Also, it was reported from muddy and sandy substrates, slightly salty inland and coastal waters (Meisch, 2000). Its tolerance ranges are wide as different environmental variables. The species also abundantly reported from strong alkaline pools up to 2160 mg/L chloride concantration at eastern Austria (Löffler, 1959, in Meisch 2000). This shows the tolerance level of species to alkalanity. There was not much species to show tolerance to that.

According to Külköylüoğlu (2015a), *Limnocythere inopinata* can be seen from Gölköy reservoir in two months through the year. During the two years which study was done, the species was reported only in June and July. Likewise in another study done Lake Van (Turkey) in July, the species was also found in the samples collected from two creeks (Aşa and Değirmen). Also, on different sides of the Lake Van *L. inopinata* was identified from five different locations (Külköylüoğlu et al., 2012a). The species' monthly occurrence was reported from June to December (without November and July) in Lake Sünnet (Turkey) (Külköylüoğlu et al., 2010). On the other hand, it was encountered from a limnocrene spring, located to nearby our study area, from April to December (Külköylüoğlu and Yılmaz, 2006). In our study period, *L. inopinata* occurred in autumn season September to November from the reservoir. Our finding corresponds to the literature reports.

Moreover, some of the reported values for *L. inopinata* as; water temperature (4.75 – 35 ºC) (Külköylüoğlu et al., 2014; Karan-Žnidaršič and Petrov, 2007), electrical conductivity (28.2 – 24265 µS/cm) (Külköylüoğlu et al., 2012b; Yavuzatmaca, 2015), pH (6.4 – 10.4) (Ruiz et al., 2013; Van der Mereen et al., 2011), dissolved oxygen (2.91 – 13.26 mg/L) (Akdemir and Külköylüoğlu, 2014; Yılmaz and Külköylüoğlu 2006), TDS (0.07 – 23973 mg/L) (present study; Van der Mereen et al., 2010). All that given knowledge shows that the ranges of our measurements for *L. inopinata* correspond to early reported studies without TDS.

Ecological characterization: polythermophilic, titanoeuryplastic, rheoeuryplastic (Vesper, 1975; Hartman and Hiller, 1977), mesohalophilic (Meisch, 2000), eurychronal (Vesper, 1975).

5.1.7 *Potamocypris variegata* (Brady and Norman, 1889)

According to Martens and Savatenalinton (2011), *P. variegata* shows Palearctic regional distribution. It prefers stagnant and slow flowing waters with dense vegetation, ponds, gravel pits, rivers, the littoral zone of lakes and occasionally, the interstitial habitats (Meisch, 2000).

The first reports of *P. varigata* from Anatolian region reported from three different stations of Lake Büyükçekmece in September 1989 and June 1990 (Külköylüoğlu et al., 1995). Another report was taken from Eğirdir Lake in October 1997 (Özuluğ et al., 2001). After that Özuluğ (2011) and Özuluğ (2012) reported the species two times from Istranca stream in April and June 2001 and Lale creek (Kazandere stream) in April 2001. Also according to Rasouli (2012), *P. variegata* was collected from a trough of Balıkesir in April 2011. Likewise, the other studies reported from Adıyaman province in July (Yavuzatmaca et al., 2015). According to our study the species reported from July to November without August. According to these results, its occurence begin from April to November.

Additionally, the species has been reported within some ranges of water temperature (3.8 – 29 ºC) (Külköylüoğlu and Yılmaz, 2006; Özuluğ, 2011), electrical conductivity (80.9 – 4085 µS/cm) (present study; Mezquita et al., 2001), pH (6.46 –

9.15) (Külköylüoğlu and Yılmaz 2006; Uçak et al., 2014), dissolved oxygen (0.9 – 14 mg/L) (Creuze des Chatellires and Marmonier, 1993; Delorme, 1991), TDS (0.07 – 418 mg/L) (present study; Külköylüoğlu et al., 2013). As a conclusion our measured ranges not show differences from the literature except TDS and EC.

Ecological characterization: Hiller (1972) collected his specimens at a chloride concentration of 18.8-23.2 mg/L) and pointed as polythermophilic (warmstenothermal according to Nüchterlein, 1969), mesorheophilic (Meisch, 2000).

5.1.8 *Koencypris ornata* (O. F. Müller, 1776)

According to Martens and Savatenalinton (2011), *K. ornata* shows Palearctic distribution. It prefers generally open field small grassy pools and ditches (Meisch, 2000). It glides over the bottom or crawl on the aquatic vegatation. The species was reported from France benthic zone of River Rhone (Meisch et al., 1990; Marmonier and Creuze des Chatelliers, 1992), rice fields from Italy (Rossi et al., 2003) and western Australia (Karanovic, 2008).

Koencypris ornata was firstly reported from Turkey in 1998 from Lake Sazlıgöl (İzmir) February to May together with *Eucypris virens* and *Cypris pubera* (Ustaoğlu et al., 2003). Another record from Turkey comes from a spring (Kırşehir) together with *Ilyocypris inermis* and *Heterocypris incongruens* and in Lake Sobe with *Candona neglecta, Ilyocypris bradyi, I. monstrifica* and *Heterocypris salina* in May (Rasouli et al., 2014). In the present study, *K. ornata was* reported in November once from two different stations only with the carapaces of *C. vidua*.

Ecological characterization: a mesothermophilic and titanoeuryplastic (Hartman and Hiller, 1977 in Meisch, 2000).

6. CONCLUSION

During the present study, total of 8 species (*Candona weltneri, Cypridopsis vidua, Herpetocypris chevreuxi, Heterocypris salina, Heterocypris incongruens, Limnocythere inopinata, Potamocypris variegata*, *Koencypris ornata*) were found for the first time report from the reservoir. While *H. salina*, *C. weltneri* and *H. chevreuxi* show stenochronal occurence, *C. vidua*, *H. incongruens* and *L. inopinata* show eurychronal occurence. Environmental and climatic changes are affective on lacustrine environments. These changes also influence ostrocods. Cosmopolitan species can tolerate such changes because of their wide tolerance to these environmental conditions. They can show wide distribution in variety of habitats. In Taşlıyayla reservoir, the habitat and environmental conditions are changed because of dam construction. Eventually, species composition changed. Pseudorichness ratio shows that the reservoir mostly includes cosmopolitan species. Hence, cosmopolitan species firstly colonize the environment and they are probably the first successive species. Moreover, effect of the air temperature on water can show significant differences. Because of small size, our results cannot be generalized. However, environmental ranges of our samples include the ranges of the literature except minimum values of TDS of *Herpetocypris chevreuxi*, *Heterocypris salina, H. incongruens*, *Limnocythere inopinata* and *Potamocypris variegata*. Also, minimum electrical conductivity values of *P. variegata* changed within present study. Additionally, when the monthly distribution of species considered, individual density increases for *Candona weltneri* in March, for *Cypridopsis vidua* in February, for *Herpetocypris chevreuxi* and *Heterocypris salina* in September, for *P. variegata* and *Koencypris ornata* in November. Station 3, 5, 6 and 13 are most diverse stations while station 14 has no living species. According to those finding species seasonal and stational preferences show differences during study period.

Species composition and environmental variables of Taşlıyayla can be monitored with long time of periods to expose the changes. Also other biotic and abiotic factors can be studied to explain the interactions. Before building that kind of areas, we need to analyse possible effects to save biological diversity and resources.

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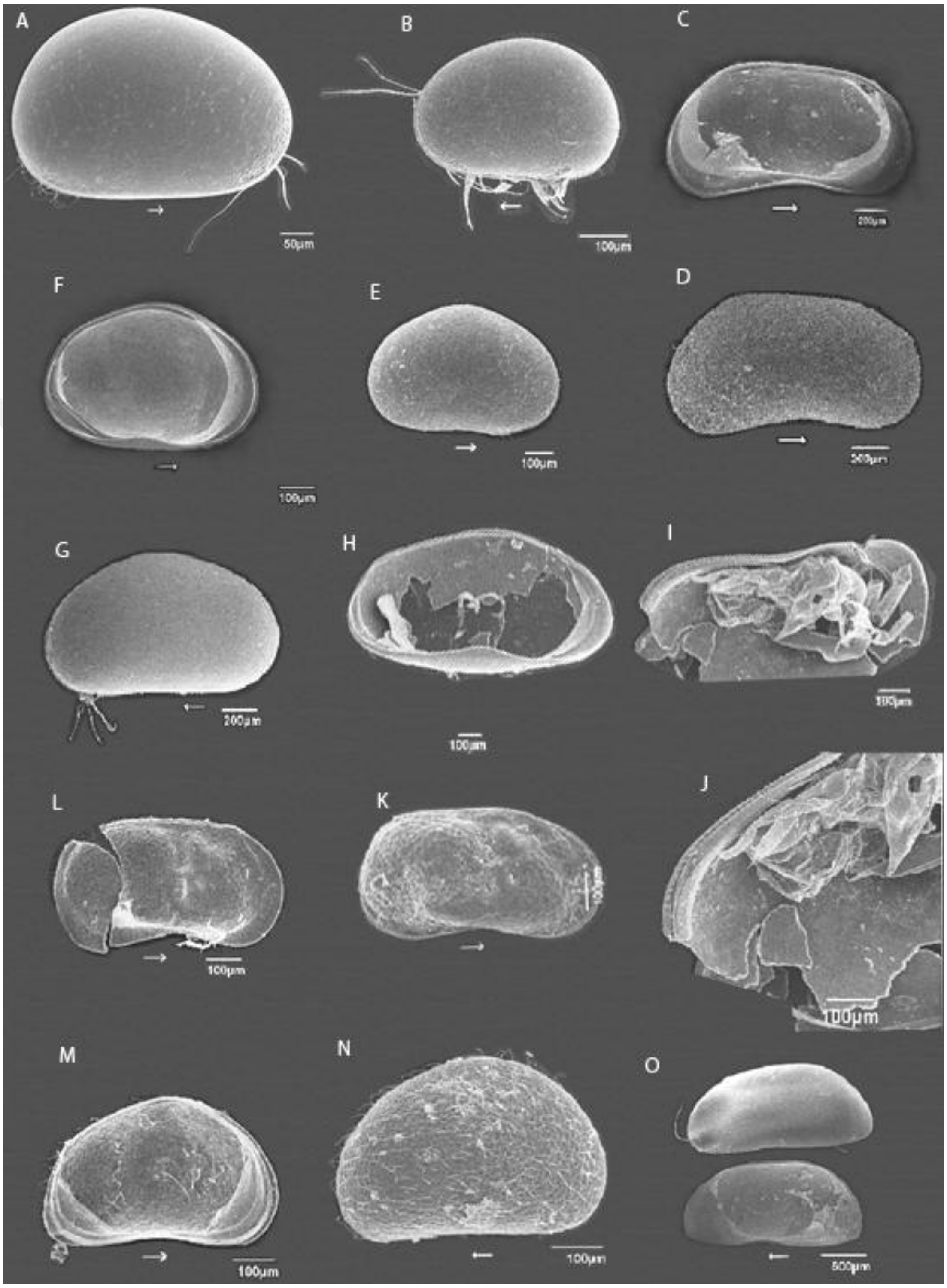
APPENDICES

APPENDICES

Appendix A SEM Photos *Cyclocypris globosa* (A) (♀), (B) (♂), *Candona weltneri* left valve internal (C), *C. weltneri* right valve external (D), *Cypridopsis vidua* right valve external (E), *C. vidua* left valve internal (F), *Heterocypris incongruens* left side individual (G), *H. salina* left valve internal (broken while preparation) (H), *H. salina* right valve internal (broken while preparation) (I, J), *Limnocythere inopinata* right valve external (K), *L. inopinata* left valve internal (L), *Potamocypris variegata* left valve internal (M), *P. variegata* right valve external (N), *Stenocypria fischeri* left side individual (uper) right valve internal (lower) (O).

Appendix A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Appendix B Environmental Variables And Collected Taxa During Present Study.Abbreviations: Station numbers (St), Moisture (Moist)(%), Wind speed (Wd) (km/h), dissolved oxygen (DO) (mg/L), percent saturation (%DO), electrical conductivity (Ec) (µS/cm), specific electrical conductivity (Spec.Ec), Salinity (Sal) (ppt), water temperature (T W) (°C), air temperature (°C), total dissolved solid (TDS) (mg/L), atmospheric pressure (Atm.P) (mmHg), elevation (Elev) (m), *Candona neglecta* (Cn), *Candona weltneri* (Cw), *Candona* sp. (Casp), *Cavernocypris* sp. (Cosp), *Cypridopsis vidua* (Cv), *Cypridopsis* sp. (Csp), *Potamocypris variegata* (Pv), *Potamocypris* sp. (Posp), *Limnocythere inopinata* (Li), *Limnocythere* sp. (Lsp), *Isocypris* sp. (Isp), *Ilyocypris* sp. (Ilsp), *Heterocypris incongruens* (Hi), *Heterocypris salina* (Hs), *Eucypris* sp. (Esp), *Cypria* sp. (Cysp), *Cyclocypris globosa* (Cg), *Cyclocypris* sp. (Ccsp), *Herpetocypris chevreuxi* (Hc), *Herpetocypris* sp. (Hrsp), *Prionacypris zenkeri* (Pz), *Koencypris ornata* (Ko), *Stenocypria fischeri* (Sf), *Heterocypris* cf. *barbara* (Hb), *Zonocypris* sp. (Zsp). Subfosil forms was given bold.

Appendix B

St	Moist	Wd	pH	DO	%DO	EC	T W	T A	Atm.P	Elev	Date	Species
1	45.7	19.7	7.98	6.81	78.4	102.5	22.1	22.3	664.2	1372	04.08.2013	Cv
2	40.2	3.5	8.17	7.05	81.4	103.6	23.6	28	644.2	1420	04.08.2013	Cv
3	36.3	6.1	7.86	6.93	80.9	102.8	23.1	26.6	644.2	1442	04.08.2013	Cv
4	37.4	8.3	7.99	6.77	79.8	101.4	21.8	28.1	644.2	1454	04.08.2013	Cv
5	48	46.2	8.1	5.94	69.4	107.2	22.4	23	644.1	1453	04.08.2013	Cv, **Casp**
6	58	21.7	7.83	6.91	78.2	99.3	21.4	20.9	644.2	1463	04.08.2013	Cv
7	50.5	8.3	8.06	7.2	85.3	101.7	24.3	20.6	644.2	1456	04.08.2013	Cv, **Casp**
8	44.2	10.9	8.09	7.03	82	104.6	23.1	23.1	644.3	1452	04.08.2013	Cv
9	52.1	11.2	7.98	6.95	79.9	99.5	21.9	22.5	644.2	1449	04.08.2013	Cv
10	50.6	16.7	7.91	6.4	81.6	98.8	23.6	23.3	644.2	1447	04.08.2013	Cv, **Casp**
11	50.6	22.3	7.83	6.64	75.7	100.4	21.8	23.5	644.2	1443	04.08.2013	Cv
12	42.8	7.2	7.84	6.42	74.4	102.1	22.9	25.5	644.2	1445	04.08.2013	Cv
13	40.7	3	7.86	6.04	66.2	96	19.8	25	644.3	1442	04.08.2013	
14	38.8	5.5	8.04	6.88	71.3	100	21.6	25.4	644.3	1442	04.08.2013	**Cv**
15	32.4	3.5	7.87	6.03	66.4	98.8	20.4	27	644.3	1447	04.08.2013	Cv
16	49.5	5.8	7.41	5.57	61	108.6	20.1	21.8	653.4	1328	04.08.2013	**Cosp**

Appendix B (Cont'd)

St	Moist	Wd	pH	DO	%DO	EC	Spec.Ec.	Sal	T W	T A	TDS	Atm.P	Date	Species
1	39.2	12.1	9.08	10.42	109.8	101.3	117.4	0.05	17.8	15.3	0.0767	645.3	08.09.2013	**Cv**
2	33.5	11.3	8.68	8.69	91.2	99.1	112.1	0.05	18.6	18.5	0.0235	645.1	08.09.2013	Cv
3	33.6	3.5	8.18	7.64	80.9	99.9	114.3	0.05	18.4	17.9	0.0741	644.8	08.09.2013	Cv
4	34.7	6.5	8.01	8.42	91.2	99.6	112.5	0.05	19	17.8	0.0735	644.9	08.09.2013	Cv
5	51.2	18.3	7.92	6.64	7.17	105.2	118.1	0.05	19.3	14.7	0.0767	644.6	08.09.2013	Cv, Li, **Posp**, Pv
6	48.4	16.3	8.18	8.9	95.2	100.1	112.8	0.05	19	17.3	0.0735	644.3	08.09.2013	Cv, Pv
7	51.7	22.8	9.47	11.28	123.1	101.7	111.7	0.05	20.2	18.9	0.0728	644.4	08.09.2013	**Csp, Isp, Posp**
8	42.5	18.3	9.43	10.55	119.8	97.4	106.8	0.05	20.6	19.6	0.0702	644.4	08.09.2013	Cv, **Ilsp**
9	43.9	23.5	8.43	8.03	86.4	100.7	114.1	0.05	18.8	19.3	0.0741	644.4	08.09.2013	Cv
10	39.2	20.2	8.13	7.43	83.4	99.3	107.6	0.05	20.9	18.5	0.0702	644.5	08.09.2013	
11	31.3	4.8	7.77	4.04	43.2	101.2	117.4	0.05	17.7	19.4	0.0761	644.2	08.09.2013	
12	34.3	3.6	9.11	10.19	118.9	103.8	10.86	0.05	22.7	20.8	0.0708	644.1	08.09.2013	Cv, Hi,**Lsp**
13	35.6	8.3	8.83	8.12	92.1	105.1	112.6	0.05	21.5	19.5	0.0728	643.9	08.09.2013	Cv
14	36.5	6.2	8.05	6.42	68.5	105.3	112.2	0.05	21.5	28.3	0.0735	644.5	08.09.2013	Cv, **Ilsp, Esp**
15	36.7	5.7	8.31	7.42	85.8	111.1	116.2	0.05	23.1	26.3	0.0754	644.3	08.09.2013	Cv, **Lsp**
16	41.5	10.3	7.75	6.54	64.4	135.9	167.7	0.08	15.1	23.8	0.1092	653.3	08.09.2013	

Appendix B (Cont'd)

St	Moist	Wd	pH	DO	%DO	EC	Spec.Ec.	Sal	T W	T A	TDS	Atm.P	Date	Species
1	34.1	10.7	8.02	10.09	94.2	89.9	118.5	0.06	12.3	17.6	0.0764	646.4	10.10.2013	Cv, **Pz, Lsp**
2	25.2	7.4	7.75	8.92	83.2	88.2	116.1	0.05	12.3	17.5	0.0754	646.6	10.10.2013	Cv
3	20.4	3.2	8.08	9.34	89.4	87.7	115.5	0.05	12.4	19.6	0.0754	646.4	10.10.2013	
4	16.2	3.4	8.53	10.96	106.8	89.4	112.2	0.05	14.4	20.3	0.0728	646.4	10.10.2013	Cv, Pv
5	17.3	12.3	8.47	9.09	85.2	88.7	116.1	0.05	12.6	20.7	0.0761	646.2	10.10.2013	Cv, Li, Pv
6	25.2	13.2	8.52	10.48	107.9	93	110.4	0.05	16.7	17.4	0.0715	645.8	10.10.2013	Cv, Li, Pv
7	22.3	14.2	9.25	12.4	128.5	95.6	111.9	0.05	17.4	20.5	0.0728	645.2	10.10.2013	Cv,Casp
8	18.3	7.4	8.26	9.43	93.9	93.2	114.7	0.05	15.2	21.2	0.0748	645.5	10.10.2013	
9	14.5	6.1	8.42	9.27	89.3	89.8	114.6	0.05	13.7	24.7	0.0748	645.4	10.10.2013	
10	17.9	3.3	9.47	12.39	133.3	100.6	113.2	0.05	19.3	24.7	0.0735	645.5	10.10.2013	Cv, **Ilsp, Cosp**
11	15.3	11.2	8.54	8.72	84.2	90.1	114.9	0.05	13.7	20.8	0.0748	645.4	10.10.2013	
12	20.2	3.4	8.65	9.84	107.9	83.7	93.7	0.04	19.6	25.5	0.0611	645.3	10.10.2013	
13	22.2	4.5	8.48	9.21	95.2	90.4	106.5	0.05	17.1	22.8	0.0696	645.1	10.10.2013	
14	24.5	9.4	8.2	9.43	96.1	95.2	113.8	0.05	16.5	19.3	0.0741	645.2	10.10.2013	
15	21.9	2.9	8	8.02	80.1	93.6	114.9	0.05	15.3	21.9	0.0748	645.3	10.10.2013	Cv, **Hrsp**
16	29.3	6.5	6.44	10.79	97	86.6	119.1	0.06	10.7	20	0.0774	654.4	10.10.2013	Cv, Cysp

Appendix B (Cont'd)

St	Moist	Wd	pH	DO	%DO	EC	Spec.Ec.	Sal	T W	T A	TDS	Atm.P	Date	Species
1	36.6	9.2	8.01	10.19	89.4	82.6	116.7	0.05	9.6	17.1	0.0761	642.9	05.11.2013	Cv, **Hrsp, Pz**
2	44.6	12.1	7.53	9.73	83.4	82.1	114.8	0.05	10.1	13	0.0748	642.9	05.11.2013	Cv
3	35.2	3.4	7.86	9.46	84.8	82.5	114.2	0.05	10.5	15.9	0.0741	642.9	05.11.2013	Ko
4	33.6	6.4	7.75	10.32	92.7	82.2	113.5	0.05	10.6	14.4	0.0735	643.1	05.11.2013	Cv
5	31.6	19.3	8.03	10.48	93.9	82.5	115.3	0.05	10	16.8	0.0748	642.9	05.11.2013	**Cv**, Li, Pv
6	22.1	4.3	8.66	12.85	121.3	80.9	105.3	0.05	12.9	20.3	0.0689	642.3	05.11.2013	Pv
7	29.5	3	9.03	13.04	126.4	88.6	112.3	0.05	14.1	16.6	0.0728	641.8	05.11.2013	
8	27.1	10.8	8.28	11.39	104.8	84.5	112.6	0.05	12	17.9	0.0735	641.8	05.11.2013	Pv
9	29.2	6.3	8	9.95	90.7	83.1	112.9	0.05	11.2	17.6	0.0735	641.4	05.11.2013	
10	30.9	11.2	8.09	10.11	97.5	83.2	107.1	0.05	12.6	17.1	0.0539	641.5	05.11.2013	**Cv**
11	32.3	9.9	7.91	8.56	78.1	83.3	113.3	0.05	11.1	14.5	0.0735	641.5	05.11.2013	
12	35.3	15.2	7.62	9.16	85.1	82.6	110	0.05	21	15.4	0.0715	641.6	05.11.2013	**Cv**
13	42.8	11.9	7.58	9.37	85.2	82.1	111.9	0.05	11.1	14.4	0.0728	641.4	05.11.2013	**Cv,** Ko
14	41.9	25.2	7.51	9.19	84.7	84.4	113.7	0.05	11.7	14.1	0.0741	641.6	05.11.2013	
15	48.9	21.2	7.69	6.44	63.6	127.4	157.5	0.07	15	12.9	0.1021	641.8	05.11.2013	Cv, **Ilsp**

Appendix B (Cont'd)

St	Moist	Wd	pH	DO	%DO	EC	Spec.Ec.	Sal	T W	T A	TDS	Atm.P	Date	Species
1	35.3	7.2	8.37	14.95	110.7	72.3	125.6	0.06	2.8	5.4	0.0819	639.4	06.12.2013	**Cv**
2	32.8	6.4	7.82	14.65	113.1	72.2	118.8	0.06	4.5	4.9	0.0774	639.3	06.12.2013	
3	35.7	15.8	7.87	15.11	113.7	69.7	118.2	0.06	3.4	4.7	0.0767	639.4	06.12.2013	
4	33.3	6.4	7.95	15.85	120.9	70.1	115.5	0.05	4.4	3.2	0.0754	639.7	06.12.2013	
5	30.4	8.3	7.93	14.71	115.2	73.2	118.4	0.06	5	6.4	0.0767	640	06.12.2013	
6	34.9	15.4	7.93	14.67	113.9	71.7	117.5	0.06	4.5	4.3	0.0767	640	06.12.2013	
7	29	12.9	-	-	-	-	-	-	-	3.9	-	-	06.12.2013	
8	25.3	2.4	7.98	15.37	120.3	71.8	115.6	0.05	5.2	9.9	0.0754	639.7	06.12.2013	
9	33.8	5.3	7.98	14.59	113.9	71.8	117.2	0.06	4.9	3.7	0.0761	639.6	06.12.2013	
10	32.1	9.3	8	15.11	119.6	74.7	116.7	0.05	5.9	9.3	0.0767	639.6	06.12.2013	
11	32.3	7.1	7.85	14.13	112.5	73.7	116.6	0.05	5.6	4.2	0.0761	639.6	06.12.2013	
12	34.3	8.7	7.81	14.75	121.7	76.5	116.3	0.05	7	7.2	0.0754	639.4	06.12.2013	
13	30.1	2.5	7.76	14.77	118.6	74.4	116.7	0.05	6	8.7	0.0761	639.1	06.12.2013	Cv
14	30.2	11.9	7.78	14.71	117.9	75.9	119.2	0.06	5.9	6.6	0.0774	639.4	06.12.2013	
15	32.4	12.3	7.74	14.74	116.1	73.5	117.9	0.06	5.3	5.2	0.0767	639	06.12.2013	

Appendix B (Cont'd)

St	Moist	Wd	pH	DO	%DO	EC	Spec.Ec.	Sal	T W	T A	TDS	Atm.P	Date	Species
1	72.8	5.8	7.98	14.85	112.5	73.8	124	0.06	3.8	4.8	0.0806	640	10.02.2014	**Csp**
2	59.4	0	7.72	14.27	108.7	69.8	115.9	0.05	4.2	8.6	0.0754	640.4	10.02.2014	
3	58.7	0	7.85	2.9	92.1	37.9	67.8	0.03	1.8	10.3	0.0448	639.9	10.02.2014	
4	66.9	5.2	7.45	14.64	109.9	56.6	96.1	0.04	3.5	8.3	0.0618	639.7	10.02.2014	
5	67.5	4.2	7.68	14.91	113.7	75.9	126.1	0.06	4.2	9.3	0.0819	640.1	10.02.2014	
6	63.5	10.2	7.78	18.03	125.2	72.4	119.3	0.06	4.4	7.7	0.0774	640.3	10.02.2014	
7	68.6	10.2	7.82	20.4	148.1	91.3	53.1	0.04	3	6.9	0.0598	640	10.02.2014	
9	79.1	2.9	7.58	12.94	100.9	70.7	116.8	0.05	4.6	5.8	0.0754	640.4	10.02.2014	
10	65.4	8.6	7.64	16.48	127.1	70.4	113.4	0.05	5.2	9.3	0.0741	640.3	10.02.2014	**Cv**
11	62.3	7.4	7.58	13.6	103.8	67.8	112.8	0.05	4.1	7.5	0.0735	640.4	10.02.2014	
12	65.2	8.4	7.8	16.03	122.1	59.6	99.3	0.05	3.9	6.2	0.0643	640.1	10.02.2014	
13	56.8	1.5	7.68	15.03	119	72.5	115.5	0.05	5.5	13.6	0.0748	639.8	10.02.2014	
14	53.7	7.9	7.81	11.06	83.1	40.8	69.2	0.03	3.4	7.1	0.0448	640.1	10.02.2014	
15	53.8	2.1	7.44	13.32	106.4	113.5	178.7	0.08	5.9	11.9	0.1157	639.8	10.02.2014	**Cv**
16	68.8	7.9	7.69	16.83	128	71.7	118.4	0.06	4.5	10.1	0.0774	649	10.02.2014	Cv

Appendix B (Cont'd)

St	Moist	Wd	pH	DO	%DO	EC	Spec.Ec.	Sal	T W	T A	TDS	Atm.P	Date	Species
1	59.5	12.4	8.32	16.4	127.8	54.5	85.4	0.05	5.1	6.5	0.0561	637.8	08.03.2014	
2	90.5	6.3	7.44	14	113.5	72.7	114.6	0.05	5.9	7.6	0.0748	638	08.03.2014	
3	94.5	3.8	7.69	19.2	164.8	72.8	114.3	0.05	5.9	11.1	0.0741	638	08.03.2014	
4	92.4	13.7	7.49	15.63	127.7	59.9	94.3	0.04	5.9	7.5	0.0611	638	08.03.2014	
5	78.5	4.2	7.62	20.49	184.2	78.2	122.5	0.06	6.1	6.1	0.0739	638.4	08.03.2014	**Cv**
6	92.2	4.2	7.65	15.7	118.9	41.2	66.1	0.03	5.2	10.9	0.0429	638.3	08.03.2014	
7	60.8	4.1	7.65	15.68	126.7	54.4	84.5	0.04	6.2	12.8	0.0533	638.5	08.03.2014	Cw
8	62.7	1.5	7.74	15.08	123.1	73.1	113.6	0.05	6.3	12.5	0.0741	638.7	08.03.2014	
9	75.6	5.4	7.68	17.63	155.4	70.5	111.2	0.05	5.9	5.5	0.0715	638.2	08.03.2014	
10	62.1	3.8	7.79	17.5	148.4	56.3	89.4	0.04	5.6	7.4	0.0579	638.3	08.03.2014	
11	58.4	3	7.79	14.81	122.1	71.5	111.8	0.05	6.2	10.9	0.0728	638.6	08.03.2014	
12	63.5	6.2	7.84	16.7	150.3	70	110.2	0.05	6.4	7.5	0.0715	638.3	08.03.2014	
13	74.2	7.9	7.76	15.88	131.2	73.8	115.8	0.05	6	5.6	0.0754	638.2	08.03.2014	
14	66.7	6	7.67	14.49	115.1	70.8	112.4	0.05	5.6	6.1	0.0735	637.8	08.03.2014	**Cv**
15	53.4	10.9	7.8	15.8	119.8	40.8	78.2	0.02	5.5	6.4	0.042	637.7	08.03.2014	
16	84.5	6.2	7.87	16.8	129.7	62.2	98.5	0.05	5.8	7.7	0.0637	647.8	08.03.2014	

Appendix B (Cont'd)

St	Moist	Wd	pH	DO	%DO	EC	Spec.Ec.	Sal	T W	T A	TDS	Atm.P	Date	Species
1	34.6	12.7	8.46	16.3	143.3	83.5	116.8	0.05	10	17.8	0.0761	638.9	07.04.2014	**Cv**
2	32.2	4.8	8.21	14.8	136.9	84.5	112.5	0.05	12	18.5	0.0735	637.7	07.04.2014	
3	23.7	7.4	8.47	14.05	124.7	81.1	113.5	0.05	10.3	19.7	0.0741	637.7	07.04.2014	
4	29.4	12.6	8.62	16.73	151	82	112.4	0.05	11.1	19.5	0.0735	637.7	07.04.2014	
5	26.7	4.1	8.45	16.21	145.9	82.2	113.5	0.05	10.7	20.8	0.0741	638	07.04.2014	
6	30.4	3.4	8.49	14.11	128.3	84.3	113.1	0.05	11.8	18.5	0.0735	638.1	07.04.2014	
7	35.1	23.9	8.61	15.76	151.3	87.7	110.9	0.05	14.2	17.8	0.0722	638.5	07.04.2014	
8	32.9	2.1	8.36	14.91	134.4	82.3	112.6	0.05	10.9	21.1	0.0735	638.1	07.04.2014	
9	29.3	3.4	8.21	14.12	124	78.7	111.6	0.05	9.6	19.2	0.0735	638.1	07.04.2014	
10	32.3	4.6	8.16	13.54	122.7	79.9	109.8	0.05	10.8	17.9	0.0715	638.2	07.04.2014	
11	23.6	2	8	12.82	112.2	73	103.7	0.05	9.5	21.1	0.0676	638.3	07.04.2014	
12	40.1	5.3	8.22	15.19	137.4	74.5	102.1	0.05	11.1	15.5	0.0663	638.5	07.04.2014	
13	31.4	5.9	8.05	15.1	136.7	80.8	109.4	0.05	11.2	21.6	0.0708	638.6	07.04.2014	
14	40.5	10.3	8.11	14.54	131.2	80.7	110.6	0.05	10.8	17.7	0.0722	638.6	07.04.2014	
15	39.3	7.5	8.19	15.24	140.6	84.3	112.8	0.05	11.9	13.4	0.0735	638.8	07.04.2014	
16	25.5	9.4	8.42	4.16	135	68	86.8	0.04	13.6	19.8	0.0565	646.4	07.04.2014	Esp
17	23.1	1.8	8.06	11.66	113.7	72.8	91.6	0.04	14.3	20	0.0591	636.7	07.04.2014	

Appendix B (Cont'd)

St	Moist	Wd	pH	DO	%DO	EC	Spec.Ec.	Sal	T W	T A	TDS	Atm.P	Date	Species
1	75.1	6.5	8.27	11.83	106.4	86.6	118.6	0.6	10.9	12.6	0.0774	638.3	05.05.2014	
2	46.2	3.6	8.66	11.76	111.2	88.8	113.7	0.05	13.5	17.8	0.0741	644.2	07.05.2014	
3	54.1	2.3	7.98	10	94.8	84.3	109.3	0.05	13	15.2	0.0708	644.4	07.05.2014	
4	44.6	3.4	8.19	11.96	118	89.6	111.3	0.05	14.8	16.2	0.0722	643.6	07.05.2014	
5	38.9	1.9	8.35	11.21	106.7	88.5	114.1	0.05	13.3	21.4	0.0741	643.7	07.05.2014	
6	44.4	1.8	8.09	14.25	138.4	74.5	94	0.04	14.2	24.6	0.0611	643.1	07.05.2014	
7	58.8	14.3	7.75	14.16	122.3	75.5	95.2	0.04	14.2	12.7	0.0618	642.8	07.05.2014	
8	57.3	6.4	7.86	12.65	121.9	91.4	115.8	0.05	14	13.6	0.0748	643.3	07.05.2014	
9	47.6	3.1	8.45	15.01	144.7	81.7	107	0.05	12.8	17.7	0.0696	643.1	07.05.2014	
10	52.5	9.6	8.64	12.35	127.4	87.7	104.8	0.05	16.5	17.2	0.0682	643.5	07.05.2014	
11	55.3	9.3	8.34	12.56	117.6	83.6	108.4	0.05	13.2	14	0.0702	643.3	07.05.2014	
12	50.3	3.3	8.04	14.52	141.5	85.3	107	0.05	14.4	15.5	0.0696	642.9	07.05.2014	
13	48.7	1.9	8.1	12.89	127.3	84.5	103.7	0.05	15.4	17.5	0.0676	642.9	07.05.2014	
14	50.2	3.2	8.18	14.07	139.9	87.1	108.3	0.05	14.6	18.1	0.0702	643.2	07.05.2014	
15	73.8	4.8	7.84	11.76	106.4	77.6	106.7	0.05	10.7	13.2	0.0696	638.4	05.05.2014	
16	55.6	8.9	8.13	12.74	119	69.9	86.1	0.04	11.5	15.7	0.0565	652.7	07.05.2014	

Appendix B (Cont'd)

St	Moist	Wd	pH	DO	%DO	EC	Spec.Ec.	Sal	T W	T A	TDS	Atm.P	Date	Species
1	47.6	14.2	8.35	65.6	6.37	175.2	207.4	0.1	16.8	18.2	0.1352	641.8	13.06.2014	**Esp**
2	38.2	1.7	8.22	7.24	79.9	90.2	100.1	0.05	19.8	22.5	0.065	641.1	13.06.2014	
3	37.2	4.4	4.46	7.65	83.3	91	101.3	0.05	19.7	20.4	0.0657	641.2	13.06.2014	
4	44.2	5.2	8.73	9.97	107.9	85.5	97	0.04	18.8	21.5	0.0631	641.4	13.06.2014	
5	40.7	13.4	8.63	9.05	87.2	88.9	101.4	0.05	18.6	21.3	0.0657	641.2	13.06.2014	
6	48.3	15.2	7.86	7.29	77.4	89.7	102.7	0.05	18.2	19.7	0.0663	641.3	13.06.2014	
7	52.4	12.9	8.12	7.7	83.6	92.1	103.6	0.05	19.2	16.7	0.067	641.4	13.06.2014	
8	49.5	11.1	7.92	6.99	75.7	92.6	104.8	0.05	18.9	16.3	0.0682	641.1	13.06.2014	
9	51.8	14.8	8.16	6.93	71.4	85.3	101.3	0.05	16.7	17.8	0.0657	641	13.06.2014	**Pv**
10	47.8	14.5	8.19	7.68	80.1	87.2	102.1	0.05	17.4	20.5	0.0663	641.2	13.06.2014	
11	37.3	4.2	8.46	8	83.3	85.7	100.4	0.05	17.3	21.6	0.065	641.1	13.06.2014	
12	33.5	2.2	8.38	5.91	61.8	87.3	102	0.05	17.4	22.3	0.0663	641.3	13.06.2014	Cv
13	33.8	6.5	8.63	7.91	83.9	87.4	100.4	0.05	18.3	23.9	0.065	641.4	13.06.2014	
14	39.2	6.9	8.3	6.83	70.5	86.1	101.9	0.05	19.9	16.9	0.0663	641.6	13.06.2014	
15	38.3	7.8	8.1	6.5	65.9	123.3	149.3	0.07	15.9	21.3	0.0969	641.8	13.06.2014	
16	44.7	9.2	8.25	8.82	79.9	73.4	87.8	0.04	16.5	20.4	0.0572	650.2	13.06.2014	Cn,Ccsp
17	38.7	3.5	7.92	6.54	68.1	107.4	125.1	0.06	17.4	23.2	0.0819	640.4	13.06.2014	Cv, Sf

Appendix B (Cont'd)

St	Moist	Wd	pH	DO	%DO	EC	Spec.Ec.	Sal	T W	T A	TDS	Atm.P	Date	Species
1	47.5	6.3	8.79	5.83	64.1	107.3	118.9	0.06	19.9	21.3	0.0774	643.3	06.07.2014	**Zsp**
2	41.4	2.7	8.93	6.39	74.4	99.2	102.9	0.05	23.2	25.4	0.067	642.2	06.07.2014	
3	40.1	3.1	8.4	6.28	69.8	95.4	103.2	0.05	21	25.7	0.067	642	06.07.2014	
4	43.2	4.1	8.5	6.06	69.3	97.3	103.2	0.05	22	26.6	0.067	642.5	06.07.2014	**Cv**
5	45.3	8.2	8.77	6	69.8	101	104.9	0.05	23.1	26.1	0.0682	642.3	06.07.2014	
6	35.7	1.9	9.13	8.14	99.9	104.7	102.8	0.05	26	26.3	0.067	642.2	06.07.2014	
7	43.8	6.3	9.28	7.86	94	103.1	104.3	0.05	24.4	24.5	0.0676	642	06.07.2014	
8	46.7	2.3	9.01	9.05	106.3	99.9	102.8	0.05	23.5	24.9	0.067	642.3	06.07.2014	
9	42.3	9.4	8.33	5.87	65.9	96.2	103.9	0.05	21.1	24.5	0.0676	642.3	06.07.2014	
10	38.4	7.3	8.13	5.82	66.3	96.8	102.8	0.05	21.9	24.5	0.067	642.1	06.07.2014	
11	37.2	4.6	8.07	6.36	71.5	95.9	103.8	0.05	21	26.2	0.0676	642.3	06.07.2014	
12	35.1	1.9	8.46	5.66	64.2	97.1	103.9	0.05	21.6	29.2	0.0676	642.6	06.07.2014	
13	35.2	1.8	8.44	6.42	72.3	97.2	103.9	0.05	21.6	32.7	0.0676	642.7	06.07.2014	
14	38.1	2.1	8.32	5.4	60.9	96.4	103.9	0.05	21.2	24.2	0.0676	643.2	06.07.2014	
15	42.4	7.6	8.44	5.66	63.4	95.5	103.7	0.05	20.9	23.1	0.0676	643.2	06.07.2014	Cv
16	41.3	10.2	7.95	7	78.7	105.2	113.6	0.05	21.1	26.3	0.0741	651	06.07.2014	Cv, Pv, **Casp**
17	40.7	2.1	7.95	5.15	52.1	66.7	80	0.04	16.3	26.5	0.052	641.7	06.07.2014	Cg, Cv, Hb

Appendix B (Cont'd)

St	Moist	Wd	pH	DO	%DO	EC	Spec.Ec.	Sal	T W	T A	TDS	Atm.P	Date	Species
1	40.8	3.5	8.24	4.65	59	121.1	115.8	0.05	25.9	27.3	0.0754	639.2	06.08.2014	**Csp**
2	30.3	3.2	7.9	7.16	87.5	112.5	110.8	0.05	24.9	26.9	0.0722	638.1	06.08.2014	
3	29.6	10.8	7.62	5.8	67.8	106.6	110.6	0.05	23.1	27.1	0.0715	638	06.08.2014	
4	28.4	2.1	7.78	5.3	63	107.8	110	0.05	24	29.2	0.0715	638.1	06.08.2014	Cv
5	41.6	15.7	7.5	3.99	45.2	122.1	120.3	0.06	25.6	24.2	0.078	638.2	06.08.2014	
6	38.5	7.5	7.84	5.21	65.3	112.4	108.4	0.05	26.9	24.8	0.0702	638.4	06.08.2014	
7	34.5	8.8	8.38	4.79	61.3	114.3	107.2	0.05	28.1	26.4	0.0696	638.2	06.08.2014	
8	36.7	12.8	8.21	5.32	67.2	113.1	109.1	0.05	27.3	25.2	0.0708	638.5	06.08.2014	Cv, **Hrsp**
9	33.4	8.4	8.32	6.01	70.9	106.4	109.3	0.05	23.6	26.2	0.0706	638.4	06.08.2014	Cv
10	41.3	17.9	8.79	5.88	73.4	110.9	107.7	0.05	26.6	24.7	0.0702	638.5	06.08.2014	**Hrsp**
11	33.6	15.3	8.07	5.88	69.3	106.5	109.4	0.05	23.6	26.2	0.0708	638.7	06.08.2014	Cv, **Hrsp**
12	27.3	1.7	8.04	5.68	68.4	107.4	107.9	0.05	26.8	28.4	0.0702	638.5	06.08.2014	Cv
13	26.5	3.5	7.74	5.25	62.5	107.3	108.6	0.05	24.4	26.6	0.0708	638.7	06.08.2014	**Hrsp**
14	29.2	2.3	7.93	5.16	60.9	106.9	109.8	0.05	23.5	28.4	0.0715	639.1	06.08.2014	
15	34.2	5.2	7.97	4.57	57.1	116.2	112.1	0.05	27	24.5	0.0728	639.5	06.08.2014	Cv, Posp
16	35.7	10.4	7.23	4.24	47.8	133.7	138.4	0.06	23.2	25.5	0.0897	647.2	06.08.2014	
17	35.2	8.5	6.99	1.25	12.7	90	105.2	0.05	17.5	27.1	0.0682	637.6	06.08.2014	Cv, Cg

Appendix B (Cont’d)

St	Moist	Wd	pH	DO	%DO	EC	Spec.Ec.	Sal	T W	T A	TDS	Atm.P	Date	Species
1	44.1	1.9	8.76	4.64	53.6	122.8	128.7	0.06	22.5	28.5	0.0832	641	04.09.2014	Cv
2	61.3	3.7	8.27	9.37	109.3	109.5	112.6	0.05	23.5	23.6	0.0735	640.2	04.09.2014	
3	62.5	10.8	8.27	7.91	91.8	111.5	116.4	0.05	22.8	22.5	0.0761	639.1	04.09.2014	Hs
4	48.4	4.9	8.51	9.83	114.6	109.4	113.9	0.05	22.9	25.2	0.0741	639.8	04.09.2014	
5	64.3	10.8	7.99	5.11	62.4	119.5	118.1	0.05	25.5	22	0.0767	639.9	04.09.2014	
6	51.5	7.8	8.38	10.03	118.4	108.8	109.9	0.05	24.7	23.2	0.0728	639.8	04.09.2014	
7	47.1	7.1	8.69	10.96	135.1	101.2	100	0.05	25.7	27.6	0.065	639.7	04.09.2014	Cv
8	35.5	3.2	8.41	10.5	124.8	110.1	112.2	0.05	24.5	27.1	0.0735	639.9	04.09.2014	
9	39.9	2.4	8.64	10.03	116.5	108.8	113.7	0.05	22.8	31.3	0.0741	640.1	04.09.2014	
10	43.9	1.8	9.36	12.69	156.7	115.1	115.1	0.05	25	25.5	0.0748	639.7	04.09.2014	Cv
11	50.1	9.8	8.37	10.7	116.6	108.1	114.2	0.05	22.6	24.5	0.0741	639.8	04.09.2014	Cv
12	41.4	1.7	8.5	9.81	115.6	110.9	113.8	0.05	23.6	29.4	0.0741	640.1	04.09.2014	Cv
13	34.02	3.4	8.97	8.48	100.7	121.2	121.4	0.06	23.6	27.6	0.08	640.2	04.09.2014	Cv, Hc
14	41.4	5.2	8.67	3.48	45.3	109	112	0.05	23.5	27.9	0.0728	640.7	04.09.2014	
15	35.9	2.1	8.37	4.01	46	109	115.2	0.05	22.2	28.7	0.0748	641.2	04.09.2014	
16	56.1	2.1	7.19	6.1	67.8	123.7	135.2	0.06	20.6	24.9	0.0878	649.7	04.09.2014	Cg, Cv
17	66.8	0	7.31	2.28	22.4	180.7	215.7	0.1	16.8	22.9	0.1378	639.5	04.09.2014	Cg

Appendix C Pseudorichness ratios of some water bodies. Pseudorichness ratio (number of noncosmopolitan/ cosmopolitan); (M) man-made; (N) natural habitats. Given sources below where the tamplate data came from.

Locations	**Total species**	**non cosmopolitan**	**cosmopolitan**	**Pseudorichness ratio**	**Sources**
Taşlıyayla Reservoir (M)	8	2	6	0.33	Present study
Lake Yeniçağa (M)	13	4	9	0.44	Külköylüoğlu et al., 2007
Dam Gölcük (M)	6	2	4	0.50	Külköylüoğlu and Dügel, 2004
Lakelet Aladağ (M)	7	1	6	0.17	Yılmaz and Külköylüoğlu, 2006
Dam Gölköy (M)	10	3	7	0.43	Külköylüoğlu, 2005a
Lake Abant (N)	12	3	9	0.33	Dügel et al., 2008
Lake Sazlı (N)	5	1	4	0.25	Ustaoğlu et al., 2003
Lake Çubuk (N)	17	9	8	1.13	Sarı, 2007

PHOTOS

Numbers on photos represents the station numbers


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T.C.
BOLU VALİLİĞİ
İL ÖZEL İDARESİ
SEBEN TAŞLIYAYLA SULAMA GÖLETİ
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