

ABANT İZZET BAYSAL UNIVERSITY
THE GRADUATE SCHOOL OF NATURAL AND APPLIED
SCIENCES



DETERMINATION OF MORPHOLOGICAL AND
ECOLOGICAL FEATURES OF FRESHWATER OSTRACODS
(CRUSTACEA) IN ADIYAMAN AND BURDUR (TURKEY): A
COMPARATIVE ANALYSIS OF GEOGRAPHICAL
DISTRIBUTION

DOCTOR OF PHILOSOPHY

Mehmet YAVUZATMACA

BOLU, JUNE 2015

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APPROVAL OF THE THESIS

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Director, Graduate School of Natural and Applied Sciences

To my mother and father

Zahide YAVUZATMACA

Mehmet YAVUZATMACA

and

to my family

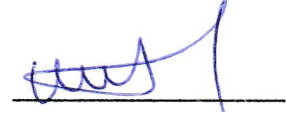
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Mehmet YAVUZATMACA



ABSTRACT

DETERMINATION OF MORPHOLOGICAL AND ECOLOGICAL FEATURES OF FRESHWATER OSTRACODS (CRUSTACEA) IN ADIYAMAN AND BURDUR (TURKEY): A COMPARATIVE ANALYSIS OF GEOGRAPHICAL DISTRIBUTION

Ph.D THESIS

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ABANT İZZET BAYSAL UNIVERSITY GRADUATE SCHOOL OF
NATURAL AND APPLIED SCIENCES

DEPARTMENT OF BIOLOGY

(SUPERVISOR: Prof. Dr. Okan KÜLKÖYLÜOĞLU)

BOLU, JUNE 2015

In order to compare species composition of non-marine ostracods and determine their distributional patterns and ecological preferences, 241 samples were collected from Adıyaman and Burdur provinces. In Adıyaman, 26 recent and 15 sub-recent taxa were reported from 111 of 120 randomly selected sampling sites. All of these taxa are new records for the region. Of which, *Schellencandona insueta* and *Gomphocythere besni* n. sp were reported for first time in Turkey and later is a new in literature. In Burdur, 22 recent and 13 sub-recent taxa were recorded from 110 of 121 randomly selected sampling sites. 21 of them are new for Burdur. The hypothesis "Ostracod species are randomly distributed among sampling sites" was accepted in Adıyaman ($P > 0.05$) while it was rejected for Burdur and both provinces (ADIBUR). According to Index of Dispersion (S^2/μ) and *d-statistics*, ostracod species showed clump and regular distribution in Burdur and ADIBUR, respectively. The first two axes of Canonical Correspondence Analyses (CCA) in Adıyaman, Burdur and ADIBUR explained 77.4, 84.5 and 69.7 % of relationships between species and environmental variables, respectively. According to the CCA, water temperature was found as the most effective environmental variable on species. A direct effect of regional factors (e.g., elevation) could not be seen while local factors (e.g., pH, water temperature) have an important influence on the occurrence and distribution of species. Cosmopolitan species with high tolerance levels to different environmental variables were generally found as dominant in both provinces and in different aquatic bodies. With respect to the Alpha Diversity indices values of springs, ponds and creeks, they can be considered as the source habitats for ostracods but that should be investigated and tested in future studies. Besides the difference in the quality of species and habitats in both provinces, a significant difference ($P < 0.05$) was found between the mean elevation and water temperatures.

KEYWORDS: Ostracoda, Poisson distribution, cosmoecious species, source-sink habitat, *Gomphocythere besni* n. sp.

ÖZET

ADİYAMAN VE BURDUR (TÜRKİYE) İLLERİNDEKİ TATLISU OSTRAKODLARININ (CRUSTACEA) MORFOLOJİK VE EKOLOJİK ÖZELLİKLERİNİN BELİRLENMESİ: COĞRAFİK DAĞILIMLARININ KARŞILAŞTIRMALI ANALİZİ

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(TEZ DANIŞMANI: Prof. Dr. Okan KÜLKÖYLÜOĞLU)

BOLU, HAZİRAN 2015

Denizel olmayan ostrakod tür kompozisyonunu karşılaştırmak ve dağılım desenleri ve ekolojik tercihlerini belirlemek amacıyla 241 numune Adıyaman ve Burdur illerinden toplanmıştır. Adıyaman'dan 41 taksa (26 güncel, 15 güncel-olmayan) rastgele seçilmiş 120 örnekleme yerinin 111'den tespit edilmiştir. Bu taksonların tümü bölge için yeni kayıttır. Bunlardan *Schellencandona insueta* ve *Gomphocythere besni* n. sp. Türkiye de ilk defa rapor edilmiş ve *G. besni* n. sp. ise literatür için yenidir. Burdur'dan 121 rastgele seçilmiş örnekleme yerinin 110'un dan 35 taksa (22 güncel 13 güncel-olmayan) kayıt edilmiştir. Bunlardan 21 tanesi Burdur için yeni kayıt. "Ostrakod türleri örnekleme yerleri arasında rastgele dağılmışlardır" hipotezi Adıyaman'da kabul edilmiş ($P > 0.05$) iken Burdur ve iki ilin verileri (ADIBUR) için kabul edilmemiştir ($P < 0.05$). Dağılım İndeksi (S^2/μ) ve *d-istatistiks'e* göre Burdur ve ADIBUR'da ostrakodların dağılım desenleri sırasıyla kümesel ve düzenli olarak bulunmuştur. Kanonik İlişki Analizi (CCA)'nin ilk iki eksenini Adıyaman, Burdur ve ADIBUR'da sırasıyla türler ve çevresel değişkenler arasındaki ilişkinin % 77.4, 84.5 ve 69.7'ni açıklamıştır. CCA'ne göre su sıcaklığı tür dağılımı üzerindeki en etkili çevresel değişken olarak bulunmuştur. Lokal faktörlerin (örneğin, pH, su sıcaklığı) türlerin bulunması ve dağılımı üzerinde önemli bir etkisi varken, bölgesel faktörlerin (örneğin, yükseklik) doğrudan bir etkisi görülememiştir. Genel olarak kozmopolitan türler iki ilde ve farklı sucul ortamlarda farklı çevresel değişkenlere gösterdikleri yüksek toleransları ile baskın olarak bulunmuşlardır. Alfa çeşitlilik indeks değerlerine göre kaynaklar, havuzcuklar ve küçük derelerin ostrakodlar için kaynak konumlu habitatlar olabileceği düşünülmektedir. Fakat ileriki çalışmalarda bu irdelenmeli ve test edilmelidir. Her iki ilde ki tür ve habitat kalitelerinin yanı sıra, önemli ($P < 0.05$) bir fark ortalama yükseklik ve su sıcaklıkları arasında da bulunmuştur.

ANAHTAR KELİMELE: Ostrakoda, Poisson dağılımı, kozmoşius tür, kaynak-çöküntü habitat, *Gomphocythere besni* n. sp.

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ACKNOWLEDGEMENTS

I wish to express my deepest gratitude to my supervisor Prof. Dr. Okan KÜLKÖYLÜOĞLU for his guidance, advice, criticism, encouragements and insight throughout the research.

I would also like to thank Mr. Mahmut KANAÇ for his helping and guidance to find sampling sites and collect samples in Adıyaman. My special thanks also go to Mrs. Sinem YILMAZ and Mr. Ozan YILMAZ for their help during field studies.

Dr. Maria Cristina CABRAL (Universidade de Lisboa) and late Prof. Dr. Jean-Paul COLIN (France) are thanked for their contribution to the description of the carapace morphology of *Gomphocythere besni* n. sp. Also, I thank to Telmo NUNES (Centro de Biologia Ambiental, University of Lisbon, Portugal) for making the Scanning Electron Microscope (SEM) photos and Vera LOPES (Departamento de Geologia, University of Lisbon, Portugal) for preparing the figure and the plates.

Ian BOOMER (University of Birmingham, U. K.) kindly sending us SEM photos of *Gomphocythere geareyi*, and Dan L. DANIELOPOL (Karl Franzens Univ. Graz, Austria) provided the geometric morphometric data are gratefully acknowledged.

This study was funded by the Scientific Research Project Agency of Abant İzzet Baysal University Project No: 2012.03.01.534.

1. INTRODUCTION

1.1 Ostracoda

Ostracods are microscobic small bivalved aquatic invertebrates of subphylum Crustacea in phylum Arthropoda and generally 0.3 - 5 mm long but some marine species pass 30 mm in length. Its name derived from Greek word "ostrakon" which refers to shell (Meisch, 2000). In 1746, Linne firstly described the ostracod species *Monoculus conchapedata* (Ferguson, 1944) and then Baker (1753) illustrated an ostracod for first time which is most likely a *Cypris* (Oertli, 1982 sensu Rodriguez-Lazaro & Ruiz-Muñoz, 2012). Thus, the entrance of ostracod to science history was began. In 1772, O. F. Müller firstly gave the Linnean taxonomy to an ostracod in Europe (Rodriguez-Lazaro & Ruiz-Muñoz, 2012). Furthermore, the French scientist Pierre André Latreille named the class Ostracoda as "Ostrahoda" in 1802 but later changed it as "Ostracoda" in 1806 (Ikeya et al., 2005; Rodriguez-Lazaro & Ruiz-Muñoz, 2012). The first fossil report of ostracods was back to the Cambrian period about 500 mya and so they are known as the oldest microfauna (Delorme, 1991). Indeed, the globally presence of ostracods in sediments beginning at the early Ordovician about 490 mya (Ozawa, 2013).

The Class Ostracoda consists of two sub-classes and five orders. The sub-class Myodocopa includes orders Myodocopida and Halocyprida whereas the other sub-class Podocopa consists of orders Paleocopida, Platycopida and Podocopida (Horne et al., 2002; Horne, 2003). The living ostracods are comprised by three orders. Of which, Platycopida and Myodocopida cover marine species while freshwater species are represented by order Podocopida which also contains some marine and brackish water species. In addition, the history of order Podocopida goes back to the Ordovician period (about 450 mya) and then splitted into Cytheroidea and Cypridoidea during the Devonian period (about 370 mya), and later Darwinuloidea during the Carboniferous period (about 300 mya) (Delorme, 1991).

Additionally, the superfamilies Cypridoidea, Ctyheroidea and Darwinuloidea encompass all non-marine species (Meisch, 2000).

1.2 Morphology of ostracods

1.2.1 Carapace

Carapace is the diagnostic and more distinct character of ostracods which is made up of two valves connected to each other at dorsal margin by a structure called as “hinge” (Meisch, 2000). This chitinous and calcitic exoskeleton protects the soft body from injury comes from outside. The outer chitinous epidermis of it is mineralized by low magnesium calcium carbonate (calcite) that covers the calcitic shell and so which is easily fossilized in sediments (Delorme, 1991; Karanovic, 2012). The closing and opening of valves are controlled by central adductor muscles whose scars (Figure 1.1) are differently oriented in superfamilies (e.g. like rosette in Darwinuloidea) (Meisch, 2000). Indeed, the surface of carapace consist of pore canals (radial pores, normal pores and sieve pores) and some of which bear sensilla and carry nerves (Karanovic, 2012) so they have sensorial functions. In addition, the surface of valves (carapace) may be smooth and covered with pits as punctate and fossae, sulci, alae, pustules, tubercles or nodes and etc. These ornamentations are used for species and generic identification especially in fossil forms (Delorme, 1991; Martens, 1998; Meisch, 2000; Karanovic, 2012; Rodriguez-Lazaro & Ruiz-Muñoz, 2012) (for more detail see the given references). The appendages of ostracods are generally kept inside of the carapace but sometimes when you outwardly look at the carapace, the tips of some of them can be seen like antenna, antennule, cleaning legs, walking legs and uropod (Figure 1.2) as long as the valves open (Meisch, 2000; Karanovic, 2012).

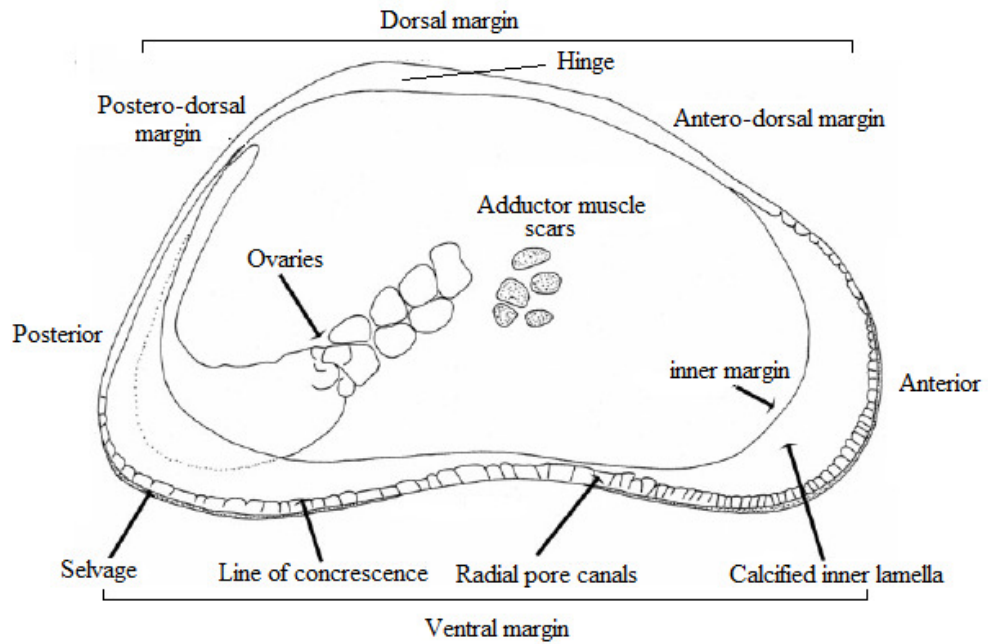


Figure 1.1. The interior view of left valve of *Candona* sp. Modified from Karanovic (2012).

1.2.2 Appendages

In general, the body segmentation as head, thorax and abdomen are available in arthropod but they are not distinguishable in ostracods (Meisch, 2000). This is because they have a shortened body and so only the head and abdomen of body segmentations are available (Delorme, 1991). Besides, it is supposed that the Podocopid ostracods have a maximum 11 trunk segmentations of thorax and abdomen (Tsukagoshi & Parker, 2000 sensu Karanovic, 2012).

The adult of Podocopid ostracods have eight pairs of appendages (Figure 1.2) which are Antennula (sensorial and locomotory function, A1), Antenna (sensorial, locomotory function and bearing swimming setae, A2), Mandibula (masticatory process for feeding and carry vibratory plate, Md), Maxillula (2 segmented palp, 3 masticatory lobes and carry vibratory plate, Mx1), First Thoracopod (second maxilla or maxilliped and which is also change in shape and function, T1 or L5), Second Thoracopod (walking leg, T2 or L6), Third Thoracopod (walking and cleaning, T3 or L7) and Uropodal ramus (or furca, for walking and feeding) (Delorme, 1991; Meisch, 2000, 2007; Karanovic, 2012).

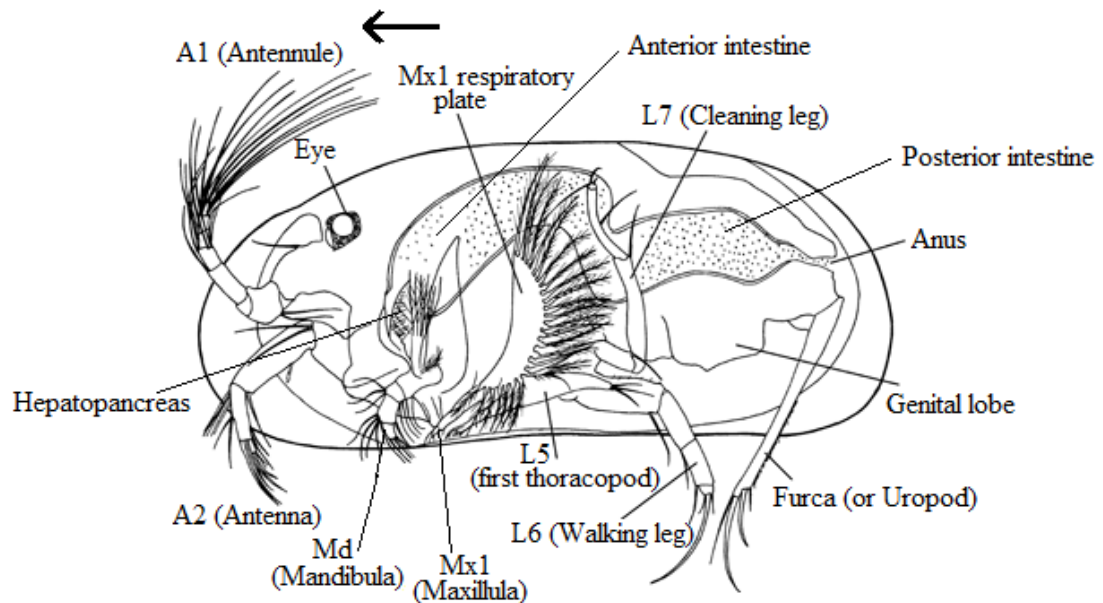


Figure 1.2. The soft body parts of *Herpetocypris reptans* (Baird, 1835) (the inside view of right valve). The arrow indicates the anterior side. Modified from Meisch (2007).

1.3 Anatomy and Physiology

Like other crustaceans, ostracods grow by moulting. Thereby, they become adult after eight moulting (ecdysis) stages (A1, A2, A3, A4, A5, A6, A7, A8 and A (being the adult stage)). After hatching of eggs, the larvae of ostracods called as “nauplius larvae” bear antennulae, antenna, mandibles and a developed carapace (Meisch, 2000).

Ostracods have desiccation and freezing resistant eggs. Since their eggs are covered by a double walled chitinous layers fertilized with calcium carbonate and a fluid is available between these walls (Delorme, 1991). Therefore, they can stay for long time without break down until the environment to being appropriate for hatching.

The Podocopid ostracods have a “nauplius” eyes like a dark spot at the anterodorsal part but Myodocopid ostracods have lateral compound eyes (Ikeya et al., 2005; Rodriguez-Lazaro & Ruiz-Muñoz, 2012).

Non-marine ostracods (e.g., Podocopid) do not carry gills and heart whereas Myodocopid have a one-chambered heart (Meisch, 2000). Hence, the gas change is assumed to be occurring on the entire surface of body and can be done by exchanging of unoxygenated waters with oxygenated by using the vibratory plates of mandibula, maxillula and fifth limb (Meisch, 2000; Karanovic, 2012).

The digestive system of ostracods made up mouth, esophagus, stomach (anterior intestine), posterior intestine and anus. In this system, the digestive glands come from the structure called hepatopancreas (Figure 1.2) (Delorme, 1991).

The central nervous system of ostracods consists of the cerebrum (protocerebrum, deutocerebrum and tritocerebrum), a circum esophageal ganglia and an antero-posteriorly running ventral chain of ganglia (Karanovic, 2012).

Ostracods are sexually and asexually (parthenogenesis) reproduce and they also show sexual dimorphism (morphological differences between males and females) (Ozawa, 2013). Although marine ostracods generally reproduce sexually, the asexual reproduction is prevalent among non-marine ostracods (Butlin et al., 1998). Accordingly, Meisch (2000) emphasized that four types of reproductive modes are available among non-marine ostracods: fully sexual (or bisexual), mixed reproduction, fully parthenogenetic reproduction in probably “recent” asexual spin-offs and parthenogenesis in ancient asexuals. In addition, the species *Darwinula stewensoni* has been accepted as an ancient asexual more than 100 mya (Butlin et al., 1998) whereas the one male of this species was found for first time by Smith et al. (2006) in Japan. In spite of the presence of it, however, the reproductive activity of male is not clear and in debate.

1.4 Ecology, Distribution and Applications

Martens et al. (2008) indicated that most investigated zoogeographic region is Palearctic with 702 species and which is followed by Afrotropical with 455, Nearctic with 298, Neotropical with 275, Oriental with 199, Australasian with 176, Pacific Oceanic Islands with 5 and Antarctic with 3 species, respectively. The most recent study of Martens and Savatnalinton (2011) revealed that 2103 species and 209

genera of recent, non-marine, free living ostracods are present in the world. Besides, approximately 65,000 ostracod species have been detected from marine and non-marine environments. Of which, 20,000 have been estimated as living species (Ikeya et al., 2005). These results show the wide distribution of ostracods in the world. The both of active and passive distribution of ostracods contribute to the wide dispersion of them through the world. Hence, species change the location (Külköylüoğlu, 2013) by using their long swimming setae on second antennae (A2) while passive dispersion is processed by human, birds, fishes, wind (for prevailing resting eggs), plants, amphibians and insects (McKenzie & Moroni, 1986; Horne & Martens, 1998; Rossi et al., 2003; Rodriguez-Lazaro & Ruiz-Muñoz, 2012).

Thereby, ostracods are found in a variety of marine and non-marine aquatic bodies like temporary and permanent ponds, lakes, creeks, streams, bromeliads, ditches, caves, irrigation canals, thermal waters, deep bottom of seas and oceans, troughs, lagoons, estuaries, springs, semi-terrestrial habitats, dams or etc. (Delorme, 1991; Külköylüoğlu & Vinyard, 2000; Meisch, 2000; Horne, 2003; Özuluğ, 2012; Külköylüoğlu, 2013; Külköylüoğlu et al., 2013; Escrivá et al., 2014).

The physico-chemical variables of aquatic bodies effect their distribution like temperature, sediment type, depth, vegetation, elevation, pH, dissolved oxygen concentration, transparency of water and salinity (Malmqvist et al., 1997; Mezquita et al., 2001; Külköylüoğlu, 2005a; Martín-Rubio et al., 2005; Pérez et al., 2010; Szlauer-Łukaszewska, 2012). In addition, they can show species specific tolerance levels to biotic and abiotic factors (Benson, 1990) and so they are used as indicator species for estimating the environmental deterioration (Benson, 1990; Delorme, 1991; Külköylüoğlu, 1999). Therefore, the ecological requirements of each species and the value of them are important (Külköylüoğlu, 2003a, 2004) for using them to estimate present and past conditions of aquatic bodies (Delorme, 1991) and to make comments about the future status of them. Accordingly, the ecological studies about ostracods should include the measuring of physico-chemical variables of aquatic bodies with correct taxonomic identification (Li et al., 2010) and the samplings should be larger for obtaining better results. Indeed, the statement of Sarı & Külköylüoğlu (2010, p. 226) as “...any changes in environmental or habitats are detected by sensitive biotic integrator of condition over time...” is also pinpointing

the importance of bioindicator species. This is because of the global warming and anthropogenic impacts, the conditions of aquatic bodies are changed by day to day.

Moreover, the anthropogenic events negatively affect species diversity because physico-chemical variables of aquatic bodies change in time and place (Lake & Bermuta, 1986). As a result, when an environment monitoring program is considered, the biological monitoring should be included because they are complementary to each other (Chapman & Jackson, 1996). In that case, ostracods are a good example for biomonitoring program. Besides, the term "Pseudorichness" was proposed by Külköylüoğlu (2004) can also be used to estimate the level of deterioration. This is because it refers to the ratio of non-cosmopolitan (sensitive species with limited ranges of tolerance) to cosmopolitans (with wide range of tolerance). Thereby, if this ratio is larger than 1, habitat quality increases but values smaller than 1 indicate low quality.

Ostracods can be herbivore, detritivore, carnivore (e.g. eat soft tissues of snails), filter-feeder and/or scavenger in trophic position (Delorme, 1991; Horne, 2003) while the only family Enterocytheridae (Cytherocopina) lives on the gills and thoraxes of crayfish, amphipods and crabs as commensals and ectoparasites (Horne, 2003; Karanovic, 2012). As well, there are some parasites and epibiont on freshwater ostracods like protozoans, helminthes, cestodes, peritrichs and acanthocephalans (Karanovic, 2012). Further, Baltanás et al. (2007) and Bruvo et al. (2011) showed that a few individuals of *Eucypris virens* are infected by a parasitic *Wolbachia* in Spain and Malta, respectively, which is a reproductive system altering and parthenogenetic introducing bacteria. In addition, the freshwater ostracods are considered as generalist because they feed on algae, organic detritus, dead and living plant parts, body of dead animals, invertebrate feces, fish food and periphyton (Delorme, 1991; Karanovic, 2012).

Because ostracods can be fossilized and can be used as bioindicator species of water bodies, they are commonly used in different scientific fields including studies in geology (biostratigraphy), palaeobiology, paleoclimatic, paleolimnologic, palaeoecologic, wetland conservation, archeology, elemental and isotopes studies on the shell chemistry and anthropogenic pollution (Forester, 1991; Holmes et al., 1998; Külköylüoğlu, 1998; Alvarez Zarikian et al., 2000; Mourguiart & Montenegro, 2002;

Padmanabha & Belagali, 2008; Jiang et al., 2008; Sarı & Külköylüoğlu, 2010; Rodriguez-Lazaro & Ruiz-Muñoz, 2012; Ruiz et al., 2013).

1.5 The History of Freshwater Ostracods in Turkey

Introducing of freshwater ostracods in Turkey to literature have been started with German scientist H.W. Schäfer at 1952 who reported the species *Ilyocypris brehmi*, *Cypris pubera*, *Eucypris pagasti*, *Heterocypris barbara*, *Stenocypris fischeri*, *Potamocypris arcuata* and *Zonocypris inconspicua* for the first time in Turkey. This study was followed by the study of another German scientist G. Hartmann in 1964.

Following to these two studies of German scientists, D. Gülen started to study freshwater ostracods of Turkey in 1965. Since 1965 to 1999, Gülen and his colleagues had several publications (eg., Gülen, 1975, 1985; Gülen et al., 1994; Gülen & Altınsaçlı, 1999). The student of Gülen, S. Altınsaçlı has been working on ostracods since 1988 (Altınsaçlı, 1988; Altınsaçlı & Kubanç, 1990; Altınsaçlı et al., 2000; Altınsaçlı & Griffiths, 2001; Altınsaçlı & Mezquita, 2008, Altınsaçlı, 2014).

In a similar period, O. Külköylüoğlu began to work on freshwater ostracods in early 1987. He has many types of publications from and out of Turkey and also expends much endeavour to contribute and develop knowledge about the ecology of these organisms. He is also a well known scientist with his studies about the ecology and taxonomy of ostracods while the ecology of these organisms are not well known through the world (e.g., Külköylüoğlu et al., 1993; Külköylüoğlu, 1998; Külköylüoğlu & Vinyard, 2000; Külköylüoğlu, 2003b, 2004, 2009; Külköylüoğlu & Sarı, 2012; Külköylüoğlu et al., 2012a, 2013, 2014).

Later in about 1995, O. Özuluğ was introduced studies on freshwater ostracods. She has several publications (e.g., Özuluğ, 2005; Özuluğ & Yaltaher, 2008; Özuluğ, 2012). In 1996, C. Aygen studied on ostracods in İzmir (e.g., Aygen & Balık, 1998, 2002; Aygen et al., 2004, 2012). After that, M. Kılıç defended his Ph.D Dissertation in 1997 about the ostracods of coasts of Black Sea along with some freshwater ostracods collaborated especially with O. Külköylüoğlu (e.g., Külköylüoğlu et al., 2007, 2010).

The students of O. Klkylođlu, D. Akdemir (since 2004) and N. Sarı (since 2007) have been studying on ostracods and they have publications from different parts of Turkey (e.g., Akdemir, 2008; Akdemir & Klkylođlu, 2011, 2014; Sarı & Klkylođlu, 2010).

Since 2009, I have been working on freshwater ostracods with the help of my supervisor O. Klkylođlu. During the time, I was able to work on freshwater cave ostracods in Western Black Sea Region of Turkey after German scientist G. Hartmann (Yavuzatmaca et al., 2012).

As far as we know the above given scientists are actively study on freshwater ostracods in Turkey. Out of them, however, there are some publications and thesis (e.g., Karakaş-Sarı, 2006; Akıncı, 2006; Yılmaz & Klkylođlu, 2006; Yaltaher, 2007; Balcı, 2008; Uçak, 2012; Rasouli et al., 2014).

2. AIM AND SCOPE OF THE STUDY

In literature, the studies about their habitat preferences (Benzie, 1989; Dügel et al., 2008), habitat similarities (Sarı & Külköylüoğlu, 2010), ecology and distribution (Teeter, 1973; Roca & Baltanás, 1993; Malmqvist et al., 1997; Kiss, 2007; Mezquita et al., 1999a, 1999b; Van der Meeren et al., 2010; Narasimha Ramulu et al., 2011; Külköylüoğlu & Sarı, 2012; Külköylüoğlu et al., 2012b, 2013), the relationships between physico-chemical variables of aquatic bodies and their valve chemistry (Xia et al., 1997; Palacios-Fest & Dettman, 2001; Wansard & Mezquita, 2001; Elmore et al., 2012), response of ostracods to UVB (ultraviolet-B, wavelength 280-320 nm) radiation (Van Den Broecke et al., 2012), using as indicators for habitat quality (Alvarez Zarikian et al., 2000; Külköylüoğlu, 2004; Padmanabha & Belagali, 2008; Ruiz et al., 2013) or for tsunami indicator (Mischke et al., 2012a) and their using in palaeolimnologic and palaeoclimatic studies (Battarbee, 2000; Horne, 2007; Horne & Mezquita, 2008; Bassetti et al., 2010; Pieri et al., 2012) are available. However, there are no specific studies testing their distributional patterns throughout the wide geographical areas in different types of aquatic bodies by means of using “Poisson Distribution” method, -except the study of Heip (1976). His study is assayed to test the spatial pattern of species *Cyprideis torosa* (Jones, 1850) in a small brackish water pond in northern Belgium in January 1971. On the other hand, the present study covers ostracods occurring in a wide geographical area within several different types of aquatic habitats where application of Poisson probabilities were suitable.

In addition, Zhaoli et al. (2007) explained the distributional characteristics of dominant pelagic ostracod species in East china with using the statemens of Zhao & Zhou (1984) as by calculation of Dominance Index (Y), Index of Clumping (I), Mean Crowding ($\bar{x}^*$), Index of Patchiness ($\bar{x}^*/\bar{x}$) and Index of Dispersion (I_δ). As far as we know, there is no any research on the non-marine ostracods in literature and Turkey.

Following two important questions are also the main concerns of this study to answer:

- 1) What is/are the suitable conditions for ostracods?
- 2) Which types of aquatic bodies are called as source or sink habitats for ostracods?

During the present study, we try to find possible answers for them. The importance of finding answers for such questions rely on the fact that source habitats have high species richness along with better conditions (Pulliam, 1988; Pulliam & Danielson, 1991).

In Turkey, about 140 non-marine free-living freshwater ostracods and 46 genera are known (Külköylüoğlu, 2013; Külköylüoğlu pers. comm.) but this number is underestimated. This is because of lack of studies and information about the ostracod diversity in many regions of Turkey. Since one of the major aims of this study was to compare the species diversity, we choose Adıyaman and Burdur for the following 3 reasons as i) there are no previously done extensive studies on ostracods in these provinces, ii) both have similar size of surface area, and iii) they are located in the same latitudinal range but in different longitudes of Mediterranean region of Turkey. These similarities are important for comparative studies to increase importance of analyzing other factors.

The main objectives of this study are i) to contribute knowledge into the ostracod fauna of Adıyaman and Burdur regions of Turkey, ii) to determine the species diversity of ostracods in both provinces, iii) to determine the most influential environmental variable(s) on species distribution, iv) to estimate ecological optimum and tolerance levels of species for different variables, v) to evaluate the relationships between geographical properties (latitude, longitude, elevation, etc.) and distribution of species in these two areas, vi) to compare the similarity and dissimilarity of biotic and abiotic factors in both provinces, vii) to analyse ostracod species diversity in different aquatic habitats, viii) to determine the dominant species in each provinces and in different habitat types with their distributional characteristics, ix) to evaluate the habitat quality of these two regions that will be done by determining their

bioindicator species (ostracod) diversity. Data of both provinces are going to be combined for some analyses.

In accordance to the main purposes, following three hypotheses are tested:

Hypothesis 1: Ostracod species are randomly distributed among sampling sites.

Rationality 1: Determining of these patterns allow us to see the effect of regional and local factors on the occurrence of species. Also, it is important to see the distributional patterns (clumped, uniform and random) of organisms. Finding a pattern will allow us to understand the distributional mode of the species.

Hypothesis 2: Based on the similar field size studied, the mean number of ostracod species in both provinces is similar.

Rationality 2: According to the Theory of Island Biogeography (Arrhenius 1921; MacArthur & Wilson, 1963, 1967), numbers of species increases with increasing size of area. Therefore, size of area can be an effective factor on species number and distribution. If one is able to reduce the effect of area-size, importance of other factors can be analysed individually. This will provide us to compare both provinces from different perspectives considered. Besides, such comparison can show how much dis/similar the two provinces are.

Hypothesis 3: The distribution of ostracod species are not affected by regional and/or spatial factors (e.g., elevation, habitat types).

Rationality 3: Several a/biotic factors play crucial role on species distribution and diversity. If one knows the types of such effective factors and their relationships to species, spatial diversity can be estimated for future. Thus, this hypothesis assumes that ostracod distribution can be mostly related to local factors than regional or spatial factors.

3. MATERIAL AND METHODS

3.1 Site Descriptions

3.1.1 Adıyaman

Adıyaman is located in the middle section of the Euphrates (south east of Turkey) between 38°11'-37°25' north latitude and 39°14'-37°31' east longitude which covers 7164 km² of surface area. The north part of the province is surrounded by the Malatya Mountains that are the extensions of Toros Mountains. However, through the south part elevation begins to decrease and generally the lowland plain with agricultural quality starts. Due to its geographical position, Adıyaman plays a bridge role for transition between East and South-East part of Anatolia. Indeed, it partially has the some features of Mediterranean Region. In southern part the summer season is dry and hot but winter is temperate and rainy. In northern part, the summer is dry and cool meanwhile the winter is rainy and cold. The minimum and maximum weather temperature of summer and winter fluctuate between 28 – 47 °C and -10 – 10 °C, respectively. The wind blows slightly with a central force and it dominantly blows from the north side (Adıyaman Valiliği, 2014).

3.1.2 Burdur

The province is located at the South Anatolia and in the Lake district between 36°53' - 37°50' north latitude and 29°24' - 30°53' east longitude which covers 6887 km² of surface area. The Burdur is surrounded at south by some extensions of west Toros Mountains which are Boncuk, Elmalı and Katrancık Mountains; at east by extensions of west Toros which are Kuyucak and Dedegöl Mountains; at north by Lake Burdur and order of Karakuş Mountain and at west side by Lake Acıgöl and Eşeler Mountain. The province has different land types consisting of 2.7 % upland,

19 % lowland, 60.6 % mountainous and 17.6 % bumpy lands (Burdur Valiliği, 2014). Burdur generally has terrestrial climate since its high mountains separate the district from Mediterranean region and so the summer is hot but winter is very cold. The lowest and highest weather temperature at the winter and summer seasons are estimated as -16.7 and 39.6 °C, respectively (Burdur, 2014).

3.2 Sampling and Measurements

In Adıyaman province, total of 120 samples were collected from randomly selected different aquatic bodies during 16 - 19 July 2012 (Figure 3.1). Sampling sites include nine different types of aquatic sites as springs, lakes, dams, ponds, creeks, streams, water fall, irrigation canals and troughs. In Burdur province, 121 samples were picked up from six different aquatic habitats like springs, lakes, dams, ponds, creeks and troughs between 30 August and 2 September, 2012 (Figure 3.2). During the sampling, we kept the distance of 5 to 10 km between each sampling sites. At each sampling site in both provinces, some of the environmental variables (dissolved oxygen concentration (DO, mgL⁻¹), percent oxygen saturation (% sat.), water temperature (Tw, °C), electrical conductivity (EC, µScm⁻¹), total dissolved solids (TDS, mgL⁻¹ and it is calculated from EC and Tw), salinity (Sal, ppt), pH, atmospheric pressure (mmHg)) were recorded before ostracods sampling to prevent possible results of “Pseudoreplication” (Hurlbert, 1984) by a YSI-Professional Plus. Depending on the density of algae in aquatic environments in Appendices A and C, the percentage ratio of dissolved oxygen concentrations in some of them rise above one hundred. Also, altering in photosynthesis affects the pH values. The air temperature (Ta, °C), wind speed (kmh⁻¹) and air moisture (%) were obtained by a Testo 410-2 model of anemometer and also the basic geographical data (elevation, coordinates) were recorded with a geographical positioning system (GARMIN etrex Vista H GPS) *in situ*. We did not use all the variables measured here due to effective collinearity to each other. However, all environmental variables we received from each sampling sites are given in appendices. This is because we know that all events in nature are related to each other (weak or strong) that providing such additional data in appendices will be useful for future studies.

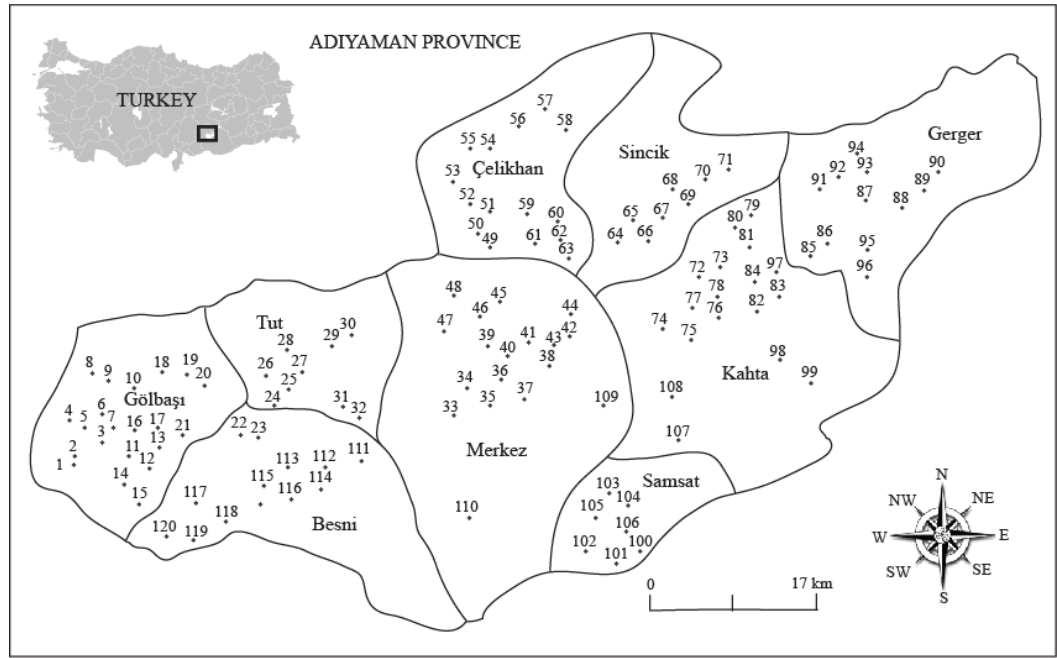


Figure 3.1. The distribution of 120 randomly selected sampling sites from nine (Gölbaşı, Tut, Besni, Merkez, Samsat, Kahta, Gerger, Sincik and Çelikhan) counties of Adıyaman.

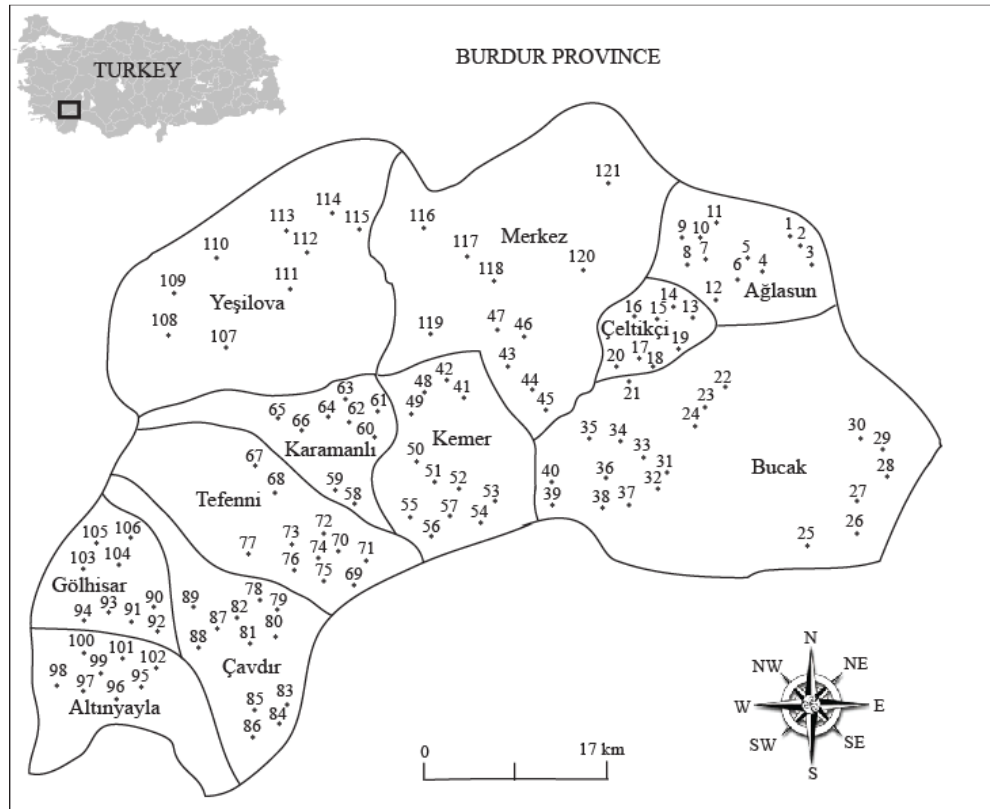


Figure 3.2. 121 randomly selected sampling sites from 11 counties (Merkez, Ağlasun, Çeltikçi, Bucak, Kemer, Yeşilova, Karamanlı, Tefenni, Çavdır, Gölhisar, and Altınyayla) of Burdur.

Ostracod samples were collected from each site with a standard sized hand net (200 μm in mesh size). We stored these samples in 250 ml of plastic bottle and fixed with 70 % of alcohol to prevent deterioration of samples *in situ*. In laboratory, each sample was filtered through four standardized sieves (0.5, 1.0, 1.5 and 2.0 mm mesh size) under tap water and then kept in 70 % alcohol for further studies. Ostracod specimens were sorted from sediments under a stereomicroscope (Olympus ACH 1X) and dissected in lactophenol solution for taxonomic identification. Carapace and valves were kept in micropaleontological slides for further studies and Scanning Electron Microscope (SEM) photographs. The taxonomic key of Meisch (2000) was primarily used for taxonomic classification and species identification but some other taxonomic keys were also used when needed (e.g., Bronhstein, 1947; Karanovic, 2012). Species identification was done under the light microscope (Olympus BX-51). All of the ostracod samples were stored in Limnology Laboratory of Abant İzzet Baysal University, Bolu/TURKEY and are available upon request.

3.3 Statistical Analyses

The hypothesis of random pattern of Poisson distribution (against aggregated and uniform distribution) which describes the random distribution where the population variance (s^2) equals to the mean (μ) was tested by the application of Poisson probabilities along with Chi-square test. Firstly, we looked at the number of species at each site and then the observed number of sites (frequency) carrying 0, 1, 2, 3 and 4 or more (4+) species was computed in Adıyaman, Burdur and combination of data from both provinces (ADIBUR) (Figures 3.3A, B and C, respectively). The mean (μ) is the only parameter in Poisson model (Ludwig & Reynolds, 1988) and for estimation of it, the $x = 0, 1, 2, 3$ and 4+ occurrences of species times with their carrying observed sites and divided by total sampling sites.

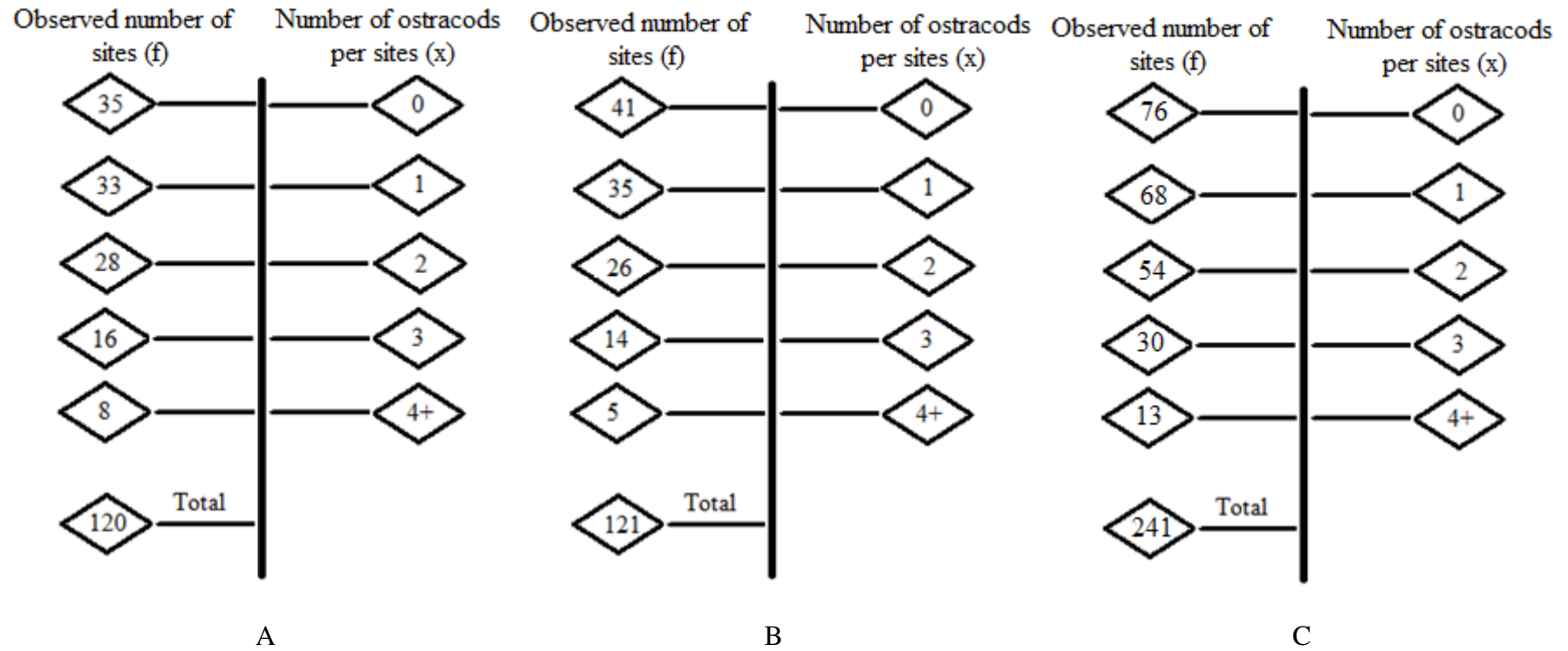


Figure 3.3. The number of sites carry 0, 1, 2, 3 and 4 or more (4+) occurrences of species (excluding sub-recent forms (empty valves and carapaces)) in Adiyaman (A), Burdur (B) and in both provinces (C).

Then, the Poisson probability of finding of x individuals in sampling units $P(x)$ was calculated by Equation 3.1.

$$P(x) = \frac{e^{-\mu} \cdot \mu^x}{x!} \quad \text{Equation 3.1}$$

where e : this is Euler's number and equal to approximately 2.71828; μ : the mean number of successes that occur in a specified region; x : the actual number of successes that occur in a specified region; $P(x; \mu)$ the Poisson Probability that exactly x successes occur in a Poisson experiment, when the mean number of successes is μ .

After that, Chi-square (X^2) test was used to compare the observed (O) frequency to expected (E) frequency and used to test the hypothesis of random distribution at cut off level 0.05. The expected (E) values of each frequencies was calculated as expected probability = N (total sample size) $\times$ Poisson probability (calculated by Equation 3.1). The value of calculated Chi-square was computed by Equation 3.2.

$$X^2 = \sum_{n=0}^n \frac{(O - E)^2}{E} \quad \text{Equation 3.2}$$

Additionally, departure from Poisson distribution was tested by application of the Index of dispersion (s^2/μ) (Ludwig & Reynolds, 1988).

- ✓ if $s^2/\mu = 1$ population is randomly distributed
- ✓ if $s^2/\mu < 1$ population is uniformly distributed
- ✓ if $s^2/\mu > 1$ population is clumped

The other test statistics, *d-statistics*, can be applied for measuring the agreement with Poisson (Equation 3.4) when the sample size is equal or larger than 30. Indeed, to find *d-statistics* value, we need Chi-square (X^2) (it is different from X^2 calculated by Equation 3.2) calculated by Equation 3.3 (Ludwig & Reynolds, 1988).

$$X^2 = \left(\sum_{i=1}^N (X_i - \bar{X})^2 \right) / \bar{X} \quad \text{or} \quad X^2 = ID (N - 1) \quad \text{Equation 3.3}$$

Where X^2 : Chi-square, X_i : the number of individuals in the i th sampling units; N : total sample size; $\bar{X}$: the mean number of successes that occur in a specified region

$$d = \sqrt{2X^2} - \sqrt{2(N - 1) - 1} \quad \text{Equation 3.4}$$

Where X^2 from Equation 3.3

The statements of *d-statistics* (Elliott, 1973 sensu Ludwig & Reynolds, 1988, p. 28) as follow;

- ✓ if $|d| < 1.96$, accept a random dispersion
- ✓ if $d < -1.96$, suspect a regular dispersion
- ✓ if $d > 1.96$, like a clump dispersion

In addition, we used Canonical Correspondence Analysis (CCA) to examine the relationships between species and most widely used environmental variables (like electrical conductivity (EC), water temperature (Tw), dissolved oxygen concentration (DO) or etc.). All data was log-transformed (ter Braak, 1987; Birks et al., 1990) and tested with Monte Carlo Permutation tests (499) where rare species were eliminated from analyses. Before performing CCA, suitability of data for CCA was tested with Detrended Correspondence Analysis (DCA).

Microsoft Excel 2010 was used to draw the relationships among number of sites, site types, taxa, species, sexual and asexually reproducing species and the relationships between water and air temperatures. Because of the geographical and sampling site differences, we used 100 and 150 m a.s.l elevational ranges in Adiyaman and Burdur, respectively.

To determine the dominant species in each province and different habitats, we used Dominance index (Y) (Equation 3.5). If the Dominance index value of any species larger than 0.02, it means that it is a dominant one. Also, for determining the even (equal) and uneven (unequal) distribution of dominant species in their present

habitats we applied several types of other indices as Index of Clumping (I) (Equation 3.6), Mean Crowding ($\bar{x}^*$) (Equation 3.7), Index of Patchiness ($\bar{x}^*/\bar{x}$) (Equation 3.8) and Index of Dispersion (I_δ) (Equation 3.9) (Zhao & Zhou, 1984 sensu Xu & Li, 2005). If they have larger positive values, it represents aggregation intensity but if any of them has negative values that show even distribution of dominant species in habitats they are available (Xu & Chen, 1989 sensu Xu & Li, 2005). In addition, when the value of Index of Clumping is larger than 5, distribution of species is clumped in habitats they are occurred (Zhao & Zhou, 1984).

$$\text{Dominance Index } (Y) = \frac{\sum ni}{N} fi \quad \text{Equation 3.5}$$

$$\text{Index of Clumping } (I) = \frac{V}{\bar{X}} - 1 \quad \text{Equation 3.6}$$

$$\text{Mean crowding } (\bar{x}^*) = \frac{(V - \bar{X} + \bar{X}^2)}{\bar{X}^2} \quad \text{Equation 3.7}$$

$$\text{Index of patchiness } (\bar{x}^*/\bar{x}) = \frac{\frac{(V - \bar{X} + \bar{X}^2)}{\bar{X}^2}}{\bar{X}} \quad \text{Equation 3.8}$$

$$\text{Index of dispersion } (I_\delta) = \frac{(V - \bar{X} + \bar{X}^2)}{\bar{X}^2} \times \frac{N}{N-1} \quad \text{Equation 3.9}$$

In above Equations, ni : abundance of species i ; fi : occurrence frequency of species i ; N : total abundance; V : variance of samples and $\bar{x}$: mean.

C2 software was used to estimate the species tolerance (t_k) and optimum (μ_k) levels to different ecological variables after using a transfer function of weighted averaging regression (Juggins, 2003). In which, if a species can be abundant in sampling sites, the optimum estimates of it closer to its real value (ter Braak & Barendregt, 1986). Therefore, the optimum and tolerance levels of a species to ecological variables can show differences according to their occurrence frequencies in different geographical areas as this is the case in Adıyaman, Burdur and combining data of both provinces.

The alpha diversity indices (Shannon Wiener, Simpsons D, Margalef D, Berger-Parker Dominance, Brillouin D, Menhinick D and Strong's) of each species and different habitat types were calculated by using the Species Diversity & Richness 4 software (Seaby & Henderson, 2006). The range fall between 1.5 and 3.5 was used for Shannon Wiener (Magurran, 1988). To measure biodiversity, Alpha, Beta, and Gamma diversity were counted (Whittaker, 1972). Of which, Alpha (α)

richness indicates the number of species or taxa found in an area (e.g., Adıyaman or Burdur) while Beta (β) richness refers to the number of species or taxa that are not same in two different environments (e.g., between Adıyaman and Burdur). Gamma diversity (γ) measures the total biodiversity over a large area or region (e.g., both provinces).

The non-parametric Spearman Rank Correlation was used to find the correlation values among environmental variables (pH, dissolved oxygen concentration, water temperature and elevation) and species by using IBM-SPSS Statistics version 21. In addition, the functional relationships among the number of species, water and air temperatures were revealed by using Linear regression analysis (Zar, 1999). These relationships are intended to define a model by using IBM-SPSS Statistics version 21. Skewness and kurtosis measures (critic values show the approximately normal distribution of data fall between -1.96 and +1.96) (Cramer, 1998; Cramer & Howitt, 2004; Doane & Seward, 2011), Shapiro-Wilk test (for normality should be $P > 0.05$) (Shapiro & Wilk, 1965; Razali & Wah, 2011) and Kolmogorov-Smirnov (for normality should be $P > 0.05$) (Lilliefors, 1967; Dallal & Wilkinson, 1986) were used to test normality of these data in Adıyaman, Burdur and combined data of both provinces (ADIBUR). Also, significance of the relationships was tested by the Analysis of variances (ANOVA).

Finally, comparison of the mean number of species per sampling site/s, elevation, water temperature, pH, dissolved oxygen concentration and electrical conductivity between Adıyaman and Burdur was done by using t-test (un-equal variance) (Microsoft Excel 2010).

4. RESULTS

In all, 41 taxa (26 recent and 15 sub-recent (empty valves and carapaces)) were reported from 111 of 120 randomly selected sampling sites in Adıyaman. All of these taxa are new reports for the region as well as we know. Living (recent) forms of *Schellencandona insueta* and *Gomphocythere besni* n. sp. (see section 5) are also firstly reported for the Turkish Ostracoda fauna and the later is a new species in literature. However, in Burdur, 35 taxa (22 recent and 13 sub-recent) were recorded from 110 of 121 randomly selected sampling sites which consist of springs, lakes, dams, ponds, creeks and troughs. Of which, 21 taxa are new for Burdur (see below). The presence of ostracods in aquatic habitats may be controlled by biotic and abiotic factors but the current study does not include biotic factors. Therefore, we only consider the effect of abiotic factors used herein. Accordingly, absence of ostracod species or taxa in 9 and 11 sampling sites in Adıyaman and Burdur, respectively, may be due to some other biotic or abiotic factors that are not included here.

4.1 Systematic Descriptions

PHYLUM: ARTHROPODA
SUBPHYLUM: CRUSTACEA Pennant, 1777
CLASS: OSTRACODA Latreille, 1802
SUBCLASS: PODOCOPA Müller, 1894
ORDER: PODOCOPIDA Sars, 1866
Suborder Podocopina Sars, 1866
Infraorder Cypridacopina Jones, 1901
Superfamily Darwinuloidea Brady & Norman, 1889
Family Darwinulidae Brady & Norman, 1889
Genus Darwinula Brady & Robertson, 1885
Darwinula stevensoni (Brady & Robertson, 1870)
Darwinula sp.
Superfamily Cypridoidea s. str. Baird, 1845

Family Candonidae Kaufmann, 1900
Subfamily Candoninae Kaufmann, 1900
Genus Candona s. str. Baird, 1845
Candona neglecta Sars, 1887
Candona angulata Müller, 1900
**Candona* sp.

Genus Fabaeformiscandona Krstić, 1972
Fabaeformiscandona brevicornis (Klie, 1925)
Genus Schellencandona Meisch, 1996
Schellencandona insueta (Klie, 1938)
Genus Pseudocandona Kaufmann, 1900
Pseudocandona semicognita (Schäfer, 1934)
**Pseudocandona albicans* (Brady, 1864)
**Pseudocandona* sp.

Genus Mixtacandona Klie, 1938
Mixtacandona sp.

Subfamily Cyclocypridinae Kaufmann, 1900
Genus Cypria Zenker, 1854
Cypria ophtalmica (Jurine, 1820)
**Cypria* sp.

Genus Physocypria Vávra, 1897
**Physocypria kraepelini* G.W. Müller, 1903

Family Ilyocyprididae Kaufmann, 1900
Subfamily Ilyocypridinae Kaufmann, 1900
Genus Ilyocypris Brady & Norman, 1889
**Ilyocypris gibba* (Ramdohr, 1808)
Ilyocypris monstifrica (Norman, 1862)
Ilyocypris bradyi Sars, 1890
Ilyocypris inermis Kaufmann, 1900
**Ilyocypris* sp.

Family Cyprididae Baird, 1845
Subfamily Eucypridinae Bronshtein, 1947
Genus Eucypris Vávra, 1891
**Eucypris* sp.

Genus Prionocypris Brady & Norman, 1896
Prionocypris zenkeri (Chyzer & Toth, 1858)

Genus Tonnacypris Diebel & Pietrzeniuk, 1975
Tonnacypris sp.

Genus Trajancypris Martens, 1989
**Trajancypris clavata* (Baird, 1838)
**Trajancypris* sp.

Subfamily Herpetocypridinae Kaufmann, 1900

Genus Herpetocypris Brady & Norman, 1889
Herpetocypris brevicaudata Kaufmann, 1900
Herpetocypris chevreuxi (Sars, 1896)
Herpetocypris helenae G.W. Müller, 1908
**Herpetocypris intermedia* Kaufmann, 1900
**Herpetocypris* sp.

Genus Psychrodromus Danielopol & Mc Kenzie, 1977
Psychrodromus olivaceus (Brady & Norman, 1889)
**Psychrodromus fontinalis* (Wolf, 1920)
**Psychrodromus* sp.

Subfamily Cyprinotinae Bronshtein, 1947

Genus Heterocypris Claus, 1892
Heterocypris incongruens (Ramdohr, 1808)
Heterocypris salina (Brady, 1868)
**Heterocypris* sp.

Subfamily Isocypridinae Rome, 1965

Genus Isocypris G.W. Müller, 1908
**Isocypris beauchampi* (Paris, 1920)
**Isocypris* sp.

Subfamily Cypridopsinae Kaufmann, 1900

Genus Cypridopsis Brady, 1867
Cypridopsis sp.

Genus Cavernocypris Hartmann, 1964
Cavernocypris sp.

Genus Potamocypris Brady, 1870
Potamocypris fulva (Brady, 1868)

Potamocypris pallida Alm, 1914

**Potamocypris fallax* Fox, 1967

**Potamocypris similis* G.W. Müller, 1912

**Potamocypris variegata* (Brady & Norman, 1889)

Potamocypris smaragdina (Vávra, 1891)

Potamocypris arcuata (Sars, 1903)

**Potamocypris* sp.

Genus *Zonocypris* G.W. Müller, 1898

Zonocypris costata (Vávra, 1897)

Superfamily *Cytheroidea* Baird, 1850

Family *Limnocytheridae* Klie, 1938

Subfamily *Limnocytherinae* Klie, 1938

Genus *Limnocythere* s. str. Brady, 1867

Limnocythere inopinata (Baird, 1843)

**Limnocythere* sp.

Genus *Paralimnocythere* Carbonnel, 1965

**Paralimnocythere* sp.

Subfamily *Timiriaseviinae* Mandelstam, 1960

Genus *Gomphocythere* Sars, 1924

Gomphocythere besni n. sp.

* represents the new reports for Burdur

4.2 Data Analyses of Adıyaman

The calculated Poisson probabilities of $P(x = 0)$, $P(x = 1)$, $P(x = 2)$, $P(x = 3)$, $P(x = 4+)$ (4 or more)) occurrences of species in Adıyaman is given in Table 4.1.

Table 4.1. Poisson probabilities of 0, 1, 2, 3 and 4(+) occurrences of ostracod species calculated using Equation 3.1 in Adıyaman.

$P(x=0)$ probability of no occurrence	0.24
$P(x=1)$ probability of one occurrence	0.34
$P(x=2)$ probability of two occurrences	0.24
$P(x=3)$ probability of three occurrences	0.11
$P(x=4+)$ probability of four(+) occurrences	0.04

According to the Poisson probabilities in Table 4.1, calculated expected probability of these occurrences ($P(x = 0)$, $P(x = 1)$, $P(x = 2)$, $P(x = 3)$ and $P(x = 4+)$) are as follows 29.35, 41.33, 29.10, 13.66 and 4.81, respectively (Table 4.2). The Chi-square (X^2) value of each occurrences were calculated and given in Table 4.2. Then, the sum of all of these Chi-square values ($X^2_{calculated} = 5.33$) (Table 4.2) was found smaller than the value of Chi-square at 0.05 cut off level ($X^2_{table (3,120,0.05)} = 7.81$). Therefore, the result is not significant and thus the hypothesis "Ostracod species are randomly distributed among sampling sites in Adıyaman" was accepted. After application of Poisson, the Index of Dispersion (s^2/μ) value was counted as 1.06. Thus, according to Index of Dispersion, ostracods are clumply distributed among sampling sites in Adıyaman but the result of *d-statistics* (0.488) which is smaller than 1.96 indicated the random distribution of them.

Table 4.2. Calculated Chi-square values of five different classes in Adıyaman. The five classes with two constants (habitat and species) so degrees of freedom = $n - 2 \Rightarrow 5 - 2 = 3$.

Class	x	f(obs.freq.)	Exp. Prob.	O-E	(O-E) ²	(O-E) ² /E
1	0	35	29.35	5.65	31.97	1.09
2	1	33	41.33	-8.33	69.37	1.68
3	2	28	29.10	-1.10	1.22	0.04
4	3	16	13.66	2.34	5.47	0.40
5	4(+)	8	4.81	3.19	10.17	2.12
N = 120				(X ²)	5.33	

According to Index of Dominance (Y), 10 of 26 species (*Candona neglecta*, *Darwinula stvensoni*, *Herpetocypris chevreuxi*, *H. intermedia*, *Ilyocypris bradyi*, *I. inermis*, *H. incongruens*, *Potamocypris fallax*, *P. similis* and *Psychrodromus olivaceus*) were found as dominant species (if $Y > 0.02$) in Adıyaman (Table 4.3). When we looked at the values of Index of Clumping (I), Mean Crowding ($\bar{x}^*$), Index of Patchiness ($\bar{x}^*/\bar{x}$) and Index of Dispersion (I), they exhibited large and positive values. This means that dominant species in Adıyaman showed aggregated distribution in the habitats they are available. Additionally, the value of Index of Clumping (> 5) for all dominant species supports the aggregated distribution, too. Based on the abundance, the dominant species showing cosmopolitan characteristics had (*I. inermis*, *H. incongruens*, *I. bradyi* and *P. olivaceus* have of 19.49; 18.75; 14.98 and 10.34 %, respectively) higher occurrence frequencies and percentages among the all present species (Table 4.3).

Table 4.3. The ecological indices values of dominant ostracod species in Adıyaman region. Abbreviations: *Y*: Dominance index, *I*: Index of Clumping, $\bar{x}^*$: Mean Crowding, $\bar{x}^*/\bar{x}$: Index of Patchiness, I_δ : Index of Dispersion, %: percentage ratio of *i*th species, Ca: *Candona angulata*, Cn: *C. neglecta*, Ds: *Darwinula stevensoni*, Fb: *Fabaeformiscandona brevicornis*, Hb: *Herpetocypris brevicaudata*, Hc: *H. chevreuxi*, Hh: *H. helenae*, Hin: *H. intermedia*, Hi: *Heterocypris incongruens*, Ib: *Ilyocypris bradyi*, Ig: *I. gibba*, Ii: *I. inermis*, Gb: *Gomphocythere besni* n. sp., Li: *Limnocythere inopinata*, Pf: *Potamocypris fallax*, Pfu: *P. fulva*, Pp: *P. pallida*, Ps: *P. similis*, Psm: *P. smaragdina*, Pv: *P. variegata*, Pa: *Pseudocandona albicans*, Pse: *P. semicognita*, Po: *Psychrodromus olivaceus*, Si: *Schellencandona insueta*, Tc: *Trajancypris clavata* and Zc: *Zonocypris costata*.

	Ca	Cn	Ds	Fb	Hb	Hc	Hh	Hin	Hi	Ib	Ig	Ii	Gb	Li	Pf	Pfu	Pp	Ps	Psm	Pv	Pa	Pse	Po	Si	Tc	Zc
<i>Y</i>	0.02	0.10	0.06	0.01	0.01	0.07	0.00	0.74	8.44	3.75	0.00	4.09	0.00	0.01	2.05	0.00	0.02	0.09	0.00	0.00	0.00	0.00	1.55	0.00	0.00	0.01
<i>I</i>	-	11.59	48.21	-	-	14.14	-	73.95	47.23	54.95	-	43.82	-	-	53.80	-	-	48.11	-	-	-	-	45.31	-	-	-
$\bar{x}^*$	-	30.58	106.18	-	-	40.46	-	41.70	11.25	15.92	-	10.07	-	-	16.98	-	-	66.60	-	-	-	-	18.83	-	-	-
$\bar{x}^*/\bar{x}$	-	78.08	231.66	-	-	112.91	-	22.96	2.44	4.32	-	2.08	-	-	5.04	-	-	90.82	-	-	-	-	7.41	-	-	-
I_δ	-	30.59	106.21	-	-	40.47	-	41.72	11.25	15.92	-	10.07	-	-	16.99	-	-	66.62	-	-	-	-	18.83	-	-	-
%	0.81	1.59	1.86	0.71	0.37	1.46	0.10	7.39	18.75	14.98	0.10	19.49	0.47	0.58	13.69	0.10	2.41	2.98	0.07	0.41	0.07	0.10	10.34	0.07	0.10	0.98

The first two axes of Canonical Correspondence Analysis (CCA) explained 77.4 % of relationships between 11 species and five environmental variables (Table 4.4).

Table 4.4. Summary table of CCA for 11 species with three or more occurrences and five environmental variables in Adıyaman (* shows the results of DCA).

Axes	1	2	3	4	Total inertia
*Lengths of gradient	5.14	3.44	2.89	4.70	
Eigenvalues	0.32	0.18	0.12	0.02	4.57
Species-environment correlations	0.71	0.53	0.48	0.23	
Cumulative percentage variance					
of species data	6.9	10.8	13.4	13.9	
of species-environment relation	49.6	77.4	96	99.4	
Sum of all eigenvalues					4.57
Sum of all canonical eigenvalues					0.64

In accordance with the diagram of CCA, the most effective factors on species distribution were arranged as electrical conductivity (EC) ($F = 3.987$, $P = 0.002$), water temperature (Tw) ($F = 3.582$, $P = 0.002$), pH ($F = 3.510$, $P = 0.002$), elevation (Elev.) ($F = 4.491$, $P = 0.02$) and dissolved oxygen concentration (DO) ($F = 0.967$, $P = 0.37$). Four species (*H. intermedia*, *P. olivaceus*, *I. inermis* and *P. similis*) were located at the opposite site of all environmental variables while *I. inermis* was relatively closer to the center. The other four species (*H. chevreuxi*, *I. bradyi*, *H. incongruens* and *D. stevensoni*) were situated at the site of EC and Tw when *Candona angulata*, *C. neglecta* and *P. fallax* positioned with the same direction with the arrows of DO, pH and Elev. (Figure 4.1). Of which, *D. stevensoni* was relatively closer to the center when *I. bradyi* and *H. incongruens* showed closer relationships with Tw.

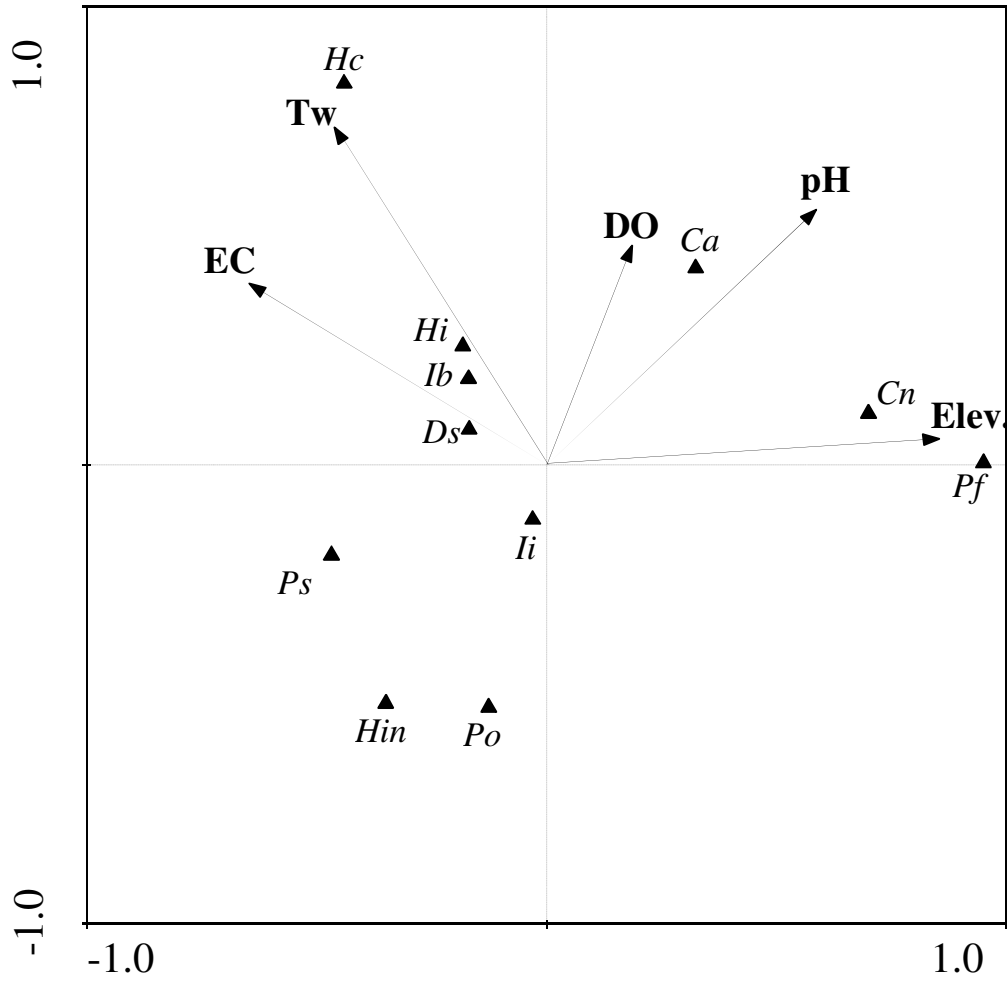


Figure 4.1. CCA diagram shows the effect of five most influential environmental variables (arrows) (EC, Tw, pH, Elev. and DO) on 11 species (*C. neglecta*, *D. stevensoni*, *H. chevreuxi*, *H. intermedia*, *I. bradyi*, *I. inermis*, *P. olivaceus*, *H. incongruens*, *P. fallax* and *P. similis*) from 83 different sampling sites in Adiyaman. Triangles show the species code while open circles (o) represent the sites number. For abbreviations of species code and environmental variables see Appendix A.

Figure 4.2 displays that there is not big difference in the number of species at some of these elevational ranges (e.g., 10 species found at 551-651 m; 854-954 m and 1056-1156 m a.s.l. elevational ranges). In addition, the number of taxa did not change when the number of sampling sites showed differences at 551-651 m (20 taxa, 15 sites), 753-853 m (20 taxa, 17 sites) and 1056-1156 m a.s.l. (20 taxa, 18 sites) elevational ranges. A sudden decline in the number of species and taxa at the range of 1157-1257 m a.s.l. corresponds to a sharp descending of number of

sampling sites. However, occurrence frequency of sexually reproducing species was higher than asexually reproducing species with increasing elevation.

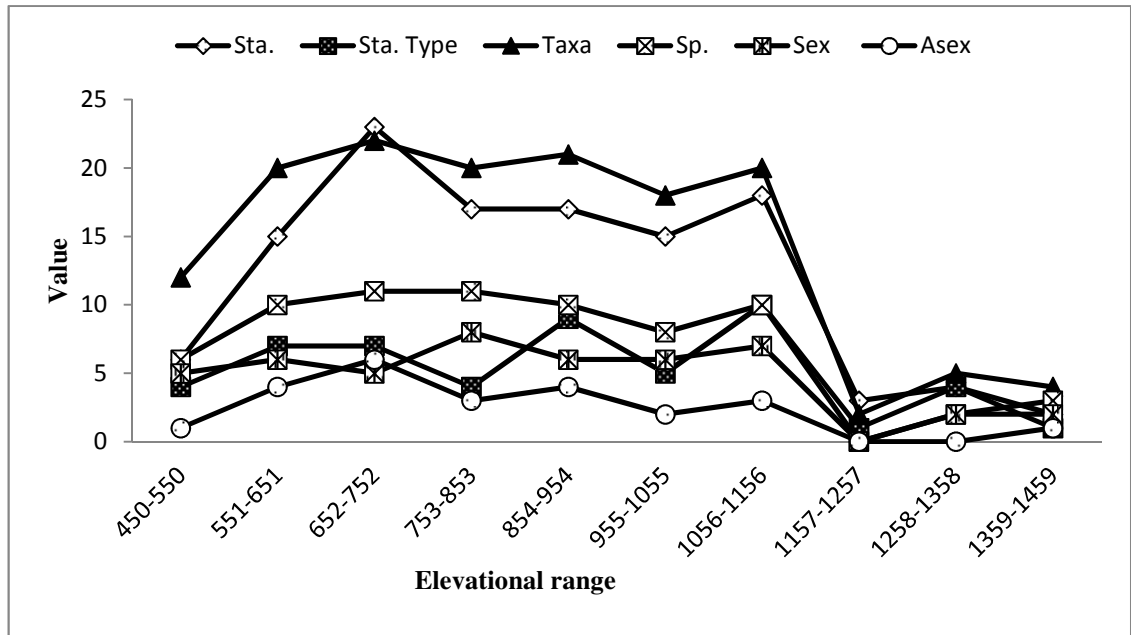


Figure 4.2. Number of taxa, species, site type, sampled site and species with sexual and asexual reproduction at nine different 100 m a.s.l. elevational ranges in Adiyaman. Abbreviations: Sta. (site number), Sta. Type (site type), Sp. (species number), Sex (species sexually reproduce) and Asex (species asexually reproduce).

In Figure 4.3, an occasional paralleling was observed between water and air temperatures at 120 sampling sites. There is no big differences between early morning (time: 05³⁰ -07³⁰ am) (max: 36.6 min: 30.4 and mean: 33.31 °C) and towards evening (time: 18³⁰ – 20³⁰ pm) (max: 42.8 min: 31.1 and mean: 36.23 °C) air temperatures at July in Adiyaman. The mean water temperatures of sampled sites in these time ranges are as 19.91 and 23.5 °C for early morning and towards evening, respectively (first five sampling sites for early morning in all days and the last five for towards evening except in last day because we finished sampling around mid-afternoon, for sampling sites see Appendix A). According to Shapiro-Wilk and Kolmogorov-Smirnov tests (Appendix B(1)), data of air temperatures (Ta) from 120 sampling sites displayed approximately normal distribution ($P > 0.05$) with a skewness of 0.01 (standard error (SE) = 0.22) and a kurtosis of -1.13 (SE = 0.44). In spite of the results of Shapiro-Wilk (Appendix B(1)), the skewness and kurtosis

values as 1.57 (SE = 0.22) and -1.12 (SE = 0.44), respectively, and Kolmogorov-Smirnov ($P > 0.05$) (Appendix B(1)) exhibited the nearly normal distribution of data of water temperatures. With respect to the Analysis of variances (ANOVA), a significant ($P < 0.05$) relationship was found between water and air temperatures (Appendix B(2a)). Accordingly, the regression models between water (T_w) and air (T_a) temperatures is as following (see Appendices B(2) and B(2b);

$$T_w = 1.770 + 0.536 * T_a \quad (P < 0.05, R^2 = 0.091)$$

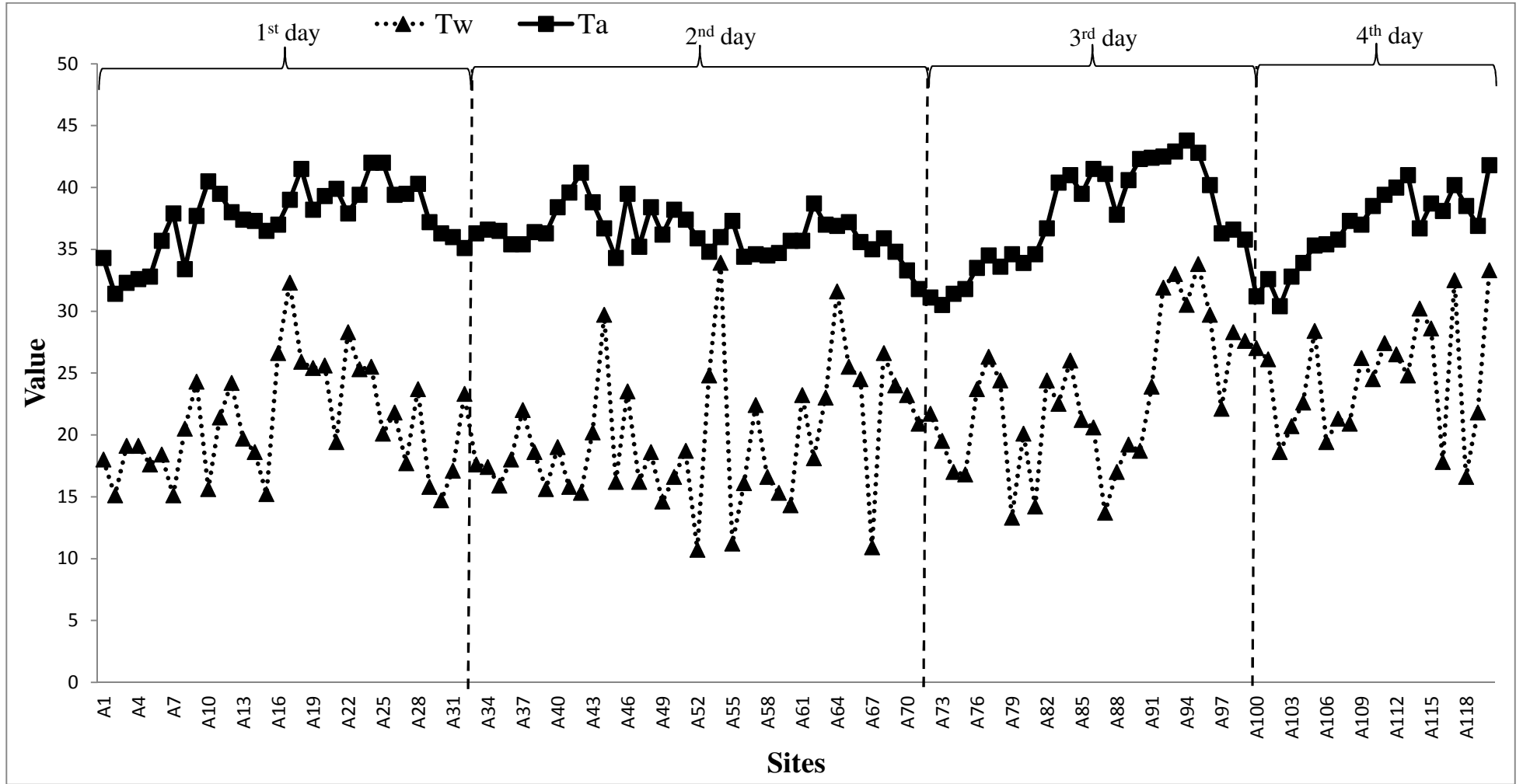


Figure 4.3. The relationships between water (Tw, °C) and air (Ta, °C) temperatures of 120 sampling sites in Adıyaman.

With respect to the tolerance (t_k) and optimum (u_k) levels of species to different environmental variables (Table 4.5), species showing cosmopolitan characteristics had higher tolerance and optimum values than the mean for all species. However, it does not mean that cosmopolitans have higher optimum and tolerance levels to all of the environmental variables. For example, *C. neglecta* had higher optimum for pH and dissolved oxygen concentration (DO) and tolerance for electrical conductivity (EC); *H. incongruens* possessed higher optimum for DO, EC and water temperature (Tw), and tolerance for EC and Tw; *I. inermis* had of higher optimum for EC and tolerance for pH; *I. bradyi* had got higher optimum for EC and Tw whereas tolerance for pH, DO, EC and Tw and *P. olicaveus* enjoyed higher optimum for EC values than the mean (for more see Table 4.5).

Table 4.5. Optimum (u_k) and tolerance (t_k) levels of eight species (with five or more occurrences) to four different ecological variables in Adıyaman. N_2 represents Hill's coefficient value is the measure of effective number of occurrences and its value depends on the abundance of species (Gotelli & Chao, 2013). Abbreviations: DO (dissolved oxygen concentration, mgL^{-1}), EC (electrical conductivity, μScm^{-1}), Tw (water temperature, $^{\circ}\text{C}$)

Species	Count	Max	N_2	pH		DO		EC		Tw	
				u_k	t_k	u_k	t_k	u_k	t_k	u_k	t_k
<i>I. inermis</i>	21	87	11.67	7.95	0.37	7.01	1.27	441.38	96.89	19.64	4.74
<i>H. incongruens</i>	46	89	10.97	7.93	0.31	8.00	1.81	500.28	230.83	22.47	6.21
<i>I. bradyi</i>	25	103	7.47	7.96	0.45	7.46	3.22	570.41	164.62	22.36	4.28
<i>P. fallax</i>	15	93	7.00	8.32	0.21	8.31	0.79	256.62	78.45	17.58	1.68
<i>P. olivaceus</i>	15	97	6.30	7.79	0.25	6.55	1.01	424.30	91.98	17.90	3.37
<i>C. neglecta</i>	6	21	3.65	8.36	0.36	7.93	1.09	342.49	134.38	18.84	2.74
<i>H. intermedia</i>	10	107	2.86	7.83	0.32	6.23	1.87	323.06	127.86	20.74	2.58
<i>H. chevreuxi</i>	5	21	2.80	8.33	0.56	8.83	1.43	421.53	128.86	30.60	4.13
Mean				8.06	0.36	7.54	1.56	410.01	131.73	21.27	3.72
Max				8.36	0.56	8.83	3.22	570.41	230.83	30.60	6.21
Min				7.79	0.21	6.23	0.79	256.62	78.45	17.58	1.68

The springs ($H' = 2.32$), creeks ($H' = 2.19$) and ponds ($H' = 2.10$) exhibited higher Shannon Diversity indices values than the other sampled aquatic habitats. Accordingly, the numbers of their encountered species were higher than the other habitats like springs (17 species; sp.), creeks (13 sp.), ponds (11 sp.), irrigation canals and troughs (7 sp.), dams (5 sp.), streams (2 sp.) and water fall (1 sp.) (Table 4.6). Besides, there is no any habitat preferences could be seen for well known cosmopolitan species (e.g., *H. incongruens* and *I. bradyi*) since they were collected in all except lakes (Table 4.6).

Table 4.6. Occurrence frequency of 26 ostracod species in eight different aquatic habitats and Shannon Diversity indices (H') of each habitats in Adiyaman. Abbreviations: Water f. (water fall), Irrigation c. (irrigation canal), ASI (All Sample Index) and JSE (Jackknife Standart Error).

Species	Code	Spring (n=43)	Creek (n=22)	Pond (n=26)	Irrigation c. (n=6)	Trough (n=11)	Dam (n=3)	Stream (n=4)	Water f. (n=1)
<i>C. angulata</i>	Ca		1	2					
<i>C. neglecta</i>	Cn	5			1				
<i>D. stvensoni</i>	Ds	1		1			1		
<i>F. brevicornis</i>	Fb	1							
<i>H. brevicaudata</i>	Hb		1		1				
<i>H. chevreuxi</i>	Hc	1	1	3					
<i>H. helenae</i>	Hh		1						
<i>H. intermedia</i>	Hin	5	1	3		1			
<i>H. incongruens</i>	Hi	16	8	7	4	6	1	2	1
<i>I. bradyi</i>	Ib	10	8	1	2	1	2	1	
<i>I. gibba</i>	Ig						1		
<i>I. inermis</i>	Ii	10	4	6	1				
<i>G. besni</i> n. sp.	Gb	1							
<i>L. inopinata</i>	Li				1		1		
<i>P. fallax</i>	Pf	6	7		1	1			
<i>P. fulva</i>	Pfu	1							
<i>P. pallida</i>	Pp					1			
<i>P. similis</i>	Ps	1	1			1			
<i>P. smaragdina</i>	Psm		2						
<i>P. variegata</i>	Pv			1					
<i>P. albicans</i>	Pa	1		1					
<i>P. semicognita</i>	Pse		1						
<i>P. olivaceus</i>	Po	11	2	1		1			
<i>S. insueta</i>	Si	1							
<i>T. clavata</i>	Tc	1		1					
<i>Z. costata</i>	Zc	1							
	H'	2.32	2.19	2.10	1.77	1.59	1.56	0.64	0.00
Shannon	Variance H'	0.01	0.02	0.03	0.06	0.09	0.07	0.09	0.00
	Exp. H'	10.20	8.89	8.15	5.86	4.90	4.76	1.89	1.00

4.3 Data Analyses of Burdur

The occurrence probability of $P(x = 0)$, $P(x = 1)$, $P(x = 2)$, $P(x = 3)$ and $P(x = 4(+))$ of species in Burdur were calculated by Equation 3.1 and given in Table 4.7.

Table 4.7. Poisson probabilities of 0, 1, 2, 3 and 4(+) occurrence of ostracod species calculated using Equation 3.1 in Burdur.

$P(x=0)$ probability of no occurrence	0.29
$P(x=1)$ probability of one occurrence	0.41
$P(x=2)$ probability of two occurrences	0.29
$P(x=3)$ probability of three occurrences	0.14
$P(x=4+)$ probability of four(+) occurrences	0.05

To test the hypothesis "Ostracod species are randomly distributed among sampling sites in Burdur", the Chi-square (X^2) values of each occurrences (0, 1, 2, 3 and 4 (+)) were calculated by Equation 3.2 as following 0.91, 4.37, 2.33, 0.36 and 0.11, respectively (Table 4.8). The sum of all these ($X^2_{calculated} = 8.08$) was found larger than $X^2_{table(3,121,0.05)} = 7.81$ at 0.05 cut off level so the result is significant. Hence, the random distribution hypothesis was rejected. In order to understand the distribution of ostracod species among sampling sites, we applied the Index of Dispersion and *d-statistics* and the results of them were found as 1.09 and 2.51, respectively. The both of these results support to each other due to their statements and they suggest clump dispersion of ostracod species among sampling sites in Burdur

Table 4.8. Calculated Chi-square values of 0, 1, 2, 3 and 4(+) occurrences of species in Burdur. Expected probability = $N \times \text{Poisson Probability}$; five classes with two constants (habitat and species) so degrees of freedom = $n-2 \Rightarrow 5-2 = 3$.

Class	x	f(obs.freq.)	Exp. Prob.	O-E	$(O-E)^2$	$(O-E)^2/E$
1	0	41	35.32	5.68	32.29	0.91
2	1	35	49.74	-14.74	217.24	4.37
3	2	26	35.02	-9.02	81.44	2.33
4	3	14	16.44	-2.44	5.96	0.36
5	4	5	5.79	-0.79	0.62	0.11
N=121					(X^2)	8.08

Total of 11 species (*C. neglecta*, *H. intermedia*, *I. bradyi*, *I. monstifica*, *H. incongruens*, *H. salina*, *P. variegata*, *Cypria ophtalmica*, *P. olivaceus*, *Limnocythere inopinata* and *Prionocypris zenkeri*) found in Burdur were dominant ((if $Y > 0.02$) (Table 4.9). According to the large and positive values of Index of Clumping (I), Mean Crowding ($\bar{x}^*$), Index of Patchiness ($\bar{x}^*/\bar{x}$) and Index of Dispersion (I), these dominant species showed uneven distribution in their occurred habitats. Also, the results of Index of Clumpings ($I > 5$) support uneven distribution of these species. Of which, *H. incongruens* (30.5 %), *P. olivaceus* (24.49 %) and *I. bradyi* (18.5 %) were amply encountered in Burdur.

Table 4.9. Ecological indices values of dominant ostracod species in Burdur region. Abbreviations: *Y*: Dominance index, *I*: Index of Clumping, $\bar{x}^*$: Mean Crowding, $\bar{x}^*/\bar{x}$: Index of Patchiness, I_δ : Index of Dispersion, % : percentage ratio of *ith* species, Cn: *C. neglecta*, Co: *Cypria ophtalmica*, Ds: *Darwinula stvensoni*, Hc: *H. chevreuxi*, Hin: *H. intermedia*, Hi: *Heterocypris incongruens*, Hs: *Heterocypris salina*, Ib: *Ilyocypris bradyi*, Ig: *I. gibba*, Im: *I. monstifica*, Isb: *Isocypris beauchampi*, Li: *Limnocythere inopinata*, Pk: *Physocypris kraepelini*, Par: *Potamocypris arcuata*, Pf: *Potamocypris fallax*, Ps: *P. similis*, Pv: *P. variegata*, Pzi: *Prionocypris zenkeri*, Pa: *Pseudocandona albicans*, Pfo: *Psychrodromus fontinalis*, Po: *Psychrodromus olivaceus* and Tc: *Trajancypris clavata*.

	Cn	Co	Ds	Hc	Hin	Hi	Hs	Ib	Ig	Im	Isb	Li	Pk	Par	Pf	Ps	Pv	Pzi	Pa	Pfo	Po	Tc
<i>Y</i>	0.36	0.03	0.00	0.01	0.04	11.61	0.62	4.72	0.00	0.03	0.00	0.09	0.00	0.00	0.00	0.00	0.26	0.04	0.00	0.01	6.37	0.00
<i>I</i>	21.69	15.27	-	-	71.07	83.32	82.82	78.30	-	12.95	-	6.45	-	-	-	-	103.26	19.28	-	-	69.90	
$\bar{x}^*$	25.76	55.33	-	-	114.16	10.39	28.38	15.85	-	63.67	-	20.05	-	-	-	-	68.91	73.90	-	-	10.82	
$\bar{x}^*/\bar{x}$	29.40	196.90	-	-	181.75	1.17	9.38	3.01	-	308.17	-	59.17	-	-	-	-	45.31	279.42	-	-	1.52	
I_δ	25.77	55.34	-	-	114.19	10.39	28.39	15.85	-	63.69	-	20.05	-	-	-	-	68.93	73.92	-	-	10.83	
%	3.01	0.97	0.03	0.77	2.16	30.55	10.41	18.15	0.11	0.71	0.06	1.17	0.09	0.20	0.14	0.06	5.23	0.91	0.28	0.31	24.49	0.20

The first two axes of CCA explained 84.5 % of relationships with a moderately low variance (8.8) between 13 species and five environmental variables (Table 4.10).

Table 4.10. Summary table of CCA for 13 species (with two or more occurrences) from 79 sites and five environmental variables in Burdur (* shows the results of DCA).

Axes	1	2	3	4	Total inertia
*Lengths of gradient	0.00	5.95	3.76	2.68	
Eigenvalues	0.34	0.21	0.07	0.03	6.19
Species-environment correlations	0.65	0.55	0.37	0.28	
Cumulative percentage variance					
of species data	5.40	8.80	9.90	10.40	
of species-environment relation	52.10	84.50	94.80	99.30	
Sum of all eigenvalues					6.19
Sum of all canonical eigenvalues					0.65

Based on effectiveness of variables on distribution of ostracods from 79 sampling sites in Burdur (Figure 4.4), they were arranged as water temperature (Tw) ($F = 3.746$, $P = 0.002$), pH ($F = 1.753$, $P = 0.074$), dissolved oxygen concentration (DO) ($F = 1.494$, $P = 0.144$), electrical conductivity (EC) ($F = 0.928$, $P = 0.484$) and air temperature (Ta) ($F = 0.569$, $P = 0.53$). The species *C. neglecta*, *P. olivaceus*, *C. ophthalmica*, *P. fontinalis*, *I. bradyi*, and *P. zenkeri* located at the opposing site of all variables but *L. inopinata* and *I. monstifrica* located at the site of pH, EC and Ta. The rest (*H. incongruens*, *P. variegata*, *H. intermedia* and *Physocypria kraepelini*) landed at the site of Tw and DO. The well known cosmopolitan species *H. incongruens* and *I. bradyi* were relatively closer to the center of diagram (Figure 4.4).

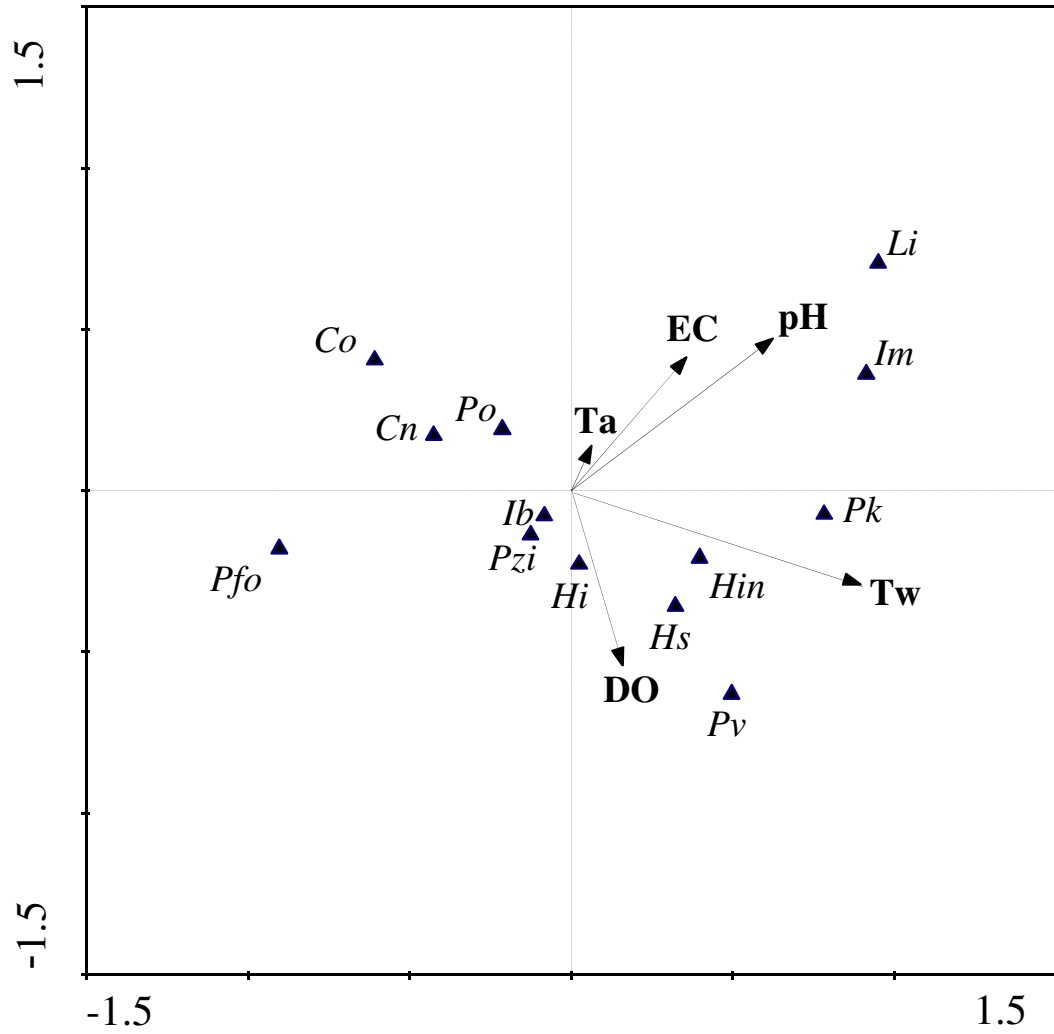


Figure 4.4. CCA diagram shows the location of 13 species based on the effect of five most influential environmental variables (arrows) (Tw, pH, DO, EC and Ta) on their distribution in Burdur. Triangles show the species code while open circles (o) represent the sites number. For abbreviations see Appendices A and C.

As seen in Figure 4.5, there was no propensity for increasing and decreasing in the number of species (e.g., presence of 8 species at 886 - 1036 m and 1339 - 1489 m) among 150 m a.s.l elevational ranges from 282 to 1640 m a.s.l. The number of sampling sites also did not affect the number of species at different elevational ranges such as 886 - 1036 m and 1339 - 1489 m with same number of species (8) when the numbers of sites (23 and 11, respectively) are different. Like Adıyaman, sexually reproducing species were encountered more frequently than asexually

reproducing species when elevation inclined, (e.g., 12 sex (sexual) and 6 asex (asexual) at 1037 - 1187 m; 4 sex and 3 asex at 1188 - 1338 m; 5 sex and 3 asex at 1339 - 1489 m and 2 sex and no asex species at 1490 - 1640 m a.s.l. (Figure 4.5)).

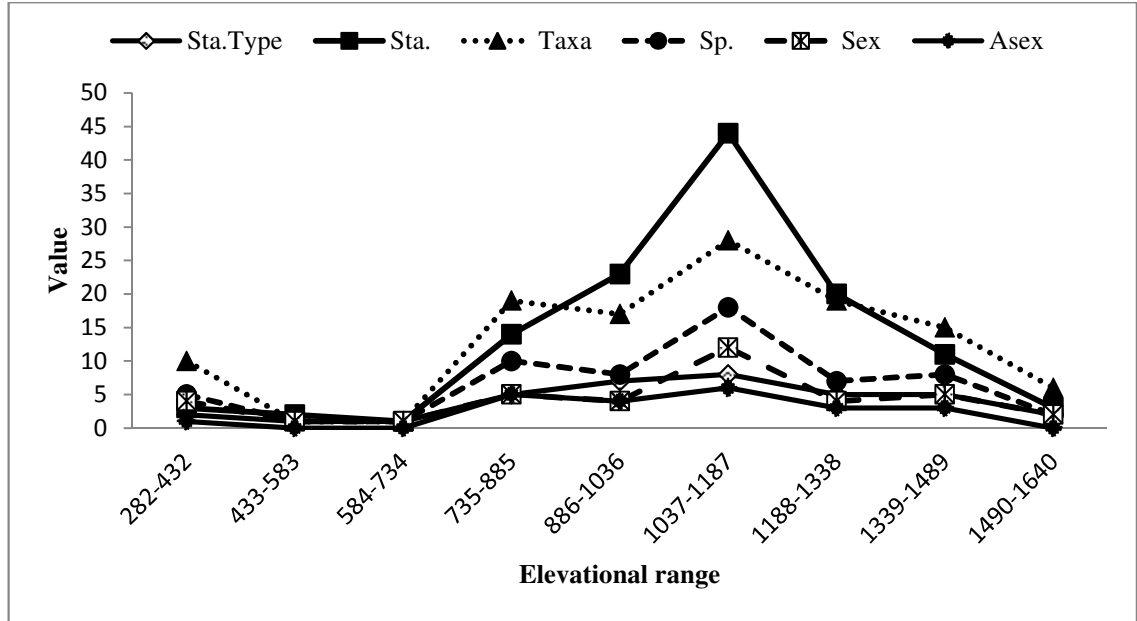


Figure 4.5. The number of taxa, species, site type, sampled site and species with sexual and asexual reproduction at the nine different 150 m a.s.l. elevational ranges in Burdur. Abbreviations: Sta. (site number), Sta. Type (site type), Sp. (species number), Sex (species sexually reproduce) and Asex (species asexually reproduce).

In Figure 4.6, close to a paralleling was observed between air and water temperatures from 121 sampling sites in Burdur. There was a relatively large differences between early morning (time: 05³⁰ - 07³⁰ am) (max: 27.2 min: 12.4 and mean: 19.75 °C) and towards evening (time: 18³⁰ - 20³⁰ pm) (max: 31.4 min: 25.5 and mean: 29.72 °C) air temperatures in Burdur. The mean water temperatures in early morning and in towards evening sampled sites are as 15.84 and 22.35 °C, respectively (first five sampling sites for early morning in all days and the last five for towards evening except in last day because we finished sampling around afternoon, in Appendix C). In accordance with the results of the Shapiro-Wilk and Kolmogorov-Smirnov tests (Appendix D(1)), data of air and water temperatures 121 sampling sites in Burdur from did not exhibit normality ($P < 0.05$). Hence, a skewness of 1 (standard error (SE) = 0.22) and a kurtosis of -2.30 (SE = 0.44) for water temperature were found when air temperature has skewness and kurtosis

values like following -4.52 (SE = 0.22) and 1.74 (SE = 0.44), respectively. Analysis of variances (ANOVA) displayed a significant ($P < 0.05$) relationship between water (Tw) and air (Ta) temperatures (Appendix D(2a)) Correspondingly, the relationship was modelled by linear regression analysis like following (see Appendices D(2) and D(2b));

$$\checkmark \quad T_w = 10.798 + 0.289 \cdot T_a \quad (P < 0.05, R^2 = 0.098)$$

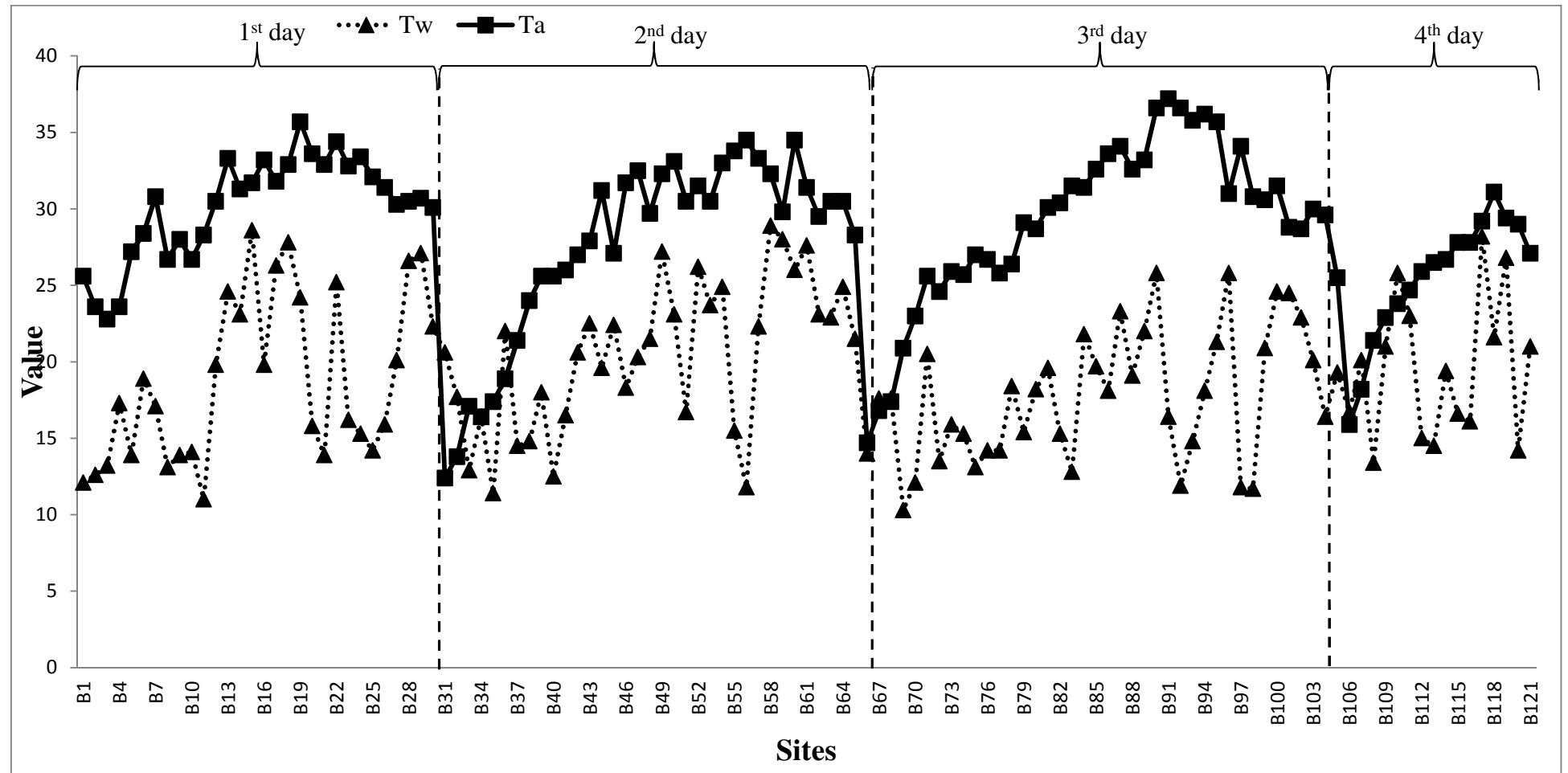


Figure 4.6. The relationships between water (Tw, °C) and air (Ta, °C) temperatures of 121 sampling sites in Burdur.

As shown in Table 4.11, cosmopolitans generally had larger tolerance and optimum values than the mean. For example, *H. incongruens* and *I. bradyi* have larger tolerance levels for water temperature but *C. neglecta* shows higher optimum values for dissolved oxygen concentration than the mean. Besides, *L. inopinata* possess larger tolerance levels for pH and electrical conductivity. These results suggest species-specific tolerance (t_k) and optimum (μ_k) levels for individual species.

Table 4.11. Optimum (u_k) and tolerance (t_k) levels of 13 species to four different ecological variables in Burdur. N_2 represents Hill's coefficient value is the measure of effective number of occurrences and its value depends on the abundance of species (Gotelli & Chao, 2013). Abbreviations: DO (dissolved oxygen concentration, mgL^{-1}), EC (electrical conductivity, μScm^{-1}), Tw (water temperature, $^{\circ}\text{C}$), Max (maximum) and Min (minimum).

Species	Count	Max	N_2	pH		DO		EC		Tw	
				u_k	t_k	u_k	t_k	u_k	t_k	u_k	t_k
<i>H. incongruens</i>	38	171	11.61	7.95	0.29	7.83	2.39	610.90	120.46	19.25	3.98
<i>P. olivaceus</i>	26	121	11.12	7.89	0.44	6.68	2.19	771.07	202.11	17.21	3.53
<i>I. bradyi</i>	26	143	7.60	7.80	0.27	7.35	1.69	632.91	120.67	17.91	4.32
<i>L. inopinata</i>	8	14	5.30	8.50	0.44	5.88	2.16	2619.36	4492.43	24.45	2.13
<i>C. neglecta</i>	12	41	4.53	7.76	0.31	7.54	1.97	633.33	175.75	14.69	3.18
<i>H. salina</i>	6	121	4.25	7.94	0.43	8.39	2.01	741.77	203.18	22.01	6.01
<i>C. ophthalmica</i>	3	19	2.07	7.56	0.37	4.58	3.70	541.34	56.85	13.56	3.42
<i>P. kraepelini</i>	2	2	1.80	8.31	0.16	7.12	4.42	368.57	34.51	25.57	3.25
<i>I. monstifica</i>	4	18	1.78	8.85	0.51	9.19	3.91	421.50	127.03	25.57	3.54
<i>P. variegata</i>	5	135	1.75	8.12	0.23	11.21	1.01	491.36	6.04	24.75	1.42
<i>P. zenkeri</i>	4	25	1.57	7.92	0.37	8.25	2.48	651.93	96.09	18.89	4.41
<i>P. fontinalis</i>	2	9	1.42	7.25	0.37	5.38	3.22	686.35	91.44	12.79	1.20
<i>H. intermedia</i>	2	74	1.05	8.10	0.36	7.08	0.83	701.61	5.57	23.03	1.77
Mean				8.00	0.35	7.42	2.46	759.38	440.93	19.97	3.24
Max				8.85	0.51	11.21	4.42	2619.36	4492.43	25.57	6.01
Min				7.25	0.16	4.58	0.83	368.57	5.57	12.79	1.20

Based on the numbers of sampled sites from high to low, habitats were arranged as troughs, creeks, ponds, dams, springs and lakes. However, this order was changed with regard to the numbers of species they bear as ponds (11 species (sp.)), troughs (10 sp.), springs and creeks (7 sp.), dams (6 sp.) and lakes (4 sp.) (Table 4.12). Accordingly, there was no clear correlation between numbers of sampled sites

and numbers of species that increasing numbers of sampling sites are not increase the numbers of species. Shannon values of ponds ($H' = 2.25$), springs ($H' = 1.79$) and creeks ($H'=1.71$) were higher than the other sampled habitats (Table 4.12).

Table 4.12. Occurrence frequencies of 22 ostracod species in six different aquatic habitats and Shannon diversity index (H') value of each habitats in Burdur. Abbreviations: ASI (All Sample Index) and JSE (Jackknife Standart Error).

Species	Code	Spring (n=10)	Lake (n=9)	Dam (n=12)	Pond (n=15)	Creek (n=17)	Trough (n=58)		
<i>C. neglecta</i>	Cn	4			2	5	1		
<i>C. ophthalmica</i>	Co	1	2						
<i>D. stevensoni</i>	Ds	1							
<i>H. chevreuxi</i>	Hc						1		
<i>H. intermedia</i>	Hin						2		
<i>H. incongruens</i>	Hi	1			4	2	31		
<i>H. salina</i>	Hs				1		5		
<i>I. bradyi</i>	Ib	2			3	7	14		
<i>I. gibba</i>	Ig			1					
<i>I. monstifica</i>	Im		1	1	2				
<i>I. beauchampi</i>	Isb			1					
<i>L. inopinata</i>	Li		2	6					
<i>P. kraepelini</i>	Pk			1	1				
<i>P. arcuata</i>	Par				1				
<i>P. fallax</i>	Pf				1				
<i>P. similis</i>	Ps						1		
<i>P. variegata</i>	Pv			1		1	3		
<i>P. zenkeri</i>	Pzi					2	2		
<i>P. albicans</i>	Pa				1				
<i>P. fontinalis</i>	Pfo	1				1			
<i>P. olivaceus</i>	Po	2	3		1	6	14		
<i>T. clavata</i>	Tc				1			ASI	JSE
	H'	1.79	1.32	1.42	2.25	1.71	1.68	2.33	0.25
Shannon	Variance H'	0.05	0.04	0.09	0.03	0.02	0.01		
	Exp. H'	6.00	3.75	4.14	9.44	5.54	5.35		

4.4 Data Analyses of ADIBUR (combining data of Adıyaman and Burdur)

Alpha diversity values of Adıyaman and Burdur were 41 and 35, respectively, while Beta and Gamma diversities were in order of 28 and 52 (this includes all recent and sub-recent forms). According to the Shannon Diversity indice range (1.5 - 3.5), the ostracod species were ordered as *H. incongruens* > *I. inermis* > *I. bradyi* > *P. olivaceus* = *P. fallax* > *C. neglecta* in Adıyaman. This order is changed in Burdur as *H. incongruens* > *P. olivaceus* > *I. bradyi* > *L. inopinata* > *C. neglecta* > *H. salina*. The other diversity indice values (e.g., Simpson's D, Margalef D, Berger-Parker Dominance, Brillouin, Menhinick D and Strong's) of these species were also higher than the values of all other species (for more details see Table 4.13).

Table 4.13. Alpha diversity indices values of each ostracod species and Alpha (α), Beta (β) and Gamma (γ) diversity values of Adiyaman and Burdur. Abbreviations; ASI (All Sample Index), JSE (Jackknife Standart Error) and – represents the absence of species and for codes of species see Appendices A and C.

	ADIYAMAN									BURDUR								
		Shannon		Simpson's D	Margalef D	Berger-Parker Dominance	Brillouin	Menhinick D	Strong's		Shannon		Simpson's D	Margalef D	Berger-Parker Dominance	Brillouin	Menhinick D	Strong's
	H	V. H	Ex.H	Ind.	Ind.	Ind.	Ind.	Ind.	Ind.	H	V. H	Ex.H	Ind.	Ind.	Ind.	Ind.	Ind.	Ind.
Ca	0.92	0.01	2.51	2.46	0.63	0.50	0.79	0.61	0.25	-								
Cn	1.53	0.01	4.61	3.88	1.30	0.45	1.35	0.88	0.33	1.86	0.01	6.39	4.69	2.36	0.39	1.69	1.17	0.48
Co	-									0.79	0.01	2.21	2.14	0.57	0.56	0.71	0.51	0.30
Ds	0.25	0.01	1.28	1.12	0.50	0.95	0.21	0.40	0.61									
Fb										-								
Gb										-								
Hb	0.69	0.00	1.99	2.20	0.42	0.55	0.56	0.60	0.05	-								
Hc	1.22	0.01	3.39	2.92	1.06	0.49	1.08	0.76	0.41									
Hh										-								
Hin	1.36	0.01	3.90	2.89	1.67	0.49	1.29	0.68	0.61	0.12	0.00	1.13	1.06	0.23	0.97	0.10	0.23	0.47
Hi	2.80	0.00	16.43	10.73	6.97	0.16	2.67	1.91	0.59	2.76	0.00	15.75	11.73	5.30	0.16	2.69	1.16	0.57
Hs	-									1.58	0.00	4.85	4.29	0.85	0.33	1.54	0.31	0.28
Ib	2.42	0.00	11.21	7.58	3.94	0.23	2.32	1.19	0.51	2.40	0.00	10.99	7.68	3.87	0.22	2.32	1.03	0.55
Ig																		
Ii	2.64	0.00	14.05	11.89	3.15	0.15	2.57	0.88	0.39	-								
Im	-									0.82	0.03	2.26	1.84	0.93	0.72	0.67	0.80	0.47
Isb	-																	
Li	0.36	0.03	1.44	1.28	0.35	0.88	0.29	0.49	0.38	1.87	0.01	6.50	5.94	1.89	0.34	1.62	1.25	0.26
Pk	-									0.64	0.09	1.89	3.00	0.91	0.67	0.37	1.16	0.17
Par	-																	
Pf	2.15	0.00	8.55	7.11	2.33	0.23	2.08	0.75	0.45									
Pfu										-								
Pp										-								
Ps	0.70	0.00	2.01	1.80	0.45	0.69	0.66	0.32	0.36									
Psm										-								
Pv										0.82	0.00	2.28	1.76	0.77	0.73	0.78	0.37	0.53
Pzi	-									0.70	0.03	2.01	1.60	0.87	0.78	0.59	0.71	0.53
Pa	0.69	0.13	2.00	2.00	1.44	0.50	0.35	1.41	0.00									
Pse										-								
Pfo	-									0.47	0.03	1.61	1.49	0.42	0.82	0.36	0.60	0.32
Po	2.15	0.00	8.60	6.41	2.45	0.32	2.06	0.86	0.41	2.57	0.00	13.05	11.25	3.70	0.14	2.51	0.89	0.51
Si										-								
Tc	0.64	0.09	1.89	3.00	0.91	0.67	0.37	1.16	0.17									
Zc										-								
ASI	3.90			38.68	10.39	0.06	3.83	1.55	0.44	3.66			29.39	9.68	0.07	3.61	1.35	0.51
JSE	0.21			8.47	1.43	0.02	0.22	0.17	0.04	0.20			7.01	1.25	0.03	0.20	0.16	0.04
α	41									35								
β	28																	
γ	52																	

The calculated Poisson probabilities of $P(x = 0)$, $P(x = 1)$, $P(x = 2)$, $P(x = 3)$ and $P(x = 4 (+))$ for ostracod species in ADIBUR were like that 0.27, 0.36, 0.25, 0.11 and 0.04, respectively and given in Table 4.14.

To test the hypothesis of Poisson distribution method, the expected probabilities were calculated by using the Poisson probability of each occurrence of species in Table 4.14 were given in Table 4.15 to compute calculated Chi-square value (Table 4.15). After application of Chi-square, the result was significant ($X^2_{calculated} = 8.48 > X^2_{table} = 7.81$) and so the null hypothesis “Ostracod species are randomly distributed among sampling sites in ADIBUR” was rejected. To test alternative hypothesis we applied the Index of Dispersion (0.32) and *d-statistics* (-9.51) and the results of both tests showed the uniform distribution of species among sampling sites in ADIBUR.

Table 4.14. Calculated Poisson probabilities of 0, 1, 2, 3 and 4(+) occurrences of ostracod species in ADIBUR.

P(x=0) probability of no occurrence	0.27
P(x=1) probability of one occurrence	0.36
P(x=2) probability of two occurrences	0.25
P(x=3) probability of three occurrences	0.11
P(x=4+) probability of four(+) occurrences	0.04

Table 4.15. Calculated Chi-square values of five different classes from ADIBUR. Abbreviations: obs. freq. (observed frequency), O (observed), E (expected), Exp. Prob. (expected probability).

Class	x	f(obs.freq.)	Exp. Prob.	O-E	(O-E) ²	(O-E) ² /E
1	0	72	61.79	10.21	104.17	1.69
2	1	69	84.10	-15.10	228.05	2.71
3	2	55	57.23	-2.23	4.98	0.09
4	3	31	25.96	5.04	25.37	0.98
5	4	14	8.83	5.17	26.69	3.02
N = 241					(X ²)	8.48

Table 4.16 indicates the dominant species (if $Y > 0.02$) in eight different aquatic habitats. They were ordered with reference to dominant species as follow pond and dams (9 sp. (species)), springs (8 sp.), trough and creeks (7 sp.), irrigation canals (6 sp.), lakes (4 sp.) and streams (2 sp.), respectively. Also, the distributional characteristics of all these dominant species in their present habitats were uneven because of the larger positive values of Index of Clumping, Mean Crowding, Index of Patchiness and Index of Dispersion. The well known cosmopolitans (*H. incongruens* and *I. bradyi*) were found as dominant in all sampled habitats except lakes (4.16).

Table 4.16. Ecological index values of dominant Ostracoda species in eight different aquatic habitats from ADIBUR. Abbreviations: Y (Dominance index), I (Index of Clumping), $\bar{x}^*$ (Mean Crowding), $\bar{x}^*/\bar{x}$ (Index of Patchiness), I_δ (Index of Dispersion), % (percentage ratio of i th species) and for abbreviations of species see Appendices A and C). The information from water fall did not given because there is only one sampling site and one species (*H. incongruens*).

		Ca	Cn	Co	Ds	Hc	Hin	Hi	Hs	Ib	Ig	Ii	Im	Isb	Li	Pk	Pf	Ps	Pv	Pa	Po
Irrigation Canal	Y		0.08					0.49		0.58		0.21			0.06		0.21				
	I		20.00					7.70		47.93		53.00			14.00		52.00				
	$\bar{x}^*$		6.71					2.49		4.94		6.89			6.60		6.89				
	$\bar{x}^*/\bar{x}$		1.92					0.48		0.41		0.77			2.64		0.78				
	I_δ		6.74					2.50		4.96		6.92			6.63		6.91				
	%		8.30					12.25		28.85		21.34			5.92		20.95				
Creek	Y		0.35				0.12	0.67		3.92		0.39					1.75				0.83
	I		30.10				106.00	15.79		23.65		36.59					59.23				68.48
	$\bar{x}^*$		19.64				39.64	11.91		4.81		17.03					11.22				29.41
	$\bar{x}^*/\bar{x}$		12.16				14.45	8.23		0.77		7.46					1.94				12.20
	I_δ		19.66				39.68	11.93		4.81		17.05					11.23				29.44
	%		6.98				11.86	6.10		26.16		9.87					25.06				10.42
Dam	Y				0.03			0.09		0.09	0.22		0.08	0.03	3.83	0.03			0.03		
	I				1.00			5.00		0.57	2.33		4.00	1.00	5.35	1.00			1.00		
	$\bar{x}^*$				8.50			13.50		3.86	5.99		13.00	8.50	3.29	8.50			8.50		
	$\bar{x}^*/\bar{x}$				63.75			33.75		19.29	12.83		39.00	63.75	1.41	63.75			63.75		
	I_δ				8.63			13.71		3.92	6.08		13.21	8.63	3.34	8.63			8.63		
	%				3.13			9.38		4.69	10.94		7.81	3.13	54.69	3.13			3.13		
Lake	Y			0.80									0.36		0.32						0.24
	I			16.93									17.00		2.64						0.27
	$\bar{x}^*$			11.16									12.33		4.95						1.82
	$\bar{x}^*/\bar{x}$			6.69									8.22		7.43						5.45
	I_δ			11.38									12.59		5.06						1.86

Table 4.16 (continued)

		Ca	Cn	Co	Ds	Hc	Hin	Hi	Hs	Ib	Ig	Ii	Im	Isb	Li	Pk	Pf	Ps	Pv	Pa	Po
Pond	Y	0.04				0.11	0.12	2.06	0.08	0.56		1.72								0.03	0.28
	I	9.49				15.83	9.90	52.07	57.00	84.50		54.41								8.14	93.03
	$\bar{x}^*$	28.78				25.03	15.00	16.70	41.29	34.47		11.73								31.33	39.14
	$\bar{x}^*/\bar{x}$	84.28				38.01	21.21	5.03	29.19	13.65		2.31								116.76	16.05
	I_δ	28.82				25.07	15.02	16.72	41.35	34.51		11.74								31.37	39.20
	%	1.93			0.14	3.71	3.99	18.71	7.98	13.89		28.61					0.69			1.51	13.76
Spring	Y		0.33		0.07		0.26	1.91		2.66		1.45					0.48				2.91
	I		8.24		50.00		58.09	44.16		88.46		38.61					45.79				45.56
	$\bar{x}^*$		8.80		51.94		39.73	13.72		14.97		10.14					21.10				7.98
	$\bar{x}^*/\bar{x}$		8.34		52.92		26.48	3.95		2.36		2.40					9.27				1.22
	I_δ		8.81		51.98		39.75	13.73		14.98		10.14					21.12				7.98
	%		3.69	0.91	3.43	0.91	5.25	11.92		22.15		14.51					7.97				22.41
Stream	Y							1.20		0.40											
	I							0.22		1.00											
	$\bar{x}^*$							1.30		3.00											
	$\bar{x}^*/\bar{x}$							1.73		6.00											
	I_δ							1.62		3.75											
	%							60.00		40.00											
Trough	Y						0.08	15.24	0.53	1.67							0.04	0.19		3.21	
	I						70.10	75.01	87.27	81.63							58.07	104.54		67.12	
	$\bar{x}^*$						63.81	5.32	20.55	18.44							64.60	40.85		8.45	
	$\bar{x}^*/\bar{x}$						57.18	0.31	4.60	3.94							70.75	15.57		0.94	
	I_δ						63.84	5.33	20.56	18.44							64.62	40.87		8.45	
	%						2.65	41.19	10.60	11.11							2.17	6.23		21.40	

With respect to Table 4.17, the results of Detrended Correspondence Analysis (DCA) (3.93) showed the suitability of data for application of Canonical Correspondence Analysis (CCA). After application of CCA, the first two axes implied the 69.7 % of relationships between 19 species and four environmental variables with a low variance (4.5).

Table 4.17. Summary table of CCA for 19 species (with three or more occurrences) from 161 sampling sites and four environmental variables from ADIBUR (* shows the results of DCA).

Axes	1	2	3	4	Total inertia
*Lengths of gradient	5.70	3.93	3.95	5.15	
Eigenvalues	0.18	0.15	0.09	0.06	7.36
Species-environment correlations	0.54	0.49	0.40	0.32	
Cumulative percentage variance					
of species data	2.40	4.50	5.60	6.40	
of species-environment relation	38.10	69.70	88.10	100	
Sum of all eigenvalues					7.36
Sum of all canonical eigenvalues					0.47

The diagram of CCA (Figure 4.7) indicated that the effective variables on distribution of species are arranged as water temperature (Tw) ($P = 0.002$, $F = 3.634$), pH ($P = 0.002$, $F = 2.936$), dissolved oxygen concentration (DO) ($P = 0.1180$, $F = 2.610$) and elevation (Elev.) ($P = 0.140$, $F = 1.347$). The species *C. angulata*, *D. stevensoni*, *H. chevreuxi*, *I. inermis*, *H. incongruens*, *H. salina*, *L. inopinata*, *P. similis* and *P. variegata* located on the site of Tw and also all of them were relatively closer to water temperature arrow except *L. inopinata*. The *Pseudocandona albicans*, *I. monstifica* and *P. fallax* embed in the site of pH but any of them were not closer to the arrow. The others (*I. bradyi*, *H. intermedia* and *Trajancypris clavata*) showed closer relationships with the arrow of DO. Although remained species (*C. neglecta*, *P. olivaceus*, *C. ophtalmica* and *P. zenkeri*) positioned on the site of elevation, any of them did not show any close relationships with its arrow. Indeed, the well known cosmopolitans (*I. bradyi*, *I. inermis* and *H. intermedia*) were relatively close to the center of diagram.

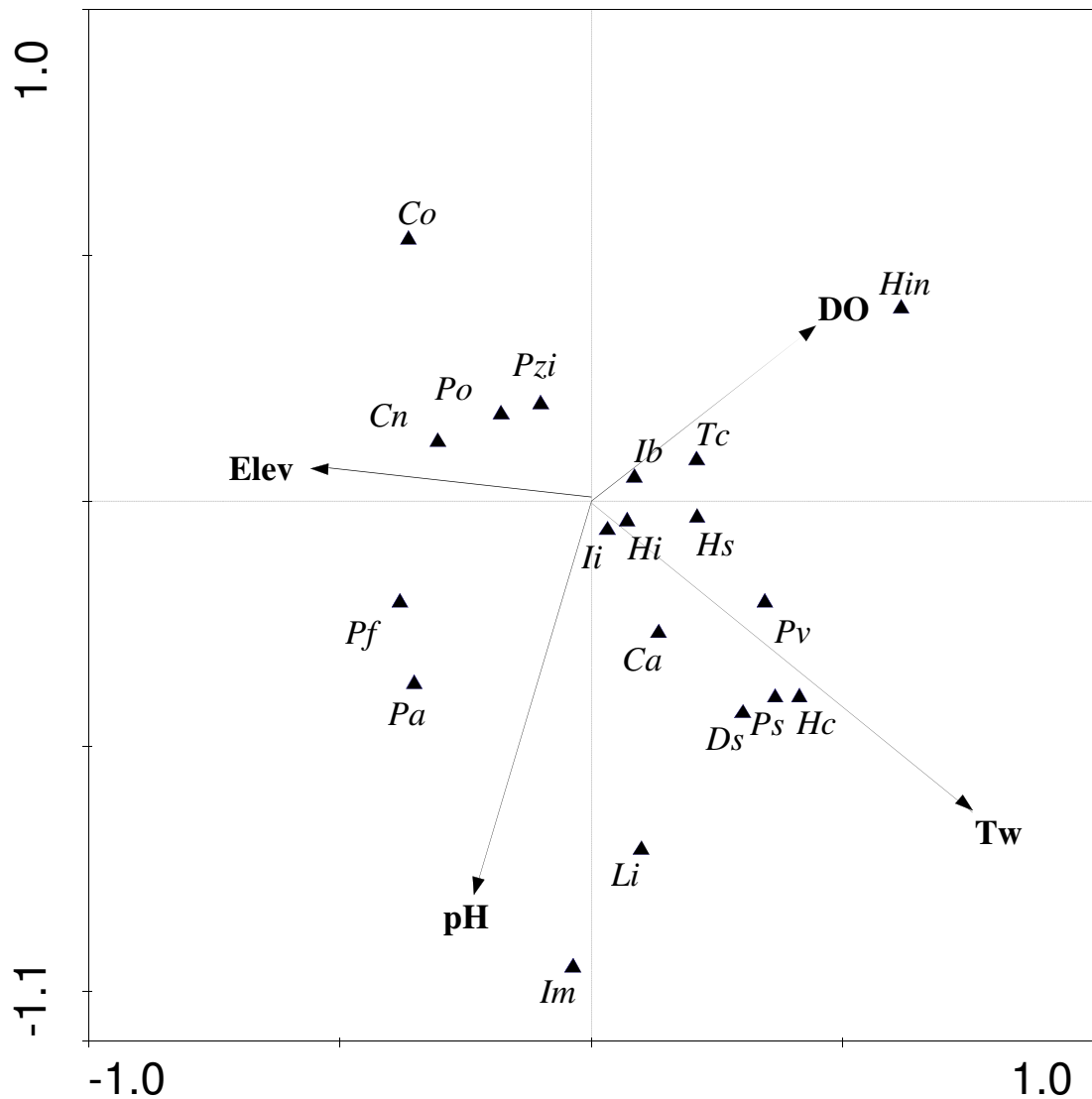


Figure 4.7. Diagram of CCA shows the location of 19 species from ADIBUR according to the effect of four most effective environmental variables (arrows) (Tw, pH, DO and Elev.) on their distribution. Triangles show the species code. For abbreviations see Appendices A and C.

In spite of the number of sampling sites rised, there was no any clear differences between number of species (e.g., 15 sp. (species) and 30 sta. (site number) at 584 - 734 m; 17 sp. and 42 sta. at 735 - 885 m and 16 sp. and 45 sta. at 886 - 1036 m a.s.l.) at different elevational ranges (Figure 4.8). In addition, the presence of approximately 750 m a.s.l. elevational differences between the 433 - 583 (13 sta., 9 sp.) and 1339 - 1489 m a.s.l. (13 sta., 9 sp.) ranges that did not affect the number of available species. Additonally, the encounterance probability of sexually reproducing species increased when the elevation ascended (Figure 4.8).

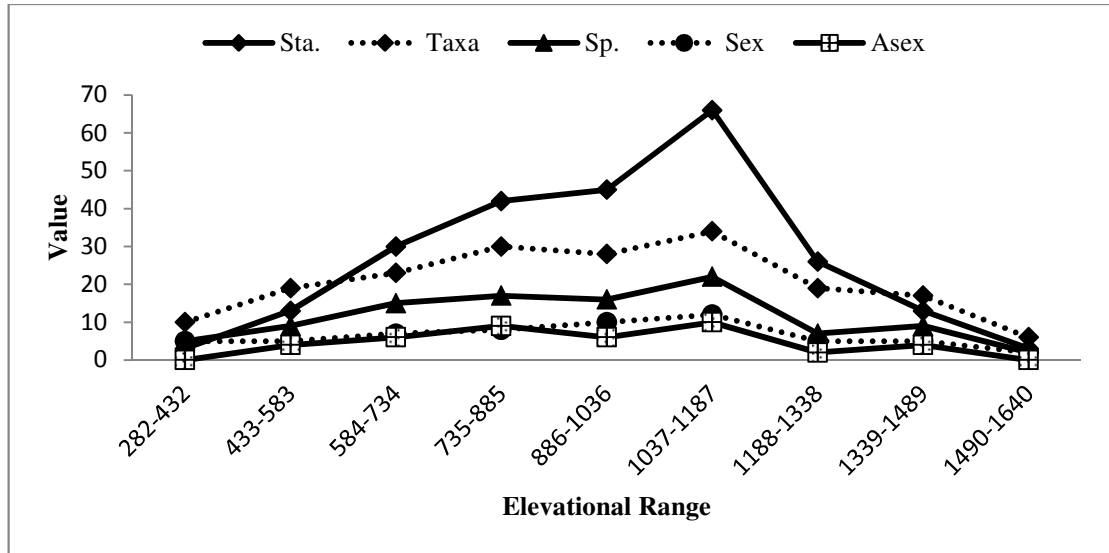


Figure 4.8. The number of taxa, species, sampled site and species with sexual and asexual reproduction at the nine different 150 m a.s.l. elevational ranges in ADIBUR. Abbreviations: Sta. (site number), Sp. (species number), Sex (species sexually reproduce) and Asex (species asexually reproduce).

When we combined the data of both provinces (ADIBUR), a downward paralleling was observed in the data of water and air temperatures from 241 sampling sites (Figure 4.9). Both data did not show normality due to the results of Shapiro-Wilk test and Kolmogorov-Smirnov tests ($P < 0.05$) (Appendix E(1)). Accordingly, data of air temperatures kepted skewness and kurtosis values as -5.44 (standard error (SE) = 0.16) and 2.59 (SE = 0.31), respectively, when a skewness of 2.15 (SE = 0.16) and a kurtosis of -1.64 (SE = 0.31) was found for the data of water temperatures. According to analysis of variance (ANOVA), relationship between the data of water and air temperatures (Appendix E(2a)) was significant ($P < 0.05$). Consequently, the model was found between the data of water (T_w) and air (T_a) temperatures by using linear regression analysis like following (see Appendices E(2) and E(2b));

$$\checkmark \quad T_w = 9.638 + 0.326 \cdot T_a \quad (P < 0.05, R^2 = 0.14)$$

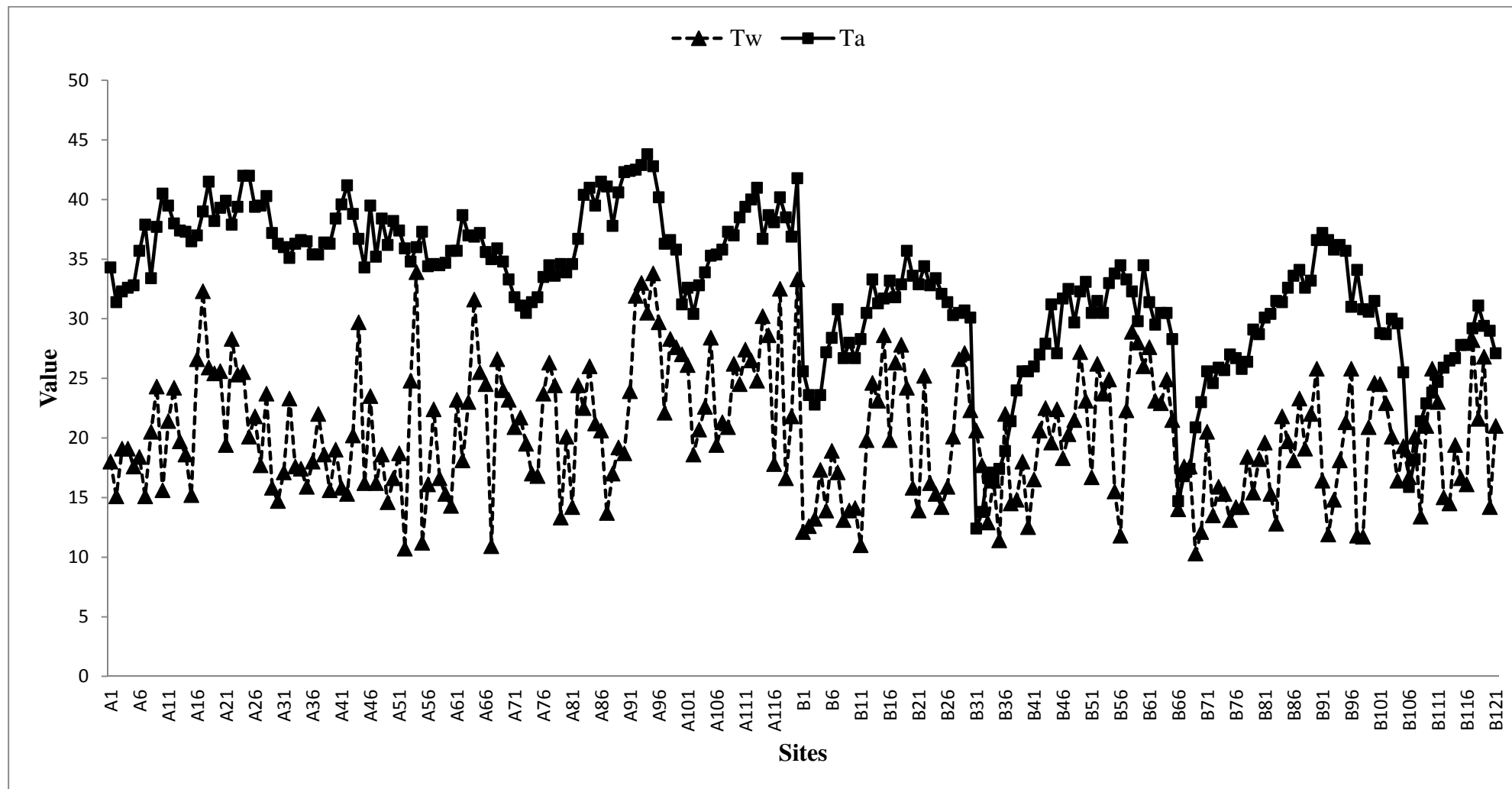


Figure 4.9. The relationships between water temperature (Tw, °C) and air (Ta, °C) temperatures of 241 sampling sites in ADIBUR.

Table 4.18 shows the tolerance and optimum levels of most frequently encountered species for pH, dissolved oxygen concentration (DO), electrical conductivity (EC), water temperature (Tw), moisture (Mist) and elevation (Elev.). Accordingly, the species showing wider geographical distribution had higher tolerance levels than the mean (such as *P. olivaceus*, *I. inermis* and *C. neglecta* for pH; *H. incongruens*, *C. ophtalmica* and *H. chevreuxi* for DO and *H. salina*, *H. incongruens*, *T. clavata* and *I. bradyi* for Tw).

The results of non-parametric Spearman Correlation Analysis showed negative correlations between three species (*C. ophtalmica* ($P < 0.01$), *H. incongruens* and *L. inopinata* ($P < 0.05$)) and pH. Also, two species (*C. ophtalmica* ($P < 0.01$) and *P. similis* ($P < 0.05$)) and one species (*P. fallax* ($P < 0.01$)) showed negative and positive correlation with dissolved oxygen concentration, respectively. Additionally, *D. stevensoni* ($P < 0.05$) and *P. fallax* ($P < 0.01$) exhibited negatively significant correlations with water temperature. Besides, *I. inermis* ($P < 0.05$) and *T. clavata* ($P < 0.01$) were positively correlated with elevation. There was a negatively significant ($P < 0.01$) correlation between elevation and water temperature (see Table 4.19).

Alpha diversity indices values (Shannon, Simpson's D, Margalef D, Berger Parker Dominance, McIntosh D, Brillouin D, Fisher's Alpha, Menhinick D and Strong's) of the different aquatic habitats arranged the habitats as ponds, springs, creeks, dams, irrigation canals and troughs. The other three aquatic habitats (lakes, dams and water falls) were not evaluated because their values were under the critical levels (digit for Shannon fall between 1.5 - 3.5) (for more details see Table 4.20).

Table 4.18. Optimum (u_k) and tolerance (t_k) levels of 19 species (with three or more occurrences) from ADIBUR to six different ecological variables. N_2 represents Hill's coefficient value is the measure of effective number of occurrences and its value depends on the abundance of species (Gotelli & Chao, 2013). Abbreviations: DO (dissolved oxygen concentration, mgL^{-1}), EC (electrical conductivity, μScm^{-1}), Tw (water temperature, $^{\circ}\text{C}$), Mist (moisture, %), Elev (Elevation, m), Max (maximum) and Min (minimum).

Species	Count	Max	N_2	pH		DO		EC		Tw		Mist		Elev	
				u_k	t_k	u_k	t_k	u_k	t_k	u_k	t_k	u_k	t_k	u_k	t_k
<i>H. incongruens</i>	83	171	20.63	7.95	0.29	7.89	2.07	534.61	145.25	20.33	5.02	24.28	13.00	1015.38	224.56
<i>P. olivaceus</i>	41	121	16.69	7.86	0.39	6.64	1.91	599.76	172.68	17.39	3.41	21.26	7.55	1019.44	228.07
<i>I. bradyi</i>	51	143	14.64	7.86	0.35	7.24	1.78	588.20	121.52	19.73	4.73	23.96	13.97	986.28	287.37
<i>I. inermis</i>	21	87	11.67	7.95	0.37	7.01	1.27	441.38	59.57	19.64	4.74	18.51	6.03	896.44	179.15
<i>C. neglecta</i>	18	41	7.59	7.94	0.43	7.66	1.66	499.54	152.94	15.96	3.53	21.89	6.87	1070.11	192.81
<i>P. fallax</i>	16	93	7.17	8.32	0.21	8.30	0.79	260.86	52.47	17.53	1.72	16.02	2.79	1104.02	110.09
<i>L. inopinata</i>	10	15	6.16	8.39	0.41	6.28	1.92	2063.89	3885.72	24.80	1.96	16.88	6.88	942.50	374.87
<i>H. salina</i>	6	121	4.25	7.94	0.43	8.39	2.01	685.15	170.71	22.01	6.01	21.99	9.71	1062.86	182.67
<i>H. intermedia</i>	12	107	3.92	7.90	0.30	6.45	1.57	414.01	114.41	21.33	2.39	21.79	7.91	815.05	186.92
<i>H. chevreuxi</i>	6	27	3.53	8.05	0.59	7.46	2.30	288.83	119.60	24.20	10.03	26.48	16.27	935.64	248.98
<i>C. angulata</i>	3	12	2.32	8.20	0.30	8.27	1.09	392.50	49.80	23.68	8.64	14.56	7.07	1047.92	121.02
<i>C. ophtalmica</i>	3	19	2.07	7.56	0.37	4.58	3.70	423.60	48.69	13.56	3.42	20.99	10.20	1298.18	156.34
<i>P. variegata</i>	6	135	1.98	8.09	0.28	10.64	3.33	500.50	28.09	24.51	1.84	15.84	7.44	870.09	119.22
<i>P. similis</i>	4	61	1.86	8.21	0.27	5.93	0.95	298.92	83.10	23.75	8.50	22.43	3.91	670.07	121.19
<i>T. clavata</i>	3	7	1.85	7.80	0.10	4.88	3.35	404.67	80.79	19.29	7.14	34.87	18.99	753.40	90.07
<i>I. monstiflica</i>	4	18	1.78	8.85	0.51	9.19	3.91	415.09	106.17	25.57	3.54	17.80	9.41	880.60	458.43
<i>P. zenkeri</i>	4	25	1.57	7.92	0.37	8.25	2.48	458.25	106.65	18.89	4.41	19.62	17.71	1054.88	118.22
<i>P. albicans</i>	3	10	1.41	8.54	0.45	8.97	2.19	233.08	51.79	17.80	4.64	16.64	1.99	1121.92	193.83
<i>D. stvensoni</i>	4	52	1.16	8.20	0.16	6.31	0.71	368.41	17.57	23.31	3.17	18.41	1.72	892.98	205.71
Mean				8.08	0.35	7.39	2.05	519.54	293.03	20.70	4.68	20.75	8.92	970.41	199.97
Max				8.85	0.59	10.64	3.91	2063.89	3885.72	25.57	10.03	34.87	18.99	1298.18	458.43
Min				7.56	0.10	4.58	0.71	233.08	17.57	13.56	1.72	14.56	1.72	670.07	90.07

Table 4.19. The Spearman Rank Correlation Analysis among four environmental variables (pH, DO: dissolved oxygen concentration (mgL⁻¹), Tw: water temperature (°C), Elev: elevation (m) and 19 species (with three or more occurrences) in ADIBUR. The codes of species are as followings Ca: *Candona angulata*, Cn: *C. neglecta*, Co: *Cypria ophtalmica*, Ds: *Darwinula stevensoni*, Hc: *Herpetocypris chevreuxi*, Hin: *H. intermedia*, Hi: *Heterocypris incongruens*, Hs: *H. salina*, Ib: *Ilyocypris bradyi*, Ii: *I. inermis*, Im: *I. monstifrica*, Li: *Limnocythere inopinata*, Pf: *Potamocypris fallax*, Ps: *P. similis*, Pv: *P. variegata*, Pzi: *Prionocypris zenkeri*, Pa: *Pseudocandona albicans*, Po: *Psychrodromus olivaceus* and Tc: *Trajancypris clavata*.

			Spearman Correlations																						
			pH	DO	Tw	Elev	Ca	Cn	Co	Ds	Hc	Hin	Hi	Hs	Ib	Ii	Im	Li	Pf	Ps	Pv	Pzi	Pa	Po	Tc
Spearman's rho	pH	Correlation Coefficient	1.000	.273**	.282**	.239**	.500	.095	-1.000**	.738	-.116	.162	-.184*	.486	-.014	-.133	.105	-.645*	.208	.738	.029	.105	.866	-.221	.866
		Sig. (1-tailed)	.	.000	.000	.001	.333	.354	.	.131	.413	.307	.048	.164	.460	.282	.447	.022	.219	.131	.479	.447	.167	.082	.167
		N	161	161	161	161	3	18	3	4	6	12	83	6	51	21	4	10	16	4	6	4	3	41	3
	DO	Correlation Coefficient	.273**	1.000	-.053	.071	-.500	.232	-1.000**	.738	-.087	-.021	-.011	.543	.053	.214	.632	-.190	.660**	-.949*	.600	.316	.866	-.035	.500
		Sig. (1-tailed)	.000	.	.251	.184	.333	.177	.	.131	.435	.474	.461	.133	.355	.176	.184	.299	.003	.026	.104	.342	.167	.415	.333
		N	161	161	161	161	3	18	3	4	6	12	83	6	51	21	4	10	16	4	6	4	3	41	3
	Tw	Correlation Coefficient	.282**	-.053	1.000	-.331**	.500	.169	-.500	-.949*	-.058	.296	.005	.029	.007	-.305	.738	.095	-.575**	.211	.543	.105	-.866	-.243	-.500
		Sig. (1-tailed)	.000	.251	.	.000	.333	.251	.333	.026	.457	.175	.480	.479	.481	.089	.131	.397	.010	.395	.133	.447	.167	.063	.333
		N	161	161	161	161	3	18	3	4	6	12	83	6	51	21	4	10	16	4	6	4	3	41	3
	Elev	Correlation Coefficient	.239**	.071	-.331**	1.000	.500	.153	.500	-.211	.522	-.327	.073	.143	.109	.450*	-.211	-.063	.369	-.738	-.486	-.105	.866	-.048	1.000**
		Sig. (1-tailed)	.001	.184	.000	.	.333	.273	.333	.395	.144	.150	.257	.394	.224	.020	.395	.431	.080	.131	.164	.447	.167	.382	.
		N	161	161	161	161	3	18	3	4	6	12	83	6	51	21	4	10	16	4	6	4	3	41	3

** Correlation is significant at the 0.01 level

* Correlation is significant at the 0.05 level

Table 4.20. Alpha (α) diversity indices values of nine different aquatic habitats from ADIBUR. Abbreviations: Irrigation c. (irrigation canal), ASI (All Sample Index) and JSE (Jackknife Standart Error).

		Spring (n=54)	Lake (n=12)	Dam (n=15)	Pond (n=41)	Creek (n=39)	Stream (n=4)	Water fall (n=1)	Irrigation c. (n=6)	Trough (n=69)	ASI	JSE
Shannon	H	2.40	1.32	1.87	2.53	2.27	0.64	0.00	1.77	1.75	2.82	0.30
	Variance H	0.01	0.04	0.06	0.02	0.02	0.09	0.00	0.06	0.01		
	Exp. H	11.03	3.75	6.48	12.52	9.69	1.89	1.00	5.86	5.78		
Simpson's D	Index	9.40	5.60	5.91	11.25	8.10	3.00	1.00	7.86	4.09	10.77	5.53
Margalef D	Index	4.06	1.44	2.82	4.20	3.65	0.91	0.00	2.50	2.47	5.73	0.52
Berger Parker Dominance	Index	0.19	0.38	0.41	0.24	0.25	0.67	1.00	0.36	0.43	0.23	0.09
McIntosh D	Index	0.74	0.73	0.70	0.79	0.72	0.60	0.00	0.78	0.56	0.73	0.08
Brillouin D	Index	2.12	0.93	1.39	2.09	1.96	0.37	0.00	1.24	1.57	2.65	0.28
Fisher's Alpha	Index	7.65	3.18	7.75	9.95	7.06	2.62	0.00	8.29	3.79	9.66	1.19
Menhinick D	Index	2.07	1.41	2.18	2.53	2.05	1.16	0.00	2.11	1.29	1.91	0.24
Strong's	Index	0.48	0.13	0.31	0.31	0.44	0.17	0.00	0.26	0.53	0.47	0.08

The results of t-test indicated that there is no significant difference ($P > 0.05$) between the mean number of species, pH, dissolved oxygen concentration and electrical conductivity in Adıyaman and Burdur but a significant difference ($P < 0.05$) was found between the elevation and water temperature (Table 4.21).

Table 4.21. The results of t-test between Adıyaman and Burdur. Abbreviations, A: Adıyaman, B: Burdur, sp.: species, elev.: elevation (m a.s.l.), Tw: water temperature ($^{\circ}\text{C}$), DO: dissolved oxygen concentration (mgL^{-1}), and EC: electrical conductivity (μScm^{-1}).

	<i>Asp.</i>	<i>Bsp.</i>	<i>Aelev.</i>	<i>Belev.</i>	<i>ATw</i>	<i>BTw</i>	<i>ApH</i>	<i>BpH</i>	<i>ADO</i>	<i>BDO</i>	<i>AEC</i>	<i>BEC</i>
df	160		238		236		233		238		120	
t Stat	1.19		-7.20		3.89		0.06		0.16		-1.10	
P(T<=t) one-tail	0.12		0.00		0.00		0.48		0.44		0.14	
t critical one-tail	1.65		1.65		1.65		1.65		1.65		1.66	
P(T<=t) two-tail	0.23		0.00		0.00		0.95		0.87		0.27	
t critical two-tail	1.97		1.97		1.97		1.97		1.97		1.98	

5. **A NEW SPECIES OF GENUS GOMPHOCYTHERE (*Gomphocythere besni* n. sp.)

Park and Martens (2001) reported 14 living species of the genus *Gomphocythere* Sars, 1924 in Africa and parts of the Middle East. The authors, pointing to the taxonomic problems between *Gomphodella* and *Cytheridella*, stressed that the distribution of the genus should be much wider in southern hemisphere. Later, Park et al. (2002) listed 17 species and analyzed the cladistic relationships of 16 species of the genus. Afterwards, according to the subjective checklist of the Recent, free-living, non-marine ostracods of Martens & Savatnalinton (2011), there are 24 species in the genus *Gomphocythere*. Twenty-two of these species have been described from the Afrotropical Region and two of them (*G. problematica* (Brehm, 1932), and *G. duffi* (Hornibrook, 1955)) are known from the Australasian Region. Most recently, Karanovic (2012) included 21 species in her systematic key, excluding three species (*G. simplex* Rome, 1962; *G. curta* Rome, 1962; *G. problematica*). Based on these reports (e.g., Martens & Savatnalinton, 2011; Karanovic, 2012), the genus seems to be almost restricted to the African region. The northern most records of the genus are the living species *G. ortalii* Martens, 1993 from Israel's River Dan (Martens, 1993) and the Holocene fossil species *G. geareyi* Boomer, 2010 from Domuztepe, Kahramanmaraş in south-east Turkey (Boomer & Gearey, 2010). In this study we describe both the carapace and the soft parts of the new species *Gomphocythere besni* n. sp.

**This section was published in Zootaxa and can be cited as KÜLKÖYLÜOĞLU O, YAVUZATMACA M, CABRAL MC & COLIN JP (2015) "*Gomphocythere besni* n. sp. (Crustacea, Ostracoda) from a man-made pool (Adıyaman, Turkey)", Zootaxa, 3937(3): 456-470.

5.1 Material and methods

Tavaş pool, a man-made rectangular concrete pool (ca. 10 m x 20 m) (3733'373"N – 3748'596"E) is located at about 637 m a.s.l. in Besni town, Adıyaman province (Figure 5.1). The pool's water source is a nearby cave, which was closed with iron bars during sampling. Samples were taken from about 50 cm depth with a plankton hand-net (150 μ m mesh size) on July 19, 2012.

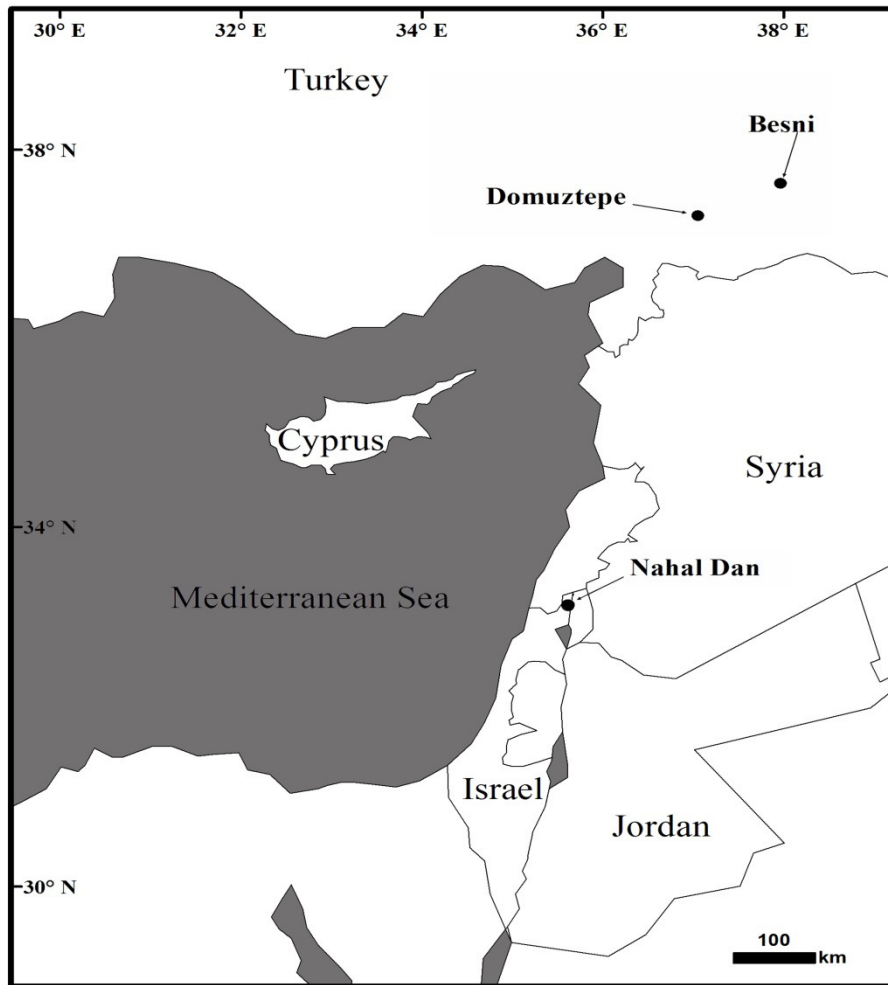


Figure 5.1. Sampling sites of *Gomphocythere ortalı*, *Gomphocythere geareyi* and *Gomphocythere besni* n. sp. in Nahal Dan (Israel), Domuztepe (Turkey) and Besni (Turkey), respectively.

Some of the data on water quality and environment, measured in situ before sampling, are: water and air temperature ($^{\circ}$ C), pH, dissolved oxygen concentration (DO) (mgL^{-1}), percent dissolved oxygen concentration (%), specific electrical

conductivity ($\mu\text{S}/\text{cm}$), salinity (ppt), air moisture (%), atmospheric pressure (mmHg), and substrate type. These variables were recorded with a YSI-Multi Plus Probe. A Testo 410-2 anemometer was used to obtain air temperature ($^{\circ}\text{C}$) and air moisture (%). Geographical data (elevation, coordinates) were recorded with a GPS system (GARMIN GPS 45) in situ. The organisms were collected from the type locality, Tavaş pool, and fixed in a 250 ml plastic container by adding 70 % ethanol at the study site. In the laboratory, the material was hand-sorted and individuals were separated into 70 % ethanol. Soft body parts of individual specimens were dissected in lactophenol solution and carapaces were kept in micropalaeontological slides whenever possible. Detailed photographs of specimens were taken with a Scanning Electron Microscope (SEM) at Centro de Biologia Ambiental, Faculty of Sciences, University of Lisbon, Portugal. Drawings of the soft body parts were prepared with a camera lucida (Olympus U-DA) attached to an Olympus BX-51 microscope. Then all drawings were digitized using an Intuos 5 tablet (Wacom) and the Illustrator CS5 software (Adobe). We used the terminology of Martens (2003) to describe the chaetotaxy of the limbs and taxonomic status of the genus. The material described here was given a catalog number (OK-AD-2012-12:01-12) and individual specimens with soft body parts kept in 70 % ethanol stored in the Limnology Laboratory of the Biology Department, Abant İzzet Baysal University, Bolu, Turkey. Additional material is also available upon request from the corresponding author.

5.2 Abbreviations

Valves: Carapace (cp); Height (H); Interior (In); Inner lamella (il); Length (L); Left valve (LV); Right valve (RV); Selvage (S); Width (W). All measurements are in μm .

Limbs: First antenna (A1); Second antenna (A2); Maxillula (Max); Masticatory process (Mastic); Mandibula (Md); First (T1), Second (T2) and Third (T3) thoracopods; Uropodal attachment (Ua); Seta of caudal ramus (crs); Lobes of caudal ramus (cr1-3); Caudal setae (cs1-3); Protopodite (Pr); rake-like organs (ro).

Female abdomen: Genital operculum (GeO); Forked organ (FO); lobes of caudal ramus (cr1-3); – caudal setae (cs1-3).

Hemipenis: copulatory process of hemipenis (cop); caudal ramus (CR); distal lobe of hemipenis (DL); upper ramus of clasping organ (UR); proximal process of UR (ppur); distal process of UR (dpur); lower ramus of clasping organ (LR); ventral lobe (VL); lateral trabecule (LT); hypostomeal lobes (hlo1-2); labium (Ib).

5.3 Systematic description

Class: Ostracoda Latreille, 1802

Order: Podocopida Sars, 1866

Suborder: Podocopina Sars, 1866

Superfamily: Cytheroidea Baird, 1850

Family: Limnocytheridae Klie, 1938

Subfamily: Timiriaseviinae Mandelstam, 1960

Genus: Gomphocythere Sars, 1924

Gomphocythere besni n. sp. (Figures 5.2 – 5.7)

Etymology: named after the type locality, Besni, where the species was found.

Type locality: Tavaş pool (37°33'373"N, 37°48'596"E), Besni town, Adıyaman, Turkey. Note that the pool is used for human activities (e.g., swimming, irrigation). Most parts of the pool were covered by macrophytes but our samples were taken from the parts of fine pebble and sandy bottom (see Photo 11, site 118 in Appendix A).

Material: a total of 39 individuals, from which 9 are paratypes, all dissected (14 females, 7 males, 3 juveniles, 13 empty carapaces and 1 valve), collected on 19 July 2012. Leg. Mehmet Yavuzatmaca and Ozan Yılmaz.

5.4 Type Materials

Holotype: One dissected female, Tavaş pool, Besni, Adıyaman, Turkey, collected by Mehmet Yavuzatmaca and Ozan Yılmaz. (no: OK-AD-2012: 01).

Allotype: one dissected male from the type locality (no: OK-AD-2012: 02). Soft body parts dissected in lactophenol (no: OK-AD-2012: 02); empty valves of the allotype kept in micropalaeontological slides (no: OKAD-2012: 03).

Paratypes (all dissected): four females and one juvenile from the type locality (no: OK-AD-2012: 04-08), and two females and two males used for SEM photography kept in the laboratory of the University of Lisbon, Department of Geology, Portugal (no: OK-AD-2012: 09-12).

Measurements: Female (RV-LV): L = 0.75–0.67 mm (n = 7), H = 0.35–0.32 mm (n = 7), W = 0.23 mm (n = 3) (Figures 5.2A–H and 5.3C). Male (RV-LV): L = 0.66–0.64 (n = 3), H = 0.34 mm, W = 0.30 mm. Juveniles: L = 0.53, H (RV) = 0.29.

Diagnosis: A species of Gomphocythere with weakly inflated posterior part in the female carapace. Valves externally reticulated, with around eight fossae arranged approximately in a circle in each mesh of the reticulum. Presence of a shallow ventral ridge along all the ventral margin and lower part of the posterior one. Main body of the hemipenis with a short and straight upper ramus of clasping organ. Copulatory organ of hemipenis short and distally curved.

5.5 Description of Female and Male

Carapace sub-rectangular in lateral view, pyriform in dorsal view, with a weak median sub-vertical sulcus. RV larger than the LV, slightly overlapping it (Figures 5.3A; B). Greatest height situated at anterior cardinal angle. Dorsal margin straight to slightly concave, sloping posteriorly; ventral margin slightly concave; anterior margin flattened and asymmetrically rounded; posterior margin rounded. External surface reticulated, with ca. eight fossae roughly arranged in a circle, in each mesh of the reticulum. A distinct shallow ventral ridge, more prominent posteriorly, running parallel to the margin (Figure 5.3D). A few sparse pore conuli (Figures 5.3H; I) visible along the anterior and posterior margins. Over the whole surface, rounded or elongated (in the margins) sieve plates and separate single pores with a sensillum present, the latter being relatively rare.

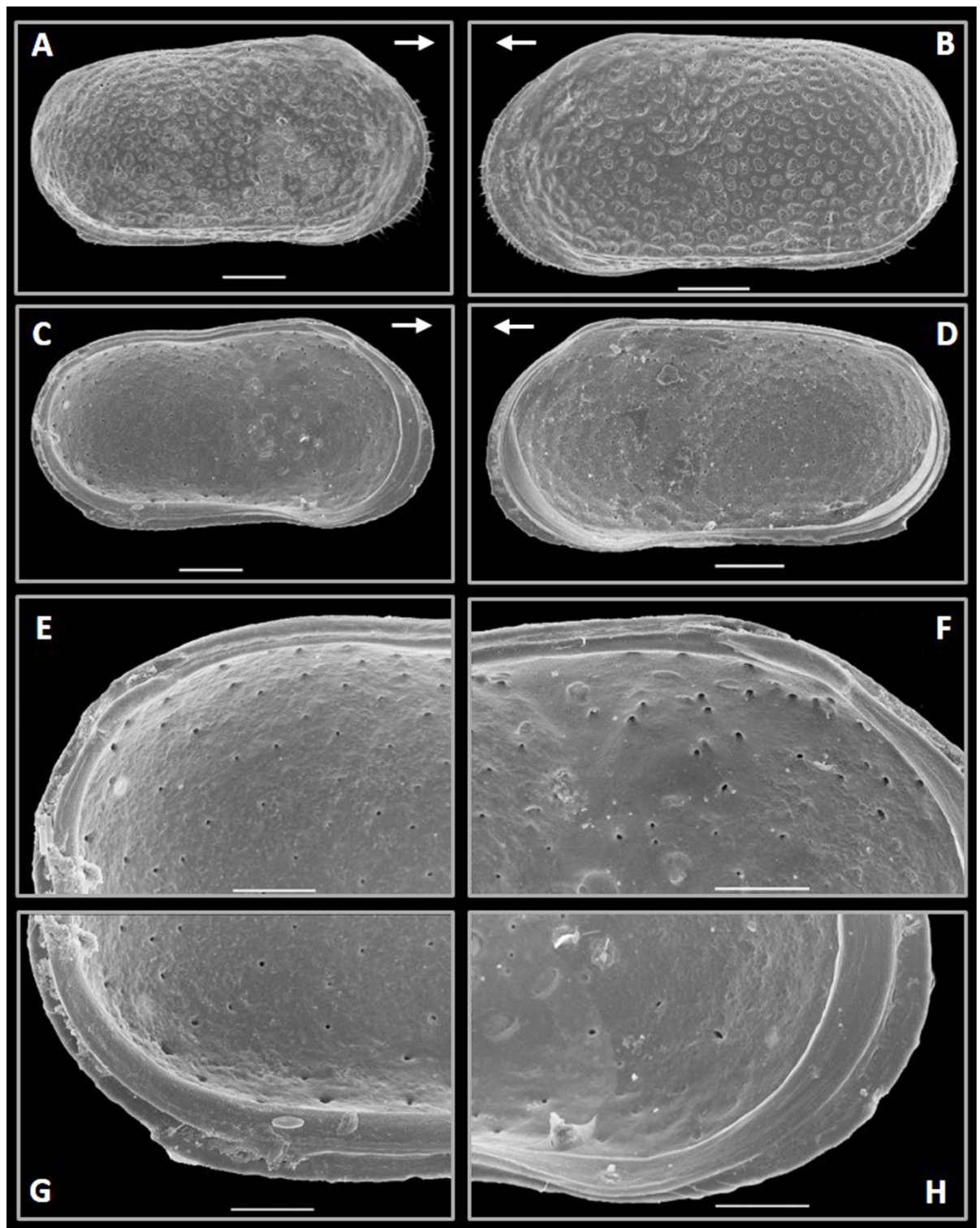


Figure 5.2. *Gomphocythere besni* n. sp. (in this study). Female: (A) right and (B) left valves, external view. (C) left and (D) right valves, internal view. (E), LV, detail of postero-dorsal tooth of the hinge. (F), LV, detail of antero-dorsal tooth of the hinge. (G), LV, detail of postero-ventral margin. (H), LV, detail of antero-ventral margin. Scale bar: 100 μ m for A-D, 50 μ m for E-H.

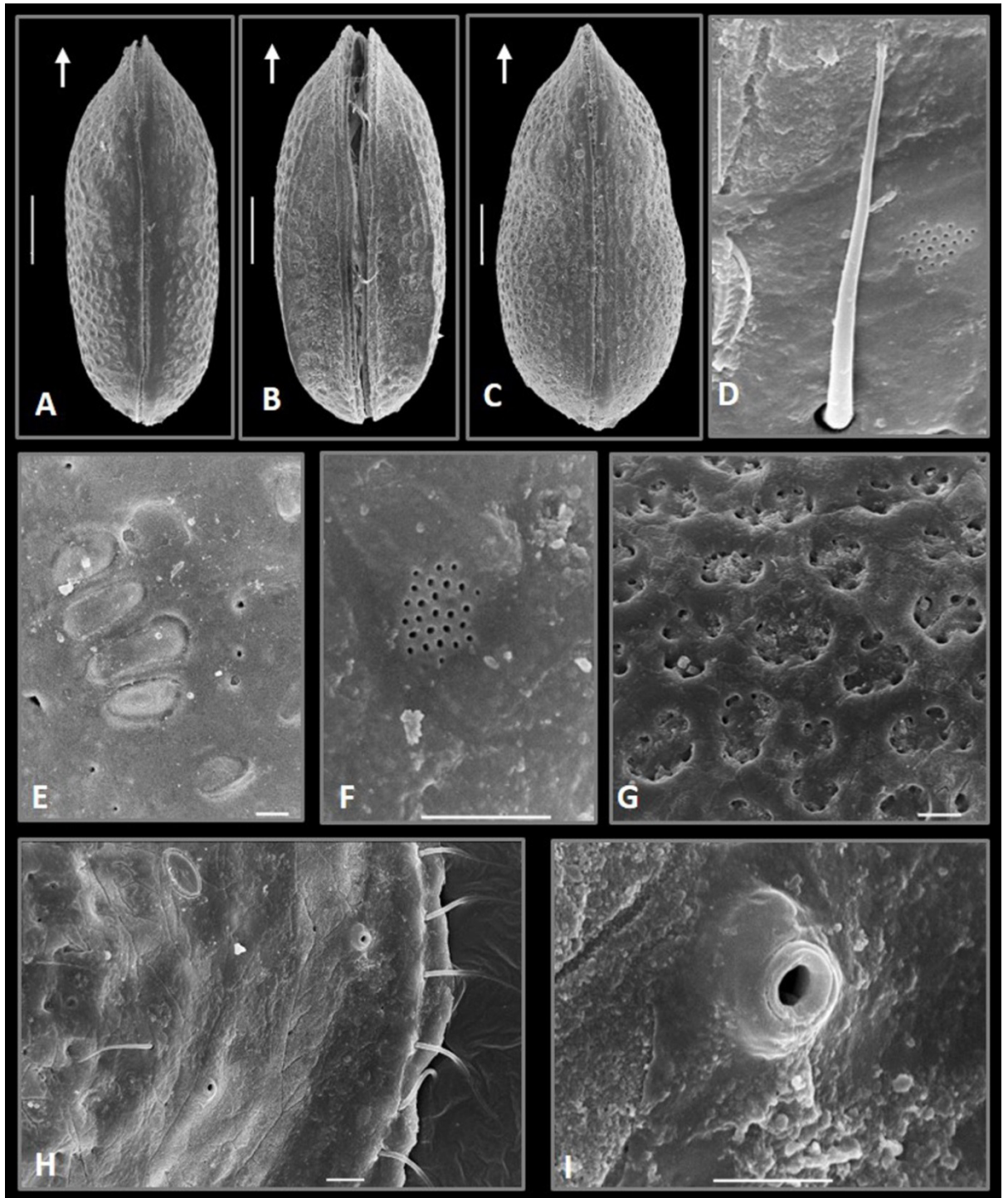


Figure 5.3. *Gomphocythere besni* n. sp. (in this study). Male: (A) dorsal view, (B) ventral view. Female: (C) dorsal view, (D) normal single pore canal with a sensillum and sieve plate, (E) detail of muscle scars, (F) sieve plate, (G) detail of ornamentation with several fossae inside the reticulum mesh, (H) single pore and pore conuli, (I) pore conuli. Scale bar: 100 μm for A-C, 5 μm for D-F and I, 10 μm for E and G-H.

Hinge “reversed lophodont with smooth teeth separated by a smooth groove in the LV. Both valves with marked selvage inwardly displaced along the anterior and posterior margins and with narrow calcified inner lamellae. Muscle scars: four elongated adductor muscle scars in a sub-vertical row, one rounded frontal scar and two rounded to elongated mandibular scars.

Sexual dimorphism well marked: females larger and swollen posteriorly; males with almost parallel sides weakly converging posteriorly in dorsal view.

Female Soft parts: Antennula (A1) (Figure 5.4A): Six segmented without setae on protopodite (first segment). Second segment with one long (ca. 1.5 x of the length of 2nd segment) medio-lateral seta posteriorly and a group of tiny setules anteriorly. Rome organ absent. Third segment, subquadrate with one medium (bluntly plumose) dorsal seta (ca. 2 x of length of this segment). Fourth segment with three apical setae: two dorsal (plumose) and one ventral smooth setae. Fifth segment with four apical smooth setae, three dorsal (one shorter than the half of the others) and one long seta (extending the length of terminal segment). Terminal segment elongated (length more than 3 times width), with four setae apically, one long and one medium claw-like setae, and one seta fused at the base with aesthetasc Ya (fused seta longer than Ya).

Second antenna (A2) (Figure 5.4B) without no seta on protopodite. First segment of endopodite subquadrate with long (ca. of second segment) apical ventral seta. Second segment long (ca. at least of the A2), mid-ventrally with two long plumose setae and aesthetasc Y (slightly shorter than accompanying setae), mid-dorsally with two subequal setae (both extending the tip of the terminal segment); one stout, claw-like medium size apical seta (ca. reaching the tip of the terminal segment). Terminal segment with three (two apically and one subapically located) smooth and stout claws, almost equal in length. Exopodite long, extending to the tips of terminal claws, not divided but a node present almost in the middle.

T1-T3 (Figures 5.4C; D; E) all well-developed walking legs, with T1 the shortest and T3 the longest. First segment (in all legs) with 2 long dorsal and one ventral seta and with two (T1) and one (T2, T3) knee-setae. Second segment with

one claw-like antero-ventral seta in all legs. Terminal claw-like seta smooth (T1-T2) and weakly sclerotized (T3).



Figure 5.4. *Gomphocythere besni* n. sp. (female, in this study). (A) A1. (B) A2. (C) T1. (D) T2. (E) T3. Scale = 39 μ m for A-E.

Mandibula (Md) (Figure 5.5A): with a masticatory process and a four-segmented palp. Masticatory process with tiny setules and 8 strong teeth, the last three in one group. First segment of palp with a vibratory plate consisting of three well developed setae only (two long, one short plumose setae) and with two subequal ventral setae. Second segment short and subquadrate, bearing three apical setae. Third segment of similar shape, with five apical setae, three dorsally (length of these setae almost reaching tips of terminal claws) and two located ventrally. Terminal (fourth segment) pyramidal, with two claws (more than twice the length of this segment).

Maxillula (Mxl) (Figure 5.5B): with 3 endites of normal shape, ending with 3, 4, and 4 slightly plumosed short setae in 1, 2, and 3rd endites, respectively. Maxillular palp with two segments fused, as typical of the subfamily, ending with 3 long sclerotized claw-like lateral and 2 (one additional short seta bluntly seen) apical setae. Vibratory plate with 14 well developed and plumose whorls.

Sternum as in Figure 5.5C.

Abdomen (Figure 5.5D): Posterior part with 3 hirsute lobes (crl1-3) equal in size, ending with a short filamentous tip. First seta of caudal ramus (crs1) short (ca. 1/2 of crs2) whip-like. Second seta (crs2) long, inverse L-shaped. Caudal seta large and claw like. Forked organ (FO) short, stout spine-like seta. Genital operculum (GeO) large, rounded.

Labium or upper lip (Figure 5.5E): with two lobes (hlo1, hlo2), anterior (hlo1) lobe at least twice as long as posterior (hlo2) one.

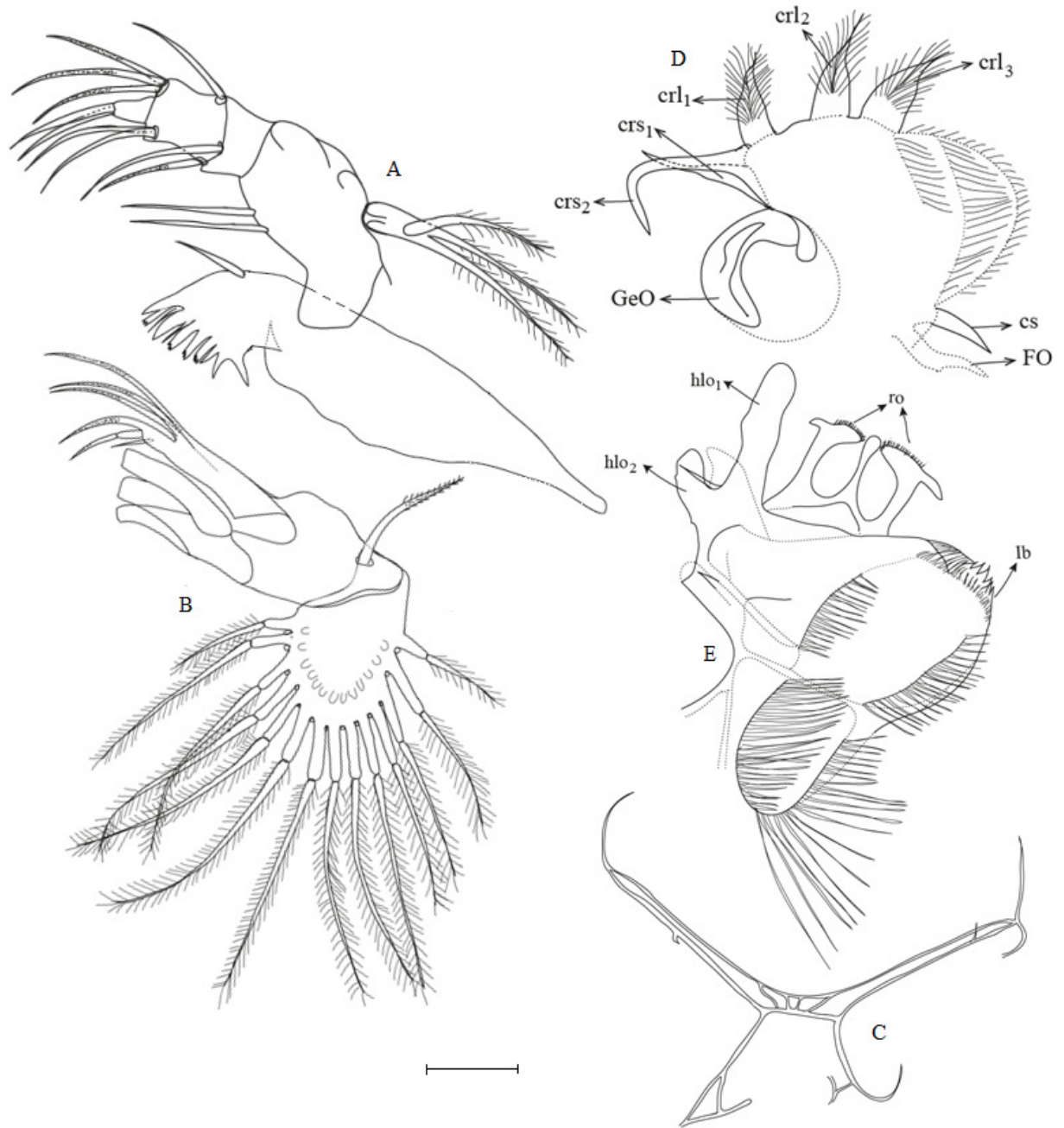


Figure 5.5. *Gomphocythere besni* n. sp. (female, in this study). (A) Md, mandibular palp. (B) Mx1, respiratory plate. (C) Sternum. (D) Abdomen (only one caudal ramus shown). (E) Labium (lb) or Upper lip, rake-like organs (ro). Scale = 39 μ m for A-E.

Male soft parts. Antennula (A1) (Figure 5.6A): Five-segmented (3rd and 4th segments fused) (also see discussion). A1 morphology and chaetotaxy are identical in both sexes, apart of the division between segments 3 and 4 (present in males, missing in females).

Second antenna (A2) (Figure 5.6B): Exopodite long extending to the tips of terminal claws, not divided but a node present almost in about 2/3 of the length.

Mandibula (Md) (Figure 5.7A): Similar as in female.

Maxillula (Mxl) (Figure 5.7B):

Similar as in female. T1-T3 (Figures 5.6C; D; E): All walking legs as in female.

Hemipenis (Figures 5.7C; D): Typical of the genus with a large, well developed muscular base and a prominent, distal lobe (DL) without setae. No comb-like structure on the blunt tip of the main body of DL. Main body with a short and straight ur (upper ramus of clasping organ of hemipenis); copulatory organ of hemipenis (cop) short and distally curved. Caudal ramus short and straight.

Remarks: The closest species, regarding the carapace morphology, are *G. geareyi* (Holocene) and *G. ortalii* (Recent), both from Middle-East (see “Discussion for comparisons), *G. huwi* Martens, 2003 and *G. lisae* Martens, 2003, both living species in Lake Nyassa/Malawi, East Africa. *Gomphocythere huwi* is smaller than *G. besni* n. sp. with a more pronounced median sulcus, different reticulation with absence of ventral ridge and a selvage inwardly displaced only along the anterior margin. *Gomphocythere lisae* is also smaller, with a more pronounced median sulcus, different reticulation with absence of ventral ridge and a posterior margin less uniformly rounded.

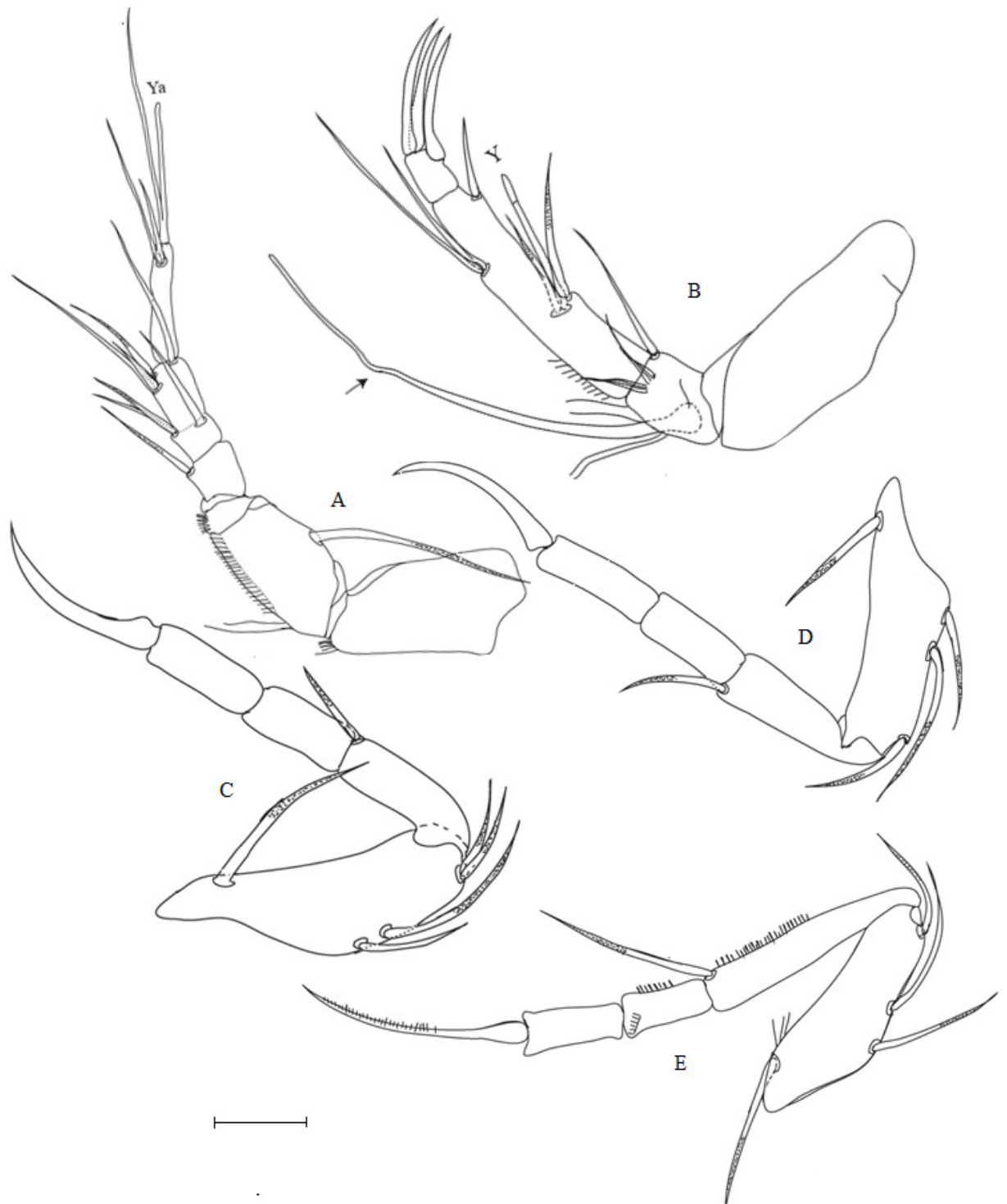


Figure 5.6. *Gomphocythere besni* n. sp. (male, in this study). (A) A1. (B) A2. (C) T1. (D) T2. (E) T3. Scale = 39 μ m for A-E.

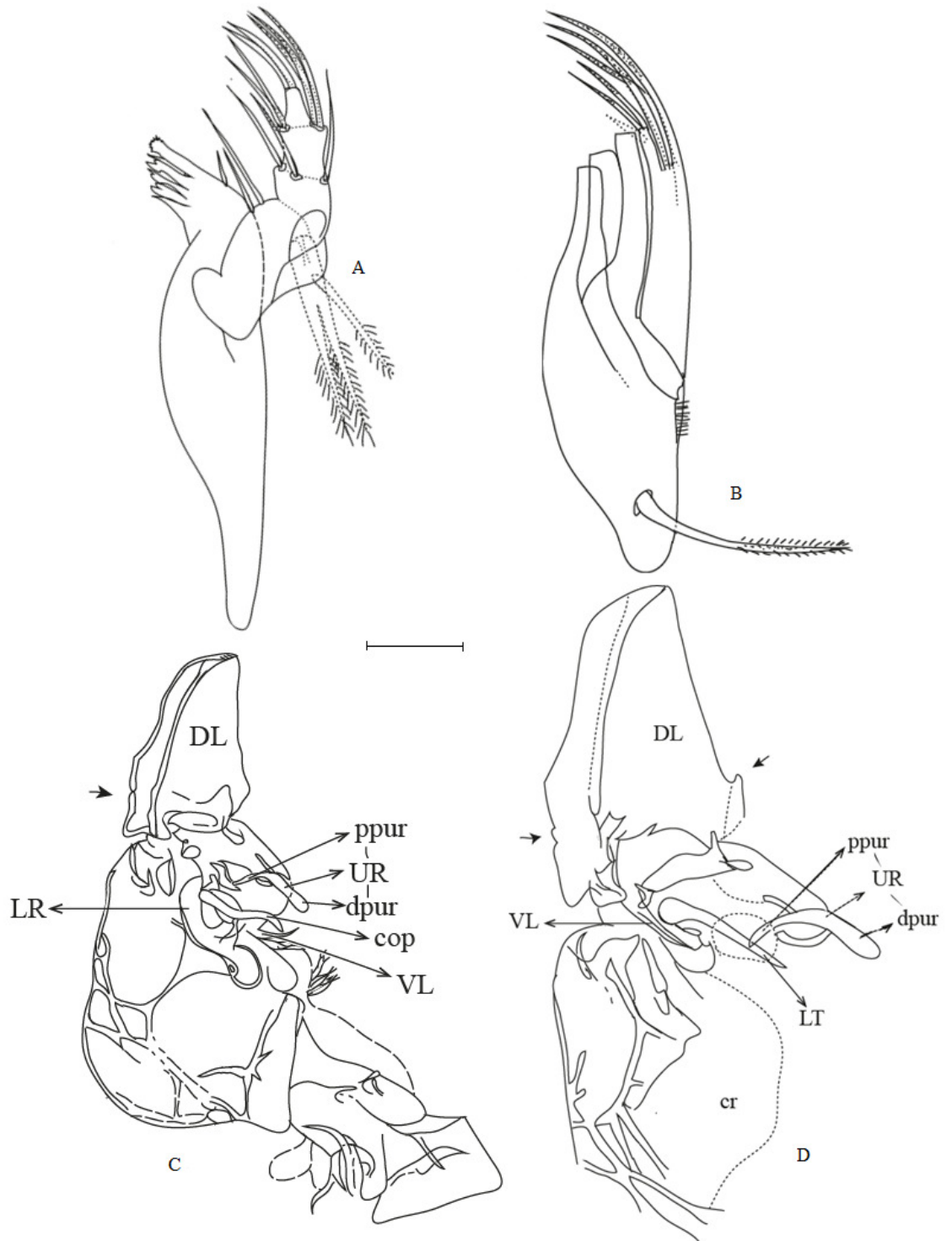


Figure 5.7. *Gomphocythere besni* n. sp. (male, in this study). (A) Md, mandibular palp. (B) Mx1, respiratory plate not shown. (C) Hemipenis, medial view. (D) Hemipenis, detail, medial view. Scale = 39 μ m for A-D.

Due to the geographical proximity of *G. besni* n. sp., *G. geareyi* and *G. ortali* and the fact that they all are very close in morphological characteristics of the carapace, we compared the area deviations between the superposed normalized outlines of the following couple of species: *G. besni* n. sp. versus *G. geareyi* (Figure 5.8A) and *G. besni* n. sp. versus *G. ortali* (Figure 5.8B) (cf. for this algorithm and its utilization Neubauer & Linhart, 2008; Minati et al., 2008).

The outline of *G. besni* n. sp. compared to the one of *G. geareyi* appears more anteriorly rounded and with a more important height displayed at the anterior and posterior cardinal angles. *G. geareyi* is more elongated than its pair species.

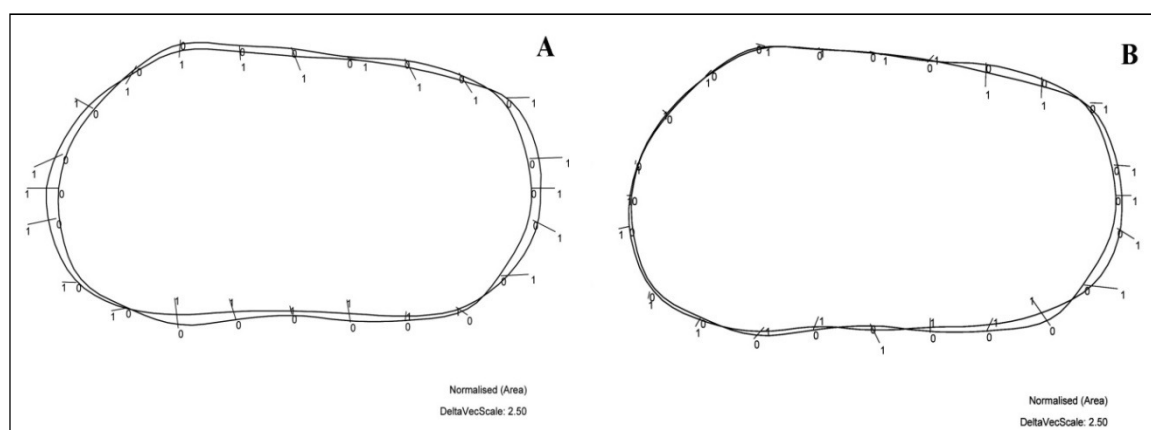


Figure 5.8. Comparison of superposed outlines of right valves oriented in reversed (left) position (cf. for this rule Stracke, 2008); A – Superposition of *G. geareyi* outline (1), prepared from the image published by Boomer & Gearey (2010) (p.117, Pl. 1, Figure 2) on the one of *G. besni* n. sp. (0) displayed above (cf. Figure 5.8A); The sizes of the vectors for the 24 control points (increased by a factor of 2.5 for better visualization) express the degree of difference between the two outlines within various parts of the valve. B – Superposition of *G. ortali* outline (1) (prepared from Figure 1C, in Martens, 1993, page 43), on the one of *G. besni* n. sp. (0) mentioned above.

The outline of *G. besni* n. sp. compared to the one of *G. ortali*, when superposed and standardized to equal surface, shows less shape differences than the species pair *G. besni* n. sp. - *G. geareyi*. This becomes particularly apparent along the anterior margin. Significant differences exist along the dorsal and posterior margins. These latter differences are due to the oblique position of the dorsal intercardinal segment and to a lower posterior height of *G. ortali*. Therefore, the geometric

morphometric data, point to three distinct morphotypes which complemented with the differences for limb traits allow to decide for separation of the new Gomphocythere taxon, *G. besni* n. sp., beside the two already known species *G. ortalii* and *G. geareyi* of the Eastern Mediterranean area, more precisely from Israel (Martens, 1993) and Western Turkey (Boomer & Gearey, 2010).

Ecology: So far, the individuals of the species *Gomphocythere besni* n. sp. have been found on sediments with a mixture of sand and gravel in the type locality only. Tavaş pool, Besni, Adıyaman has relatively cool (16.6°C), medium oxygenated (dissolved oxygen concentration = 7.36 mgL⁻¹, percent dissolved oxygen concentration = 75 %), slightly alkaline (pH = 7.53) and brackish to fresh waters (specific electrical conductivity = 609 µScm⁻¹, salinity = 0.3 ppt). Air temperature (38.5 °C), air moisture (25.5 %) and atmospheric pressure (701 mm Hg) were also measured in situ before sampling. Accompanying species included *Ilyocypris inermis* Kaufmann, 1900 (20 individuals) and *Psychrodromus olivaceus* (Brady & Norman, 1889) (4 individuals).

5.6 Differential Diagnosis

Gomphocythere besni n. sp. is here described as a new species of the genus from Turkey. The species differs from its close relatives in carapace size, shape and morphology and soft parts (also see below). Sexual dimorphism is present with the female's carapace forming brood pouches (Martens, 2003). Comparing the species with the fossil species *G. geareyi* from the Holocene of Turkey, the new species is less elongate than *G. geareyi*, with a more symmetrically rounded posterior margin. The ventral ridge is more pronounced in *G. geareyi* than in *G. besni* n. sp. and is located more ventrally, with the posterior part almost coincident with the ventral margin. Besides, *G. besni* n. sp. has a particular ornamentation with up to eight fossae in each mesh of the reticulation and has abundant sieve plates covering the whole surface area.

Moreover, the male dorsal view is different from the fossil species having the maximum width in the median part, whereas in the *G. besni* n. sp. it is located anteriorly to the mid-length. Since there are no living forms of *G. geareyi*, it is not

possible to compare the soft parts. Nevertheless, as shown, the two species are different in the characters compared above. On the other hand, *G. besni* n. sp. shows several taxonomic differences from *G. ortali*, the recent species from Israel (Martens, 1993). Concerning the carapace, *G. ortali* is smaller and has a different lateral outline, with the dorsal margin straighter and sloping more strongly towards the posterior margin, which is less rounded. Moreover, there is no ventral ridge in the female carapace of *G. ortali*.

The antennule of *G. ortali* is five segmented (3rd and 4th segments not separated), but they are divided (six segments) in the females of *G. besni* n. sp., as is the case in *G. emrysi*, *G. huwi*, *G. lisae* and *G. piriformis* Martens, 2003.

The chaetotaxy of the segments in A2 of the new species differs from its congeners. For example, the dorsal seta is about the length of the third segment in *G. besni* n. sp. but it reaches about half this segment in *G. capensis* (Martens et al., 1996). Similarly, there are two long and one short seta in the fifth segment of A2 in *G. besni* n. sp. but two short and one long seta found in *G. downingi* Park & Martens, 2001 and *G. wilsoni* Park & Martens, 2001. The length of the subapical (short) seta on the terminal segment is more than 2/3 of that of the aesthetasc Ya in *G. besni* n. sp. but this seta is less than (or about) 1/2 of the length of Ya in *G. lisae*, *G. huwi*, *G. irvinei* and *G. piriformis*. Unlike *G. besni* n. sp., the seta is about the same size or slightly extends the length of Ya in *G. ortali*.

The undivided exopod of the A2 ends with a thin whip-like shape in *G. ortali* (and in *G. downingi*) while it is claw-like and rounded with a node in *G. besni* n. sp. The presence of the node at about 2/3 of the length of the exopod in both sexes of the new species is another difference from *G. ortali*, whose males do not carry this node, but can be seen in the female, albeit weakly (see Figure 3E and Figure 4B in Martens, 1993). Besides, the exopod is divided with two (e.g., *G. emrysi* and *G. irvinei*) and/or one (*G. lisae*, *G. huwi*, *G. cristata* Rome, 1962) nodes in some species.

The shape of the Md (Figures 5.6A and 5.7A) is similar in *G. besni* n. sp. and *G. ortali* (and others) except for the length of three apical setae which extend up to the tips of terminal claws in *G. besni* n. sp., but is reaching about 2/3 of terminal

claws of *G. ortali*. Three of eight teeth of the Md mastigatory process are united in a group in the female while these teeth are free in males of *G. besni* n. sp.

Maxillular palp (Mxl) (Figures 5.5B and 5.7B) in *G. besni* n. sp. ends with three long sclerotized claw-like lateral and two (one additional short seta bluntly seen) apical setae. These three long setae in equal length extend the tips of apical setae in *G. besni* n. sp., but they are smaller and barely reach the tips of apical setae in *G. ortali*. Although we do not see any sexual dimorphism in the length and position of the apical setae in our new species, *G. ortali* shows dimorphic differences (see e.g., Figures 2E and 4C in Martens, 1993). Unlike *G. simplex* (Rome, 1962), the palp is not divided into two sections as in *G. ortali*. Rome (1962) stated that the palp is undivided in *G. lenis*. However, according to Rome, there is only one claw at the distal edge and another a little behind of it. We believe that this could be a mistake in drawings since many (if not all) species of the genus carry at least three claw-like setae on the palp.

Hemipenis (Figures 5.7C; D) with a large, well developed muscular base and a prominent, distal lobe (DL) without setae. DL of *G. besni* n. sp. hemipenis is subtriangular in shape, with a small dorsal expansion. In contrast, DL is broadly subtriangular with a squarish base in *G. ortali*. No comb-like structure on the blunt tip of the main body in *G. besni* n. sp. but this structure is present in *G. ortali*. Another difference can also be seen in the shape and size of cop which is S-shaped in our species while it is short and distally curved in *G. ortali*. VL lobe is short and pointed distally in *G. besni* n. sp. but the same lobe is long and wide in *G. ortali* and *G. lisae* (also compare with other species of the genus). LR is unevenly rounded and distally pointed towards the ventral side. Unlike the new species, VL is thick in *G. emrysi* and also triangular in shape in *G. piriformis*.

Gomphocythere besni n. sp. has three hirsute lobes (crl1-3) at the posterior part of the abdomen (Figure 5.5D) almost equal in size, while four hirsute lobes with unequal and equal size are present in *G. curta* and *G. ortali*, respectively. It seems that *G. besni* n. sp. is so far the only species of the genus with equal hirsute lobes. FO not well seen in *G. besni* n. sp. which is a short claw like spiny seta without a distal lobe but in *G. emrysi* with two lateral spines and a distal lobe. *Gomphocythere alata* is the only species of genus having a divided FO (see Figure 77-O in Rome, 1962).

Caudal seta (cs) in *G. besni* n. sp. claw like which is very similar to the cs of *G. simplex* and thicker and larger than the cs of *G. ortali*. However, in *G. emrysi*, cs is large with rounded base (Martens, 2003) as in *G. irvinei*, *G. lisae*, *G. huwi*, *G. piriformis*, and *G. woutersi* Park & Martens, 2001. Genital organ (Geo) in *G. besni* n. sp. and *G. ortali* is round and larger but it is round and smaller in *G. irvinei*.

In *G. besni* n. sp., second seta of caudal rami (crs2) long and L-shaped (Figure 5.5D) and the first seta (crs1) is whip like and equals approximately half of crs2; in *G. ortali* crs1 and crs2 have bifurcate whip like tips (see Figure 5-D in Martens, 1993) and small, equally sized crs1 and crs2 appear in *G. piriformis*. A unique feature of *G. besni* n. sp. in the genus is the L-shaped crs2.

5.7 Zoogeography

The living species of the genus Gomphocythere are mostly restricted to East Africa especially in Lake Tanganyika (Park & Martens, 2001) and Lake Malawi (Martens, 2003). The species of this genus live mostly in lakes and also in springs, pools, rivers (Martens, 1993; the present study). Cohen et al. (1983) pinpointed that Gomphocythere assemblages dominated the waters where electrical conductivity values were between 1500 – 4000 $\mu\text{S}/\text{cm}$ and alkalinity values were between 15 – 30 meq/L. Gomphocythere species were found on different types of substrate (e.g., silt, sand, stromatolites, oolitic sand, rock, etc.) and also at a broad depth range (0 – 125 m) (Park, 1995). The genus is especially reported in fresh to slightly saline water. The available ecological information about each species is given in Appendix F, showing that the data on *G. besni* n. sp. do not differ considerably from those on its congeners. However, data are still scarce and broader conclusions cannot be drawn at the moment.

5.8 Conclusion

The present study describes the new species *Gomphocythere besni* n. sp. from the town of Besni (Adıyaman), which elevates the number of living species of the genus to 25. Our sampling site is about 80 km north-east of Domuztepe and extends the geographic limits of the genus to the Northeast. Since extensive geographic and ecological studies on freshwater ostracods have been increased in the last 10 years in Turkey (Külköylüoğlu et al., 2013), we believe that the number of species will increase as well. The same could also be true for the other continents.

6. DISCUSSION AND CONCLUSION

In the present study, total of 41 ostracod taxa (26 recent and 15 sub-recent) in Adıyaman are new reports for the region. Of which, *Gomphocythere besni* n. sp. and *S. insueta* (also see section 5 and 6.3.5, respectively) are firstly reported for Turkish Ostracoda fauna. In Burdur, 35 taxa (22 recent and 13 sub-recent) were reported. Until now, 24 living species (Gülen, 1985; Altınsaçlı, 2004; Rasouli et al., 2014) have been known in Burdur and 14 of them are also encountered in this study. Therefore, 21 taxa in our study are new for the region and thus the numbers of ostracod taxa in Burdur are increased to 45 with the finding of the present study.

6.1 Evaluation of data

In spite of the absence of big differences between the surface areas of Adıyaman (7164 km²) and Burdur (6887 km²), their species diversity is different. These species diversity of both provinces are believed to be under-estimated, however, when we compared these results with the findings of some previous studies the numbers of taxa reported in both provinces are not too low. The presence of 48 taxa in Kahramanmaraş with 14346 km² surface area (Külköylüoğlu et al., 2012a), 31 taxa in Ankara with 25437 km² surface area (Uçak et al., 2014) and 30 species in Van with 21334 km² surface area (Külköylüoğlu et al., 2012b) show that the surface area may not be important on the numbers of encountered taxa. Besides, when we compared the sampling sites in Adıyaman (41 taxa from 111 sampling sites) and Burdur (35 taxa from 110 sampling sites), there is no significant differences but the number of taxa encountered is different. The effect of sampling sites on the number of reported species in some previous studies show similarity with our results, such as, 25 taxa from 50 sites in Diyarbakır (Akdemir & Külköylüoğlu, 2011), 34 taxa from 133 sites in Ordu (Külköylüoğlu et al., 2012c), 14 species from 38 sites in northern Finland (Iglíkowska & Namiotko, 2010), 74 taxa from 320 sites in north east Italy (Pieri et al., 2009) and 54 species from 132 sites in upper Paraná River, Brazil (Higuti et al., 2009a). All of these and the present study indicate that the "Sampling

Effect Hypothesis" (Williamson, 1988; Hill et al., 1994) which states the number of species increases with the number of sampling sites cannot be supported. However, the condition in ostracods may be considered under the assumption of the "Habitat Diversity Hypothesis" (Williams, 1943) as the numbers of species increase with the availability of suitable habitats (Külköylüoğlu et al., 2012a). In this view, the species differences in Adıyaman and Burdur may be explained by the habitat quality because in Burdur the mostly sampled habitats are artificial troughs ($n = 58$) while in Adıyaman, they are natural springs ($n = 44$). This affects the presence of non-cosmopolitan species (e.g., *S. insueta*) because they generally choose natural and undamaged habitats but the cosmopolitan species (like *H. incongruens*) do not have any habitat preferences. Consequently, the numbers of ostracod species in an area are affected by sampled habitat types and by their quality.

Additionally, when we compared the Gamma diversity (52) of both areas with the Gamma diversity of upper Paraná River (Brazil) as 54 species from 50 water bodies (Higuti et al., 2009b) which is not very high but the Beta diversity (28) was larger than the half of the Gamma diversity (Table 4.13). Unfortunately, this value is very high. This means that Adıyaman and Burdur have different species composition. Since Beta diversity is defined as variability in species (or taxa) composition among sampling sites (Anderson et al., 2006), the cause of high Beta diversity value may be explained by the factors affecting the habitat suitability. Similarly, different Alpha and Beta diversity of different places might be explained by the presence of different factors (González-Megías et al., 2011). These factors were arranged as physico-chemical variables of water, habitat destruction, climatic change (global warming), industrial and agricultural wastes (e.g., heavy metals, pesticides) for ostracods.

Species found in Adıyaman and Burdur with high diversity values (Table 4.13) showed cosmopolitan characteristics that they spread out almost all over the continents. Indeed, having with high diversity values, some cosmopolitan species (e.g., *C. neglecta* ($H' = 1.52$); *H. incongruens* ($H' = 2.80$); *I. inermis* ($H' = 2.64$); *I. bradyi* ($H' = 2.42$) and *P. olivaceus* ($H' = 2.15$)) occurred more frequently than the other species. These values correspond to the findings (e.g., *C. neglecta* ($H' = 2.626$), *H. incongruens* ($H' = 2.458$), *I. inermis* ($H' = 2.717$), *I. bradyi* ($H' = 2.647$) and *P. olivaceus* ($H' = 2.617$)) of Külköylüoğlu et al. (2013) who reported these species

from troughs. The outcomes of the present study and this previous study may suggest that if the cosmopolitan species are encountered in an area, they can suppress the presence and abundance of non-cosmopolitans. Therefore, their Alpha diversity indices values are found higher than others.

The hypothesis "Ostracod species are randomly distributed among sampling sites in Adıyaman" was accepted ($X^2_{\text{calculated}} = 5.33 < X^2_{\text{table}} (3, 120, 0.05) = 7.81$ (Table 4.2)). On the other hand, the calculated value of Index of Dispersion (ID) (s^2/μ) equals to 1.06 which is slightly larger than 1 that states the clump distribution (Ludwig & Reynold, 1988). However, we suggested that the 6 % is not statistically important for changing the distribution of ostracods from random to clump so we accepted random distribution. The calculated *d-statistics* value (0.488) was also support our suggestion and stated the accepting of random distribution. Unlike Adıyaman, in Burdur ($X^2_{\text{calculated}} = 8.08 > X^2_{\text{table}} (3, 120, 0.05) = 7.81$ (Table 4.8)) and ADIBUR ($X^2_{\text{calculated}} = 8.48 > X^2_{\text{table}} (3, 120, 0.05) = 7.81$ (Table 4.15)) the results were significant and so the null hypotheses were rejected for both. The ID and *d-statistics* values of Burdur ($s^2/\mu = 1.09$; $d = 2.51$) and ADIBUR ($s^2/\mu = 0.32$; $d = -9.52$) exhibit the clump and regular spatial patterns among sampling sites, respectively.

The testing of distributional patterns of ostracod species among sampling sites in a wider geographical area is being done for the first time in literature except the study of Heip (1976) who observed the aggregated distributional pattern of species *Cyrideis torosa* (Jones, 1850) in a brackish pool in northern Belgium. Besides, the studies about the distributional patterns of some other taxonomic groups are available in literature. Like Adıyaman, fleas on leaf and some sessile invertebrates (Gabbutt, 1961; Schmidt, 1982) and species *Chloroperla torrentium* in riffles of Shelligan Burn and River Almond (Egglishaw, 1969) showed random distribution while some other groups of benthic populations (Heip, 1976), marine benthic (Heip, 1975), some sessile invertebrates (Schmidt, 1982) displayed aggregated distributional pattern in nature as in Burdur. Also, Nelson (1992) pinpointed that clams and oysters usually show patchy distribution rather than uniform. In all, these distributional patterns of invertebrates may be implied by their habitat preferences, selective abilities of species, biotic and abiotic factors in species available habitats (Benzie, 1989; Pulliam & Danielson, 1991; Külköylüoğlu, 2004;

Kiss, 2007; Boztazzi et al., 2011; González-Megías et al., 2011; Poquet & Mesquita-Joanes, 2011; Külköylüoğlu et al., 2012a). In the sense of ostracods, the passive distribution (see Teeter, 1973) and the mixed reproduction (see Meisch, 2000) are other important influential factors. Further, the dominant presence of cosmopolitan species in Adıyaman, Burdur and ADIBUR as about 48.15 %, 63.64 % and 47.06 %, respectively, may cause the occurrence of these spatial patterns. This is because, they have of a wide geographic distribution and high tolerance levels to different ecological variables (Külköylüoğlu, 2004) so they can be found in most of the aquatic bodies. Indeed, the high number of sampled naturel habitats (e.g., springs) and correspondingly the presence of the high numbers of non-cosmopolitans (about 51.85 %) in Adıyaman may contribute and support the random distribution of ostracod species. However, in Burdur, aggregation of ostracod species may be due to the habitat destruction because dominantly sampled habitat is troughs. These habitats are generally constructed by villager to store water for animals but also used for irrigation, cleaning and drinking purposes (Külköylüoğlu et al., 2013). In such habitats, a direct anthropogenic effect is obvious that alter physico-chemical characteristics of water sources. Such changes may not be suitable for specialist ostracods but cosmopolitans. This is probably the case in Burdur where most of the sampling sites were troughs (n=58) with higher rate of cosmopolitans (as about 63.64 %) than non-cosmopolitans. If we consider troughs as a source of point diversity, this may explain the way of aggregated distribution of the ostracods in Burdur.

Furthermore, regular distribution of ostracod species among the sampling sites of both provinces (ADIBUR) is a surprising result because of its scarcity in nature. Actually, clump and random distributions are common among some of the benthic (Egglishaw, 1969) and planktonic systems (Downing, 1991), respectively. Similarly, ostracods showed clump distributin in Burdur but it was random in Adıyaman. Heip (1975) stated that in nature only a few case of uniform distributions to be observed and this pattern could be explained by competition for food. He also emphasized that if energy is being a limiting factor, uniform strategy has more advantageous than aggregated pattern. Hence, if we accept ostracods as mesoplanktonic organisms (Omori & Ikeda, 1984), random and clump distributions are not surprising (Heip, 1976) in Adıyaman and Burdur, respectively. On the other hand, again, combination of the values from both provinces (ADIBUR) supports

regular distribution. Consequently, high frequency of cosmopolitans, presence of undisrupted habitats (for occurrence of noncosmopolitan or specialist species), passive dispersion and mixed reproduction (especially parthenogenetic) may be used as explanatory factors to elucidate different distributional patterns of ostracod species. In addition, one other important reason may be related to their desiccation and freezing resistant eggs. The eggs can stay in unfavourable conditions for many years (e.g., >100 years) until the conditions became suitable for hatching (Delorme, 1991). Such resistant eggs provide a great advantage to ostracods distribution and surviving in unfavourable conditions. Since we do not know the period (e.g., season, time, etc.) for suitable conditions, our sampling time was not possibly coincide with that period. This may cause low ostracod diversity. This is possibly the case for our samplings. Besides, occurrence of these patterns may be due to our sampling techniques that may be due to applied process. Therefore, our result on distributional patterns cannot be generalized at the moment. As a result, further studies with data in different geographical areas are needed for a better conclusion.

In Adıyaman 10 species were found as dominant ($Y > 0.02$) (Xu & Chen, 1989) (Table 4.3). Of which eight species are well known cosmopolitans but in Burdur nine of 11 dominant (Table 4.9) species are cosmopolitans. Besides, *C. neglecta*, *H. intermedia*, *I. bradyi*, *H. incongruens*, and *P. olivaceus* are the common dominant species in both provinces. Finding cosmopolitans as dominant in both provinces suggest that the cosmopolitan species have high probability of occurrence in different geographical areas. This can be related to their wide tolerances to different environmental variables. According to Rombach's classification (1999), species can be called based on their percentage occurrences as eudominants (32 – 100 %), dominant (10 – 31 %), subdominant (0.32 – 9 %), recedents (1 - 3.1 %), subrecedents (0.32 - 0.99 %) and sporadic species (< 0.31 %). Therefore, *H. incongruens*, *H. salina*, *P. fallax*, *I. bradyi*, *I. inermis* and *P. olivaceus* are classified as dominant but the rest are as subdominant (Tables 4.3 and 4.9). At the same time, all of the dominant species in both areas except *H. incongruens* in Burdur showed as incidental species according to classification of Trojan (1975) who arranged species due to the frequency coefficients like that euconstants (100 – 76 %), constants (75 – 51 %), accessory (50 – 26 %) and incidental species (25 – 0 %). The larger positive values of Index of Clumping, Index of Dispersion and Mean Crowding indicated that

all dominant species (Tables 4.3 and 4.9) in both provinces show aggregation intensity in their available habitats. Similar to our results, Zhaoli et al. (2007) stated that the uneven distribution is a characteristic of ostracods. Cohen (2000) also stated that ostracods in Lake Tanganyika is very patchy that may exist even there is a uniform habitat or substrate type. Indeed, the results of Index of Clumping (> 5) support our findings (Tables 4.3 and 4.9). Like our results, the aggregation characteristics of Heteropods in East China was explained by fast growing of them (Xu & Li, 2005) which may be acceptable for ostracods because they have a short life span (it may change species to species) and so they grow fast especially in ephemeral water bodies. Additionally, another explanation of Xu & Li (2005) for aggregation intensity of Heteropods might also be valid for ostracods as aggregation due to the less sensitive to the environmental changes. This is because most dominant species in this study are cosmopolitans with high tolerance ranges to environmental changes. As a result, they are less affected by environmental changes. Moreover, aggregation may also be explained by the quality of habitats, food availability, escape from predators (e.g., between vegetation), the presence of suitable sediments and so on.

Relatively high dominance ratios of cosmopolitan species in different aquatic bodies can be seen in Table 4.16. In almost all aquatic bodies except lakes, species *H. incongruens* and *I. bradyi* were found as dominant. With respect to the classification of Rombach (1999), *H. incongruens* was classified as eudominant in streams and troughs when *I. bradyi* was only found as eudominant in streams (Table 4.16). Similarly, Külköylüoğlu et al. (2013) stated that *H. incongruens* was the most common species followed by *I. bradyi*, *P. olivaceus* and *C. neglecta* in troughs. However, in our study, *C. neglecta* was not the dominant one in troughs. Among the dominant species in different habitats (Table 4.16), *L. inopinata*, *C. ophtalmica* and *I. monstifica* were found as eudominant species in dams and lakes, respectively. The mutual feature of these three species is related to their preferences for slow flowing and lake like aquatic bodies (Meisch, 2000). Of which, *C. ophtalmica* and *I. monstifica* have longer A2 natatory setae but *L. inopinata* does not have these features. Consequently, *C. ophtalmica* and *I. monstifica* are encountered from littoral to abyssal depth of lakes but *L. inopinata* generally prefers littoral zone. In agreement with Trojan's classification (1975), the dominant species in all habitat

types (Table 4.16) were tabulated as accidental and incidental species except *L. inopinata* and *H. incongruens* that were classified as constant species in dams and streams, respectively. Szlauer-Łukaszweska & Kowaluk-Jagielska (2011) also reported that *D. stevensoni* and *C. ophtalmica* as dominant but *L. inopinata* as eudominant in the Oder River in Poland. In addition, Szlauer-Łukaszweska (2012) found *D. stevensoni* as a dominant and accessory species in the Lake Świdwie in Poland. These kinds of informations allow us to do comment about the quality of habitats and to estimate the characteristic species in different aquatic bodies. Accordingly, the number of studies include these informations should be increase in future.

The first two axes of CCA explained 77.4 % (Table 4.4), 84.5 % (Table 4.10) and 69.7 % (Table 4.17) of relationships between environmental variables and species in Adıyaman, Burdur and ADIBUR, respectively. When we compare the most effective factors on species distribution in these three data, it is seen that water temperature is the most influential factor followed by pH. These findings show that especially water temperature is a very important factor on distribution of ostracods even though the condition and regions change. Similarly, several previous studies pinpointed the importance of water temperature (Malmqvist et al., 1997; Külköylüoğlu & Dügel, 2004; Viehberg, 2006; Kiss, 2007; Külköylüoğlu et al., 2012a, 2012c, 2014; Uçak et al., 2014). Since physico-chemical variables of water are changed by temperature (e.g., electrical conductivity, dissolved oxygen concentration) (Wetzel, 2001), occurrence of species in a habitat can be affected by such changes. The levels (or magnitude) of effect can be related to individual species' tolerance levels to different variables. In this case, it appears that water temperature can play a primary role on the occurrence of species with low tolerance ranges. Likewise, Külköylüoğlu & Sarı (2012) also found pH as the most effective variables on species distribution in variety of aquatic bodies in Bolu. Close to water temperature (Roca & Wansard, 1997; Xia et al, 1997; Palacios-Fest & Dettman, 2001; Elmore et al., 2012), pH is also very important for calcification of ostracod valves. This is because soluble concentration of carbonate and calcium in water is changed by the fluctuations in pH (Wetzel, 2001). Hence, calcification process of shell is affected by this alteration.

Species were placed differently on CCA diagrams. Although *H. chevreuxi*, *I. bradyi*, *H. incongruens*, and *D. stevensoni* located in direction of electrical conductivity (EC) and water temperature (Tw), all of these except *H. chevreuxi* showed relatively close relationships with water temperature (Figure 4.1, Adıyaman). The species *H. incongruens* displayed close relationships with Tw in all CCA diagrams while *D. stevensoni* and *H. chevreuxi* were only in ADIBUR (Figure 4.7). Additionally, Tw was also seen as an effective factor on distribution of *C. angulata*, *H. intermedia*, *P. kraepelini*, *H. salina*, *I. inermis*, *P. similis* and *P. variegata* (Figures 4.4 (Burdur) and 4.7 (ADIBUR)). The other species *I. bradyi* located relatively close to dissolved oxygen concentration in ADIBUR (Figure 4.7) but oppose to all of used environmental variables (Figure 4.4) in Burdur. The location of *C. neglecta* and *P. fallax* showed that their distribution can be correlated to elevation in Adıyaman (Figure 4.1) but not in Burdur and in ADIBUR. The dissolved oxygen concentration was seen as a mostly effective factor on distribution of *C. angulata* in Adıyaman, *H. incongruens* and *H. salina* in Burdur and *H. intermedia*, *I. bradyi* and *T. clavata* in ADIBUR. Even though pH was among the used environmental variables, no species located close to it (Figures 4.1; 4.4 and 4.7) on CCA diagrams. Accordingly, the effectiveness of variables on individual species may change in different geographical areas. This may indicate the fact that species distribution, occurrence and diversity can be under the control of some of the other a/biotic factors.

Among the species (*H. incongruens*, *D. stevensoni* and *I. bradyi*) were relatively close to the center of all diagrams (Figures 4.1; 4.4 and 4.7) because they are well-known cosmopolitan species (Külköylüoğlu, 2013). The other species *I. inermis* was also located relatively close to the center of diagrams while it shows Holarctic distribution (Martens & Savatnalinton, 2011; Karanovic, 2012). Meanwhile, Yavuzatmaca (2011) stated that *I. inermis* can have a cosmopolitan distribution. This is probably related to their high tolerance and optimum levels to different variables used herein (Tables 4.5; 4.11 and 4.18) where individual species showed species-specific levels to different environmental variables. Therefore, such environmental variables may not have critical influence on the distribution of these species.

In the current literature, there is still a conflict about the effect of elevation on species richness and distribution. Stevens (1992) stated that species richness and elevations are negatively correlated. In other words, species richness declines with increasing elevation. Mezquita et al. (1999a) elaborating this idea stated that elevation was a limiting factor for ostracod distribution living in different water bodies of Spain. Likewise, Pieri et al. (2009) noted the importance of altitudinal range as a critical factor for the distribution of freshwater ostracods in regional scale in Italy. Some other studies, however, did not support (Malmqvist et al., 1997; Külköylüoğlu et al., 2012a, 2012b) these previous statements. Additionally, Van der Meeren et al. (2010) showed the response of fauna of western Mongolia to elevation and also Poquet & Mesquita-Joanes (2011) stated that elevational range may increase regional diversity in warm or temperate climates because water temperature, alkalinity and conductivity value of aquatic bodies are high at low elevation. In the present study when we look at the distribution of species at different elevational ranges, it can be seen that elevation could not limit distribution of them in different geographical areas (Adıyaman and Burdur). In Adıyaman, there were no differences in the number of species (10 species) at 551 - 651 m, 854 - 954 m and 1056 - 1156 m a.s.l. In like manner, 11 species were encountered between 652 - 752 m a.s.l. and 753 - 853 m a.s.l. (Figure 4.2) which is not statistically different from 10. Above 1156 m, decreasing numbers of species may be corresponding to the number of sampled sites (Figure 4.2). Analogously, as in Adıyaman, there was no constraint effect of elevation on distribution of species in Burdur where eight species were found at 886 - 1036 m and 1339 - 1489 m a.s.l. (Figure 4.5). In addition, similar results were seen when we tested it with the data of both provinces (ADIBUR). With respect to Figure 4.8, nine species occurred at 433 - 583 m and 1339 - 1489 m a.s.l. elevational ranges while the numbers of sampled sites were equal to each other. Thus, results imply that the number of sampled sites and elevational gradient do not play a critical role on the number of available species and species occurrences (Figures 4.2; 4.5 and 4.8).

Increasing elevation may cause reduction in air density and pressure. This causes 10 °C of reduction in air temperature for every 100 m of increase. Consequently, altitudinal increases cause air temperature decrease because less dense air causes heat loss due to the radiation back through the atmosphere (Brown & Gibson, 1983). These decreasing of air temperature eventually lead to a decline in

water temperature. This is actually why water bodies located at higher elevational ranges are generally cooler than the water bodies in lower ranges. Van der Meeren et al. (2010) reached similar results that water temperature of Tibetan region was gradually lower from 2668 to 5133 m a.s.l. Studying with monthly samplings in the lakes of Tatra Mountain, Novikmec et al. (2013) reported declining surface water temperature from 0.6 to 1.8 °C per 100 m a.s.l. Accordingly, the physico-chemical variables of aquatic bodies change with the ascending or descending of elevation (Reeves et al., 2007; Rogora et al., 2008). Such kind of changes may affect the occurrence and distribution of species. In that event, species with wider tolerance levels to different variables and have higher mutational ratio for adapting to changing environments have much more advantages in that kind of environments when we compared with others. This is because of the higher mutational ratio of sexually reproducing species, occurrence frequency of sexually reproducing species increased with elevation (see Figures 4.2; 4.5 and 4.8) can be seen in the present study. Like some previous studies, we also suggest that the elevation is not a limitation factor for ostracods because ostracods have been reported from 0 to 4570 m a.s.l. (Altınışlı, 2004; Guo et al., 2013). Instead of elevation, the suitability of habitats as proposed by Mezquita et al. (1999b) and Kùlköylüoğlu et al. (2012c) are important for distribution and presence of ostracods. However, because of the changing of physico-chemical variables of water with elevation, it may play a secondary role on distribution of ostracods.

In freshwater ecosystem, the ultraviolet radiation (UVB, 280 – 315 nm) can reach up to 57 cm depth (Williamson & Rose, 2010) and affect water temperature and physico-chemical variables as well. Indeed, Morill (2005) illustrated that in majority of streams for a 1 °C increase in air temperature cause about 0.6 - 0.8 °C rise in water temperature and this ratio ascend to 2 – 3 °C when air temperature shows 3 or 5 °C increase in the surface water of streams. Additionally, Mohseni & Stefan (1999) indicated that the stream water temperature and air temperature have a S-shaped relationships but Kothandaramans & Evans (1972) said that air and water temperature show a linear relationships. In the present study, we found a positive linear relationship between air (T_a) and water temperatures (T_w) ($P < 0.05$) in Adıyaman, Burdur and in the combining data of them (ADIBUR) (Appendices B(2) – (2b); D(2) – (2b) and E(2) – (2b), respectively). Hence, the 1 unit change in air

temperature incorporated with a 0.37, 0.289 and 0.326 units change in the average water temperatures in Adıyaman, Burdur and ADIBUR, respectively. However, the low percentages of the variations in water temperatures being explained by the variations in air temperatures as 9.1, 9.8 and 14 % in Adıyaman, Burdur and ADIBUR (Appendices B(2), D(2) and E(2)), respectively. Also, these results show that the relationships between T_a and T_w may be changed from region to region and from month to month. This is also the case for Adıyaman and Burdur where samples were collected in July and August-September, respectively. The influence of air temperatures on water temperatures is important since the effect of water temperature is known on the occurrence of ostracods in an environment. This is because the physico-chemical properties of the water vary depending on water temperature. Therefore, the effect of it on the species may change from species to species due to their tolerance levels. Accordingly, the results of the Mutual Ostracod Temperature Range (MOTR) stated by Horne (2007) cannot be supported which described the estimation of past air temperature by using data obtained from recent non-marine ostracod assemblages. In all, as far as we know there has been no any information about the association between T_w of shallow aquatic bodies < 1 m depth and ambient air temperature. Thus, our finding of for these type habitats is first in literature. In further, if the relationships between water temperature of small aquatic bodies and air temperature can be proved, the effect of climate change will be well documented on ostracods (or other organisms). This is because ostracods generally prefer these types of habitats. In addition, the low R^2 values herein may be due to the different types of habitats (e.g., dams, springs, creek) used together in regression analysis since weather temperature quickly heats up a small water body (e.g., small pond) while this situation takes much more times in creeks, springs, etc (as seen in the above mentioned information). This is because of that the relationship between air and water temperatures should be tested in the same types of habitats in future studies for better results.

The optimum and tolerance levels of ostracod species to different variables showed differences in Adıyaman, Burdur and ADIBUR (Tables 4.5; 4.11 and 4.18, respectively). Accordingly, *H. incongruens* had the higher tolerance level for water temperature in both provinces (Table 4.18). However, another dominant species *I. bradyi* showed higher tolerance levels than the mean for pH, dissolved oxygen

concentration (DO), electrical conductivity (EC) and water temperature (Tw) in Adıyaman (Table 4.5), it had lower tolerance levels than the mean for all of variables used in Burdur (Table 4.11). In Table 4.18, *I. bradyi* displayed lower tolerance levels than the mean to DO and EC but higher tolerance levels for Tw, moisture and elevation (Elev.) (Tables 4.5; 4.11 and 4.18). Similarly, previous studies in different geographical areas indicate that the tolerance level of species to different variables can be changed (see Karakaş Sarı & Külköylüoğlu, 2008; Külköylüoğlu et al., 2013; Rasouli et al., 2014; Uçak et al., 2014). Having the knowledge of species-specific tolerance and optimum levels to different ecological variables is important for understanding the life history of ostracods, using them in palaeoreconstruction studies, understanding the environmental changes and also important for using ostracod species as bioindicator (Külköylüoğlu et al., 2012b).

The Shannon Diversity values for different aquatic bodies revealed that first three habitats are arranged in Adıyaman as springs ($H' = 2.32$), creeks ($H' = 2.19$) and ponds ($H' = 2.10$) (Table 4.6), respectively. The first three are same in Burdur but their order is changed as ponds ($H' = 2.25$), springs ($H' = 1.79$) and creeks ($H' = 1.71$) (Table 4.12). These changes may be due to differences in the number of sampled sites and quality of habitat. In addition, the significant ($P < 0.05$, $t_{critical} = 1.65$) differences between the average elevation and water temperature between the Adıyaman and Burdur (Table 4.21) may also cause these differences. As mentioned above, effect of elevation on some of the physico-chemical variables of aquatic bodies are well known but ostracods. Thereby, the number of species can change in the same habitat types in different geographical areas. In addition, due to data of both provinces (Adıyaman and Burdur), the first three habitats were also ordered as ponds ($H' = 2.53$), springs ($H' = 2.40$) and creeks ($H' = 2.27$) like in Burdur. Simpson's Diversity Index was also supporting these results (Table 4.20).

The Shannon Diversity values of lotic (e.g., creeks) and lentic (e.g., ponds) habitats in here are higher than the Shannon Diversity values of 46 samples taken from flowing waters in the Eastern Iberian Peninsula ($H' = 0.826 \pm 0.533$) (Mezquita et al., 1999a) and 65 samples taken from a shallow lake (Lake Świdwie) in Poland ($H' = 1.668$) (Szlauder-Lukaszewska, 2012). However, species diversity of streams (3.8 species per sample (sps)), lakes (3.0 sps), wetland and springs (2.8 sps) and

ponds (2.1 sps) noted by Van der Meeren et al. (2010) in western Mongolia are higher than the present study as ponds (0.41sps), springs (0.352 sps), lakes (0.34 sps) and streams (0.5 sps). Another study done in Kahramanmaraş (Turkey) by Külköylüoğlu et al. (2012a) showed partially similar results with our findings when first four habitats were arranged as limnocrone springs ($H' = 2.89$), ponds ($H' = 2.2$), streams ($H' = 2.08$) and creeks ($H' = 1.95$). Such differences may be explained by several factors such as sampling time, number of sampling sites and geographical differences. In our case, we collected samples in a short time in one season which may cause for such differences. Over all habitats, such as ponds, springs and creeks may be called as suitable (or source) habitats for ostracods but this view should be tested in different geographical areas in future.

Among the habitats, springs are known as natural biological laboratories with stable ecological conditions (Forester, 1991) if there is no disturbance. Having been relatively stable ecological conditions, springs provide different opportunities for organism. Additionally, Hynes (1970) revealed that undamaged old springs have much more endemic species than new one. Hence, springs have good conditions for ostracods diversity especially for noncosmopolitans.

Unlike springs, creeks have spatial and temporal heterogeneity in physico-chemical and biological features. This is possibly because of different water sources merging into the creeks by means of precipitation and dissolved and/or particulate matters produced from drainage basin of flowing waters (Wetzel, 2001). As stated by Lansac-Tôha et al. (2004), lotic habitats are the connection between the lentic habitats (e.g., especially open lakes) and so their fauna comes from all types of lentic habitats. Therefore, this eventually increases heterogeneity of creeks where microhabitats will provide alternative places for organism. Thus, this will make important changes in species richness and biodiversity. Our findings about lotic systems as being the way of entrance of the ostracods into a new place support the idea of Higuti et al. (2010). This implies that lotic habitats may provide high species diversity. Supportive conclusions come from the study of Kihn & Pall (2013) who emphasized high values of Shannon-Wiener values in the Lagoons of the Central Region of Argentina during the increased supply of water and nutrients to the basin along October. Besides of these, there can be some negative effects of flowing waters

on species diversity. For example, large flood events negatively effect the flowing water environments because they disturb all substrate types and the species as well. All these information may allow us to express the high diversity index value of creeks in the present study. Thus, taking all scenarios in one hand, creeks may be considered as suitable habitats for ostracods diversity and dispersion.

Last habitat that we can consider as suitable for ostracods is “ponds”. Céréghino et al. (2012) pinpointed that biogeographic turnover is higher in ponds than in other freshwater bodies for freshwater species. Ponds are either small wetlands or key components of wider landscapes to observe the effect of climatic change and to study water management like nutrient retention, rainfall interception and carbon sequestration (Céréghino et al., 2014). Similarly, Martín-Rubio et al. (2005) stated most continental ostracods inhabit the stable water of lakes and ponds. In addition, the expression of Marmonier et al. (1994) may be used to elucidate high diversity of ostracods in ponds in the present study as they stated that temporary ponds have species with short life spans, desiccation resistance and tolerance, high migratory ability and have spherical or cylindrical body shape. The life spans of ostracods (e.g., *Cypridopsis vidua* reach to maturity in 45 days) that change species to species (Delorme, 1991) and the body shape of them (e.g., kidney, bean, elliptical, etc., (for more see Karanovic, 2012) imply the why species diversity of ostracods are high in ponds. The well known dispersion way of ostracods by birds is another important event for explanation of ponds that are suitable or may be called as source habitats for ostracods. This is because ponds are the stepping stones for migration, dispersion and genetic exchange especialy for wild species (e.g., birds) (Céréghino et al., 2014) and so the eggs and ostracods attached to their feather disperse to large distance in different geographical areas and habitats on the way of migratory birds. Finally, species diversity in these three habitats may be affected by similar factors as stated by Higuti et al. (2009b). If suitable conditions and source habitats for ostracods are known, we may have chance to prevent their extinction. Also, number of studies like present should be increase in the world and in Turkey for ostracods and for other taxonomic groups since they are important for the protection of biodiversity.

6.2 Autecology of species reported in Adıyaman and Burdur

The following section includes 34 species found in this study. Further, the differences between the ecological tolerance and optimum values of species in here and the values in literature may be explained by the used occurrence frequencies of them and their abundances in analysis. This situation should be considered and evaluated when talking about the ecological preferences of individual species and using them as indicator of environmental conditions.

6.2.1 *Darwinula stevensoni* (Brady & Robertson, 1870)

Darwinula stevensoni is called as “ancient asexual” because it has been reproduce asexually more than 100 Myr (Butlin et al., 1998). This cosmopolitan species is distributed in all over the continents except Antarctic region, Pacific region and Oceanic Islands (Martens & Savatnallinton, 2011). Recently, because of wide geographical distribution and wider tolerance ranges of the species to different environmental variables, Külköylüoğlu (2013) characterized it as a “cosmoecious species”. Although Szlauer-Łukaszewska (2012) and Ruiz et al. (2013) stated that *D. stevensoni* is a lake littoral species and benthos of shallow aquatic bodies, respectively, it has been reported from variety of habitats, such as ponds, low flowing streams, lakes, springs, rivers, troughs, coastal lagoons, wetlands, artificial dam lakes, reed beds, peat bogs and channel (Mezquita et al., 1999a, 1999c; Altınsaçlı, 2004; Higuti et al., 2009b; Pieri et al., 2009; Külköylüoğlu et al., 2013; Akdemir & Külköylüoğlu, 2014; Escrivá et al., 2014). Total of 56 (55 in Adıyaman and 1 in Burdur) individuals were collected from pond, springs and dam (Tables 4.6 and 4.12). Also, the species was found as a dominant one in dams and springs in Adıyaman (Table 4.16). These information above mentioned support the plasticity of species for habitats as proposed by Ranta (1979). Contrary to common belief as species is generally found in shallow aquatic bodies, it has been reported from 0 to a maximum 20 m depth in literature (Meisch, 2000; Pérez et al., 2010b; Lorenschat & Schwalb, 2013; Lorenschat et al., 2014). Külköylüoğlu & Vinyard (2000) found this species from muddy and sandy sediments with high dissolved oxygen concentration (DO). Besides, species was encountered on different types of sediments, e.g.,

saprobial (mud), rocks, stones and gravel (Szlauder-Lukaszewska & Kowaluk-Jagielska, 2011; Lorenschat & Schwalb, 2013), suggesting the proposal of Ranta 1979. Additionally, Ranta (1979) stated that life cycle of species takes between 3 - 4 years but Delorme (1991) and Van Doninck et al. (2003) underlined that *D. stevensoni* could have a life cycle about 6 - 24 months and one year or less, respectively. Klkyliglu (2005b) was also specify it as a eurychronal species (occurring throughout the year), supporting its life cycle with about one or more years. During such a relatively long life span females produce two or more generations. In the course of which females can carry maximum of 11 embryos within their brood pouch (Ranta, 1979). Accordingly, Van Doninck et al. (2003) pinpointed that species is a K-selected or an r - K continuum. Besides, when we look at the literature the presence of species in different areas was related with biological oxygen demand (BOD), ammonium content (Mezquita et al., 1999a), DO, pH (Martens & Tudorancea, 1991), low (Rieradevall & Roca, 1995) or highest temperature (Escriv et al., 2014), warm water, carbonated water rich with sulfate and chloride (Mezquita et al., 1999c) but negatively with iron content (Iglikowska & Namiotko, 2012). On the other hand, in our CCA diagram for Adıyaman (Figure 4.1) species was relatively close to the center of diagram near to water temperature, pointing a significantly negative ($P < 0.05$) correlation with water temperature (Table 4.19). This was suggest that distribution of species may not be correlated by the other variables used in here. The ranges of environmental variables where species recorded show similarity with previous reports. Minimum and maximum ranges of ecological variables of water bodies the species present are like that water temperature (below 4 (in subarctic) - 35 °C) (Van Doninck et al., 2003; Klkyliglu, 2013), electrical conductivity (86 – 9600 (after 15 days 100% mortality observe) μScm^{-1}) (Gandolfi et al., 2001), pH (5.5 - 9.67) (Ruiz et al., 2013; Rossetti et al., 2004); dissolved oxygen concentration (0.32 - 16.478 mgL^{-1}) (Klkyliglu et al., 2007; Klkyliglu, 2009), air temperature (12 – 30.2 °C) (Horne, 2007; Klkyliglu, 2005b), elevation (5 - 1440 m a.s.l.) (Mezquita et al., 1999c; Klkyliglu, 2013), (species was also reported in Argentina at 3500 – 4500 m a.s.l. (Laprida et al., 2006) but the specific elevation of habitat cannot be described), total dissolved solid (4.6 – 342 mgL^{-1}) (Mischke et al., 2012a; Klkyliglu et al., 2013) and salinity [(1 – 15 ‰) (Keyser, 1976; Meisch, 2000) and (0 – 30 gL^{-1}) (Van Doninck et al., 2002)]. In all, the

cosmoecious characteristics of species give much more opportunity for its distribution to in man made habitats (e.g., dams, Table 4.16).

6.2.2 *Candona neglecta* Sars, 1887

Although Martens & Savatnalinton (2011) stated that *C. neglecta* shows distribution in Palearctic region, Meisch (2000) revealed the distribution of species in Holarctic region (Palearctic and Nearctic regions). The species was previously collected in a variety of aquatic bodies including springs, ponds, brooks, pools, shallow muddy ditches, streams, wells, interstitial habitats, troughs, creeks, cave, underground waters, shallow lakes, swamps, marshes, flooded meadows, groyne fields, ricefields, wetlands, dams and reed beds (Fox, 1965; Meisch, 2000; Altınışıl, 2004; Külköylüoğlu et al., 2012b; Szlauer-Łukaszewska, 2012; Yavuzatmaca et al., 2012; Rasouli et al., 2014; Mazzini et al., 2014; Uçak et al., 2014; Szlauer-Łukaszewska, 2014). Total of 94 and 106 individuals of species collected from springs, irrigation canals, creeks and ponds in Adıyaman and Burdur, respectively. Accordingly, this species was characterized as a dominant one in Adıyaman (Table 4.3) and Burdur (Table 4.9) and also characterized as dominant in irrigation canals, creeks and springs (Table 4.16). Meisch (2000) and Karakaş Sarı & Külköylüoğlu (2008) pinpointed that *C. neglecta* can tolerate hypoxic conditions. Mischke (2001) stated that species has wide tolerance to cold and organically rich habitats. And so on, this deep benthos species (> 40 m) (Ruiz et al., 2013) was reported from habitats with different types of sediments as very fine gravel, clayly, sandy, silty and algae sediment (Cusminsky et al., 2005; Mazzini et al., 2014). Also, Szlauer-Łukaszewska & Kowaluk-Jagielska (2011) revealed the positively correlation of species with saprobel sediment. Most recently, it was collected in rushes (unrelated emergent plants) and between *Ceratophyllum* and *Myriophyllum* in Lake Świdwie (Poland) (Szlauer-Łukaszewska, 2012). The studies showed that the distribution of species can be correlated to variety of factors, suggesting that its habitat preferences can be much higher than previously known. Additionally, *Candona neglecta* showed positive correlation with elevation (Mezquita et al., 1999a; Pieri et al., 2009; Poquet & Mesquita-Jones, 2011), redox potential (Külköylüoğlu, 2005b), DO and pH (Külköylüoğlu, 2009), ammonia nitrogen content, total dissolved solid (TDS),

conductivity and visibility (Szlauer-Łukaszewska, 2014) but negatively correlated with water temperature and oxygen level (Külköylüoğlu, 2005b, 2009; Szlauer-Łukaszewska, 2014), EC and salinity (Rasouli et al., 2014; Külköylüoğlu et al., 2014). Like above given literature, in the present study species showed close relationships to elevation (Figures 4.1 and 4.7) but located on the opposite direction with electrical conductivity (EC), air temperature (Ta), pH, water temperature (Tw) and dissolved oxygen concentration (DO) (Figures 4.4 and 4.7). In Adıyaman, however, it showed close relationships with DO and pH (Figure 4.1) but located relatively close to the center of CCA diagram in Burdur and ADIBUR (Figures 4.4 and 4.7, respectively). All these data suggest wider tolerance ranges of species to different variables. Actually, species exhibited wider tolerance ranges for EC (Table 4.5) and pH (Table 4.18) in here. Recently, the species was found to be effected by concentration of nitrates (Ruiz et al., 2013), temperature and pH in caves (Meleg et al., 2011) and the lake area (Viehberg, 2006). Meisch (2000) stated that *C. neglecta* prefers relatively cold water and also Roca & Baltanás (1993) supported and characterized the species as a crenophilic, cold-stenothermal and oligothermophilic. Similarly, Rieradevall & Roca (1995) pinpointed that low temperature values favor the development of *C. neglecta* in Lake Banyoles (Spain) but high temperature values negatively effect the abundance of species. When we look at the life cycle of species, the species is a permanent form with two generation in one year, Meisch (2000) and Külköylüoğlu (2005b) confirmed this view as “*C. neglecta* is a eurychronal species”. Furthermore, the species was reported from 11 m to 311 m depth in lacustrine environment (Meisch, 2000; Külköylüoğlu et al., 2010). Even if Pieri et al. (2009) declared that species prefers habitats with low conductivity, Altınsaçlı & Mezquita (2008) reported the species from Lake Acıgöl (a very salt lake, Turkey). Likewise, Mischke & Zhang (2011) stated that tolerance range of *C. neglecta* to specific electrical conductivity changed in Tibetan Plateau, Israel and Spain as 0.5 - 3.2, 0.6 - 3.7 and 0.3 - 0.8 mScm⁻¹, respectively. Table 4.5 displays that species have wide tolerance for electrical conductivity. Finally the range of different environmental variables for species in literature are as follow transparency (140 – 210 cm) and turbidity (2.61 – 3.68 NTU) (Külköylüoğlu et al, 2010), water temperature (2.13 - 28.9 °C) (Külköylüoğlu, 2005a; Külköylüoğlu et al., 2012c), electrical conductivity (4.5 – 5290 µScm⁻¹) (Külköylüoğlu et al., 2013; Rasouli et al., 2014), pH (6 - 11.8) (Mazzini et al., 2014; Külköylüoğlu et al., 2013), dissolved

oxygen concentration (0.32 - 15.4 mgL⁻¹) (Külköylüoğlu, 2013), elevation (0 – 3194 m a.s.l.) (Külköylüoğlu et al., 2012c; Külköylüoğlu, 2013), total dissolved solid (0.0520 – 1691.3 mgL⁻¹) (Uçak et al., 2014; Akdemir & Külköylüoğlu, 2014), salinity (0 – 40 ‰) (Meisch, 2000; Gao & Hailei, 2014) and air temperature (6.6 – 42.3 °C) (Külköylüoğlu, 2005c; the present study). Ecological variables were recorded in the present study show similarity with these previously reported ranges of variables except air temperature. In addition, Li et al. (2010) collected species in Lake Qinghai (Northwestern China) with the ranges of Na (0.154 - 3.425 gL⁻¹), K (0.009 – 0.211 gL⁻¹), Ca (0.084 – 0.615 gL⁻¹), Mg (0.056 – 0.078 gL⁻¹), Cl (0.130 – 5.300 gL⁻¹) and SO₄ (0.060 – 2.130 gL⁻¹). Over all, being the last disappearing species from a hyper eutrophic lake (Lake Mondsee) (Danielopol et al., 1993) and the continuous presence of species in core samples taken from Lateglacial lacustrine environments in the southern Baltic sea (Germany) (Viehberg, 2005) support the cosmopolitan and cosmoeious characteristics of species.

6.2.3 *Candona angulata* Müller, 1900

Candona angulata shows distribution in Palearctic region (Martens & Savatnallinton, 2011). The species was previously found in brackish coastal ponds, ditches, rivers, troughs, creeks and lakes (Meisch, 2000; Martín-Rubio et al., 2005; Özuluğ, 2012; Külköylüoğlu et al., 2013). In the present study, 24 individuals of species were collected from ponds and creeks in Adıyaman. According to the Dominance index value, species was founded as a dominant one in ponds (Table 4.18). In addition, it was reported from a wide range of depth from 0.35 m (Griffiths et al., 1993) to 220 m depth in Lake Loch Ness (Scotland) (Martín-Rubio et al., 2005). Meisch (2000) stated that species prefers slightly salty water. Also, Mischke et al. (2014) revealed that optimum value of *C. angulata* to electrical conductivity (EC) is equal to 2762 µScm⁻¹. Poquet et al. (2008) reported species from Lake Albufera (Spain) with EC of 2.5 mScm⁻¹. Although it is located on the same direction with pH, dissolved oxygen concentration (DO) and elevation, species showed close realtionships only with dissolved oxygen concentration (Figure 4.1) in Adıyaman. The data of both provinces showed that *C. angulata* had high tolerance to water temperature ($t_k = 8.64$) and elevation ($t_k = 121.02$) (Table 4.18). These show that the

species may have wider tolerance ranges to ecological variables than previously known. Indeed, a wide range between minimum and maximum values of different ecological variables support this comment, such as water temperature (12.9 - 30.2 °C) (Özuluğ, 2012; the present study), electrical conductivity (145 - 1225 μScm^{-1}) (Özuluğ, 2012; Külköylüoğlu et al., 2013), pH (6.5 – 8.37) (Özuluğ, 2012; the present study), dissolved oxygen concentration (3.89 – 13.2 mgL^{-1}) (Akdemir & Külköylüoğlu, 2014; Altınsaçlı, 2014), air temperature (16 - 37.8 °C) (Horne & Mezquita, 2008; the present study), elevation (0 – 1579 m a.s.l.) (Altınsaçlı, 2004; Külköylüoğlu et al., 2013), total dissolved solid (145.92 – 146 mgL^{-1}) (Akdemir & Külköylüoğlu, 2014; Külköylüoğlu et al., 2013) and salinity (0.2 – 14 ‰) (Meisch, 2000).

6.2.4 *Fabaeformiscandona brevicornis* (Klie, 1925)

Fabaeformiscandona brevicornis is distributed in Palearctic region (Martens & Savatnalinton, 2011). The species has been reported in a variety of habitats, such as stagnant and slow flowing water connected to springs (Meisch, 2000), springs and ponds (Valls et al., 2014). Mori & Meisch (2012) stated that species is a spring benthos and found in hyporheic zone. In the present study, 21 individuals of species were collected from a spring in Adıyaman. Although there is less information about the life cycle and ecology of species, Meisch (2000) implied that species can be seen throughout the year. Additionally, Poquet et al. (2008) reported species from lakes Baldovi and Prat de Cabanes (Spain) with about 2.5 and 14 mScm^{-1} electrical conductivity values in July and August, respectively. Külköylüoğlu et al. (2014) encountered the species in November from Lake Çubuk (Bolu, Turkey). Some physico-chemical variables of the lake when species found are as follows secchi depth (120 cm), turbidity (9.6 NTU), NH_4 (0.229 mgL^{-1}), N-NO_2 (0.043 mgL^{-1}) and chlorophyll-a (15.18 μgL^{-1}). These corresponds to the the minimum and maximum ranges of species to different ecological variables in literature as water temperature (8.73 - 22.6 °C) (Külköylüoğlu et al., 2014; Sarı, 2007), electrical conductivity (212 – 605 μScm^{-1}) (Külköylüoğlu et al., 2014; Sarı, 2007), pH (7.74 – 7.93) (Sarı, 2007; the present study), dissolved oxygen concentration (8.02 – 8.60 mgL^{-1}) (the present study; Külköylüoğlu et al., 2014), air temperature (11.3 – 34.7 °C) (Külköylüoğlu et

al., 2014; the present study), elevation (301 – 1132 m a.s.l.) (Mori & Meisch, 2012; the present study), total dissolved solid (137.80 - 393.25 mgL⁻¹) (Külköylüoğlu et al., 2014; Sarı, 2007) and salinity (0.11 - 0.3 ‰) (Külköylüoğlu et al., 2014; Sarı, 2007).

6.2.5 *Schellencandona insueta* (Klie, 1938)

Schellencandona insueta was reported for first time in Turkey. It shows distribution in Palearctic region (Martens & Savatnalinton, 2011). Meisch (1996) stated that all known species of the genus are stygobiont. In that case, *S. insueta* is a stygobiotic species and Stein et al. (2012) also supported this statement. Accordingly, species was previously reported from well and interstitial habitats (Meisch, 2000). However, Yılmaz (2014) recorded a taxon *Schellencandona* sp. from a trough with pH (7.36), dissolved oxygen concentration (DO = 5.51 mgL⁻¹), electrical conductivity (EC = 905 µScm⁻¹), water temperature (Tw = 22°C), total dissolved solid (0.624 mgL⁻¹) and elevation (1036 m a.s.l.) in Karabük (Turkey). In the present study, 2 individuals of the species were reported from a spring in Adıyaman. Thus, this recent and the present study showed that the species may not be a completely stygobiont but it may be a hypogeal species. Additionally, Stoch et al. (2004) pinpointed that *S. insueta* shows association with altitudinal gradient and in here species was encountered at 933 m a.s.l. Some ecological variables of water species recorded in the present study are like that pH (7.29), DO (3.97 mgL⁻¹), EC (545 µScm⁻¹), salinity (0.33 ‰) and Tw (15.1 °C). Because of scarcity in ecological information about the species, we cannot do descriptive comments about the ecological tolerance and habitat preferences of it. Therefore, ecological studies should be done in future for determining the tolerance of species to different ecological variables.

6.2.6 *Pseudocandona semicognita* (Schäfer, 1934)

Pseudocandona semicognita has Holarctic (Palearctic and Nearctic) distribution (Karanovic, 2012) but Martens et al. (2013) noted its distribution only in Palearctic region. The life history and ecology of species is poorly known (Meisch,

2000). He noticed that species has one generation in one year and the mature form may be encountered from spring to autumn season. However, Hussein et al. (2004) abundantly encountered the species in autumn and stated species may occur throughout the year. In the present study, 3 individuals of the species were collected from a creek in Adıyaman (see Appendix A and Table 4.6). It was also reported in a variety of habitats including springs, shallow pools, ponds, seasonal ditches, shallow littoral zone of lakes, streams, water piths, canals, troughs and fountain basins (Meisch, 2000; Hussein et al., 2004; Pieri et al., 2009; Klkylođlu et al., 2012b, 2013). Besides, Mori & Meisch (2012) reported the species in hypohellic zone of a cave. Most recently, Klkylođlu et al. (2013) pinpointed that species shows significantly positive correlation with elevation and water temperature ($P < 0.01$). Similarly, Klkylođlu et al. (2012b) indicated high tolerance of species to water temperature and electrical conductivity with low tolerance for dissolved oxygen concentration. On the other hand, species showed negative correlation with electrical conductivity (Klkylođlu et al., 2014) in Lake Çubuk (Bolu). Minimum and maximum ranges of species to different ecological variables follow as water temperature (17.55 – 28.5 °C) (Klkylođlu et al., 2014; Klkylođlu et al., 2013), electrical conductivity (95.60 – 868 μScm^{-1}) (Sarı, 2007; Klkylođlu et al., 2012b), pH (5.5 – 8.59) (Meisch, 2000; Klkylođlu et al., 2013), dissolved oxygen concentration (2.45 – 6.47 mgL^{-1}) (Klkylođlu et al., 2013; the present study), air temperature (15.1 – 42.4 °C) (Klkylođlu et al., 2014; the present study), elevation (887 – 1728 m a.s.l.) (the present study; Klkylođlu et al., 2012b), total dissolved solid (0.377 – 418 mgL^{-1}) (the present study; Klkylođlu et al., 2013) and salinity (0.1 – 0.28 ‰) (Klkylođlu et al., 2013; the present study). As seen above, the ranges of some ecological variables of species have been expanded than previously known with the present study.

6.2.7 *Pseudocandona albicans* (Brady, 1864)

Martens & Ortal (1999) stated that *P. albicans* shows Holarctic distribution but Meisch (2000) and Karanovic (2012) noticed the distribution of species in Palearctic region. Meisch (2000) declared that species has one generation in one year. He also noticed that species generally prefer permanent, temporary, stagnant

and slow flowing waters with muddy sediment and without vegetation. Besides, species has previously been reported in cave, well, interstitial habitats of stream, lakes, fish ponds, peaty pools, springs with sulphorous water, creeks, streams, dams, sloughs, springs and peat bogs (Meisch, 2000; Petkovski et al., 2009; Iglukowska & Namiotko, 2012; Külköylüoğlu et al., 2012a, 2012b). In the present study, 12 individuals of the species were recorded in a spring and ponds in Adıyaman and Burdur (see Tables 4.6 and 4.12 and Appendices A and C). Malmqvist et al. (1997) noticed that *P. albicans* is an epigeal species and also Creuzé des Châtelliers & Marmonier (1993) detailed that it is a stygophilous species which was dominantly encountered in interstitial habitats of Rhône River (France). Escrivá et al. (2014) recorded species from 22.5 to 76.3 m of depth in an artificial dam lake. Peterson et al. (2013) reported the species in a muddy sulfidic pool at the entrance of Grotta del Fiume cave (Italy) when it has been collected from different types of sediments as follows sand, gravel and pebbles (Mezquita et al., 1996, 1999a). Similarly, Scharf & Brunke (2013) stated that the grain size cannot be important but the velocity of water more important for the occurrence of species. In the current study, species was found as a dominant one ($Y = 0.03$) in ponds (Table 4.16) when we combined the data of both provinces. Mezquita et al. (1999a) showed the relatedness of species with high elevation and low winter temperature and similarly Akdemir & Külköylüoğlu (2014) showed the correlation of species occurrence with elevation. Poquet & Mesquita-Joanes (2011) noticed that species does not prefer cold water and high elevation and Mezquita et al. (1999a)'s statement support this finding as species tolerated higher temperatures. The recent study of Külköylüoğlu et al. (2012a) showed close relationships of species with pH but a negative relationship with elevation and water temperature. In the present study, species located on the same direction of pH but in opposing to dissolved oxygen concentration (Figure 4.7). Additionally, the results of studies done in different geographical areas showed the relationship of the species with electrical conductivity (Külköylüoğlu et al., 2014) and dissolved oxygen concentration and calcium content (Iglukowska & Namiotko, 2012). Also, Szlauer-Łukaszewska (2014) indicated close relationship of species with pH, hardness and percent oxygen saturation in littoral area of Oder River (Poland). Moreover, the ecological variables of species recorded aquatic bodies in here mostly show confidence with previously reported values except air temperature. Thereby, the ranges of some variables for the species are like followings water temperature (2.9 –

29.2 °C) (Scharf & Brunke, 2013; Külköylüoğlu et al., 2013), electrical conductivity (92.9 – 5063 μScm^{-1}) (Iglikowska & Namiotko, 2012; Mezquita et al., 2001), pH (6.4 – 9) (Iglikowska & Namiotko, 2012; Scharf & Brunke, 2013), dissolved oxygen concentration (0.75 – 15.8 mgL^{-1}) (Yılmaz, 2014; Delorme, 1991), air temperature (9.3 - 36.3 °C) (Külköylüoğlu et al., 2014; the present study), elevation (61 – 2290) (Mezquita et al., 1999a; Külköylüoğlu et al., 2012b), total dissolved solid (0.1534 - 580.5 mgL^{-1}) (the present study; Külköylüoğlu et al., 2012a), salinity (0.1 - 5.5 ‰) (Rasouli et al., 2014; Meisch, 2000) and transparency (16.5 – 33 cm) (Iglikowska & Namiotko, 2012). Similarly, species recorded in waters with total Fe (0.4-2 mgL^{-1}), Ca^{+2} (10-160 mgL^{-1}), PO_4^{-3} (0.250- 1.5 mgL^{-1}) (Iglikowska & Namiotko, 2012), NO_3^- (0.5 – 6.8 mgL^{-1}) (Iglikowska & Namiotko, 2012; Szlauer-Łukaszewska, 2014), NH_4 (0.216 – 0.245 mgL^{-1}) (Szlauer-Łukaszewska, 2014), NO_2 (0.027 – 0.216 mgL^{-1}) (Szlauer-Łukaszewska, 2014). According to these above mentioned literature and findings of Külköylüoğlu et al. (2012b) may give us to say that this species may show cosmopolitan characteristics with wider tolerance ranges to different environmental variables in its distributional areas.

6.2.8 *Cypria ophtalmica* (Jurine, 1820)

Although Martens & Savatnalinton, (2011) stated that species distributed in Nearctic and Palearctic regions, Karanovic (2012) expended its distribution in Palearctic, Nearctic, Afrotropical, Neotropical and Oriental regions except Australasian. The species has cosmopolitan distribution and wide tolerance to environmental variables (Meisch, 2000). It has two generation annually (Meisch, 2000) and so it is eurychronall (Meisch, 2000; Martín-Rubio et al., 2005). Thus, the life span of one adult is about one year (Meisch, 2000). *C. ophtalmica* has been reported in a variety of aquatic bodies as polluted waters with organic materials, temporary, permanent and stagnant flowing waters, springs, spring benthos, caves, wells, interstitial groundwaters, lagoons, marshes, swamps, peat bogs, lakes, ditches, meadows, hyporheic zone, channel, fountain, karstic sinkhole, moss and wetlands (Meisch, 2000; Altınsaçlı, 2004; Martín-Rubio et al., 2005; Pieri et al., 2009; Iglikowska & Namiotko, 2012; Mori & Meisch, 2012; Mazzini et al., 2014; Rasouli et al., 2014). In the present study, 34 individuals of species were recorded from three

sites in Burdur (Appendix C). Additionally, it was also reported in a phreatic pool with sulfidic waters (Peterson et al., 2013), deeper benthos (Ruiz et al., 2013), shallow eutrophic areas (Rossetti et al., 2004) and in the deep and unfavourable conditions of Caicedo de Yuso-Arreo Lake (Western Ebro Basin, Spain) with high concentration of CO₂ (Martín-Rubio et al., 2005). The information mentioned above show that there is no any habitat preferences of the species. In the present study, however, species was found as a dominant one ($Y = 0.03$) in Burdur (Table 4.9) and lakes ($Y = 0.8$) (Table 4.16). Recently, Szlauer-Łukaszewska & Kowaluk-Jagielska (2011) pinpointed that *C. ophtalmica* is a dominant species in Oder river (Poland) and positively correlated with saprobel sediment. When we look at the sediment types in different waters, it is clearly seen that the species can be found in different kind of sediment types, such as muddy bottom with devoid of plants in Lake Świdwie (Poland) (Szlauer-Łukaszewska, 2012), clayly and sandy sediments (Mazzini et al., 2014) and generally clayly sedimented warm waters of Banat district (Serbia) (Karan-Žnidaršič & Petrov, 2007). On the other hand, Scharf & Brunke (2013) stated that the velocity of water is more important than the sediment or grain size for species. This may be correct because *C. ophtalmica* is a good swimmer and so the velocity of water effects its movement ability. Also, Szlauer-Łukaszewska (2014) indicated that species is found as euconstants, constants and accessory species in the groyne fields of Oder river (Poland) throughout the year. The species had high tolerance to hypoxic conditions in Lake Caicedo (Spain) (Martin-Rubio et al., 2005). Similarly, Kiss (2007) pinpointed highest abundance of species in the hypoxic degraded die-back reed belt habitats. Külköylüoğlu & Sarı (2012) showed high tolerance of species to elevation. According to the CCA diagram herein, *C. ophtalmica* located on the opposite site of dissolved oxygen concentration (DO), water temperature (Tw), pH and electrical conductivity (EC) (Figure 4.4). When we combined data of both provinces it landed on opposite site of Tw but on the same direction of elevation with no close relationships (Figure 4.7). In addition, although species showed negatively significant correlation with pH ($P < 0.01$) and DO ($P < 0.05$) (Table 4.19), it displayed high tolerance value in Burdur and in combination of both provinces for pH, DO and for Tw (Tables 4.11 and 4.18) in the present study. As well, Benzie (1989) declared that species prefers low oxygen and acidic environment and the statement of Fernandes-Martin et al. (2010) support that as species occurs in aquatic conditions with lowest pH. On the other hand, Rossetti et

al. (2004) collected species from water with acidities and temperature larger than 7 and 35 °C, respectively. Indeed, Fernandes-Martin et al. (2010) said that species characterise the conditions with highest salinity while Kulköylüoğlu et al. (2014) showed negatively correlation of species with electrical conductivity. Besides, Delorme (1991) stated that frozen individuals of *C. ophtalmica* can able to survive for several hours. All of these mentioned above support the cosmoeccious characteristics of species (Kulköylüoğlu, 2013). Thus, using the species as indicator species should be done carefully. Minimum and maximum values of different ecological variables for the species include as water temperature (1.1 – 33 °C) (Dügel et al., 2008; Kulköylüoğlu, 2013), electrical conductivity (40.8 – 5260 μScm^{-1}) (Kulköylüoğlu, 2013), pH (4.7 – 13) (Meisch, 2000; Kulköylüoğlu, 2013), dissolved oxygen concentration (0 – 20 mgL^{-1}) (Kulköylüoğlu, 2013), air temperature (6 – 34.5 °C) (Horne & Mezquita, 2008; the present study), elevation (0 – 2500 m a.s.l.) (Pieri et al., 2009; Meisch, 2000), total dissolved solid (0.2478 - 450.5 mgL^{-1}) (the present study; Kulköylüoğlu et al., 2012a), salinity (0 – 25 ‰) (Ruiz et al., 2013; Meisch, 2000) and depth (0 – 330 m) (Martín-Rubio et al., 2005; Meisch, 2000).

6.2.9 *Physocypria kraepelini* G.W. Müller, 1903

Species shows distribution in Nearctic, Oriental, Palearctic and Nearctic regions (Martens & Savatnalinton, 2011) but Martens et al. (2013) showed its distribution in Nearctic, Oriental and Palearctic regions. It was previously recorded in ponds, littoral zone of lakes, streams, canals, ditches, fish ponds with macrophyte coverage, temporary pools, reedbeds and also collected from a eutrophic gravel pit over anoxic H_2S producing mud types habitats (Meisch, 2000; Karan-Žnidaršič & Petrov, 2007; Pieri et al., 2009; Kulköylüoğlu et al., 2012b). It has cosmopolitan characteristics (Kulköylüoğlu, 2013). Shornikov & Trebukhova (2001) underlined its high tolerance to heavily polluted water bodies. In the present study, 3 individuals of species were collected from two sites in Burdur which are dam and pond (Appendix C). The habitats species recorded in here show similarity with previous researches. According to the above mentioned information, it is may be true that species does not show a clear habitat preferences. In the present study, species was characterized as a

dominant ($Y = 0.03$) one in dams (Table 4.16). Additionally, Szlauer-Łukaszewska (2012) stated that species prefers high mud content and also Scharf & Brunke (2013) pinpointed the positive association of species with middle sand. Likewise, species was recorded as a eudominant species in saprobel (mud) and hard sediment types in Oder river (Poland) (Szlauer-Łukaszewska & Kowaluk-Jagielska, 2011). In addition, Van der Meeren et al. (2010) found association of species with aquatic vegetation. Although Külköylüoğlu (2005b) stated that species shows a seasonal or stenochronal life cycle, it was collected from throughout the year in Lake Çubuk (Bolu) (Külköylüoğlu et al., 2014). Also, Hiller (1972) implied that species remains constant throughout the year. Recently, Szlauer-Łukaszewska (2014) recorded species as a subdominant and dominant throughout the year in the groyne fields of Oder river (Poland). All of those studies support long life cycle of species as proposed by Külköylüoğlu (1998). In the present study, species showed a close relationship with water temperature on CCA diagram (Figure 4.4). When we look at the tolerance levels of the species, it can be seen that species had high tolerance for dissolved oxygen concentration (DO) and water temperature (Table 4.11). Similarly Külköylüoğlu et al. (2010) stated that species has high tolerance to water temperature in Lake Sünnet (Bolu). Although negative correlation was reported between species and temperature (Yılmaz & Külköylüoğlu, 2006; Kiss, 2007), Scharf & Viehberg (2014) described the species from warm waters. According to some earlier studies, species showed negative correlation with redox potential (Külköylüoğlu, 2005b) but the correlation was positive with EC, turbidity and DO (Külköylüoğlu, 2005b; Yılmaz & Külköylüoğlu, 2006; Külköylüoğlu et al., 2014). Besides, Kiss (2007) mentioned that species tolerates hypoxic conditions in reed belt edge while Külköylüoğlu (2005b) stated that species sensitive to low temperature and high oxygen concentration in Lake Gököy (Bolu). Finally, the experimental studies of Na et al. (2009) showed safe concentration value of species to different variables, such as for ammonia is 58.38 mgL^{-1} , NH_3 is 0.27 mgL^{-1} and for phosphate is 390.55 mgL^{-1} . In the same study, the complete mortality of species was seen after 24 hours in acidic condition ($\text{pH} = 4.33$). In the present study, the environmental variables of aquatic bodies species encountered lied in the range of variables recorded for species previously (for more see Appendix C) except total dissolved solid. The ecological ranges of species to different ecological variables are like following water temperature ($0.9 - 31.4 \text{ }^{\circ}\text{C}$) (Kiss, 2007; Özuluğ, 2011), electrical conductivity

(64.29 – 799 μScm^{-1}) (Yılmaz & Külköylüoğlu, 2006; Kiss, 2007), pH (6.59 – 10.44) (Na et al., 2009; Kiss, 2007), dissolved oxygen concentration (1.07 – 19.12 mgL^{-1}) (Külköylüoğlu et al., 2014; Kiss, 2007), air temperature (4.10 – 34 °C) (Külköylüoğlu et al., 2014; Özuluğ, 2011), elevation (0.5 – 1663 m a.s.l.) (Külköylüoğlu, 2013), total dissolved solid (0.2152 – 702 mgL^{-1}) (the present study; Van der Meeren et al., 2010) and salinity (0 - 2.4 ‰) (Yılmaz & Külköylüoğlu, 2006; Meisch, 2000). Those wide ranges of species to different variables support the cosmoeious characteristics of species as proposed by Külköylüoğlu et al. (2014). Therefore, increasing abundance of *P. kraepelini* is an indication of increasing water eutrophication (Na et al., 2009).

6.2.10 *Ilyocypris gibba* (Ramdohr, 1808)

Ilyocypris gibba shows distribution in Nearctic, Neotropical and Palearctic regions (Martens & Savatnalinton, 2011). Species has been reported from small and shallow permanent waters, temporary pools, springs, brooks, slightly salty waters, ricefields, interstitial habitats, troughs, dams, ponds, reservoirs, streams, canals, slow flowing rivers, permanent pools, shallow lakes, reed beds and creeks (McKenzie & Moroni, 1986; Meish, 2000; Malmqvist et al., 1997; Külköylüoğlu, 2005a; Karan-Žnidaršič & Petrov, 2007; Sarı, 2007; Külköylüoğlu et al., 2012a; Uçak et al., 2014). Roca & Baltanás (1993), but, stated that species is crenoxenic. Külköylüoğlu (2013) called it as a “cosmopolitan” species. In the present study, a total of 7 individuals were counted from dams in both provinces (see Appendices A and C). Also, it was found as a dominant species in dam ($Y = 0.22$). However, Malmqvist et al. (1997) stated that it is a lotic species and similarly Külköylüoğlu & Vinyard (2000) abundantly collected species from running waters (e.g., stream bed). According to Meisch (2000), species produces two generation annually as it was case in the study of Külköylüoğlu (1998) who collected the species throughout the year. Moreover, the species have been collected from different types of sediments like clayey, fine-mudded or sandy substrate, rock pool with clayey sediment and temporary pond with carbonatic soil (Meisch, 2000; Pieri et al., 2006). The relationships between the species and vegetation and mosses were pinpointed by Külköylüoğlu & Vinyard (2000) on sandy bottom. We encountered the species between 537 m to 1104 m a.s.l.

elevation indicating a wide altitudinal distribution. This corresponds to the results of some of the previous studies showed that larger tolerance values of the species to elevation (Külköylüoğlu et al., 2012a, 2013; Uçak et al., 2014). In contrast, Mezquita et al. (1999a) stated that species exhibited positive association with low elevation. Hartmann & Hiller (1977) characterized species as a polythermophilic and stated its preferences for mostly warm waters. Accordingly, the species can be polythermophilic (Külköylüoğlu et al., 2013; Rasouli et al., 2014). The findings of the present study support the preferences of species for warm waters because we collected species in waters with 24.9 and 28.4 °C temperatures. On the other hand, Külköylüoğlu et al. (2012a) showed a significant negative correlation of the species with water temperature ($P < 0.01$). Rossetti et al. (2004) pinpointed that the species tolerate lower oxygen concentration. In the present study, the species was collected between 5.77 and 6.12 mgL⁻¹ concentration of dissolved oxygen concentration. Külköylüoğlu & Vinyard (2000) declared the species distribution is mostly effected by dissolved oxygen concentration (DO) and pH in springs in Nevada (USA). According to Sarı (2007) species showed positive correlation with pH and conductivity whereas Külköylüoğlu et al. (2012a) also noticed the high tolerance level of species to pH and electrical conductivity (EC). However, Hussein et al. (2004) stated that species negatively correlated with conductivity. We encountered the species in slightly basic (pH = 8.45 – 8.53) and low EC (419.2 – 491.4 µScm⁻¹) of aquatic bodies. According to Delorme (1991), species can survive in fresh to brackish water. In this study, the species was collected in slightly saline (0.19 – 0.24 ‰) but in some previous studies the species was recorded in highly saline environments with an optimum range of salinity 8.86 gL⁻¹ in Lake Qinghai (Li et al., 2010), in very salty Lake Acıgöl (Turkey) (Altınsaçlı & Mezquita, 2008) and in Lake Fondo D'Elx (Spain) with about 20 mScm⁻¹ salinity (Poquet et al., 2008). Additionally, species showed as a characteristic species of bicarbonate rich water enriched with sulfate and chloride in springs (Mezquita et al., 1999c). Szlauer-Lukaszewska (2014) noticed the correlation of species with phosphate content and Rossetti et al. (2004) encountered with species in water with high pH, ionic content, concentration of chlorophyll-a and inorganic nutrients. These ranges clearly indicate wider tolerance levels of the species. Lowest and highest values of different physico-chemical variables of aquatic bodies where species was collected as follow Ca⁺² (60 - 533 mgL⁻¹) (Iglikowska & Namiotko, 2012; Li et al., 2010), NO₃⁻ (1 – 33.7 mgL⁻¹)

(Iglikowska & Namiotko, 2012; Valls et al., 2014), PO_4^{-3} (0.25 mgL^{-1}) (Iglikowska & Namiotko, 2012), water temperature ($3.7 - 42 \text{ }^\circ\text{C}$) (Mezquita et al., 2001; Külköylüoğlu, 2013), electrical conductivity ($122.2 - 13810 \text{ }\mu\text{Scm}^{-1}$) (Külköylüoğlu et al., 2012c; Mezquita et al., 2001), pH ($5.8 - 9.8$) (Ruiz et al., 2013; Külköylüoğlu, 2013), dissolved oxygen concentration ($2.03 - 14 \text{ mgL}^{-1}$) (Narasimha Ramulu et al., 2011; Külköylüoğlu, 2013), air temperature ($11.2 - 42.35 \text{ }^\circ\text{C}$) (Külköylüoğlu et al., 2014; Narasimha Ramulu et al., 2011), elevation ($1 - 3199 \text{ m a.s.l.}$) (Külköylüoğlu, 2013), total dissolved solid ($0.099 - 575.3 \text{ mgL}^{-1}$) (De Deckker, 1981; Külköylüoğlu et al., 2012a), salinity ($0 - 3.6\text{‰}$) (Ruiz et al., 2013; De Deckker, 1981) and depth ($0 - 76.3 \text{ m a.s.l.}$) (Escrivá et al., 2014).

6.2.11 *Ilyocypris monstrifica* (Norman, 1862)

Species is distributed in Palearctic region (Martens & Savatnalinton, 2011). Until now, it has been recorded in stagnant and slowly flowing waters with muddy bottom, fish ponds, littoral zone of lakes, slowly flowing brooks, rivers, canals, interstitial habitat of rivers, puddles, slow flow rivers, permanent ponds and lakes (Meisch, 2000; Karan-Žnidaršič & Petrov, 2007; Poquet et al., 2008; Yılmaz, 2014). In the present study, it was found as a dominant species ($Y = 0.03$) (Table 4.9) in Burdur with 26 individuals collected from 4 sampling sites (dam, pond and lakes (Table 4.12). Additionally, it was also recorded in eutrophic water bodies (Altınışıl, 2004), stagnant pond with vegetation (Creuzé des Châtelliers & Marmonier, 1993) when some authors indicated that it is restricted to downstream lentic areas, in sulfidic spring pool (Peterson et al., 2013), pond fed by ground water (Rossetti et al., 2004) and in groyne field of river Elbe (Germany) (Scharf & Brunke, 2013). In addition, it was characterized as a dominant species in ponds ($Y = 0.08$) and lakes ($Y = 0.36$) when we combined the data from both provinces (Table 4.16) in the present study. Previously, species was recorded on different types of sediments as clayey, hard and saprobial/hard sediments (Karan-Žnidaršič & Petrov, 2007; Szlauer-Łukaszewska & Kowaluk-Jagielska, 2011). Szlauer-Łukaszewska (2014) indicated higher abundance of species at summer season in groyne fields of the Oder river (Poland) and noted a strong positive correlation of the species with phosphate and nitrate concentration but negative with dissolved oxygen concentration (DO),

hardness, and pH. Similarly, Karan-Žnidaršič & Petrov (2007) collected species in warm waters. Even if species did not show any significant correlations with ecological variables used in here, species placed on the sites of electrical conductivity (EC), pH and air temperature (Ta) (Figure 4.4) on the CCA diagram. It showed close relationships with pH in ADIBUR (Figure 4.7). In Tables 4.11 and 4.18, species showed high tolerance levels to elevation ($t_k = 458.43$), EC ($t_k = 127.03$), DO ($t_k = 3.91$) and water temperature (Tw) ($t_k = 3.54$) but low to pH ($t_k = 0.51$). As seen above, information about its ecological preferences is scarce so we cannot do much comments about the ecological characteristics of it. Finally the value of ecological variables (EC, salinity, Tw and elevation) of habitats where species collected in here show confirmity with previously records but the range of pH, DO, total dissolved solid and air temperature have been extended. Minimum and maximum values of different variables for species are like following water temperature (10.5 - 35 °C) (Karan-Žnidaršič & Petrov, 2007), electrical conductivity (300 - 5260 μScm^{-1}) (Rasouli et al., 2014), pH (6.8 – 9.26) (Karan-Žnidaršič & Petrov, 2007; the present study), dissolved oxygen concentration (4.07 – 10.79 mgL^{-1}) (the present study), air temperature (15 – 34.5 °C) (Horne & Mezquita, 2008; the present study), elevation (7 - 1398 m a.s.l.) (Altınsaçlı, 2004; Rasouli et al., 2014), total dissolved solid (0.2152 - 0.3003 mgL^{-1}) (the present study; Yılmaz, 2014) and salinity (0.1 – 3.30 ‰) (Rasouli et al., 2014).

6.2.12 *Ilyocypris bradyi* Sars, 1890

This cosmopolitan species (Külköylüoğlu, 2013) is distributed in Nearctic, Neotropical, Oriental and Palearctic regions (Martens & Savatnalinton, 2011). It was previously recorded in different types of habitats like springs, ponds, eutrophic gravel pits, rivers, swamps, lakes, interstitial habitats, eutrophic and mesotrophic lakes, ponds, slow flowing waters, troughs, streams, reservoirs, swampy puddles, lagoons, dams, sloughs, canals, water pits, sulfidic spring, spillway of reservoirs and peat bogs (Meisch, 2000; Altınsaçlı, 2004; Pieri et al., 2009; Li et al., 2010; Külköylüoğlu et al., 2012b; Özuluğ, 2012; Külköylüoğlu, 2013; Peterson et al., 2013; Escrivá et al., 2014; Uçak et al., 2014). We collected 548 individuals from spring, creek, irrigation canal, stream, trough, dam and pond (see Appendices A and C) in

Adıyaman and Burdur. Yavuzatmaca et al. (2012) firstly recorded species in cave, suggesting stygophilic (some affinity to ground water) characteristic of species. Staplin (1963) stated that species tolerates moderate current flow. Delorme (1991) characterized it as a lotic species. However, most recently Külköylüoğlu et al. (2013) pinpointed that species is one of the most frequently occurring species in troughs with high Shannon diversity index value = 2.647. In the present study, the species was characterized as a dominant one in 8 different aquatic bodies (see Table 4.16). The results of this study combined with the literature suggest that species does not have a specific habitat preferences. Indeed, the species has two generation annually (Meisch, 2000) and so it occurs throughout the year (Karakaş Sarı & Külköylüoğlu, 2008). It was recorded on different types of sediments as muddy, sandy, gravel and silty (Mezquita et al., 1996; Külköylüoğlu & Vinyard, 2000; Meisch, 2000) and crawl or burrow among aquatic plants (Kotlia et al., 1998 in Mischke et al., 2003). Also, recently Karanovic & Lee (2013) collected species from a stream has 15 cm depth with sandy and gravelly bottom. Szlauer-Łukaszewska & Kowaluk-Jagielska (2011) noticed a negative and positive association of the species with saprobel and hard sediment types, respectively. The species did not show any significant correlations with environmental variables (pH, dissolved oxygen concentration (DO), water temperature (Tw) and elevation (Elev.)) (Table 4.15). On the other hand, some previous studies showed positively significant correlation of species with DO, electrical conductivity (EC) and redox potentials (Külcöylüoğlu, 2005b; Külcöylüoğlu et al., 2012b, 2013) but negative correlation with pH (Külcöylüoğlu, 2005b). Uçak et al. (2014) implied negatively significant correlation of species with DO. On CCA diagram of Adıyaman, species located closer to EC and Tw (Figure 4.1). Unlike in Adıyaman, species was located on the center of diagrams in Burdur and ADIBUR (Figures 4.4 and 4.7, respectively). Correspondingly, tolerance levels of the species to pH ($t_k = 0.45$), DO ($t_k = 3.22$) and EC ($t_k = 164.62$) (Table 4.5) in Adıyaman were higher than in Burdur (e.g., pH ($t_k = 0.27$), DO ($t_k = 1.69$), EC ($t_k = 120.67$)) (Table 4.11) except water temperature ($t_k = 4.32$). when the data of both provinces used tolerance levels of species founded as to pH ($t_k = 0.35$), DO ($t_k = 1.78$), EC ($t_k = 121.52$), Tw ($t_k = 4.73$) and elevation ($t_k = 287.3$). However, the results of some previous studies indicated high tolerance levels than in the present study. For example, in Kahramanmaraş, Külcöylüoğlu et al. (2012a) portrayed the relationships of species with elevation and stated that it has higher tolerance ranges

for pH, water temperature, and elevation. The highest tolerance level of species to DO ($t_k = 5.88$) was also reported in a heavily polluted lake of Turkey by Klkylođlu et al. (2007). Most recently, Akdemir & Klkylođlu (2014) pinpointed high tolerance level of it to elevation ($t_k = 239.25$), water temperature ($t_k = 5.92$) and EC ($t_k = 349.03$). These results support the findings of Anadon et al. (1986) who found the species surviving in nutrient and bicarbonate enriched water. Similarly, Mezquita et al. (1999c) recorded species in a bicarbonate rich spring with relatively low temperature and mineralization and stated that species tolerates oxygen concentrations below 3 mgL^{-1} . Gao & Hailei (2014) emphasized that species has been reported from fresh to hypersaline aquatic bodies and in acidulous waters as well. Furthermore, the species was recorded in waters with salinity below 6 ‰ by Ruiz et al. (2013) and in Lake Qinghai with a salinity range of $4.63 - 13.98 \text{ gL}^{-1}$ by Li et al. (2010). In contrast, Klkylođlu & Vinyard (2000) stated that it prefers less saline alkaline waters. Besides, Bunbury & Gajewski (2005) found higher tolerance of the species to increasing Na^+ concentration. Overall, studies support that species generally has wide tolerance ranges to different variables and so it occurs widely. Due to the ecological properties of different geographical areas, tolerance and association of species to/with different ecological variables may change. The being of this well known cosmopolitan as dominant one in Adıyaman ($Y = 3.75$) (Table 4.3), Burdur ($Y = 4.72$) (Table 4.9) and in eight different types of habitats (Table 4.16) and the presence of it in anthropogenic pressure lake up to 30 m depth (Lake Ohrid) (Lorenschat et al., 2014) may support the “cosmoecious” (Klkylođlu, 2013) characteristics of the species. Ranges of the most ecological variables in the present study fall between previous reports except water and air temperatures. Therefore, the water and air temperature ranges of it are extended than previously known. Thus, minimum and maximum values of some variables for species are like following water temperature ($1.68 - 33.8 \text{ }^\circ\text{C}$) (Dgel et al., 2008; the present study), electrical conductivity ($15.64 - 5290 \text{ }\mu\text{Scm}^{-1}$) (Klkylođlu, 2013; Rasouli et al., 2014), pH ($5.43 - 9.89$) (Klkylođlu, 2013; Uçak et al., 2014), dissolved oxygen concentration ($0.28 - 20.7 \text{ mgL}^{-1}$) (Klkylođlu, 2013; Klkylođlu et al., 2012b), air temperature ($8.4 - 42.8 \text{ }^\circ\text{C}$) (Klkylođlu, 2005c; the present study), elevation ($0 - 3194 \text{ m a.s.l.}$) (Altınsaçlı, 2004; Klkylođlu, 2013), total dissolved solid ($0.1482 - 1776 \text{ mgL}^{-1}$) (Yılmaz, 2014; Van der Meeren et al., 2010), salinity ($0 - 4.5 \text{ ‰}$) (Ruiz et al., 2013; De Deckker, 1981).

6.2.13 *Ilyocypris inermis* Kaufmann, 1900

According to Martens & Savatnalinton (2011), species distributes in Palearctic region. In the present study, 575 individuals of species were collected from 21 sampling sites with four different habitat types as springs, creeks, irrigation canals and ponds only in Adıyaman (Table 4.6 and Appendix A). It has been encountered from springs, wells, streams, troughs, ditches, dams, pools, waterfalls, reed beds, creeks, sulfidic springs, lakes and peat bogs (Meisch, 2000; Pieri et al., 2009; Külköylüoğlu et al., 2012b, 2013; Peterson et al., 2013; Akdemir & Külköylüoğlu, 2014; Escrivá et al., 2014; Mazzini et al., 2014; Uçak et al., 2014). As shown, there seems to be no special habitat preferences of the species. This was the case in our study (see Table 4.16). However, Roca & Baltanás (1993) indicated it as a crenobiont species while Külköylüoğlu & Sarı (2012) noticed a strong correlation between species and habitat type ($P < 0.05$) that includes ponds and slow flowing creeks. Like *I. bradyi*, it was also reported in cave for the first time by Yavuzatmaca et al. (2012). With respect to Meisch (2000), species has two (in spring and autumn) generations annually and so it is a permanent form. Besides, it has been collected on different types of sediments as mud, gravel, sandy and clay (Mezquita et al., 1996; Meisch, 2000; Mazzini et al., 2014). In the present study, it was relatively close to the center of CCA in Adıyaman (Figure 4.1) while the species showed close relationship with water temperature in ADIBUR (Figure 4.7). Similar to our results, Sarı (2007) mentioned the location of species on the center of CCA diagram which means species cannot be affected by the variables used. Although Meisch (2000) and Külköylüoğlu et al. (2010) stated that species prefers relatively cold waters, Roca & Baltanás (1993) collected species in Pyrenean springs with above 14 °C temperature and said that it is a crenobiont. However, Mezquita et al. (1999c) recorded species in bicarbonate rich springs with relatively low temperature and low mineralization. Külköylüoğlu & Yılmaz (2006) stated that presence of species was affected by water temperature and redox potential. Recently, Külköylüoğlu et al. (2013) pinpointed a negative significant correlation of species with water temperature (Tw) and electrical conductivity (EC). In the current study, the ranges of species occurred water temperatures are as 10.9 – 31.9 °C. Accordingly, the species had high tolerance levels to EC ($t_k = 96.89$) and Tw ($t_k = 4.74$) but slightly low to dissolved oxygen concentration (DO) ($t_k = 1.27$) and pH ($t_k = 0.37$) (Table 4.5).

When we combined the data of both provinces, the tolerance levels of the species to EC decreased to $59.57 \mu\text{Scm}^{-1}$ (Table 4.18). Those fluctuations indicate the tolerance levels of the species may change from local to regional and support the wider tolerance levels of it to different variables. For example, Akdemir & Klkylođlu (2014) showed high tolerance levels of species to elevation ($t_k = 329.42$), water temperature ($t_k = 2.72$), pH ($t_k = 4.16$) and EC ($t_k = 229.17$). During the present study, species showed a significant ($P < 0.01$) correlation with elevation (Table 4.19). Even if high tolerance of it to EC, the species negatively correlated with EC in different aquatic bodies of the province Van (Turkey) (Klkylođlu et al., 2012b). Besides, Van der Meeren et al., (2010) noted the association of species occurrence with total phosphorous. Overall, the statement of Pieri et al. (2010) could not be supported as *I. inermis* was an indicator of good ecosystem health. This is because wide ranges of species to different variables forcing the idea as species may be a cosmopolitan and so it easily adapt to new conditions. The values of ecological variables we recorded *in situ* show similarity with previously recorded values except air temperature. Minimum and maximum values of different ecological variables for species are like that water temperature ($5.7 - 36.7 \text{ }^{\circ}\text{C}$) (Klkylođlu & Ylmaz, 2006; Ylmaz, 2014), electrical conductivity ($0 - 2740 \mu\text{Scm}^{-1}$) (Klkylođlu et al., 2012a; Mezquita et al., 2001), pH ($5.3 - 9.46$) (Klkylođlu et al., 2012a; Klkylođlu et al., 2012c), dissolved oxygen concentration ($1.96 - 12 \text{ mgL}^{-1}$) (Sarı, 2007; Mezquita et al., 2001), air temperature ($13 - 42.5 \text{ }^{\circ}\text{C}$) (Klkylođlu et al., 2010; the present study), elevation ($10 - 2018 \text{ m a.s.l.}$) (Klkylođlu et al., 2012c; Van der Meeren et al., 2010), total dissolved solid ($0 - 5516 \text{ mgL}^{-1}$) (Klkylođlu et al., 2012a; Van der Meeren et al., 2010), salinity ($0 - 1.3 \text{ }_{\text{‰}}$) (Klkylođlu et al., 2012a; Akdemir & Klkylođlu, 2014) and depth ($0 - 20 \text{ m}$) (Meisch, 2000).

6.2.14 *Prionocypris zenkeri* (Chyzer & Toth, 1858)

This dominant ($Y = 0.04$) species in Burdur (Table 4.9) shows distribution in Palearctic region (Martens & Savatzenalinton, 2011). In the present study 32 individuals were collected in creeks and troughs in Burdur (Table 4.12) while in Adıyaman empty valves and carapaces of species were encountered only in two sites (see Appendix A). Until now, this cosmopolitan species (Klkylođlu, 2013) has

been recorded in slow flowing waters with vegetation, ponds, interstitial habitats of streams, creeks, ricefields, channels, lakes, rivers, sluices, springs, streams, wetlands, troughs, dams, lakelets, reedbeds, water falls, puddles, oligotrophic, mesotrophic and eutrophic freshwaters (McKenzie & Moroni, 1986; Meisch, 2000; Altınsalı, 2004; Pieri et al., 2009; Klkylođlu et al., 2012a, 2012b, 2012c, 2013; Akdemir & Klkylođlu, 2014). Peterson et al. (2013) collected species in a sulfidic spring and in a phreatic pool at the entrance of Grotta del Fiume cave (Italy) with sulfidic waters. In here, the habitats of species recorded had slow flowing and stagnant waters. Suggestion of Scharf & Viehberg (2014) as the species prefers slow flowing waters is supported by our findings but Mezquita et al. (1999a) encountered with the species in flowing waters of Eastern Iberian Peninsula with gravel sediment. In addition, Rossetti et al. (2004) emphasized its preferences for waters with high alkalinity and mostly encountered it in pond fed by ground waters. Furthermore, it is a permanent form and so occurs throughout the year (Meisch, 2000; Karakaş Sarı & Klkylođlu, 2008). During the present study, species did not show any correlation with variables (e.g., pH, dissolved oxygen concentration (DO), etc.) used in here (Table 4.19). Also, it was located relatively close to the center of CCA diagrams in Burdur and ADIBUR (Figures 4.4 and 4.7). According to some previous studies, whereas, species showed positively significant correlation with DO (Klkylođlu et al., 2012b), moisture (Uak et al., 2014) and redox potential but negatively with pH (Klkylođlu & Sarı, 2012). Indeed, high tolerance levels of species to electrical conductivity (EC) ($t_k = 106.65$), water temperature (Tw) ($t_k = 4.41$) and elevation (Elev.) ($t_k = 118.22$) but slightly low to pH ($t_k = 0.37$) and DO ($t_k = 2.48$) could be seen (Tables 4.11 and 4.18). When we compare our findings with some previous reports, it seems that tolerance levels of the species to these variables are higher than in the present study, such as, for EC ($t_k = 183.12$), Tw ($t_k = 4.45$) and Elev. ($t_k = 138.16$) (Klkylođlu & Sarı, 2012) and for DO ($t_k = 5.38$) (Klkylođlu et al., 2012b). Unlike above mentioned, Mischke et al. (2014) pointed its low tolerance ranges to specific electrical conductivity and presence only in cool freshwaters in the Jordan. Additionally, it was collected up to 8.7 m depth in Lake Ohrid by Lorenschat et al. (2014). Overall, suggesting the cosmopolitan characteristic of species and so it easily adapts to new conditions and tolerates situations of unfavourable sites for non-cosmopolitans. Minimum and maximum values of some ecological variables for the species are as follow water temperature (7.14 – 31.7 °C) (Klkylođlu et al., 2014;

Uçak et al., 2014), electrical conductivity (15.94 – 1393 μScm^{-1}) (Uçak et al., 2014), pH (6.29 – 9.36) (Külköylüoğlu et al., 2012a; Külköylüoğlu, 2013), dissolved oxygen concentration (2.01 – 20.70 mgL^{-1}) (Külköylüoğlu, 2013), air temperature (2.2 – 33.3 °C) (Külköylüoğlu et al., 2014; Uçak et al., 2014), elevation (10 - 2980 m a.s.l.) (Altınsaçlı, 2004; Aygen et al., 2012), total dissolved solid (0.2145 – 615 mgL^{-1}) (Uçak et al., 2014; Külköylüoğlu et al., 2013) and salinity (0 – 0.83 ‰) (Külköylüoğlu et al., 2012b; Uçak et al., 2014).

6.2.15 *Trajancypris clavata* (Baird, 1838)

Trajancypris clavata shows distribution in Palearctic region (Martens & Savatnallinton, 2011). It is known from small shallow temporary waters, ricefields, springs, lakes, eutrophic and mesotrophic lakes, temporary ponds and ditches (Meisch, 2000; Altınsaçlı, 2004; Pieri et al., 2006; Van der Meeren et al., 2010; Uçak et al., 2014). It was also characterized as a typical species of small, usually temporary and silty bottom water bodies (Martens, 1989) and found in oligo to mesotrophic waters. In the present study, 3 and 7 individuals were encountered in ponds and a spring in Adıyaman (Table 4.6) and Burdur (Table 4.12), respectively. The species has two generation annually (Meisch, 2000) and was found in waters with mud, marl soil, sand, pebbles and gravel bottom (Meisch, 2000; Pieri et al., 2006; Mezquita et al., 1999a, 1999b). In addition, Mezquita et al. (1999b) collected species in more polluted and mesosaprobic waters in Magre River and stated that it palaeoenvironmentally may indicate eutrophic trophic state. Mezquita et al. (2001) reported the species in waters with low $\text{Alk}/\text{Ca}^{+2}$. Valls et al. (2014) displayed the species may not be affected by alkalinity, oxygen and NH_4 (see their Figures). Herein, species showed close relationships with dissolved oxygen concentration (DO) on CCA diagram (Figure 4.7) when it displayed high tolerance to DO ($t_k = 3.35$), electrical conductivity (EC) ($t_k = 80.79$), water temperature (Tw) ($t_k = 7.14$), elevation (Elev.) ($t_k = 90.07$) and pH ($t_k = 0.1$) (Table 4.18). Also, *T. clavata* showed positive correlation with elevation ($P < 0.01$) (Table 4.19). Unlike these studies, Mischke et al. (2014) indicated low tolerance range of species for specific electrical conductivity (0.358 mScm^{-1}). As seen, there is lack of information about the ecological preferences of species. The variables recorded in our study show similar

outcomes with previous results except DO, air temperature (Ta) and total dissolved solid (TDS). Thus, the ranges of some ecological variables for species are like following water temperature (3.7 – 30.6 °C) (Mezquita et al., 2001; Valls et al., 2014), electrical conductivity (187.4 - 3529 μScm^{-1}) (Külköylüoğlu et al., 2012a; Mezquita et al., 2001), pH (7.2 – 8.8) (Mezquita et al., 1999b; Uçak et al., 2014), dissolved oxygen concentration (1.84 – 19.23 mgL^{-1}) (the present study), air temperature (17.1 -38.7 °C) (the present study), elevation (10 - 2426 m a.s.l.) (Altınsağılı, 2004; Van der Meeren et al., 2010), total dissolved solid (0.2522 - 122 mgL^{-1}) (the present study; Van der Meeren et al., 2010) and salinity (0.1 – 1.3 ‰) (Külköylüoğlu et al., 2012a; Valls et al., 2014).

6.2.16 *Herpetocypris brevicaudata* Kaufmann, 1900

The species shows distribution in Nearctic and Palearctic regions (Martens et al., 2013). It has been encountered in springs and waters connected to springs, ditches, littoral zone of lakes, rivers, troughs, reservoirs, lakes, ponds, eutrophic pond fed by canals and creeks (Roca & Wansard, 1997; Meisch, 2000; Akdemir & Külköylüoğlu, 2011, 2014; Escrivá et al., 2014; Uçak et al., 2014). The life cycle of species is not well known. We encountered 11 individuals of the species in creek and irrigation canal in Adıyaman (Table 4.6). Similarly, Rossetti et al. (2004) reported species in a small channel flooded by running water. The water bodies where the species was reported species reported have different types of bottom sediments as sand, gravel, pebbles, mud and siliceous soil (Mezquita et al., 1996, 1999a; Pieri et al., 2006). Species was characterized as eurythermic by Forester (1991) due to its wide temperature range. Mezquita et al. (1999a) showed it as a thermophilic and also Mezquita et al. (1999c) noticed that warm and well oxygenated bicarbonate rich springs were characterized by this species. According to Roca & Wansard (1997), species showed fast development and succesfull reproduction between 19.8 and 23.3 °C but below the 15 - 19 °C that cannot be seen. The range of water temperatures (18.6 – 23.3 °C) species recorded herein support the statements proposed by this previous study. However, when we look at the literature, ranges of water temperature for it are wider than the expalined above (see below). Besides, Forester (1991) pinpointed that it can live in cool to warm waters with 25 - 30 % calcium and

carbonate content. At the same time, Roca & Wansard (1997) emphasized that it is an indicator of the minimum water temperature in palaeoenvironmental reconstruction studies. In the present study, species was recorded at relatively high pH (8.04 – 8.1). The findings of Rossetti et al. (2004) support the presence of the species at higher pH values. *Herpetocypris brevicaudata* was encountered at moderately low elevations herein (495.8 – 567 m a.s.l.) and Poquet & Mesquita-Joanes (2011) also showed its relationships with low elevation in sites of the Tejeda-Almijara mountain range. On the other hand, Malmqvist et al. (1997) implied association of the species with running waters at high elevation with low conductivity. Indeed, it was reported up to a 20.7 m depth in the Caicedo de Yuso-Arreo Lake (Spain) by Martín-Rubio et al. (2005). Finally, Mezquita et al. (2001) said that it is an indicator of medium high water quality in Iberian Mediterranean brooks but when we look at the ranges of variables for species (see below) these statements may be underestimate. This is because it seen that the ecological preferences of species may be wider than the previously known. Thereby, lowest and highest values of some ecological variables for species are as following water temperature (3.7 – 28.1 °C) (Mezquita et al., 2001; Akdemir & Külköylüoğlu, 2014), electrical conductivity (193 - 5520 μScm^{-1}) (Mezquita et al., 1999c), pH (6.5 – 8.8) (Mezquita et al., 1996; Mezquita et al., 2001), dissolved oxygen concentration (2.3 – 13.3 mgL^{-1}) (Mezquita et al., 2001; Uçak et al., 2014), air temperature (16 – 35.1 °C) (Horne & Mezquita, 2008; the present study), elevation (20 - 1720 m a.s.l.) (Mezquita et al., 1999c; Poquet & Mesquita-Joanes, 2011), total dissolved solid (0.1547 – 590.2 mgL^{-1}) (Uçak et al., 2014; Külköylüoğlu et al., 2012a) and salinity (0.11 – 0.7 ‰) (Uçak et al., 2014).

6.2.17 *Herpetocypris chevreuxi* (Sars, 1896)

Herpetocypris chevreuxi shows distribution in Nearctic, Neotropical and Palearctic regions (Martens et al., 2013). It has been recorded in small stagnant water bodies, littoral zone of lakes, swamps, slow flowing streams, rivers, sewage polluted with organics and heavy metals, troughs, creeks, downstream of springs, temporary ponds, hot water springs and swamps, canals, small lakes, reed beds, lagoons, mesotrophic and eutrophic freshwaters, mesotrophic brackish waters, ricefields

(Gülen, 1977, 1985; Meisch, 2000; Altınsaçlı, 2004; Escrivá et al., 2008-2009; Karakaş Sarı & Külköylüoğlu, 2008; Akdemir & Külköylüoğlu, 2014; Uçak et al., 2014). Besides, it was collected in sulfidic (H_2S) springs and phreatic pool at the entrance of Grotta del Fiume cave (Italy) (Peterson et al., 2013) and in a pond fed by ground water (Rossetti et al., 2004). During this study, total of 43 individuals were collected from 5 sites (e.g., creek, ponds and spring) in Adıyaman (Table 4.6) and also 27 individuals were recorded from a trough in Burdur (Table 4.12). According to Malmqvist et al. (1997), the species showed low affinity for habitat types. This view is supported in the present study. However, Külköylüoğlu & Sarı (2012) indicated the strong correlations of species with habitat types (pond and slow flowing creek) ($P < 0.05$) in Bolu. We found the species as a dominant one in ponds ($Y = 0.11$) (Table 4.16). The species has been reported from stone, sandy-muddy, silty and carbonatic soil (Külköylüoğlu & Vinyard, 2000; Meisch, 2000; Pieri et al., 2006). This dominant species (Table 4.3) in Adıyaman did not show any close relationship with water temperature (T_w) and electrical conductivity (EC) (Figure 4.1). However, it showed a close relationship with water temperature in ADIBUR (Figure 4.7). Similar to our result, Szlauer-Łukaszewska (2014) noticed close relationship of the species with temperature when Külköylüoğlu et al. (2012a) showed its close relationships with EC in Kahramanmaraş. Accordingly, it had higher tolerance levels to EC ($t_k = 128.86; 119.60$), T_w ($t_k = 4.13; 10.03$) and also to dissolved oxygen concentration (DO) ($t_k = 1.43; 2.30$) in Adıyaman and ADIBUR, respectively (see Tables 4.5 and 4.18). In a like manner, high optimum ($u_k = 20.3^\circ C$) (Viehberg, 2006) and tolerance ($t_k = 6.33$) (Külköylüoğlu & Sarı, 2012) levels of the species for water temperature were reported. Although the range of temperature ($14 - 33.8^\circ C$) species recorded herein supports the findings of Roca & Baltánas (1993) who described the species preferring warm waters above $10^\circ C$. Thereby, tolerance of species to temperature is wider than previously known (see below). In the current study, species did not show any correlations with pH, DO, T_w and elevation (Elev.) (Table 4.19). Rossetti et al. (2004) pinpointed its association with high pH (> 8). Additionally, Fernandes Martins et al. (2010) stated that it is one of the first species to be encountered after inundation and indicated it as a eurytopic species. In addition, species was abundantly encountered in eutrophic springs with organic matters content in Spain (Roca & Baltánas, 1993). The authors indicated species as crenoxenic and eurythermic. In addition, Meisch (2000) stated its occurrence in

Lippe river with 500 – 1100 mgL⁻¹ CI concentration. Finally, one of the most recent study of Scharf & Meisch (2014) showed the presence of abundant empty valves and carapaces of species in water bodies with 8 ‰ salinity and large number of living individuals (> 100) in 3 ‰ salinity waters. Overall, these values reported so far suggest that *H. chevreuxi* probably tolerate wide ranges of ecological conditions. Therefore, appears to support Külköylüoğlu (2013) who called the species as “cosmoecious species”. The ranges of some ecological variables in literature and with the results of the present study for species are as follow water temperature (5.7 – 33.9 °C) (Külköylüoğlu & Vinyard, 2000; Sarı, 2007), electrical conductivity (74.7 - 1475 µScm⁻¹) (Yılmaz, 2014; Sarı, 2007), pH (6.3 – 9.3) (Fernandes Martins et al., 2010; Dügel et al., 2008), dissolved oxygen concentration (2.11 – 17 mgL⁻¹) (Karakaş Sarı & Külköylüoğlu, 2008; Rossetti et al., 2004), air temperature (10 – 42.8 °C) (Horne & Mezquita, 2008; the present study), elevation (0 – 1921 m a.s.l.) (Altınsaçlı, 2004; Akdemir & Külköylüoğlu, 2014), total dissolved solid (0.1352 – 958.75 mgL⁻¹) (the present study; Sarı, 2007), and salinity (0.04 – 4 ‰) (Yılmaz, 2014; Meisch, 2000).

6.2.18 *Herpetocypris helenae* G.W. Müller, 1908

Although Martens & Ortal (1999) showed distribution of the species in Holarctic region, Martens et al. (2013) stated that the species can also be found in Afrotropical and Palearctic regions. We found 3 individuals of the species from a creek in Adıyaman (Table 4.6). *Herpetocypris helenae* shows similar ecological preferences and morphological characters with *H. chevreuxi*. This is may be why it is considered as a synonymous of *H. chevreuxi* (Meisch, 2000). There is no enough information about the ecology of species. Therefore, limited information was gained from couple of studies. *Herpetocypris helenae* has been reported in springs, dams, troughs, and reservoirs (Külköylüoğlu et al., 2012a; Escrivá et al., 2014; Uçak et al., 2014). Also, it was collected in water bodies with gravel bottom by Mezquita et al. (1999a). In Turkey, it was most abundantly encountered in very salty Lake Acıgöl by Altınsaçlı & Mezquita (2008). According to Mezquita et al. (1999c), it was a secondary species of species characterized the bicarbonate rich waters with high sulfate and chloride content. Most recently, Uçak et al. (2014) noticed its high

tolerance levels to water temperature ($t_k = 5.9\text{ }^{\circ}\text{C}$). The ecological variables of creek species recorded herein (Appendix A) show similarity with previously known. Thereby, lowest and highest values of some ecological variables for the species are as follow water temperature ($13.4 - 28\text{ }^{\circ}\text{C}$) (Mezquita et al., 1999c; Uçak et al., 2014), electrical conductivity ($117 - 1070\text{ }\mu\text{Scm}^{-1}$) (Mezquita et al., 1999c; Uçak et al., 2014), pH ($5.43 - 9.85$) (Külköylüoğlu et al., 2012a; Mezquita et al., 1999c), dissolved oxygen concentration ($5.4 - 19.1\text{ mgL}^{-1}$) (Uçak et al., 2014; Mezquita et al., 1999c), air temperature ($26 - 39.5\text{ }^{\circ}\text{C}$) (Uçak et al., 2014), elevation ($68 - 1183\text{ m a.s.l.}$) (Mezquita et al., 1999a; Uçak et al., 2014), total dissolved solid ($0.1475 - 417.3\text{ mgL}^{-1}$) (Uçak et al., 2014; Külköylüoğlu et al., 2012a) and salinity ($0.11 - 0.5\text{ ‰}$) (Uçak et al., 2014).

6.2.19 *Herpetocypris intermedia* Kaufmann, 1900

According to Martens et al. (2013), *H. intermedia* shows distribution in Afrotropical and Palearctic regions. It has been reported in ditches, streams, rivers, large pools, on swampy grounds, dams, fountain troughs, lakes, springs, brooks and bicarbonate rich springs (Meisch, 2000; Wansard & Mezquita, 2001; Külköylüoğlu et al., 2012a, 2012c; Uçak et al., 2014). In the present study, 218 individuals of the species were counted from 10 sites in Adıyaman while 76 individuals were reported from 2 sites in Burdur. These 12 sites consist of pond, spring, trough and creeks (see Appendices A and C). *Herpetocypris intermedia* was found as a dominant species in Adıyaman ($Y = 0.74$; Table 4.3) and in Burdur ($Y = 0.04$; Table 4.9) and also in creeks ($Y = 0.12$) and ponds ($Y = 0.11$) (Table 4.16). In contrast, Mezquita et al. (1999c) showed it as a characteristic species of bicarbonate rich springs with relatively low temperature and mineralization. Meisch (2000) stated that the life history of species remain unknown but according to Wansard & Mezquita (2001), the population of the species could be renewed in nearly half of a year. With respect to the diagrams of CCA, in Adıyaman, species did not show any relationships with variables used herein (Figure 4.1) but in Burdur and ADIBUR, it showed close relationships with water temperature (T_w) and dissolved oxygen concentration (DO) (Figures 4.4 and 4.7), respectively. Mezquita et al. (1999b) revealed occurrence of the species in relation to water temperature and seasons when it maintains large

population in winter months corresponding to a decrease in water temperature. Tolerance levels of the species to ecological variables used in here show differences among the provinces studied. Highest tolerance levels of the species were recorded as DO ($t_k = 1.87$), electrical conductivity (EC) ($t_k = 127.86$) and Tw ($t_k = 2.58$) in Adıyaman, for pH ($t_k = 0.36$) in Burdur and for elevation (Elev.) ($t_k = 186.92$) in ADIBUR (Tables 4.5; 4.11 and 4.18, respectively). Supportive evidence comes from the study of Külköylüoğlu et al. (2012a) who showed lower tolerance levels of species than herein to pH ($t_k = 0.9$), EC ($t_k = 299$), Tw ($t_k = 2.3$) and Elev. ($t_k = 171.4$) in Kahramanmaraş (Turkey). In addition, Mezquita et al. (1999c) stated that it shows positive correlation with high elevation and low chloride with respect to alkalinity in cooler water in low oxygen concentration. Similarly, we encountered it between 2.64 and 7.27 mgL⁻¹ of DO but in moderately warm waters (15.3 – 28.3 °C). Furthermore, the findings of Mezquita et al. (1999a) and (2001) as high tolerance of the species to organic matter pollution may support the statement of Mezquita et al. (1999b) as increasing population of the species indicate the eutrophication. The most ranges of ecological variables recorded herein lie between the ranges previously known except water and air temperatures. Accordingly, minimum and maximum values of some ecological variables for species are like as water temperature (5 – 28.3 °C) (Mezquita et al., 1999b; the present study), electrical conductivity (221.2 – 3320 µScm⁻¹) (Uçak et al., 2014; Mezquita et al., 1999b), pH (6 - 9.18) (Külköylüoğlu et al., 2012a; Uçak et al., 2014), dissolved oxygen concentration (1.4 – 12.1 mgL⁻¹) (Mezquita et al., 1999c), air temperature (12.4 – 42 °C) (the present study), elevation (125 – 1420 m a.s.l.) (Külköylüoğlu et al., 2012c; Mezquita et al., 1999c), total dissolved solid (0.1475 – 494 mgL⁻¹) (Uçak et al., 2014; Külköylüoğlu et al., 2012a) and salinity (0.1 - 0.4 ‰) (Külköylüoğlu et al., 2012a)

6.2.20 *Psychrodromus olivaceus* (Brady & Norman, 1889)

This well known cosmopolitan species (Külköylüoğlu, 2013) shows distribution in Palearctic region (Martens et al., 2013). On the other hand, Sarı & Külköylüoğlu (2010) stated that the species widely distributed in Holarctic region. Until now, *P. olivaceus* has been reported in springs, ponds fed by springs, spring brooks, ponds, lakes, sulphurous springs, interstitial riverine habitats, troughs,

streams, ricefields, creeks, rivulets, pools, water ditches and in slow flow or non-flowing waters (McKenzie & Moroni, 1986; Meisch, 2000; Külköylüoğlu et al., 2012a, 2012c, 2013; Külköylüoğlu & Sarı, 2012). Peterson et al. (2013) reported the species in sulfidic spring, river and in the shallow site of a phreatic pool at the entrance of Grotta del Fiume cave with H₂S in muddy bottom (Italy). Total of 305 and 861 individuals of the species were recorded from 15 and 26 sites in Adıyaman and Burdur (see Tables 4.6 and 4.12), respectively. Although Mischke et al. (2014) stated that *P. olivaceus* prefers flowing water especially in stream and springs and also groundwater related habitats, we collected species in a variety of habitats not only in flowing waters but also in stagnant water bodies (e.g., trough, pond, creek, lake (for more see Appendices A and C)). It can be seen that habitat preferences of the species to be much wider than previously known. Being as a dominant species not only in Adıyaman ($Y = 1.55$, Table 4.3) and Burbur ($Y = 6.37$, Table 4.9) but also in its recorded habitats (Table 4.16) supports its abundant occurrences in a variety of habitats. Therefore, it can live in different environmental conditions as proposed by Külköylüoğlu & Sarı (2012) since species showed high environmental tolerance index values to different variables. According to Meisch, (2000), it is a permanent form and occurs throughout the year. The presence of species under the ice in Lake Abant (Bolu) in winter season (Dügel et al., 2008) supports its tolerance to low temperature values. In addition, Külköylüoğlu (2013) stated that it prefers waters with low temperature, low salinity and low dissolved oxygen concentration. Mischke et al. (2014) also noticed the preferences of the species for low water temperature, low specific electrical conductivity (EC) and waters with stable ion composition and low specific EC optima. Therefore, it can be characterized as an oligothermophilic species. However, the temperature ranges (11 - 26.6 °C) in the current study and previously known (1.68 – 36.7 °C) show its wide range of tolerance limits. Griffiths & Evans (1991) revealed that *P. olivaceus* is the most tolerant species among all of the species of genus *Psychrodromus*. Findings of the present study support this idea. It can also be seen in the results of this study as *P. olivaceus* showed wider tolerance levels to pH ($t_k = 0.25; 0.44; 0.39$), dissolved oxygen concentration (DO) ($t_k = 1.01; 2.19; 1.91$), EC ($t_k = 91.98; 202.11; 172.68$) and water temperature (Tw) ($t_k = 3.37; 3.53; 3.41$) (Tables 4.5; 4.11 and 4.18) in Adıyaman, Burdur and ADIBUR, respectively. Additionally, it was a most frequently encountered species in troughs in Turkey with high Shannon diversity value ($H' = 2.617$) and tolerance levels to

elevation ($t_k = 337.8$), pH ($t_k = 4.1$), and EC ($t_k = 197.8$) (Külköylüoğlu et al., 2013). According to the CCA diagrams in Adıyaman and Burdur, species did not show any tendency for a particular variables used in here (Figures 4.1 and 4.4). Similarly it did not reveal any significant correlations with pH, DO, Tw and elevation (Table 4.19). Whereas in some previous studies, a negative singificant correlation of the species to elevation ($P < 0.01$) and pH, DO ($P < 0.05$) (Külköylüoğlu et al., 2013) and water temperature ($P < 0.05$) (Külköylüoğlu et al., 2012a) and positive to EC ($P < 0.01$) (Külköylüoğlu et al., 2013) were exhibited. Furthermore, high tolerance of the species to elevation ($t_k=228.07$) in ADIBUR and finding of Mischke et al. (2003) as the abundant valves of species at 3200 m a.s.l. support that it may be found in wide ranges of elevation. The lowest and highest values of some variables of water bodies where species recorded are like that water temperature (1.68 – 36.7 °C) (Külköylüoğlu, 2013; Yılmaz, 2014), electrical conductivity (0 – 2478 μScm^{-1}) (Külköylüoğlu et al., 2012a; the present study), pH (5 – 11.4) (Boomer et al., 2006; Külköylüoğlu et al., 2013), dissolved oxygen concentration (1.74 – 20 mgL^{-1}) (Külköylüoğlu, 2013), air temperature (18 – 40.5) (Yılmaz, 2014; the present study), elevation (0.5 – 1700 m a.s.l.) (Külköylüoğlu, 2013; Meisch, 2000), total dissolved solid (0– 1774 mgL^{-1}) (Külköylüoğlu et al., 2012a; the present study) and salinity (0 – 2.1 ‰) (Külköylüoğlu et al., 2012a; Külköylüoğlu et al., 2013).

6.2.21 *Psychrodromus fontinalis* (Wolf, 1920)

Similar to *P. olivaceus*, it shows distribution in Palearctic region (Martens et al., 2013). During the present study, 11 individuals were collected from 2 sites (spring and creek) in Burdur. There is limited information available about the ecology of it. *Psychrodromus fontinalis* was previously reported in springs, stream flowing from springs, troughs, subterranean waters (interstitial waters and cave waters), spring puddles, ditches, peat bogs, streams, lakes, irrigation canals and creeks (Meisch, 2000; Pieri et al., 2009; Külköylüoğlu et al., 2013; Akdemir & Külköylüoğlu, 2014; Mazzini et al., 2014). Additionally, Meish (2000) stated that this permanent species especially found in cold water and similarly Roca & Baltanás (1993) characterized species as crenobiont and coldstenothermal. The temperature of water bodies species found (11.4 – 13.1 °C) herein show confirmity with the

previous. On CCA diagram, species did not show any relationships with variables used in here (Figure 4.4) and also the tolerance levels of species to pH ($t_k = 0.37$), dissolved oxygen concentration (DO) ($t_k = 3.22$), electrical conductivity (EC) ($t_k = 91.44$) and water temperature (Tw) ($t_k = 1.20$) were not too high (Table 4.11). In contrast, Akdemir & Külköylüoğlu (2014) stated wider tolerance range of it to water temperature ($t_k = 5.6$). Some other studies showed positively significant correlation of the species with redox potentials and elevation ($P < 0.05$) but negative to pH and water temperature ($P < 0.01$) (Külköylüoğlu & Sarı, 2012; Uçak et al., 2014). Most recently, Mazzini et al. (2014) collected species in waters with silty, clayly, very fine and gravel bottoms and also explicated the occurrence of species to be influenced by total dissolved solid and nutrients (in Italy). The ranges of variables species recorded in this study show similarity with previously known except total dissolved solid and salinity. Thus, minimum and maximum values of some variables for species are like following water temperature (7.4 – 29.8 °C) (Roca & Baltanás, 1993; Akdemir & Külköylüoğlu, 2014), electrical conductivity (84.9 - 3866 μScm^{-1}) (Külköylüoğlu et al., 2012c; Uçak et al., 2014), pH (6 – 9.92) (Mazzini et al., 2014; Külköylüoğlu et al., 2012c), dissolved oxygen concentration (2.55 – 17.1 mgL^{-1}) (Akdemir & Külköylüoğlu, 2014; Sarı, 2007), air temperature (15.9 – 31.1 °C) (Uçak et al., 2014), elevation (285 - 2235 m a.s.l.) (Rasouli et al., 2014; Külköylüoğlu et al., 2012b), total dissolved solid (0.2542 – 565.5 mgL^{-1}) (the present study; Akdemir & Külköylüoğlu, 2014) and salinity (0 - 0.37 ‰) (Külköylüoğlu et al., 2012c; the present study).

6.2.22 *Heterocypris incongruens* (Ramdohr, 1808)

This “horse trough” (Fryer, 1997) ostracod shows wide distribution in Afrotropical, Australasian, Nearctic, Neotropical, Oriental, Pacific region and Oceonic Islands and Palearctic regions (Martens et al., 2013). According to Külköylüoğlu (2013), it is a good example of cosmoeccious species. Until now, *H. incongruens* has been reported in seasonal pools, small permanent water bodies, rain puddles, wheel ruts on clayey ground, water butts, cattle and horse troughs, fountains, tree cavities, rock pools, brooks, rivers, ricefields, springs, underground waters, permanent large waterbodies, streams, oxbow pools, seeps and ephemeral

lagoons (Rossi & Menozzi, 1990; Meisch, 2000; Mischke et al., 2003; Cusminsky et al., 2005; Mischke et al., 2014). Totally 1627 adult individuals of the species were reported in the current study. Of which, 553 from 46 sites and 1074 individuals from 38 sites were in Adıyaman and Burdur, respectively (see Appendices A and C). The species was found as dominant one in all habitats of both provinces (Table 4.16) except lakes in which we did not find it. Most recently, it was reported as a dominant species encountered in troughs with high Shannon diversity index value ($H' = 2.458$) (Külköylüoğlu et al., 2013). Another study showed significant correlation of the species with habitat types resembling to stagnant shallow water bodies (Külköylüoğlu et al., 2012b). It was also commonly reported in eutrophic springs with high accumulation of organic matter by Roca & Baltanás (1993) who also characterized the species as crenoxenic and eurythermic. After that Schornikov & Trebukhova (2001) described the species from heavily polluted waters in Tumen (Tumangan, Russia). Külköylüoğlu (2013) revealed tolerance of the species to low oxygen, high chloride and organic matters supporting its indicator value for organic pollution (Mezquita et al., 1999b). In addition, occurrence of the species was correlated with biological oxygen demand (BOD) and ammonium content by Mezquita et al. (1999a) and with total phosphate and organic nitrogen by Van der Meeren et al. (2010). In here, *H. incongruens* showed close relationships with water temperature (T_w) (Figure 4.1) in Adıyaman, dissolved oxygen concentration (DO) (Figure 4.4) in Burdur and relatively close to center of CCA diagrams of Burdur and ADIBUR (Figures 4.4 and 4.7). Finding of species at the center of CCA supporting that species is of no close relation to any variables used here. In Poland, abundance of the species was correlated with high values of dissolved oxygen concentration, conductivity and calcium content in temporary waters (Iglikowska & Namiotko, 2012). Further, tolerance levels of the species to pH, DO, electrical conductivity (EC) and T_w were higher in Adıyaman (Table 4.5) than in Burdur (Table 4.11). When we combined the data of both provinces, tolerance levels of the species to these variables (Table 4.18) showed similarity with values in Burdur but not same. Thus, the highest tolerance levels were reported herein for pH ($t_k = 0.31$), EC ($t_k = 230.83$) and T_w ($t_k = 6.21$) in Adıyaman (Table 4.5), for DO ($t_k = 2.39$) in Burdur (Table 4.11) and for elevation (Elev.) ($t_k = 224.56$) in ADIBUR (Table 4.18). High tolerance of species to elevation supports the findings of Mischke et al. (2003) who collected abundant empty valves of it in a small swampy brook at between 3080 –

3200 m a.s.l. elevational ranges in China. As previously noted high tolerance of the species to different variables varied as Tw ($t_k = 6.02$), EC ($t_k = 159$) and pH ($t_k = 2.6$) (for more see Klkylođlu et al., 2012a; Klkylođlu & Sarı, 2012). Indeed, Mischke et al. (2014) implied the adaptation of the species to brackish waters along with a wide tolerance ranges to specific EC. Additionally, this dominant species in Adıyaman and Burdur (Tables 4.3 and 4.9) showed a negatively significant ($P < 0.05$) correlation with pH (Table 4.19). Moreover, a couple of studies indicated the significantly positive correlation of the species with water temperature ($P < 0.05$), dissolved oxygen concentration ($P < 0.01$) and strong correlation with EC (Klkylođlu & Sarı, 2012; Uak et al., 2014). Furthermore, Ganning (1971) noted that species produce two or three generations during summer and autumn. Fernandes Martins et al. (2010) stated that it is one of the firstly occurred species after inundation in a pond. In addition, Rossi et al. (2011) noted that they put 5 adult individuals of species into a water bodies previously without ostracods and only after 45 days they observed a big populations with about 30000 and 100000 individuals. This fast proliferation of the species shows that it may consume a lot of things and being a predator. Besides, it will increase its survival changes in variety of habitats. For example predation on amphibian eggs and larvae of species was observed by Ottonello & Romano (2010). Sometimes cannibalism can also be seen among individuals of the species when they attach the prey (Rossi et al., 2011). As well, Ganning (1971) noticed that individuals die above salinity ranges than 16 ‰. For a successful survival and development, suitable range of salinity for species should be about 5 – 10 ‰. Whereas it was showed as an indicator of slightly brackish waters by Li et al. (2010) who collected the valves of the species in swampy puddles near Lake Qinghai and Lake Gahai with 1.9 gL⁻¹ and 12.3 gL⁻¹ salinity concentration, respectively. These previous results were also supported by finding of Scharf & Meisch (2014) as the presence of abundant empty valves and carapaces of species in waters with 60 ‰ salinity. In laboratory, Hurtubise et al. (1998) observed that the species survived under 16 kJ.m⁻² UVB for 7 days. Later Van den Broecke et al. (2012) found 80 % of ultraviolet-B (wavelength 280 – 320 nm, UVB) radiation blocked by valves and 110 kJ.m⁻² UVB as lethal dose for species. Finally, Ruiz et al. (2013) stated that species tolerate the 0.04 – 1.74 µgL⁻¹ concentration of DDT (for more see this paper). Finally, we can say that it is a well know cosmopolitan species and when its abundance increase, the quality of habitats start to decrease. Lowest and

highest values of some variables for the species are like following water temperature (3.7 – 33.9 °C) (Mezquita et al., 2001; the present study), electrical conductivity (11.04 – 10050 μScm^{-1}) (Uçak et al., 2014; Rasouli et al., 2014), pH (5.3 – 12.8) (Külköylüoğlu et al., 2012a; Külköylüoğlu, 2013), dissolved oxygen concentration (0.28 – 20 mgL^{-1}) (Yılmaz, 2014; Külköylüoğlu et al., 2013), air temperature (12.4 – 42.9 °C) (the present study), elevation (0 – 3194; (4570) m a.s.l.) (Külköylüoğlu et al., 2012c; Külköylüoğlu, 2013; (Guo et al., 2013)), total dissolved solid (0.1313 – 20034 mgL^{-1}) (Uçak et al., 2014; Van der Meeren et al., 2010) and salinity (0- 50 ‰) (Külköylüoğlu, 2009; Rasouli et al., 2014).

6.2.23 *Heterocypris salina* (Brady, 1868)

This species shows distribution in Nearctic, Neotropical and Palearctic regions (Martens et al., 2013). Up to now, it has been encountered from springs, wells, salty sulphurous springs, rarely in interstitial habitats, troughs, dams, ditches, streams, ponds, the edge of some lakes and salt marshes (Forester, 1991; Meisch, 2000; Uçak et al., 2014). Meisch (2000) claimed it as halophilic species referring to its preference for small and slightly saline coastal and inland waters. Besides, the species recorded water bodies had many sediment types like sandy, gravel, pebbles, sand/mud and silty-sand (Mezquita et al., 1999a, 1999b; Mazzini et al., 2014). Neale (1964) recorded species in brackish waters with 400 -13000 mgL^{-1} salinity. During the present study, 366 adult individuals of this dominant species ($Y = 0.62$; Table 4.9) in Burdur were collected from troughs and in a permanent pool with the salinity range of 0.2 - 0.68 ‰ (see Appendix C and Table 4.12). Roca & Baltanás, (1993) specialized it as a crenoxenic and eurythermic species when Forester (1991) called it “eurytopic” species. This cosmopolitan species was indicated as a dominant one occurred in both stagnant and temporary waters with high conductivity at low elevation by Malmqvist et al. (1997). Recently, Van der Meeren et al. (2010) also showed it as a pond and stream species focusing on the presence of it in high calcium content (average % $C_a = 30.4$) and at high elevation (759 – 2079 m a.s.l.). Indeed, species was found as one of the dominant one in ponds ($Y = 0.08$) and troughs ($Y = 0.53$) (Table 4.16) in here. Additionally, it was shown as a secondary characteristic species of brackish sulfate rich and chlorinated waters by Mezquita et al. (1999c). All

these suggest that it has high tendency for different habitats where conditions fluctuate high. With regard to CCA diagram (Figure 4.4) in Burdur, it showed a weak relationship to dissolved oxygen concentration (DO) but located relatively closer to the center of diagram in ADIBUR (Figure 4.7). This indicates that the distribution of the species was not effected by these variables used herein. Besides, its occurrence was related to biological oxygen demand (BOD) and ammonium content (Mezquita et al., 1999a) and than it can be called as an indicator species of organic pollution (Mezquita et al., 1999b). Although significant correlation of the species with elevation (Uçak et al., 2014) and electrical conductivity (Rasouli et al., 2014) were showed, we did not see significant correlation with pH, dissolved oxygen concentration (DO), water temperature (Tw) and elevation (Table 4.19). It showed moderately high tolerance levels to pH ($t_k = 0.43$), DO ($t_k = 2.01$), electrical conductivity (EC) ($t_k = 203.18$) and Tw ($t_k = 6.01$) in Burdur (Table 4.11) and to elevation ($t_k = 182.67$) in ADIBUR (Table 4.18). Most recently, high tolerance levels of the species was indicated for water temperature ($t_k = 3.6$) and DO ($t_k = 4.4$) by Uçak et al. (2014) and for EC ($t_k = 1996.31$) and elevation ($t_k = 399.06$) by Rasouli et al. (2014). In addition, Mischke et al. (2003) abundantly encountered its valves in a small swampy brook at 3200 m a.s.l. Furthermore, tolerance of species to 20000 mgL^{-1} of salinity was claimed by Ganning (1967). After that Ganning (1971) stated that it produces 2 or 3 generations during summer and autumn in waters with 35.2 ‰ of salinity. Who also revealed suitable ranges of salinity should be 5 – 10 ‰ for its survival and development while Göttner (1980) declared the upper salinity limit for reproduction of species as 20 - 25 ‰. Forester (1991) encountered the species in the margin of Zuni Salt Lake where conductivity varied from 2000 to 50000 μScm^{-1} with the wind direction. Also, Akdemir (2008) collected the species in Lakes Meke and Acı (Turkey) with 60 gL^{-1} of salinity concentration. Scharf & Meisch (2014) collected empty valves and carapaces of species in waters with 60 ‰ of salinity while recent forms present in 1 - 8 ‰ salinity waters. Mischke et al. (2014) pinpointed wide tolerance ranges of the species to specific EC in brackish waters. Overall, these reports strongly support its high tolerance to high salinities. This is also supported with the present study. Thus, ranges of some variables for species are as follow water temperature (3.7 - 34 °C) (Mezquita et al., 2001; Meisch, 2000), electrical conductivity (15.94 - 10050 μScm^{-1}) (Uçak et al., 2014; Rasouli et al., 2014), pH (6.05 – 9.9) (Yılmaz, 2014; Van der Meeren et al., 2010), dissolved

oxygen concentration ($0 - 18.84 \text{ mgL}^{-1}$) (Ruiz et al., 2013; Uçak et al., 2014), air temperature ($18.5 - 39.1 \text{ }^{\circ}\text{C}$) (Yılmaz, 2014 ; Uçak et al., 2014), elevation ($0 - 2079$; $(4570) \text{ m a.s.l.}$) (Altınsağı, 2004; Van der Meeren et al., 2010; (Guo et al., 2013)), total dissolved solid ($0.1748 - 20034 \text{ mgL}^{-1}$) (Uçak et al., 2014; Van der Meeren et al., 2010) and salinity ($0.1 - 50 \text{ ‰}$) (Uçak et al., 2014; Rasouli et al., 2014).

6.2.24 *Isocypris beauchampi* (Paris, 1920)

Isocypris beauchampi has been distributed in Nearctic, Neotropical and Palearctic regions (Martens et al., 2013). In the present study, 2 individuals of the species were picked up from a dam in Burdur (Appendix C). The species is not frequently found in Turkey. Up to the present, it has been found in mesotrophic-eutrophic lakes, slightly flowing streams, canals, fish ponds, littoral zone of lakes, ricefields, benthic and littoral zone of rivers, temporary waters, slightly oligohaline waters and groyne fields of rivers (Scharf, 1993; Meisch, 2000; Rasouli et al., 2014; Szlauer-Łukaszewska, 2014). In addition, Mezquita et al. (1999a) pointed group it is in occur in the lower and/or eutrophic site of river at lower elevation where flow discharge high and characterized it as a warmstenothermal species. Rieradevall & Roca (1995) mentioned that high temperature increases the abundance of species found in the sites with high organic matter. During the current study, species was occurred in the water with high water temperature ($24.9 \text{ }^{\circ}\text{C}$). Similarly, close relationship of the species with water temperature was reported by Szlauer-Łukaszewska (2014) in Poland. Recently Escrivá et al. (2014), however, recorded species up to 41.8 m depth in reservoirs encountered highest oxygen saturation and lowest temperature. It was reported in Lake Geneva (Switzerland) from 13 to 33 m depth by Decrouy & Vennemann (2014). Finally, Poquet et al. (2008) summed up it in Lake Albufera (Spain) with about 3 mScm^{-1} conductivity. Because of the scarce information about the ecology of species, the ranges given below was not show the actual ranges of the species and so we believe that these ranges may be extended by the further studies. The ecological variables of the habitat where species recorded herein are as follow pH (8.45), dissolved oxygen concentration (5.77 mgL^{-1}), electrical conductivity ($491.4 \text{ } \mu\text{Scm}^{-1}$), salinity (0.24 ‰), elevation (1104 m a.s.l.), total dissolved solid (0.3204 mgL^{-1}) and air temperature ($33 \text{ }^{\circ}\text{C}$). The previously

known ranges of some variables for species was expanded with this study that are as following water temperature (15 - 25.9 °C) (Mezquita et al., 2001; Rasouli et al., 2014), electrical conductivity (254.1 – 1234 μScm^{-1}) (Külköylüoğlu, 2005b; Escrivá et al., 2014), pH (7.34 – 8.45) (Rasouli et al., 2014; the present study), dissolved oxygen concentration (5.05 – 10.8 mgL^{-1}) (Akdemir & Külköylüoğlu, 2014; Külköylüoğlu, 2003c), air temperature (17 – 33 °C) (Külköylüoğlu, 2005b; the present study), elevation (300 - 1560 m a.s.l.) (Escrivá et al., 2014; Akdemir & Külköylüoğlu, 2014), total dissolved solid (0.3204 – 186.03 mgL^{-1}) (the present study; Külköylüoğlu, 2005b) and salinity (0.1 – 0.24 ‰) (Rasouli et al., 2014; the present study).

6.2.25 *Potamocypris fulva* (Brady, 1868)

Martens et al. (2013) noticed its distribution in Palearctic region. In Turkey, *P. fulva* was recorded in a eutrophic shallow Lake Yeniçağa by Külköylüoğlu et al. (2007) for first time. In the present study, 3 adult individuals were collected from a spring in Adıyaman (Table 4.6). Habitats of species was previously recorded are as follows very shallow and slowly flowing surface waters, cave waters, interstitial habitats of streams, ditches with leaf litter and filamentous algae, small slowly flowing streams, springs, lakes, troughs, pools, creeks, streams, ricefields, sulfidic spring and rivers (McKenzie & Moroni, 1986; Meisch, 2000; Pieri et al., 2009; Külköylüoğlu et al., 2012c, 2013; Peterson et al., 2013). Szlauer-Łukaszewska & Kowaluk-Jagielska (2011) noticed its presence in waters with saprobel/hard sediment in Poland. This scarce appeared species in Turkey was characterized as a stygophilic species by Meisch (2000) who also stated that it occurs throughout the year and reported it up to 1.5 m depth. Additionally, Külköylüoğlu et al. (2013) displayed its negatively significant correlation with redox potential ($P < 0.05$) and dissolved oxygen concentration ($P < 0.01$) in Turkey. According to results of the present study, it showed high tolerance levels to elevation ($t_k = 348.9$), pH ($t_k = 5.3$), water temperature (T_w) ($t_k = 4.4$), electrical conductivity (EC) ($t_k = 154.5$) and redox potential ($t_k = 36.9$). Similarly, Akdemir & Külköylüoğlu (2014) pinpointed its high tolerance levels to elevation ($t_k = 488.62$), water temperature ($t_k = 2.29$), DO ($t_k = 1.24$) and EC ($t_k = 195.66$). As shown that, there is less information about the

ecology of species because of that it cannot be possible to make any comments about its ecological preferences. The species recorded spring herein had ecological variable values as follow pH (7.93), DO (8.02 mgL⁻¹), EC (322.6 µScm⁻¹), salinity (0.19 ‰), Tw (15.3 °C), elevation (Elev.) (1132 m a.s.l.), total dissolved solid (0.2574 mgL⁻¹) and air temperature (34.7 °C). The some of these variables show suitability with previously known ranges except total dissolved solid and air temperature as can see below. Accordingly, lowest and highest values of some variables for species are like that water temperature (1.56 – 27.40 °C) (Külköylüoğlu et al., 2007; Sarı, 2007), electrical conductivity (112.4- 574 µScm⁻¹) (Külköylüoğlu et al., 2013; Akdemir & Külköylüoğlu, 2014), pH (5.56 - 10.3) (Külköylüoğlu et al., 2012b; Külköylüoğlu et al., 2013), dissolved oxygen concentration (4.33 - 11.368 mgL⁻¹) (Sarı, 2007; Külköylüoğlu et al., 2007), air temperature (21.70 – 34.7 °C) (Sarı, 2007; the present study), elevation (345 - 2290 m a.s.l.) (Mori & Meisch, 2012; Külköylüoğlu et al., 2012b), total dissolved solid (0.2574 – 373.10 mgL⁻¹) (the present study; Akdemir & Külköylüoğlu, 2014) and salinity (0 – 0.3 ‰) (Külköylüoğlu et al., 2012b; Külköylüoğlu et al., 2013).

6.2.26 *Potamocypris pallida* Alm, 1914

It is distributed in Nearctic and Palearctic regions (Martens et al., 2013) and widely encountered throughout the faunal area (Meisch, 2000). In spite of this, there is not enough information about the ecological preferences of it. Further, *P. pallida* has been recorded in springs, ponds, streams, interstitial habitats of streams, institial ground waters, troughs, river basins, rivulets, creeks, pools and ponds (Meisch, 2000; Pieri et al., 2012; Külköylüoğlu et al., 2012a, 2012c, 2013). In the present study, it was found only in a trough in Adıyaman with 71 individuals (Table 4.6 and Appendix A). Additionally, Meisch (2000) stated that this permanent form is stygophilic and euryplastic (ability to tolerate a wide spectrum of environmental conditions) for substrate. Recently, Külköylüoğlu et al. (2013) indicated its high tolerance levels to elevation ($t_k = 560.7$), pH ($t_k = 4.9$), water temperature ($t_k = 2.7$) and electrical conductivity ($t_k = 303.7$) in troughs of Turkey. According to the information gathered from the literature, the ranges of some variables for species are as follow water temperature (11 – 24.5 °C) (Pieri et al., 2012; Yılmaz, 2014),

electrical conductivity (112.5 – 1129 μScm^{-1}) (Külköylüoğlu et al., 2012c; Yılmaz, 2014), pH (6.92 – 9.47) (Külköylüoğlu et al., 2012a; Külköylüoğlu et al., 2012c), dissolved oxygen concentration (2.7 - 11.48 mgL^{-1}) (Yılmaz, 2014; Uçak et al., 2014), air temperature (36.3 - 38.5 °C) (the present study; Uçak et al., 2014), elevation (292 - 1404 m a.s.l.) (Külköylüoğlu et al., 2013; Uçak et al., 2014), total dissolved solid (0.3133 – 378.3 mgL^{-1}) (Uçak et al., 2014; Külköylüoğlu et al., 2012c) and salinity (0 – 0.66 ‰) (Külköylüoğlu et al., 2012c; Yılmaz, 2014).

6.2.27 *Potamocypris fallax* Fox, 1967

Potamocypris fallax has been distributed in Palearctic region (Martens et al., 2013) and collected in springs and water connected to the springs, fountain troughs, pools, creeks, water ditches, ponds and streams (Meisch, 2000; Külköylüoğlu et al., 2012a, 2012c; Özuluğ, 2012; Akdemir & Külköylüoğlu, 2014). In the present study, 404 individuals were collected from 15 sites which includes springs, through, creeks and irrigation canal in Adıyaman (Table 4.6 and Appendix A) while 5 individuals were encountered in a pond in Burdur (Table 4.12 and Appendix C). This species was found as a dominant one in Adıyaman ($Y = 2.05$; Table 4.3) and in irrigation canals ($Y = 0.21$), creeks ($Y = 1.75$) and springs ($Y = 0.48$) of ADIBUR (Table 4.16). Further, it showed close relationships with elevation on CCA diagram (Figure 4.1) in Adıyaman but it did not show such close relationship with variables used in ADIBUR (Figure 4.7). Additionally, Pieri et al. (2009) collected species from waters at high elevation with low conductivity in Italy. With respect to Meisch (2000), it is a cold stenothermal species. The findings of Akdemir & Külköylüoğlu (2014) support this view. It prefers cold waters at high elevations and also tolerates high salinities with low oxygenated waters. Association of the species with cold spring waters was also pinpointed by Van der Meeren et al. (2010). In here, a negative significant correlation of *P. fallax* with water temperature ($P < 0.01$) corresponds with these of previous findings except with dissolved oxygen concentration (DO) ($P < 0.01$) (Table 4.19). Like the present study, negatively significant correlation of the species with water temperature ($P < 0.01$) was indicated by Külköylüoğlu et al. (2013). According to data of Adıyaman and ADIBUR, highest tolerance levels of the species to variables were as follow pH ($t_k = 0.21$), DO ($t_k = 0.79$), electrical conductivity

(EC) ($t_k = 78.45$) (Table 4.5) and water temperature (T_w) ($t_k = 1.72$) (Table 4.18), respectively. Previously, highest tolerance levels of species were noticed for water temperature ($t_k = 3.49$) by Akdemir & Klkylođlu (2014) and for elevation ($t_k = 391.2$), pH ($t_k = 4.2$) and EC ($t_k = 408.1$) by Klkylođlu et al. (2013). Together with the values found in here, minimum and maximum values of some variables for species are as water temperature (10.6 – 26.9 °C) (Van der Meeren et al., 2010; Akdemir & Klkylođlu, 2014), electrical conductivity (178.4 - 1074 μScm^{-1}) (the present study; Klkylođlu et al., 2013), pH (5.04 – 9.73) (Akdemir & Klkylođlu, 2014; Klkylođlu et al., 2012c), dissolved oxygen concentration (1.47 – 10.30 mgL^{-1}) (the present study; zuluđ, 2012), air temperature (24.2 – 42.3 °C) (Akdemir & Klkylođlu, 2014; the present study), elevation (605 - 1954 m a.s.l.) (Klkylođlu et al., 2012c; Akdemir & Klkylođlu, 2014), total dissolved solid (0.1339 - 1776 mgL^{-1}) (the present study; Van der Meeren et al., 2010) and salinity (0.1 – 1.10 ‰) (Klkylođlu et al., 2013; Akdemir & Klkylođlu, 2014).

6.2.28 *Potamocypris similis* G.W. Mller, 1912

Potamocypris similis shows distribution in Palearctic region (Martens et al., 2013). Up to now, it has been collected in a variety of habitats including littoral zone of lakes, gravel pits, ponds, troughs, springs, creeks, streams and rivers (Meisch, 2000; Akdemir & Klkylođlu, 2011; Klkylođlu et al., 2012a., 2013). In Adıyaman, 88 adult individuals were encountered in 3 sites (creek, trough and spring) (Table 4.6 and Appendix A) but in Burdur, only 2 individuals were collected from a trough (Table 4.12 and Appendix C). Furthermore, it was found as a dominant species in Adıyaman ($Y = 0.09$; Table 4.3) and in troughs ($Y = 0.04$; Table 4.16) in ADIBUR. The dominance of the species (Shannon Diversity index value equals to 1.01) in troughs supports the finding of Klkylođlu et al. (2013) in Turkey. Besides, this summer form (Meisch, 2000) was collected from water bodies with sandy, stony and muddy bottoms and also recorded up to a depth of 6 m. Similarly, Decrouy & Vennemann (2014) stated that it mostly occurs from spring to early summer when temperature high in Lake Geneva. We did not find significant relationships of the species with pH, electrical conductivity (EC), water temperature (T_w) and dissolved oxygen concentration (DO) in Adıyaman (Figure 4.1) but in

ADIBUR when a close relationship with Tw was clear (Figure 4.7). Additionally, *P. similis* showed a significantly negative correlation ($P < 0.05$) with DO (Table 4.19) and had tolerance levels to pH ($t_k = 0.27$), DO ($t_k = 0.95$), EC ($t_k = 83.10$), Tw ($t_k = 8.5$) and elevation (Elev.) ($t_k = 121.19$) (Table 4.18). According to Klkylođlu et al. (2012a), it showed higher tolerance levels to EC ($t_k = 185$) and pH ($t_k = 3.7$) but low to elevation ($t_k = 117.3$) and water temperature ($t_k = 0.6$). In addition, a clear correlation of species with elevation and a positively significant correlation with water temperature ($P < 0.01$) were recorded in Kahramanmarař (Klkylođlu et al., 2012a). Complete with the present study, ranges of some variables previously known for species are extended as water temperature (12.9 – 33 °C) (Ylmaz, 2014; the present study), electrical conductivity (0 - 3866 μScm^{-1}) (Klkylođlu et al., 2012a; Uçak et al., 2014), pH (6.5 – 8.84) (Klkylođlu et al., 2012a; Klkylođlu et al., 2012c), dissolved oxygen concentration (3.27 – 13.54 mgL^{-1}) (Akdemir & Klkylođlu, 2014; Ylmaz, 2014), air temperature (19.60 – 42.9 °C) (Sarı, 2007; the present study), elevation (114 - 1789 m a.s.l.) (Ylmaz, 2014; Akdemir & Klkylođlu, 2014), total dissolved solid (0 – 414.7 mgL^{-1}) (Klkylođlu et al., 2012a; Akdemir & Klkylođlu, 2014), and salinity (0 - 0.39 ‰) (Klkylođlu et al., 2012a; the present study).

6.2.29 *Potamocypris variegata* (Brady & Norman, 1889)

Although Martens et al. (2013) stated its distribution in Nearctic and Palearctic regions, Karanovic (2012) noticed presence of it in all geographical regions except Australasian region. According to Meisch (2000), it prefers stagnant and slowly flowing waters with dense vegetation and has two generation per year. Additionally, it was previously reported in ponds, gravel pits, rivers, littoral zone of lakes, occasionally in interstitial habitats, troughs, canals, creeks, streams, reservoirs, oligotrophic, mesotrophic and eutrophic freshwaters (Meisch, 2000; Altnsaçlı, 2004; Hussein et al., 2004; Akdemir & Klkylođlu, 2011; Escriv et al., 2014; Rasouli et al., 2014). In addition, Mezquita et al. (1999a) collected the species in waters with gravel, silt and pebbles bottom and characterized it with stygophilic behavior. Totally 196 individuals were collected in the present study. Of which, 12 are from one site (pond) (Table 4.6) and 184 are from 5 sites (troughs, dam and creek) (Table 4.12) in

Adıyaman and Burdur, respectively. Also, it was found as a dominant species in Burdur ($Y = 0.26$; Table 4.9), dams ($Y = 0.03$) and troughs ($Y = 0.19$) (Table 4.16). These results support its preference for stagnant and slowly flowing waters. However, Mezquita et al. (1999a) pointed the presence of the speices in waters with high flow discharge at low elevation and in chloride and organic enriched warm waters. According to these, *P. variegata* can be indicator of poor water quality. Similarly, Meisch (2000) stated that it occurs in waters enhanced with chloride concentration ($18.8 - 23.2 \text{ mgL}^{-1}$). With reference to ADIBUR, *P. variegata* showed a close relationship with water temperature on CCA diagram (Figure 4.7) but it did not show any close relationships in Burdur (Figure 4.4). However, Külköylüoğlu & Dügel (2004) indicated its close relationships with pH and water temperature, underlining its preference for warm waters. All these information support the previous statement of Nüchterlein (1969) that was a warm stenothermal species. Besides, Hussein et al. (2004) also found its negative correlation with conductivity in canals in Qena Governorate (Upper Egypt). During the present study, highest tolerance levels of the species were found in both provinces (Table 4.18) when it compared with the results only in Burdur (Table 4.11). Thus, high tolerance levels of the species are as follow for pH ($t_k = 0.28$), dissolved oxygen concentration (DO) ($t_k = 3.33$), electrical conductivity (EC) ($t_k = 28.09$), water temperature (T_w) ($t_k = 1.84$) and elevation (Elev.) ($t_k = 119.22$). In addition to these, sensitivity of the species to lack of oxygen was pronounced by Creuzé des Châtelliers & Marmonier (1993) who collected species from 50 cm depth water with 0.9 mgL^{-1} DO concentration. On the other hand, Delorme (1991) stated that presence of the species in a water body may describe at least 3 mgL^{-1} dissolved oxygen concentration. Further, Escrivá et al. (2014) collected the species from up to 24.5 m depth. Finally, if we accept the current statement of Karanovic (2012) as *P. variegata* is distributed in all geographical areas except Australasian, *P. variegata* can be showed as a cosmopolitan species. The ecological variables we recorded in Adıyaman and Burdur show confirmity with the values given in previous studies, except air temperature. Hence, lowest and highest values of some variables for species are like that water temperature ($9.9 - 29 \text{ }^{\circ}\text{C}$) (Külköylüoğlu & Dügel, 2004; Özuluğ, 2011), electrical conductivity ($137.4 - 4085 \text{ } \mu\text{Scm}^{-1}$) (Uçak et al., 2014; Mezquita et al., 2001), pH ($6.5 - 9.15$) (Özuluğ, 2012; Uçak et al., 2014), dissolved oxygen concentration ($0.9 - 14 \text{ mgL}^{-1}$) (Creuzé des Châtelliers & Marmonier, 1993; Delorme, 1991), air

temperature (12.5 – 35.7 °C) (Külköylüoğlu & Dügel, 2004; the present study), elevation (110- 1684 m a.s.l.) (Rasouli et al., 2014; Külköylüoğlu et al., 2013), total dissolved solid (0.0890 - 418 mgL⁻¹) (Uçak et al., 2014; Külköylüoğlu et al., 2013) and salinity (0.06 – 0.36 (1)) ‰ (Uçak et al., 2014; Rasouli et al., 2014 (Altınsaçlı, 2014; Yılmaz, 2014)).

6.2.30 *Potamocypris smaragdina* (Vávra, 1891)

Like *P. variegata*, Karanovic (2012) shows its distribution in all geographical areas except Australasian while Martens et al. (2013) includes its distribution in Nearctic, Neotropical and Palearctic regions. In the present study, 2 individuals of the species were encountered in a creek (site 82; see Appendix A) in Adıyaman. Meanwhile, *P. smaragdina* has been reported in littoral zone of lakes, ponds, slowly flowing streams, creeks, dams, streams, troughs, lakes, springs, pools and ricefields (McKenzie & Moroni, 1986; Meisch, 2000; Cusminsky et al., 2005; Van der Meeren et al., 2010; Külköylüoğlu et al., 2012a; Rasouli et al., 2014). Furthermore, Cusminsky et al. (2005) encountered it in water bodies with sandy organic, sandy, silty and algae bottom. Additionally, Meisch (2000) called it as a summer form and probably produce 2 or 3 generations per year. Similarly, this species was collected in summer and early autumn in groyne fields of Oder river (Poland) by Szlauer-Łukaszewska (2014). Additionally, Meisch (2000) indicated its tolerance to slightly saline conditions while, Mercau et al. (2012) recorded it in waters with relatively low salinities and total dissolved solid (below 500 mgL⁻¹) values in Na-Ca-Mg and bicarbonate dominated waters. Therefore, it was characterized as a stenohaline species. In addition, Allen & Dodson (2011) stated that presence of the species indicates high levels of oxygen and low spring pelagic productivity in lakes. Accordingly, Rossetti et al. (2004) pinpointed its preference for well oxygenated waters and encountered it in relatively large and deep pond with sandy bottom. The authors also showed strong relationships of the species with high pH. Meanwhile, presence of the species in deeper benthos (> 40 m depth) was also noticed by Ruiz et al. (2013). Most recently, Decrouy & Vennemann (2014) collected species from spring to early summer in Lake Geneva when the temperatures were high. The value of variables recorded from the species collected creek show similarity with values of

variables and statements proposed by literature. Like *P. variegata*, we may suggest this species as a cosmopolitan due to the presence of it in all geographical areas except Australasian (Karanovic, 2012). The ranges of some variables gathered from literatures for species are like following water temperature (5 – 27.8 °C) (Delorme, 1991; Külköylüoğlu et al., 2012a), electrical conductivity (92 – 850 μScm^{-1}) (Rasouli et al., 2014; Mischke et al., 2014), pH (6.29 – 9.6) (Külköylüoğlu et al., 2012a; Van der Meeren et al., 2010), dissolved oxygen concentration (1 – 15 mgL^{-1}) (Delorme, 1991), air temperature (19.60 – 36.7 °C) (Sarı, 2007; the present study), elevation (229 – 1075 m a.s.l.) (Allen & Dodson, 2011; Sarı, 2007), total dissolved solid (0.2717 – 341.9 mgL^{-1}) (Yılmaz, 2014; Sarı, 2007) and salinity (0.1 – 14.5 ‰) (Külköylüoğlu et al., 2012a, De Deckker, 1981).

6.2.31 *Potamocypris arcuata* (Sars, 1903)

It is distributed in Palearctic region (Martens et al., 2013). There is not enough information about its ecology. In the present study, we collected 7 individuals from a pool in Burdur with the following physico-chemical variables as pH (8.29), dissolved oxygen concentration (DO) (8.4 mgL^{-1}), electrical conductivity (EC) (365.3 μScm^{-1}), salinity (0.2 ‰), water temperature (T_w) (19.6 °C), elevation (Elev.) (1341 m a.s.l.), total dissolved solid (0.2646 mgL^{-1}) and air temperature (T_a) (30.1 °C). Meisch (2000) stated that it is probably a summer and pure freshwater species. Until now, it has been found in sunny ponds, ditches, temporary waters, lakes, troughs, mesotrophic freshwaters, creeks, pools, ricefields and brooks (McKenzie & Moroni, 1986; Meisch, 2000; Mezquita et al., 2001; Altınsaçlı, 2004; Pieri et al., 2009; Van der Meeren et al., 2010; Akdemir & Külköylüoğlu, 2011; Uçak et al., 2014). Furthermore, Pieri et al. (2006) collected species in calcareous temporary pond, marly temporary pond, carbonatic rock pool and carbonatic settling pond. More recently, it was reported in a dam up to 15.3 m depth by Escrivá et al. (2014). It is evident that the ecological information about species is scarce and doing comments about its ecology is limited. The values of variables herein correspond to the previous reports. Thus, the ranges of some variables for the species are as follow water temperature (13 - 28 °C) (Mezquita et al., 2001; Uçak et al., 2014), electrical conductivity (163 – 1279 μScm^{-1}) (Mezquita et al., 1999c; Mezquita et al., 2001), pH

(6.32 – 9.95) (Pieri et al., 2006), dissolved oxygen concentration (7.11 - 12 mgL⁻¹) (Uçak et al., 2014; Mezquita et al., 2001), air temperature (27.2 – 39.5 °C) (Uçak et al., 2014), elevation (5 - 2018 m a.s.l.) (Pieri et al., 2006; Van der Meeren et al., 2010), total dissolved solid (0.1313 - 1631 mgL⁻¹) (Uçak et al., 2014; Van der Meeren et al., 2010) and salinity (0.1 - 0.5 ‰) (Uçak et al., 2014).

6.2.32 *Zonocypris costata* (Vávra, 1897)

Species shows distribution in Afrotropical and Palearctic regions (Martens et al., 2013). Besides, recent forms of *Zonocypris* restricted to Africa, Madagascar and Eastern Mediterranean (including Turkey) (Cabral et al., 2004). Because of its scarce occurrences, there is no more information about the ecology and biology of species. Nevertheless, Cohen et al. (1983) stated that species indicates an average of Ca⁺² (11.9 mgL⁻¹), CI (10.1 mgL⁻¹) and alkalinity (2 meq.L⁻¹). According to Hare & Carter (1987), the species collected in Opi lake (Nigeria) from 2.5 – 4 m of depth with water conductivity (15 - 24 µScm⁻¹), pH (6 -6.5), transparency (0.6 – 1.7 m) and bottom temperature (24 – 29 °C). Additionally the most valves of species were found above the 112 cm core samples taken from Empakaai or Embagai Crater in Northern Tanzania at about 2100 – 2800 m a.s.l. by Ryner et al. (2007). In the present study, 29 individuals were encountered in a spring in Adıyaman. In *situ*, the instant measurements of this spring are like that pH (7.53), dissolved oxygen concentration (6.48 mgL⁻¹), electrical conductivity (565 µScm⁻¹), salinity (0.34 ‰), water temperature (15.6 °C), elevation (991 m a.s.l.), total dissolved solid (0.4485 mgL⁻¹) and air temperature (40.5 °C).

6.2.33 *Limnocythere inopinata* (Baird, 1843)

It shows distribution in Afrotropical, Nearctic and Palearctic regions (Martens et al., 2013) but Van der Meeren et al. (2011) stated that it is a eurytopic Holarctic ostracod. Also, Meisch (2000) pinpointed that it is a permanent form and tolerates a wide range of environmental variables. So far, *L. inopinata* has been collected in ponds, swamps, ditches, slowly flowing brooks and rivers, ricefields, interstitial

habitats, slightly salty inland and coastal waters, slightly brackish waters, reservoirs, streams, lakes, springs, interstitial habitats, creeks, water falls, sulfidic springs, phreatic pools with H₂S waters, oligotrophic, mesotrophic and eutrophic freshwaters (Creuzé des Châtelliers & Marmonier, 1993; Malmqvist et al., 1997; Meisch, 2000; Altınsaçlı, 2004; Karan-Žnidaršič & Petrov, 2007; Van der Meeren et al., 2010; Külköylüoğlu et al., 2012b; Peterson et al., 2013; Mischke et al., 2014). Most recently, Yılmaz (2014) recorded species in a trough in Karabük that it was the first time in the literature. In the current study, 17 individuals of species from 2 sites (irrigation canal and dam) (Table 4.6) and 41 individuals from 8 sites (dams and lakes) (Table 4.12) were picked up in Adıyaman and Burdur, respectively. It was also found as a dominant species in Burdur ($Y = 0.09$; Table 4.9) and in all of habitats species recorded in there (see Table 4.16). The presence of the species as a dominant one in irrigation canals may be due to the type of canals that can be used to move waters from reservoirs to farms by villager for irrigation purposes. Therefore, the fauna in this water bodies comes from the connected reservoirs (stagnant). This is because *Limnocythere inopinata* was showed as an indicative of lake and ponds (Van der Meeren et al., 2010). In contrast, Mischke et al. (2003) encountered abundantly of the valves of it in running waters. Additionally, the role of substratum particle size was revealed by Benzie (1989) that it preferred sandy but strongly preferred faecal pellet (in laboratory) and coarser particle sizes. Recently, Scharf & Brunke (2013) found a positive association between the species and middle sand where abundantly collected in hyporheal zone of Elbe river with gravel of subaqueous dunes. Further, it was recorded in water bodies with muddy, sandy, fine-grained sediment, pebbles and substrate lacking aquatic vegetation bottoms (Mezquita et al., 1999a; Meisch, 2000; Van der Meeren et al. 2011; Ruiz et al., 2013). Indeed, due to the CCA diagrams constructed based on data of Burdur (Figure 4.4) and ADIBUR (Figure 4.7), *L. inopinata* did not show any close relationships with variables used in here. However, in some previous studies its occurrence was related to high oxygen and pH (Iglikowska and Namiotko, 2012), nitrate content (Mezquita et al., 2001), saline lake waters and calcium content (Van der Meeren et al., 2010). Most recently, Escrivá et al. (2014) stated that its occurrence related to more eutrophic conditions and recorded species up to 76.3 m in reservoirs of the Eastern Iberian Peninsula. With regard to Külköylüoğlu et al. (2014), but, it was not founded below 9 m depth in Lake Çubuk (Turkey). Besides, it was negatively correlated ($P < 0.05$) with pH (Table 4.19) and

negative correlation of the species with dissolved oxygen concentration (Hussein et al., 2004), elevation ($P < 0.05$) (Külköylüoğlu et al., 2012b) and electrical conductivity ($P < 0.01$) (Külköylüoğlu et al., 2014) were previously proposed. Estimated tolerance levels of species to different variables in Burdur (Table 4.11) are higher than the tolerances estimated from the data of ADIBUR (Table 4.18) in the present study. Accordingly, the high tolerance levels of species are as follow for pH ($t_k = 0.44$), dissolved oxygen concentration (DO) ($t_k = 2.16$), electrical conductivity (EC) ($t_k = 4492.43$) and water temperature (Tw) ($t_k = 2.13$). The high tolerance levels of the species to EC supports the findings of some previous studies. Of which, Mischke et al. (2012) found the species in a wide range of specific EC (5.6 – 57.5 mScm⁻¹) and Mischke et al. (2014) also showed the broad tolerance of the species for specific EC and pinpointed its tolerance to specific EC fluctuations. Moreover, Mischke & Zhan (2010) estimated the specific electrical conductivity tolerance levels of the species as 0.6 to 9 mScm⁻¹. Supporting to all of these wide tolerance values of the species to EC, Van der Meeren et al. (2011) collected species in waters had 262 – 32276 µScm⁻¹ specific EC ranges. Further, Külköylüoğlu et al. (2010) revealed high environmental tolerance index value of it for pH (0.8). Accordingly, Löffler (1959) sated that it tolerates chloride concentration of up to 2160 mgL⁻¹ and encountered species in waters with high alkalinity. After that, Zenkevitch (1963) recorded species between 11.2 and 40 ‰ salinity ranges in Azov Sea. In addition, Meisch (2000) underlined it occurrence in strongly alkaline waters where tolerates chloride concentration up to 2160 mgL⁻¹. Li et al. (2010) also implied surviving of the species in lakes with salinities (46 gL⁻¹) and low calcium concentrations. In this previous study, subfossil of the species was also recorded at pH (6.2 – 9.2) and salinity (0.54 – 26.88 gL⁻¹) ranges and the authors claimed that presence of species indicates the sodium chloride rich alkaline lake environments. In Turkey, species was reported from Lake Van with high salinity (16.9 ‰) and high pH (10.2) by Külköylüoğlu et al. (2012b). All of these above given informations show that *L. inopinata* has wide tolerance to different environmental variables and so it can easily adapt to unfavourable contidions. Thus, the statement of Yılmaz & Külköylüoğlu (2006) for the species indicates low water quality was supported. Finally, all these suggest that *L. inopinata* is a well known cosmopolitan (Külköylüoğlu & Dügel, 2004) and a cosmoecious species (Külköylüoğlu et al., 2014). With the variables values in the present study and the values gathered from the literaure, the ranges of

some variables for species are as follow water temperature (4.75 – 35 °C) (Külköylüoğlu et al., 2014; Karan-Žnidarič & Petrov, 2007), electrical conductivity (28.2 – 24265 μScm^{-1}) (Külköylüoğlu et al., 2012b; the present study), pH (6.4 – 10.4) (Ruiz et al., 2013; Van der Meeren et al. 2011), dissolved oxygen concentration (2.91 – 13.26 mgL^{-1}) (Akdemir & Külköylüoğlu, 2014; Yılmaz & Külköylüoğlu, 2006), air temperature (4.10 – 34 °C) Külköylüoğlu et al., 2014; Özuluğ, 2011), elevation (5 – 2376 (4570) m a.s.l.) (Altınışlı, 2004; Van der Meeren et al., 2010 (Guo et al., 2013)), total dissolved solid (0.2152 – 23973 mgL^{-1}) (the present study; Van der Meeren et al., 2010) and salinity (0 – 25 ‰) (Ruiz et al., 2013).

6.2.34 *Gomphocythere besni* n. sp.

For detailed information about the description and ecology of species, see section 5, page 55.

7. SUMMARY AND SUGGESTIONS

Total of 41 ostracod taxa were reported from Adıyaman. All these taxa are new reports for the region. Of which, *S. insueta* and *G. besni* n. sp. are firstly reported for Turkey when *G. besni* n. sp. is a new species in literature (Külköylüoğlu et al., 2015). In contrast, 35 ostracod taxa were encountered in Burdur. 21 of them are new records for the region. Now, the number of taxa in Burdur increases up to 45.

In both provinces, generally species having high diversity indices were cosmopolitans. It indicates that the occurrence of cosmopolitans is not significantly affected by different types of habitats, water conditions in different geographical areas. In other words, they seem to be suppress the occurrence of non-cosmopolitans by having such characters. Accordingly, dominant species were generally cosmopolitans when they have higher abundance values than non-cosmopolitans in the present study. On the other hand, they show aggregation characteristics in their present habitats.

It is clearly seen that there is no any habitat preferences of cosmopolitans and so they were found every where. This is because they have wide tolerance ranges and they are not affected by ecological variables. These can be seen in the present study as cosmopolitan species especially located relatively closer to the center of CCA diagrams where they do not show close relationships with the variables used in here. As a result, frequent occurrences of them in aquatic bodies may be related the quality of these habitats, usually showing tendency for decrease. These conditions should be carefully monitored and should be taken under consideration for the protection of biodiversity.

During this study, the diversity of ponds, springs and creeks were found higher among all habitats. In spite of some of these habitats are under the human impact, they may be showed as source habitats for ostracods. It should be tested in future.

The presence of a linear relationship between air temperature and temperature of waters bodies with < 1 m depth cannot be generalized at the moment. If these relationships can be conducted, we can easily estimate the effect of global warming on the biodiversity in aquatic bodies. Unfortunately we did not have a solid and clear result on this issue.

Hypothesis Testing

Hypothesis 1: “Ostracod species are randomly distributed among sampling sites” was accepted in Adiyaman but it was not accepted in Burdur and ADIBUR. Therefore, the clump and regular distribution of ostracod species among sampling sites were accepted for Burdur and ADIBUR, respectively. The sampling of natural habitats (for non-cosmopolitans), frequent presence of cosmopolitans and dispersal ability of ostracods may contribute to and be used as a way of explain the happennig of these type of spatial patterns.

Hypothesis 2: “Based on the similar field size studied, the mean number of ostracod species in both provinces is similar”. This hypothesis is not accepted. Because Adiyaman (7164 km²) and Burdur (6887 km²) have surface areas relatively close to each other but reported number of living species (26 and 22, respectively) is different to each other. The results of some other previous studies suggested that the area of a region was not significantly important on the number of available taxa or species (see section discussion and conclusion). The quality and availability of suitable habitats are more important than the surface area for the occurrence of taxa or species.

Hypothesis 3: Although the occurrence of elevation among the effective variables on species distribution, Hypothesis 3 “The distribution of ostracod species are not affected by regional and/or spatial factors (e.g., elevation, habitat types)” was partially accepted since it seems that local factors (e.g., pH, dissolved oxygen concentration, water temperature) are more effective than the regional factors. However, it may be described as regional factors indirectly affect the species. As seen in the present study, the most effective factors on the distribution of ostracods are water temperature and pH.

Finally, the ecological information of each species in the present study is very important for using them as bioindicator and for paleoenvironmental reconstruction studies.

In future, types of source and sink habitats, relationships between air and water temperatures, distributional patterns and ecological characterization of individual species with correct taxonomic identification, behavior of species in different aquatic bodies, the relationships between ostracod species and water quality, biomarker potential of ostracods and studies include the physiological properties of these small organisms should be considered.

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APPENDICES

8. APPENDICES

Appendix A Ecological variables and taxa were reported from different aquatic bodies in Adıyaman. Abbreviations: St. no: site number, St. Ty.: site type, DO (dissolved oxygen concentration, mgL^{-1}), % DO (percent saturation), EC (electrical conductivity, μScm^{-1}), Sp. EC (specific electrical conductivity), Sal (salinity, ppt), Tw (water temperature, $^{\circ}\text{C}$), Ta (air temperature, $^{\circ}\text{C}$), TDS (total dissolved solid, mgL^{-1}), Atm. (atmospheric pressure, mmHg), Moist. (Moisture, %), Elev. (Elevation, m a.s.l), W. s. (wind speed, kmh^{-1}), Ca: *Candona angulata*, Cn: *C. neglecta*, Csp: *Candona* sp., Cvs: *Cavernocypris* sp., Cysp: *Cypridopsis* sp., Ds: *Darwinula stvensoni*, Dsp: *Dolerocypris* sp., Esp: *Eucypris* sp., Fb: *Fabaeformiscandona brevicornis*, Gb: *Gomphocythere besni* n. sp., Hb: *Herpetocypris brevicaudata*, Hc: *H. chevreuxi*, Hh: *H. helenae*, Hin: *H. intermedia*, Hts: *Herpetocypris* sp., Hi: *Heterocypris incongruens*, Hsp: *Heterocypris* sp., Ib: *Ilyocypris bradyi*, Ig: *I. gibba*, Ii: *I. inermis*, Isp: *Ilyocypris* sp., Li: *Limnocythere inopinata*, Ms: *Mixtacandona* sp., Pf: *Potamocypris fallax*, Pfu: *P. fulva*, Pp: *P. pallida*, Ps: *P. similis*, Psm: *P. smaragdina*, Pv: *P. variegata*, Pos: *Potamocypris* sp., Pzi: *Prionocypris zenkeri*, Pa: *Pseudocandona albicans*, Pse: *P. semicognita*, Psp: *Pseudocandona* sp., Po: *Psychrodromus olivaceus*, Pysp: *Psychrodromus* sp., Si: *Schellencandona insueta*, Ts: *Tonnacypris* sp., Tc: *Trajancypris clavata*, Tsp: *Trajancypris* sp., Zc: *Zonocypris costata*. The sub-recent form of taxa are shown in parenthesis. Site types; 1: spring, 2: lake, 3: dam, 4: pond (or pool), 5: creek, 6: stream, 7: water fall, 8: irrigation channel and 9: trough.

Appendix A (continued)

St. no	City	St. Ty	pH	DO	%DO	EC	Sp. EC	Sal	Tw	Ta	TDS	Atm.	Moist.	W. s.	Elev.	Coordinate	Date	Taxa
1	Adiyaman	4	7.52	7.97	84	512	591	0.29	18	34.3	0.3835	686.4	30.7	3.8	850	N37°34'422", E037°28'431"	7/16/2012	Ca; Hin; Hi; Ii; (Pzi; Pysp)
2	Adiyaman	1	7.5	6.3	63	454	560	0.27	15.1	31.4	0.3601	680.8	25.8	4.2	886	N37°36'919", E037°29'085"	7/16/2012	Hi; Ib
3	Adiyaman	5	7.94	5.61	61	549	620	0.3	19.1	32.3	0.403	682.5	24.2	3.2	859	N37°37'443", E037°30'217"	7/16/2012	Ib; (Csp; Pzi; Pysp)
4	Adiyaman	4	7.57	2.64	29.6	499	561.3	0.27	19.1	32.6	0.3646	678.2	30	32.5	915	N37°39'221", E037°30'517"	7/16/2012	Hin; (Csp; Isp)
5	Adiyaman	1	7.6	6.06	63.7	471.4	550	0.27	17.6	32.8	0.3575	676.9	24.5	7.8	937	N37°39'803", E037°30'811"	7/16/2012	Ib; (Csp; Hsp; Ms)
6	Adiyaman	4	7.4	5.64	59.3	583	667	0.33	18.4	35.7	0.4355	677	25.2	4	928	N37°39'239", E037°30'878"	7/16/2012	
7	Adiyaman	1	7.29	3.97	39.9	545	672	0.33	15.1	37.9	0.4355	677	23	1.7	933	N37°39'229", E037°30'896"	7/16/2012	Ii; Si
8	Adiyaman	4	8.3	6.74	73.9	595	656	0.32	20.5	33.4	0.4225	672.5	23	10.2	981	N37°41'180", E037°31'865"	7/16/2012	Hi; (Cysp; Isp; Tsp)
9	Adiyaman	8	8	6.51	78.4	667	676	0.33	24.3	37.7	0.443	673.3	21.3	1.9	987	N37°40'908", E037°31'502"	7/16/2012	Hi; Ib; (Hts)
10	Adiyaman	1	7.53	6.48	64.5	565	689	0.34	15.6	40.5	0.4485	673.6	21.8	1.6	991	N37°40'906", E037°31'775"	7/16/2012	Cn; Po; Zc; (Hts; Hsp; Isp)
11	Adiyaman	4	7.92	4.43	49.6	446	479.9	0.23	21.4	39.5	0.312	667.2	13.4	6.5	1050	N37°38'915", E037°35'497"	7/16/2012	(Hsp; Isp)
12	Adiyaman	4	9.17	12.24	141.7	308.4	315.2	0.15	24.2	38	0.2047	665.4	15	10.2	1080	N37°39'363", E037°35'714"	7/16/2012	(Hsp; Isp)
13	Adiyaman	1	8.09	6.1	66.1	450.4	501.7	0.24	19.7	37.4	0.3256	666.3	13.8	6.6	1069	N37°39'431", E037°35'868"	7/16/2012	(Esp; Isp; Pysp)
14	Adiyaman	1	7.51	5.65	60.3	534	608	0.3	18.6	37.3	0.3965	670.1	16.3	2.3	1016	N37°39'474", E037°33'528"	7/16/2012	(Isp)
15	Adiyaman	9	7.84	7.15	70.07	492	607.3	0.3	15.2	36.5	0.3946	669.1	15.3	14.2	1023	N37°39'603", E037°33'447"	7/16/2012	Po; (Isp)

Appendix A (continued)

St. no	City	St. Ty	pH	DO	%DO	EC	Sp. EC	Sal	Tw	Ta	TDS	Atm.	Moist.	W. s.	Elev.	Coordinate	Date	Taxa
16	Adiyaman	4	8.71	5.4	67.1	484.1	469	0.22	26.6	37	0.3848	668.3	14	11	1030	N37°40'735", E037°32'414"	7/16/2012	
17	Adiyaman	4	8.63	9	122	1241	1090	0.53	32.3	39	0.7085	668.7	14.7	0	1029	N37°40'818", E037°32'465"	7/16/2012	(Hsp)
18	Adiyaman	8	8.63	7.52	95.9	389.3	382.6	0.18	25.9	41.5	0.2489	680.2	19.7	5.2	883	N37°44'607", E037°33'228"	7/16/2012	(Csp; Hsp; Isp)
19	Adiyaman	2	8.5	7.41	89.6	327.3	324.5	0.15	25.4	38.2	0.2112	679.5	13.5	4	885	N37°47'885", E037°39'691"	7/16/2012	(Esp; Isp)
20	Adiyaman	2	8.63	9.02	110.9	322.3	318	0.15	25.6	39.3	0.2067	679.5	14.9	4.4	888	N37°47'903", E037°39'658"	7/16/2012	(Csp; Isp; Pysp)
21	Adiyaman	1	8.12	6.59	70.3	537	603	0.29	19.4	39.9	0.39	664.5	13.5	1.8	1070	N37°45'028", E037°42'229"	7/16/2012	Cn; Hi; Li
22	Adiyaman	5	7.95	6.8	91.3	584	549	0.26	28.3	37.9	0.3575	683.7	13.9	2	849	N37°45'230", E037°44'987"	7/16/2012	(Csp; Isp; Psp)
23	Adiyaman	8	8.09	7.38	90	560	557	0.27	25.3	39.4	0.364	689.7	13.4	6.8	749	N37°45'203", E037°49'380"	7/16/2012	Hi; Ib; Li; (Csp; Psp)
24	Adiyaman	9	8.1	7.4	90.2	419.2	416.1	0.2	25.5	42	0.2704	687.1	12	11.4	780	N37°45'169", E037°50'127"	7/16/2012	Hi
25	Adiyaman	1	8.19	7.27	80.2	410.7	453.5	0.22	20.1	42	0.2944	696.8	15.4	4.5	625	N37°47'000", E037°50'867"	7/16/2012	Hin; Ib; (Hsp; Pysp)
26	Adiyaman	1	7.82	4.13	46.8	638	680	0.33	21.8	39.4	0.442	691.9	18.5	2.3	681	N37°46'706", E037°52'487"	7/16/2012	Hi; Li; Po
27	Adiyaman	1	7.9	7.01	73.2	382.5	445.2	0.21	17.7	39.5	0.2906	681.2	13.1	2	837	N37°46'694", E037°52'480"	7/16/2012	Hin; Li; Po; (Hsp)
28	Adiyaman	4	8.25	5.28	62	440.5	451.2	0.22	23.7	40.3	0.2931	681.4	12.6	7.5	843	N37°47'233", E037°52'779"	7/16/2012	(Esp; Isp; Pysp)
29	Adiyaman	1	8.01	8.35	84	211.6	256.7	0.12	15.8	37.2	0.167	666.4	15.4	0	1028	N37°47'854", E037°53'669"	7/16/2012	Ib; Pf; Po
30	Adiyaman	1	7.53	5.16	50.7	413.8	515.1	0.25	14.7	36.3	0.3347	666.5	21.9	0	1040	N37°47'854", E037°53'671"	7/16/2012	Po; (Csp; Esp; Isp)

Appendix A (continued)

St. no	City	St. Ty	pH	DO	%DO	EC	Sp. EC	Sal	Tw	Ta	TDS	Atm.	Moist.	W. s.	Elev.	Coordinate	Date	Taxa
31	Adiyaman	4	7.81	6.1	63.1	460.8	542.1	0.26	17.1	36	0.3542	696.5	14	0	680	N37°46'408", E037°57'350"	7/16/2012	Ii; Po; (Hsp)
32	Adiyaman	8	8.04	4.96	58.9	495.8	512	0.25	23.3	35.1	0.3321	701.5	24.9	1.6	615	N37°46'316", E037°58'134"	7/16/2012	Hb; Hi; (Csp; Isp)
33	Adiyaman	1	7.31	7.3	78.2	359.2	418.2	0.2	17.6	36.3	0.2717	696.1	38	0	678	N37°47'950", E038°17'906"	7/17/2012	
34	Adiyaman	1	7.42	7.93	82.9	338.1	396.1	0.19	17.4	36.6	0.2574	696.1	28.7	0	573	N37°48'018", E038°17'873"	7/17/2012	Po; (Isp; Psp)
35	Adiyaman	6	8.16	8.84	89.7	314.2	380	0.18	15.9	36.5	0.247	699.8	34.1	0	629	N37°48'097", E038°18'304"	7/17/2012	Hi; (Csp; Isp; Psp; Pysp)
36	Adiyaman	1	7.6	6.84	71.8	339.9	392.8	0.19	18	35.4	0.2554	691.8	21.5	1.5	730	N37°48'557", E038°19'953"	7/17/2012	Ib; (Hts; Hsp; Pysp)
37	Adiyaman	9	7.77	6.4	76.6	371.4	394.2	0.19	22	35.4	0.2561	692.8	22	3.2	716	N37°48'381", E038°19'992"	7/17/2012	(Hts; Hsp; Isp)
38	Adiyaman	5	7.56	7.63	81.3	476.5	542.3	0.26	18.6	36.4	0.3523	691.7	23	0	728	N37°48'654", E038°20'926"	7/17/2012	Hc; Hi; Ii; Ps; Po; (Csp)
39	Adiyaman	9	7.56	7.44	74.3	431.7	526.5	0.26	15.6	36.3	0.3425	678	22.1	0	915	N37°51'224", E038°18'678"	7/17/2012	Hin; Hi; Pp
40	Adiyaman	9	7.56	1.47	15.7	523	591	0.29	19	38.4	0.3835	673.7	20.1	2.7	970	N37°51'600", E038°18'882"	7/17/2012	Pf; (Hsp)
41	Adiyaman	1	8.8	7.74	78	362.4	439.6	0.21	15.8	39.6	0.2854	672.5	17.8	4.3	985	N37°51'604", E038°18'951"	7/17/2012	Pos; (Hts; Isp)
42	Adiyaman	1	7.77	8.27	82.7	325.4	399.5	0.19	15.3	41.2	0.26	670.7	17	0	1004	N37°51'669", E038°18'893"	7/17/2012	Hin; Hi; Pos; (Csp)
43	Adiyaman	5	8.48	7.61	84	477.8	526	0.25	20.2	38.8	0.3419	682.2	22	1.7	854	N37°51'801", E038°17'596"	7/17/2012	Hi; Pf; (Isp; Psp)
44	Adiyaman	4	8.68	9.86	129	343.4	315.3	0.15	29.7	36.7	0.2047	674	16.4	5.1	850	N37°52'817", E038°17'395"	7/17/2012	Hc; (Esp; Hsp; Isp; Psp)

Appendix A (continued)

St. no	City	St. Ty	pH	DO	%DO	EC	Sp. EC	Sal	Tw	Ta	TDS	Atm.	Moist.	W. s.	Elev.	Coordinate	Date	Taxa
45	Adiyaman	1	8.6	8.49	86.7	124.7	150.5	0.07	16.2	34.3	0.1203	652.2	16.7	12.3	1253	N37°54'334", E038°17'102"	7/17/2012	
46	Adiyaman	1	8.04	6.21	73.2	658	677	0.33	23.5	39.5	0.442	665.4	15.6	0	1089	N37°55'598", E038°15'676"	7/17/2012	(Hsp; Isp)
47	Adiyaman	9	8.45	8.32	86	277.1	329.9	0.16	16.2	35.2	0.2145	664.7	15.4	12	1083	N37°55'722", E038°15'585"	7/17/2012	Hi
48	Adiyaman	5	8.22	8.55	91.6	388.2	442.4	0.21	18.6	38.4	0.2873	664.8	15	2.3	1074	N37°56'409", E038°15'826"	7/17/2012	Ib; Ks; (Hsp)
49	Adiyaman	1	8.4	8.56	84.1	237.5	358.6	0.17	14.6	36.2	0.2334	657.5	14.5	3.5	1172	N37°58'163", E038°17'896"	7/17/2012	Pos
50	Adiyaman	1	8.52	8.53	87.5	210.6	25.9	0.12	16.6	38.2	0.1631	660	20	6.8	1145	N37°54'022", E038°16'929"	7/17/2012	Pf; (Cvs; Hsp; Isp; Pysp)
51	Adiyaman	6	8.54	7.77	82.4	264.7	300.7	0.14	18.7	37.4	0.1957	661.2	16.1	2	1126	N37°59'023", E038°16'934"	7/17/2012	Pos; (Hts; Hsp; Isp)
52	Adiyaman	1	8.04	9.53	86.6	119.3	163.9	0.08	10.7	35.9	0.1073	653.5	16	3.5	1213	N37°59'038", E038°15'535"	7/17/2012	(Isp)
53	Adiyaman	8	8.35	7.99	96.3	407.3	409.9	0.2	24.8	34.8	0.2665	646.7	14.8	12.5	1308	N38°00'958", E038°12'854"	7/17/2012	(Hsp; Isp; Pos)
54	Adiyaman	5	8.78	10.64	149.7	435.8	372.5	0.17	33.9	36	0.2424	647.9	21	4.3	1295	N38°01'436", E038°12'972"	7/17/2012	Hi
55	Adiyaman	1	8.26	10.27	93.2	188.3	255.4	0.12	11.2	37.3	0.1658	648	9.9	3.2	1302	N38°01'629", E038°10'858"	7/17/2012	Po
56	Adiyaman	4	8.16	9.16	92.4	216.4	261	0.12	16.1	34.4	0.1697	647.9	10	3.5	1304	N38°01'654", E038°10'889"	7/17/2012	Hi; (Isp)
57	Adiyaman	5	7.96	6.4	73.9	357.9	377.2	0.18	22.4	34.6	0.2444	642.4	15.6	3.2	1383	N38°02'017", E038°15'134"	7/17/2012	Hi; Ib; Pf
58	Adiyaman	5	8.2	8.03	81.9	254.9	302.1	0.15	16.6	34.5	0.1963	642.5	16.2	2.5	1383	N38°02'017", E038°15'094"	7/17/2012	Pf; (Csp)

Appendix A (continued)

St. no	City	St. Ty	pH	DO	%DO	EC	Sp. EC	Sal	Tw	Ta	TDS	Atm.	Moist.	W. s.	Elev.	Coordinate	Date	Taxa
59	Adiyaman	1	7.93	8.02	80.2	322.6	396.4	0.19	15.3	34.7	0.2574	662.7	19.1	1.9	1132	N37°58'943", E038°17'943"	7/17/2012	Fb; Hi; Ii; Pfu
60	Adiyaman	1	8.47	9.16	89.5	184.6	232.2	0.11	14.3	35.7	0.1508	662.3	14.5	2.2	1116	N37°58'935", E038°18'112"	7/17/2012	Cn; Pf
61	Adiyaman	9	8.31	6.29	73.3	197.4	204.3	0.1	23.2	35.7	0.1326	663.1	13.1	0	1103	N37°58'921", E038°18'783"	7/17/2012	
62	Adiyaman	5	8.45	7.97	84.4	178.4	205.6	0.1	18.1	38.7	0.1339	666.2	15	3.2	1065	N37°59'129", E038°19'680"	7/17/2012	Pf
63	Adiyaman	1	8.21	6.31	73.9	362.5	376.8	0.18	23	37	0.2451	678.6	18.4	0	909	N37°59'066", E038°21'876"	7/17/2012	Ds; Hin; Hi; Ii; Po
64	Adiyaman	4	8.1	9.51	129.1	449.5	399.8	0.19	31.6	36.9	0.2593	683.4	10.3	3	853	N37°58'812", E038°27'694"	7/17/2012	Hc; (Hsp; Isp)
65	Adiyaman	5	8.27	5.57	68.3	432.7	429.1	0.2	25.5	37.2	0.2789	686.4	11.3	3.3	800	N37°58'992", E038°27'488"	7/17/2012	Ib; Pf; Po; (Esp; Hsp; Psp)
66	Adiyaman	1	8.03	6.47	77.5	455.2	459.5	0.22	24.5	35.6	0.2983	687.1	20.2	3.5	780	N37°58'745", E038°28'345"	7/17/2012	Cn; Ii; Pf; Pa; Po
67	Adiyaman	4	8.21	10.61	95.5	139.7	191.4	0.09	10.9	35	0.1241	675.3	12.1	2.7	763	N37°58'577", E038°30'553"	7/17/2012	Ii; (Hts; Hsp)
68	Adiyaman	1	7.59	2.13	26.6	817	792	0.39	26.6	35.9	0.5135	690.1	13.7	4.5	748	N37°58'518", E038°32'650"	7/17/2012	Hi; (Hts; Isp; Psp)
69	Adiyaman	5	8.26	5.98	71	767	784	0.38	24	34.8	0.507	696.4	15.4	2.7	667	N37°58'214", E038°34'995"	7/17/2012	Hi
70	Adiyaman	5	7.94	6.18	71.1	674	698	0.34	23.2	33.3	0.455	692.2	24.5	2.3	720	N37°58'079", E038°36'155"	7/17/2012	(Esp; Hts; Hi; Isp; Psp)
71	Adiyaman	5	7.63	5.41	60.2	222.7	240.9	0.11	20.9	31.8	0.156	688.8	28.6	1.7	753	N37°58'076", E038°36'155"	7/17/2012	Hin; Ib; (Psp)
72	Adiyaman	6	8.14	7.42	85.1	570	608	0.03	21.7	31.1	0.3965	698.3	27.2	1.5	638	N37°56'632", E038°36'226"	7/17/2012	Hi; Ib; (Hts)

Appendix A (continued)

St. no	City	St. Ty	pH	DO	%DO	EC	Sp. EC	Sal	Tw	Ta	TDS	Atm.	Moist.	W. s.	Elev.	Coordinate	Date	Taxa
73	Adiyaman	1	7.67	5.45	58.8	365	409	0.2	19.5	30.5	0.2659	684.5	25.6	6.5	819	N37°56'634", E038°36'227"	7/18/2012	(Cvs; Hts; Isp)
74	Adiyaman	1	7.35	8.08	83.8	366	431.6	0.21	17	31.4	0.2808	683.1	26.2	6.5	858	N37°51'674", E038°34'643"	7/18/2012	(Esp; Hts; Isp)
75	Adiyaman	1	7.55	7.92	81.8	386.8	459.7	0.22	16.8	31.8	0.3003	683.6	25.6	10	855	N37°52'279", E038°35'337"	7/18/2012	Hi; Ib; (Hts; Pos)
76	Adiyaman	5	8.18	7.08	86	490.4	502.7	0.24	23.7	33.5	0.327	699.9	26.8	6.5	659	N37°53'143", E038°35'627"	7/18/2012	Hh; Hi; Ii; (Psp)
77	Adiyaman	4	7.92	2.72	30.5	326.5	351.9	0.17	26.3	34.5	0.2288	703.5	23.4	2.5	604	N37°55'956", E038°36'492"	7/18/2012	(Hts; Isp; Pos)
78	Adiyaman	1	7.9	6.49	77.2	771	780	0.38	24.4	33.6	0.507	697.8	23.2	8	671	N37°55'980", E038°38'071"	7/18/2012	Hi; (Hts; Isp; Ts)
79	Adiyaman	1	8.11	9.89	94.4	184.3	237.5	0.11	13.3	34.6	0.1547	697.8	22.4	8.5	668	N37°57'022", E038°39'781"	7/18/2012	(Csp; Isp; Pos)
80	Adiyaman	9	8.18	5.5	60.8	217.1	239.6	0.11	20.1	33.9	0.156	698.4	24.2	7.5	662	N37°57'054", E038°39'785"	7/18/2012	Hi; Ps
81	Adiyaman	1	7.82	8.9	87	280.5	354	0.17	14.2	34.6	0.2301	689.1	26.9	2	783	N37°54'728", E038°39'143"	7/18/2012	(Hsp; Isp; Pysp)
82	Adiyaman	5	7.95	6.5	77.8	482.8	487.2	0.23	24.4	36.7	0.3185	687	20	4.5	807	N37°53'088", E038°41'715"	7/18/2012	Ii; Psm; (Cn; Cvs; Hsp)
83	Adiyaman	1	7.7	6.48	74.2	539	565	0.27	22.5	40.4	0.3705	682.7	14.8	9	856	N37°53'466", E038°45'647"	7/18/2012	Hin; Hi; Ib
84	Adiyaman	9	7.77	7.07	86.2	543	534	0.26	26	41	0.3445	683.5	14.4	0	847	N37°54'310", E038°47'310"	7/18/2012	Hi
85	Adiyaman	1	8.34	7.49	84.2	263.4	284.2	0.14	21.2	39.5	0.1846	663.6	23	0	1090	N37°56'643", E038°48'160"	7/18/2012	Hi; Pf; (Csp; Isp)
86	Adiyaman	9	7.65	7.05	78.5	550	601	0.29	20.6	41.5	0.39	664.3	15.5	2.5	1101	N37°56'912", E038°48'379"	7/18/2012	Hi; Ib

Appendix A (continued)

St. no	City	St. Ty	pH	DO	%DO	EC	Sp. EC	Sal	Tw	Ta	TDS	Atm.	Moist.	W. s.	Elev.	Coordinate	Date	Taxa
87	Adiyaman	9	7.87	7.73	74.4	286.3	365	0.18	13.7	41.1	0.2379	663.6	18.1	0	1110	N37°57'761", E038°48'771"	7/18/2012	
88	Adiyaman	5	8.37	9.23	95.6	303.2	357.6	0.17	17	37.8	0.2327	660.2	15.6	2.5	1145	N37°58'368", E038°49'049"	7/18/2012	Ca; Ib; Pf; (Psp)
89	Adiyaman	8	8.48	8.03	87.1	320.8	360.6	0.17	19.2	40.6	0.2346	665.7	14	3.5	1080	N37°58'932", E038°49'568"	7/18/2012	Cn; Hi; Ii; Pf
90	Adiyaman	1	8.63	8.92	95.1	239.3	272.2	0.13	18.7	42.3	0.1775	669	26.3	0	1038	N37°59'104", E038°50'025"	7/18/2012	Cn; Hi; Ii; Pf
91	Adiyaman	5	8.16	6.47	77.2	570	583	0.28	23.9	42.4	0.377	681.2	19.7	0	887	N37°58'908", E038°51'164"	7/18/2012	Hi; Ib; Pse; (Cvs)
92	Adiyaman	4	8.72	4.92	67.2	517	457	0.22	31.9	42.5	0.299	697.7	20	0	673	N37°58'844", E038°53'211"	7/18/2012	Ii; (Csp; Hts; Hsp; Pos; Pysp)
93	Adiyaman	1	8.41	6.71	93.3	444.2	385.6	0.18	33	42.9	0.2509	700.5	18.5	1.5	642	N37°58'795", E038°54'806"	7/18/2012	Hi; Ps; (Isp; Psp)
94	Adiyaman	5	8.07	6.97	79.1	442.1	400.7	0.19	30.5	43.8	0.2606	701.6	12	2.5	604	N37°58'186", E038°53'698"	7/18/2012	
95	Adiyaman	1	7.86	7.49	105.4	552	473	0.22	33.8	42.8	0.3055	696	15.2	0	661	N37°57'870", E038°54'037"	7/18/2012	Hc; Hi; Ib; (Esp; Hts; Isp; Pos)
96	Adiyaman	4	8.08	6.2	81.5	410.2	376.4	0.18	29.7	40.2	0.2451	694.9	15	6.5	675	N37°56'930", E038°51'564"	7/18/2012	Ds; (Isp; Pos)
97	Adiyaman	4	7.97	6.18	70.7	360.7	381.8	0.18	22.1	36.3	0.2496	661.1	16.5	3.5	1093	N37°56'086", E038°46'204"	7/18/2012	Ii; Pa; (Pysp)
98	Adiyaman	4	7.93	9.86	126.1	377	354.8	0.17	28.3	36.6	0.2307	688.6	18	1.5	761	N37°52'063", E038°40'783"	7/18/2012	Hin; (Isp)
99	Adiyaman	4	9.25	7.33	91.3	217.7	207.6	0.1	27.6	35.8	0.1352	690.5	14.5	2	737	N37°51'659", E038°40'372"	7/18/2012	Hc; (Cysp; Hsp; Isp; Pos)
100	Adiyaman	3	8.4	7.27	90.6	408.2	393.6	0.19	27	31.2	0.2561	708.7	21	2.5	543	N37°32'029", E038°29'155"	7/19/2012	(Esp; Isp)

Appendix A (continued)

St. no	City	St. Ty	pH	DO	%DO	EC	Sp. EC	Sal	Tw	Ta	TDS	Atm.	Moist.	W. s.	Elev.	Coordinate	Date	Taxa
101	Adiyaman	3	8.31	7.11	88.1	407.4	398.5	0.19	26.1	32.6	0.2593	708.9	20.7	1.5	538	N37°32'205", E038°29'132"	7/19/2012	Ds; Ib;(Hts)
102	Adiyaman	5	8.1	7.36	78.5	567	645	0.31	18.6	30.4	0.4225	707.7	24.6	2.5	548	N37°32'185", E038°27'743"	7/19/2012	Hb; Hi; (Isp)
103	Adiyaman	1	7.58	8.92	99.5	1068	1165	2.58	20.7	32.8	0.754	705.6	31.6	0	573	N37°34'084", E038°27'744"	7/19/2012	Dsp; Hi
104	Adiyaman	5	7.82	4.94	57	552	578	0.28	22.6	33.9	0.377	706.4	27.8	3.5	564	N37°34'046", E038°27'235"	7/19/2012	Hi; Ib; (Hts; Psp)
105	Adiyaman	3	8.53	6.12	78.5	419.2	393.7	0.19	28.4	35.3	0.2554	708.8	33.3	0	537	N37°34'507", E038°27'223"	7/19/2012	Hi; Ib; Ig; Li; (Cysp)
106	Adiyaman	1	7.36	4.57	49.4	555	623	0.3	19.4	35.4	0.403	708.3	25.4	2	545	N37°34'413", E038°26'207"	7/19/2012	Ib; (Hsp; Pos)
107	Adiyaman	5	8.2	7.38	83	587	634	0.36	21.3	35.8	0.4095	706	17.6	7.5	567	N37°37'436", E038°29'332"	7/19/2012	(Esp; Hts)
108	Adiyaman	4	7.6	1.84	20.5	658	714	0.35	20.9	37.3	0.4615	704.9	15.2	10.5	583	N37°45'315", E038°32'076"	7/19/2012	Pv; Tc; (Csp; Hts; Hsp; Isp)
109	Adiyaman	2	8.36	6.69	70.5	367.5	359.2	0.17	26.2	37	0.2334	696.2	15.6	5.6	687	N37°47'015", E038°25'252"	7/19/2012	
110	Adiyaman	6	8.27	8.22	99.1	340.8	343.7	0.16	24.5	38.5	0.2236	712.8	12.8	12.5	499	N37°40'912", E038°05'164"	7/19/2012	
111	Adiyaman	5	8.35	6.6	83.1	510	486	0.23	27.4	39.4	0.3185	704.4	10	11.5	594	N37°42'605", E037°56'279"	7/19/2012	Ii; (Hsp)
112	Adiyaman	4	8.46	9.44	116.2	790	766	0.37	26.5	40	0.5005	694.8	10.5	2.5	708	N37°41'786", E037°53'623"	7/19/2012	Hi; Ib
113	Adiyaman	7	8.67	6.53	78.8	298.6	299.5	0.14	24.8	41	0.195	678.9	13.2	2.1	898	N37°41'747", E037°50'944"	7/19/2012	Hi
114	Adiyaman	4	8.18	7.51	99.2	447	407.9	0.19	30.2	36.7	0.2639	670.1	11	13	1000	N37°40'781", E037°49'092"	7/19/2012	Ii

Appendix A (continued)

St. no	City	St. Ty	pH	DO	%DO	EC	Sp. EC	Sal	Tw	Ta	TDS	Atm.	Moist.	W. s.	Elev.	Coordinate	Date	Taxa
115	Adiyaman	1	7.82	19.23	247.6	560	506	0.24	28.6	38.7	0.3315	692.7	15.2	4.5	728	N37°39'280", E037°48'488"	7/19/2012	Hi; Ib; Tc; (Csp; Psp)
116	Adiyaman	1	7.44	7.5	78.6	462.8	536.5	0.26	17.8	38.1	0.3484	692.6	19.2	0	746	N37°39'339", E037°48'639"	7/19/2012	Ii; Po
117	Adiyaman	4	8.06	10.24	140.6	409.6	358.1	0.17	32.5	40.2	0.2334	684.2	11.8	1.5	845	N37°39'893", E037°48'209"	7/19/2012	Hi; (Isp; Psp)
118	Adiyaman	1	7.53	7.36	75	511	609	0.3	16.6	38.5	0.3945	701	25.3	0	637	N37°33'373", E037°48'596"	7/19/2012	Ii; Gb; Po
119	Adiyaman	4	7.32	10.27	112	557	592	0.29	21.8	36.9	0.3835	700.9	37.5	0	605	N37°33'933", E037°48'575"	7/19/2012	(Csp; Cvs; Hsp; Isp; Pysp)
120	Adiyaman	4	8.01	11.01	154	604	520	0.26	33.3	41.8	0.336	691.7	10.5	2	720	N37°32'698", E037°44'565"	7/19/2012	Hi; (Esp; Isp; Pos)
		Min	7.29	1.47	15.7	119.3	25.9	0.03	10.7	30.4	0.1073	642.4	9.9	0	499			
		Max	9.25	19.23	247.6	1241	1165	2.58	33.9	43.8	0.754	712.8	38	32.5	1383			

Appendix B Results of normality tests ((1)), analysis of variance (ANOVA) ((2a)) and regression analysis ((2) and (2b)) for the data of water (Tw) and air (Ta) temperatures from 120 sampling sites in Adıyaman.

Tests of Normality

	Kolmogorov-Smirnov ^a			Shapiro-Wilk		
	Statistic	df	Sig.	Statistic	df	Sig.
Ta	.047	120	.200*	.989	120	.480
Tw	.077	120	.077	.977	120	.036

*. This is a lower bound of the true significance.

a. Lilliefors Significance Correction

(1)

Model Summary^b

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate	Change Statistics					Durbin-Watson
					R Square Change	F Change	df1	df2	Sig. F Change	
1	.301 ^a	.091	.083	5.167	.091	11.793	1	118	.001	1.451

a. Predictors: (Constant), Ta

b. Dependent Variable: Tw

(2)

Appendix B (continued)

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	314.832	1	314.832	11.793	.001 ^b
	Residual	3150.280	118	26.697		
	Total	3465.112	119			

a. Dependent Variable: Tw

b. Predictors: (Constant), Ta

(2a)

Coefficients ^a								
Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.	Collinearity Statistics	
		B	Std. Error	Beta			Tolerance	VIF
1	(Constant)	1.770	5.796		.305	.761		
	Ta	.536	.156	.301	3.434	.001	1.000	1.000

a. Dependent Variable: Tw

(2b)

Appendix C Ecological variables and taxa were reported from different aquatic bodies in Burdur. Abbreviations; Co: *Cypria ophtalmica*, Cps: *Cypria* sp., Hs: *Heterocypris salina*, Im: *Ilyocypris monstifica*, Isb: *Isocypris beauchampi*, Isbp: *Isocypris* sp., Lis: *Limnocythere* sp., Pas: *Paralimnocythere* sp., Pk: *Physocypris kraepelini*, Par: *Potamocypris arcuata* and Pfo: *Psychrodromus fontinalis*. See Appendix A for other abbreviations.

St. no	City	St. Ty	pH	DO	%DO	EC	Sp. EC	Sal	Tw	Ta	TDS	Atm.	Moist.	W. s.	Elev.	Coordinate	Date	Taxa
1	Burdur	9	7.24	8.7	79.5	496.7	659.7	0.32	12.1	25.6	0.429	685.7	26.7	2.2	855	N37°31'837", E036°02'383"	8/30/2012	Po; (Isp)
2	Burdur	1	7.25	9.3	87.3	512	670	0.33	12.6	23.6	0.4355	680.5	26.3	2.7	921	N37°38'791", E030°41'594"	8/30/2012	(Hsp; Isp; Psp; Pysp)
3	Burdur	5	7.13	5.77	55.1	480.8	620	0.3	13.2	22.8	0.403	683	27.2	5.5	907	N37°38'107", E030°42'167"	8/30/2012	Cn; Pzi; (Isp)
4	Burdur	9	7.86	8.53	88.6	451.7	530.2	0.26	17.3	23.6	0.3452	671.5	20.9	4.3	1050	N37°38'569", E030°35'921"	8/30/2012	Hi
5	Burdur	4	7.83	8.66	84.6	355.3	450.5	0.22	13.9	27.2	0.2944	661.7	21	6.5	1181	N37°39'551", E030°35'551"	8/30/2012	(Csp; Isp; Pzi)
6	Burdur	9	7.62	11.55	122.3	665	760	0.37	18.9	28.4	0.494	669.2	19.2	2.5	1083	N37°38'919", E030°33'190"	8/30/2012	Hi; Ib
7	Burdur	9	7.96	8.94	91.9	279	328	0.16	17.1	30.8	0.2132	664.2	19.5	5.1	1139	N37°38'926", E030°30'906"	8/30/2012	(Esp; Hts; Hsp; Isp)
8	Burdur	1	7.15	4.55	43.3	581	752	0.37	13.1	26.7	0.4875	665.5	20.2	3.5	1124	N37°38'581", E030°30'393"	8/30/2012	Pfo; (Isp)
9	Burdur	4	7.93	7.39	71.5	603	766	0.38	13.9	28	0.5005	665.1	23.5	1.6	1123	N37°38'388", E030°30'493"	8/30/2012	Cn; Ib; Pf; (Pzi)
10	Burdur	9	8.51	8.41	81.5	181.3	228.8	0.11	14.1	26.7	0.1489	635.4	25.2	4.5	1538	N37°40'638", E030°31'080"	8/30/2012	Po
11	Burdur	9	8.23	9.85	89.5	179.4	245	0.12	11	28.3	0.1592	635	22.9	4.9	1521	N37°40'694", E030°31'196"	8/30/2012	Po; (Hsp)

Appendix C (continued)

St. no	City	St. Ty	pH	DO	%DO	EC	Sp. EC	Sal	Tw	Ta	TDS	Atm.	Moist.	W. s.	Elev.	Coordinate	Date	Taxa
12	Burdur	4	8.62	8.78	96.7	347.2	386.5	0.19	19.8	30.5	0.2509	671.2	19.4	3.2	1083	N37°37'626", E030°31'253"	8/30/2012	(Isp)
13	Burdur	9	8.19	11.33	135.6	483	486.7	0.23	24.6	33.3	0.3172	684.3	13.7	5.5	882	N37°32'555", E030°31'127"	8/30/2012	Hi; Pv
14	Burdur	9	8.11	7.11	83.5	677	703	0.34	23.1	31.3	0.455	672.5	16.9	2.5	1061	N37°34'509", E030°28'308"	8/30/2012	Hin; Hi
15	Burdur	4	7.89	2.65	34.4	1390	1296	0.64	28.6	31.7	0.8385	681.2	12.6	3.2	946	N37°33'680", E030°28'235"	8/30/2012	
16	Burdur	9	7.99	9.04	98.9	536	598	0.29	19.8	33.2	0.39	675.1	14.4	8.2	1027	N37°34'564", E030°26'708"	8/30/2012	Hi; Ib; Pzi; Po
17	Burdur	9	7.76	10.9	133.3	525	513	0.25	26.3	31.8	0.3315	685.1	28.7	3.9	898	N37°31'227", E030°28'277"	8/30/2012	Hi; Ib; Pv
18	Burdur	5	8.01	3.2	40.4	800	762	0.37	27.8	32.9	0.494	684.3	13	2.7	906	N37°30'531", E030°27'003"	8/30/2012	(Hsp; Pos)
19	Burdur	9	8.06	11.57	138.5	487	493.7	0.24	24.2	35.7	0.3211	683.9	12.8	2.4	878	N37°29'825", E030°26'687"	8/30/2012	Hi; Pv; Po; (Isp)
20	Burdur	9	8.06	9.35	92.1	303.8	370	0.18	15.8	33.6	0.2412	682.4	13.6	3.6	904	N37°30'527", E030°25'110"	8/30/2012	
21	Burdur	9	7.98	8.86	85.7	288	364.8	0.18	13.9	32.9	0.2379	681.9	14	0	905	N37°30'453", E030°24'693"	8/30/2012	
22	Burdur	3	8.76	5.6	67.9	327.7	326.6	0.15	25.2	34.4	0.2119	686.5	22.2	0	843	N37°30'715", E030°32'463"	8/30/2012	(Csp; Im)
23	Burdur	1	7.36	4.77	48.2	978	1176	0.59	16.2	32.8	0.767	684.8	14.3	5.5	907	N37°30'156", E030°33'286"	8/30/2012	Cn; (Hsp; Isp; Psp)
24	Burdur	9	7.74	7.63	76.5	472.2	579.4	0.28	15.3	33.4	0.377	688.4	17.5	3.3	813	N37°28'623", E030°32'090"	8/30/2012	Ib; Po; (Pzi)
25	Burdur	1	7.82	7.95	73.3	290.6	367	0.18	14.2	32.1	0.2392	707.5	23.7	0	637	N37°18'918", E030°46'278"	8/30/2012	Cn

Appendix C (continued)

St. no	City	St. Ty	pH	DO	%DO	EC	Sp. EC	Sal	Tw	Ta	TDS	Atm.	Moist.	W. s.	Elev.	Coordinate	Date	Taxa
26	Burdur	9	7.84	8.94	89.4	301.6	365.2	0.18	15.9	31.4	0.2373	721.4	26.5	0	460	N37°19'051", E030°48'237"	8/30/2012	Po
27	Burdur	3	8.13	6.6	72.4	351.4	388	0.19	20.1	30.3	0.2522	737.8	24.8	0	287	N37°20'007", E030°48'767"	8/30/2012	(Hsp; Isp)
28	Burdur	9	7.35	8.26	103.1	623	603	0.29	26.6	30.5	0.39	728.8	21.8	1.5	348	N37°22'519", E030°48'876"	8/30/2012	Hi; Po
29	Burdur	3	8.38	5.04	62	344.7	331.4	0.16	27.1	30.7	0.2152	732.2	21.7	2.4	282	N37°22'239", E030°49'626"	8/30/2012	Im; Li; Pk; (Hsp; Pos; Psp; Pysp)
30	Burdur	9	7.39	6.09	71.2	615	649	0.32	22.3	30.1	0.4225	769.9	21.2	2.2	443	N37°23'364", E030°47'747"	8/30/2012	
31	Burdur	9	7.6	5.94	66.7	597	650	0.32	20.6	12.4	0.4225	692.8	54.2	1.5	792	N37°26'745", E030°29'863"	8/31/2012	Hin; Hi; Ib
32	Burdur	9	7.33	5.71	59.8	590	685	0.34	17.7	13.8	0.442	692.5	51.7	0	792	N37°26'310", E030°29'447"	8/31/2012	(Hsp; Pzi)
33	Burdur	4	8.08	7.08	66.8	672	874	0.43	12.9	17.1	0.5655	691.2	42.3	0	808	N37°25'078", E030°26'957"	8/31/2012	Hi; Ib
34	Burdur	4	7.82	4.07	41.6	324.1	387.8	0.19	16.4	16.4	0.2522	693	43.3	0	785	N37°25'205", E030°25'556"	8/31/2012	Cn; Ib; Im; Tc; (Hsp; Psp)
35	Burdur	5	7.68	9.1	83.7	289.5	390.9	0.19	11.4	17.4	0.2542	690.2	50.5	2	815	N37°25'859", E030°23'902"	8/31/2012	Pfo
36	Burdur	9	7.41	7.95	92.3	1068	1130	0.56	22	18.9	0.7345	690.6	33.4	4.6	815	N37°23'448", E030°24'430"	8/31/2012	Hs
37	Burdur	4	8.16	9.53	92.6	612	767	0.38	14.5	21.4	0.4875	691.3	28.5	0	810	N37°22'132", E030°23'441"	8/31/2012	
38	Burdur	9	7.42	7.6	74.4	832	1036	0.52	14.8	24	0.676	684.8	28.7	0	884	N37°22'527", E030°20'878"	8/31/2012	Hs; Po
39	Burdur	9	7.94	9.3	100	372.5	429.7	0.21	18	25.6	0.2821	672.3	24.7	1.6	1033	N37°21'242", E030°14'817"	8/31/2012	Hi; (Isp; Pysp)

Appendix C (continued)

St. no	City	St. Ty	pH	DO	%DO	EC	Sp. EC	Sal	Tw	Ta	TDS	Atm.	Moist.	W. s.	Elev.	Coordinate	Date	Taxa
40	Burdur	9	8.1	7.42	67.6	338.6	435.7	0.02	12.5	25.6	0.2704	651	21.9	7	1310	N37°23'290", E030°14'920"	8/31/2012	Hi; (Isp; Tsp)
41	Burdur	4	8.03	6.35	64.7	1824	2181	1.12	16.5	26	1477	674.2	23.5	5	1032	N37°26'205", E030°05'593"	8/31/2012	
42	Burdur	5	8.31	7.58	84.5	466.4	509.1	0.25	20.6	27	0.3308	674.6	35.4	1.6	1033	N37°27'908", E030°05'668"	8/31/2012	(Cps; Hsp; Isp)
43	Burdur	4	8.16	11.29	130.4	420.9	442.9	0.21	22.5	27.9	0.2867	663.5	20.5	6.1	1171	N37°29'728", E030°08'682"	8/31/2012	Pk; (Isp; Psp)
44	Burdur	5	8.13	6.96	76.3	525	586	0.29	19.6	31.2	0.3835	663.9	29	1.6	1172	N37°28'535", E030°10'296"	8/31/2012	Cn; Hi; Ib; Po
45	Burdur	3	8.38	7.02	81.5	352.8	371.2	0.18	22.4	27.1	0.2412	660.7	26	12	1194	N37°28'261", E030°10'481"	8/31/2012	Li; (Cps; Im)
46	Burdur	9	7.05	4.54	48.7	1010	1158	0.58	18.3	31.7	0.754	665.8	22.3	1.6	1129	N37°29'210", E030°09'476"	8/31/2012	Hi; Ib; (Csp; Psp)
47	Burdur	4	8.21	5.95	66.2	346.9	381.3	0.18	20.3	32.5	0.2477	672.3	20.1	2.5	1038	N37°29'505", E030°06'228"	8/31/2012	(Csp)
48	Burdur	5	8.51	9.74	110.7	658	705	0.34	21.5	29.7	0.455	676.1	18.9	17.5	990	N37°28'640", E030°04'570"	8/31/2012	Ib; Po; (Csp; Hsp)
49	Burdur	1	7.82	4.7	59	556	532	0.26	27.2	32.3	0.3445	676.1	17.8	1.8	988	N37°27'177", E030°03'511"	8/31/2012	Ds; (Ig)
50	Burdur	9	8.15	9.5	110.4	407.1	421.7	0.2	23.1	33.1	0.2743	671.1	15.8	2.7	1042	N37°23'500", E030°03'182"	8/31/2012	Hi
51	Burdur	4	8.65	9.5	96.3	198.1	235.4	0.11	16.7	30.5	0.1534	661.8	16.3	0	1159	N37°21'135", E030°03'711"	8/31/2012	Hi; Pa
52	Burdur	5	8.51	5.88	72.9	395.6	386.6	0.18	26.2	31.5	0.2516	655.5	22.2	1.6	1239	N37°20'154", E030°04'103"	8/31/2012	Ib; Pzi; Po; (Csp; Cps; Hsp; Lis)
53	Burdur	4	8.2	4.16	49.7	329.6	338.2	0.16	23.7	30.5	0.2197	657.5	10.4	2.5	1224	N37°20'443", E030°04'510"	8/31/2012	Li; (Isp)

Appendix C (continued)

St. no	City	St. Ty	pH	DO	%DO	EC	Sp. EC	Sal	Tw	Ta	TDS	Atm.	Moist.	W. s.	Elev.	Coordinate	Date	Taxa
54	Burdur	4	8.45	5.77	69.1	491.4	492.1	0.24	24.9	33	0.3204	666.4	19.9	1.6	1104	N37°21'289", E030°02'458"	8/31/2012	Ig; Isb; Li; Pv; (Cps)
55	Burdur	9	7.63	7.18	73.2	497.7	608.3	0.3	15.5	33.8	0.3952	662.7	14.2	0	1145	N37°18'747", E029°59'996"	8/31/2012	Hi; Ib; (Po)
56	Burdur	1	7.63	7.26	67.2	335.1	447.8	0.22	11.8	34.5	0.2912	640.3	12.6	2	1428	N37°16'436", E029°59'061"	8/31/2012	Co; Ib; (Hsp; Pzi; Psp; Pysp)
57	Burdur	9	7.85	8.25	94.4	992	518.7	0.25	22.3	33.3	0.3367	644.9	15.5	0	1375	N37°17'829", E030°00'243"	8/31/2012	Cn; Hi; Ib
58	Burdur	4	8.79	5.34	69	1064	989	0.48	28.9	32.3	0.6435	669.6	25.8	1.9	1059	N37°20'620", E029°57'475"	8/31/2012	(Pzi)
59	Burdur	2	8.96	12.05	154.1	628	594	0.29	28	29.8	0.3835	670.1	26	6	1042	N37°21'607", E029°59'053"	8/31/2012	(Cps; Hsp; Isp; Lis)
60	Burdur	2	9.02	10.79	135.2	395.2	396.2	0.17	26	34.5	0.2478	670	14.8	6	1042	N37°23'158", E029°59'084"	8/31/2012	Co; Im; Li; (Hsp; Pos)
61	Burdur	9	8.26	10.59	131.2	500	471.2	0.22	27.6	31.4	0.3075	668.8	13.2	11	1058	N37°24'593", E029°59'093"	8/31/2012	Hs; Ib; (Hts; Im)
62	Burdur	9	7.89	7.26	84	329.5	343.2	0.17	23.1	29.5	0.2567	665.2	13	2.6	1101	N37°24'720", E029°56'417"	8/31/2012	(Hsp)
63	Burdur	3	8.61	7.04	83.6	358.3	373.4	0.18	22.9	30.5	0.2418	659.1	14.4	5.7	1191	N37°26'076", E029°54'596"	8/31/2012	(Cps; Isp; Isbp; Lis; Psp)
64	Burdur	9	8.02	5.6	67.6	469.7	470.1	0.23	24.9	30.5	0.3048	665.4	14.4	12.7	1110	N37°23'091", E029°54'010"	8/31/2012	Hi
65	Burdur	3	8.73	7.52	84.6	580	621	0.3	21.5	28.3	0.403	660.2	23	3.8	1183	N37°23'920", E029°50'076"	8/31/2012	Li; (Cps; Pzi; Psp)
66	Burdur	9	7.61	5.28	51	77.5	981	0.49	14	14.7	0.637	660	43.7	2	1187	N37°23'921", E029°50'077"	9/1/2012	Hc; Hi; Pzi
67	Burdur	9	8.29	6.21	65.3	459.1	532	0.26	17.6	16.8	0.3464	657.2	43.7	1.6	1236	N37°21'217", E029°45'737"	9/1/2012	Hi

Appendix C (continued)

St. no	City	St. Ty	pH	DO	%DO	EC	Sp. EC	Sal	Tw	Ta	TDS	Atm.	Moist.	W. s.	Elev.	Coordinate	Date	Taxa
68	Burdur	9	7.94	8.01	93.9	488.2	568.9	0.28	17.6	17.4	0.3698	656.3	38.2	0	1235	N37°21'347", E029°45'673"	9/1/2012	
69	Burdur	5	8.41	9.93	88.4	391	543.9	0.26	10.3	20.9	0.3536	646.1	32.6	0	1391	N37°11'685", E029°57'708"	9/1/2012	(Hsp; Isp; Pysp)
70	Burdur	5	8.25	9.5	88.5	269.1	356.9	0.17	12.1	23	0.232	651.3	34.1	0	1340	N37°13'363", E029°56'692"	9/1/2012	Cn; (Esp; Isp; Pysp)
71	Burdur	3	8.5	7.17	79.7	351.1	383.6	0.18	20.5	25.6	0.2189	662.3	28.9	1.8	1201	N37°13'363", E029°56'691"	9/1/2012	(Isp; Lis)
72	Burdur	4	8.01	6.57	63.1	438.7	563	0.27	13.5	24.6	0.366	661.4	36.5	0	1204	N37°14'513", E029°52'186"	9/1/2012	Hi; Po; (Esp; Isp)
73	Burdur	5	8.42	7.71	77.7	540	653	0.32	15.9	25.9	0.4225	659.2	32.2	0	1229	N37°14'095", E029°50'124"	9/1/2012	Hi; (Isp; Pysp)
74	Burdur	5	8.39	8.16	81.4	421.4	518	0.25	15.3	25.7	0.338	652.7	30.3	4	1313	N37°12'345", E029°48'594"	9/1/2012	
75	Burdur	9	8.16	7.08	67.3	261.6	339	0.16	13.1	27	0.2203	648.2	27.9	0	1367	N37°10'954", E029°48'759"	9/1/2012	Hi
76	Burdur	9	7.77	8.65	84.2	293.4	369.9	0.18	14.2	26.7	0.2405	655.6	26.5	5	1277	N37°10'496", E029°46'906"	9/1/2012	(Csp; Hsp)
77	Burdur	2	7.44	2.27	22.4	490.3	617.9	0.3	14.2	25.8	0.4017	660.6	27.5	3	1216	N37°11'069", E029°45'365"	9/1/2012	Co; Pos; Po; (Hsp)
78	Burdur	5	8.49	7.34	78.1	266.1	304.9	0.15	18.4	26.4	0.1976	648	20	12	1380	N37°08'460", E029°45'521"	9/1/2012	(Isp)
79	Burdur	5	8.02	7.33	73.4	625	510	0.31	15.4	29.1	0.4095	649.7	30.7	1.5	1356	N37°08'438", E029°46'046"	9/1/2012	Cn; Ib; Pv; Po; (Psp)
80	Burdur	1	8.23	6.36	67.4	272.1	312.8	0.15	18.2	28.7	0.2028	646.1	22.7	7.4	1398	N37°07'890", E029°46'191"	9/1/2012	Cn; Hi; Po
81	Burdur	4	8.29	8.4	89.2	365.3	407.3	0.2	19.6	30.1	0.2646	650.8	22.9	0	1341	N37°06'883", E029°46'313"	9/1/2012	Hs; Par

Appendix C (continued)

St. no	City	St. Ty	pH	DO	%DO	EC	Sp. EC	Sal	Tw	Ta	TDS	Atm.	Moist.	W. s.	Elev.	Coordinate	Date	Taxa
82	Burdur	9	7.87	8.58	86.3	449	546.4	0.27	15.3	30.4	0.3549	654	25	3	1289	N37°05'643", E029°46'500"	9/1/2012	(Pysp)
83	Burdur	9	8.23	7.52	70.7	223.6	290.6	0.14	12.8	31.5	0.1911	641.9	15.5	3.5	1464	N37°00'046", E029°49'821"	9/1/2012	Hi
84	Burdur	3	8.3	5.91	67.4	311.3	330.8	0.16	21.8	31.4	0.2152	638	14.8	2.3	1515	N37°59'365", E029°51'134"	9/1/2012	Li; (Cps; Esp; Psp)
85	Burdur	9	8.31	7.75	84.6	327	364	0.17	19.7	32.6	0.2366	649.8	14.8	4	1357	N37°01'750", E029°46'891"	9/1/2012	Hi; (Hts; Isp)
86	Burdur	9	7.75	6.37	68.2	588	678	0.33	18.1	33.6	0.442	654.6	16.9	0	1300	N37°01'454", E029°46'683"	9/1/2012	(Isp; Psp; Pysp)
87	Burdur	3	8.47	5.87	68.7	394.7	407.8	0.2	23.3	34.1	0.2652	667	16.8	6	1143	N37°04'445", E029°44'149"	9/1/2012	(Hsp; Isp; Lis)
88	Burdur	9	7.65	5.12	54.9	870	982	0.49	19.1	32.6	0.637	667.4	18.9	1.9	1121	N37°04'485", E029°42'489"	9/1/2012	(Hsp; Isp)
89	Burdur	9	7.79	6.27	71.9	831	882	0.43	22	33.2	0.572	666.4	15.3	9.5	1119	N37°05'647", E029°39'705"	9/1/2012	Hi; Ib; Po; (Hts)
90	Burdur	2	8.01	5.65	72.6	750	724	0.35	25.8	36.6	0.468	679.7	15.2	0	955	N37°06'497", E029°36'491"	9/1/2012	(Cps; Isp; Psp)
91	Burdur	9	7.67	8.41	85.6	535	643	0.31	16.4	37.2	0.416	678.1	14.4	0	973	N37°06'422", E029°36'713"	9/1/2012	Hi; Ib; (Cn; Hts; Pzi; Psp)
92	Burdur	5	7.65	9.3	86.1	401.9	535.9	0.26	11.9	36.6	0.3484	667.5	24	0	960	N37°05'412", E029°35'351"	9/1/2012	Cn; Ib; (Psp)
93	Burdur	9	7.56	3.1	30.9	700	870	0.43	14.8	35.8	0.5655	678.7	19	0	965	N37°06'691", E029°33'537"	9/1/2012	Hi; (Csp; Hts; Isp)
94	Burdur	9	7.63	2.54	26.7	866	998	0.5	18.1	36.2	0.65	676.3	16.2	4	990	N37°05'560", E029°31'836"	9/1/2012	Hi; Po; (Ig)
95	Burdur	9	7.77	5.94	66.7	568	611	0.3	21.3	35.7	0.3965	654.9	29.1	0	1266	N37°01'434", E029°32'172"	9/1/2012	Ib; (Hsp)

Appendix C (continued)

St. no	City	St. Ty	pH	DO	%DO	EC	Sp. EC	Sal	Tw	Ta	TDS	Atm.	Moist.	W. s.	Elev.	Coordinate	Date	Taxa
96	Burdur	3	8.22	5.76	71.1	438.9	432.7	0.21	25.8	31	0.2815	670.4	21.1	6	1073	N37°59'959", E029°27'499"	9/1/2012	(Isp)
97	Burdur	1	7.57	7.3	68	470.9	628.2	0.31	11.8	34.1	0.4101	668.4	17.2	4.2	1079	N36°58'770", E029°28'495"	9/1/2012	(Csp; Hsp; Isp; Pysp)
98	Burdur	1	7.41	7.16	66.1	446.1	599.3	0.29	11.7	30.8	0.3893	668.1	16.6	2	1079	N36°59'158", E029°29'133"	9/1/2012	(Pysp)
99	Burdur	9	7.49	5.56	61.8	672	729	0.36	20.9	30.6	0.468	667.6	17.7	1.7	1106	N36°59'334", E029°29'031"	9/1/2012	Hi; Ib; Po
100	Burdur	9	7.93	6.08	73.1	784	793	0.39	24.6	31.5	0.5135	663.5	15.9	2.3	1161	N37°00'084", E029°30'448"	9/1/2012	Hs; (Isp)
101	Burdur	9	7.49	7.6	90.1	801	803	0.39	24.5	28.8	0.52	659.5	17	2.4	1209	N37°00'659", E029°31'922"	9/1/2012	Hi; Ps
102	Burdur	9	7.53	6.95	80.3	628	655	0.32	22.9	28.7	0.4225	655.8	16.5	2.2	1259	N37°00'939", E029°32'130"	9/1/2012	(Esp)
103	Burdur	9	7.59	4.09	45	1072	1185	0.59	20.1	30	0.767	673.3	17.7	0	1038	N37°04'203", E029°32'179"	9/1/2012	Hi; Po; (Isp)
104	Burdur	9	7.55	2.31	23.5	852	1021	0.51	16.4	29.6	0.663	676.6	18.5	2.2	995	N37°05'805", E029°31'858"	9/1/2012	Hi; Po; (Hsp)
105	Burdur	9	8.59	8.42	92	606	681	0.33	19.3	25.5	0.442	662.5	21.3	9.4	1164	N37°09'657", E029°29'727"	9/1/2012	
106	Burdur	9	7.78	6.21	63.8	463.2	550.9	0.27	16.7	15.9	0.3581	658.9	29.9	0	1208	N37°09'655", E029°29'726"	9/2/2012	
107	Burdur	2	9.1	7.34	82	2478	2735	1.42	20.1	18.2	1774	668.7	48.7	1.7	1116	N37°31'175", E029°43'107"	9/2/2012	Po; (Isp)
108	Burdur	5	8.78	8.98	85.8	568	729	0.36	13.4	21.4	0.481	663.1	39.5	4	1204	N37°32'774", E029°35'720"	9/2/2012	Po
109	Burdur	2	9.13	6.94	79.3	2411	2617	1.35	21	22.9	1729	668.7	49.4	0	1134	N37°33'781", E029°38'509"	9/2/2012	Po; (Csp; Isp; Lis)

Appendix C (continued)

St. no	City	St. Ty	pH	DO	%DO	EC	Sp. EC	Sal	Tw	Ta	TDS	Atm.	Moist.	W. s.	Elev.	Coordinate	Date	Taxa
110	Burdur	9	8.08	5.21	67.8	1387	1360	0.68	25.8	23.8	0.884	666.8	41.8	1.3	1153	N37°35'255", E029°40'590"	9/2/2012	Hs; (Pysp)
111	Burdur	9	8.44	7.34	85.9	321.7	334.2	0.16	23	24.7	0.217	664.4	28.6	2.8	1180	N37°33'909", E029°45'243"	9/2/2012	Hi
112	Burdur	1	8.03	5.67	55.8	774	958	0.48	15	25.9	0.624	669	32.4	2.8	1119	N37°37'823", E029°45'988"	9/2/2012	Cn; Ib; Po
113	Burdur	9	8.64	6.59	62.7	720	903	0.45	14.5	26.5	0.585	678.6	34.4	0	1009	N37°39'861", E029°44'858"	9/2/2012	(Psp)
114	Burdur	4	9.26	6.18	67	1216	1361	0.68	19.4	26.7	0.884	674.4	26.9	2.7	1064	N37°40'544", E029°51'051"	9/2/2012	Hi; Im
115	Burdur	9	7.85	5.64	57.7	739	880	0.43	16.6	27.8	0.572	667.5	27.5	5.5	1156	N37°43'174", E029°58'959"	9/2/2012	(Esp; Isp; Pysp)
116	Burdur	5	8.14	7.3	74.2	896	1080	0.54	16.1	27.8	0.702	676.2	31.7	1.5	1060	N37°42'829", E030°00'849"	9/2/2012	Ib; Po; (Hsp; Psp)
117	Burdur	2	8.95	5.61	81.1	389056	380.74	23.33	28.2	29.2	23.037	691.3	28.1	3.7	848	N37°41'883", E030°04'609"	9/2/2012	(Hts; Hsp; Lis; Pas)
118	Burdur	9	7.91	7.82	88.5	762	816	0.4	21.6	31.1	0.533	687.4	21.1	3	890	N37°39'077", E030°02'855"	9/2/2012	Hi; Ib; (Hts)
119	Burdur	2	9.44	6.55	90	24265	23430	14.22	26.8	29.4	15.288	684.9	26.5	2.7	917	N37°35'143", E029°58'931"	9/2/2012	Li; (Isp)
120	Burdur	2	9.05	8.13	79.2	435.7	557	0.26	14.2	29	0.352	663.2	39	0	1183	N37°39'565", E030°22'474"	9/2/2012	
121	Burdur	5	8.27	7.94	89.1	486.5	526.9	0.25	21	27.1	0.3425	669	21.3	16.3	1120	N37°45'645", E030°23'855"	9/2/2012	Ib; (Cn; Hsp; Pysp)
			Max	9.44	12.05	154.1	389056	23430	23.33	28.9	37.2	1774	769.9	54.2	17.5	1538		
			Min	7.05	2.27	22.4	77.5	228.8	0.02	10.3	12.4	0.1489	635	10.4	0	282		

Appendix D Results of normality tests ((1)), analysis of variance (ANOVA) ((2a)) and regression analysis ((2) and (2b)) for the data of water (Tw) and air temperatures (Ta) from 121 sampling sites in Burdur.

Tests of Normality						
	Kolmogorov-Smirnov ^a			Shapiro-Wilk		
	Statistic	df	Sig.	Statistic	df	Sig.
Tw	.089	121	.020	.964	121	.003
Ta	.103	121	.003	.929	121	.000

a. Lilliefors Significance Correction

(1)

Model Summary ^b										
Model	R	R Square	Adjusted R Square	Std. Error of the Estimate	Change Statistics					Durbin-Watson
					R Square Change	F Change	df1	df2	Sig. F Change	
1	.312 ^a	.098	.090	4.645	.098	12.872	1	119	.000	1.256

a. Predictors: (Constant), Ta

b. Dependent Variable: Tw

(2)

Appendix D (continued)

ANOVA ^a						
Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	277.781	1	277.781	12.872	.000 ^b
	Residual	2568.008	119	21.580		
	Total	2845.789	120			

a. Dependent Variable: Tw
b. Predictors: (Constant), Ta

(2a)

Coefficients ^a											
Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.	Correlations			Collinearity Statistics	
		B	Std. Error	Beta			Zero-order	Partial	Part	Tolerance	VIF
1	(Constant)	10.798	2.333		4.629	.000					
	Ta	.289	.081	.312	3.588	.000	.312	.312	.312	1.000	1.000

a. Dependent Variable: Tw

(2b)

Appendix E Results of normality tests ((1)), analysis of variance (ANOVA) ((2a)) and regression analysis ((2) and (2b)) for the data of water (Tw) and air (Ta) temperatures from 241 sampling sites in ADIBUR.

Tests of Normality						
	Kolmogorov-Smirnov ^a			Shapiro-Wilk		
	Statistic	df	Sig.	Statistic	df	Sig.
	Ta	.078	241	.001	.954	241
Tw	.060	241	.036	.980	241	.002

a. Lilliefors Significance Correction

(1)

Model Summary ^b										
Model	R	R Square	Adjusted R Square	Std. Error of the Estimate	Change Statistics					Durbin-Watson
					R Square Change	F Change	df1	df2	Sig. F Change	
1	.374 ^a	.140	.136	4.915	.140	38.832	1	239	.000	1.396

a. Predictors: (Constant), Ta

b. Dependent Variable: Tw

(2)

Appendix E (continued)

ANOVA ^a						
Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	938.094	1	938.094	38.832	.000 ^b
	Residual	5773.664	239	24.158		
	Total	6711.758	240			

a. Dependent Variable: Tw

b. Predictors: (Constant), Ta

(2a)

Coefficients ^a										
Model	Unstandardized Coefficients		Standardized Coefficients	t	Sig.	Correlations			Collinearity Statistics	
	B	Std. Error	Beta			Zero-order	Partial	Part	Tolerance	VIF
1	(Constant)	9.638	1.742		5.532	.000				
	Ta	.326	.052	.374	6.232	.000	.374	.374	.374	1.000

a. Dependent Variable: Tw

(2b)

Appendix F The available ecological information of each living species of genus *Gomphocythere*. Abbreviations; EC (μScm^{-1}): electrical conductivity, Tw ($^{\circ}\text{C}$): water temperature; Elev. (m a.s.l.): elevation. See the text for ecological data of *G. besni* n.sp. (*11m according to Table 1 of Martens, 2003). (**see Appendix of Park and Martens, 2001 for details about sampling sites). (***) see details in the section 5).

Species	pH	EC	Tw	Depth (m)	Substrate	Habitat type**	Elev.	Reference
<i>G. alata</i>				5-29	sand and rock	Lake Tanganyika		Park, 1995; Park & Martens, 2001
<i>G. angulata</i>		0-30000						Martens, 1990
<i>G. angusta</i>							400-3500	Klie, 1939
<i>G. besni</i> n. sp.	7.53	609	16.6	0,5	sand and gravel	Tavaş pool, Besni	637	This study***
<i>G. capensis</i>	7.7	3870-4200	20-22		temporary and permanent			Martens et al., 1996
<i>G. coheni</i>				50	very coarse sand and green algae	Lake Tanganyika		Park & Martens, 2001
<i>G. cristata</i>				40-49		Lake Tanganyika		Park, 1995
<i>G. curta</i>				20-29, 50	small pond, freshwater	Delta of Dama River (Burundi), Lake Tanganyika		Park, 1995; Rome, 1962
<i>G. downingi</i>				18-52	mud, sand and wood fragment, sand and shell debris	Lake Tanganyika		Park & Martens, 2001

Appendix F (continued)

Species	pH	EC	Tw	Depth (m)	Substrate	Habitat type**	Elev.	Reference
<i>G. emrysi</i>				10		Lake Malawi		Martens, 2003
<i>G. expansa</i>	5.6-10							Martens, 1993
<i>G. irvinei</i>				8		Lake Malawi		Martens, 2003
<i>G. lisae</i>				8		Lake Malawi		Martens, 2003
<i>G. obtusata</i>	7.7-8.8	2000-4340	21-23			Fresh and slightly saline, purely benthic		Martens et al., 1996
<i>G. ortalii</i>	8.2		15.3			spring of Nahal River		Martens, 1993
<i>G. piriformis</i>				30		Lake Malawi		Martens, 2003
<i>G. simplex</i>					freshwater and muddy sediment	Lake Tanganyika		Rome, 1962
<i>G. wilsoni</i>				6-18	fine sand, sand and shell debris	Bujumbura Lake, Lake Tanganyika		Park & Martens, 2001
<i>G. woutersi</i>				18	sand and shell debris	Lake Tanganyika		Park & Martens, 2001

PHOTOS

9. PHOTOS

Some selected photos were taken during samplings in Adıyaman and Burdur.



1- Site 1 (Adıyaman)



2 - Site 6 (Adıyaman)



3 - Site 11 (Adıyaman)



4 - Site 33 (Adıyaman)



5 - Site 56 (Adıyaman)



6 - Site 80 (Adıyaman)



7 - Site 83 (Adıyaman)



8 - Site 96 (Adıyaman)



9 - Site 101 (Adıyaman)



10 - Site 112 (Adıyaman)



11 - Site 118 (Adıyaman)



12 - Site 8 (Burdur)



13 - Site 10 (Burdur)



14 - Site 13 (Burdur)



15 - Site 23 (Burdur)



16 - Site 44 (Burdur)



17 - Site 53 (Burdur)



18 - Site 56 (Burdur)



19 - Site 72 (Burdur)



20 - Site 77 (Burdur)



21 - Site 112 (Burdur)

10. CURRICULUM VITAE

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7. Çelekli A, **Yavuzatmaca M** & Bozkurt H (2010) “Modeling the Removal of Reactive Red 120 on Pistachio Husk”, *Clean-Soil Air Water*, 38(2): 173-180.
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