**BOLU ABANT IZZET BAYSAL UNIVERSITY**
**THE GRADUATE SCHOOL OF NATURAL AND APPLIED SCIENCES**

# DETERMINATION OF THE RELATIONSHIP BETWEEN OSTRACODA (CRUSTACEA) CARAPACE SIZE AND GEOGRAPHIC AND ECOLOGICAL FACTORS IN DIFFERENT AQUATIC HABITATS OF MERSİN (TURKEY)

**MASTER OF SCIENCE**

**ENES DALGAKIRAN**

**BOLU, NOVEMBER 2018**

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**DEPARTMENT OF BIOLOGY**

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## APPROVAL OF THE THESIS

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**Director of Graduate School of Natural and Applied Sciences**

**To my family**

**Naci DALGAKIRAN, Ayşe DALGAKIRAN**
**and**
**Talha DALGAKIRAN**

**DECLARATION**

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

**Enes DALGAKIRAN**

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# ABSTRACT

**DETERMINATION OF THE RELATIONSHIP BETWEEN OSTRACODA (CRUSTACEA) CARAPACE SIZE AND GEOGRAPHIC AND ECOLOGICAL FACTORS IN DIFFERENT AQUATIC HABITATS OF MERSİN (TURKEY)**

**MSC THESIS**

**ENES DALGAKIRAN**

**BOLU ABANT IZZET BAYSAL UNIVERSITY GRADUATE SCHOOL OF NATURAL AND APPLIED SCIENCES**

**DEPARTMENT OF BIOLOGY**

**(SUPERVISOR: PROF. DR. OKAN KÜLKÖYLÜOĞLU)**

**BOLU, NOVEMBER 2018**

In the present study, total of 117 different non-marine aquatic habitats were sampled from Mersin province during 03-09 October 2015. In total, 36 species and14 sub-fossils (valves or carapace) were detected from 66 of 117 sites. 34 of the 36 species found in here are new records for the province of Mersin. In addition, four ostracod taxa (*Bradleycypris* cf. *obliqua, Cypretta* cf. *reticulata, Fabeaformiscandona* cf. *wegelini, Hemicypris* cf. *largereticulata*) were new record for the Turkish Ostracoda fauna. Water and sediment samples were analyzed to show the relationship between distribution of ostracod species and their valve size at different elevational ranges. Valve length of 1990 individuals which found three or more than three times were measured. The first two axes of the Canonical Corresponding Analysis (CCA) revealed 72.6% of the relationship between 12 taxa and five ecological variables. Among the variables, water temperature ($P < 0.05$) and pH were the most effective variable whereas elevation, salinity and dissolved oxygen were less effective on the taxa. According to C2 analysis, two species *Ilyocypris inermis* and *Potamocypris fallax* showed the lowest and highest optimum values for elevation, respectively. While *Psychrodromus fontinalis* had a maximum tolerance for elevation, *Limnocthere inopinata* showed a minimum tolerance. There was a significant difference between the length of right and left valves of the individuals ($P<0.05$, $N = 1990$). In contrast, some individuals of species displayed no significant difference when some species showed variabilities among elevational ranges. Aditionally, the species *P. fontinalis* showed no significant result related to elevation ($N=191$, $t=1.45$, $P> 0.05$ ) for all the individuals wheras *Ilyocypris bradyi* for all the individual of this species had showed significant result ($N=308$, $t=4.24$, $P < 0.001$) was observed. It is clear that there is a change in valve lengths as the elevation increases, but more sampling and more measurements are required to talk about the relationship between elevation and valve length.

**KEYWORDS:** Ostracoda, Ecology, Body size, Elevation, Mersin.

# ÖZET

**MERSIN (TÜRKIYE) ILINDEKI FARKLI HABITATLARDA OSTRAKODA (CRUSTACEA) KABUK BOYLARI ILE COĞRAFIK VE EKOLOJIK FAKTÖRLER ARASINDAKI ILIŞKININ BELIRLENMESI**
**YÜKSEK LISANS TEZI**
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**FEN BİLİMLERİ ENSTİTÜSÜ**
**BIYOLOJI ANABILIM DALI**
**(TEZ DANIŞMANI: PROF. DR. OKAN KÜLKÖYLÜOĞLU)**

**BOLU, KASIM - 2018**

Bu çalışmada, 03-09 Ekim 2015 tarihleri arasında Mersin ilinden toplam 117 adet denizel olmayan sucul habitatlardan örnekleme yapılmıştır. Toplam 117 noktadan 36 tür ve 14 alt fosil (kabuk veya karapaks) tespit edilmiştir. Burada bulunan 36 türün 34'ü Mersin ili için yeni kayıttır. Buna ek olarak, dört Ostracoda türü (*Bradlycypris* cf. *obliqua*, *Cypretta* cf. *reticulata*, *Fabeaformiscandona* cf. *wegelini*, *Hemicypris* cf. *largeeticulata*), Türkiye Ostracoda faunası için yeni kayıttır. Su ve sediman örnekleri, farklı yükseklik aralıklarında ostrakod türlerinin dağılımı ile kabuk büyüklüğü arasındaki ilişkiyi göstermek için analiz edilmiştir. Üç veya daha fazla bulunan türlerden 1990 bireyin kabuk boyu ölçülmüştür. Kanonik ilişki Analizinin (CCA) ilk iki ekseni, 12 taksa ve beş çevresel değişken arasındaki ilişkinin % 72.6'sını ortaya çıkarmıştır. Değişkenler arasında su sıcaklığı (P <0.05) ve pH en etkili değişken iken, yükseklik, tuzluluk ve çözünmüş oksijen takson üzerinde anlamlı bir etki göstermemiştir. C2 analizine göre, iki tür *Ilyocypris inermis* ve *Potamocypris fallax*, sırasıyla yükseklik için en düşük ve en yüksek optimum değerleri göstermiştir. *Psychdromus fontinalis* yükseklik için maksimum toleransa sahipken, *Limnocythere inopinata* minimum tolerans göstermiştir. Bireylerin sağ ve sol kabuk uzunlukları arasında anlamlı bir fark vardır (P <0.05, N = 1990). Bunun aksine, bazı türlerin bireyleri yükseklik menzilleri arasında çeşitlilik gösterirken, bazı türler anlamlı bir fark göstermemiştir. Ek olarak, *Ilyocypris bradyi*'nin yükseklik açısından anlamlı bir sonuç verdiği gözlemlenirken (N = 308, t = 4.24, P <0.001), *Psychdromus fontinalis*, tüm bireyler için yükseklik açısından anlamlı bir sonuç göstermemiştir (N = 191, t = 1.45, P> 0.05). Yükseklik arttıkça kabuk uzunluklarında bir değişiklik olduğu açıktır, ancak kabuk uzunluğu ve yükseklik arasındaki ilişki hakkında konuşmak için daha fazla örnekleme ve daha fazla ölçüm gereklidir.

**ANAHTAR KELİMELER:** Ostrakoda, Ekoloji, Boy uzunluğu, Yükseklik, Mersin.

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# LIST OF ABBREVIATIONS AND SYMBOLS

**A1** : First antenna
**A2** : Second antenna
**a.s.l** : above sea level
**Atm.p** : Atmospheric Pressure
**CCA** : Canonical Correspondance Analysis
**DCA** : Detrended Correspondance Analysis
**DO** : Dissolved Oxygen
**EC** : Electrical Conductivity
**Elev** : Elevation
**Hp** : Hemipenis
**Md** : Madibula
**Mx** : Maxillula
**Nit** : Nitrate concentration of water
**ORP** : Oxidation Reduction Potential
**Sal** : Salinity
**Spe.EC** : Specific Eletrical Conductivity
**St. No** : Station Number
**St. Ty** : Station Type
**T1** : First thoracopod
**T2** : Second thoracopod
**T3** : Third thoracopod
**TDS** : Total Dissolved Solid
**TW** : Water temperature
**Ur** : Uropod (furca)
**W.S** : Wind Speed
**Zk** : Zenker organ
**%DO** : Percentage of Dissolved Oxygen

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# 1. INTRODUCTION

## 1.1 Ostracoda

The name of ostracod originated from Greek word ‘ostrakon’ which means ‘shell’ (Meisch, 2000). Ostracods were described firstly in 18th century by Linnaeus in 1748 (Ferguson, 1944). After that, O. F. Müller illustrated ostracods in Europe (Veihberg, 2006). The class Ostracoda belongs to the subphylum Crustacea within Phylum Arthropoda. (Maddocks, 1982, Meisch, 2000). Generally, length of ostracods ranges within 0.3 – 5.0 mm but some marine forms of ostracods pass over 30 mm in length (Delorme, 1991; Meisch, 2000).

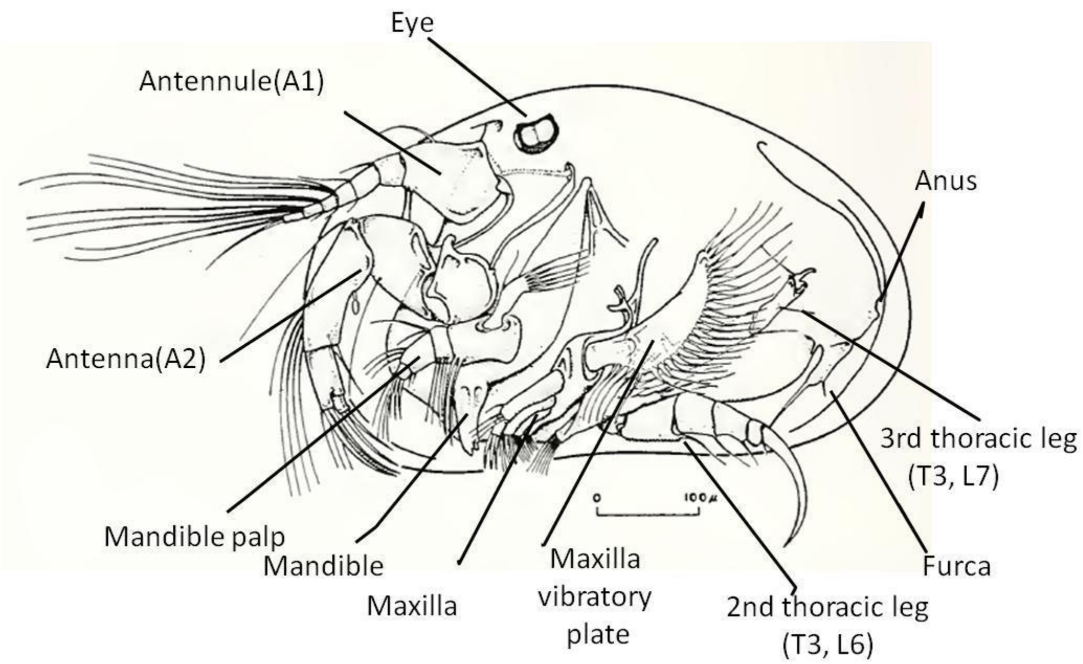


**Figure 1.1.** The arrangement of limbs on the right side of *Cypridopsis vidua* (modified from Kesling 1951).

The class Ostracoda divided into two subclasses (Myodocopa and Podocopa) and four orders (Myodocopida, Platycopida, Palaecopida and Podocopida). Of which, Myodocopida has only marine forms of Ostracoda while Platycopida has mainly marine forms with a few brackish water species. Palaecopida has merely fossil form of Ostracoda when Podocopida includes only freshwater species (Meisch, 2000). Freshwater ostracods have three superfamilies (Darwinuloidea, Cypridoidea and Cytheroidea) (Martens et al., 2008).

Ostracods compose of two calcareous valves and soft body parts (Figures 1.1, 1.2). The calcified carapace is the remarkable features of ostracods (Meisch, 2000) that carapace can easily be fossilized due to its $CaCO_3$ structure. Thus, this calcified structure is used in paleolimnological and paleoclimatic studies (Forester, 1991; Smith, 1993; Holmes et al., 1998, Külköylüoğlu, 1998; Mischke et al., 2005; Mischke and Wünnemann, 2006; Wünnemann et al., 2006; Jiang et al., 2008). The group is also known as the 'oldest microfauna' (Delorme, 1991). Fossil species goes back to the period of Cambrian (circa 500 mya) (Sars, 1928; Henderson, 1990). However, the presence of ostracods in the sediment has begun from the time of the Ordovician (490 mya) (Ozawa, 2013). On the other hand, the earliest records of freshwater ostracods belonged to Devonian period of approximately 360 mya (Martens et al., 2008).

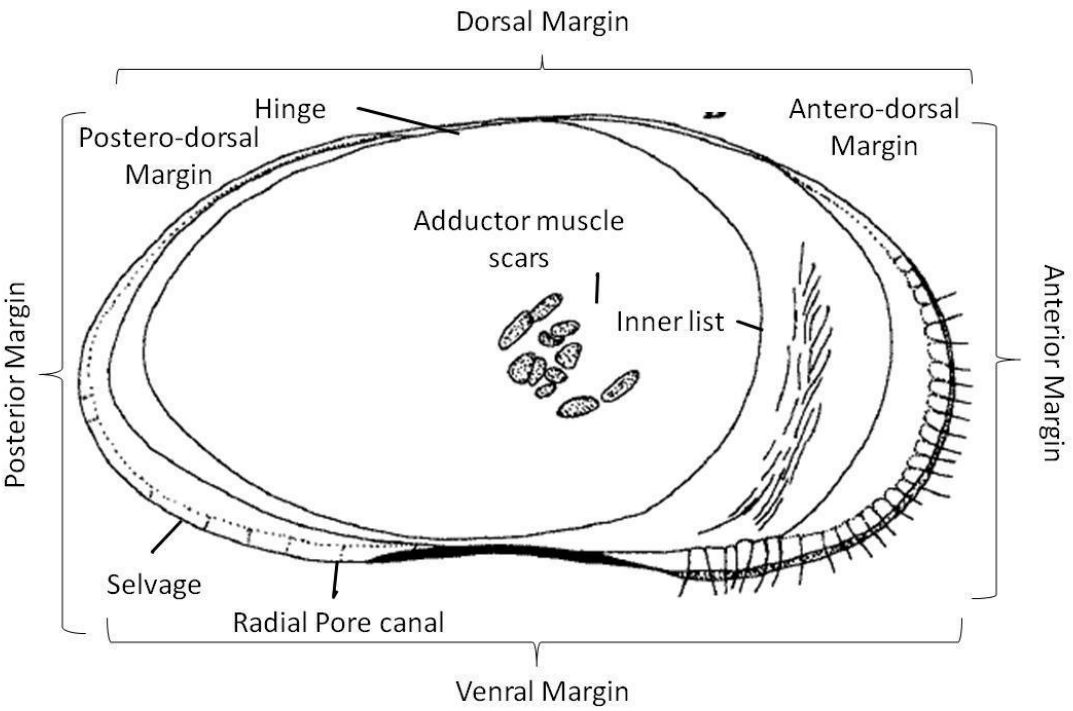


**Figure 1.2.** The internal view is left valve of *Strandesia kimberleyi* (modified from Karanovic 2005).

### 1.1.1 Morphology

#### 1.1.1.1 Carapace of Ostracoda

All ostracods have a pair of calcium carbonated valves and these valves linked to each other at medio-dorsal part and this structure known as ‘hinge’ (Figure 1.2) (Meisch, 2000). Therefore, carapace totally enclosed the appendages of organisms which includes about seven pairs of limbs. This structure is one of the most distinctive features for all Ostracoda because it helps to protect their soft body and against some predators. Valves are connected each other and motion of valves are provided by central adductor muscles (Figure 1.2) and it can easily be seen from outside of carapace. Changes in the specific form of the carapace, such as triangular or trapezoidal shaped, can be observed according to the size of the internal organs (Danielopol, 1980). Muscle scars also used for the description of some ostracods up to superfamily level (Meisch, 2000). Additionally, carapace provides extra stability to live in the benthic condition (Karanovic, 2012). Essentially, carapace have several different type of structures such as tubercules, pores, nodes and spines and the structures play key role for the Ostracoda activity (Martens, 1998; Meisch, 2000; Karanovic, 2012). In this way, these ornaments are used for generic and species identification in fossil form of Ostracoda exclusively (Delorme, 1991; Martens, 1998; Meisch, 2000; Karanovic, 2012; Rodriguez-Lazaro & Ruiz-Muñoz, 2012).

When one examines the carapace chemical structure, it can be seen that carapace contains some of those trace elements (e.g. magnesium, strontium and calcium) other than $CaCO_3$ (Chivas et al.,2002). According to researchers, only two of the three elements are present as a pair like Ca/Mg, Ca/Sr, Mg/Sr etc. (Turpen and Angel, 1971; Xia et al., 1997; Wansard et al., 1999; Gouramanis and De Decker, 2010; Külköylüoğlu et al., 2015) but other combinations (although rare) can also be possible.

#### 1.1.1.2 Appendages

Ostracods have no true segmentation like other arthropods. Thus, they can be recognized among other crustacean (Naimotko et al., 2011). We can assume that an individual with a lateral view consists of 1/3 anterior and 2/3 posterior sections (Danielopol, 1980). Soft body parts of ostracods consist of seven to eight appendages in Podocopid ostracods. These are Antennule (A1), Antenna (A2), Mandible (Md), Maxillula (Mx1), First thoracopod (T1, clasping organ in male), Second thoracopod (T2, walking leg), Third thoracopod (T3, cleaning leg) and Uropod (furca, Ur), Hemipenis (Hp) Zenker organ (Zk) (Figure 1.3). Before examining the appendages, carapace are the most important identification factors but most distinguished feature is appendages for the recent forms. For example, the number of setae on any appendages is important characteristic as well as the location, length and types of mean used during identification of Ostracoda (Meisch, 2000).

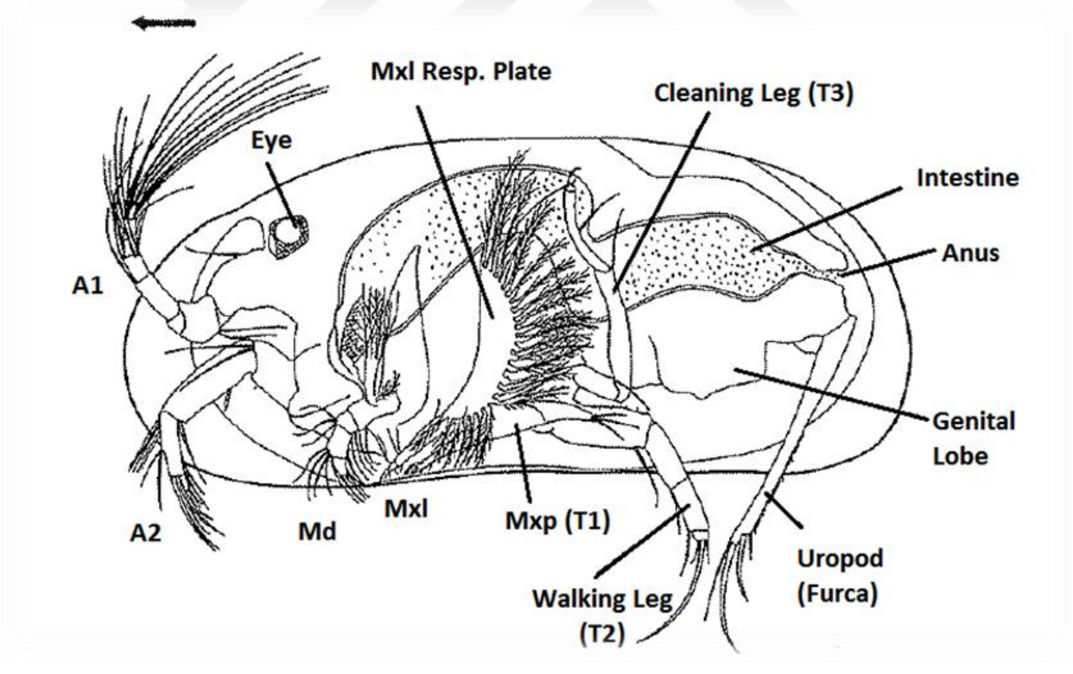


**Figure 1.3.** Internal view of *Herpetocypris reptans* modified from Meisch (2000).

### 1.1.2 Reproductive System

Reproductive mode of marine forms of ostracods mainly is bisexual reproduction mode whereas nonmarine ostracods show parthenogenetic reproduction and bisexual modes (Bell, 1982; Butlin et al., 1998). However, oldest asexual (parthenogenetic) reproductive group of ostracods is the family of Darwininulidea (Schön et al., 1998, 2008; Van Donnick et al., 2002; Schön and Martens, 2003; Van Donnick et al., 2003; Martens et al., 2005). According to Martens et al. (2003) *Darwinula stevensoni* has asexual reproduction mode over 200 million years old without males.

Actually, freshwater ostracods have four different reproductive modes (Meisch, 2000). First one is the ‘fully sexual (or bisexual)’ reproduction mode and this mode includes both male and female individuals in population. The genus Cyclocypris is a good example for this mode. Second type of mode is “mixed reproduction” and including three populations: (i) fully sexual reproduction and there is no any parthenogenetic reproduction, (ii) bisexual population with mixed reproduction (i.e *Eucypris virens* (Adolfsson et al., 2009)) (iii). Third one is fully parthenogenetic reproductive populations or named as ’recent asexual population’ (Butlin et al., 1998).

The last one is the mode of reproduction is ancient asexual populations. They have almost permanent parthenogenetic reproduction for a long time. The Darwinuloidea one of the great examples for this (Meisch, 2000).

Podocopid ostracods consist of a pair of reproductive organs (Meisch 2000) such as Hemipenis, Zenker organ (absent in Myodocopa and Cytheroidea), clasping organ (originated from maxullar palp), testes or seminiferous tubules whereas female organs include ovary, seminal receptal, genital lob and vagina (Figure 1.4).

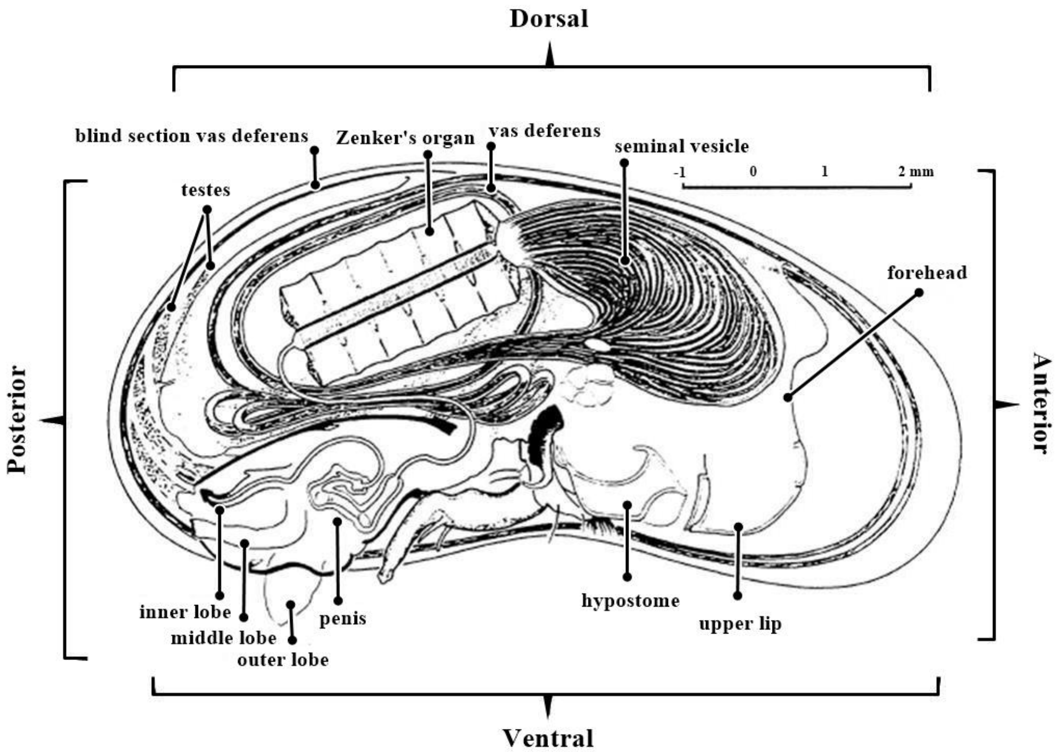


**Figure 1.4.** The genital organs of male individual (*Candona suburban*) (modified from Kesling 1957).

### 1.1.3 Ecology and Distribution

Ostracoda occurs in almost all aquatic environment. They can be found from littoral zone to the abyssal depths of the ocean (Fricke et al., 1989), temporary and permanent freshwater bodies, lakes, streams, rivers, semiterrestrial habitats, pools etc. (Meisch, 2000; Horne, 2003; Özuluğ, 2012; Karanovic, 2012; Külköylüoğlu, 2013; Külköylüoğlu et al., 2013; Yavuzatmaca et al., 2015). Indeed, a few genera can also be encountered in semi-terrestrial habitats (e.g., *Metacypris cordata*) (Danielopol and Vespremeanu, 1964; Delorme, 1991; Douglas and Healy, 1991; Külköylüoğlu and Vinyard, 2000).

Most of freshwater species can survive different kind of conditions at different latitude, longitude, elevation and seasonal differences. Also, some species can survive in extreme chemical and physical conditions; for instance, *Cyprideis torosa* can survive in higher level of salt water (Delorme, 1991) and highly sulfuric condition. According to the previous studies, ostracods can be sensitive to changes in elevation, dissolved oxygen, temperature, salinity, pH, conductivity (Külköylüoğlu, 2005a; Mischke et al., 2007; Perez et al., 2010). Thereby, eventually, the changes affect their distribution and abundance (Mezquita et al., 2001; Külköylüoğlu, 2005a; Pérez et al., 2010). Hence, nonmarine ostracods can be used as bioindicator species so they have specific level of toleration to several different ecological factors (Benson, 1990; Delorme, 1991; Külköylüoğlu, 1999).

On the other hand, ostracods have wide distribution depending on their tolerance of ecological condition and dispersion abilities. Hence, the movement of the ostracods can be passive and active (Danielopol et al., 1994). During active movement, they can swim via their long setae and also can walk (Delorme, 1991). Another transport system of ostracods is passive distribution. Can be carried by human activities, wind, fishes, birds, and insects (Horne and Martens, 1998; Külköylüoğlu, 1999; Meisch, 2000, Rossi et al., 2003).

Some Ostracoda species can demonstrate wide distribution and tolerance ranges. Although they can be affected by several ecological condition such as pollution so this kind of species called as ‘cosmopolitan species’ and they can adapt rapidly different ecological condition (Külköylüoğlu, 2004; 2005a). In some casei however, a few species do show wide tolerances to different environmental variables within a relatively wide geographical distribution. Such species are called ‘cosmoecious species’ (Külköylüoğlu, 2013a). Moreover, an increasing number of cosmopolitan species may be affected by the disturbance and pollution that causes degradation of local species. In such a case the ratio of non/cosmopolitan species can ve changed to represent water quality levels (Külköylüoğlu, 2004; 2005b).

Ostracods can live as predator, herbivore, omnivores or detritor. Even cannibalism, commensal or ectoparasite can be observed (Hobbs, 1971).

### 1.1.3.1 Elevation

In relation to carapace length, several ecological rules may be considered. One of them is the Cope's rule and another is Bergman's rule. According to Cope's rule body size tends to increase over time. On the other hand Bergman's rule states that there is a tendency of the sizeto decrease by increasing temperature. There are some studies in the literature about elevation and body size of some organisms. Hadkinson (2005) published a review on the relationship between the changes in elevation and the length of terrestrial insects. Size increases are usually explained by a negative relationship between developmental temperature and size between ectothermic animals in a resource-limited environment (Smith et al., 2000). In contrast, as in the *Cacopsylla* species fed on *Salix lapponum* in Norway, the size decreases, often associated with seasonal resource availability, thought to be due to resource limitations that restrict potential growth (Hill, Hamer, & Hodkinson, 1998). Another study, Jaramillo and his friends (2017), differentiation of body size can be defined according to climatic changes. Likewise, the relationship between body size and height, an endemic species of frogs worked in Asia was studied by Hu et al (2011). In general, these studies have shown that some groups have increased, the body size generally decreased with inversely elevation while some groups d,splayed the opposite relationship.

Like other ecological variables, elevation has an impact on the distribution of ostracod species (Mezquita et al.,1999) because elevation affect other ecological variables directly or indirectly . As move up from sea level, the amount of oxygen in the air decreases while the capacity to retain oxygen in the water increases. Additionally, water depth, water chemistry, temperature and conductivity are affected by elevation (Reeves et al., 2007).

It is known that nonmarine ostracods are generally distributed from sea level to about 4000 m a.s.l. (Laprida et al., 2006) or even higher. Such a high level of distribution can be related to species tolerance levels, suggesting that ostracods can inhabitat aquatic habitats as long as conditions are suitable for them. On the other hand, there are studies about decreasing of species diversity with increasing elevation such as in insect herbivores (Lawton et al. 1987), copepods (Jersabeck et al. 2001), zoo and phytoplankton (Tolotti et al. 2006). It is thought that decline of species diversity may be due to lack of suitable habitats, decreasing of source diversity, unpredictable conditions and climatic difficulties (Külköylüoğlu et al., 2012a).

When we consider all these factors, we see that altitude (or elevation which will be changably used in this study) can in/direct affect on species distribution. Although cosmopolitan species can be dispersed at high range of altitudes, differences in the type of aquatic habitats located at different altitudional ranges are also important on species occurrences (Külköylüoğlu et al., 2015).

### 1.1.4 The History of Freshwater Ostracods in Turkey

German scientist H.W. Schäfer was the first scientist who reported non-marine (freshwater) Ostracoda in Turkey in 1952. *Ilyocypris brehmi, Cypris pubera, Eucypris pagasti, Heterocypris barbara, Stenocypris fischeri, Potamocypris arcuata* and *Zonocypris inconspicua* were the first living and recent species of non-marine Ostracoda from Turkey. Next, another German scientist G. Hartman collected Ostracoda and reported them in 1964.

After Hartmann, Gülen (since 1965) and his students have published several publications (Gülen, 1975; 1977; 1985; Gülen et al., 1994; Gülen and Altınsaçlı, 1999) including ostracods from Turkey.

Külköylüoğlu starting to work on ostracods in 1987 was interested in ecological factors on Ostracoda, their distrubution and taxonomy (Külköylüoğlu, 1998, 1999, 2003a-c, 2004, 2005a-c, 2007, 2008, 2013; Külköylüoğlu and Yılmaz, 2006; Külköylüoğlu et al., 1993, 2007, 2010, 2012a-c, 2017).

In 1995 O. Özuluğ contributed to freshwater ostracods studies in Turkey (Özuluğ, 2005; Özuluğ and Yaltalıer, 2008; Özuluğ, 2012). In about same periods, M. Kılıç was able to collect both marine and a few freshwater ostracods from the coasts of Black Sea (e.g., Kılıç 1997, Külköylüoğlu et al., 2007, 2010). During the time, there have been couple of other studies on nonmarine ostracods by a few scientists who are only interested in ostracods; for example, in 1996, C. Aygen reported some ostracods in İzmir (e.g., Aygen & Balık, 1998, 2002; Aygen et al., 2004, 2012).

Students of Okan Külköylüoğlu, D. Akdemir (since 2004), N. Sarı (2007), M. Yavuzatmaca (since 2009) did work on freshwater ostracods at both MsC and PhD levels and able to publish several manuscripts (Akdemir, 2008; Sarı and Külköylüoğlu, 2010; Yavuzatmaca et al., 2012), and the studies are still ongoing.

In addition to these, a few paleontological studies on nonmarine Ostracoda (Nazik and Gross-Uffenorde, 2016; Tuncer and Tunoğlu, 2015; Tunoğlu and Ertekin, 2008) from different regions of Turkey have been published for since the last 30 years.

## 2. AIM AND SCOPE OF THE STUDY

Until now, great numbers of studies have been published about freshwater Ostracoda such as ecology and distribution (e.g., Teeter, 1973; Delorme, 1991; Mezquita et al., 1999a, 2001; Meisch, 2000; Külköylüoğlu, 2005a; Özuluğ, 2012; Külköylüoğlu et al., 2013; Yavuzatmaca, et al., 2015), taxonomy (e.g., Baird, 1835; Sars, 1910; Bronstein, 1947; Hoff, 1943; Danielopol, 1968; Martens, 1986; Karanovic, 2000; Külköylüoğlu, 2008; Külköylüoğlu et al., 2015). However, relationship between carapace size and ecological variables especially elevation in the samples in geographical factors has not been investigated. Therefore, the aim of this study determination of the relationship between Ostracoda carapace size and geographic and ecological factors in different aquatic habitats.

Thus, the main purposes of this study are:

i. To observe the relationship between carapace size of nonmarine ostracod species at different elevational rangesof Mersin.

ii. To investigate ostracod species diversity in the study area.

iii. To determine the effect of ecological variable(s) on species.

iv. To estimate ecological optimum and tolerance level of the species for those of selected variables.

# 3. MATERIALS AND METHODS

## 3.1 Site Description of Mersin Province

Mersin is part of the Mediterranean region of Turkey where 87% of Mersin province is mountainous and 13% is woodland (Mersin Governor 2011). The area studied lies about 36-37° North latitudes and 33-35° East longitudes. Mersin’s land border is 608 km while the sea border is 321 km and its surface area covers about 15.853 $km^2$. Most of the parts of the area is quite high, rugged and rocky West and Central Taurus Mountains. This province has a semi-arid low humidity, mild winters, hot summers, watery winters and very strong seaside crisps according to known classification methods. The average temperature in Mersin is 19.2°C. Looking at Mersin's long-term average temperature trend, there is an increasing trend of 6.5ºC / 100 years in average. Sea water temperature average is 20.8°C. It varies from 25 to 28°C in the summer months. The total amount of rainfall per year is 591.6 mm. The maximum amount of rainfall in December is the lowest in August. Average annual relative humidity is 69% (1975-2006) and varies between 64% and 76% per month (Mersin Governor 2011).

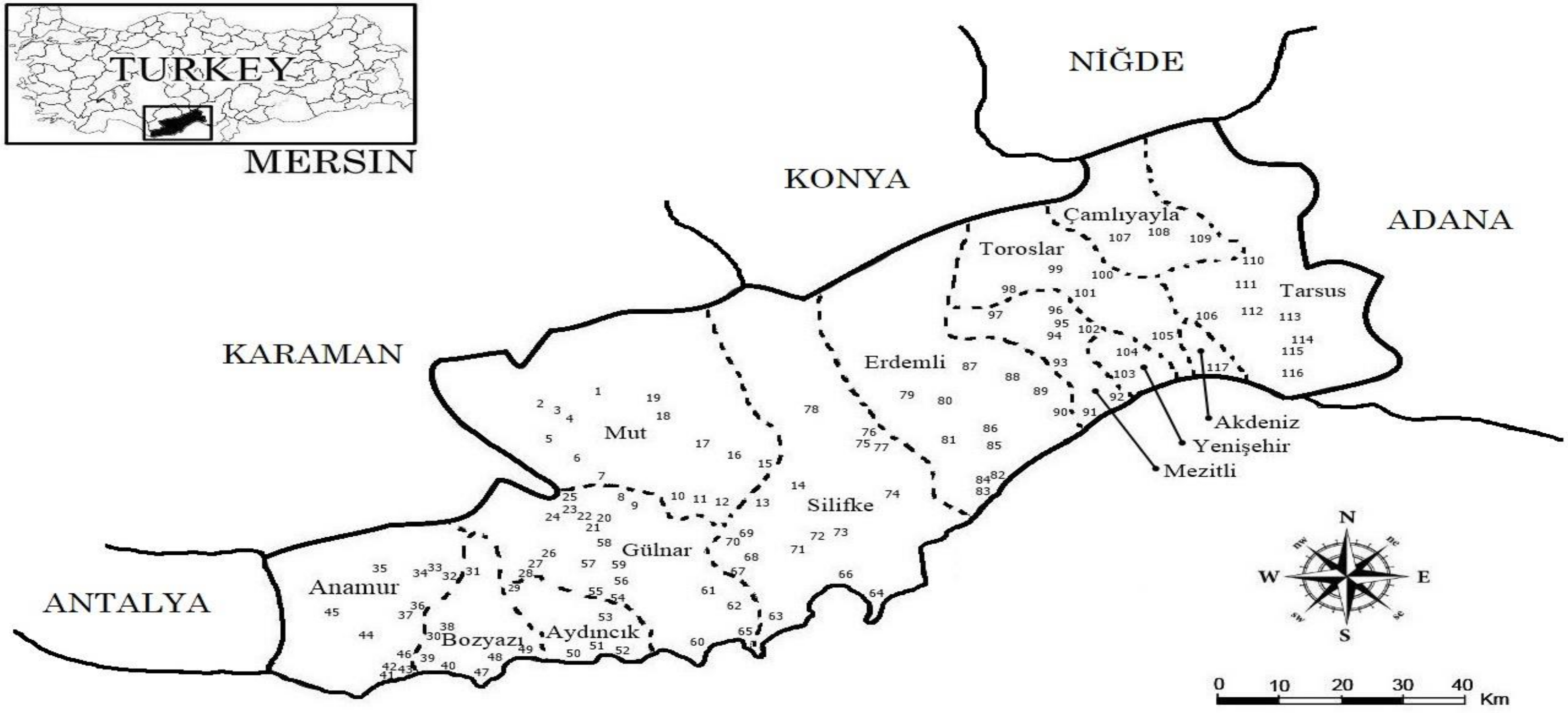


**Figure 3.1**. 117 sampling sites from 13 counties (Akdeniz, Anamur, Aydıncık, Bozyazı, Çamlıyayla, Erdemli, Gülnar, Mezitli, Mut, Silifke, Tarsus, Toroslar, Yenişehir) of Mersin, Turkey.

### 3.2 Sampling and Measurements

Total of 117 samples were randomly collected from 13 different aquatic bodies (lakes, creeks, troughs, dams, ponds, rivers, spring waters, canals, waterbodies (slough), pools, helocrene, rheocrene, and other unnamed water bodies types) in the course of 3- 9 October 2015 (Figure 3.1).

Ecological variables including electrical conductivity (EC $\mu Scm^{-1}$), dissolved oxygen concentration (DO, $mgL^{-}$), pH, percent oxygen saturation (% sat.), water temperature (TW, $^{o}C$), salinity (SAL, ppt), atmospheric pressure (Atm.p, mmHg), total dissolved solids (TDS, $mgL^{-1}$), oxidation reduction potential (ORP)) were measured at each site before samples were collected to avoid possible results of pseudoreplication (Hurlbert, 1984). Measurments were done by YSI- I professional plus. Moreover, coordinates and elevation were reported with GARMIN e-trex Vista H GPS in each sampling site. On the other hand, air temperature (Ta $^{o}C$), air moisture (%), and wind speed ($kmh^{-1}$) were measured with Testo 410-2 model of anemometer (Appendices A).

Ostracod samples were collected from each sampling site by hand net (150 μm mesh size) from sediment and were kept in 250ml of plastic bottle, and fixed in %70 alcohol was put on the samples tofix the materials in situ. Therefore, every bottle was filtered from four standard sieves (0.5, 1.0, 1.5 and 2.0mm mesh size) with water in the Limnology Laboratory of Hydrobiology Subdivision. Afterwards, the samples were sorted under stereomicroscope (Olympus ACH 1X) from sediments and prepared for taxonomic identification. During the identification, we used taxonomic keys of Mesich (2000), Karanovic (2012), and other related keys. Both the soft body parts and carapace were reserved in slides with solution of lactophenol and valves were also kept in the micropaleontological slides. These slides were also used for Scanning Electron Microscope (SEM). Additionally, the light microscope (Olympus BX-51) and inverted microscope (Leica DMi1) were used to measure carapace length and height. Leica MC170 HD camera with Leica Application Suite V4 software were used during valve length measurement. During the measurements the longest distance on the valves from left (posterior side) to right (anterior side) was accepted as the length while the height point of the valve in the middle was used as the height. All samples are reserved at the Limnology Laboratory of Bolu Abant İzzet Baysal University, Turkey.

In addition to the measurements taken from each site as explained above, we also collected water samples for some of those major ions (anions and cations) analyses. In about 200 ml of water samples were collected from each site into a sterile plastic bottles. The water samples were arranged to analyze by filtering from syringe-type membrane filter (0.45 µm) and then standard method was applied anion and cation analyses no:4110 in Ion Chromatography (Dionex 1100) to water samples of the Department of Engineering, Bolu Abant İzzet Baysal University. At the end of these analyses, some chemical values in water (sodium ($Na^{2+}$), calcium ($Ca^{2+}$), potassium ($K^{2+}$), magnesium ($Mg^{2+}$), chloride ($Cl^{-}$), sulphate ($SO_4^{-2}$) nitrite ($NO_2^{-}$) and nitrate ($NO_3^{-}$) were calculated (Appendice B).

### 3.3 Statistical Analyses

Microsoft Office (2016) was used to arrange actual data collected from each site in situ. To compare the, two tailed t-tests with un/equal variance analyses were applied the mean values of species carapace length and width separately. During the measurements, 36 species were put under our attention but the most common species were focused on in detailed examination due to their frequent occurrences at different elevational ranges. Also, a simple regression model was used to test possible effect of water temperature on the lenthg of the valves in Excel program. Afterwards, to explain relationship between ostracod distribution and ecological variables along with elevation, different statistical analyses and methods were used in Canonical Corresponding Analysis (CCA), and t-tests. Furthermore, Canonical Corresponding Analysis with Monte Carlo Permutation test (499 permutations) were used to asses possible relationship between ostracods and ecological variables (TW, DO, EC, Sal, pH, ORP, Atm.p , Moist., St.Ty, Elev. W.S, TDS, Ta).

Before using CCA analyses, DCA analysis was applied. In the event of DCA higher than three, data is suitable (TW, DO, Sal, pH, Elev) to use for CCA analysis

(Ter Braak, 1987; Birks et al., 1990). It is important to note that I used *Candona* sp. during the analyses because it was reported more than 3 times in the present study. Due to the uncertainty about its taxonomic level, I preferred to leave it as sp. for future studies.

C2 program was also used to estimate species tolerance (tk) and optimum (uk) levels to variety of chemical and ecological variables such as $Na^{+2}$, $K^{+}$, $Mg^{2+}$, $Ca^{2+}$, $Cl^{-}$  $NO_2^{-}$, $NO_3^{-}$,  $SO_4$ and pH, DO, EC, TW, elevation, salinity. During the analyses,  transfer function of weighted averaging regression models were applied as suggested  (Juggins, 2003) (Appendix C).

# 4. RESULTS

## 4.1 Taxonomic Results

Until this study, five ostracod species (*Heterocypris incongruens*, *Eucypris virens*, *Eucypris mareotica*, *Tonnacypris lutaria and Heterocypris salina*) were known from Mersin (Hartmann 1964; Gülen 1988). During this study 50 taxa (36 recent and 14 subfossil) were reported from 66 of 117 randomly selected sampling site in Mersin. *Heterocypris salina* and *H. incongruens* were the two common species found in both previous and the present study. Furthermore, a possibly new species (*Pseudostrandesia* n. sp.) was firstly reported from the area (it will be published elsewhere). In addition, four recent taxa of Ostracoda (*Bradlycypris* cf. *obliqua*, *Cypretta* cf. *reticulata*, *Fabeaformiscandona* cf. *wegelini*, *Hemicypris* cf. *largereticulata*) were new record for the Turkish Ostracoda fauna. According to Külköylüoğlu and his friends (2015), a total of 143 non marine ostracod were known from Turkey. However, with this study, this number increased to 147 taxa.

## 4.2 Taxonomic Description

| | |
|---|---|
| **PHYLUM:** | ARTHROPODA |
| **SUBPHYLUM:** | CRUSTACEA Pennat, 1777 |
| **CLASS:** | OSTRACODA Latreille, 1802 |
| **SUBCLASS:** | PODOCOPA Müller, 1894 |
| **ORDER:** | PODOCOPIDA Sars, 1866 |
| **SUBORDER:** | Podocopina Sars, 1866 |
| **INFRAORDER:** | Cypridacopina Jones, 1901 |

**Superfamily:** Darwinuloidea Brady and Norman, 1889

**Family:** Darwinulidea Brady and Norman, 1889

**Genus:** *Darwinula* Brady and Robertson, 1885

*Darwinula stevensoni* Brady and Robertson, 1870

**Superfamily:** Cypridoidea s. str. Baird, 1845

**Family:** Candonidae Kaufmann, 1900

**Subfamily:** Candoninae Kaufmann, 1900

**Genus:** *Candona* s. str. Baird, 1845

*Candona weltneri* Hartwig, 1899

*Candona neglecta* Sars, 1887

*Candona* sp.

*Candona* sp1.

**Genus**: *Fabaeformiscandona* Krstic, 1972

*Fabaeformiscandona* cf. *wegelini* Petkovski, 1962

**Genus:** *Pseudocandona* Kaufmann, 1900

*Pseudocandona albicans* Brady, 1864

*Pseudocandona* sp.

**Subfamily:** Cyclocypridinae Kaufmann, 1900

**Genus:** *Cypria* Zenker, 1854

*Cypria ophtalmica* Jurine, 1820

**Family**: Ilyocyprididae Kaufmann, 1900

**Subfamily:** Ilyocypridinae Kaufmann, 1900

**Genus:** *Ilyocypris* Brady and Norman, 1889

*Ilyocypris gibba* Ramdohr, 1808

*Ilyocypris monstrifica* Norman, 1862

*Ilyocypris inermis* Kaufmann, 1900

*Ilyocypris bradyi* Sars, 1890

*Ilyocypris* sp.

**Family:** Cyprididae Baird, 1845

**Subfamily:** Cyprettinae Hartmann, 1964

**Genus:** *Cypretta* Vavra, 1895

*Cypretta* sp.

**Subfamily:** Cypridinae Baird, 1845

**Genus:** *Cypris* O. F. Müller, 1776

*Cypris pubera* O. F. Müller, 1776

**Subfamily:** Eucypridinae Bronshtein, 1947

**Genus:** *Eucypris* Vavra, 1891

*Eucypris* sp.

**Genus:** *Prionocypris* Brady and Norman, 1896

*Prionocypris zenkeri* Chyzer and Toth, 1858

*Prionocypris* sp.

**Subfamily:** Cypricercinae McKenzie, 1971

**Genus:** *Bradleycypris* McKenzie, 1982

*Bradleycypris* cf. *obliqua* Brady, 1868

*Bradleycypris* sp.

**Subfamily:** Herpetocypridinae Kaufmann, 1900

**Genus:** *Herpetocypris* Brady and Norman, 1889

*Herpetocypris reptans* Baird, 1835

*Herpetocypris helenae* G. W. Müller, 1908

*Herpetocypris intermedia* Kaufmann, 1900

*Herpetocypris* sp.

**Genus:** *Psychrodromus* Danielopol and McKenzie, 1977

*Psychrodromus olivaceus* Bardy and Norman, 1889

*Psychrodromus fontinalis* Wolf, 1920

*Psychrodromus* cf. *robertsoni* Brady and Norman, 1889

*Psychrodromus* sp.

**Genus:** *Stenocypris* Sars, 1889

*Stenocypris* sp.

**Subfamily:** Cyprinotinae Bronshtein, 1947

**Genus:** *Heterocypris* Claus, 1892

*Heterocypris incongruens* Ramdohr, 1808

*Heterocypris rotundata* Bronshtein, 1928

*Heterocypris salina* Brady, 1868

*Heterocypris reptans* Kaufmann 1900

*Heterocypris* sp.

**Genus:** *Hemicypris* Sars, 1903

*Hemicypris* cf. *largereticulata* (Rome 1969)

*Hemicypris* sp.

**Subfamily:** Isocypridinae Rome, 1965

**Genus:** *Isocypris* G. W. Müller, 1908

*Isocypris beauchampi* Paris, 1920

**Subfamily:** Cypridopsinae Kaufmann, 1900

**Genus:** *Cypridopsis* Brady, 1867

*Cypridopsis vidua* O. F. Müller, 1776

*Cypridopsis* sp.

**Genus:** *Plesiocypridopsis* Rome, 1965

*Plesiocypridopsis newtoni* Brady & Robertson, 1870

**Genus:** *Potamocypris* Brady, 1870

*Potamocypris fallax* Fox, 1967

*Potamocypris variegata* Brady and Norman, 1889

*Potamocypris smaragdina* Vávra, 1891

*Potamocypris villosa* Jurine, 1820

*Potamocypris arcuata* Sars, 1903

*Potamocypris* sp.

**Superfamily:** Cytheroidea Baird, 1850

**Family:** Limnocytheridae Klie, 1983

**Subfamily:** Limnocytherinae Klie, 1938

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

*Limnocythere inopinata* Braid, 1843

**Family:** Cytherideidae Sars, 1925

**Genus:** *Cyprideis* Jones, 1857

*Cyprideis torosa* (Jones, 1850)

### 4.3 Auto Ecology and Measurements

For the statistical analysis, individuals were expected to repeat at least three or more times. Because of this reason, we did not use 24 taxa (*Bradleycypris* cf. *obliqua* , *Candona neglecta, C. weltneri*, *Cypretta* cf. *reticulata, Cypria ophtalmica, Cyprideis torosa*, *Cypris pubera, Darwinula stevensoni*, *Fabeaformiscandona* cf. *wegelini*, *Hemicypris* cf. *largereticulata, Herpetocypris helenae, H. intermedia, H. reptans*, *Heterocypris rotundata*, *Ilyocypris gibba, I. monstrifica*, *Isocypris beauchampi*, *Plesiocypridopsis newtoni*, *Potamocypris arcuata*, *P. smaragdina, P. variegata, P. villosa, Psychrodromus* cf. *robertsoni*, *Pseudostrandesia* n. sp.).

However, a brief information about each of these species that are not statistically analyzed are provided below. (Also appendices A, B and C). The rest is also discussed as well.

**Tablo 4.1** Occurred Less Than Three Times During the Study

| Species | St. Ty | St. No | RL (mm) | RH (mm) | LL (mm) | LH (mm) | Elev (m) |
|---|---|---|---|---|---|---|---|
| ***Bradleycypris* cf. *obliqua*** | 11 | 66 | 0 | 0 | 0 | 0 | 262 |
| ***Candona negletta*** | 9 | 12 | 1,093 | 0,566 | 1,126 | 0,597 | 444 |
| ***Candona weltneri*** | 2 | 29 | 0,864 | 0,437 | 0,896 | 0,477 | 1125 |
| ***Cyretta* cf. *Reticulata*** | 3 | 66 | 0,000 | 0,000 | 0,000 | 0,000 | 80 |
| ***Cypria opthalmica*** | 2 | 42 | 0,558 | 0,381 | 0,578 | 0,400 | 240 |
| ***Cypris pubera*** | 7 | 23; 50 | 1,384 | 0,842 | 1,395 | 0,930 | 84; 925 |
| ***Darwinula stevensoni*** | 9 | 65 | 0,000 | 0,000 | 0,000 | 0,000 | 294 |
| ***Fabaeformiscandona* cf . *wegelini*** | 10 | 2 | 0,835 | 0,391 | 0,851 | 0,417 | 235 |
| ***Hemicypris cf. largereticulata*** | 11 | 116 | 0,750 | 0,502 | 0,761 | 0,493 | 3 |
| ***Herpetocypris helenae*** | 11 | 60 | 1,687 | 0,729 | 1,819 | 0,780 | 262 |
| ***Herpetocypris intermedia*** | 3 | 1,22 | 1,533 | 0,660 | 1,614 | 0,709 | 793; 1002 |
| ***Herpetocypris reptans*** | 7 | 23 | 0,863 | 0,476 | 0,883 | 0,513 | 925 |
| ***Heterocypris rotundata*** | 3 | 66 | 1,118 | 0,650 | 1,169 | 0,692 | 80 |
| ***Ilyocypris gibba*** | 10 | 3 | 0,816 | 0,447 | 0,829 | 0,472 | 7 |
| ***Ilyocypris monstrifica*** | 2; 7 | 91;92 | 0,712 | 0,385 | 0,726 | 0,404 | 84; 224 |
| ***Isocypris beauchampi*** | 4 | 8 | 0,986 | 0,526 | 0,977 | 0,526 | 130 |
| ***Plesiocypridopsis newtoni*** | 3 | 37; 72 | 0,782 | 0,425 | 0,787 | 0,440 | 219; 860 |
| ***Potamocypris arcuata*** | 3 | 99 | 0,549 | 0,341 | 0,562 | 0,358 | 1414 |
| ***Potamocypris smaragdina*** | 2 | 38 | 0,501 | 0,318 | 0,514 | 0,319 | 141 |
| ***Potamocypris variegata*** | 3 | 61 | 0,477 | 0,284 | 0,492 | 0,303 | 470 |
| ***Potamocypris villosa*** | 3 | 55 | 0,699 | 0,426 | 0,722 | 0,478 | 975 |
| ***Psychrodromus* cf. *robertsoni*** | 9 | 83 | 1,068 | 0,534 | 1,104 | 0,577 | 83 |
| ***Pseudostrandesia* n.sp.** | 7 | 50 | 0,731 | 0,371 | 0,707 | 0,364 | 84 |

For the regression analyses, we only used *I. bradyi* an *H.salina* because they were found almost every elevational range when *I. bradyi* was found seven different elevational range and *H. salina* was six different elevational range (Table 4.2 and 4.3). According to results of regression analysis, it was observed that temperature did not show significant effect on the length of right and left valves lengths and height between these ranges (Table 4.2 and 4.3). However, it was observed that the height and length of the valves increased with elevation (Figure 4.1 and 4.2) . The data used in regression are given in the (Table 4.2 and 4.3) below.

**Table 4.2** Change of valves lengths depending on temperature in different elevational ranges for *H.salina.* Abbreviations; RL:Length of right valve, RH:Height of right valve, LL:Length of left valve, LH: Height of left valve, TW:Water temperature. Note that ranges without species are not included into the table.

| **Elevation (m)** | **RL** | **RH** | **LL** | **LH** | **TW** |
|---|---|---|---|---|---|
| 991-1155 | 0.908 | 0.566 | 0.939 | 0.607 | 15.6 |
| 661-825 | 1.018 | 0.594 | 1.06 | 0.629 | 20.8 |
| 496-660 | 0.954 | 0.56 | 0.991 | 0.631 | 19.5 |
| 331-495 | 0.96 | 0.572 | 1.149 | 0.618 | 20 |
| 166-330 | 0.831 | 0.506 | 0.849 | 0.536 | 19.4 |
| 0-165 | 0.999 | 0.587 | 1.042 | 0.635 | 23.2 |

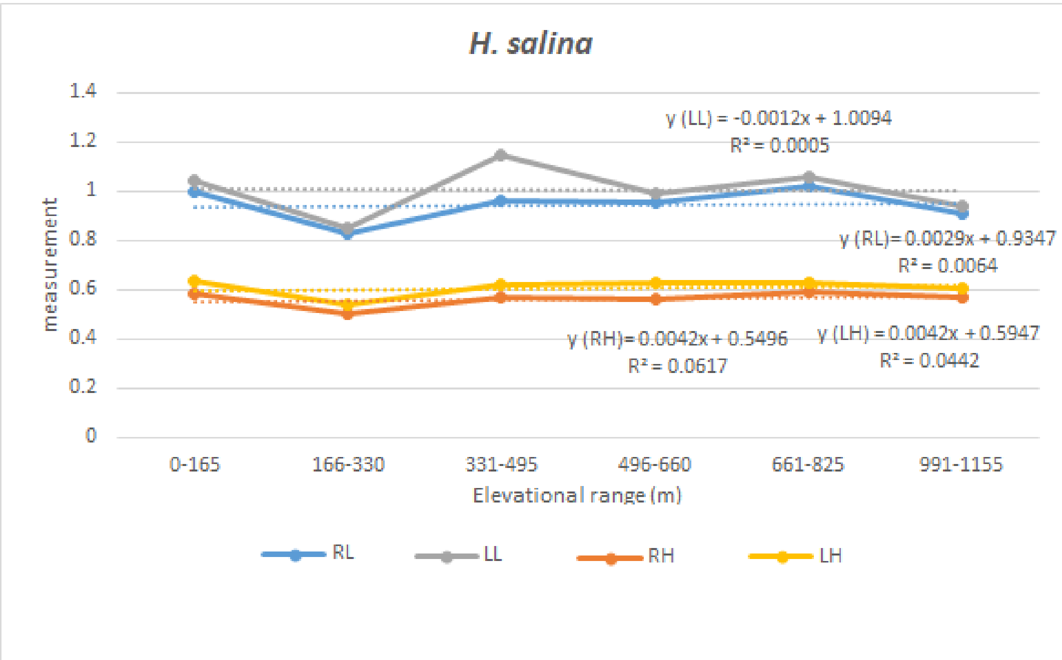


**Figure 4.1** The tendency of valves depending on elevation for *H. salina*.

**Table 4.3** Change of valves lengths depending on temperature in different elevational ranges for *I.bradyi*. Abbreviations; RL:Length of right valve, RH:Height of right valve, LL:Length of left valve, LH: Height of left valve, TW:Water temperature. Note that ranges without species are not included into the table.

| **Elevation (m)** | **RL** | **RH** | **LL** | **LH** | **TW** |
|---|---|---|---|---|---|
| 1321-1485 | 0.797 | 0.415 | 0.825 | 0.432 | 16.1 |
| 1156-1320 | 0.896 | 0.461 | 0.900 | 0.473 | 16.8 |
| 991-1155 | 0.805 | 0.434 | 0.827 | 0.463 | 15.6 |
| 826-990 | 0.844 | 0.442 | 0.857 | 0.461 | 17.5 |
| 496-660 | 0.784 | 0.414 | 0.804 | 0.433 | 19.5 |
| 331-495 | 0.817 | 0.422 | 0.836 | 0.444 | 20 |
| 0-165 | 0.793 | 0.408 | 0.820 | 0.434 | 23.2 |

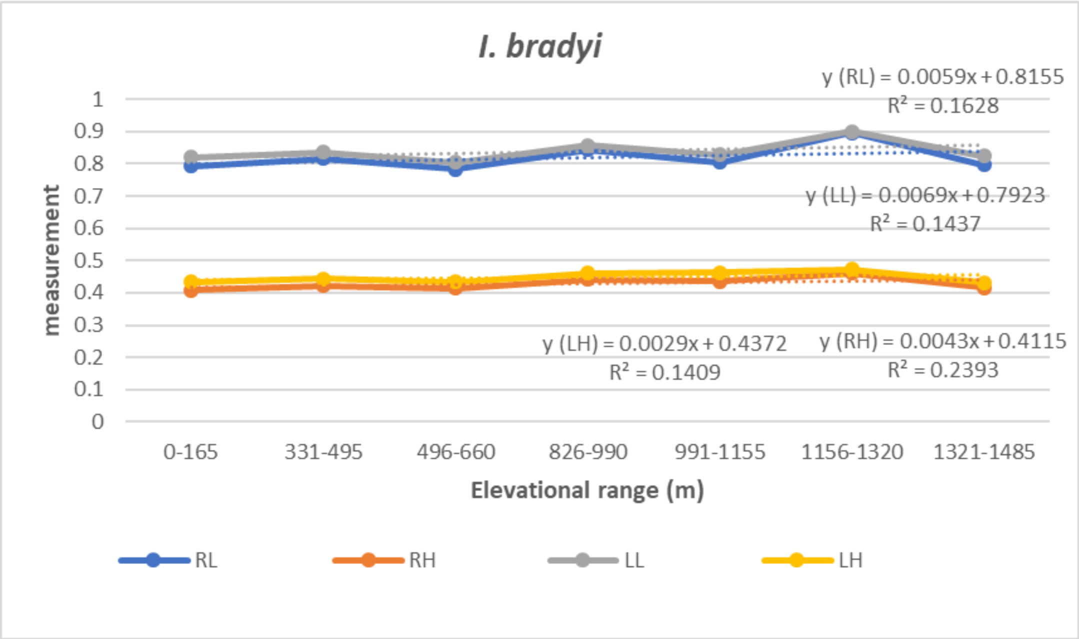


**Figure 4.2** The tendency of valves depending on elevation for *I. bradyi*.

CCA was applied to explain relationship between 12 taxa (*Candona* sp, *Cypridopsis vidua*, *Heterocypris incongruens*, *H. reptans* , *Heterocypris salina*, *Ilyocypris bradyi*, *I.inermis*, *Limnocythere inopinata*, *Potamocypris fallax*, *Prionocypris zenkeri*, *Psychrodromus fontinalis*, *P. olivaceus*). and 5 (sal, pH, elev, DO and TW) ecological variables with at least 3 or more occurrences (Table 4.4).

**Table 4.4.** CCA summary table with five variables (Elevation (Elev), pH, TW( Water temperature), Dissolved Oxygen (DO), Salinity (sal)). * refers to DCA value.

| **Axes** | **1** | **2** | **3** | **4** | **Total inertia** |
|---|---|---|---|---|---|
| Eigenvalues | 0.380 | 0.325 | 0.171 | 0.063 | 5.958 |
| Species-environment correlations | 0.731 | 0.714 | 0.516 | 0.348 | |
| Lengths of gradient* | 5.829 | 3.291 | 5.010 | 4.405 | |
| Cumulative percentage variance: | | | | | |
| of species data | 6.4 | 11.8 | 14.7 | 15.8 | |
| of species-environment relation | 39.1 | 72.6 | 90.1 | 96.7 | |
| Sum of all eigen values | | | | | 5.958 |
| Sum of all canonical eigenvalues | | | | | 0.971 |

According to Table 4.4, first two axes of CCA diagram shows about %72.6 of the relationship between 5 variables and 12 taxa (Fig. 4.3.)

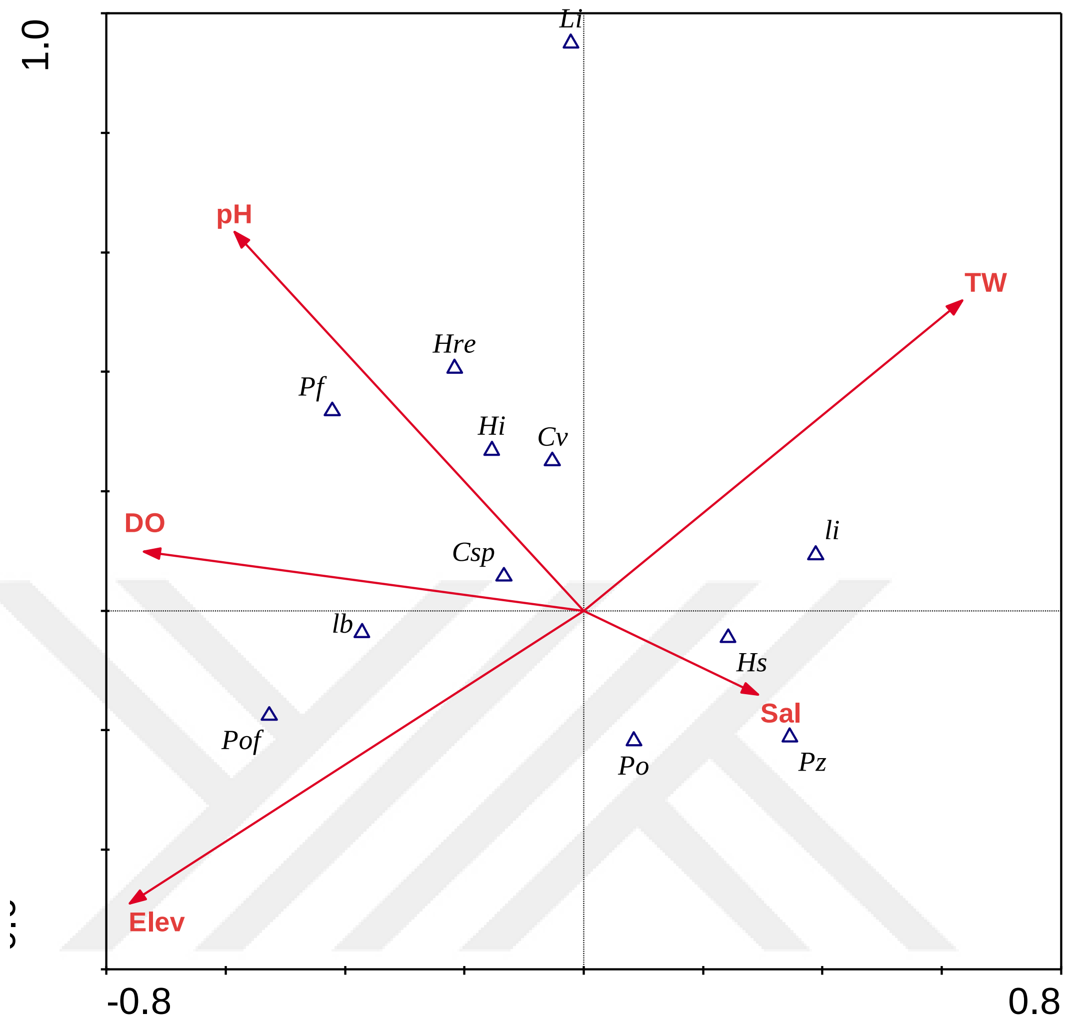


**Figure 4.3.** The diagram of CCA indicate the relationship between five ecological variables, (sal (salinity), pH, elevation (elev), DO (dissolved oxygen), TW (water temperature)) and 12 taxa ( *Candona* sp (Csp), *Cypridopsis vidua* (Cv), *Heterocypris incongruens* (Hi), *H. reptans* (Hre), *H. salina* (Hs), *Ilyocypris bradyi* (Ib), *I. inermis* (li), *Limnocythere inopinata* (Li), *Potamocyppris fallax* (Pof), *Prionocypris zenkeri* (Pz), *Psychrodromus fontinalis* (Pf), *P. olivaceus* (Po)).

CCA diagram (Figure 4.3) shows that two of five ecological variables (TW ($F = 3.259$, $P = 0.006$), pH ($F = 3.251$, $P = 0.006$)) were the most effective variables on species while the rest of three (DO ($F = 1.187$, $P = 0.272$), salinity ($F = 0.835$, $P = 0.398$), Elevation ($F = 1.970$, $P = 0.280$)) did not show significant relationships with ostracods.. Except *Candona* sp. all of species have enough distance from the center of the diagram. .On the CCA diagram, three species (*P. olivaceus*, *H. salina* and *Prionocypris zenkeri*) are placed closer to the salinity while I. *inermis* is closely related to the arrows of salinity and water temperature. Four other species (Cv, Hi, Hre, Pf) are found nearby the arrow of pH.

On the other hand, *Candona* sp. is located between the arrows of DO and pH. Although not at an extreme level, these two variables may have both effective on the species (see discussion). Meanwhile, I. bradyi, one of the most common species of aquatic bodies, seems to have close relationship with DO due to its location on CCA diagram where *L. inopinata* is located relatively outsite of the range. The only species with a close relationship with elevation was *P. fallax*.

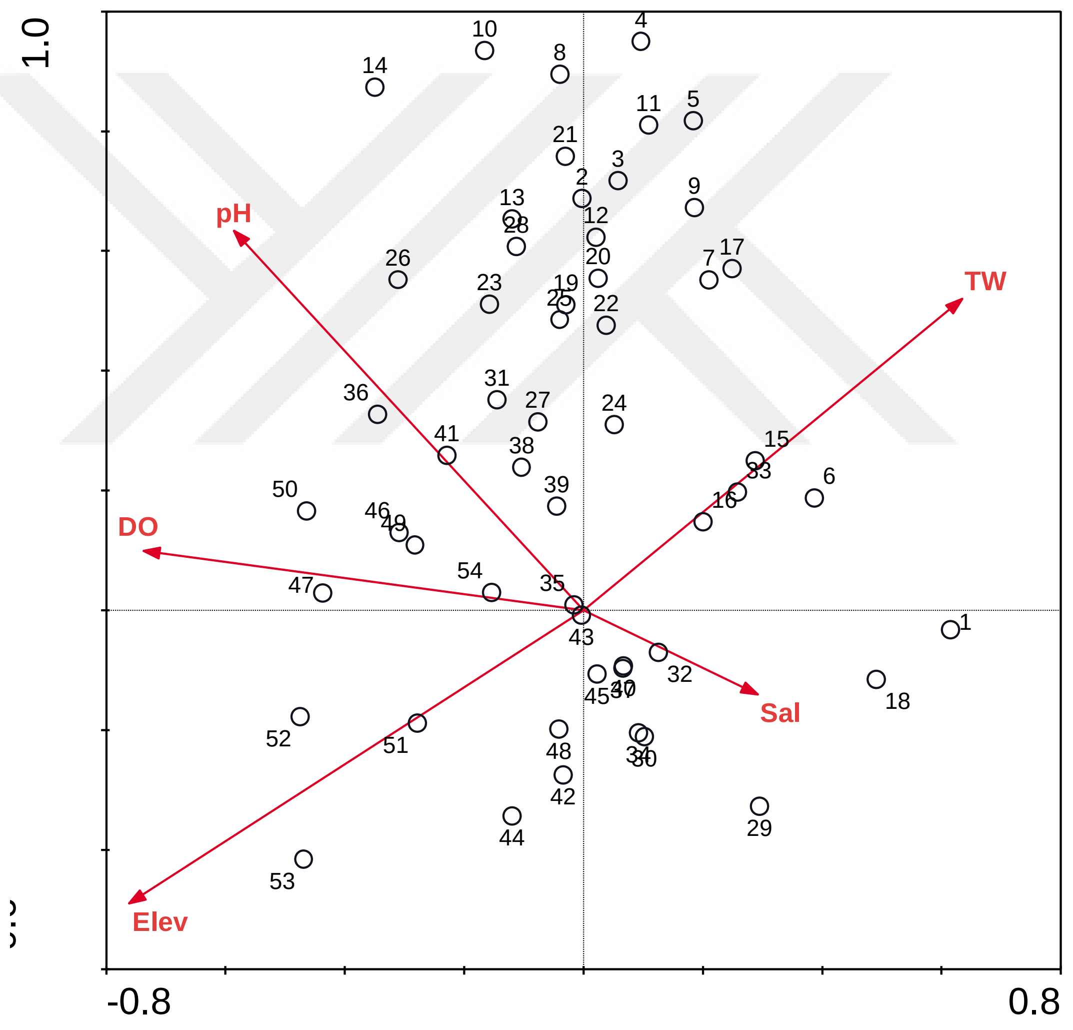


**Figure 4.4.** CCA results with sampling sites shown with empty circles on the diagram

**Table 4.5** Comparison of 13 habitat types (Habitat) with the ostracod species observed from sampling sites. Abbreviations: Cod:Code, Hab:habitat type TSS: Total numbers of sampling sites, Ost: Ostracoda , SS/O %: Ratio of ostracods per site , No.Spp: Number of species. (-) no ostracod found. For species abbreviations Appendix B.

| Code | Hab | TSS | Ost | No. Spp | SS/O (%) | Species |
|---|---|---|---|---|---|---|
| 1 | Lake | 3 | 1 | 1 | 33.33 | Hs |
| 2 | Creek | 21 | 10 | 15 | 47.61 | Cw,Co,Cv,Hi,Hs,Ib,Im,Isbe,Li Pf,Pof,Po,Ps,Pz,Hre |
| 3 | Troughs | 36 | 15 | 15 | 41.67 | Cv,Hin,Hi,Hro,Hs,Ib,Pw Pof Pa,Pv,Pvi,Pz,Po,Hre |
| 4 | Dam | 3 | 2 | 4 | 66.67 | Cv,Ib,Isbe,Li |
| 5 | Pond | 16 | 7 | 13 | 43.75 | Cv,Cp,Hr,Hi,Hs,Ib,Ig,Im,Li Pof,Pf,Po,Pnsp |
| 6 | River | - | - | - | - | - |
| 7 | Spring water | 7 | 6 | 9 | 85.71 | Cn,Ds,Ib,Ii,Pof,Pf,Po,Pr |
| 8 | Canal | 13 | 4 | 6 | 30.77 | Ib,Ig,Li,Pof |
| 9 | Water body | 11 | 5 | 5 | 45.45 | Hh,IHi,Hs,Bo,Hla |
| 10 | Pool | 3 | 1 | 2 | 33.33 | Ib |
| 11 | Helocrene | 1 | 2 | 2 | 200.0 | Hs,Ib |
| 12 | Rheocrene | - | - | - | - | - |
| 13 | Other | - | - | - | - | - |

The results of tolerance and optimum estimaes are provided in Appendix C Accordingly, optimum values of *L. inopinata* and *P. zenkeri* for pH were the maximum and minimum, respectively. while *P. zenkeri* and *P.fallax* .showed highest levels of tolerances to elevation.

Depend on DO variable results, for optimum estimates, *P. fontinalis* has maximum while *Prionocypris zenkeri* has minimum levels. However, for tolerance level, *L. inopinata* and *H. incongruens* displayed minimum and maximum tolerances, respectively.

Analyses of the EC results showed that both of tolerance and optimum values are maximum for *H. salina*. *Heterocypris reptans* had minimum tolerance for EC.

*Limnocythere. inopinata* has maximum point of optimum estimates for water temperature whereas *Potamocypris fallax* has minimum value . *Candona* sp. has maximum tolerance level and *Cypridopsis vidua* has minimum tolerance of water.

Among the species, *Potamocypris fallax* exhibited maximum optimum valuefor elevation while *Ilyocypris inermis* had minimum value. . In contrast, *Psychrodromus fontinalis* revealed maximum tolerance to elevation while *Limnocythere inopinata* had minimum value.

Both *Heterocypris salina* and *Prionocypris zenkeri* had maximum values for optimum estimates of salinity (reffering to electrical conductivity). Additionally, *Heterocypris salina* has maximum level for tolerance when *Psychrodromus fontinalis* and *Psychrodromus olivaceus* showed minimum and maximum optimum and minimum tolerance values for salinity estimates. As a result of Sodium amount of water analysis, *Psychrodromus olivaceus* has the maximum point of optimum and *Heterocypris incongruens* has the minimum point. *Potamocypris fallax* has the maximum level of tolerance and *Ilyocypris inermis* has the minimum level.

Potassium amount of water show us, for the optimum, *Heterocypris reptans* is located on maximum point, both of *Heterocypris salina* and Ib are located on minimum point. For the tolerance levels, Although Pof has the maximum level, Ii has the minimum.

According to magnesium amount of water for the optimum, *Ilyocypris bradyi* has up level of the optimum point and *Heterocypris incongruens* has minimum point. For the tolerance levels, Hre has maximum level and *Ilyocypris inermis* minimum level.

Result of the Calcium analysis show us, *Psychrodromus olivaceus* has maximum point of optimum and *Potamocypris fallax* has minimum point. If we look at the tolerance level, *Psychrodromus olivaceus* has maximum level and *Prionocypris zenkeri* has minimum level of tolerance.

For the chloride analysis show us, *Limnocythere inopinata* has maximum level of optimum whereas *Potamocypris fallax* has minimum level. *Heterocypris salina* has maximum tolerance level and *Candona* sp. has minimum tolerance.

If we look at the nitrite, *Prionocypris zenkeri* has the maximum point of optimum and *Ilyocypris inermis* has the minimum point. On the other hand, *Potamocypris fallax* has the maximum level of tolerance and *Psychrodromus fontinalis* has the minimum level.

As a result of nitrate analysis, *Candona* sp. has minimum optimum point and minimum tolerance level. *Prionocypris zenkeri* has the maximum point of optimum. Otherwise, for the tolerance, *Heterocypris salina* is located at the maximum level.

Finally, for sulfate amount of water, *Limnocythere inopinata* has the maximum point of optimum and *Heterocypris reptans* has the minimum point. When we look at the tolerance levels, *Cypridopsis vidua* has the maximum point and *Ilyocypris inermis* has the minimum.

### 4.3.1 Elevation vs Length

The purpose of doing t-test was to compare if there was a significant difference between right and left valves of the species found from all sites at different elevational ranges. In here, our null hypothesis (Ho) is “there is no significant difference between the lengt of right and left valves of individual species”. (Table 4.3 and 4.4).

As a result of these tests, a significant difference was observed between the length of the right and left valves ($P < 0.05$). At the same time, as well as the valve length, the valve height was also analyzed by t-test and a significant difference was observed (Table 4.4).

**Table 4.6.** Two-Sample Assuming Equal Variances of t-test between RL (Right Valve Length) and LV (Left Valve Length) of all samples.

| | *RL* | *LL* |
|---|---|---|
| Mean | 0.959 | 0.993 |
| Variance | 0.073 | 0.083 |
| Observations | 1990 | 1990 |
| Pooled Variance | 0.078 | |
| Hypothesized Mean Difference | 0 | |
| df | 3978 | |
| t Stat | 3.882 | |
| P(T<=t) one-tail | 5.25869E-05 | |
| t Critical one-tail | 1.645 | |
| P(T<=t) two-tail | 0.0001 | |
| t Critical two-tail | 1.960 | |

**Table 4.7.** Two-Sample Assuming Equal Variances of t-test between RH (Right Valve Height) and LH (Left Valve Height) of all samples.

| | *RH* | *LH* |
|---|---|---|
| Mean | 0.518 | 0.545 |
| Variance | 0.015 | 0.020 |
| Observations | 1990 | 1990 |
| Pooled Variance | 0.017 | |
| Hypothesized Mean Difference | 0 | |
| df | 3978 | |
| t Stat | 6.240 | |
| P(T<=t) one-tail | 2.40396E-10 | |
| t Critical one-tail | 1.645 | |
| P(T<=t) two-tail | 4.80791E-10 | |
| t Critical two-tail | 1.960 | |

T-test was applied to explain relationship between the length of left and right valves at different elevational ranges. The results, however, showed clear differences among the species for each of the elevational ranges. If we look at the *I. bradyi*, there was no significant difference at about130m, (t=1.46, P= 0.15), 1002m (t=2.17, P= 0.03), and at 1379m (t=0.18, P= 0.85) between the valves. In all cases, LV overlaps (larger) the RV.

For the *H. salina*, t-test was applied to explain relationship between the length of left and right valves at different elevational ranges. As a conclusion, there is no any clear differences among the 265m (t=0.65, P= 0.51), 470m (t=1.22, P= 0.22), 1051m (t=1.69, P= 0.09) whereas at the 772m (t=5.5, P= 0.1.1E-07), 775m (t=4.37, P= 5E-05) were seen significant differences between valves and LV overlaps th RV.

When we look at the *I.inermis*, the t-test was applied to explain relationship between the length of left and right valves at different elevational ranges at the 294m (t=3.98, P= 0.0001) was seen significant result on the other hand there is no any clear differences at the 444m (t=129, P= 0.19). In all cases LV overlaps the RV.

For the *P. olivaceus*, t-test was applied to explain relationship between the length of left and right valves at different elevational ranges. As a conclusion, there is no any clear differences at 875m (t=1.81, P= 0.07) left and right valves in contrast at the 294m (t=2.57, P= 0.01), 925m (t=5.85, P= 3.35E-08) and1600m (t=2.51, P= 0.01) were seen significant differences between valves and LV overlaps th RV.

When we look at the *H. incongruens* t test was applied to explain relationship between length of left and right valves different elevational ranges. As a result of this test, there is no clear differences between right and left valve at the 540m (t=0.51, P= 0.60) but at the 889m (t=2.37, P= 0.01) and 1002m (t=2.20, P= 0.02) were seen significant differences between valves L>R.

Finally, *P. fallax* at the same way the t-test was applied to explain relationship between length of left and right valves different elevational ranges. When we look at the 1125m (t=1.07, P= 0.28) and 1600m (t=1.77, P= 0.08) elevational ranges were seen not significat on the other hand at 1371m was seen statiscilally significant results (t=1.77, P= 0.08). LV overlaps the RV.

On the other hand, most repetitive inter-individual t test. Firstly, *H. salina* significant (N=447, t=2.65, P=0.008), P. olivaceus, significant (N=269, t=3.48, P=0.0005), *P. fallax*, not significant (N=191, t=1.45, P=0.14), *I. bradyi*, significant, (N=308, t=4.24, P=2.57403E-05), *L. inopinata*, (N=59, t=0.51, P=0.60), *H. incongruens*, slightly significant (N=167, t=2.32, P=0.02).

# 5. DISCUSSION AND CONCLUSION

During this study, 36 species of non-marine Ostracoda were detected in Mersin, Turkey. According to previous studies, five species (*Heterocypris incongruens, Eucypris virens, Eucypris mareotica*, *Tonnacypris lutaria*, *Heterocypris salina*) already known for Mersin. *Heterocypris incongruens* and *Heterocypris salina* were found before and present study. Among the species, three (*Eucypris virens*, *Eucypris mareotica, Tonnacypris lutaria*) of them were not found during the present study. Including these three species elevates the total numbers of specis upto 39 in Mersin. Finding four new taxa (*Bradleycypris* cf. *obliqua, Cypretta* cf. *reticulata, Fabeaformiscandona* cf. *wegelini*, *Hemicypris* cf. *largereticulata*) is of important value to show the species richness and high diversity of the area. As stated above, although not ready yet for publication, reporting possibly a new species of *Pseudostrandesia* n. sp. increases the value of the area as well. In addition to this, it is howevere important to point out that three previously known species (*Eucypris virens*, *Eucypris mareotica*, *Tonnacypris lutaria*) were not found in this study. There might be several reasons for this such as sampling site deficiency, sampling time or habitat types. This may also include habitat loss since these species were reported in about 30-40 years ago. Moreover, including other taxonomic groups reported with either only fossil forms or damaged individuals that were not identified, ostracod species diversity may be considered as one of the most diverse among the other provinces of Turkey.

## 5.1 Evaluation of Data

Throughout this study, Mersin province has revealed 50 (36 recent and 14 sub-recent) different Ostracoda taxa from 66 of 117 sampling sites. Most common species was *I.bradyi* found from 16 different sites. Followed by, *H. salina* (15 sites), *H. incongruens* (12 sites), *P. olivaceus* (10 sites), and *P. fallax* (9 sites) and *I. bradyi* as well. According to Külköylüoğlu 2007, *I. bradyi, P. olivaceus*, and *H. incongruens* can be called ‘cosmoecious species’ due to their high levels of tolerance to variety of variables within a relatively wide geographical ranges Also, other studies support these views that these three species are indeed the most common forms ( Külköylüoğlu, 2004; Rossi et al., 2007 ; Kılıç, 2011; Külköylüoğlu et al., 2012c Yavuzatmaca et al., 2017).

Below, detailed information about autoecology and body size of the species along with elevational distribution is provided for the most commonly found 11 species:

*Ilyocypris bradyi* was found almost all elevation ranges during study (Appendix B). It was found from 16 different sites with nine different aquatic habitats (creek, trough, dam, pond, spring water, canal, pool and helocrene) supporting the previous knowledge about the species (Meisch, 2000; Pieri et al., 2009; Li et al., 2010) and all around the world (Meisch, 2010; Martens and Savatenalinton, 2011; Külköylüoğlu et al., 2012b). When we look at the CCA diagram (Figure 4.3) *I. bradyi* is relatively close to DO arrow but elevation. On the other hand, previous study (Külköylüoğlu et., al 2016) indicated that DO was not effective for the distribution this species, since its tolerance levels for DO was one of the highest. Indeed, *I. bradyi* had maximum optimum level and slightly high tolerance for Mg. According to Mesich (2000), size of *I. bradyi* ranges in about 0.80-1.00 mm in length and the result of our t-test with 308 individuals coincides to this range LV=0.847mm and RV=0.823mm. This also corresponds its distributional range of the species (reported at about 1379 m in this study) where the species was reported up to 1850 m of elevation until today (Meisch 2000) . If we look at the t-test results (Table 4.2), this species shows differences depending on the elevation. For example, it at 130m ($t=1.46$, $P= 0.15$), and 1379m ($t=0.18$, $P= 0.85$) a.s.l it shows us not significant results but significant difference was found at 1002m ($t=2.17$, $P= 0.03$). Besides, when we analyze the whole body length and height of *I.bradyi*, the result favors that LV>RV. This may be due to ecological and/or geographic factors. When we look at the regression results, water temperature did not show any significant effect on the valves length and height. On the other had, one may observe the fact that both valves (carapace) has a linear relationship with increasing elevation (Figure 4.2).

*Heterocypris salina* was second abundant species within 15 sampling sites in six different aquatic bodies(lake, creek, trough, pond, waterbody, helocrene spring). This species usually inhabits small and slightly salty water bodies (Meisch, 2000; Akdemir, 2004; Sarı, 2007; Van der Meeren et al., 2010; Uçak, 2012; Rasouli et al., 2014; Yılmaz, 2014; Yavuzatmaca, 2015). CCA diagram (Figure 4.3) shows its close relationship with salinity. According to Ganning (1971), *H. salina* can survive at 5ºC temperature and can live up to 34ºC (Stammer 1932; Pax 1942, 1946). In the present study, this species had optimum value at 20.84ºC, found within the earlier ranges. The average length of a total of 447 *H. salina* individuals measured (RV= 0.941mm, LV=0.980mm) was in the range of the previous works (Meisch, 2000). Interestingly, however, *H. salina* did not show significant differences among some of those elevational ranges (at the 265m (t=0.65, P= 0.51) and 470m (t=1.22, P= 0.22)) until it reached a certain elevation (at the 772 and 775 meters). This may be related to the specific habitat requirements of the species that generally prefers saline waters. However, it was observed that the height did not give any significant results when it increased again at 1051m (t=1.69, P= 0.09). Results do not give out solid answer to explain why such difference was possible, we assume that it can be related to species proportionally high tolerance values.. When we look at the general t test result, we see significant differences LV>RV. Furthermore, regression analysis results show that temperature is not significantly effective on the length and height of the valves. However, although slightly and not significant, there seems to be a negative relationship between LV and elevation when this is positive with RV and the height of both valves. It is difficult to explain why LV shows such a tendency with increasing elevation but RV is not. One possibility is to consider that LV may be more prone to the elevational ranges than RV. Altough this possibility exist, we do not have a solid answers to explain the situation. Further studies are recommended.

*Heterocypris incongruens* was the third frequently occurring species within 15 sampling sites in six aquatic habitats (creek, trough, pond, water body, pool). It is called as cosmoecious species (Külköylüoğlu, 2013). Shallow habitat types seem to be preferred by the species (Külköylüoğlu, 2012b, Martens et al., 2013). According to CCA diagram H. incongruens showed a negative relationship with salinity. On the C2 results, this species has maximum tolerance for DO and minimum optimum value  for Na and Mg. On previous works, *Heterocypris incongruens* found in low DO levels (Fox and Taylor, 1955; Ganning, 1971; Meisch, 2000) contrary on our study. Individuals of *H. incongruens* measured (RV= 1.567mm, LV=0.1.589mm) in this study was slightly below the ranges of the previous works  (Meisch 2000).  Like *H. salina*, the species did not show statistically significant difference between the length measurements at about 540m (t=0.51, P= 0.60) until the appropriate conditions were reached at about 889m (t=2.37, P= 0.01) and 1002m (t=2.20, P= 0.02) where ecological conditions were probably better supporting that LV>RV.

Although *Psychrodromus olivaceus* was seen from 10 sampling sites on this study (creek, trough, pond, spring water, canal), this species is also known as cosmoecious species (Sarı and Külköylüoğlu, 2010). In the present study, this species shows minimum tolerance range for salinity,maximum optimum and tolerance values for calcium. Individuals of *P. olivaceus* (269 specimens) were measured (RV= 1.085mm, LV=1.126mm) and found  in the range of the previous works (Meisch 2000). When we look at the CCA diagram (Fig 4.3), *P. olivaceus* displayed  opposite relationship with pH.  In contrast, , Külköylüoğlu (2007) showed a positive relationship between the species and DO values.  For this species, different from the other ones because it was found four different range and at the upper (1600m) and lower (294) elevation level, it was giving significant result whereas it was statistically negative result at middle point of these two upper (1600m) and lower (294) elevation. Also, it was giving significant result for at the 925m (t=5.85, P= 3.35E-08), supporting that L>R.

*Potamocypris fallax* was the final most abundant species presentedwithin 9 sampling sites (creek, trough, pond, spring water, canal). This species, which appeared to occur at high altitudes like 2680 m (Meisch 2000), also appeared in our study at high altitudes (1125, 1371, 1620m). In this study, it is the species that is most closely associated with elevation (Figure 4.3). *Potamocypris fallax* has shown maximum and minimum optimum values for elevation and water temperature, respectively. However, the species exhibited highest tolerances to sodium, potassium and nitrite. This may suggest that the species may have been found from wider geographical regions in variety of habitats.. One of the previous studies (Külköylüoğlu 2013) supported our negative correlation with TW. When we look at the carapace size *P. fallax*, 191 individuals were measured (RV= 0.697mm, LV=0.718mm) in this study and these results support the values provided by Meisch (2000). In present study, *P. fallax* was observed at higher elevational ranges at 1125, 1371, 1600m that statistically significant result of the difference in RV and LV measurments were only obtained at 1371 m.

*Limnocythere inopinata* was found from 6 sampling sites in four different habitats (creek, dam, pond, canal). As a result of C2 (Appendix C), *Limnocythere inopinata* did show maximum optimum values for pH, TW, chloride and sulphate while its m tolerance levels for DO and elevation were the least. Our findings support Meisch (2000) and Keyser and Nagorskaya (1998) for the pH value. If we look at the carapace size *L.inopinata*, total of 59 individuals were measured (RV= 0.536mm, LV=0.540mm) and these results supported by Meisch (2000). We have found this species maximum at 435 meters elevation.

Külköylüoğlu and his colleagues (2013) stated that *P. fontinalis* had rare distribution compared to its conspecifics. This view was partially supported in the present study where it was found in 5 different sampling sites and 3 different habitat types (creek, pond, spring water), at maximum of 1044 meters. According to Mesich (2000) it prefers relatively cool water that we found the species between 10 to 19 ºC of water temperature. When we look at the C2 result *P. fontinalis* has maximum optimum level for DO and EC, butit has maximum tolerance for elevation. Additionally, it has minimum optimum for salnity and minimum tolerance for nitrite. CCA diagram shows that *P. fontinalis* positive correlation between DO and pH.

*Prionocypris zenkeri* was detected from 4 sampling sites in 3 habitats (creek, trough, spring water). Although it is a cosmoecious species (Külköylüoğlu 2013), it was only found in 3 different habitat types during the present study. On the C2 results, it has maximum optimum point for salinity nitrite and nitrate, minimum optimum point for pH and DO, minimum tolerance range for calcium. According to CCA diagram, this species has strong relationship with salinitysupporting the results of tolerance and optimum estimate values (Appendix C). We have found this species maximum of 711 m elevation. However, it is considered that the species seems to have much broader geographic and elevational distributions than what is known in the literature.

*Heterocypris reptans* was found 4 sampling sites of creek and troughs. In this study, this species tolerance range for elevation and Mg was minimum and maximum, respectively. For optimum value considered inhere, this species revealed maximum value for potassium and minimum value for sulphate (Appendix C). On CCA diagram this species has close relationship with pH. We have found this species at maximum of 1239 meters elevation. There is not much information about the ecology of this species in the literature. Therefore, detailed discussion is not possible at the moment. Future studies are recommended.

*Cypridopsis vidua* was found 4 sampling sites from creek, trough, dam and pond habitats. According to C2 results, it has maximum tolerance for sulphate. On CCA diagram this species has close correlation with pH like *H.reptans*. Besides, we have found this species maximum 860 meters elevation but its broader distribution was reported by Martens and Savatenalinton (2011). Külköylüoğlu (2013), described this species as cosmoecious species.

*Ilyocypris inermis* was only found from spring water during the present study. In the literature (Mesich 2000), this species was found maximum of 1060 m. Like the present study, it was found 861 m. . When we look at the C2 results, it has minimum tolerance for sodium, potassium, magnesium and sulphate on the other hands, it has maximum tolerance for pH. Nitrite and elevation have the minimum optimum values for *I. inermis*. At the 294m was significant result (t=3.98, P= 0.0001) however, at the 444m not significant (t=129, P= 0.19) L>R.

### 5.1.1 Occurred Less Than Three Times During the Study

*Bradleycypris* cf. *obliqua* was found at station 60 in about 262 m of elevation. We found only one individual of this species that a full taxonomic classification was not completed. According to Meisch (2000), this species was found in Ireland (Dougleas & McCall 1992), Britain (Henderson 1990; Fryer 1993) also northern France (Meisch et al. 1990), German records from Kempf & Scharf (1981), Belgium (Wouters 1989), Netherlands (Du Saar 1967), Hungary (Meisch & Forro 1998). Finally, this is the first report of the species for Turkish Ostracoda Fauna from Mersin province.

*Candona neglecta* was found from station 12 at about 444 m of elevation. The species is one of the most common one among others in Turkey. It is therefore interesting to report its rare occurrences inhere. However, we cannot explain it rare occurrences while one may assume seasonal difference might have an influence on it. Future studies may reveal better answer for such a dilemma..

*Candona weltneri* generally prefers to different aquatic habitats such as lakes, ponds, and found in the region of Palearctic (Meisch 2000). In this study, unlike Meisch (2000), the species was found from troughs and new record for Turkish Ostracoda fauna.

*Cypretta* cf. *reticulata* was found from station 66 at 80 m of elevation in present study. It was found from a trough. Duran et al., (2013) accepted this species taxanomic position while (Martens et al., 2013) considers the species synonyms to the species *Neocypridella fosulata* (Daday, 1910). Since there are not enough specimens in our study, we prefer to leave it for future discussion in the literature.

*Cypria ophtalmica* was collected from creek at 240 m. This species has very large tolerance levels todifferent ecological variables. According to Külköylüoğlu (2013), this species was cosmoecious species widely distributed with relatively high levels of tolerances. This view is supported in here.

*Cyprideis torosa* was detected from station 64, a lake,at elevation 14 m. According to Martens and his friends (2013), this species has large distribution in the world. The species prefers salty water like see and salty lakes (Meisch, 2000). Like Meisch (2000), when we look at the ecological variable such as salinity, it was supported by the present study.

*Cypris pubera* was found in two different stations 23 and 5. stations at 84 and 925 m, respectively. Unlike Meisch (2000), it was found in a pond in this study. Uçak (2012) found this species from a trough in Ankara while Yılmaz et al (2014) recorded it from stream and lake in Düzce.

*Darwinula stevensoni* was one of the good examples of cosmoecious species Külköylüoğlu (2013). In present study, it was found from a spring at elevation of 294 m. This species is also called as 'ancient asexual' (Chaplin et al.,1994; Judson &

Normark, 1996; Butlin et al., 1998; Martens et al., 2003) because of its asexual (parthenogenetic) reproduction without males are known since about 250 my. Külköylüoğlu (pers. comm.) stated its rare occurrences in Turkish aquatic habitats especially for the last 10-15 years. This might be related to the factors playing role on habitats but there is no certain answers for that.

*Fabeaformiscandona* cf. *wegelini* was found from a canal at 235 m. It was found only one individual because of this reason we did not provide its taxonomic level as species and left it open to discussion. .

*Hemicypris* cf. *largereticulata* was found from a helocrene spring at 3 m. Some ecological variables for this species; pH=8.1, TW=27.7°C, DO=1.43 $mgL^{-1}$. There is not much known it ecology and distribution. Therefore, future studies are recommended.

*Herpetocypris helenae* was found from one station at 262m. Unlike other studies (Külköylüoğlu et al., 2012a; Uçak et al., 2014; Yavuzatmaca, 2015) found the species from troughs, dams, and creeks, we did not find these habitat types.

*Herpetocypris intermedia* was found in one type habitat (trough) and 2 different stations 1 and 22 at 793, 1002m. respectively. Also, it was previously reported from  trough (Meisch, 2000; Akdemir, 2009; Akdemir et al., 2011; Külköylüoğlu et al., 2012a, 2012c; Rasouli et al., 2014; Uçak et al., 2014).

*Herpetocypris reptans* was found from only one station (23) at 925m from pond. Size of female ranges from 1.8 to 2.6 mm (Mesich 2000).

*Heterocypris rotundata* was found only one station (66) a trough and located at 80 m. Some of important ecological variables, pH=8.49, DO=6.52 $mgL^{-1}$, TW=21.4°C, salinity= 0.46 ppt.

Although *Ilyocypris gibba* was the another cosmoecious species (Külköylüoğlu, 2013), in present study was found two different stations from canal and pond. Like *I. bradyi*, it is seen to live entirely large scale of habitat types as in rice fields, pools, springs, salty waters, ponds, dams, troughs, streams etc.

(Malmqvist et al., 1997; Meisch, 2000; Külköylüoğlu, 2005a; Sarı, 2007; Uçak et al., 2014; Yavuzatmaca, 2015) but we did not find except canal and pond.

*Ilyocypris monstrifica* was found 2 different station and habitat types. Mersin 91 and 92 very close two station each other and 84, 224m a.s.l. respectively.

*Isocypris beauchampi* dispersed in a wide range from Nearctic, Palearctic to Neotropical regions on the World (Martens et al., 2013). Because of this reason it might be cosmopolitan species. In contrast, present study was found only one station.

When we look at the in Turkey, this species was first detected by Külköylüoğlu (2003a) dam lake in Bolu. Although this species usually presents in lake, the present study was found in dam.

*Plesiocypridopsis newtoni* was found same habitat types (trough) but different stations (37 and 72) it was collected from 219 and 860, respectively. General distribution of this species has Europe, Canary İslands, North and Subsaharan Africa, Middle east, central and eastern Asian, Indian included (Meisch 2000).

*Potamocypris arcuata*, was found at 1414m a.s.l and it only found 10 individuals from trough in Mersin 99 station. Some of important ecological variables; pH=8.2, DO=9.12 $mgL^{-1}$, TW=14.9°C.

In spite of *Potamocypris smaragdina* has widespread distribution from Nearctic, Neotropical to Palearctic regions, in present study, it was only found from one habitat type from creek. Unlike other studies troughs, lakes, dams, streams, pools, rice field and springs (Meisch, 2000; Cusminsky et al., 2005; Sarı, 2007; Külköylüoğlu et al., 2012a; Yılmaz, 2014; Yavuzatmaca, 2015).

*Potamocypris variegata* was found only one station (61) at 470m a.s.l from trough. According to Meisch (2000) this species has wide distribution. Ireland (Dougles & McCall 1992), England (Yorksihire; Fryer 1993), Austria (Löffler 1969), Netherlands (Redeke & Den Dulk 1940).

According to Meisch (2000), *Potamocypris villosa* has widely dispersion in the word except Australia. Külköylüoğlu (2013) was described as a cosmoecious species. This species was found from a trough located at 979m a.s.l.

*Psychrodromus* cf. *robertsoni* was found station 83 from spring water at 83m elevation. There is no any clear information about this species. The distribution this species is seen Palearctic region (Martens et al. 2013).

*Pseudostrandesia* n.sp. was found station 50 from pond at 84m a.s.l. This taxa for the new record for literature. Some of ecological variables are pH=7.8, DO=7.94 $mgL^{-1}$, EC: 742 $\mu Scm^{-1}$, TW=22.8°C, ORP:78.3 mV and salinity= 0.38 ppt.

As a conclusion, in this study, total of 50 taxa were reported from Mersin. 34 of them new reports for the region. In addition, four recent taxa of Ostracoda (*Bradleycypris cf. obliqua, Cypretta cf. reticulata, Fabeaformiscandona cf. wegelini, Hemicypris cf. largereticulata*) were new record for the Turkish Ostracoda fauna. According to results, suggest that carapace size is affected with elevation. The right and left valves showed a statistically significant difference a one elevational range. Generally species with wide tolerance and geographic distribution are found as cosmopolitan or cosmoecious. The most abundant species were *I. bradyi* (found in eight different type of habitast ) and *H.salina* ( found in six different type of habitats) (Table 4.2.). These species displeyed that they were not affected by habitat types, water conditions and any geographical condition. When we look at the CCA diagram results, the first two axes of CCA revealed 72.6% of the relationship between 12 taxa and five ecological variables. Among the variables, TW and pH were the most effective variable whereas elevation, salinity and DO did not show significant effect on the taxa. This result shows that elevation had not a clear effect on species. Indeed, several species exhibited high ranges of elevational tolerances, suggesting that elevation may play an indirect role on species distribution and occurrences. According to C2 results for elevation *Potomacypris. fallax* had maximum optimum value for elevation. While *Psychrodromus fontinalis* had a maximum tolerance for elevation, *Limnocythere inopinata* had a minimum tolerance.

In summary, the ecological data collected from the province of Mersin is not sufficient to explain the relationship between the species valve size and elevation (Table 5.1) as a whole However, it is thought that more extensive studies should be done and this is the first study conducted widely in this province.

**Table 5.1.** Different elevational ranges and some ecological variable with species. Abbrevations: #Spp: Number of species, Ha.Tp: Habitat type, TW: Water temperature, DO: Dissolved Oxygen, Sal: Salinity.

| Elevation | Code | #Spp | Ha.Tp | TW | pH | DO | Sal |
|---|---|---|---|---|---|---|---|
| 1486-1650 | Pof,Po | 2 | 3,5,9 | 10.7-20.3 | 8-8.9 | 5.51-7.73 | 0.08-0.16 |
| 1321-1485 | Ib,Pa,Pof | 3 | 1,3,5,7,9 | 11.4-20.8 | 7.6-8.7 | 4.62-9.85 | 0.1-0.54 |
| 1156-1320 | Hre,Ib, | 2 | 1,3,5,8 | 13.2-20.5 | 7.4-8.5 | 4.42-8.62 | 0.16-0.54 |
| 991-1155 | Cw,Hin,Hi,Hs,Ib,Pof | 6 | 2,3,5,7,9 | 10.1-21.2 | 7.9-8.3 | 2.93-15.4 | 0.1-0.55 |
| 826-990 | Cp,Hr,Hi,Hs,Ib,Ii,Pw,Pof,Pvi,Pf Po | 11 | 2,3,5,7,8,9,10 | 12.3-22.7 | 7.3-8.5 | 5.08-9.93 | 0.14-0.51 |
| 661-825 | Hin,Hi,Hre,Hs,Pof,Po | 6 | 3,5,9,10,12 | 12.3-29.3 | 7.2-8.4 | 3.69-10.1 | 0.17-1.09 |
| 496-660 | Hi,Hre,Hs,Ib,Pf | 5 | 2,3,5,10 | 14.1-25.0 | 7.4-8.6 | 5.34-9.35 | 0.16-0.29 |
| 331-495 | Cn,Hs,Ib,Ig,Ii,Li,Pv, Pzi,Po | 9 | 2,3,4,5,7,9 | 14.8-25.2 | 7.5-8.6 | 4.84-10.1 | 0.19-0.48 |
| 166-330 | Bo,CoDs,Fw,Hh,Hs,Ig,Ii,Pw,Po f,Pal,Po | 12 | 2,3,4,8,9 | 13.7-25.1 | 7-8.6 | 5.8-10.9 | 0.15-1.17 |
| 0-165 | Cr,Ct,Cv,Cp,Hl,Hro,Hs,Ib,Ig,Im Isbe,Li,Ps,Pz,Pr,Pf,Pnsp | 17 | 1,2,3,4,5,6,7,8, 9,13 | 17.6-28.9 | 7.8-8.8 | 1.43-14.9 | 0.11-5.57 |

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# APPENDICES

# 7. APPENDICES

**Appendix A** Ecological variables and taxa were found from different aquatic lands in Mersin. Abbreviations: St. no: Sitation number, St. Ty.: site type, DO (dissolved oxygen, mgL$^{-1}$), % DO (percent saturation), EC (electrical conductivity, µScm$^{-1}$), TW (water temperature, ºC), Ta (air temperature, ºC), Atm.p (atmospheric pressure, mmHg), ORP (redox potential), Mois. (Moisture, %), WS (wind speed, kmh$^{-1}$), Elev (Elevation, m a.s.l), Sal (salinity, ppt), TDS (total dissolved solid mgL$^{-1}$).

| St.No | St.Ty | pH | DO | %DO | EC | Spe. EC | TW | Ta | Atm.p | ORP | Mois. | WS | Elev | Sal | TDS | Time | Date |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 3 | 8.09 | 8.13 | 80.4 | 329.2 | 411.2 | 14.7 | 19.3 | 692.1 | 14.8 | 65.8 | 0.4 | 793 | 0.19 | 262.6 | 08:17 | 03.10.2015 |
| 2 | 8 | 8.13 | 8.05 | 78.1 | 363.1 | 453.6 | 14.5 | 28 | 743 | 64.3 | 78 | 0 | 235 | 0.22 | 295.1 | 08:58 | 03.10.2015 |
| 3 | 8 | 8.06 | 8.26 | 82.3 | 348.7 | 445.8 | 13.6 | 27.9 | 742.5 | 73.1 | 65.1 | 0 | 274 | 0.22 | 289.9 | 09:16 | 03.10.2015 |
| 4 | 3 | 7.21 | 4.69 | 46.5 | 819 | 957 | 17.5 | 29.5 | 702.3 | 79.5 | 56.7 | 0 | 711 | 0.48 | 624 | 10:00 | 03.10.2015 |
| 5 | 3 | 7.36 | 7.52 | 79.8 | 716 | 842 | 17.3 | 28.2 | 700.9 | 77.2 | 56.8 | 1.8 | 775 | 0.41 | 546 | 10:27 | 03.10.2015 |
| 6 | 2 | 8.39 | 8.09 | 91.6 | 553 | 598 | 21 | 32.9 | 739.6 | 79.6 | 54.9 | 1 | 315 | 0.29 | 390 | 10:57 | 03.10.2015 |
| 7 | 2 | 8.62 | 7.82 | 93.3 | 525 | 533 | 24.2 | 32.7 | 750.3 | 63.9 | 49.9 | 1.3 | 181 | 0.26 | 344.5 | 11:32 | 03.10.2015 |
| 8 | 4 | 8.44 | 9.01 | 95.9 | 347.7 | 401.4 | 18 | 34.8 | 753.7 | 63.5 | 49.9 | 0 | 130 | 0.19 | 260.65 | 12:05 | 03.10.2015 |
| 9 | 2 | 8.33 | 3.88 | 48.1 | 1069 | 1066 | 25.1 | 36.1 | 739.1 | 77.1 | 45.3 | 0 | 294 | 0.53 | 695.5 | 12:30 | 03.10.2015 |
| 10 | 9 | 8.18 | 5.12 | 67.1 | 502 | 467 | 28.9 | 36 | 754.6 | 66.3 | 39.8 | 0.8 | 112 | 0.22 | 305.5 | 14:51 | 03.10.2015 |
| 11 | 2 | 8.12 | 5.86 | 66.6 | 675 | 714 | 22.2 | 36 | 754.3 | 57.5 | 48.3 | 0 | 105 | 0.35 | 461.5 | 15:19 | 03.10.2015 |
| 12 | 7 | 8.15 | 7.84 | 80 | 330.2 | 411.3 | 14.8 | 33.5 | 724.5 | 60.3 | 40 | 0.4 | 444 | 0.2 | 265.85 | 16:05 | 03.10.2015 |
| 13 | 2 | 7.66 | 6.25 | 64.6 | 423.5 | 516.4 | 15.6 | 31.4 | 726.6 | 80.4 | 48.8 | 0 | 424 | 0.25 | 335.4 | 16:16 | 03.10.2015 |
| 14 | 2 | 8.13 | 6.01 | 59.7 | 355.2 | 435.2 | 15.6 | 30.6 | 731.2 | 83.4 | 45.2 | 0.5 | 363 | 0.21 | 282.1 | 16:30 | 03.10.2015 |
| 15 | 3 | 8.13 | 5.34 | 53.2 | 292.6 | 365.4 | 14.6 | 29.1 | 709.5 | 78 | 50 | 0 | 613 | 0.18 | 236.6 | 17:10 | 03.10.2015 |
| 16 | 10 | 7.91 | 9.1 | 86.7 | 268.5 | 354.5 | 12.3 | 28.7 | 703.1 | 89.8 | 47.2 | 0 | 702 | 0.17 | 230.75 | 17:27 | 03.10.2015 |
| 17 | 3 | 8.15 | 5.59 | 59 | 398.6 | 459.2 | 18.1 | 27.6 | 654 | 85.4 | 35 | 0 | 1305 | 0.22 | 298.35 | 18:04 | 03.10.2015 |
| 18 | 9 | 8.85 | 5.51 | 60.4 | 163.9 | 180.1 | 20.3 | 20.5 | 636.1 | 74.8 | 43.1 | 0.8 | 1586 | 0.08 | 115.7 | 19:07 | 03.10.2015 |
| 19 | 3 | 8.04 | 7.73 | 67.1 | 265.7 | 367.5 | 10.7 | 18 | 633.4 | 93.6 | 46.3 | 1.4 | 1630 | 0.18 | 239.2 | 19:22 | 03.10.2015 |
| 20 | 2 | 8.19 | 3.63 | 36.3 | 1595 | 2077 | 12.8 | 20 | 698.8 | 94.3 | 60.9 | 0 | 791 | 1.09 | 1352 | 07:00 | 04.10.2015 |

**Appendix A** (Continued)

| St.No | St.Ty | pH | DO | %DO | EC | Spe. EC | TW | Ta | Atm.p | ORP | Mois. | WS | Elev | Sal | TDS | Time | Date |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 21 | 9 | 7.8 | 2.53 | 25.5 | 1198 | 1468 | 15.4 | 18 | 698.7 | 88.3 | 58.7 | 0.4 | 791 | 0.74 | 955.5 | 07:05 | 04.10.2015 |
| 22 | 3 | 8.03 | 2.93 | 30.1 | 522 | 630 | 16.1 | 24 | 681.1 | 88.8 | 58.7 | 1 | 1002 | 0.31 | 409.5 | 08:00 | 04.10.2015 |
| 23 | 5 | 8.03 | 6.18 | 60.5 | 516 | 652 | 14.1 | 22.4 | 679.8 | 94.7 | 50.9 | 0.8 | 925 | 0.32 | 422.5 | 08:21 | 04.10.2015 |
| 24 | 3 | 8.24 | 8.75 | 83.7 | 269 | 348.9 | 13.1 | 26.4 | 697.9 | 92.7 | 52.3 | 0 | 802 | 0.17 | 226.85 | 09:06 | 04.10.2015 |
| 25 | 4 | 8.23 | 7.49 | 77.4 | 326.6 | 387.2 | 17.2 | 30.9 | 738.1 | 96.5 | 52.4 | 0 | 337 | 0.19 | 252.85 | 09:45 | 04.10.2015 |
| 26 | 3 | 7.54 | 5.43 | 54.1 | 871 | 1094 | 14.3 | 27.6 | 655.1 | 92.9 | 31.9 | 1.3 | 1311 | 0.54 | 708.5 | 10:50 | 04.10.2015 |
| 27 | 8 | 7.71 | 5.36 | 55 | 486.9 | 586 | 16 | 26.4 | 658 | 96.3 | 38.4 | 1 | 1300 | 0.29 | 381.2 | 11:12 | 04.10.2015 |
| 28 | 3 | 7.39 | 6.29 | 59.9 | 470.5 | 613.7 | 12.9 | 27.5 | 657.9 | 99.5 | 41.9 | 0.8 | 1303 | 0.3 | 398.8 | 11:28 | 04.10.2015 |
| 29 | 2 | 8.34 | 9.66 | 90.7 | 345.3 | 438.7 | 14.2 | 30.2 | 672.2 | 89.3 | 42.2 | 0.6 | 1125 | 0.21 | 286 | 12:17 | 04.10.2015 |
| 30 | 3 | 8.08 | 9.37 | 86.6 | 370.2 | 495.8 | 11.8 | 29.7 | 650.3 | 84.1 | 40.9 | 0.8 | 1379 | 0.24 | 321.75 | 13:09 | 04.10.2015 |
| 31 | 5 | 8.65 | 4.55 | 53.6 | 342.6 | 372.9 | 20.8 | 26.2 | 645.9 | 85.6 | 43.3 | 1.4 | 1437 | 0.18 | 242.45 | 13:39 | 04.10.2015 |
| 32 | 7 | 8.25 | 6.43 | 70.2 | 465.4 | 518 | 19.7 | 28 | 694.3 | 75.8 | 43.1 | 3.2 | 841 | 0.25 | 337.35 | 14:39 | 04.10.2015 |
| 33 | 7 | 7.74 | 5.08 | 52.3 | 663 | 788 | 16.7 | 29.8 | 694.5 | 85.2 | 43.8 | 0.6 | 829 | 0.39 | 513.5 | 14:48 | 04.10.2015 |
| 34 | 11 | 8.18 | 3.69 | 51.1 | 511 | 472 | 29.3 | 29 | 699 | 89.2 | 43.8 | 0.9 | 772 | 0.22 | 305.5 | 15:16 | 04.10.2015 |
| 35 | 3 | 8.26 | 8.4 | 86.5 | 574 | 698 | 16.2 | 28.2 | 676.4 | 69 | 49.6 | 0.4 | 1041 | 0.34 | 455 | 16:08 | 04.10.2015 |
| 36 | 2 | 8.43 | 10.39 | 100.6 | 232.9 | 297.6 | 13.7 | 28.1 | 743.3 | 82.8 | 50.5 | 0.4 | 261 | 0.14 | 193.05 | 16:34 | 04.10.2015 |
| 37 | 3 | 7.95 | 9.34 | 106.7 | 303.6 | 323.6 | 21.7 | 31 | 747 | 91.8 | 49.5 | 1.3 | 219 | 0.15 | 210.6 | 16:58 | 04.10.2015 |
| 38 | 2 | 8.31 | 6.61 | 79 | 292.4 | 297 | 24.2 | 31.4 | 752.4 | 80.1 | 48.2 | 0.3 | 141 | 0.14 | 193.05 | 17:21 | 04.10.2015 |
| 39 | 8 | 8.12 | 7.68 | 84.2 | 307.2 | 343.2 | 19.5 | 30.7 | 759.8 | 80.5 | 58.1 | 0 | 45 | 0.16 | 222.95 | 17:52 | 04.10.2015 |
| 40 | 5 | 8.01 | 7.87 | 95.3 | 314.4 | 314.3 | 25 | 29.6 | 759.1 | 90.7 | 60.8 | 0 | 41 | 0.15 | 204.75 | 18:03 | 04.10.2015 |

**Appendix A** (Continued)

| St.No | St.Ty | pH | DO | %DO | EC | Spe. EC | TW | Ta | Atm.p | ORP | Mois. | WS | Elev | Sal | TDS | Time | Date |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 41 | 2 | 7.85 | 6.38 | 77.4 | 516 | 520 | 24.5 | 29.5 | 761 | 87.9 | 64.6 | 0 | 17 | 0.25 | 338 | 18:28 | 04.10.2015 |
| 42 | 2 | 8.18 | 3.6 | 44.3 | 289 | 285.1 | 25.6 | 28.9 | 761.3 | 77 | 66.8 | 0 | 4 | 0.13 | 185.9 | 18:57 | 04.10.2015 |
| 43 | 13 | 8.05 | 6.51 | 79.9 | 16657 | 43636 | 27.1 | 27.2 | 761.3 | 85.6 | 69.2 | 0.6 | 3 | 0.14 | 16815 | 19:05 | 04.10.2015 |
| 44 | 5 | 8.61 | 6.74 | 79.5 | 504 | 524 | 22.9 | 23 | 706.7 | 69.4 | 57.2 | 0.5 | 622 | 0.25 | 338 | 07:00 | 05.10.2015 |
| 45 | 5 | 7.97 | 5.12 | 56.7 | 332.2 | 374.6 | 18.8 | 21.9 | 680.9 | 70.9 | 54.3 | 1 | 938 | 0.18 | 243.1 | 07:22 | 05.10.2015 |
| 46 | 8 | 7.97 | 7.55 | 79.2 | 285.1 | 332 | 17.6 | 24.7 | 758.4 | 87.3 | 66.1 | 1.4 | 28 | 0.16 | 215.8 | 08:00 | 05.10.2015 |
| 47 | 8 | 8.15 | 6.76 | 75.3 | 373.7 | 412 | 20.2 | 29.9 | 760.4 | 71.9 | 65.2 | 1.5 | 7 | 0.2 | 267.8 | 09:37 | 05.10.2015 |
| 48 | 2 | 7.63 | 5.8 | 62.3 | 813 | 932 | 18.4 | 31.4 | 740.3 | 72.9 | 55.6 | 0.5 | 240 | 0.46 | 604.5 | 10:15 | 05.10.2015 |
| 49 | 2 | 8.24 | 8.16 | 88.4 | 962 | 1093 | 18.7 | 30.2 | 756.2 | 74.9 | 59.5 | 1.1 | 65 | 0.54 | 708.5 | 11:12 | 05.10.2015 |
| 50 | 5 | 7.78 | 7.94 | 92.2 | 742 | 773 | 22.8 | 31.6 | 754.3 | 78.3 | 62 | 0 | 84 | 0.38 | 500.5 | 12:09 | 05.10.2015 |
| 51 | 8 | 8.35 | 9.44 | 113.6 | 700 | 711 | 24.2 | 30.7 | 745 | 74 | 59.2 | 1.2 | 191 | 0.35 | 461.5 | 13:00 | 05.10.2015 |
| 52 | 2 | 7.81 | 10.27 | 108.6 | 517 | 598 | 17.9 | 31.7 | 759.8 | 72.9 | 63.6 | 0.8 | 16 | 0.29 | 390 | 13:42 | 05.10.2015 |
| 53 | 9 | 7.57 | 7.09 | 75.3 | 585 | 636 | 21.3 | 26.3 | 694.1 | 80.4 | 55.8 | 2.6 | 765 | 0.31 | 416 | 14:44 | 05.10.2015 |
| 54 | 3 | 8.15 | 10.12 | 121.2 | 439.8 | 448.4 | 24 | 29 | 694.6 | 82.6 | 52.2 | 1 | 762 | 0.21 | 291.2 | 15:26 | 05.10.2015 |
| 55 | 3 | 7.72 | 8.84 | 86.4 | 524 | 658 | 14.5 | 29 | 677 | 80.5 | 82.2 | 0.4 | 979 | 0.32 | 429 | 15:45 | 05.10.2015 |
| 56 | 3 | 7.42 | 7.39 | 69.4 | 526 | 673 | 13.7 | 28.5 | 681.3 | 92.8 | 64.9 | 0 | 925 | 0.33 | 435.6 | 16:08 | 05.10.2015 |
| 57 | 1 | 7.79 | 5.79 | 64.6 | 991 | 1094 | 20.1 | 23.4 | 650.1 | 31.4 | 65.8 | 0.6 | 1314 | 0.54 | 708.5 | 17:08 | 05.10.2015 |
| 58 | 9 | 8.21 | 10.28 | 117.2 | 814 | 878 | 21.2 | 22.2 | 669.2 | 77.4 | 66.8 | 1.5 | 1088 | 0.43 | 572 | 17:33 | 05.10.2015 |
| 59 | 2 | 8.42 | 7.88 | 81.5 | 455.2 | 542 | 16.5 | 25.5 | 695.7 | 87 | 66.1 | 0.4 | 767 | 0.27 | 354.25 | 18:12 | 05.10.2015 |
| 60 | 9 | 7.61 | 4.97 | 54.1 | 654 | 733 | 19.3 | 24.5 | 738.2 | 84.2 | 66 | 1.3 | 262 | 0.36 | 474.5 | 06:50 | 06.10.2015 |

**Appendix A** (Continued)

| St.No | St.Ty | pH | DO | %DO | EC | Spe. EC | TW | Ta | Atm.p | ORP | Mois. | WS | Elev | Sal | TDS | Time | Date |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 61 | 3 | 7.91 | 6.16 | 65.3 | 464.9 | 540.2 | 17.6 | 23.7 | 715.4 | 87.9 | 69.9 | 0.4 | 470 | 0.26 | 351 | 07:36 | 06.10.2015 |
| 62 | 5 | 7.3 | 6.88 | 69.4 | 503 | 615 | 15.5 | 22.3 | 692.6 | 97.1 | 68.8 | 1.5 | 739 | 0.3 | 396.6 | 08:14 | 06.10.2015 |
| 63 | 5 | 8.59 | 7.12 | 85.4 | 547 | 545 | 25.2 | 28 | 720.4 | 93.1 | 62.8 | 1.4 | 416 | 0.26 | 351 | 10:53 | 06.10.2015 |
| 64 | 1 | 8.44 | 5.17 | 66.1 | 9766 | 9879 | 24.2 | 31.9 | 755.8 | 90.4 | 57 | 1.6 | 14 | 5.57 | 643.5 | 12:05 | 06.10.2015 |
| 65 | 7 | 7 | 4.53 | 49.7 | 631 | 702 | 19.6 | 27 | 731.2 | 105 | 73.1 | 0 | 294 | 0.34 | 456 | 08:44 | 06.10.2015 |
| 66 | 3 | 8.49 | 6.52 | 78.1 | 921 | 943 | 21.4 | 30.9 | 745.3 | 61.8 | 53.9 | 1.4 | 80 | 0.46 | 611 | 12:33 | 06.10.2015 |
| 67 | 8 | 8.23 | 9.38 | 95.3 | 460 | 559.1 | 15.8 | 28.4 | 679.6 | 74 | 50.4 | 0.7 | 895 | 0.27 | 363.35 | 13:41 | 06.10.2015 |
| 68 | 3 | 7.72 | 5.85 | 63.5 | 485.3 | 546 | 19.2 | 26.2 | 678.4 | 83.2 | 55.6 | 1.3 | 873 | 0.26 | 354.9 | 14:00 | 06.10.2015 |
| 69 | 3 | 7.86 | 10.05 | 110 | 114 | 885 | 21 | 28.1 | 711.1 | 93.6 | 59.4 | 0.4 | 483 | 0.44 | 578.5 | 14:15 | 06.10.2015 |
| 70 | 6 | 8.26 | 6.98 | 77.1 | 508 | 550 | 21 | 27.1 | 749.1 | 88.4 | 78.3 | 0.9 | 47 | 0.27 | 357.5 | 14:41 | 06.10.2015 |
| 71 | 5 | 7.9 | 11.65 | 129.3 | 632 | 697 | 20.6 | 32.7 | 749.8 | 78.5 | 62.2 | 0 | 40 | 0.34 | 455 | 15:35 | 06.10.2015 |
| 72 | 3 | 8.15 | 6.17 | 69.5 | 377.6 | 409.2 | 20.9 | 27.8 | 679.9 | 73.5 | 52.5 | 0.5 | 860 | 0.2 | 265.85 | 16:17 | 06.10.2015 |
| 73 | 3 | 8.18 | 10.03 | 114.7 | 524 | 564 | 21.3 | 27.8 | 677.6 | 77.7 | 53.8 | 0 | 889 | 0.27 | 364 | 16:42 | 06.10.2015 |
| 74 | 10 | 8.47 | 9.93 | 116.8 | 284.8 | 298.1 | 22.7 | 23.7 | 682.7 | 78.9 | 56.8 | 0 | 845 | 0.14 | 193.7 | 17:54 | 06.10.2015 |
| 75 | 9 | 8.39 | 7.25 | 84.8 | 323 | 339.4 | 22.3 | 24.1 | 682.5 | 86.6 | 60.3 | 0.5 | 857 | 0.16 | 221 | 18:34 | 06.10.2015 |
| 76 | 2 | 8.35 | 9.2 | 87.3 | 306.2 | 399.3 | 12.9 | 22.7 | 672.4 | 91.1 | 46.4 | 0 | 987 | 0.19 | 258.05 | 07:23 | 07.10.2015 |
| 77 | 7 | 7.28 | 9.06 | 85.2 | 397.4 | 524.3 | 12.3 | 17.1 | 672.3 | 97.5 | 56.8 | 0 | 988 | 0.26 | 340.6 | 07:36 | 07.10.2015 |
| 78 | 7 | 7.74 | 8.76 | 79.7 | 338.6 | 458.6 | 11.4 | 21.7 | 640 | 106 | 58.3 | 0.4 | 1393 | 0.22 | 297.7 | 09:00 | 07.10.2015 |
| 79 | 9 | 8.5 | 9.65 | 97.2 | 162.6 | 200.4 | 15.1 | 17.5 | 641.7 | 87.4 | 53.8 | 3.9 | 1373 | 0.1 | 130.65 | 09:50 | 07.10.2015 |
| 80 | 1 | 7.95 | 4.62 | 49.5 | 291.2 | 327.6 | 19.2 | 20.1 | 643.3 | 96.7 | 51.6 | 1.5 | 1359 | 0.16 | 213.2 | 10:15 | 07.10.2015 |

**Appendix A** (Continued)

| St.No | St.Ty | pH | DO | %DO | EC | Spe. EC | TW | Ta | Atm.p | ORP | Mois. | WS | Elev | Sal | TDS | Time | Date |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 81 | 3 | 8.13 | 8.54 | 96.3 | 292 | 309.6 | 22.4 | 26.5 | 684.5 | 90.6 | 56.3 | 1 | 874 | 0.15 | 200.85 | 12:00 | 07.10.2015 |
| 82 | 10 | 8.21 | 7.66 | 87.4 | 336.2 | 356.6 | 22.1 | 30.8 | 712.7 | 87.7 | 50.7 | 0.6 | 540 | 0.17 | 231.4 | 12:43 | 07.10.2015 |
| 83 | 7 | 7.19 | 6.66 | 74.3 | 732 | 815 | 19.7 | 30.2 | 752.6 | 87.8 | 51.7 | 0 | 83 | 0.4 | 526.5 | 13:19 | 07.10.2015 |
| 84 | 2 | 8.04 | 9.18 | 96.8 | 459.3 | 532.4 | 17.8 | 26.2 | 752.7 | 84.7 | 59.3 | 0.8 | 82 | 0.26 | 345.8 | 13:20 | 07.10.2015 |
| 85 | 5 | 8.57 | 6.62 | 80.7 | 328 | 328.1 | 25 | 24.3 | 715.7 | 84.6 | 56.8 | 1.5 | 499 | 0.16 | 213.2 | 14:36 | 07.10.2015 |
| 86 | 3 | 7.4 | 8.13 | 84 | 495.9 | 587.4 | 16.8 | 27.8 | 709.1 | 93 | 55.2 | 0 | 543 | 0.29 | 381.55 | 15:11 | 07.10.2015 |
| 87 | 5 | 8.28 | 7.19 | 74.1 | 282.7 | 336 | 16.7 | 16 | 619.1 | 92.5 |  | 2.9 | 1655 | 0.16 | 218.4 | 15:59 | 07.10.2015 |
| 88 | 12 | 7.76 | 8.62 | 83 | 326 | 422.3 | 13.2 | 24.9 | 655.5 | 106.1 | 50.3 | 0 | 1191 | 0.2 | 271.7 | 17:04 | 07.10.2015 |
| 89 | 2 | 8.19 | 6.46 | 72.3 | 745 | 810 | 20.8 | 24 | 716.4 | 112.7 | 58.8 | 0 | 435 | 0.4 | 526.5 | 17:34 | 07.10.2015 |
| 90 | 3 | 7.96 | 7.33 | 81.1 | 641 | 724 | 19.1 | 26 | 729.8 | 106.2 | 62.3 | 0 | 312 | 0.35 | 468 | 17:56 | 07.10.2015 |
| 91 | 2 | 8.39 | 7.96 | 88.1 | 572 | 634 | 20 | 24 | 748 | 100.2 | 66 | 0 | 84 | 0.31 | 409.5 | 18:29 | 07.10.2015 |
| 92 | 5 | 7.79 | 4.32 | 47.2 | 543 | 612 | 19.1 | 23.1 | 737 | 105.3 | 53.6 | 0.3 | 224 | 0.3 | 396.5 | 07:07 | 08.10.2015 |
| 93 | 3 | 7.51 | 4.53 | 49.8 | 922 | 1021 | 19.9 | 24.6 | 679.8 | 101.3 | 51.9 | 0 | 898 | 0.51 | 663 | 08:19 | 08.10.2015 |
| 94 | 5 | 8.47 | 4.42 | 48.5 | 303.9 | 340.5 | 19.4 | 22.6 | 655.2 | 90.4 | 50.3 | 0 | 1202 | 0.16 | 221 | 09:00 | 08.10.2015 |
| 95 | 5 | 7.86 | 15.35 | 161.9 | 521 | 612 | 17.2 | 26.2 | 665.1 | 106 | 46.4 | 0.5 | 1145 | 0.3 | 396.5 | 09:35 | 08.10.2015 |
| 96 | 7 | 7.94 | 10.04 | 88.8 | 281.3 | 393.7 | 10.1 | 25.1 | 674 | 106.3 | 44.4 | 0 | 1044 | 0.1 | 256.1 | 10:08 | 08.10.2015 |
| 97 | 5 | 8.04 | 8.42 | 87.5 | 328 | 381 | 17.7 | 27.2 | 646.3 | 100.1 | 43.3 | 0 | 1366 | 0.18 | 247.65 | 11:05 | 08.10.2015 |
| 98 | 3 | 7.56 | 9.85 | 98.7 | 891 | 1072 | 16.1 | 24 | 635.9 | 105.2 | 40.8 | 0.5 | 1469 | 0.54 | 702 | 11:41 | 08.10.2015 |
| 99 | 3 | 8.21 | 9.12 | 91.7 | 327.1 | 404.7 | 14.9 | 23 | 643.4 | 103.6 | 43.3 | 1.7 | 1414 | 0.19 | 262.6 | 12:30 | 08.10.2015 |
| 100 | 3 | 8.04 | 8.02 | 89.5 | 550 | 600 | 20.5 | 25.5 | 657.4 | 115.3 | 43.1 | 0.6 | 1229 | 0.29 | 390 | 13:02 | 08.10.2015 |

**Appendix A** (Continued)

| St.No | St.Ty | pH | DO | %DO | EC | Spe. EC | TW | Ta | Atm.p | ORP | Mois. | WS | Elev | Sal | TDS | Time | Date |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 101 | 3 | 7.97 | | | 531 | 668 | 14.3 | 25.9 | 680 | 102.4 | 48.2 | 0 | 951 | 0.33 | 435.5 | 13:40 | 08.10.2015 |
| 102 | 3 | 8.38 | 7.65 | 82.2 | 745 | 828 | 19.6 | 28.4 | 677.8 | 105.5 | 47.6 | 0 | 978 | 0.41 | 539.5 | 14:00 | 08.10.2015 |
| 103 | 8 | 8.58 | 8.72 | 107.9 | 405.3 | 410 | 24.4 | 30 | 747.6 | 96.4 | 43.8 | 2.2 | 134 | 0.2 | 266.5 | 14:56 | 08.10.2015 |
| 104 | 8 | 8.41 | 10.01 | 111.8 | 398.5 | 431 | 21.1 | 29 | 743.3 | 75.9 | 49 | 0.4 | 166 | 0.21 | 280.15 | 16:18 | 08.10.2015 |
| 105 | 3 | 7.37 | 4.87 | 53.4 | 898 | 988 | 20.2 | 28.4 | 749.5 | 97.1 | 54.8 | 0.4 | 105 | 0.49 | 643.5 | 16:55 | 08.10.2015 |
| 106 | 3 | 7.4 | 10.9 | 125.4 | 2160 | 2278 | 22.3 | 28.1 | 734.9 | 109 | 54.2 | 0 | 265 | 1.17 | 1482 | 17:47 | 08.10.2015 |
| 107 | 3 | 7.98 | 7.73 | 74.8 | 557 | 702 | 14.2 | 23.4 | 656.9 | 91.9 | 54.2 | 0 | 1239 | 0.34 | 455 | 19:04 | 08.10.2015 |
| 108 | 3 | 7.84 | 6.3 | 64.2 | 936 | 1094 | 17.5 | 22.7 | 671.6 | 135.8 | 62.8 | 0 | 1051 | 0.55 | 708.5 | 07:00 | 09.10.2015 |
| 109 | 2 | 8.31 | 9.35 | 91.4 | 408 | 510 | 14.1 | 19.6 | 714.4 | 119.3 | 63.8 | 0.4 | 549 | 0.25 | 331.5 | 07:56 | 09.10.2015 |
| 110 | 3 | 7.49 | 6.42 | 75.4 | 946 | 968 | 23.7 | 26.7 | 729.8 | 126.9 | 59.8 | 0 | 370 | 0.48 | 630.5 | 08:21 | 09.10.2015 |
| 111 | 9 | 8.33 | 4.84 | 53.7 | 397.8 | 449.6 | 19 | 27.3 | 726.6 | 99.9 | 53.8 | 0 | 415 | 0.22 | 292.5 | 09:07 | 09.10.2015 |
| 112 | 4 | 8.29 | 5.3 | 69.3 | 362.9 | 373.4 | 23.5 | 28.5 | 755 | 102.9 | 51.2 | 0 | 58 | 0.18 | 242.5 | 09:34 | 09.10.2015 |
| 113 | 8 | 8.42 | 7.35 | 89.8 | 454.8 | 450.8 | 25.5 | 33.3 | 756.4 | 78.5 | 51.6 | 1.4 | 42 | 0.22 | 293.15 | 12:07 | 09.10.2015 |
| 114 | 8 | 8.45 | 10.09 | 116.6 | 444.3 | 470 | 22.2 | 30.6 | 758.2 | 82.2 | 48.9 | 2.9 | 22 | 0.23 | 304.85 | 12:33 | 09.10.2015 |
| 115 | 9 | 8.83 | 14.9 | 187 | 256.4 | 244.9 | 27.5 | 29.7 | 758.6 | 82.9 | 52.8 | 1.1 | -3 | 0.11 | 159.28 | 13:02 | 09.10.2015 |
| 116 | 9 | 8.09 | 1.43 | 18.2 | 568 | 543 | 27.7 | 30.4 | 758.6 | 93.9 | 51.6 | 0.9 | 3 | 0.26 | 357.5 | 13:54 | 09.10.2015 |
| 117 | 8 | 8.59 | 10.54 | 122.6 | 286.5 | 398.2 | 23.5 | 29.9 | 758.7 | 65.2 | 55.4 | 2 | 2 | | 258.7 | 14:34 | 09.10.2015 |
| **Mean** | | 8.05 | 7.36 | 79.54 | 735.67 | 1043.84 | 18.98 | 27.07 | 707.57 | 86.7 | 54.47 | 0.67 | 626.5 | 0.34 | 579.72 | | |
| **Maximum** | | 8.85 | 15.35 | 187 | 16657 | 43636 | 29.30 | 36.10 | 761.3 | 135.8 | 82.20 | 3.9 | 1655 | 5.57 | 16815 | | |
| **Minimum** | | 7.00 | 1.43 | 18.2 | 114 | 180.1 | 10.10 | 16.00 | 619.10 | 14.80 | 31.90 | 0.00 | -3 | 0.08 | 115.7 | | |

**Appendix B** Chemical variables on water and sediment were reported from different aquatic bodies in Mersin. Abbreviations: $Na^{+2}$: sodium ion concentration of the water (ppm), $K^{2+}$: potassium ion concentration of water (ppm), $Mg^{2+}$: Magnesium ion concentration of water (ppm), $Ca^{2+}$: calcium ion concentration of water (ppm), $Cl^{-}$: chloride ion concentration of water (ppm), $NO_2^{-}$: nitrite ion concentration of water (ppm), $NO_3^{-}$: nitrate ion concentration of water (ppm), $SO_4^{2-}$: sulphate ion concentration of water (ppm), Spp: species, Bo: *Bradleycypris obliqua*,Cn: *Candona neglecta*, Csp: *Candona* sp, Cw: *Candona weltneri*, Cr: *Cypretta* cf. *reticulata* Co: *Cypria ophtalmica*, Cv: *Cypridopsis vidua*, Cp: *Cypris pubera*, Ds: *Darwinula stevensoni*, Esp: *Eucypris* sp, Fw: *Fabeaformiscandona* cf. *wegelini* Hl: *Hemicypris* cf. *largereticulata* Hh: *Herpetocypris helenae* Hin: *Herpetocypris intermedia* Hr: *Herpetocypris reptans* Hi: *Heterocypris incongruens* Hre: *Heterocypris reptans*, Hro: *Heterocypris rotundata*, Hs: *Heterocypris salina* Hsp: *Heterocypris* sp. lb: *Ilyocypris bradyi* lg: *Ilyocypris gibba* li: *Ilyocypris inermis* Im: *Ilyocypris monstrifica* lsp: *Ilyocypris* sp. lsbe: *Isocypris beauchampi* Li: *Limnocythere inopinata*, Pw: *Plesiocypridopsis newtoni* Pa: *Potamocypris arcuata* Pof: *Potamocypris fallax* Ps: P*otamocypris smaragdina* Posp: *Potamocypris* sp. Pv: *Potamocypris variegata* Pvi: *Potamocypris villosa* Pcsp: *Prionocypris* sp. Pz: *Prionocypris zenkeri* Pal: *Pseudocandona albicans* Pasp: *Pseudocandona* sp. Pnsp: *Pseudostrandesia* n. sp. Pr: *Psychrodromus* cf. *robertsoni* Pf: *Psychrodromus fontinalis* Po: *Psychrodromus olivaceus* Psp: *Psychrodromus* sp. Sp: *Stenocypris* sp.

| St.No | $Na^{2+}$ | $K^{2+}$ | $Mg^{2+}$ | $Ca^{2+}$ | $Cl^{-}$ | $NO_{2-}$ | $NO_{3-}$ | $SO_4^{2-}$ | Coordinate | Spp |
|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 2.7873 | 0.6123 | 5.5408 | 44.3707 | 6.0571 | 0.6307 | 5.7388 | 8.3526 | N 36.47168 E 33.20435 | Hin |
| 2 | 3.3883 | 0.5529 | 8.3572 | 49.5048 | 6.9494 | 0.5621 | 4.702 | 9.1405 | N 36.46088 E 33.11646 | Fw, Pof, Po |
| 3 | 0.6061 | 0.2003 | 2.9717 | 27.6852 | 1.1166 | 0.2789 | 1.6556 | 2.2824 | N 36.45501 E 33.12356 | |
| 4 | 17.1312 | 0.9003 | 13.9114 | 66.5537 | 37.2455 | 1.8174 | 45.5623 | 30.6685 | N 36.42964 E 33.13997 | Hs, Pz |
| 5 | 15.7248 | 1.0328 | 13.6541 | 93.9817 | 18.2396 | 1.4276 | 14.6026 | 48.4898 | N 36.40953 E 33.11019 | Hs |
| 6 | 12.4928 | 2.4503 | 15.0018 | 45.3559 | 18.1102 | 1.1864 | 1.6427 | 39.684 | N 36.37783 E 33.14022 | |
| 7 | 11.1708 | 3.3943 | 12.087 | 49.4435 | 13.4856 | 0.4713 | 2.4089 | 27.7397 | N 36.35142 E 33.17706 | |
| 8 | 58.2534 | 2.5841 | 39.3918 | 40.43 | 3.7229 | 0.5248 | 0.1801 | 16.2899 | N 36.34903 E 33.20508 | Cv, Ib, Isbe, Li |
| 9 | 4.8427 | 0.8264 | 10.8934 | 41.5947 | 35.143 | b.d.l. | 0.1714 | 144.7886 | N 36.32997 E 33.20861 | Hs, Ib, Pal |
| 10 | 8.1227 | 1.0601 | 22.3173 | 61.1256 | 5.8931 | 0.6994 | 0.7856 | 21.2467 | N 36.32050 E 33.27734 | |
| 11 | 2.3604 | 0.4629 | 8.2304 | 45.2575 | 6.8669 | 0.6655 | 3.1282 | 57.8874 | N 36.30506 E 33.32618 | Ib, Pz |
| 12 | 3.7543 | 0.7981 | 12.3407 | 58.6034 | 3.5979 | 0.6175 | 6.5495 | 7.6938 | N 36.36066 E 33.38449 | Cn, Ii |
| 13 | 2.4271 | 0.5195 | 6.5521 | 47.0628 | 5.2148 | 0.7535 | 0.3285 | 19.3291 | N 36.36247 E 33.38679 | |
| 14 | 1.5363 | 0.3091 | 4.0759 | 45.3479 | 3.1357 | 0.2584 | 5.7303 | 12.1932 | N 36.36976 E 33.38305 | Ib, Pz |
| 15 | 1.3556 | 0.2431 | 4.1974 | 46.3279 | 2.2108 | 0.5136 | 5.3827 | 1.7191 | N 36.40071 E 33.38736 | Hre |
| 16 | 2.899 | 0.7467 | 6.1661 | 75.4915 | 2.0424 | 0.6247 | 5.8994 | 2.3886 | N 36.39690 E 33.38021 | Hsp, Posp |
| 17 | 0.4669 | 2.9947 | 1.3069 | 32.8524 | 3.562 | 0.5682 | 14.6582 | 4.907 | N 36.41192 E 33.34357 | |
| 18 | 1.7452 | 0.1647 | 1.0287 | 51.5855 | 1.1702 | 0.2631 | 2.099 | 2.0653 | N 36.44901 E 33.30540 | |
| 19 | 114.2024 | 35.0264 | 8.6771 | 83.5867 | 3.321 | 0.6484 | 21.4405 | 2.3506 | N 36.45765 E 33.29245 | |
| 20 | 90.8446 | 12.1233 | 18.4563 | 111.5524 | 143.0414 | 16.545 | 4.4735 | 33.3353 | N 36.29218 E 33.16942 | Pof, Po |

**Appendix B** (Continued)

| St.No | $Na^{2+}$ | $K^{2+}$ | $Mg^{2+}$ | $Ca^{2+}$ | $Cl^{-}$ | $NO_{2-}$ | $NO_{3-}$ | $SO_4^{2-}$ | Coordinate | Spp |
|---|---|---|---|---|---|---|---|---|---|---|
| 21 | 3.1248 | 0.6608 | 5.0355 | 76.9946 | 88.2669 | b.d.l. | 0.5104 | 26.6213 | N 36.29218 E 33.16942 | |
| 22 | 4.8011 | 0.5916 | 6.6687 | 65.58 | 6.0208 | 0.8854 | 0.9553 | 9.8217 | N 36.30399 E 33.14792 | Hin, Hi,Ib, Pof |
| 23 | 2.3145 | 0.5485 | 4.6302 | 35.151 | 8.4883 | 0.9375 | 8.6642 | 10.5172 | | Cp, Hr, Hi, Hs, Pof |
| 24 | 2.8655 | 0.6853 | 7.6327 | 36.784 | 10.1724 | 0.4967 | 10.1311 | 5.3175 | N 36.29787 E 33.09825 | Hi |
| 25 | 5.7471 | 3.7691 | 20.3651 | 126.4381 | 3.7005 | 0.5594 | 0.3945 | 16.1248 | N 36.31691 E 33.11463 | |
| 26 | 1.4917 | 0.5493 | 3.2538 | 61.6277 | 8.7299 | 1.132 | 4.6308 | 233.319 | N 36.23574 E 33.08350 | |
| 27 | 3.0218 | 0.6133 | 4.0258 | 75.6191 | 4.3088 | 0.4214 | b.d.l. | 24.0212 | N 36.22694 E 33.08642 | |
| 28 | 1.5588 | 0.2406 | 3.2554 | 57.8032 | 5.7006 | 0.4189 | 3.6053 | 21.7207 | N 36.21589 E 33.08290 | |
| 29 | 1.7963 | 0.1475 | 1.4646 | 72.7072 | 2.8858 | 0.5849 | 3.5849 | 4.6857 | N 36.20258 E 33.04502 | Cw, Ib, Pof, Po |
| 30 | 1.747 | 0.7412 | 21.2725 | 20.3258 | 3.2335 | 0.546 | b.d.l. | 2.7076 | N 36.18532 E 32.57421 | Ib,Pof |
| 31 | 5.4964 | 0.5429 | 8.0166 | 60.2862 | 2.7434 | 0.4762 | b.d.l. | 3.4004 | N 36.18300 E 32.50800 | Posp |
| 32 | 5.5104 | 0.5616 | 8.4544 | 86.8332 | 5.7266 | 0.711 | 0.1048 | 21.9746 | N 36.17541 E 32.53089 | Ii, Pf |
| 33 | 4.1928 | 0.7903 | 9.6387 | 45.3411 | 5.1047 | 0.5404 | b.d.l. | 42.0652 | N 36.17527 E 32.53077 | Ib |
| 34 | 3.4401 | 0.2592 | 15.7293 | 73.8388 | 8.0584 | 0.7215 | b.d.l. | 43.5757 | N 36.17720 E 32.51500 | Csp, Ib |
| 35 | 1.1164 | 0.1898 | 4.2557 | 46.4737 | 7.0164 | 0.303 | b.d.l. | 37.9943 | N 36.17117 E 32.48640 | Ib |
| 36 | 1.1806 | 0.2385 | 3.6991 | 40.0438 | 3.3585 | 0.6749 | 0.2323 | 60.3742 | N 36.15729 E 32.48697 | Hi |
| 37 | 10.1019 | 0.8448 | 8.0498 | 25.4225 | 2.2461 | 0.3922 | 1.3106 | 10.4967 | N 36.13228 E 32.49446 | Pw,Pof |
| 38 | 3.0333 | 0.5081 | 3.8902 | 36.0156 | 2.2381 | 0.4434 | 1.9635 | 11.2253 | N 36.10795 E 32.51844 | Cv,Ps |
| 39 | 1.9731 | 0.4601 | 3.6906 | 37.188 | 4.9002 | 0.5029 | b.d.l. | 21.524 | N 36.06596 E 32.51175 | |
| 40 | 7.1929 | 0.7615 | 7.4603 | 65.625 | 4.6654 | 0.504 | 0.2814 | 11.5534 | N 36.06148 E 32.51045 | |

**Appendix B** (Continued)

| St.No | $Na^{2+}$ | $K^{2+}$ | $Mg^{2+}$ | $Ca^{2+}$ | $Cl^{-}$ | $NO_{2-}$ | $NO_{3-}$ | $SO_4^{2-}$ | Coordinate | Spp |
|---|---|---|---|---|---|---|---|---|---|---|
| 41 | 3.1457 | 0.9993 | 4.1833 | 31.916 | 3.4878 | 0.4865 | b.d.l. | 10.8903 | N 36.03722 E 32.49191 | |
| 42 | 904.4404 | 29.2749 | 58.219 | 74.0148 | 9.0236 | 0.5472 | 8.0799 | 32.7869 | N 36.02319 E 32.49083 | |
| 43 | 8.678 | 1.1749 | 20.3453 | 31.3086 | 4.9678 | 0.343 | b.d.l. | 12.8097 | N 36.02318 E 32.49089 | |
| 44 | 8.2664 | 1.2027 | 3.1619 | 47.6143 | - | - | - | - | N 36.09250 E 32.45282 | Hs |
| 45 | 2.0759 | 0.9859 | 3.4557 | 35.3567 | 12.742 | 0.8535 | b.d.l. | 11.8794 | N 36.10290 E 32.42897 | Hi, Pf |
| 46 | 3.0581 | 0.4643 | 6.8168 | 48.6312 | 3.9252 | 0.0874 | 0.6847 | 4.0844 | N 36.05458 E 32.47790 | Ib |
| 47 | 11.8996 | 1.7625 | 14.1472 | 76.6401 | 3.0466 | 0.3678 | b.d.l. | 7.1173 | N 36.06615 E 32.58589 | Ig |
| 48 | 4.8489 | 0.5913 | 25.374 | 109.2682 | 4.0929 | 0.43 | 0.8831 | 9.9942 | N 36.08296 E 33.02351 | Co |
| 49 | 10.992 | 0.5264 | 14.3536 | 68.308 | 27.0035 | 1.4114 | b.d.l. | 41.173 | N 36.09876 E 33.06131 | |
| 50 | 6.457 | 0.8192 | 25.7708 | b.d.l. | 9.0834 | 0.8009 | b.d.l. | 367.0306 | N 36.09041 E 33.11944 | Cv,Cp, Hs, Pnsp |
| 51 | 2.5676 | 0.3787 | 6.7521 | 18.39 | 26.8808 | 1.2716 | b.d.l. | 21.7064 | N 36.09709 E 33.13871 | |
| 52 | | | | | 14.0432 | 0.7636 | b.d.l. | 53.9982 | N 36.08146 E 33.17772 | Pf |
| 53 | 4.7376 | 0.1382 | 2.6049 | 33.5541 | 4.9554 | 0.1797 | 2.5649 | 13.4183 | N 36.15138 E 33.18061 | Hs |
| 54 | 8.5986 | 15.6655 | 2.2806 | 76.676 | 8.045 | 0.5091 | b.d.l. | 2.9522 | N 36.16649 E 33.18690 | Csp, Hi, Hre, Hs, Isp |
| 55 | 3.7203 | 0.7325 | 10.8095 | 68.747 | 16.2253 | 1.1519 | 33.7554 | 9.409 | N 36.19252 E 33.15936 | Esp, Pvi |
| 56 | 6.4938 | 1.3622 | 10.7562 | 163.0238 | 5.5449 | 0.5954 | 4.8262 | 17.0872 | N 36.20174 E 33.18188 | Po |
| 57 | 4.3094 | 1.7774 | 21.0514 | 86.5751 | 6.6752 | 1.0288 | b.d.l. | 303.9083 | N 36.23827 E 33.13944 | |
| 58 | 3.4547 | 0.5976 | 12.3428 | 58.6949 | 5.8936 | 0.4845 | b.d.l. | 157.9417 | N 36.25555 E 33.17224 | Hi |
| 59 | 10.4461 | 0.5593 | 11.7852 | 64.6293 | 5.5257 | 0.6623 | 0.2233 | 16.793 | N 36.23102 E 33.18560 | |
| 60 | 4.6685 | 0.2938 | 2.2105 | 63.8144 | 15.8503 | 0.6189 | b.d.l. | 18.6128 | N 36.11044 E 33.32146 | Bo, Hh, Hs |

**Appendix B** (Continued)

| St.No | $Na^{2+}$ | $K^{2+}$ | $Mg^{2+}$ | $Ca^{2+}$ | $Cl^{-}$ | $NO_{2-}$ | $NO_{3-}$ | $SO_4^{2-}$ | Coordinate | Spp |
|---|---|---|---|---|---|---|---|---|---|---|
| 61 | 5.0059 | 0.5271 | 7.0886 | 68.3975 | 8.8923 | 0.5318 | 4.2314 | 4.0284 | N 36.17432 E 33.33251 | Hs,Pv,Po |
| 62 | 16.3272 | 2.062 | 15.6348 | 34.033 | 8.6296 | 0.7757 | 1.7729 | 17.5299 | N 36.16352 E 33.36622 | Po |
| 63 | 4.7461 | 1.0035 | 10.2707 | 50.0122 | 41.6513 | 1.4303 | b.d.l. | 62.1997 | N 36.15431 E 33.43656 | Ig, Li |
| 64 | 9.4665 | 0.9654 | 13.939 | 67.4326 | | | | | N 36.17735 E 33.56055 | Hs |
| 65 | 7.5902 | 0.6474 | 13.8897 | 81.9686 | 21.3502 | 0.2165 | 0.4303 | 9.3266 | N 36.12928 E 33.37653 | Ds,Ii,Po |
| 66 | 3.435 | 0.3826 | 5.4266 | 71.682 | 13.0054 | 1.2413 | 1.3771 | 97.4512 | N 36.21401 E 33.52820 | Cr, Hro |
| 67 | 14.9878 | 0.6477 | 11.2204 | 44.4069 | 6.585 | 0.4765 | 2.3419 | 4.2903 | N 36.20701 E 33.38788 | |
| 68 | 12.1981 | 0.9427 | 17.6627 | 91.952 | 13.0757 | 0.7945 | b.d.l. | 17.2514 | N 36.22411 E 33.37210 | Hi, Po |
| 69 | 10.6922 | 1.1267 | 15.0186 | 36.4868 | 23.3802 | 1.4225 | b.d.l. | 81.8239 | N 36.24799 E 33.37700 | |
| 70 | 18.0265 | 0.9255 | 17.8698 | 59.2579 | 11.4441 | 0.6225 | 4.3982 | 33.9706 | N 36.26320 E 33.38441 | |
| 71 | 8.5433 | 1.702 | 2.9859 | 43.7598 | 31.6069 | b.d.l. | 13.3228 | 21.4214 | N 36.25871 E 33.45297 | |
| 72 | 6.8867 | 1.012 | 5.5586 | 63.7416 | 18.11 | 0.9643 | b.d.l. | 8.1571 | N 36.27705 E 33.49435 | Cv,Pw |
| 73 | 1.0097 | 0.2226 | 1.2091 | 40.5022 | 13.8815 | 0.6069 | 0.6812 | 29.7245 | N 36.28200 E 33.50953 | Hi |
| 74 | 1.0255 | 0.603 | 1.5075 | 57.7533 | 1.8111 | 0.497 | 4.4144 | 1.3308 | N 36.32075 E 33.59485 | |
| 75 | 1.492 | 0.3809 | 2.2041 | 52.9273 | 1.6143 | 0.5905 | b.d.l. | 1.628 | N 36.32287 E 33.59640 | |
| 76 | 1.6949 | 0.3918 | 1.883 | 76.0686 | 0.8842 | 0.1507 | 1.6452 | 0.9288 | N 36.39519 E 34.00251 | |
| 77 | 1.7839 | 1.019 | 2.3821 | 53.0716 | 2.8434 | 0.3283 | 1.4095 | 0.2122 | N 36.39570 E 34.00416 | Po |
| 78 | 0.9239 | 1.9738 | 0.9161 | 31.3218 | 2.5202 | 0.5066 | b.d.l. | 3.6268 | N 36.43188 E 33.52215 | |
| 79 | 1.3174 | 1.8907 | 4.7043 | 39.6146 | 1.4232 | 0.2614 | b.d.l. | 8.4532 | N 36.47186 E 34.01951 | |
| 80 | 1.8432 | 1.1946 | 1.9093 | 41.1141 | 2.6694 | 0.3386 | b.d.l. | 8.5499 | N 36.46829 E 34.08162 | |

**Appendix B** (Continued)

| St.No | $Na^{2+}$ | $K^{2+}$ | $Mg^{2+}$ | $Ca^{2+}$ | $Cl^{-}$ | $NO_{2-}$ | $NO_{3-}$ | $SO_4^{2-}$ | Coordinate | Spp |
|---|---|---|---|---|---|---|---|---|---|---|
| 81 | 1.328 | 0.3021 | 1.9409 | 47.325 | 3.1166 | 0.3649 | 1.8361 | 0.7785 | N 36.39706 E 34.09242 | |
| 82 | 7.6766 | 0.5481 | 3.7982 | 116.9093 | 2.5176 | 0.5802 | 3.8716 | 1.7967 | N 36.36581 E 34.12449 | Hi,Ib |
| 83 | 5.1535 | 0.5012 | 8.4962 | 66.262 | 13.7645 | 1.1958 | 9.4754 | 2.5977 | N 36.34438 E 34.13197 | Ib,Pz,Pr |
| 84 | 5.4972 | 0.8517 | 9.9247 | 33.2866 | 8.8715 | 0.3601 | 6.3824 | 16.6139 | N 36.34921 E 34.13297 | |
| 85 | 5.0432 | 0.4164 | 5.8209 | 76.1322 | 12.1099 | 0.7143 | b.d.l. | 11.2364 | N 36.40582 E 34.15218 | |
| 86 | 2.1151 | 0.4241 | 4.4001 | 93.3105 | 8.5489 | 0.7126 | 1.1879 | 3.8451 | N 36.42996 E 34.15963 | |
| 87 | 1.5412 | 0.1847 | 6.0352 | 53.3571 | 2.0862 | 0.7696 | b.d.l. | 1.5226 | N 36.51325 E 34.10753 | |
| 88 | 5.7522 | 0.4421 | 43.8404 | 42.9306 | 2.4795 | 0.4021 | 3.9914 | 4.1813 | N 36.49125 E 34.18578 | |
| 89 | 7.7469 | 1.0101 | 5.7751 | 80.0888 | 12.938 | 1.4344 | 2.6347 | 11.2364 | N 36.46748 E 34.21883 | Ib, Li, Po |
| 90 | 8.2089 | 0.8443 | 29.622 | 37.4531 | 19.5662 | 1.2622 | 6.6998 | 6.1637 | N 36.45776 E 34.23643 | |
| 91 | 11.5804 | 0.9967 | 9.6083 | 66.9925 | 10.6859 | 0.994 | 5.0664 | 25.3568 | N 36.43630 E 34.24005 | Im, Li |
| 92 | 3.7661 | 0.1004 | 74.1328 | 6.2009 | 19.5547 | 1.3501 | 0.8818 | 21.5998 | N 36.47010 E 34.27480 | Im |
| 93 | 3.6968 | 0.6139 | 9.044 | 33.223 | 8.5629 | b.d.l. | 0.5031 | 3.848 | N 36.52478 E 34.24148 | |
| 94 | 5.4921 | 1.2634 | 13.2687 | 65.5114 | 3.4815 | 0.4485 | b.d.l. | 9.8947 | N 36.5681 E 34.23871 | |
| 95 | 1.3874 | 0.234 | 4.4457 | 51.3277 | 7.4205 | 1.0374 | 1.8279 | 11.8172 | N 36.59134 E 34.26026 | |
| 96 | 1.8618 | 0.4609 | 4.5331 | 49.2181 | 2.0142 | 0.5508 | 0.6576 | 3.0254 | N 37.00305 E 34.26612 | Pof, Pf |
| 97 | 21.5116 | 20.1199 | 10.7954 | 119.7344 | 2.6791 | 0.4063 | 0.3829 | 7.7467 | N 37.00407 E 34.16929 | |
| 98 | 2.0031 | 0.1796 | 6.3225 | 44.8654 | 28.1719 | b.d.l. | 109.9358 | 40.037 | N 37.03066 E 34.20421 | |
| 99 | 3.353 | 0.0951 | 7.8419 | 67.7008 | 2.9031 | 0.4669 | 0.7247 | 5.242 | N 37.05417 E 34.26449 | Pa |
| 100 | 8.9664 | 1.7375 | 12.9113 | 69.3432 | 2.9398 | 0.6414 | b.d.l. | 7.2722 | N 37.05237 E 34.31843 | |

**Appendix B** (Continued)

| St.No | $Na^{2+}$ | $K^{2+}$ | $Mg^{2+}$ | $Ca^{2+}$ | $Cl^{-}$ | $NO_{2-}$ | $NO_{3-}$ | $SO_4^{2-}$ | Coordinate | Spp |
|---|---|---|---|---|---|---|---|---|---|---|
| 101 | 1.8222 | b.d.l. | 67.6492 | 3.2601 | 9.4254 | 0.9027 | 24.4292 | 17.7696 | N 37.01692 E 34.29154 | |
| 102 | 8.9972 | 0.8167 | 8.7276 | 39.6491 | 4.3759 | 1.3563 | 0.8132 | 3.141 | N 36.59710 E 34.29694 | |
| 103 | 7.831 | 0.5639 | 8.5476 | 41.8958 | 10.4285 | 0.3797 | 2.1852 | 12.2257 | N 36.51148 E 34.34433 | Sp |
| 104 | 33.902 | 1.1993 | 14.8054 | 99.0798 | 12.3718 | 0.8382 | 2.5588 | 12.3404 | N 36.54399 E 34.38962 | |
| 105 | 92.5734 | 52.5089 | 17.5084 | 218.7508 | 73.7797 | b.d.l. | 27.3166 | 73.2879 | N 36.45758 E 34.42688 | |
| 106 | 3.0431 | 0.2324 | 11.7726 | 81.3142 | 116.0432 | b.d.l. | 176.471 | 142.9631 | N 36.59603 E 34.46900 | Hs |
| 107 | 2.9156 | 0.232 | 53.7034 | 35.928 | 4.6844 | 0.8372 | 6.9764 | 8.6005 | N 37.10535 E 34.37713 | Hre, Ib |
| 108 | 6.4864 | 0.6161 | 7.4464 | 49.4971 | 5.7044 | 1.3584 | b.d.l. | 5.092 | N 37.09103 E 34.40576 | Csp, Hs |
| 109 | 12.8833 | 5.7719 | 15.4884 | 94.963 | 10.4569 | 0.8195 | 15.5006 | 10.9621 | N 37.09334 E 34.48514 | Hs, Hre, Ib, Pf |
| 110 | 7.8131 | 3.8595 | 3.2377 | 51.0078 | 17.9861 | b.d.l. | 75.0534 | 44.2568 | N 37.06217 E 34.53111 | |
| 111 | 7.9225 | 0.6058 | 9.4115 | 34.1986 | 13.174 | 0.282 | 3.5987 | 58.6627 | N 37.02696 E 34.54294 | Hi |
| 112 | 12.0622 | 1.2013 | 15.3615 | 30.3464 | 11.0931 | 0.423 | 1.9975 | 13.2465 | N 37.00557 E 34.53793 | Li |
| 113 | 12.4665 | 1.0965 | 15.0365 | 31.222 | 15.1882 | 0.2232 | 0.8023 | 26.2081 | N 36.58795 E 34.59803 | Li |
| 114 | 4.5334 | 5.0617 | 6.883 | 20.6984 | 17.1289 | 0.766 | 0.9233 | 25.8536 | N 36.55031 E 35.00649 | |
| 115 | 27.8033 | 9.4019 | 18.1176 | 27.4127 | 8.3834 | 0.1667 | b.d.l. | 13.8771 | N 36.51901 E 35.03770 | Isp |
| 116 | 8.0828 | 0.6989 | 9.3701 | 36.3046 | 37.9303 | 0.7424 | 1.6217 | 20.7843 | N 36.50884 E 34.58163 | Hl |
| 117 | 3.3158 | 0.7736 | 6.5293 | 40.0204 | 11.0466 | 0.4373 | 2.6241 | 10.9602 | N 36.50830 E 34.51043 | |

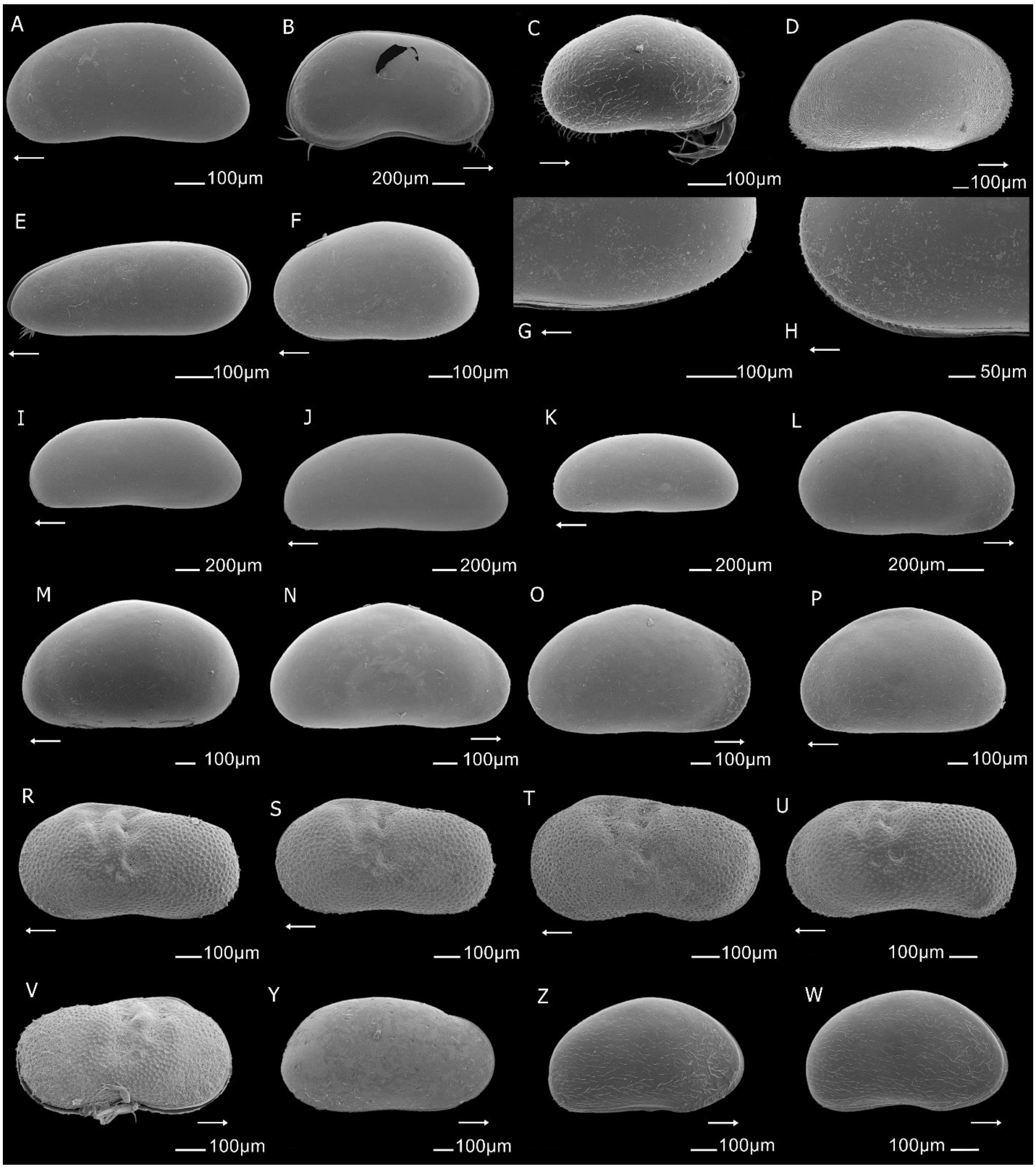
**Appendix C** Tolerance (tk) and optimum (uk) values of 12 taxa and 14 ecological variables in Mersin. Abbreviations: DO: dissolved oxygen, EC: electrical conductivity, TW: water temperature, Elev: elevation, Sal: salinity, $Na^{2+}$: sodium ion concentration of the water (ppm), $K^{2+}$: potassium ion concentration of water (ppm), $Mg^{2+}$: Magnesium ion concentration of water (ppm), $Ca^{2+}$: calcium ion concentration of water (ppm), $Cl^{-}$: chloride ion concentration of water (ppm), $NO_2^{-}$: nitrite ion concentration of water (ppm), $NO_3^{-}$: nitrate ion concentration of water (ppm), $SO_4^{2-}$: sulphate ion concentration of water (ppm), Csp: *Candona* sp. Cv: *Cypridopsis vidua*, Hi: *Heterocypris incongruens*, Hre: *Heterocypris reptans*, Hs: *Heterocypris salina*, Ib: *Ilyocypris bradyi*, Ii: *Ilyocypris inermis*, Li: *Limnocythere inopinata*, Pof: *Potamocypris fallax*, Pz: *Prionocypris zenkeri*.

| | | | | pH | | DO | | EC | | TW | | Elev | | Sal | | Na | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Species** | **Count** | **Max** | **N2** | **uk** | **tk** | **uk** | **tk** | **uk** | **tk** | **uk** | **tk** | **uk** | **tk** | **uk** | **tk** | **uk** | **tk** |
| **Csp** | 4 | 1 | 4 | 8.06 | 0.15 | 7.37 | 2.96 | 564.25 | 225.66 | 20.65 | 7.62 | 991.00 | 291.29 | 0.31 | 0.16 | 5.07 | 3.06 |
| **Cv** | 4 | 192 | 1.06296 | 8.14 | 0.24 | 6.22 | 1.31 | 384.38 | 53.00 | 20.94 | 1.69 | 837.01 | 323.66 | 0.20 | 0.11 | 7.12 | 15.01 |
| **Hi** | 12 | 73 | 3.55511 | 8.14 | 0.11 | 7.45 | 3.51 | 490.80 | 114.61 | 19.84 | 3.13 | 851.43 | 239.80 | 0.26 | 0.08 | 3.98 | 3.39 |
| **Hre** | 4 | 16 | 1.52672 | 8.14 | 0.11 | 9.60 | 2.07 | 442.57 | 51.21 | 22.06 | 6.62 | 791.60 | 270.56 | 0.22 | 0.07 | 7.88 | 4.26 |
| **Hs** | 15 | 500 | 4.05755 | 7.70 | 0.50 | 5.30 | 2.18 | 801.87 | 747.09 | 20.84 | 6.59 | 820.45 | 427.75 | 0.44 | 0.48 | 8.77 | 7.68 |
| **lb** | 16 | 200 | 3.71093 | 8.06 | 0.20 | 7.97 | 1.88 | 484.54 | 130.37 | 14.58 | 3.69 | 1100.74 | 444.65 | 0.29 | 0.08 | 5.40 | 13.59 |
| **li** | 3 | 81 | 1.78731 | 7.36 | 0.81 | 5.51 | 2.24 | 541.91 | 138.50 | 18.25 | 3.26 | 350.33 | 156.91 | 0.30 | 0.10 | 6.45 | 2.60 |
| **Li** | 6 | 67 | 1.56761 | 8.51 | 0.26 | 7.02 | 0.65 | 576.30 | 85.33 | 24.27 | 3.09 | 403.62 | 120.52 | 0.28 | 0.09 | 6.15 | 9.80 |
| **Pof** | 9 | 203 | 2.26988 | 8.08 | 0.08 | 8.46 | 2.13 | 390.64 | 100.56 | 12.39 | 1.86 | 1397.71 | 298.54 | 0.25 | 0.08 | 13.48 | 45.31 |
| **Pz** | 4 | 15 | 1.56277 | 7.35 | 0.56 | 4.99 | 1.01 | 758.02 | 146.34 | 17.66 | 2.22 | 609.42 | 343.60 | 0.44 | 0.14 | 14.08 | 9.91 |
| **Pf** | 5 | 18 | 2.56 | 8.01 | 0.22 | 9.66 | 1.36 | 353.19 | 92.54 | 12.77 | 4.28 | 765.44 | 484.02 | 0.17 | 0.10 | 4.10 | 6.08 |
| **Po** | 10 | 100 | 4.4846 | 7.52 | 0.39 | 6.33 | 1.43 | 498.34 | 107.38 | 16.53 | 3.75 | 824.03 | 436.82 | 0.29 | 0.06 | 20.57 | 38.15 |
| | | | **Min** | 7.35 | 0.08 | 4.99 | 0.65 | 353.19 | 51.21 | 12.39 | 1.69 | 350.33 | 120.52 | 0.17 | 0.06 | 3.98 | 2.60 |
| | | | **Max** | 8.51 | 0.81 | 9.66 | 3.51 | 801.87 | 747.09 | 24.27 | 7.62 | 1397.71 | 484.02 | 0.44 | 0.48 | 20.57 | 45.31 |
| | | | **Mean** | 7.92 | 0.32 | 7.18 | 1.92 | 531.56 | 199.35 | 18.39 | 4.08 | 820.77 | 317.33 | 0.29 | 0.15 | 9.11 | 14.77 |

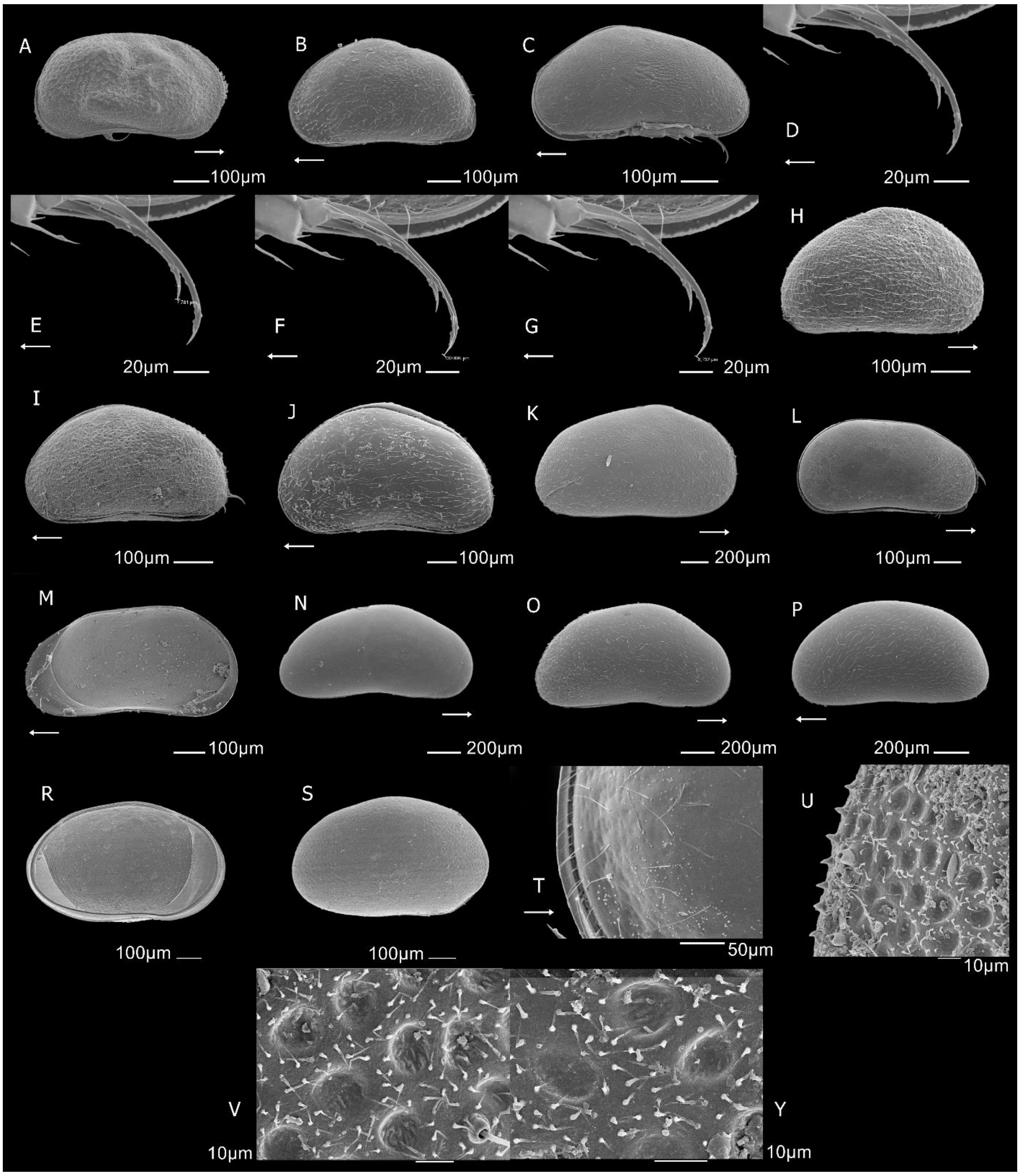
**Appendix C** (Continued)

| | | K | | Mg | | Ca | | Cl | | $NO_2$ | | $NO_3$ | | $SO_4$ | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Species** | **N2** | **uk** | **tk** | **uk** | **tk** | **uk** | **tk** | **uk** | **tk** | **uk** | **tk** | **uk** | **tk** | **uk** | **tk** |
| **Csp** | 4 | 4.32 | 7.57 | 11.68 | 8.46 | 55.08 | 26.19 | 6.26 | 2.30 | 0.78 | 0.39 | 0.00 | 11.22 | 13.58 | 20.02 |
| **Cv** | 1.06296 | 1.01 | 0.50 | 6.13 | 15.22 | 62.20 | 38.18 | 17.77 | 8.06 | 0.96 | 0.22 | 0.01 | 0.57 | 15.46 | 207.45 |
| **Hi** | 3.55511 | 0.63 | 1.92 | 4.27 | 4.03 | 66.30 | 34.91 | 8.57 | 5.53 | 0.67 | 0.17 | 1.64 | 2.30 | 24.45 | 40.36 |
| **Hre** | 1.52672 | 12.86 | 9.74 | 8.18 | 26.30 | 72.00 | 24.49 | 7.54 | 2.88 | 0.56 | 0.20 | 1.74 | 6.66 | 3.86 | 4.05 |
| **Hs** | 4.05755 | 0.63 | 0.99 | 12.22 | 4.66 | 65.06 | 16.79 | 26.99 | 32.83 | 1.11 | 0.69 | 31.42 | 52.35 | 38.46 | 41.16 |
| **lb** | 3.71093 | 0.63 | 0.97 | 31.87 | 23.02 | 38.62 | 23.39 | 5.06 | 4.88 | 0.69 | 0.26 | 3.71 | 4.29 | 10.90 | 21.67 |
| **li** | 1.78731 | 0.69 | 0.11 | 13.31 | 1.58 | 75.50 | 16.00 | 15.94 | 12.23 | 0.34 | 0.29 | 2.15 | 4.16 | 9.19 | 3.31 |
| **Li** | 1.56761 | 1.03 | 0.28 | 9.93 | 6.18 | 54.90 | 20.14 | 35.18 | 20.27 | 1.39 | 0.33 | 0.55 | 1.86 | 51.36 | 34.01 |
| **Pof** | 2.26988 | 4.13 | 13.77 | 15.59 | 10.20 | 33.78 | 29.54 | 4.67 | 10.68 | 0.68 | 1.20 | 3.86 | 8.91 | 4.50 | 4.71 |
| **Pz** | 1.56277 | 0.79 | 0.35 | 12.29 | 5.48 | 63.19 | 12.89 | 30.82 | 21.00 | 1.56 | 0.88 | 37.24 | 26.92 | 28.68 | 17.67 |
| **Pf** | 2.56 | 1.57 | 2.86 | 6.31 | 6.63 | 52.28 | 37.94 | 6.19 | 6.38 | 0.66 | 0.16 | 3.76 | 7.96 | 13.59 | 22.98 |
| **Po** | 4.4846 | 4.84 | 12.26 | 12.86 | 4.61 | 103.39 | 41.17 | 11.18 | 7.33 | 0.57 | 0.25 | 4.08 | 7.41 | 12.47 | 6.75 |
| | **Min** | 0.63 | 0.11 | 4.27 | 1.58 | 33.78 | 12.89 | 4.67 | 2.30 | 0.34 | 0.16 | 0.00 | 0.57 | 3.86 | 3.31 |
| | **Max** | 12.86 | 13.77 | 31.87 | 26.30 | 103.39 | 41.17 | 35.18 | 32.83 | 1.56 | 1.20 | 37.24 | 52.35 | 51.36 | 207.45 |
| | **Mean** | 3.33 | 4.66 | 12.91 | 10.30 | 62.82 | 26.83 | 15.43 | 12.11 | 0.85 | 0.46 | 9.10 | 13.40 | 20.12 | 45.35 |

**Appendices D1:** A, *Candona negletta* ; B, *Candona weltneri*; C, *Cypridopsis vidua*; D, *Cypris pubera*; E, *Darwinula stevensoni;* F,G,H *Hemicypris* cf. *largereticulata*; I, *Herpetocypris helenae*; J, *Herpetocypris intermedia*; K, *Herpetocypris reptans*; L, *Heterocypris incongruens* (M22); M, *Heterocypris incongruens(M36);* N, *Heterocypris reptans*; O, *Heterocypris rotundata*; P, *Heterocypris salina*; R, *Ilyocypris bradyi* (M107-Female); S, *Ilyocypris bradyi* (M107-Male); T, *Ilyocypris gibba.* U, *Ilyocypris inermis*; V, *Ilyocypris monstrifica*; Y, *Isocypris beauchampi*; Z, *Plesiocypridopsis newtoni* (M72-Female); W, *Plesiocypridopsis newtoni* (M72-Male).



**Appendices D2:** A, *Limnocythere inopinata*; B, *Potamocypris arcuata*; C,D,E,F,G, *Potamocypris fallax*; H, *Potamocypris smaragdina*; I, *Potamocypris variegata*; J, *Potamocypris villosa*; K, *Prionocypris zenkeri*; L,M, *Pseudocandona albicans*; N, *Psychrodromus fontinalis*; O, *Psychrodromus olivaceus*; P, *Psychrodromus olivaceus*; R,S, *Pseudostrandesia* n.sp. ; T, *Candona weltneri* ; U,V,Y , *Ilyocypris gibba.*



**Appendix E** Photographs of some sampling sites in the study

| | | |
|---|---|---|
| 1. | Samplings site 8 | (3.10.2015) |
| 2. | Samplings site 22 | (4.10.2015) |
| 3. | Samplings site 23 | (4.10.2015) |
| 4. | Samplings site 24 | (4.10.2015) |
| 5. | Samplings site 29 | (4.10.2015) |
| 6. | Samplings site 31 | (4.10.2015) |
| 7. | Samplings site 41 | (4.10.2015) |
| 8. | Samplings site 57 | (5.10.2015) |
| 9. | Samplings site 58 | (5.10.2015) |
| 10. | Samplings site 69 | (6.10.2015) |
| 11. | Samplings site 78 | (7.10.2015) |
| 12. | Samplings site 84 | (7.10.2015) |
| 13. | Samplings site 88 | (7.10.2015) |
| 14. | Samplings site 94 | (8.10.2015) |
| 15. | Samplings site 97 | (8.10.2015) |
| 16. | Samplings site 116 | (9.10.2015) |

**Appendix E** (continued)

**Appendix E** (continued)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10


11


12


13

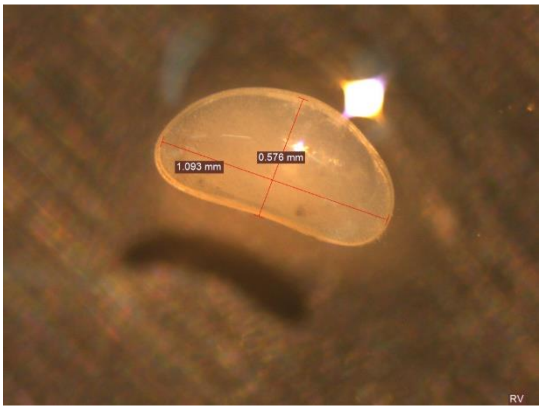

14

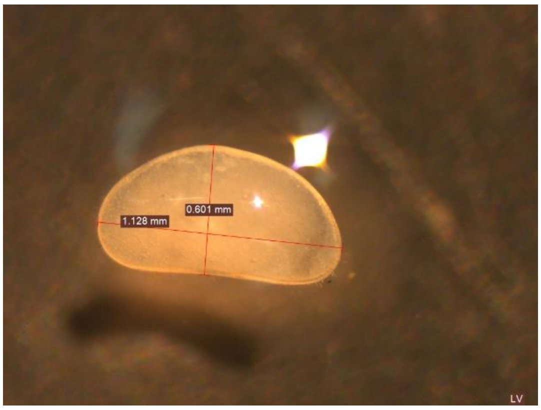

15


16

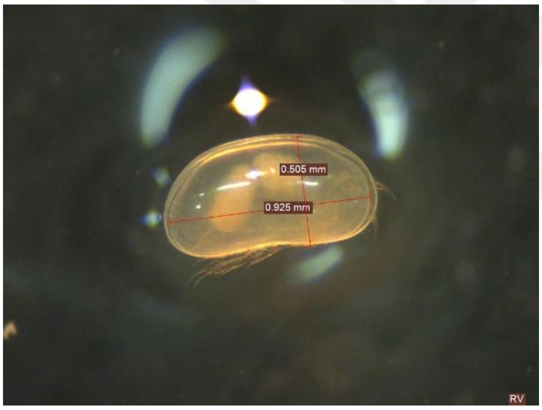
**Appendix F** right and left valves size of some species

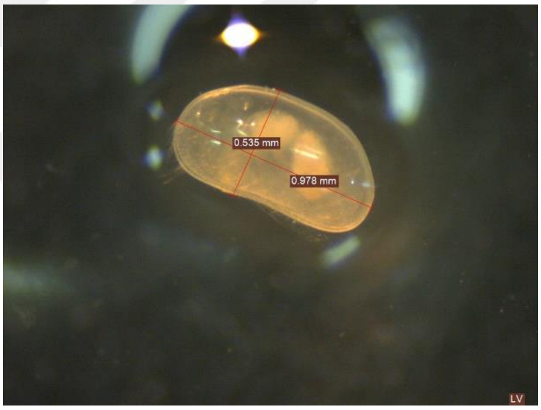
*Candona neglecta*



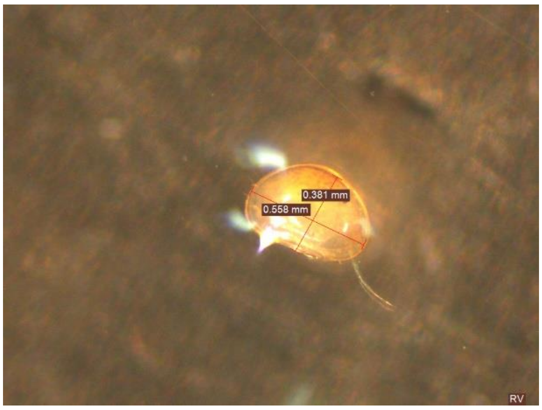



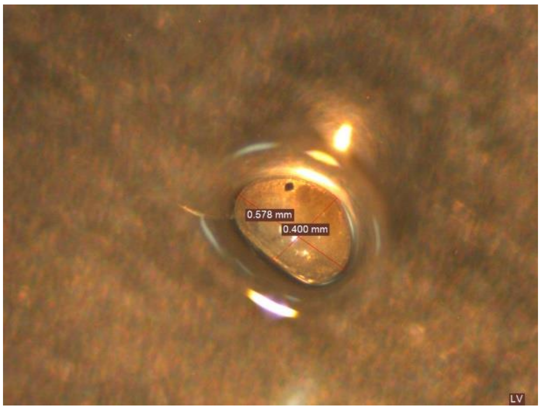

*Candona weltneri*



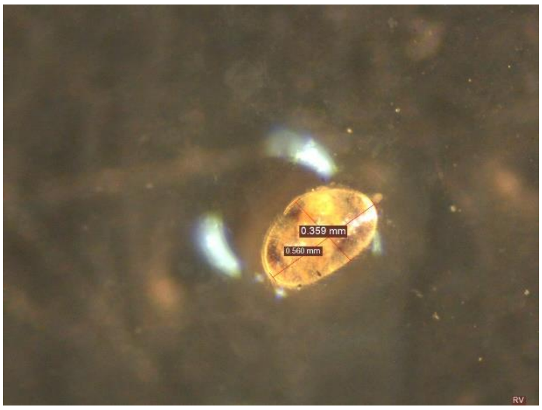

*Cypria opthalmica*

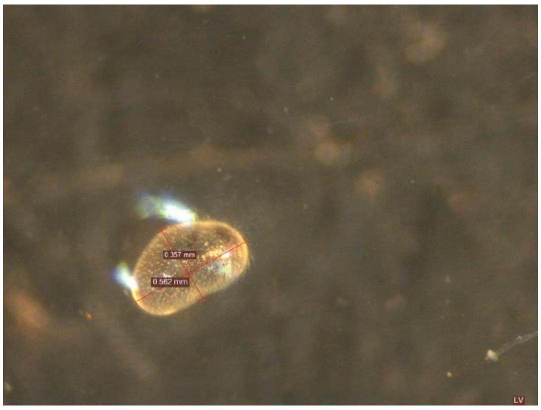


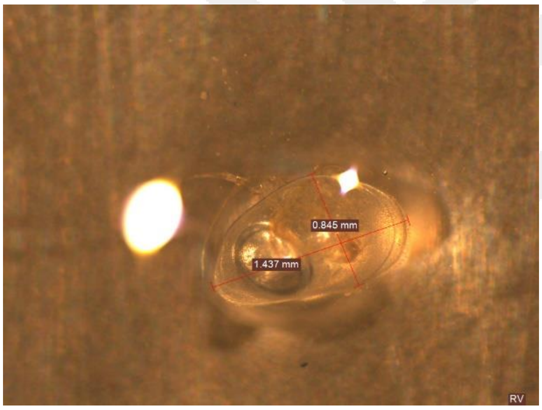
**Appendix F** (continued)

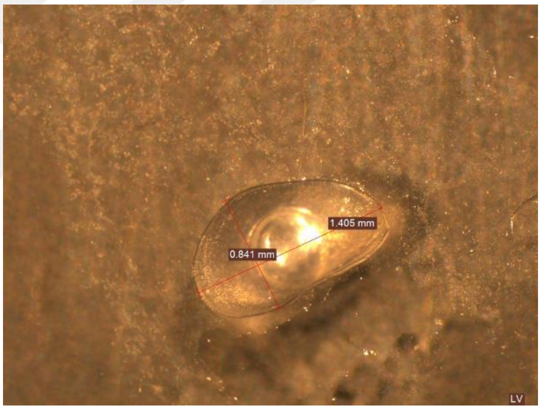
*Cypridopsis vidua*



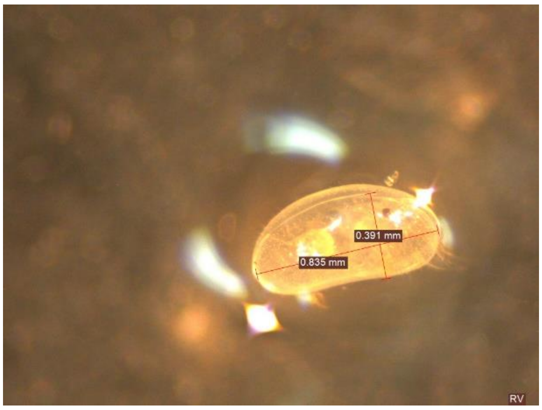



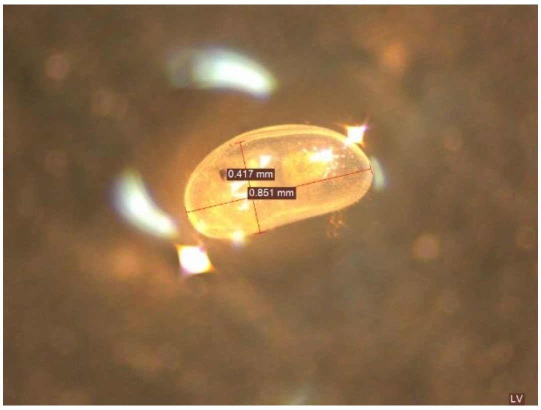

*Cypris pubera*



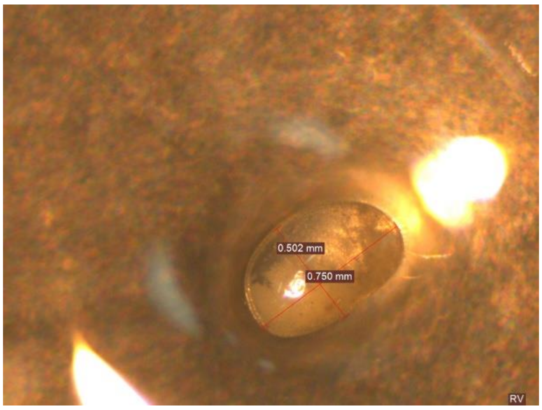

*Fabaeformiscandona* cf. *wegelini*

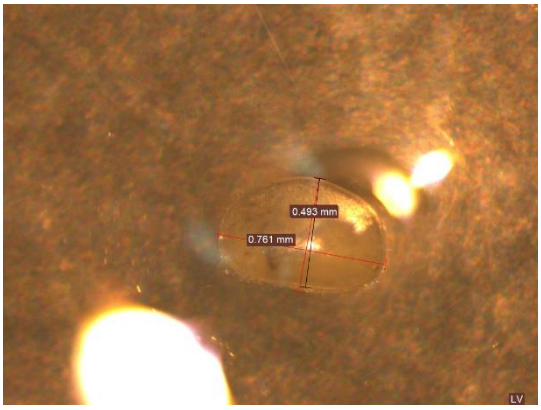


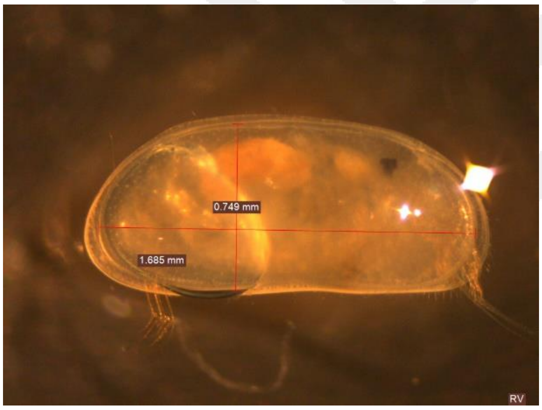
**Appendix F** (continued)

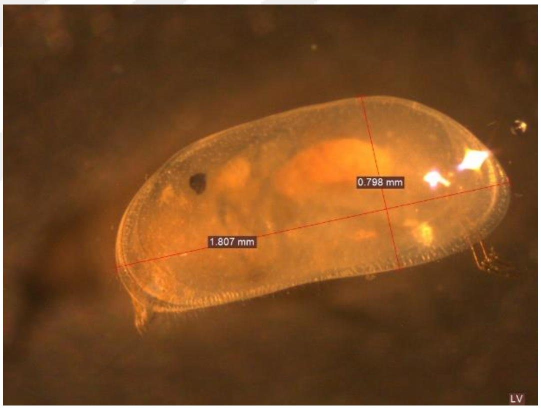
*Hemicypris* cf. *largeriticulata*



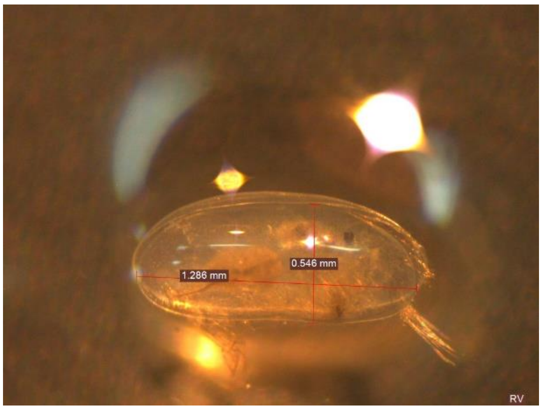



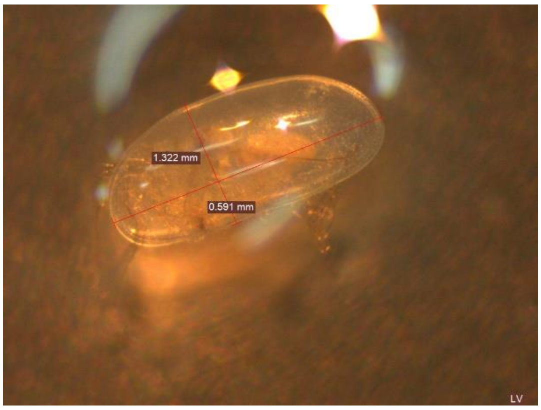

*Herpetocypris helenae*



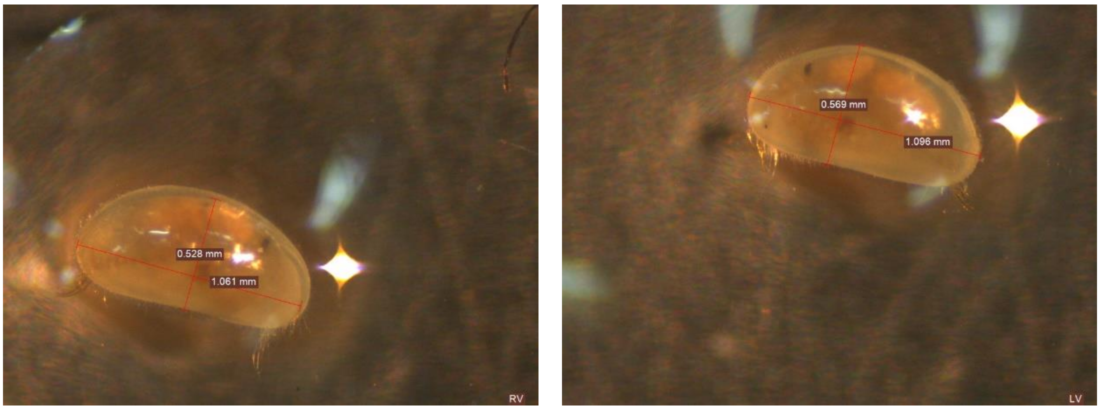

*Herpetocypris intermedia*



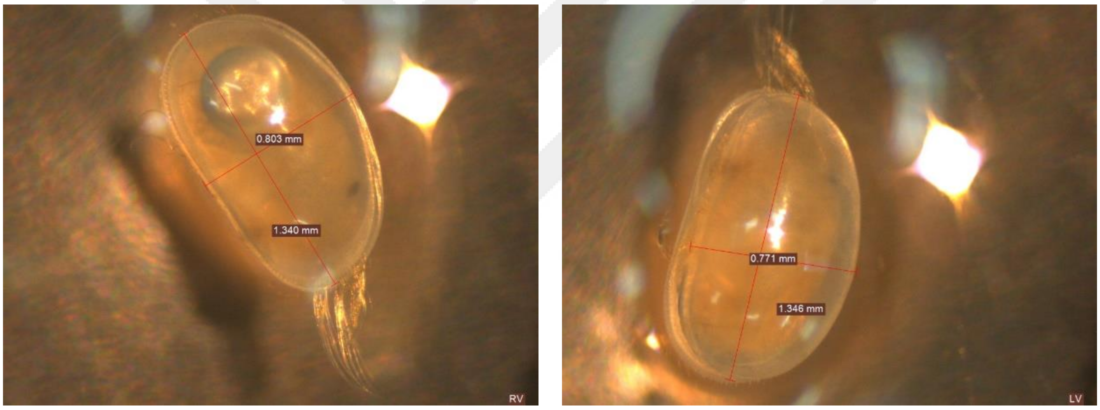



**Appendix F** (continued)

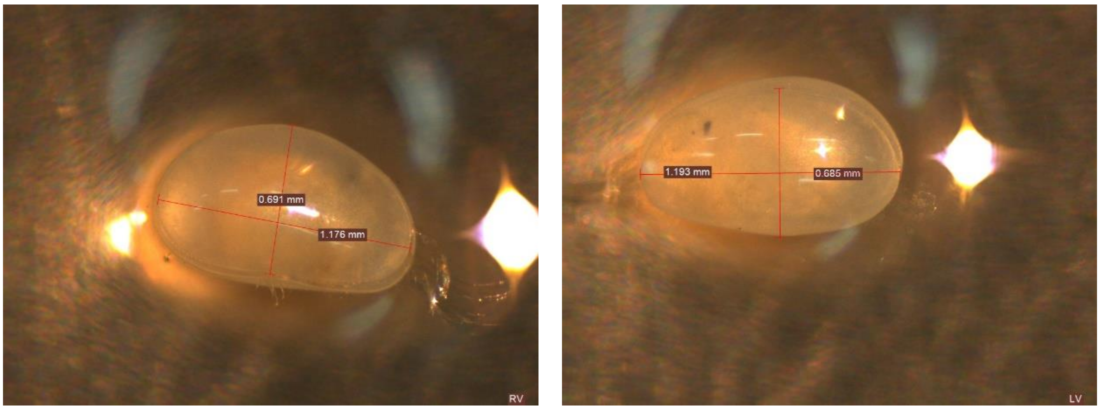
*Herpetocypris reptans*




*Heterocypris incongruens*

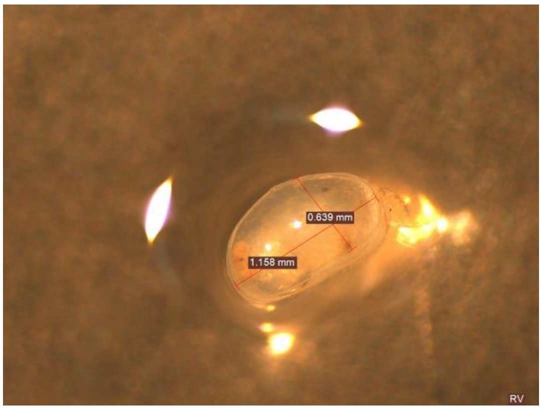


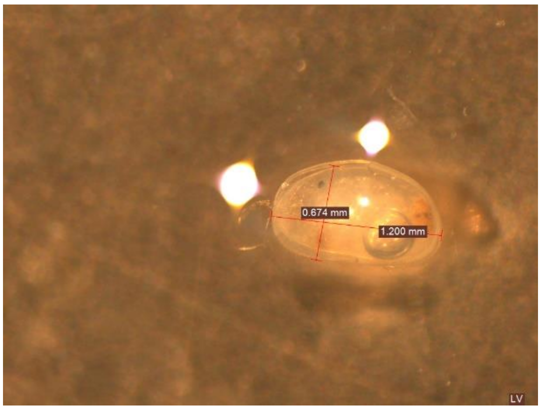

*Heterecypris reptans*



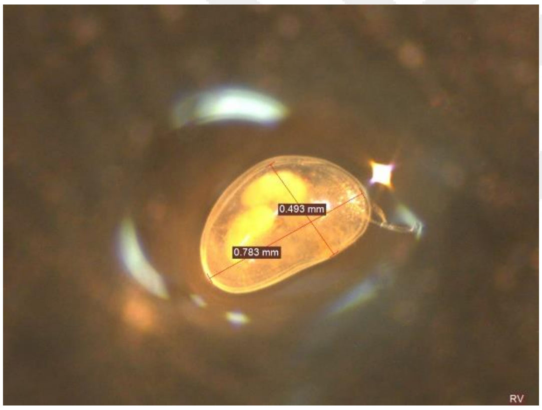
**Appendix F** (continued)

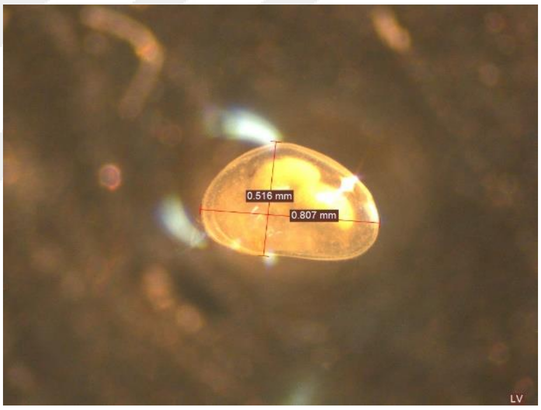
*Heterocypris rotundata*



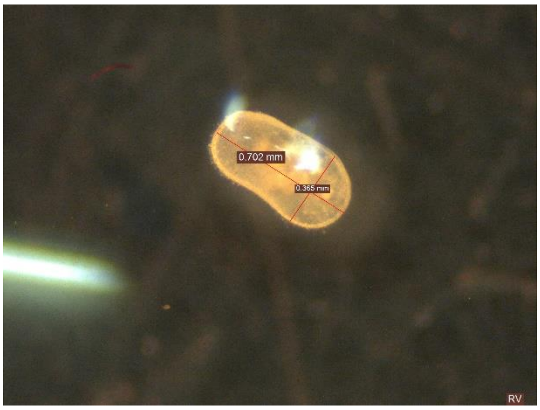



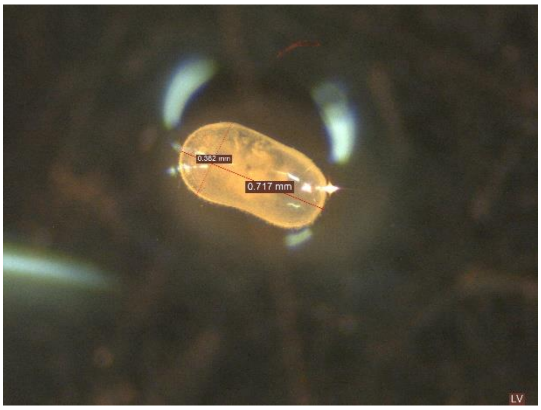

*Heterocypris salina*



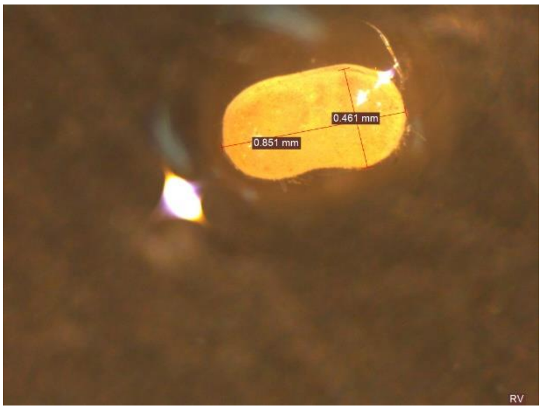

*Ilyocypris bradyi*

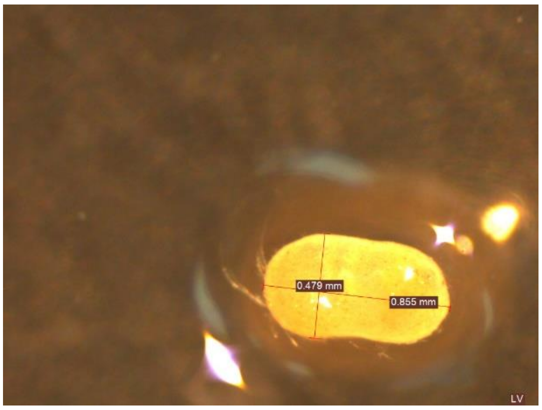


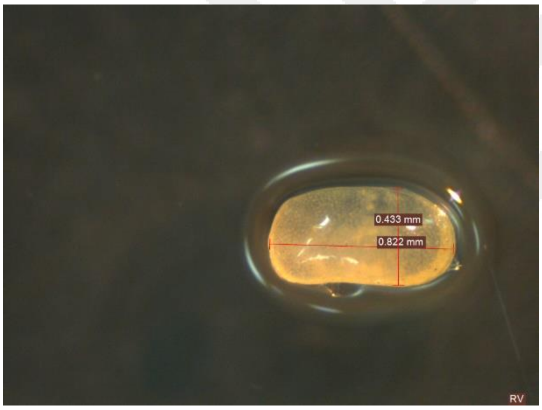
**Appendix F** (continued)

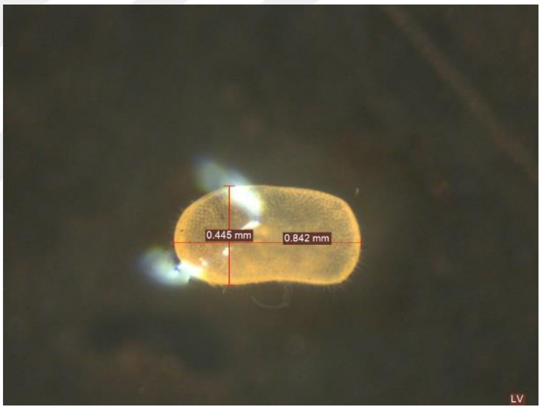
*Ilyocypris gibba*



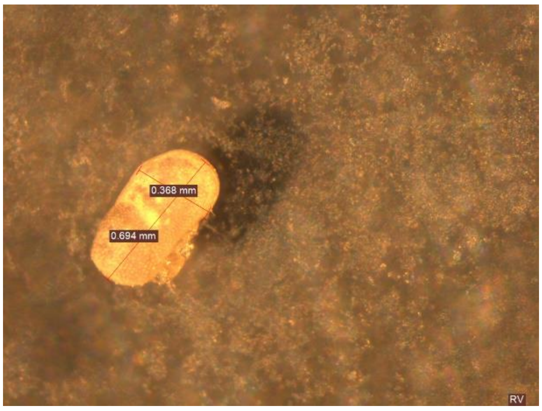



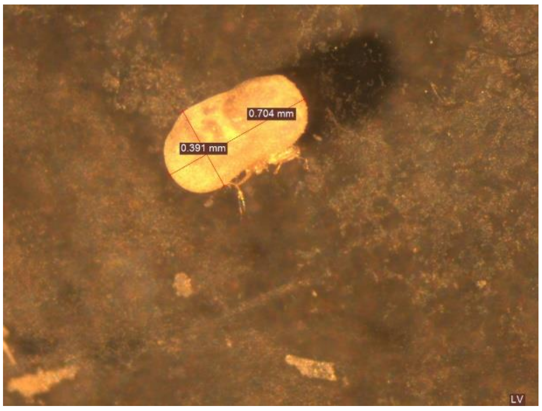

*Ilyocypris inermis*



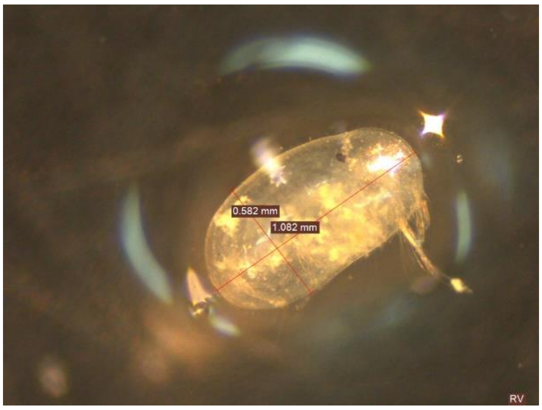

*Ilyocypris monstrifica*

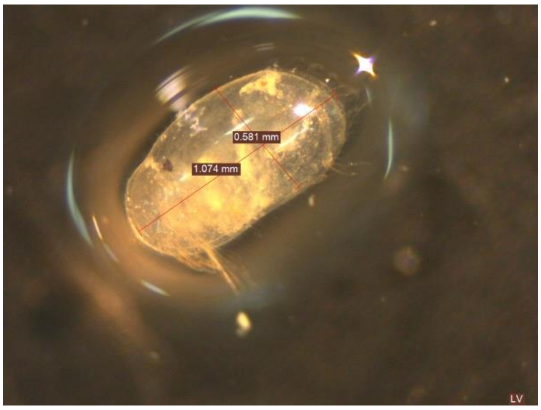


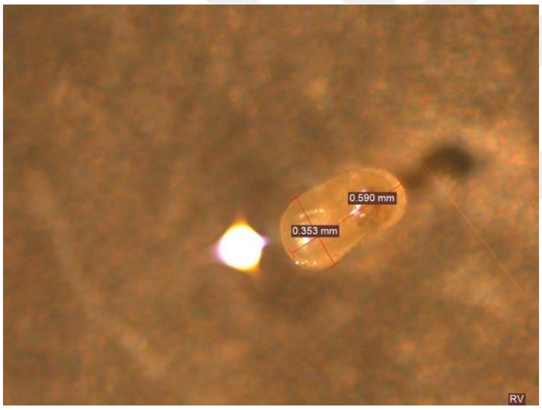
**Appendix F** (continued)

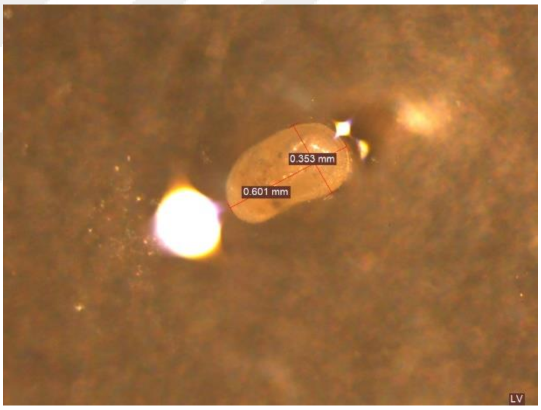
*Isocypris beauchampi*



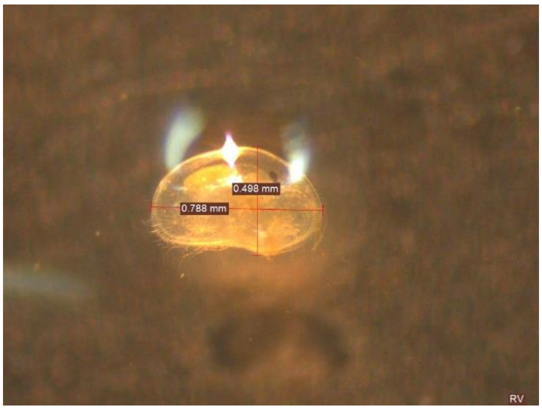



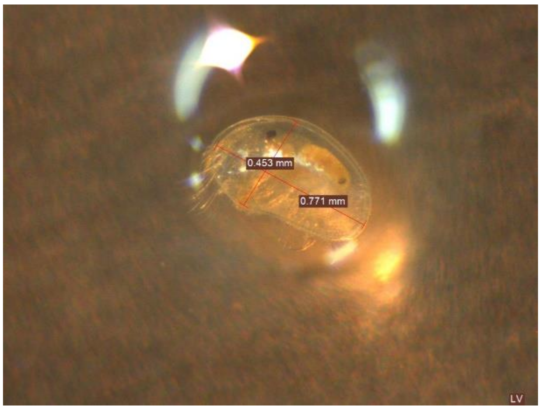

*Limnocythere inopinata*



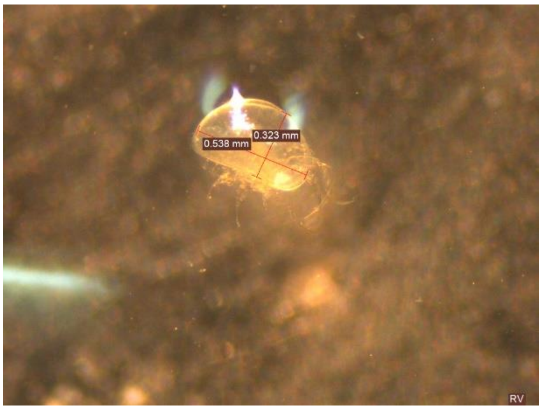

*Plesiocypridopsis newtoni*



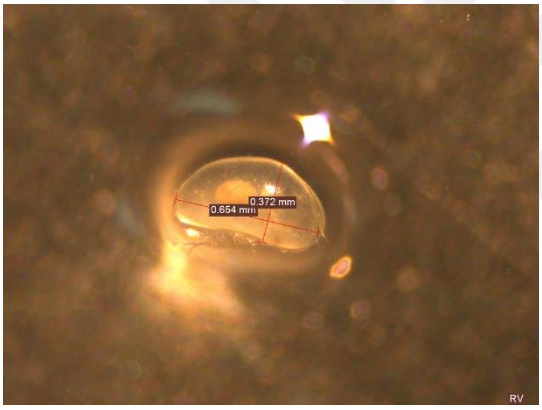
**Appendix F** (continued)

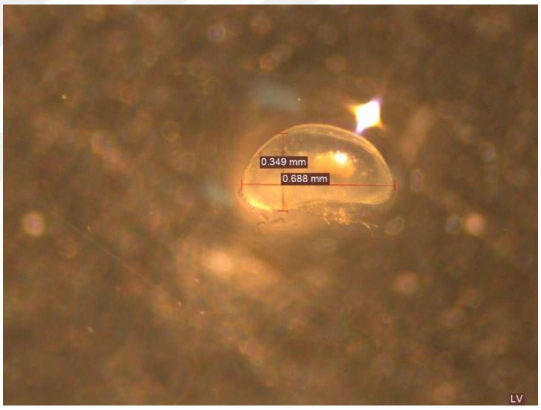
*Potamocypris arcuata*



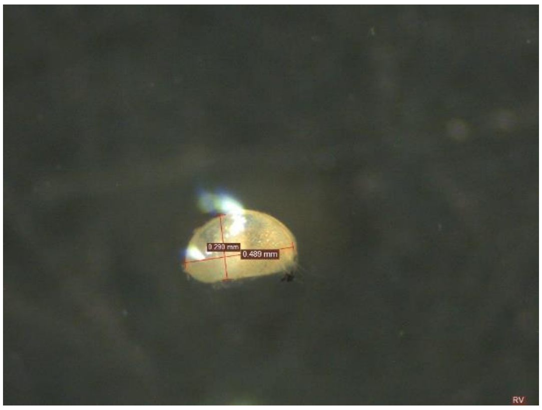


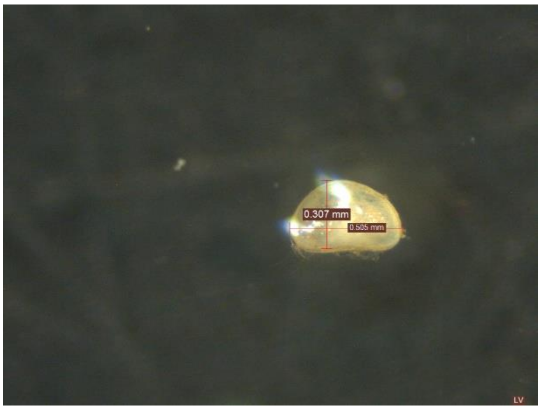
*Potamocypris fallax*



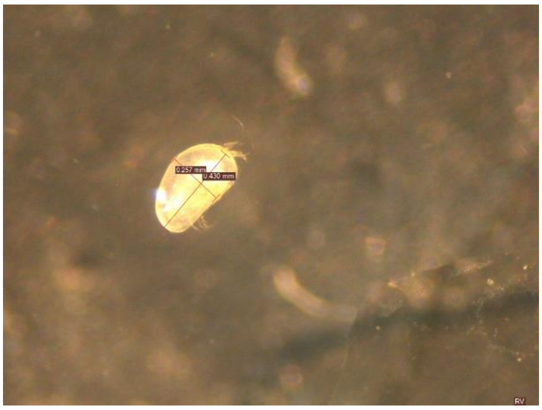

*Potamocypris smaragdina*

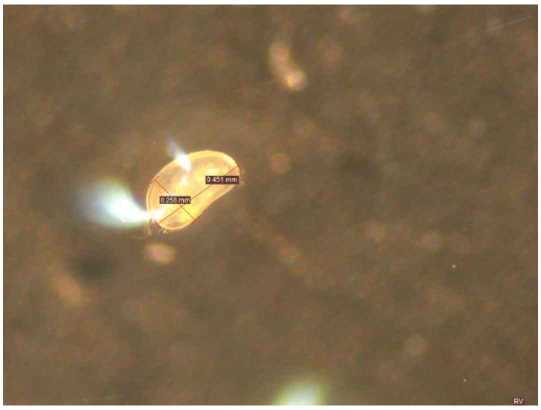


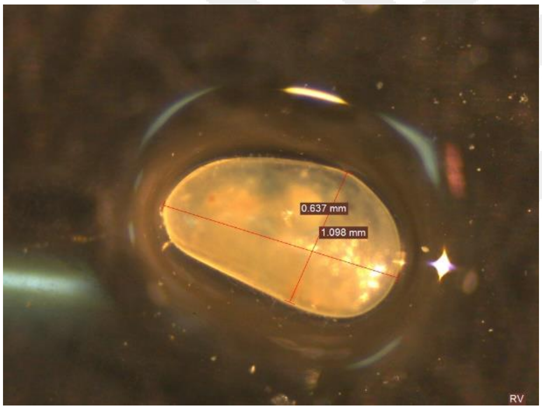
**Appendix F** (continued)

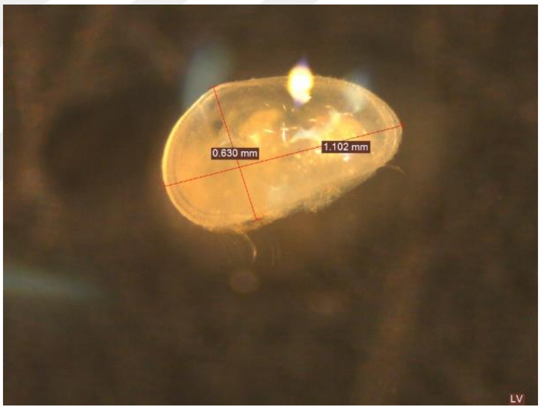
*Potamocypris variegata*




*Prionocypris zenkeri*

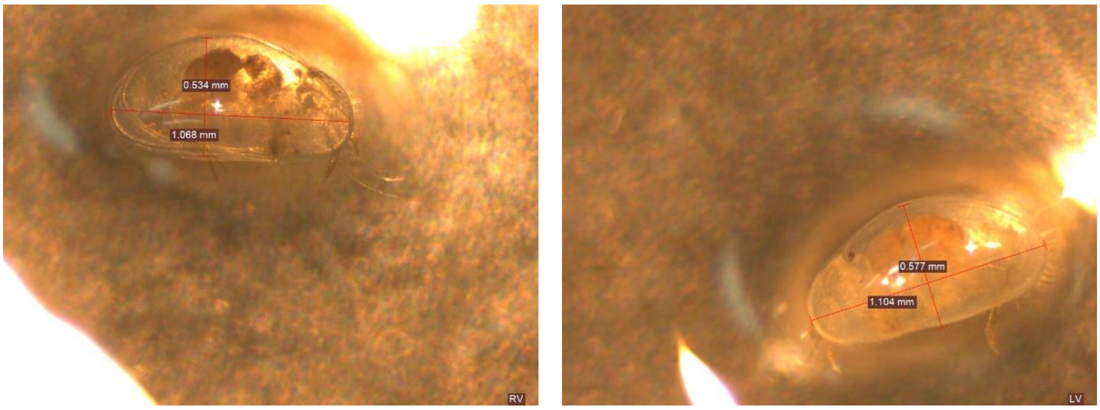


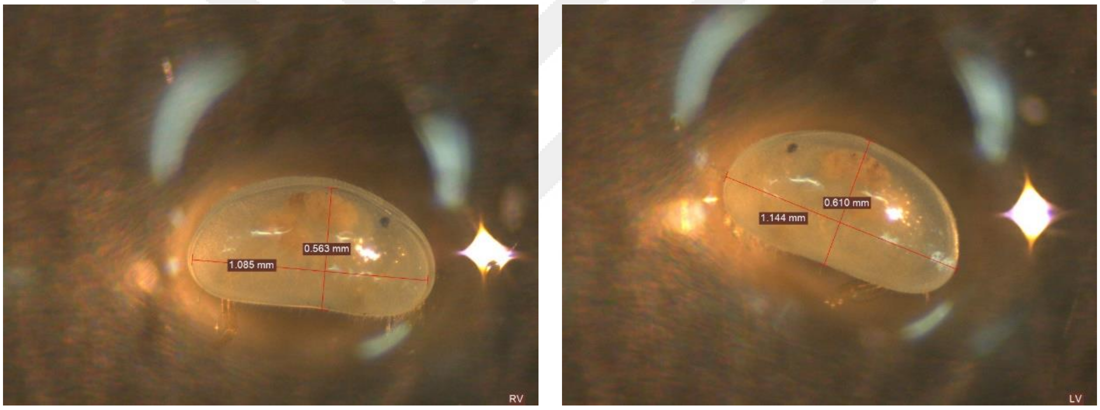

*Pseudocandona albicans*


**Appendix F** (continued)

*Psychrodromus* cf. *robertsoni*




*Psychrodromus fontinalis*




*Psychrodromus olivaceus*