

## Full Length Research Paper

# Diversity of micro-crustaceans in temporary habitats of the province of Sasaı (Izmir, Turkey)

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**A study on the distribution of micro-crustaceans in seven temporary habitats of the province of Sasaı (Izmir) was conducted between 27 March and 10 April 2011. 15 micro-crustacean species, comprising eight ostracods, four branchiopods and three copepods were identified. All species registered represent new reports for the studies area. One of these, living populations of *Heterocypris barbara* var. *barbara* is recorded for the first time. The highest number of species per site was nine, with the most frequent species being *Daphnia* (*Ctenodaphnia*) *magna* (Cladocera) and *Eucypris virens* (Ostracoda). Our results highlight the importance of temporary habitats as potential biodiversity hotspots, in spite of a few carried out by freshwater ecologists and taxonomists in undertaking scientific investigations in these environments.**

**Key words:** Ostracoda, cladocera, copepoda, biodiversity, Izmir, Turkey.

## INTRODUCTION

In Turkey, traditional freshwater research has generally been water body specific and mainly focused on lakes, rivers and streams. However, Turkey is located at the Eastern Mediterranean basin and studies on the Mediterranean temporary ponds in this area are almost negligible. Temporary ponds are varied ecosystems extensively widespread on a world scale. They shelter a significant portion of aquatic biodiversity at the landscape scale. In semi-arid regions, such as the Mediterranean region, temporary water bodies are important ecosystems and have been included in the framework of the Ramsar Convention on Wetlands since 2002 (Caramujo and Boavida, 2010).

Mediterranean temporary ponds are normally shallow ponds isolated from permanent water bodies, which undergo a periodic cycle of flooding and drought, and have a characteristic flora and fauna adapted to this alternation. They occur in substrate depressions that may have been created by various geomorphological processes. Some of these ponds may be of artificial origin, such as in abandoned quarries. Mediterranean temporary ponds show great variability depending on their geology, geomorphology, depth and source of water (ground or run-off). Temporary ponds are of major conservation importance because despite their small size, they shelter many rare and endangered species;

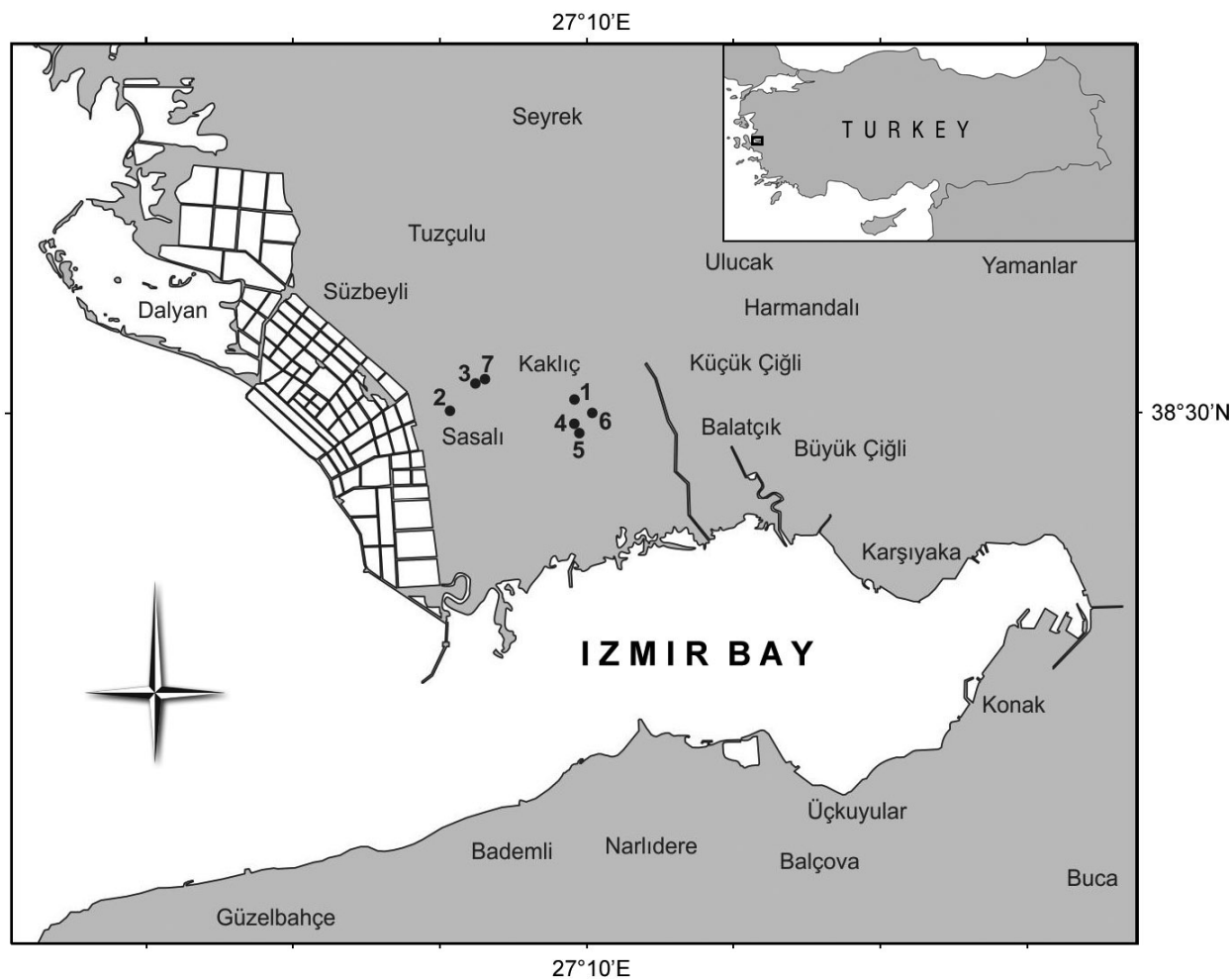
however increased urbanization and agriculture in addition to climate change in the Mediterranean region, has led to the extinction of a very large number of these valuable water bodies (Zacharias and Zamparas, 2010).

This work aimed at providing a faunal account of micro-crustaceans living in temporary ponds of the province of Sasaı (Izmir, Western Turkey). We primarily focused our attention on species richness of temporary habitats in this territory. It is hoped that the data available would allow a comparison to be carried out between the occurrence of micro-crustaceans on the other Mediterranean temporary ponds.

## MATERIALS AND METHODS

Gediz delta (3TR009) is one of the 13 Ramsar sites of Turkey and covers 14,900 ha area. The studied temporary pools are located between Tuzla Bird's Paradise and Izmir Wildlife Park. The locations of the seven temporary pools studied, as well as the characteristics of the sampling sites are given in Figure 1 and Table 1.

Sampling was performed between 27 March and 10 April 2011 in seven sites. Samples were collected using a 180 µm hand net and preserved in 4% formaldehyde. Geographical data were recorded with a geographical positioning system (Magellan Explorist 500) unit. For taxonomical identification of the specimens, the keys by Alonso (1996), Benzie (2005), Bronstein (1947), Einsle (1996),



**Figure 1.** Map of the province of Sasalı (Izmir) showing the sampling sites considered in this study (circles).

**Table 1.** Geographic characteristics of sampling stations and list of samples used in this study.

Sampling code	Coordinate	Habitat type	Sampling date
S1	38°29'44"N 26°59'37"E	Temporary pool	27.03.2011
S2	38°29'24"N 26°57'03"E	Temporary pool	27.03.2011
S3	38°29'47"N 26°57'33"E	Temporary pool	27.03.2011
S4	38°29'23"N 26°59'41"E	Ditch	10.04.2011
S5	38°29'21"N 26°59'44"E	Ditch	10.04.2011
S6	38°29'35"N 27°00'00"E	Temporary pool	10.04.2011
S7	38°29'50"N 26°57'43"E	Temporary pool	10.04.2011

Henderson (1990), Meisch (2000) and Van Damme and Dumont (2008) were used and samples were deposited in the Limnology Laboratory of the Faculty of Fisheries, Ege University, Izmir.

## RESULTS AND DISCUSSION

In total, 15 micro-crustacean taxa, comprising eight ostracods, four cladocerans and three copepods were identi-

fied (Table 2). All species recorded represent new report for the area. One of these, living specimens of *Heterocypris barbara* var. *barbara* is recorded for the first time. The maximum number of species reported in a single sample (S6) was nine. Another sample with a relatively high number of species was S2, containing eight species. On the other hand, six species were found only in one site (Table 2).

**Table 2.** Species of micro-crustaceans recorded in this study and stations (codes as in Table 1) where they were sampled.

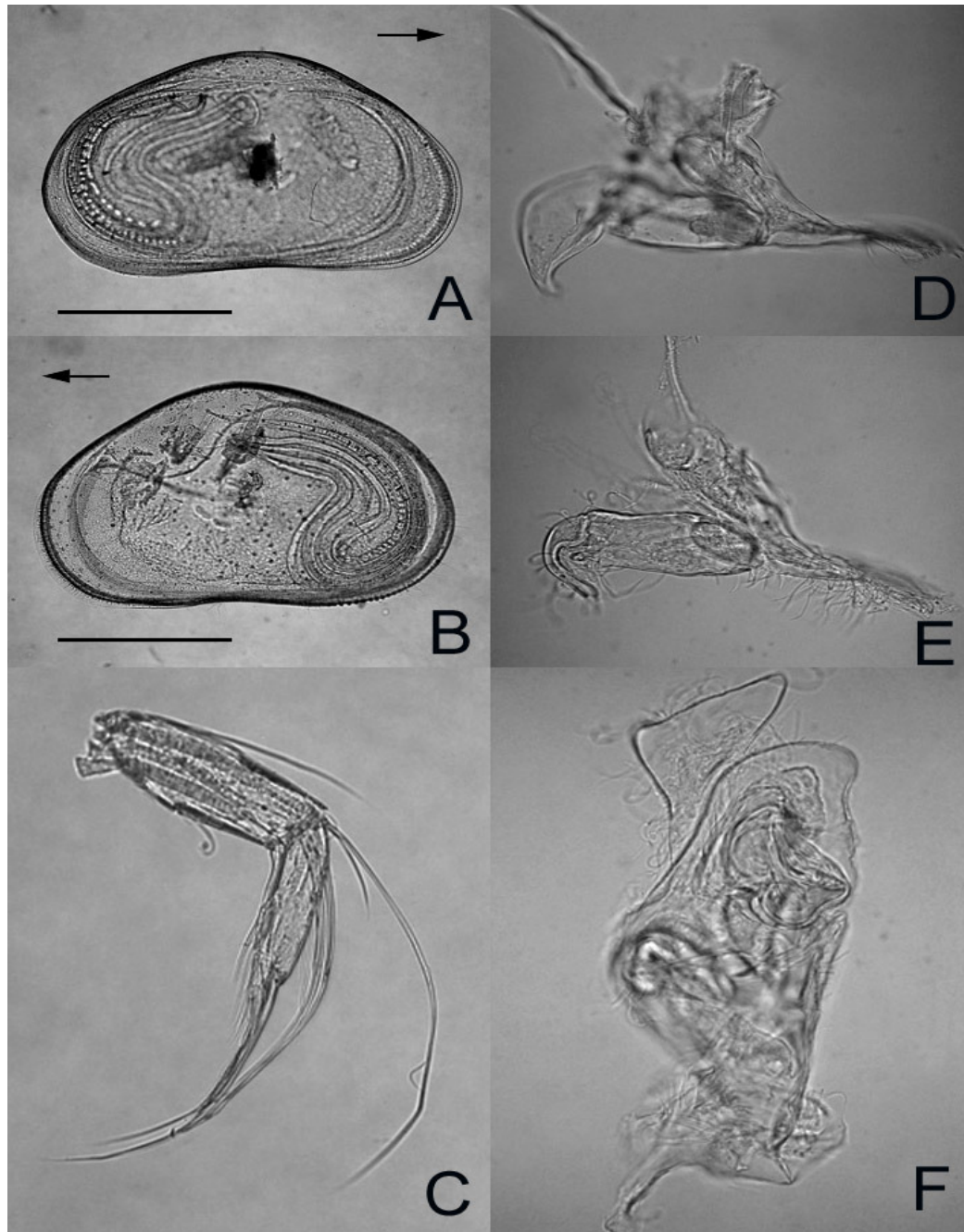
Taxa	Station list
<b>Ostracoda</b>	
<i>Eucypris virens</i> (Jurine, 1820)	S2, S3, S4, S5, S6
<i>Sarscypridopsis aculeata</i> (Costa, 1847)	S3, S6, S7
<i>Cypridopsis vidua</i> (Müller, 1776)	S1, S3
<i>Cypris pubera</i> (Müller, 1776)	S2, S6
<i>Potamocypris unicaudata</i> (Schafer, 1943)	S6
<i>Heterocypris salina</i> (Brady, 1868)	S1, S2, S6
<i>Heterocypris barbara</i> var. <i>barbara</i> (Gauthier & Brehm, 1928)	S2, S3, S6
<i>Plesiocypridopsis newtoni</i> (Brady and Robertson, 1870)	S7
<b>Branchiopoda</b>	
<i>Daphnia (Ctenodaphnia) magna</i> (Straus, 1820)	S1, S2, S3, S4, S5, S6
<i>Daphnia (Daphnia) curvirostris</i> (Eylman, 1820)	S2
<i>Simocephalus exspinosus</i> (DeGeer, 1776)	S1, S6
<i>Coronatella rectangula</i> (Sars, 1861)	S7
<b>Copepoda</b>	
<i>Cyclops furcifer</i> (Claus, 1857)	S2, S4
<i>Cyclops strenuus</i> (Fischer, 1851)	S6
<i>Megacyclops viridis</i> (Jurine, 1820)	S2

The species *Daphnia (Ctenodaphnia) magna* (Cladocera) and *Eucypris virens* (Ostracoda) were the most common species, with six and five records, respectively. Other species which occurred frequently were *Sarscypridopsis aculeata*, *Heterocypris salina* and *H. barbara* var. *barbara* (in three samples each) (Table 2). Among the cladocera, *D. (Ctenodaphnia) magna* was found in temporary and permanent ponds in temperate regions to arid areas, often marginal habitats, eutrophic or slightly saline (Benzie, 2005). Alonso (1996) defines this cladoceran as pollution-tolerant. Its distribution area is Holarctic and Africa. *Coronatella rectangula* is a helio-planktonic species frequently associated to macrophytes. It is more frequently found in small water bodies (Alonso, 1996). Its distribution is Holarctic and Ethiopian. *D. (Daphnia) curvirostris* occurs in temporary and permanent puddles, ponds and in the littoral of small lakes in temperate and arctic or montane regions (Benzie, 2005).

Among the copepoda, *Cyclops furcifer* is typical of ephemeral waters, often with long periods of desiccation (Einsle, 1996). Its distribution area comprises Europe, North America and Asia. *Cyclops strenuus* is found in ponds and mesotrophic to eutrophic lakes (Einsle, 1996). Its distribution area is Europe. *Megacyclops viridis* occurs in ponds and the littoral of lakes. In periodical ponds, the species passes through a diapause in fourth copepodid stage during periods of desiccation of the habitat (Einsle, 1996). Its distribution area includes Europe, Asia, North America, North Africa and China.

For the ostracoda, *Eucypris virens* prefers grassy pools

and ditches in the open field that dry up in late spring or in the summer. Its distribution area comprises Europe, Greenland, Azores, North Africa, Middle East, Central Asia, China and North America (Holarctic) (Meisch, 2000). *Sarscypridopsis aculeata* prefers slightly brackish small water bodies where it often produces large populations. It occurs in both permanent and temporary waters common in coastal rock pools and ponds influenced by marine water, often together with *H. salina*, which shows a similar preference for slightly salty conditions. It is a cosmopolitan species (Meisch, 2000). *Cypridopsis vidua* is found in a wide range of aquatic habitats. It occurs in both permanent and temporary waters and is considered as a cosmopolitan species (Meisch, 2000). *Cypris pubera* lives in both temporary and permanent water bodies. It tolerates a slight increase in salinity. Its distribution area embraces Europe, North Africa, Turkey, Middle East, central Asia, China and North America (Holarctic) (Meisch, 2000). *Potamocypris unicaudata* is fairly common in coastal water bodies submitted to a slight influence of marine water and often co-occurs with *H. salina*. Its distribution area covers Europe and North America (Meisch, 2000). *H. salina* prefers both small and slightly salty coastal and inland water bodies where it often coexists with other halophilic ostracods, such as *S. aculeata*, *Herpetocypris chevreuxi* and *P. unicaudata*. *H. salina* also occurs in pure freshwater habitats. Its distribution area is Holarctic (Meisch, 2000). *Plesiocypridopsis newtoni* prefers small permanent stagnant water bodies, such as ponds, ditches,



**Figure 2.** *Heterocypris barbara* var. *barbara*. A and B, Left valve and right valve of male internal view; C, apical end of male antenna; D and E, left and right male clasping organs; F, penis. Scale bar: 500  $\mu$  for A and B.

man-made basins and reservoirs. It is also found in the shallow littoral zone of lakes, slow rivers, rice fields, wells. *P. newtoni* tolerates and apparently even prefers brackish conditions, being often found in coastal water bodies influenced by marine water. Its distribution area comprises Europe, the Canary Islands, North and Sub-Saharan Africa, the Middle East, central and eastern Asia, and India (Meisch, 2000).

Of particular interest is the record of bisexual populations of *H. barbara* (Figure 2) in three ponds. According to Meisch (2000), *H. barbara* occurs in both temporary and permanent small water bodies and lakes and is widely distributed in the circum-Mediterranean area. This species apparently has two varieties which differ in their morphology and ecology: *H. barbara* var. *barbara* and *H. barbara* var. *inermis*, both originally recorded

from North Africa. The females of the var. *inermis* differ in the following features from those of the nominal form: (1) carapace is wider in dorsal view and more distinctly beak-shaped; (2) posterior selvage of left valve is broader; (3) right valve has no marginal pustules; (4) males are absent from all the populations thus far recorded in North Africa (however, males included in the population of the var. *inermis* is so far only known from Spain in Europe); (5) the var. *inermis* was collected from salty inland waters, while the var. *barbara* was found in the freshwater habitats Meisch (2000). The only previous record of *H. barbara* in Turkey comes from subrecent fossil remains from the travertines of Zamanti River (Kayseri) (Tunoğlu and Ertekin, 2008). Thus, the living populations of *H. barbara* var. *barbara* were recorded for the first time in this study. Previously, Bellavere et al. (2002) and Rossi et al. (2007) reported the coexistence of *H. barbara* and *H. incongruens* from the temporary habitats of Lampedusa Island (Sicily, Italy). In this study, our findings suggest an alternative coexistence of *H. barbara* and *H. salina* from two temporary pools of Sasali.

## Conclusion

This study led to the identification of an unexpectedly high number of micro-crustacean species, although all of the sampled sites were visited only once, meaning that seasonal changes in the community structure were not adequately taken into account. Within the present work on species diversity and distribution of ostracods, copepods and cladocerans in temporary waters of Sasali, eight ostracods, three copepods and four cladocerans were recorded. One of these, living specimens of *H. barbara* var. *barbara* is recorded for the first time. By reporting the presence of the species in Turkey, its geographical distribution is extended. The most remarkable aspect of this study lies in the faunal analysis of aquatic bodies, which are hardly considered in traditional limnological works. Indeed, minor freshwater ecosystems may represent, when considered in their whole extent, vast reservoirs of biological diversity, and in this regard they appear to be as important as larger environments.

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