Pakistan J. Zool., vol. 44 (3), pp. 635-639, 2012.

The Effect of Dam Construction on the Ostracoda (Crustacea) Assemblages in Kazandere Stream, Thracea, Turkey

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Abstract.- Natural running water systems are important for ecological conditions of many organisms. Dams are built across a running water valley for multiple-purpose, therefore natural running water system is divided to three different habitats; stream, reservoir and spillway. In order to understand the effects of dam construction on the Ostracoda dispersion, ostracod fauna of three habitats, Kazandere stream and its branches that flow into the reservoir, newly formed Kazandere Reservoir and spillway were investigated and compared. Even though 17 species were determined from the streams, only two species from the reservoir and three species from the spillway were found.

Key words: Ostracoda, habitat preferences, reservoirs, stream, Thracea.

INTRODUCTION

Streams are linear systems that transfer precipitation from continental masses towards sea. The character of a stream network is influenced by the climate, relief, geological structure and age of river system. After the dam construction, a reservoir and a spillway are formed on the stream system. The hydrological regime of a reservoir is ambiguous since it is neither a lake nor a stream. The water level fluctuation in a reservoir is usually high and irregular while the littoral zone is poorly developed. Also a spillway is a discharge water system for the reservoir between dam and sea. Generally former river drainage area is used to transport the discharge water of reservoir to sea. The water level fluctuation in a spillway is irregular like a reservoir (Holcik *et al.*, 1989).

It is known that the construction of dams is an important factor that might affect ecological circumstances. It is well known that the water status is important environmental condition for aquatic organisms. After dam construction, water status of running water is changed to stagnant water in reservoir therefore, three habitats were formed (Fig. 1). In order to understand the effects of the change of water status, freshwater ostracods was chosen as study object and ostracod assemblages of three habitats were compared because ostracods could occur almost all aquatic habitats.

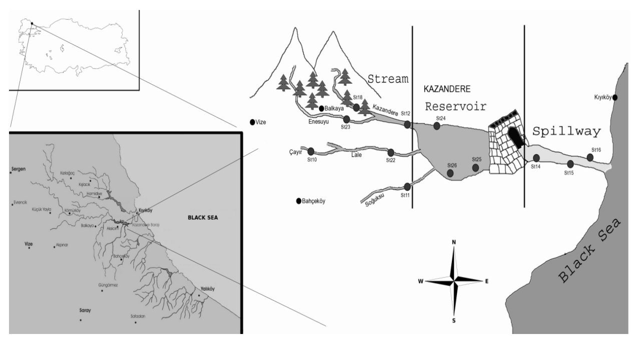

Fig. 1. The map of the study area and illustration of the three habitats in the Kazandere Basin.

Ostracods are calcified, bivalved small crustaceans. Fossil records extend to Ordovician (approximately 500 Ma); ostracods (Podocopida) have successfully invaded non-marine habitats and are found today in many environments (Horne and Martens, 1998). Many times certain ostracod species could be prefer certain habitats such as lakes, lagoons, groundwater and running waters because they have different ecological tolerances and preferences. Habitat preferences of Ostracoda were mentioned in several studies (Özuluğ, 2000; Mischke *et al.*, 2003; Külköylüoğlu, 2004; Dügel *et al.*, 2008).

To observe the effects of water status that was changed after dam construction, Kazandere streams and its branches that flow into the reservoir,

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0030-9923/2012/0003-0635 $ 8.00/0

newly formed Kazandere reservoir and spillway were selected as study area, and ostracod assemblages of three habitats were determined and compared. Kazandere Reservoir was chosen because the water of the reservoir is used as drinking water and there are not any industrial plants near the stream and reservoir which may contaminate the water. Finally, this study was performed to find answers for the following questions: how were the Ostracoda assemblages influenced by change of water status due to dam construction? And which species would be able to adapt to newly formed habitat? Additionally, this is a basic study to understand the evolution of Ostracoda fauna in a new reservoir. Also, the study will provide the compare chance between past and future about development of ostracod fauna.

MATERIALS AND METHODS

Before the dam construction, Kazandere stream and branches, originates from the Istranca Mountains (the north-east of Thrace Region in Turkey) and flows into the Black Sea. Lale and Soğuksu creeks are former branches of Kazandere stream and after dam construction, Kazandere, Soğuksu, Lale streams flows separately into Kazandere Reservoir (Fig. 1). Kazandere Basin is completely surrounded with oak and beech forests. Until recent years, it was very difficult to access the stream in the forest region. In 1995, within the scope of the project started to supply drinking water to Istanbul, dams were built at the stream fronts (Fig. 1). The completion year of reservoir is 1997, the major river name is Kazandere and the annual average capacity is 100.000.000 m^3 (Kucukmehmetoglu and Geymen, 2008).

All of the material from the stream was collected with a special hand net made of Müller fabric between September 2000 and June 2001. Material from deep regions of the reservoir was collected with a special net with long rope. Material inside mud was fixed with 4% formaldehyde and washed with pressurized tap water using sieves, 0.25; 0.16; 0.08 mm of mesh sizes repeatedly in the laboratory. Ostracod specimens were gathered from sediment and preserved in 70% of ethyl alcohol, and soft body parts slides were prepared inside polyvinyl alcohol-lactophenol and orange-G with dissection needles under a stereoscopic dissection microscope. Identification of species was based on morphological aspects of the carapace and the soft body parts. During the classification Meisch (2000) was used. Dissolved oxygen and pH values of the stations were measured at the area with portable WTW multiline P4. Coordinates, codes and some physicochemical parameters of study areas are given at the Table I. Dominancy are calculated via specimen number in a group X 100 / total specimen number of all groups

RESULTS

The study area consists of three different habitats; streams, reservoir and spillway that are formed after dam construction. Materials were collected totally from twelve stations. Six locations from streams, three locations from reservoir, and three locations from spillway were investigated. Ostracod specimen was not found in three locations (St15, St16, St26). Totally seventeen species, *Ilyocypris bradyi* Sars, 1890; *Ilyocypris decipiens* Masi, 1905; *Candona angulata* Müller, 1900; *Physocypria kraepelini* G. W. Müller, 1903; *Cypria opthalmica* (Jurine, 1820); *Prionocypris zenkeri* (Chyzer & Toth, 1850); *Eucypris pigra* (Fischer, 1851); *Heterocypris incongruens* (Rhamdohr, 1808); *Psychrodromus fontinalis* (Wolf, 1920); *Psychrodromus olivaceus* (Brady & Norman, 1884); *Cypridopsis vidua* (O.F. Müller, 1776); *Potamocypris fallax* Fox, 1967; *Potamocypris variegata* (Brady & Nonman, 1889); *Potamocypris arcuata* (Sars, 1903); *Potamocypris zschokkei* (Kaufmann, 1900); *Tyrrhenocythere donetziensis* (Dubowsky, 1926); *Loxoconcha immodulata* (Stepanaitys, 1958) were identified from ten locations at the study area (Table II).

A maximum of six species (*Prionocypris zenkeri, Psychrodromus fontinalis, Psychrodromus olivaceus, Potamocypris fallax, Tyrrhenocythere donetziensis, Loxoconcha immodulata)* were found in one site of Kazandere stream (St23), a minimum of one species (excluding valve) was recorded in two sites of the Kazandere Reservoir. The most frequent (6 records) and dominant (29.1%) species, *Ilyocypris bradyi*, was recorded in the stream,

Table I.- The Codes and the physicochemical parameters of the study area are showed. C: Conductivity (µS/cm); DO, Dissolved oxygen (mg/L); Tw, Water temperature (ºC).

Sampling sites	Code	Coordinates	Date	DO (mg/L)	C (µS/cm)	pH	Tw (ºC)
Kazandere Stream	St18a	41° 37' 47" N 27° 54' 03" E	18.09.2000	-	-	7.49	20.0
Kazandere Stream	St18b	41° 37' 47" N 27° 54' 03" E	30.04.2001	10.77	347	7.05	15.0
Kazandere Stream	St23	41° 36' 51" N 27° 57' 03" E	4.05.2001	10.30	557	7.05	14.0
Kazandere Stream	St12	41° 37' 32" N 28° 02' 36" E	30.04.2001	11.46	376	7.05	14.8
Lale Creek	St10	41° 32' 03" N 28° 01' 22" E	30.04.2001	10.55	145	6.50	12.9
Lale Creek	St22	41° 36' 21" N 28° 02' 36" E	4.05.2001	9.75	465	7.02	14.8
Soğuksu Creek	St11	41° 36' 11" N 28° 03' 39" E	30.04.2001	9.80	538	6.95	13.8
Kazandere Reservoir	St24	41° 37' 36" N 28° 02' 28" E	12.06.2001	9.84	538	6.87	23.7
Kazandere Reservoir	St25	41° 36' 50" N 28° 04' 13" E	12.06.2001	9.80	536	6.90	24.0
Kazandere Reservoir	St26	41° 36' 53" N 28° 03' 56" E	12.06.2001	9.77	539	6.92	24.2
Spilway	St14	41° 36' 56" N 28° 04' 30" E	30.04.2001	10.75	413	7.03	14.0
Spilway	St15	41° 37' 09" N 28° 05' 27" E	30.04.2001	12.16	1100	7.03	17.1
Spilway	St16	41° 37' 09" N 28° 05' 28" E	30.04.2001	12.09	1090	7.02	17.0

Table II.- Distribution of species at the study area. n, number of specimens; D, dominance.

Species/ Site	Stream						Reservoir		Spillway		
	St10	St11	St 12	St18	St22	St23	St24	St25	St14	n	D%
Candona angulata	*									4	3.1
Cypria opthalmica					*		v			5	3.9
Physocypria kraepelini			*					*		5	3.9
Ilyocypris decipiens		*			*					11	8.6
Ilyocypris bradyi		*	*	*	*		*		*	37	29.1
Eucypris pigra	*									2	1.5
Prionocypris zenkeri				*		*				5	3.9
Psychrodromus olivaceus		*				*				3	2.3
Psychrodromus fontinalis		*	*	*	*	*				24	18.8
Heterocypris incongruens				*						2	1.5
Cypridopsis vidua	*							v	*	8	6.2
Potamocypris zschokkei	*									2	1.3
Potamocypris fallax						*				5	3.9
Potamocypris variegata	*									5	3.9
Potamocypris arcuata					*					2	1.3
Tyrrhenocythere donetziensis						*				3	2.3
Loxoconcha immodulata						*			*	4	3.1
Total specimen number										127	
Total species number	5	4	3	4	5	6	1	1	3		

*specimen; v: valve

reservoir and spillway, and *Psychrodromus fontinalis* (5 records) was recorded only in the stream. *Ilyocypris decipiens*, *Physocypria kraepelini*, *Prionocypris zenkeri*, *Psychrodromus* *olivaceus, Cypridopsis vidua* and *Loxoconcha immodulata* were each found two times and the other species were each recorded only in one sampling site: *Candona angulata, Cypria opthalmica, Eucypris pigra, Heterocypris incongruens, Potamocypris fallax, Potamocypris arcuata, Potamocypris zschokkei* and *Tyrrhenocythere donetziensis* (Table II).

In the reservoir only two species, *I. bradyi* and *P. kraepelini,* were identified. *I. bradyi* with high dominance is common in all habitats and it was found not only in the reservoir but also in the stream and spillway. On the other hand, *P. kraepelini* was found both in the stream and reservoir.

In the spillway, *I. bradyi, C. vidua* and *L. immodulata* were found, two of which (*C. vidua* and *L. immodulata)* were found only in the stream and spillway (Table II). Also there was not found any more species in the reservoir or spillway that are different from the stream fauna.

Stream, reservoir and spillway are evaluated as different habitats and ecological features as conductivity, dissolved oxygen, pH values were measured. Conductivity were recorded a minimum 145 µS/cm at Lale Creek and a maximum 1100 µS/cm at the spillway. Dissolved oxygen level are recorded a minimum 9.75 mg/L in the Lale Creek and a maximum 12.16 mg/L in the spillway (St15). The values of pH were recorded a minimum 6.50 at the Lale creek and maximum 7.48 at the Kazandere stream (Table I)

DISCUSSION

The species diversity of streams is higher than Sakarya River and Rezve Stream but lower than Karasu Stream (*e.g.*, Gülen and Altınsaçlı, 1999; Yaltalıer, 2007; Özuluğ and Yaltalıer, 2008).

Two species, *I. bradyi, P. kraepelini,* were found in the reservoir. Species number of the Kazandere Reservoir is very low among other reservoirs that mentioned in former studies in Turkey (*e.g.*, Özuluğ, 2002; Külköylüoğlu, 2005; Yılmaz and Külköylüoğlu, 2006).

I. bradyi are found in various types of water like as seasonal water holes, lakes and rivers but, its favorite habitat is springs and distributed throughout Europe (Bronshtein, 1947). Also the species are dominant and it is the only species not affected by habitual change in the stream basin, it could be said that *I. bradyi* has high adaptation ability. The second species is *P. kraepelini*. Generally it found in ponds, littoral zone of lakes, streams, canals and ditches. Its distribution is generally in Europe and Asia (Meisch, 2000). According to Dügel *et al.* (2008), *P. kraepelini* usually prefers large aquatic bodies. This explains how the species can easily adapt to reservoir.

I. bradyi, C. vidua and *L. immodulata* were found in the spillway. Therefore, *C. vidua* tolerates a wide range of environmental conditions and prefers both large and small permanent water bodies (Meisch, 2000; Dügel *et al.*, 2008), in the present study, the species was not found in the reservoir. Even though water of the reservoir is supplied by the stream, *C. vidua* and *L. immodulata* that are present in streams and spillways were not found in the reservoir. As is known, spillway is a discharge water system, and former river drainage area is generally used to transport the water. *L. immodulata* generally lives in marine habitat. The presence of *L. immodulata* both in the spillway and stream, supports the idea that the ostracod fauna in the spillway differs from the reservoir, but is similar the stream due to former river drainage area.

When the ecological parameters of habitats were compared (Table I), water conductivity of the running water (streams and spillway) showed considerable variability (145 - 1100µS/cm). The highest rates of conductivity were measured in the spillway (St15, St16 - it has not found any ostracod specimen). High level conductivity is indicate the “salty water” that is possible for spillway that close contact with the marine. In contrast to streams, conductivity values of the reservoir did not have high variability (536-539 µS/cm). The other important ecological parameter is dissolved oxygen. The oxygen levels in the streams were between 9.75 and 11.46 mg/L, in the reservoir between 9.77 and 9.84 mg/L and in the spillway between 10.75 and 12.16 mg/L. Dissolved oxygen level of the running water (streams and spillway) was higher than reservoir (stagnant water) and that is in accordance with our knowledge. In addition the ecological parameters same differs among the habitats like as water status and water flow regime are important.

Water status are changed from running water to stagnant water bodies in reservoir and water flow regime are irregular in the spillway.

Finally, dispersion of ostracod species in the Kazandere Basin is negative affected by the construction of the dam. The variations of ecological features allow species diversity and richness, but according to the present study, not only ecological parameters but also water status is effective factor for ostracod dispersion. Ostracoda fauna of the reservoir will be shaped in the future. However, the natural fauna could be lost when the drainage area of the streams is damaged.

ACKNOWLEDGEMENTS

This work was supported by the Research Fund of the Istanbul University, Project number 1550/16012001. I would like to thank Dr. Hülya Sarı De-Zeu for her help during the lab study and Dr. E. Pietrzeiniuk for giving me the opportunity to compare the carapace with the collection in the Naturkunde Museum, Berlin.

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(Received 30 April 2011, revised 27 May 2011)