ZooNotes 153: 1-4 (2020)
www.zoonotes.bio.uni-plovdiv.bg
ISSN 1313-9916

Zooplankton species composition of Cladocera and Cyclopoida (Copepoda) in the Vaya Lake

ELENA NENOVA

Sofia University, Faculty of Biology, Department of Zoology and Anthropology, 8, Dragan Tzankov blvd., Sofia 1164, Bulgaria, elena_pnenova@abv.bg

Abstract. Nine species of Cladocera and three species of Cyclopoida were identified in the Vaya Lake during the period 2003-2007. The results show a complete change in the species composition of cyclopoids compared to the period 1953-1957, when the only systematic study of the zooplankton of the Vaya Lake was conducted. From Cladocera, only two species are common for both periods.

Key words: zooplankton, Vaya Lake.

Introduction

One of the first studies on the zooplankton and zoobenthos of the Vaya Lake was carried out by Valkanov (1936). Zashev and Angelov (1958) performed the only systematic studies of the zooplankton and zoobenthos lake fauna.

The authors established a poor and uniform species composition throughout the lake during the period 1954-1957. The zooplankton and zoobenthos found were euryhalinic. This could be explained by the wide range of salinity variations during the period (0.76-18.40 ‰). Salinity of the lake increases thanks to the inflow of seawater through the channel between the lake and the Black Sea. Most of the planktonic species identified during this study period were predominantly marine. Later, Naydenov (1967) reported 3 species of Rotifera, 5 species of Cladocera, and 3 species of Copepoda. Dimoff (1967) examined the zooplankton of the Vaya Lake and found a predominance of Cyclopoida and Cladocera. Konsulov (1973) found 9 species of Cladocera and 4 species of Copepoda. In the last 50 years the Vaya Lake has gone through various significant changes – most notable of which are shallowing, combined with the evening of the bed, the reduction of water surface and volume, along with the dramatic decrease of lake salinity. During the period 1999-2000, Pandourski (2001) identified 10 species of Cladocera and 4 species of Copepoda, predominantly widespread eurybiontic representatives.

The goal of the study was to determine zooplankton of Cladocera and Cyclopoida for the period 2003-2007. Until then, the only complete systematic and long-term studies on the Vaya Lake were carried out by Zashev and Angelov during the period 1953-1957. Some other studies were done but they are sporadic, fragmentary and just for short periods of time. The sampling points were selected to have close coordinates to those investigated by Avgelov and Zashev, and the results were compared.

Accepted: 7 January 2020
Published: 15 January 2020
Университетско издателство "Паисий Хилендарски"
Plovdiv University Press "Paisii Hilendarski"

Material and Methods

Zooplankton specimens were collected seasonally during the period 2003 – 2007 from 14 permanent stations with an Apstein type net - 16 cm inlet diameter and mesh size 55 µm (Fig.1). The station coordinates were determined with an Etrex Summit GPS receiver (GARMIN).

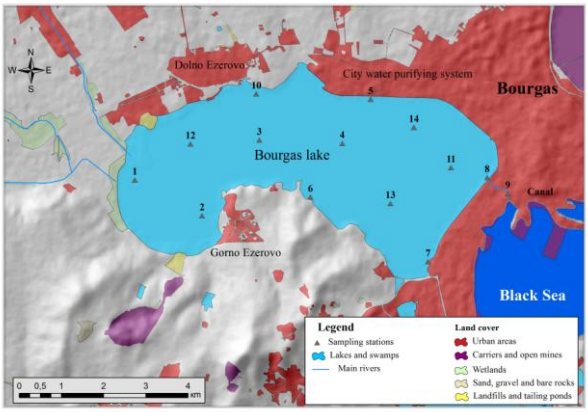

Fig. 1. Map of the Vaya Lake with the location of the stations.

A total of 167 planktonic samples were collected and fixed in 4% formalin. The zooplanktons were sorted under a stereomicroscope. They were determinate to a species or a genus level. To evaluate the diversity of zooplankton in the Vaya Lake α-diversity indices are used.

Results and Discussion

Two families (Daphnidae and Bosminidae) were identified from Cladocera with 3 genera and 8 species (Tab. 1). The α-diversity indices showed that the number of species found in this group were distributed relatively even between the stations. Seven species have been established in stations 1, 2, 6, 8, 9 and 10, and 6 species were installed in stations 3, 4, 5, 7 and 11. From Cyclopoida we identified representatives of 3 genera and 3 species (Tab. 1).

The representatives of the genus *Daphnia* are the main cladocerans in our samples. *Daphnia pulex* (Leydig, 1860) was found with the highest frequency of occurrence (pF = 43.11%) - in the fall of 2003 and 2004 at an average temperature of 14.4°C and 17.9°C; the winter of 2004 and 2007 at 13.8°C and 11.3°C; spring 2004, 2005 and 2006 at 17.7°C, 18.1°C and 17.4°C. *Daphnia longispina* (Müller, 1785) (pF = 34.73%) was found in spring and winter 2004, spring 2005, spring 2006 and winter 2007. The strongest development is in the southern and eastern parts of the Lake and at the mouth of the channel. *Daphnia magna* (Straus, 1820) was detected at oxygen concentrations above 3mg/l in the winter of 2004 and in the spring of 2004, 2005 and 2006 (pF = 13.17%). The lowest occurrence rate found for *Daphnia galeata* (Sars, 1864) is pF = 5.39%. *Daphnia curvirostris* (Eylmann, 1887) was established in winter 2004 and spring 2006 at high pH - above 7 (pF = 12.57%). Single representatives of the species *Daphnia cucullata* (Sars, 1864), have also been found. *Moina micrura* (Kurz, 1875) (pF = 23.35%) is characterized exclusively by summer samples, which is related to its preference for higher temperatures. The eurybiotic species *Bosmina longirostris* (Müller, 1785) was detected in spring 2005 and 2006 and autumn 2006 at a frequency of occurrence of pF = 20.96%.

From the order of Cyclopoida with 100% frequency of study, copepodites and nauplii stages were established in all seasons and in all stations. *Cyclops vicinus* (Uljanin, 1875) was one of the most commonly found in our samples, the dominant species among copepods. It is found in all seasons of all three studied years with a frequency of occurrence pF = 86.83%. The thermophilic species *Thermocyclops oithonoides* (Sars, 1863) was found

from Cyclopoida to be pF = 44.31%. It occurs in the summer and autumn of all years (except for the autumn of 2006). *Acanthocyclops vernalis* (Fischer, 1853) was found only once in October 2004.

Tab. 1. Species composition of Cladocera and Cyclopoida in the Vaya Lake during the two periods: 2003 - 2007 and 1953 - 1957 ("-" - missing species for one or the other period).

2003 - 2007	1953 - 1957
Cladocera (Arthropoda, Crustacea, Branchiopoda)	
Daphnia pulex (Leydig, 1860)	-
Daphnia longispina (Müller, 1785)	-
Daphnia magna (Straus, 1820)	*Daphnia magna* (Straus, 1820)
Daphnia curvirostris (Eylmann, 1887 emend.	-
Daphnia cucullata (Sars, 1864)	-
Daphnia galeata (Sars, 1864)	-
Daphnia sp.	-
Moina micrura (Kurz, 1875)	*Moina micrura* (Kurz, 1875)
Bosmina longirostris (Müller, 1785)	-
-	*Alona guttata* (Sars, 1862)
-	*Rhynchotalona rostrata* (Koch, 1841)
Cyclopoida (Arthropoda, Crustacea, Copepoda)	
Acanthocyclops vernalis (Fischer, 1853)	-
-	*Metacyclops minutus* (Claus, 1863)
Cyclops vicinus (Uljanin, 1875)	-
-	*Halicyclops sp*
Thermocyclops oithonoides (Sars G.O., 1863)	-
Copepodites	Copepodites
Nauplii	Nauplii

Pandourski (2001) recorded *D. longispina* in March and May 2000 for the Vaya Lake, which coincides with our spring finding of the species. *D. magna* is commonly found in calcium-rich alkaline waters, high in inorganic salts and low brackish water (Potts & Fryer, 1979). This is the reason this species is also found among Angelov – Zashev's planktonic samples, but in larger quantities (when salinity drops to an average of 1.5 ‰). It has been identified with a relative increase in the content of calcium and magnesium at the expense of sodium ions, which proves the continued change of Vaya Lake from salt to freshwater (Nenova et al., 2007). The low frequency of the *D. galeata* according to Bendorf *et al.* (2001), is due to the high summer temperatures and the predatory press. Urabe and Watanabe report probable toxic effects of *Microcystis aeroginosa* (Kützing, 1846) on *D. galeata* (algae is the preferred trophic resource for this species). *Daphnia cucullata* (Sars, 1864) is a typical species of eutrophic water basins (Naidenow, 1994). Its poor occurrence may be due to the predatory press, although such small cladocers as *D. cucullata* usually have a well-developed phenotypic plasticity (Laforsch & Tollrian, 2004). As the trophic status of the lake progresses, *B. longirostris* gradually displaces other species of this genus. The poor species diversity, accompanied by a high degree of dominance of one species, was due to the massive development of Nauplii and Copepodites of Copepoda. This could be indicative of the destabilization of the environment. A possible cause might be the advanced eutrophication of the lake, which advantegaes the development of species, resistant to these conditions, such as *C. vicinus*. Pandourski (2001) cites *C. vicinus* as the dominant species for Lake Vaya. The copepodites and adult stages of *C. vicinus* dominate and represent more than half of the total zooplankton biomass. The low water level of the lake, as well as the additional influence of snowy winters and reduced rainfall during certain periods may have contributed to the low species diversity. In worse hydrological conditions, the degradation processes in the sediments increases and significantly load the water with biogenes and

detritus. This is a prerequisite for phytoplankton flowering and major development of small detritus plankton. As the most thermophilic species of the established cyclopoids, *Thermocyclops oithonoides* (Sars, 1863) may be an indicator of changes in the thermal regime of the waters in our country. The winter diapause of *Th. oithonoides* may be an adaptation to avoid low oxygen content and low water temperatures.

The results obtained from our studies showed changes in the species composition of the studied zooplankton groups compared with the results of the studies conducted in the period 1953-1957 by Zashev & Angelov (1958) (Tab. 1). This is likely mainly due to the disrupted connection with the sea, the imbalance of the trophic levels, and the ongoing eutrophication of the lake. Influences that alter the physical and chemical parameters of the environment or alter the balance in the zooplankton community may lead to the disappearance of some species and the emergence of others. Of course, environmental factors interact, which explains why the same species may behave differently in different habitats and have different seasonal distributions.

References

Benndorf, J., Kranich, J., Mehner, T. & Wagner, A. (2001) Temperature impact on the midsummer decline of *Daphnia galeata*: an analysis of long-term data from the biomanipulated Bautzen Reservoir (Germany). *Freshwater Biology*, 46(2): 199-211.

Dimov, I. (1967) Seasonal and annual dynamics of the zooplankton biomass in some lakes along the Bulgarian Black Sea coast. *Proceedings of the research institute of fisheries and oceanography, Varna,* 8: 157-176 (In Bulgarian, English Summary).

Konsulov A. (1973) Seasonal and annual dynamics of the zooplankton of the Bourgas Lake and of the Mandra dam during the 1967-1970 period. – *Proceedings of the Institute of Oceanography and Fisheries, Varna,* 12: 67-85.

Laforsch, C. & Tollrian, R. (2004) Inducible defenses in multipredator environments: cyclomorphosis in *Daphnia cucullata*. *Ecology*, 85(8): 2302-2311.

Naydenow, W. (1967) Hydrobiologische untersuchungen der wasserbecken an der südlichen schwarzmeerküste und im Strandža-gebirge I. *Bulletin de l'institut de zoologie et musee*, 24: 57-96 (in Bulgarian, German Summary).

Naidenow, W. (1994) Wandel in der Zusammensetzung der Cladocera und Copepoda-Fauna des Süßwassers in Bulgarien im letzten Jahrhundert. *Lauterbornia*, 19: 95-106.

Nenova, E., Tishkov, S. & Shishiniova, M. (2007) Investigation of hydrochemical parameters of the Vaya lake and their influence on the quantitative composition of plankton invertebrates. *Ecological engineering and environment protection*, 1: 13-20.

Pandourski, I. (2001) Recherches Hydrobiologiques des zones humides de la côte bulgare de la Mer Noire. I. Le lac de Vaja. – Rivista di idrobiologia, 40(2-3): 321-334.

Pejler, B. (1983) Zooplanktic indicators of trophy and their food. *Hydrobiologia,* 101: 111-114.

Potts, W.T.W. & Fryer, G. (1979) The effects of pH and salt content on sodium balance in *Daphnia magna* and *Acantholeberis curvirostris* (Crustacea: Cladocera). *Journal of Comparative Physiology*, 129: 289-294.

Urabe, J. & Watanabe, Y. (1991) Effect of food condition on the bacterial feeding of *Daphnia galeata*. *Hydrobiologia*, 225: 121-128.

Valkanov A. (1936) Notizen über die Brackwässer Bulgariens II. *Annuaire de l'Université de Sofia. Faculté physico-mathématique*, 32(3): 209-341. (In Bulgarian, German summary).

Zaschev, G. & Angelov, A. (1959) Untersuchungen über den Burgas-see (Vaja) in beziehung zur verbesserung seiner fischwirtschaftlichen ausbeutung. *Annuaire de Sofia, Faculte de biologie, geologie et geographie, 51, Livre 1 - Biologie*: 161-210 (in Bulgarian, German Summary).