Acta Biol. Univ. Daugavp. 20 (1) 2020
ISSN 1407 - 8953

DYNAMICS AND FACTORS INFLUENCING ZOOPLANKTON IN THE LAKES SVENTE, RIČA, DRIDZIS AND GERAŅIMOVAS-ILZAS (EASTERN LATVIA)

Aija Brakovska, Jana Paidere, Artūrs Škute

Brakovska A., Paidere J., Škute A. 2020. Dynamics and factors influencing zooplankton in the lakes Svente, Riča, Dridzis and Geraņimovas-Ilzas (Eastern Latvia). *Acta Biol. Univ. Daugavp., 20 (1): 71 – 94.*

According to the analysis of the collected zooplankton samples the highest zooplankton species diversity was observed in lakes Dridzis and Svente. 73 zooplankton species were identified in Lake Dridzis, while 68 zooplankton species were identified in Lake Svente. In turn, 47 species were identified in Lake Riča, and 42 zooplankton species were identified in Lake Geraņimovas-Ilzas.

During Spearman's rank correlation the obtained results over the years, investigated lakes and zooplankton groups are different. Positive correlation in Lake Svente was among *Asplanchna priodonta*, *Gastropus stylifer*, *Conochilus hippocrepis*, *Pompholux sulcata*, *Keratella cochlearis*, *Kellicottia longispina* (Rotifera), *Daphnia cucullata*, *Daphnia cristata*, *Bosmina crassicornis*, *Bosmina longispina*, *Chydorus ovalis* (Cladocera), dissolved oxygen, *Cyclops* sp. and Nauplii (Copepoda). Negative correlation coefficient was obtained for *Keratella quadrata*, *Filinia longiseta* (Rotifera). Positive correlation in Lake Dridzis was among *Daphnia cucullata*, *Daphnia cristata*, *Bosmina crassicornis*, *Bosmina longispina*, *Diaphanosoma brachyurum* (Cladocera), *Keratella cochlearis*, *Kellicottia longispina*, *Gastropus stylifer*, *Filinia longiseta*, *Conochilus unicornis* (Rotifera), *Megacyclops viridis*, *Cyclops* sp. and Nauplii (Copepoda). Negative correlation coefficient was obtained for *Asplanchna priodonta* (Rotifera) and *Eurytemora lacustris* (Copepoda), it is suggested that there is negative interaction among these species. While positive correlation in Lake Geraņimovas-Ilzas was among *Asplanchna priodonta*, *Keratella cochlearis*, *Pompholux sulcata* (Rotifera), *Daphnia cucullata*, *Daphnia cristata*, *Diaphanosoma brachyurum* (Cladocera), dissolved oxygen, chlorophill α, water temperature, *Eudiaptomus gracilis*, *Cyclops* sp. and Nauplii (Copepoda), but positive correlation in Lake Riča was obtained for *Keratella cochlearis* (Rotifera), *Daphnia cucullata* (Cladocera) and *Cyclops* sp. (Copepoda). Negative correlation coefficient was obtained for *Polyarthra major* (Rotifera), *Bosmina longispina* (Cladocera), chlorophill α and total dissolved solids.

Key words: Zooplankton taxa, Lake Svente, Lake Riča, Lake Dridzis, Lake Geraņimovas-Ilzas, Spearman's rank correlation, Shannon - Wiener species diversity index, redundancy analysis (RDA).

Jana Paidere, Aija Brakovska, Artūrs Škute. Laboratory of Hydroecology, Department of Ecology, Institute of Life Sciences and Technologies, Daugavpils University, Daugavpils, Parādes 1a, Latvia, E-mail: jana.paidere@du.lv, aija.brakovska@inbox.lv

INTRODUCTION

Zooplankton organisms occupy a central position in the food webs of aquatic ecosystem. They do not only form an integral part of the lentic community but also contribute significantly, the biological productivity of the fresh water ecosystem (Dodson 1992, Wetzel 2001). The importance of the zooplankton is well recognized as these have vital part in food chain and play a key role in cycling of organic matter in an aquatic ecosystem (Sharma 1998). Nearly all fish depend on zooplankton for their food during their larval phases and some fishes continue to eat zooplankton in their entire lives (Chang & Hanazato 2004, Cimdiņš 2001, Hebert 1982, Madin et al. 2001, Malone & McQueen 1983, Pinel-Alloul 1995, Wetzel 2001).The potential of zooplankton as a bioindicator is very high because its development and spread depends on many abiotic (e.g. temperature, dissolved oxygen, pH, transparency, wind, social aggregates, water turbulence, trophic gradient, salinity, stratification, pollution, etc.) (Beaugrand et al. 2001, Bengtsson 1986, Bertilsson et al. 1995, Bērziņš & Pejler 1987, 1989a, 1989b, Dagg 1977, Dumont et al. 1973, Fernandez-Rosado & Lucena 2001, Geller et al. 1992, Hanazato 1991, 1992, Hart 1994, Horppila et al. 2000, Locke & Sprules 2000, Malone & McQueen 1983, Pidgaiko 1984, Pinel-Alloul 1995, Reid & Wood 1976, Seda & Devetter 2000, Tallberg et al. 1999, Wetzel 2001) and biotic parameters (e.g. food, predation, interspecific competition) (Brooks & Dodson 1965, Chang & Hanazato 2004, Cimdiņš 2001, DeMott 1989, Dodson 1974, Dodson 1984, Dumont 1972, Escribano & Hidalgo 2000, Gilbert 1988, Harris et al. 2012, Hebert 1982, Larsson & Dodson 1993, Lazareva 2010, Malone & McQueen 1983, Pinel-Alloul 1995, Tilzer 2000, Urabe 1990, Weider & Pijanowska 1993, Wetzel 2001). Almost all fish depend on zooplankton as they eat it during their larval phases and some fishes continue to eat zooplankton during their entire lives (Chang & Hanazato 2004. Cimdiņš, 2001, Hebert 1982, Madin et al. 2001, Malone & McQueen 1983, Pinel-Alloul 1995, Wetzel 2001). Carrying out the complex study of the zooplankton coenosis composition, researchers should never forget about the seasonality of zooplankton taxa i.e., if they want to obtain the most accurate information about the zooplankton species living there, their mutual interactions, the samples should be collected in spring, summer and autumn from different places of water bodies (Mergeay et al. 2005, Smirnov 1979). As a result of the studies on various environmental factors and the influence of seasonality on zooplankton organisms in different years and seasons some qualitative and quantitative differences have been observed in separate zooplankton groups which are associated with different environmental factors (Bertilsson et al. 1995, Bērziņš & Pejler 1987, Bērziņš & Pejler 1989a, 1989b, Malone & McQueen 1983, Pinel-Alloul 1995, Seda & Devetter 2000). Since the spatial and temporal apect of the composition of zooplankton species in the lakes Svente, Riča, Dridzis and Geraņimovas-Ilzas has not been studied in detail recently (Brakovska & Paidere 2012, Brakovska & Škute 2007, 2009, Brakovska et al. 2012, Brakovska et al. 2013, Brakovska 2014), the aim of this research is to study the spatial distribution of the composition of zooplankton species in the lakes Svente, Riča, Dridzis and Geraņimovas-Ilzas in the course of several years covering spring, summer and autumn seasons. So the author could get the fullest possible view of the current composition of zooplankton species in the lakes Svente, Riča, Dridzis and Geraņimovas-Ilzas, their mutual interactions, interactions with different environmental factors.

MATERIAL AND METHODS

Location of research and sampling

Material for the study of zooplankton cenoses composition was collected in four deep lakes of Eastern Latvia, which belong to deep, well-transparent mesotrophic and mesoeutrophic Latvian lakes (Urtāne 1998). Our investigated lakes are relatively similar in terms of their morphometric characteristics. Lake Dridzis is the deepest Lake in Latvia. Moreover, it is the deepest Lake in Baltia (www.ezeri.lv database (accessed

30.03.2020)). Lake Geraņimovas-Ilzas is the fifth deepest, but Lake Svente is the tenth deepest Lake in Latvia (Eipurs 1995, Tidriķis 1998, www.ezeri.lv database (accessed 30.03.2020)). In turn, Lake Riča is the ninth deepest Lake in Latvia (Tidriķis 1997). Lake characteristics and location are presented in Table 1 and Fig. 1.

Zooplankton and water sampling

Zooplankton samples in the lakes Svente Riča, Dridzis and Geraņimovas-Ilzas (Fig. 1) were collected from 2007 to 2011, during the summer season, in various areas of the lakes at different depth with *Hydro-bios* Apstein type plankton net with an opening-closing mechanism (mesh size

Table 1**.** Morphometric and ecological parameters of Lakes Svente, Riča, Dridzis and Geraņimovas-Ilzas

Lake	**Coordinates X/Y**	**Average depth, m**	**Maximum depth, m**	**Surface area, km²**	**Trophy**
Dridzis	705390.852/ 208462.077	12.8	65.1	7.53	Mesotrophic
Geraņimovas-Ilzas	696251.015/ 228167.042	9.8	46	3.28	From the mesotrophic to eutrophic
Svente	647412.511/ 192388.091	7.8	38	7.35	Eutrophic
Riča	670715.594/ 175721.067	9.7	39.7**	12.86*	Mesoeutrophic

* In Latvia 5.88 km², in Belarus 6.98 km².
** Depth in Latvia, while the maximum depth is in Belarus- 51.9 m
(Eipurs 1995, Tidriķis 1997, Tidriķis 1998, Urtāne 1998, www.ezeri.lv database (accessed 30.03.2020))

Fig.1. Location of the studied lakes.

64 μm), preserved with 37- 40% formaldehyde solution (4% final concentration) (Brakovska et al. 2013; Brakovska 2014). Sampling sites were chosen so that they could reflect the diversity of habitats in the lake. Along with zooplankton sampling water physico-chemical parameters (water temperature (^{0}C), pH, conductivity (μS cm^{-1}), total dissolved solids (gl^{-1}), dissolved oxygen (mg^{-1}), oxygen saturation (%), oxidation-reduction potential-ORP (mV), chlorophill α ($μg^{-1}$), turbidity (NTU)) per one imagined line were also measured using a *HACH DS5* probe in the deepest locality of the lakes Svente Riča, Dridzis and Geraņimovas-Ilzas (Brakovska and Škute 2007; Brakovska et al. 2012; Brakovska et al. 2013; Brakovska 2014). The collection of the zooplankton samples and their quantitative and qualitative analysis was performed using the APHA standard methods procedure for the water and wastewater analysis (APHA 2005; Wetzel & Likens 2000).

Zooplankton analysis

The samples of zooplankton were analysed by using *Zeiss Primo Star* upright light microscope (100- 400 x magnification). The samples of zooplankton were analysed repeatedly by *Gridded Sedgewick Rafter* counting chamber with the volume of 1 ml, in total 6 ml sample's subvolume examined (1 ml x 6) (Wetzel & Likens 2000). Having studied the samples in the light microscope the zooplankton organisms were then calculated and identified as species or families. The zooplankton organisms were identified according to the taxonomic keys by Alekseev & Tsalokhin (2010), Benzie (2005),Dagg (1977); Dumont & Negrea (2002), Dussart & Defaye (2001), Einsle (1996), Flössner (1972), Flössner (2000), Flössner (2002), Hudec (2010), Key to freshwater invertebrates... (1995), Key to zooplankton and zoobenthos... (2010), Kotov (2006), Krauter & Streble (1988), Kutikova (1970), Kutikova & Starobogatov (1977), Lieder (1996), Manuilova (1964), Nogrady & Segers (2002), Paidere & Škute (2011), Pontin (1978), Radwan et al. (2004), Rivier (1998), Ruttner-Kolisko (1974), Scourfield and Harding (1994), Segers (1995), Segers (2007), Sloka (1981), Smirnov (1996).

Statistical analysis of zooplankton samples

In order to determine the structure and the diversity of the zooplankton communities, the analysis of the species abundance (number of species in the sample) and species diversity in the samples (Shannon - Wiener index H') was performed (Krebs 1999, MacArthur 1965, Margalef 1958, Williams & Feltmate 1992). Statistical data analysis (Spearman's rank correlation) factor was used to test the relationships among water physico-chemical parameters and zooplankton was performed using *IBM SPSS Statistics 20* (Arhipova & Bāliņa 2003, Zar 1999). Redundancy analysis (RDA) and its resulting ordination diagram to analyse the covariance structure of interspecies and environmental variables were generated using *CONOCO* for Windows, version *4.5* (Gotelli & Ellison 2004, Lepš & Šmilauer 1999, Lepš & Šmilauer 2003, Quinn & Keough 2002, Ter Braak 1994, Van den Brink et al. 2003). For statistical data analysis zooplankton species were scored as presence/absence and abundance records from different depths of lakes Svente, Riča, Dridzis and Geraņimovas-Ilzas. Rare species were downweighted. Only taxa with frequency of occurrence >20% were considered.

RESULTS AND DISCUSSION

In all the lakes under research, the largest quantity of species was in Rotifera group, followed by Cladocera and Copepoda groups. Throughout the years the number and the composition of species in the lakes under research was slightly different. Analyzing the collected zooplankton samples the highest zooplankton species diversity was observed in lakes Dridzis and Svente. 73 zooplankton species were identified In Lake Dridzis (Table 4), and 68 zooplankton species in Lake Svente (Table 2). In turn, 47 species were identified in Lake Riča (Table 3), and 42 zooplankton species in Lake Geraņimovas-Ilzas (Table 5). In all the lakes under research, the Rotifera group was the most observed

Table 2. Presence of zooplankton species in Lake Svente from 2007 to 2011

Species (taxon)	**Date of sampling**				**Common species**
	2007	**2008**	**2010**	**2011**	
ROTIFERA	**14**	**19**	**35**	**30**	**40**
Ascomorpha ecaudis Perty, 1850	+	+	+	+	+
Ascomorpha ovalis (Bergendal, 1892)			+	+	+
Ascomorpha saltans saltans Bartsch, 1870	+				+
Asplanchna priodonta Gosse, 1850	+	+	+	+	+
Brachionus angularis Gosse, 1851			+	+	+
Brachionus sp. Pallas, 1766			+	+	+
Brachionus urceolaris Müller, 1773			+		+
Cephalodella gibba (Ehrenberg, 1832)		+	+	+	+
Collotheca sp. Harring, 1913			+	+	+
Conochilus (Conochilus) hippocrepis (Schrank, 1803)	+	+	+	+	+
*Conochilus (Conochilus) unicornis*Rousselet, 1892			+	+	+
Conochilus sp.Ehrenberg, 1834			+	+	+
Euchlanis dilatata Ehrenberg, 1832		+	+	+	+
Euchlanis sp. Ehrenberg, 1832				+	+
Filinia longiseta (Ehrenberg, 1834)	+	+		+	+
Gastropus stylifer (Imhof, 1891)	+	+	+	+	+
Kellicottia longispina Kellicott, 1879	+	+	+	+	+
Keratella cochlearis Gosse, 1851	+	+	+	+	+
Keratella quadrata Müller, 1786	+	+	+	+	+
Lecane ludwigii (Eckstein, 1883)			+		+
Lecane luna (Müller, 1776)	+	+	+	+	+
Lecane lunaris (Ehrenberg, 1832)			+	+	+
Lecane sp. (Nitzsch, 1827)			+		+
Ploesoma hudsoni (Imhof, 1891)		+	+	+	+
Ploesoma lenticulare Herrick, 1885			+		+
Polyarthra dolichoptera Idelson, 1925		+	+	+	+
Polyarthra major Burckhardt, 1900	+	+	+	+	+
Polyarthra vulgaris Carlin, 1943	+	+	+	+	+
Pompholyx sulcata Hudson, 1885	+	+	+	+	+
Rotatoria sp. Scopoli, 1777		+		+	+
Synchaeta kitina Rousselet, 1902			+		+
Synchaeta pectinata Ehrenberg, 1832		+			+
Synchaeta tremula (Müller, 1786)			+	+	+
Testudinella patina (Hermann, 1783)			+		+
Trichocerca capucina (Wierzejski & Zacharias, 1893)	+	+	+	+	+
Trichocerca cylindrica (Imhof, 1891)			+	+	+
Trichocerca rousseleti (Voigt, 1902)			+	+	+

Species (taxon)	Date of sampling				Common species
	2007	2008	2010	2011	
Trichocerca similis(Wierzejski, 1893)			+	+	+
Trichotria pocillum (Müller, 1776)			+		+
CLADOCERA	**7**	**10**	**14**	**15**	**20**
Acroperus harpae (Baird, 1835)				+	+
Bosmina (Eubosmina) crassicornis Lilljeborg 1887	+	+	+	+	+
Bosmina (Bosmina) longirostris (O. F. Müller, 1776)	+	+	+	+	+
Bosmina (Eubosmina) coregoni Baird, 1857				+	+
Bosmina (Eubosmina) longispina Leydig, 1860		+	+	+	+
Bythotrephes longimanus Leydig, 1860				+	+
Ceriodaphnia pulchella Sars, 1862	+		+	+	+
Ceriodaphnia quadrangula (O.F.Müller, 1785)			+		+
Ceriodaphnia rectangula (Jurine, 1820)	+	+	+		+
Chydorus ovalis (Kurz, 1875)			+	+	+
Chydorus sphaericus (O. F. Müller, 1776)				+	+
Daphnia (Daphnia) cristata Sars, 1862	+	+	+	+	+
Daphnia (Daphnia) cucullata Sars, 1862	+	+	+	+	+
*Daphnia (Daphnia) longispina (*O. F. Müller, 1776)		+	+	+	+
Daphnia longispina hyalina (O.F. Müller, 1775)			+		+
Diaphanosoma brachyurum (Liévin, 1848)	+	+	+	+	+
Leptodora kindtii (Focke, 1844)			+	+	+
Polyphemus pediculus (Linnaeus, 1758)			+	+	+
Scapholeberis mucronata (O. F. Müller, 1776)		+			+
Sida crystallina (O. F. Müller, 1776)		+			+
COPEPODA	**2**	**3**	**7**	**8**	**8**
Copepodite					
Cyclops scutifer G.O.Sars, 1863				+	+
Cyclops sp. Müller, 1785	+	+	+	+	+
Eudiaptomus gracilis (G.O. Sars, 1863)	+	+	+	+	+
Eudiaptomus graciloides(G.O. Sars, 1863)			+	+	+
Limnocalanus macrurus G.O.Sars., 1863		+	+	+	+
Megacyclops sp. Kiefer, 1927			+	+	+
Megacyclops viridis (Jurine, 1820)			+	+	+
Mesocyclops leucarti (Claus, 1857)			+	+	+
Nauplii					
Thermocyclops crassus (Fischer, 1853)			+	+	+
Thermocyclops oithonoides (G.O.Sars, 1863)			+	+	+
TOTAL	**23**	**32**	**56**	**53**	**68**

Table 3. Presence of zooplankton species in Lake Riča from 2007 to 2011

Species (taxon)	Date of sampling			Common species
	2007	2010	2011	
ROTIFERA	**18**	**16**	**16**	**22**
Ascomorpha ecaudis Perty, 1850	+	+	+	+
Ascomorpha ovalis (Bergendal, 1892)		+	+	+
Ascomorpha saltans saltans Bartsch, 1870	+			+
Asplanchna priodonta Gosse, 1850	+	+	+	+
Conochilus (Conochilus) hippocrepis (Schrank, 1803)	+	+	+	+
*Conochilus (Conochilus) unicornis*Rousselet, 1892	+	+	+	+
Filinia longiseta (Ehrenberg, 1834)	+			+
Gastropus stylifer (Imhof, 1891)	+	+	+	+
Kellicottia longispina Kellicott, 1879	+	+	+	+
Keratella cochlearis Gosse, 1851	+	+	+	+
Keratella quadrata Müller, 1786	+	+	+	+
Ploesoma hudsoni (Imhof, 1891)		+	+	+
Polyarthra major Burckhardt, 1900	+	+	+	+
Polyarthra remata Skorikov, 1896	+			+
Polyarthra vulgaris Carlin, 1943	+	+	+	+
Pompholyx sulcata Hudson, 1885	+	+	+	+
Rotatoria sp. Scopoli, 1777			+	+
Synchaeta tremula (Müller, 1786)	+			+
Testudinella patina (Hermann, 1783)	+			+
Trichocerca capucina (Wierzejski & Zacharias, 1893)	+	+	+	+
Trichocerca cylindrica (Imhof, 1891)	+	+		+
Trichocerca similis(Wierzejski, 1893)	+	+	+	+
CLADOCERA	**14**	**9**	**9**	**16**
Bosmina (Eubosmina) crassicornis Lilljeborg 1887	+	+	+	+
Bosmina (Bosmina) longirostris (O. F. Müller, 1776)	+	+	+	+
Bosmina (Eubosmina) coregoni Baird, 1857	+			+
Bosmina (Eubosmina) longispina Leydig, 1860	+	+	+	+
Bosmina (Eubosmina) reflexa Seligo, 1907		+		+
Bythotrephes longimanus Leydig, 1860	+		+	+
Ceriodaphnia affinis Lilljeborg, 1900	+			+
Ceriodaphnia pulchella Sars, 1862	+		+	+
Ceriodaphnia reticulata (Jurine, 1820)	+	+		+
Ceriodaphnia sp. Dana, 1855	+			+
Daphnia (Daphnia) cristata Sars, 1862		+	+	+
Daphnia (Daphnia) cucullata Sars, 1862	+	+	+	+
*Daphnia (Daphnia) longispina (*O. F. Müller, 1776)	+			+
Diaphanosoma brachyurum (Liévin, 1848)	+	+	+	+

Species (taxon)	Date of sampling			Common species
	2007	2010	2011	
Leptodora kindtii (Focke, 1844)	+	+	+	+
Polyphemus pediculus (Linnaeus, 1758)	+			+
COPEPODA	**2**	**6**	**6**	**9**
Cyclops sp. Müller, 1785	+	+	+	+
Copepodite				
Eudiaptomus gracilis (G.O. Sars, 1863)	+	+	+	+
Eudiaptomus graciloides(G.O. Sars, 1863)		+	+	+
Limnocalanus macrurus G.O.Sars., 1863		+		+
Megacyclops viridis (Jurine, 1820)		+		+
Mesocyclops leucarti (Claus, 1857)			+	+
Mesocyclops sp. Kiefer, 1927		+		+
Nauplii				
Thermocyclops crassus (Fischer, 1853)			+	+
Thermocyclops oithonoides (G.O.Sars, 1863)			+	+
TOTAL	**34**	**31**	**31**	**47**

Table 4. Presence of zooplankton species in Lake Dridzis from 2007 to 2011

Species (taxon)	Date of sampling			Common species
	2007	2010	2011	
ROTIFERA	**20**	**27**	**25**	**36**
Ascomorpha ecaudis Perty, 1850	+	+	+	+
Ascomorpha ovalis (Bergendal, 1892)		+	+	+
Ascomorpha saltans saltans Bartsch, 1870	+	+	+	+
Asplanchna priodonta Gosse, 1850	+	+	+	+
Brachionus angularis Gosse, 1851	+	+		+
Brachionus calyciflorus Pallas, 1766		+		+
Brachionus quadridentatus Hermann, 1783			+	+
Conochilus (Conochilus) hippocrepis (Schrank, 1803)	+	+	+	+
*Conochilus (Conochilus) unicornis*Rousselet, 1892	+	+	+	+
Conochilus sp.Ehrenberg, 1834			+	+
Euchlanis dilatata Ehrenberg, 1832			+	+
Filinia longiseta (Ehrenberg, 1834)	+	+	+	+
Gastropus stylifer (Imhof, 1891)		+	+	+
Kellicottia longispina Kellicott, 1879	+	+	+	+
Keratella cochlearis Gosse, 1851	+	+	+	+
Keratella quadrata Müller, 1786	+	+	+	+
Lecane luna (Müller, 1776)			+	+
Lecane lunaris (Ehrenberg, 1832)			+	+

Species (taxon)	Date of sampling			Common species
	2007	2010	2011	
Monommata longiseta (Müller, 1786)		+		+
Mytilina mucronata (Müller, 1773)		+		+
Ploesoma hudsoni (Imhof, 1891)		+	+	+
Polyarthra dolichoptera Idelson, 1925		+	+	+
Polyarthra major Burckhardt, 1900	+	+	+	+
Polyarthra remata Skorikov, 1896	+			+
Polyarthra sp. Ehrenberg, 1834		+		+
Polyarthra vulgaris Carlin, 1943	+	+	+	+
Pompholyx sulcata Hudson, 1885	+	+	+	+
Rotatoria sp. Scopoli, 1777				
Synchaeta pectinata Ehrenberg, 1832		+		+
Synchaeta sp. Ehrenberg, 1832	+	+	+	+
Synchaeta tremula (Müller, 1786)	+			+
Testudinella patina (Hermann, 1783)	+			+
Testudinella truncata (Gosse, 1886)	+			+
Trichocerca capucina (Wierzejski & Zacharias, 1893)	+	+	+	+
Trichocerca cylindrica (Imhof, 1891)		+	+	+
Trichocerca similis(Wierzejski, 1893)	+	+	+	+
Trichotria pocillum (Müller, 1776)		+		+
CLADOCERA	**9**	**19**	**16**	**21**
Acroperus harpae (Baird, 1835)			+	+
Alonella nana (Baird, 1843)			+	+
Bosmina (Eubosmina) crassicornis Lilljeborg 1887	+	+	+	+
Bosmina (Bosmina) longirostris (O. F. Müller, 1776)	+	+	+	+
Bosmina (Eubosmina) coregoni Baird, 1857		+	+	+
Bosmina (Eubosmina) longispina Leydig, 1860	+	+	+	+
Bosmina (Eubosmina) reflexa Seligo, 1907		+		+
Ceriodaphnia affinis Lilljeborg, 1900	+	+		+
Ceriodaphnia pulchella Sars, 1862		+	+	+
Ceriodaphnia rectangula (Jurine, 1820)		+		+
Ceriodaphnia reticulata (Jurine, 1820)		+		+
Ceriodaphnia sp. Dana, 1855		+	+	+
Chydorus ovalis (Kurz, 1875)		+	+	+
Chydorus sphaericus (O. F. Müller, 1776)	+	+	+	+
Daphnia (Daphnia) cristata Sars, 1862	+	+	+	+
Daphnia (Daphnia) cucullata Sars, 1862	+	+	+	+
Daphnia (Daphnia) longispina (O. F. Müller, 1776)	+	+	+	+
Diaphanosoma brachyurum (Liévin, 1848)	+	+	+	+
Leptodora kindtii (Focke, 1844)		+	+	+

Species (taxon)	Date of sampling			Common species
	2007	2010	2011	
Macrothrix laticornis (Jurine, 1820)		+		+
Polyphemus pediculus (Linnaeus, 1758)		+	+	+
COPEPODA	**2**	**16**	**10**	**16**
Acanthocyclops sp. (Kiefer, 1927)		+		+
Copepodite				
Cyclops scutifer G.O.Sars, 1863		+	+	+
Cyclops sp. Müller, 1785	+	+	+	+
Cyclops strenuus Fischer, 1851		+		+
Cyclops vicinus Ulyanin, 1875		+		+
Eucyclops sp. Claus, 1893		+		+
Eudiaptomus gracilis (G.O. Sars, 1863)	+	+	+	+
Eudiaptomus graciloides(G.O. Sars, 1863)		+	+	+
Eurytemora lacustris (Poppe, 1887)		+	+	+
Heterocope apendiculata G.O. Sars, 1863		+	+	+
Megacyclops sp. Kiefer, 1927		+		+
Megacyclops viridis (Jurine, 1820)		+	+	+
Mesocyclops leucarti (Claus, 1857)		+	+	+
Mesocyclops sp. Kiefer, 1927		+		+
Nauplii				
Thermocyclops crassus (Fischer, 1853)		+	+	+
Thermocyclops oithonoides (G.O.Sars, 1863)		+	+	+
TOTAL	**31**	**47**	**51**	**73**

Table 5. Presence of zooplankton species in Lake Geraņimovas-Ilzas from 2007 to 2011

Species (taxon)	Date of sampling			Common species
	2007	2010	2011	
ROTIFERA	**18**	**14**	**13**	**21**
Ascomorpha ecaudis Perty, 1850	+	+	+	+
Ascomorpha minima Hofsten, 1909	+			+
Ascomorpha ovalis (Bergendal, 1892)		+		+
Ascomorpha saltans saltans Bartsch, 1870	+			+
Asplanchna priodonta Gosse, 1850	+	+	+	+
Conochilus (Conochilus) hippocrepis (Schrank, 1803)	+			+
*Conochilus (Conochilus) unicornis*Rousselet, 1892	+		+	+
Filinia longiseta (Ehrenberg, 1834)	+	+	+	+
Gastropus stylifer (Imhof, 1891)	+	+	+	+
Kellicottia longispina Kellicott, 1879	+	+	+	+
Keratella cochlearis Gosse, 1851	+	+	+	+
Keratella quadrata Müller, 1786	+	+	+	+

Species (taxon)	**Date of sampling**			**Common species**
	2007	**2010**	**2011**	
ROTIFERA	**18**	**14**	**13**	**21**
Lecane sp. (Nitzsch, 1827)	+			+
Polyarthra major Burckhardt, 1900	+	+	+	+
Polyarthra remata Skorikov, 1896		+		+
Polyarthra sp. Ehrenberg, 1834		+		+
Polyarthra vulgaris Carlin, 1943	+		+	+
Pompholyx sulcata Hudson, 1885	+	+	+	+
Synchaeta sp. Ehrenberg, 1832				
Trichocerca capucina (Wierzejski & Zacharias, 1893)	+	+	+	+
Trichocerca similis(Wierzejski, 1893)	+	+	+	+
Trichocerca sp. Lamarck, 1801	+			+
CLADOCERA	**8**	**5**	**7**	**12**
Bosmina (Bosmina) longirostris (O. F. Müller, 1776)	+			+
Bosmina (Eubosmina) longispina Leydig, 1860	+		+	+
Bythotrephes longimanus Leydig, 1860			+	+
Ceriodaphnia affinis Lilljeborg, 1900	+			+
Ceriodaphnia sp. Dana, 1855		+		+
Chydorus sphaericus (O. F. Müller, 1776)	+			+
Daphnia (Daphnia) cristata Sars, 1862	+	+	+	+
Daphnia (Daphnia) cucullata Sars, 1862	+	+	+	+
*Daphnia (Daphnia) longispina (*O. F. Müller, 1776)	+		+	+
*Daphnia (Daphnia)*sp. O. F. Müller, 1785		+		+
Diaphanosoma brachyurum (Liévin, 1848)	+	+	+	+
Leptodora kindtii (Focke, 1844)			+	+
COPEPODA	**2**	**8**	**8**	**9**
Copepodite				
Cyclops scutifer G.O.Sars, 1863			+	+
Cyclops sp. Müller, 1785	+	+	+	+
Eudiaptomus gracilis (G.O. Sars, 1863)	+	+		+
Eudiaptomus graciloides(G.O. Sars, 1863)		+	+	+
Eurytemora lacustris (Poppe, 1887)		+	+	+
Megacyclops viridis (Jurine, 1820)		+	+	+
Mesocyclops leucarti (Claus, 1857)		+	+	+
Nauplii				
Thermocyclops crassus (Fischer, 1853)		+	+	+
Thermocyclops oithonoides (G.O.Sars, 1863)		+	+	+
TOTAL	**28**	**27**	**28**	**42**

species, followed by Cladocera and Copepoda. Throughout the years the number and the composition of species in these lakes have been slightly different (Table 2, 3, 4, 5). Common species in Rotifera group in all samplings in Lake Svente were *Ascomorpha ecaudis*, *Asplanchna priodonta*, *Conochilus hippocrepis*, *Gastropus stylifer*, *Kellicottia longispina*, *Keratella cochlearis*, *Keratella quadrata*, *Lecane luna*, *Polyarthra major*, *Polyarthra vulgaris*, *Pompholyx sulcata* and *Trichocerca capucina*. common species in Cladocera group in all sampling sites were *Bosmina crassicornis*, *Bosmina longirostris*, *Daphnia cristata*, *Daphnia cucullata* and *Diaphanosoma brachyurum*, but in Copepoda group *Cyclops* sp. un *Eudiaptomus gracilis* (Table 2). Common species in all sampling in Rotifera group in Lake Riča were *Ascomorpha ecaudis*, *Asplanchna priodonta*, *Conochilus hippocrepis*, *Conochilus unicornis*, *Gastropus stylifer*, *Kellicottia longispina*, *Keratella cochlearis*, *Keratella quadrata*, *Polyarthra vulgaris*, *Pompholyx sulcata*, *Trichocerca capucina* and *Trichocerca similis*. Common species in all samplings in Cladocera group were *Bosmina crassicornis*, *Bosmina longirostris*, *Bosmina longispina*, *Diaphanosoma brachyurum* and *Leptodora kindtii*. Copepoda group was similar to that one in Lake Svente with *Cyclops* sp. and *Eudiaptomus gracilis* (Table 3). Conversely, common species in all samplings in Rotifera group in Lake Dridzis were *Ascomorpha ecaudis*, *Ascomorpha saltans, Asplanchna priodonta*, *Conochilus hippocrepis*, *Conochilus unicornis*, *Filinia longiseta*, *Kellicottia longispina*, *Keratella cochlearis*, *Keratella quadrata*, *Polyarthra vulgaris*, *Pompholyx sulcata* and *Trichocerca capucina*. Common species in all samplings in Cladocera group were *Bosmina crassicornis*, *Bosmina longirostris*, *Bosmina longispina*, *Chydorus sphaericus*, *Daphnia cristata*, *Daphnia cucullata*, *Daphnia longispina* and *Diaphanosoma brachyurum*. Common species in the Copepoda species were not found in all samplings (Table 4). Accordingly common species in Rotifera group in all samplings in Lake Geraņimova-Ilzas were *Ascomorpha ecaudis*, *Asplanchna priodonta*, *Filinia longiseta*, *Gastropus stylifer*, *Kellicottia longispina*, *Keratella cochlearis*, *Keratella quadrata*, *Polyarthra major*, *Pompholyx sulcata*, *Trichocerca capucina* and *Trichocerca similis*. Common species in Cladocera group in all samplings were *Daphnia cristata*, *Daphnia cucullata* and *Diaphanosoma brachyurum*, but in Copepoda- *Cyclops* sp. (Table 5).

Zooplankton is mostly seasonal, but there are also those species that can be found throughout the year. *Keratella cochlearis*, *Kellicottia longispina*, *Polyarthra remata*, *Filinia longiseta* are some of the Rotifera species which can be found throughout the year (Līne 1966). The peak in the development of Rotifera species is usually observed in spring, but there are also lakes when the second peak of Rotifera species is in autumn (Līne 1966). *Daphnia cucullata*, *Daphnia cristata*, and *Leptodora kindtii* are typical widespread pelagic species (Kačalova & Laganovska 1961, Sloka 1981). The most common species in the zooplankton of Latvian lakes are *Keratella cochlearis*, *Asplanchna priodonta*, *Filinia longiseta*, *Kellicottia longiseta*, *Lecane luna*, *Trichocerca capucina*, *Euchlanis dilatata* (Sloka 1998, Paidere & Škute 2011). In all the investigated lakes and sampling localities Daphniidae, Bosminidae and Sididae dominated in the Cladocera group. Comparison of the morphological characteristics of Cladocera species in the four studied lakes allows us to agree with the statement that the more planktofagous fish are in a lake, the smaller the size of zooplankton organisms is in comparison with other lakes with fewer planktofagous fish or none at all (Bohn & Amundsen 1998, Brooks & Dodson 1965, De Meester et al. 1995, Halvorsen et al. 2004, Larsson & Dodson 1993, Saksgård & Hesthagen 2004, Sutela & Huusko 1997, Viljanen 1983). Many authors state that this lakes will have a higher diversity of zooplankton species or species with some morphological adaptations (such as smaller size) compared with the lakes where no planktofagous fish is observed (Bohn & Amundsen 1998, De Meester et al. 1995, Sutela & Huusko 1997, Viljanen 1983). This may explain the fact that among our studied lakes. Namely, the size of Cladocera specimens in lakes Svente and Dridzis was smaller in places where the number of planktofagous fish was greater, whilst in lakes Riča and Geraņimovas-Ilzas Cladocera specimens were larger and there were fewer planktofagous fish.

Positive correlation (after Spearman) in Lake Svente was among *Asplanchna priodonta, Gastropus stylifer, Conochilus hippocrepis, Pompholux sulcata, Keratella cochlearis*, *Kellicottia longispina* (Rotifera), *Daphnia cucullata*, *Daphnia cristata*, *Bosmina crassicornis*, *Bosmina longispina*, *Chydorus ovalis* (Cladocera), dissolved oxygen, *Cyclops* sp. and Nauplii (Copepoda). Negative correlation coefficient was obtained for *Keratella quadrata, Filinia longiseta* (Rotifera). Positive correlation (after Spearman) in Lake Dridzis was among *Daphnia cucullata, Daphnia cristata*, *Bosmina crassicornis*, *Bosmina longispina*, *Diaphanosoma brachyurum* (Cladocera), *Keratella cochlearis*, *Kellicottia longispina*, *Gastropus stylifer*, *Filinia longiseta*, *Conochilus unicornis* (Rotifera), *Megacyclops viridis*, *Cyclops* sp. and *Nauplii* (Copepoda). Negative correlation coefficient was obtained for *Asplanchna priodonta* (Rotifera) and *Eurytemora lacustris* (Copepoda), it is suggested that there is negative interaction among these species. While positive correlation in Lake Geraņimovas-Ilzas was among *Asplanchna priodonta, Keratella cochlearis*, *Pompholux sulcata* (Rotifera), *Daphnia cucullata*, *Daphnia cristata*, *Diaphanosoma brachyurum* (Cladocera), dissolved oxygen, chlorophill *α,* water temperature, *Eudiaptomus gracilis, Cyclops* sp. and Nauplii (Copepoda), but positive correlation in Lake Riča was obtained for *Keratella cochlearis* (Rotifera), *Daphnia cucullata* (Cladocera) and *Cyclops* sp. (Copepoda). Negative correlation coefficient was obtained for *Polyarthra major* (Rotifera), *Bosmina longispina* (Cladocera), chlorophill *α* and total dissolved solids.

Large Cladocera taxa such as *Daphnia* and *Polyphemus pediculus* require water bodies with high transparency, low chlorophyll α concentrations, low fish density, and high macroinvertebrate density (Gliwicz & Pijanowska 1986; Irvine et al. 1989; 1990; Lampert 1987). Predation are the structuring mechanisms of various zooplankton taxa population dynamics. The negative effect of crustacean plankton on smaller components of the planktonic food web e.i. Rotifers has been well documented in different investigations (Cottenie et al. 2001; Fussmann 1996). Rotifera species are differentially influenced by crustaceans via predation and competition. Cyclopoid copepods have often been described as effective predators of rotifers (Fussmann 1996; Williamson 1983), but some calanoid species may include rotifers in their diets, too (Fussmann 1996; Williamson & Butler 1986; Schulze & Folt 1990). A close interaction between Cyclopoida and Rotifera was also observed in our studies. However, other authors (Brettum & Halvorsen 2004) point out that some specific phytoplankton species have a strong effect on some zooplankton species.

Having performed the Redundancy data analysis (RDA), the results obtained over the lakes and years are different. For example, in accordance with the RDA ordination analysis of the data of Lake Dridzis in 2010, close interaction have between *Daphnia cucullata, Daphnia cristata*, chlorophyll- α and sampling time (Fig. 2). The dissolved substances content and conductivity - with certain species of Copepoda group, but turbidity and temperature was identified closer interaction with *Diaphanosoma brachyurum* and *Polyarthra major* (Fig. 2). Oxygen saturation and pH affect the development of Copepoda (Bertilsson et al. 1995). The dissolved oxygen content and oxygen saturation interact with *Asplanchna priodonta*, *Polyarthra dolichoptera* and *Synchaeta* sp., but conductivity and total dissolved solids with *Megacyclops* sp., *Gastropus stylifer* and *Cyclops scutifer* (Fig. 2).

By contrast, in accordance with the RDA analysis of samples of Lake Dridzis in 2011, different results were obtained. In this case, close interaction have between *Daphnia cucullata, Bosmina crassicornis*, *Gastropus stylifer*, total dissolved solids and conductivity (Fig. 3). Chlorophyll- α and pH affect *Polyarthra major* and *Eudiaptomus gracilis*, while Chlorophyll- α, the dissolved oxygen content and the oxygen

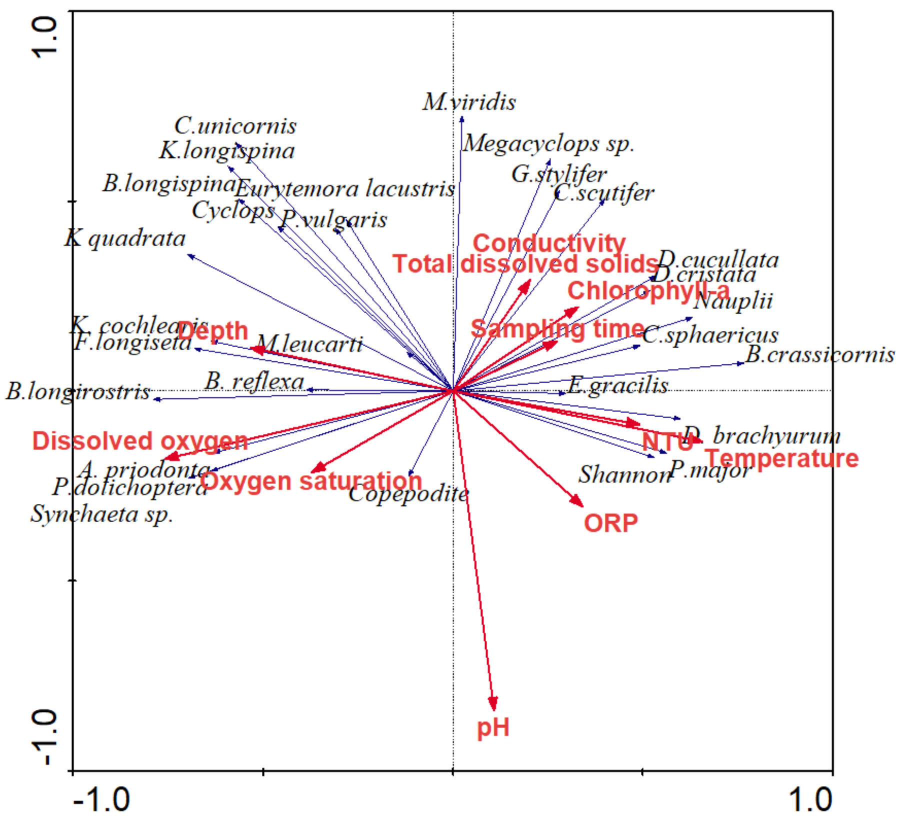

Fig. 2. Redundancy analysis (RDA) ordination plot for zooplankton abundance from Lake Dridzis during the sampling period. Abbreviations: ORP- Oxidation-reduction potential; NTU- Turbidity.

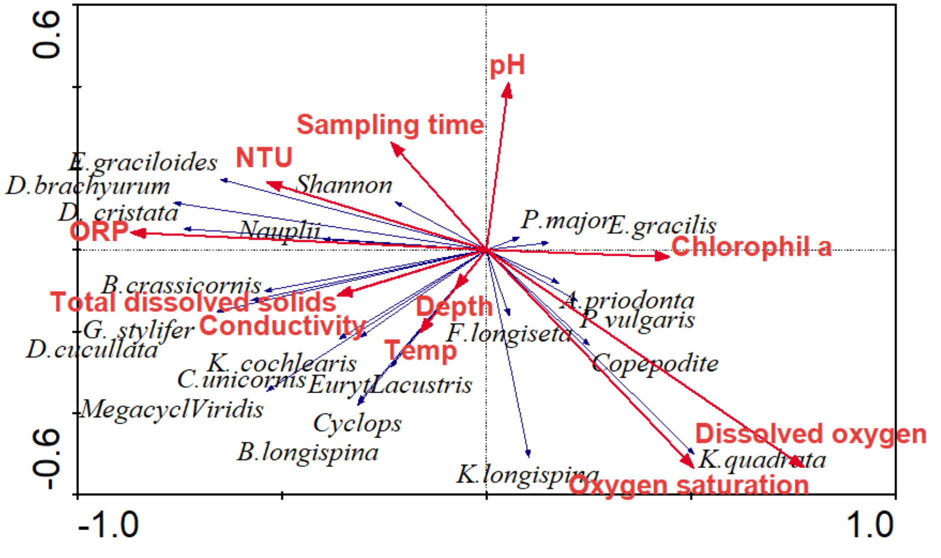

Fig. 3. Redundancy analysis (RDA) ordination plot for zooplankton abundance from Lake Dridzis during the sampling period. Abbreviations: ORP- Oxidation-reduction potential; NTU- Turbidity.

saturation influence, *Asplanchna priodonta*, *Polyarthra vulgaris*, *Keratella quadrata* and Copepodite. The turbidity and the oxidation reduction potential affect *Daphnia cristata*, *Diaphanosoma brachyurum*, *Eudiaptomus graciloides*. On the other hand, the depth and temperature affect *Keratella cochlearis*, *Conochilus unicornis*, *Bosmina longispina*, *Megacyclops viridis*, *Eurytemora lacustris* and *Cyclops* (Fig. 3). In accordance with the RDA data analysis performed in 2011 the species diversity (according to Shannon) was dependent on the turbidity and sampling time (Fig. 3). Having performed the RDA for the data obtained in Lake Geranimovas-Ilzas (Fig. 4), it can be seen that three distinct groups are formed between the zooplankton taxa and physicochemical factors. One group to be mentioned here is that which includes the following taxa: *Ascomorpha ecaudis*, *Eudiaptomus graciloides*, *Mesocyclops leucarti*, *Daphnia cucullata*, *Diaphanosoma brachyurum*, oxygen saturation, *Trichocerca similis*, *Asplanchna priodonta*, Copepodite, pH, temperature, Chlorophyll- α, *Thermocyclops crassus*, Shannon, turbidity and *Polyarthra major*. The second group contains *Eurytemora lacustris*, *Polyarthra vulgaris*, *Daphnia cristata*, *Pompholyx sulcata*, *Keratella cochlearis*, *Cyclops* sp., *Nauplii*, *Thermocyclops oithonoides*, *Ascomorpha ovalis*, *Megacyclops viridis*, *Daphnia cucullata*, sampling data. The third group consists of *Kellicottia longispina*, *Keratella quadrata*, *Filinia longiseta*, conductivity, dissolved substances, dissolved oxygen, oxidation reduction potential and depth of the lake. When analyzing RDA data on the zooplankton taxa of Lake Svente, it can be seen that no distinct groups are formed here (Fig. 5), the data is distributed in all sectors fairly uniformly.

Dynamics and influencing factors succession in zooplankton taxa has been extensively studied. The biomass proportions of zooplankton found by Halvorsen et al. (2004) during their long-term studies in Lake Atnsjøen in the ice-free season (June-October) were very similar to those found by us, i.e. the Cladocera group had the highest percentages, followed by Copepoda and Rotifera. Halvorsen et al. (2004) emphasize that the detection of specific determinants is limited because various factors have a different effect on different species, and each of the factors should be checked under the unchanged conditions for a long period of time. Zooplankton development and spread depends on many abiotic parameters (e.g. temperature, dissolved oxygen, pH, transparency, wind, social aggregates, water turbulence, trophic gradient, salinity, stratification, pollution, etc.) (Bengtsson 1986, Bertilsson et al. 1995, Bērziņš & Pejler 1987, 1989a, 1989b, Bottrell et al. 1976, Dagg 1977, Dumont et al. 1973, Fernandez-Rosado & Lucena 2001, Hanazato 1991, 1992, Horppila et al. 2000, Locke & Sprules 2000, Malone & McQueen 1983, Moore 1977, Pidgaiko 1984, Pinel-Alloul 1995, Seda & Devetter 2000, Tallberg et al. 1999, Wetzel 2001) and biotic parameters (e.g. food, predation, interspecific competition) (Beaver & Havens 1996, Chang & Hanazato 2004, Cimdiņš 2001, Dodson 1984, Escribano & Hidalgo 2000, Gliwicz & Pijanowska 1988, Harris et al. 2012, Hebert 1982, Larsson & Dodson 1993, Lazareva 2010, Malone & McQueen 1983, Pinel- Alloul 1995, Weider & Pijanowska 1993, Wetzel 2001). Conductivity is also of great importance. The higher the conductivity is the less the number of Rotifera is and vice versa (Swadling et al. 2000). In accordance with the research by Cottenie et al. (2001) the zooplankton species need waterbodies with a high level of turbidity, high concentretation of chlorophyll-α, high fish density and low density of macrozoobenthos (Cottenie et al. 2001). Seasonality, lake morphology, anthropogenic activities in the lake basin, and which part of the lake (pelagic, littoral) is investigated should also be taken into account (Līne 1966, Pinel-Alloul et al. 2004, Wetzel 2001). Most Rotifera, Cladocera and Copepoda species were positively and significantly correlated with temperature and chlorophyll α distribution, suggesting that the aggregation of these organisms may be dependent on food concentration and have a wide temperature range at which the species can exist (Bertilsson et al. 1995, Bērziņš & Pejler 1989a, Bērziņš & Pejler 1989b, Weglenska et al. 1997). Many studies have shown that the higher temperature variation over a specified period in lakes is, the greater is the species diversity

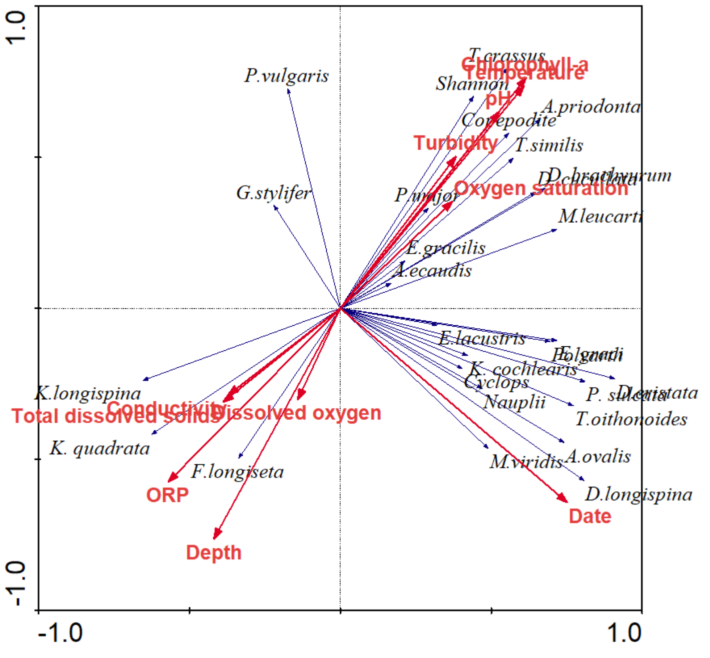

Fig. 4. Redundancy analysis (RDA) ordination plot for zooplankton abundance from Lake Geranimovas-Ilzas during the sampling period. Abbreviations: ORP- Oxidation-reduction potential.

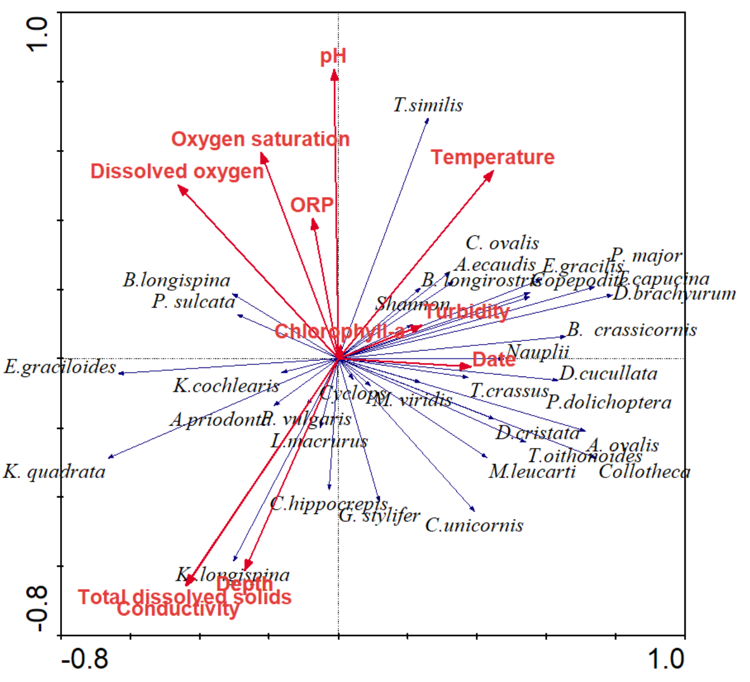

Fig. 5. Redundancy analysis (RDA) ordination plot for zooplankton abundance from Lake Svente during the sampling period. Abbreviations: ORP- Oxidation-reduction potential.

(Beaver & Havens 1996, Gilbert 2011, Shurin et al. 2010). The sampling was also carried out in early spring, a time when edible phytoplankton peaked. Since our investigated lakes are well stratified mesoeutrophic lakes, phytoplankton production to be high and sufficient for herbivorous zooplankton feeding. Zooplankton species response to temperature changes in natural communities are often not predictable due to the complexity of the natural systems (Schiel et al. 2004). The positive correlation between temperature and zooplankton can be attributed to the increase of phytoplankton and algae providing food resources for zooplankton (Matsubara 1993, Castro et. al. 2005) and temperature directly influence the rate of most biocemical processes in organisms, as well as the abiotic properties of the environment (Gillooly et al. 2001, Loiterton et al. 2004, Wagner & Benndorf 2007). It is accepted that due to the adaptations to certain environmental conditions, the same population of species is separated in different water layers and can be distinguished by their development cycles. Overall, Rotifera species have a wide temperature range (0 - 30 ^{0}C) at which the species can exist (Bērziņš & Pejler 1989a). By contrast, the optimum temperature for the existence of Cladocera and Copepoda is within 0- 24 ^{0}C (Bertilsson et al. 1995). However, the level of dissolved oxygen of Rotifera must be within the range 0 - 16 mg^{-1} (Bērziņš & Pejler 1989b), but of Cladocera and Copepoda must be within the range 2 - 13 mg^{-1} (Bertilsson et al. 1995). If I compare the literature data with the data received during our research in the corelation of Rotifera, Cladocera and Copepoda species with water temperature and dissolved oxygen (Bertilsson et al. 1995, Bērziņš & Pejler 1989a, Bērziņš & Pejler 1989b, Doulka & Kehayias 2011, Elliott 1977, Field & Prepas 1997, Kaya et.al. 2010, Kessler & Lampert 2004, Kizito & Nauwerck 1995, Taylor et. al. 1993), I can conclude that the species described in my research coincide with the optimal temperature and dissolved oxygen range specified in the literature. According to the samples of Rotifera species collected during my research such species as *Polyarthra major*, *Polyarthra vulgaris*, *Polyarthra dolichoptera*, *Asplanchna priodonta*, *Kallicottia longispina*, *Keratella cochlearis* have the highest range of dissolved oxygen i.e. 1-13 mg^{-1} (Bērziņš & Pejler 1989b). By contrast, in according to the temperature data, such species as *Polyarthra dolichoptera*, *Keratella quadrata*, *Keratella cochlearis*, *Synchaeta pectinata* have the widest range for optimal existence, i.e 0-23 ^{0}C are (Bērziņš & Pejler 1989a). For certain Cladocera species e.g. *Diaphanosoma brachyurum*, *Daphnia cucullata*, *Daphnia cristata* and *Bosmina longispina* the temperature optimum is within 7- 23 ^{0}C, but for *Bosmina crassicornis*- 14- 15 ^{0}C (Bertilsson et al. 1995). The situation is similar to the Copepoda species. In turn, the optimal amount of dissolved oxygen both in Cladocera and Copepoda species is within the range 5- 11 mg^{-1} (Bertilsson et al. 1995).

CONCLUSIONS

According to the data obtained from our research, the quantitative and qualitative composition of zooplankton in the lakes of Svente, Riča, Dridzis un Geraņimovas-Ilzas is not homogeneous. The distinguishing feature of the zooplankton species is seasonality, for example, some species are found only during a particular season or, in turn, occur throughout the season, but reach their peak in a given season. The zooplankton species in these lakes have also showed interactions with physico-chemical parameters and species among themselves because specimens choose the most optimal ecological niche for themselves as a result of the variety of physiological and behavioral mechanisms.

ACKNOWLEDGEMENTS

The research was supported by the European Social Fund Project Formation of Interdisciplinary Research Group for Securing the Sustainability of Salmonid Lakes in Latvia No 2009/0214/1DP/1.1.1.2.0/09/APIA/VIAA/089.

REFERENCES

[APHA] American Public Health Association. 2005. Standard Methods for the Examination of Water and Wastewater. 21st edn., Washington, D.C.

Alekseev V.R., Tsalokhin S.Ya. (ed.). 2010. The determinant of zooplankton and zoobenthos of fresh water in European Russia. Volume 1. Zooplankton. The Partnership of Scientific Publications KMK, Moscow - St. Petersburg. Pp. 494 (In Russian).

Arhipova I., Balina S. 2003. Statistics in economic. Solutions with SPSS and Microsoft Excel. Riga, Centre of Computer Science. Pp. 349 (In Latvian).

Beaugrand G., Ibanez F., Lindley J.A. 2001. Geographical distribution and seasonal and diel changes in the diversity of calanoid copepods in the North Atlantic and North Sea. *Marine Ecology Progress Series,* 219: 189– 203.

Beaver J.R., Havens K.E. 1996. Seasonal and spatial variation in zooplankton community structure and their relation to possible controlling variables in Lake Okeechobee. *Freshwater biology,* 36: 45- 56.

Bengtsson J. 1986. Life histories, interspecific competition between three *Daphnia* species in rockpools. *Journal of Animal Ecology,* 55(2): 641–655.

Benzie J.A.H. 2005. Cladocera: The genus *Daphnia* (including *Daphniopsis*). Leiden, Kenobi Product & Backhuys Publ., Ghent. Pp. 376.

Bertilsson J., Bērziņš B., Pejler B. 1995. Occurrence of limnic micro-crustaceans in relation to temperature and oxygen. *Hydrobiologia,* 299: 163- 167.

Bērziņš B., Pejler B. 1987. Rotifer occurrence in relation to pH. *Hydrobiologia,* 147: 107- 116.

Bērziņš B., Pejler B. 1989a. Rotifer occurrence in relation to temperature.. *Hydrobiologia,* 175: 223- 231.

Bērziņš B., Pejler B. 1989b. Rotifer occurrence in relation to oxygen content. *Hydrobiologia,* 183: 165- 172.

Bohn T., Amundsen P. A. 1998. Effects of invading vendace (*Coregonus albula* L.) on species composition and body size in two zooplankton communities of the Pasvik River System, northern Norway. *Journal of Plankton Research,* 20 (2): 243-256.

Bottrell H. H., Duncan A., Gliwicz Z. M., Grygierek E., Herzig A., Hillbricht-Ilkowska A., Kurasawa H., Larson P., Weglenska T. 1976. A review of some problems in zooplankton production studies. *Norwegian Journal of Zoology*, 24: 419- 456.

Brakovska A. 2014. *Daphnia cucullata* Sars, 1862 (CRUSTACEA: CLADOCERA) distribution and location in composition of zooplankton cenosis in Lake Dridzis. *Acta Biologica Universitatis Daugavpiliensis,* 14 (1): 1 - 19.

Brakovska A., Škute R. 2009. Ecological evaluation of zooplankton groups in Lake Geranimovas-Ilzas and Lake Garais. In Proceedings of the 7th International Scientific and Practical Conference. Vol. *2*, Rēzeknes Augustskola, Rēzekne. Pp. 43- 50.

Brakovska A., Škute R. 2007. Ecological characteristic of groups of zooplankton in the deepest Lakes of East-Latvia. *Acta Biologica Universitatis Daugavpiliensis,* 7 (2): 165 - 174.

Brakovska A., Paidere J., Škute R., Škute N., Škute A.. 2013. Occurrence of Cladocera and the genetic diversity of *Daphnia cucullata* in the pelagic zone of Latvian salmonid lakes. *Estonian Journal of Ecology,* 62(4): 244 - 264.

Brakovska A., Škute R., Škute A. 2012. Heterogeneity of distribution and community composition of zooplankton in upper layers of Lake Svente. *Zoology and Ecology,* 22(34): 172- 180.

Brettum P., Halvorsen G. 2004. The phytoplankton of Lake Atnsjøen, Norway – a long-term investigation. *Hydrobiologia,* 521: 141- 147.

Brooks J. L., Dodson S. I. 1965. Predation, body size and composition of plankton. *Science,* 150: 28– 35.

Castro B.B., Antunes S.C., Pereira R., Soares A.M.V.M., Goncalves F. 2005. Rotifer community structure in three shallow lakes: seasonal fluctuations and explanatory factors. *Hydrobiologia,* 543: 221– 232.

Chang K.-H., Hanazato T. 2004. Diel vertical migrations of invertebrate predators (*Leptodora kindtii*, *Thermocyclops taihokuensis*, and *Mesocyclops* sp.) in a shallow, eutrophic lake. *Hydrobiologia,* 528: 249- 259.

Cimdiņš P. 2001. Limnoecology. Riga, Textbook. Pp. 159 (In Latvian).

Cottenie K., Nuytten N., Michels E., De Meester L. 2001. Zooplankton community structure and environmental conditions in a set of interconnected ponds. *Hydrobiologia,* 442: 339– 350.

Dagg M. 1977. The Biology of Calanoid Copepods: The Biology of Calanoid Copepods. Pp. 710.

De Meester L., Weider L. J., Tollrian R. 1995. Alternative antipredator defences and genetic polymorphism in a pelagic predator–prey system. *Nature,* 378: 483- 485.

DeMott W. R. 1989. The role of competition in zooplankton succession. In Sommer, U. (ed.), Plankton Ecology: Succession in Plankton Communities... New York,Springer, Heidelberg. Pp. 195– 252.

Dodson S. I. 1974. Zooplankton competition and predation: an experimental test of the size-efficiency hypothesis. *Ecology,* 55: 605– 613.

Dodson S. I. 1984. Predation of Heterocope septentrionalis on two species of Daphnia: morphological defenses and their cost. *Ecology,* 65: 1249- 1257.

Dodson S.I. 1992. Predicting crustacean zooplankton species richness. *Limnology & Oceanography,* 37 (4): 848 - 856.

Doulka E., Kehayias G. 2011. Seasonal vertical distribution and diel migration of zooplankton in a temperate stratified lake. *Biologia,* 66 (2): 308- 319.

Dumont H. J. 1972. Acompetition-based approach of Reverse Vetical Migration in Zooplnkton and its Implications, Chiefly Based on a Study of the Interactions of the Rotifer *Asplanchna priodonta* (Gosse) with Several Crustacea Entomostraca. *International Revlew of Hydrobiology,* 57(1): 1– 38.

Dumont H.J., Negrea S.V. 2002. Introduction to the Class Branchiopoda. Guides to the identification of the microinvertebrates of the continental waters of the World. Vol. 19. Coord. Ed. H.J.F. Dumont. The Netherlands, SPB Academic Publ. Amsterdam. Pp. 398.

Dumont H.J., Miron I., Dall'Asta U., Decraemer W., Claus C., Somers D. 1973. Limnological aspects of someMoroccon Atlas Lakes, with reference to some physical and chemical variables, the nature and distribution of the Phyto- and Zooplankton, including a note on possibilities for the development of an inland fishery. *Hydrobiologia,* 58: 33– 60.

Dussart B. H., Defaye D. 2001. Introduction to the Copepoda, Vol. 16. In: Dumont HJF, editor. Guides to the identification of the microinvertebrates of the continental waters of the world. Second edition. Leiden, Backhuys Publishers. Pp. 344.

Einsle U. 1996. Copepoda: Cyclopoida. Genera Cyclops, Megacyclops, Acanthocyclops, Vol. 10. In: Dumont HJF, editor. Guides to the identification of the microinvertebrates of the continental waters of the world. The Hague, SPB Academic Publishing. Pp. 83.

Eipurs I. 1995. Lake Geraņimovas-Ilzas. The Nature of Latvia. Vol. 2. Riga, Encyclopedia of Latvia. Pp. 106 (In Latvian).

Elliott J.I. 1977. Seasonal changes in the abundance and distribution of planktonic rotifers in Grasmere (English Lake District). *Freshwater biology,* 7: 147- 166.

Escribano R., Hidalgo P. 2000. Spatial distribution Spatial distribution of copepods in the north of the Humboldt Current region off Chile during coastal upwelling. *Journal of the Marine Biological Association of the UK* , 80: 283- 290.

Fernandez-Rosado M.J., Lucena J. 2001. Space-time heterogeneities of the zooplankton distribution in LaConcepción reservoir (Istán, Málaga; Spain). *Hydrobiologia,* 455: 157– 170.

Field K.M., Prepas E.E. 1997. Increased abundance and depth distribution of pelagic crustacean zooplankton during hypolimnetic oxygenation in a deep, eutrophic Albert lake. *Canadian Journal of Fisheries and Aquatic,* 54: 2146- 2156.

Flössner D. 1972. Krebstiere, Crustacea, Kiemen- und Blattfüsser, Branchiopoda, Fischläuse, Branchiura. *Tierwelt Deutschlands,* 60: 1- 501.

Flössner D. 2000. Die Haplopoda und Cladocera (ohne Bosminidae) Mitteleuropas. Leiden, Backhuys Publishers. Pp. 428.

Flössner D. 2002. Die Haplopoda und Cladocera Mitteleuropas. Leiden, Backhuys Publishers. Pp. 428.

Fussmann G. 1996. The importance of crustacean zooplankton in structuring rotifer and phytoplankton communities: an enclosure study. *Journal of Plankton Research,* 18 (10): 1897– 1915.

Geller W., Pinto-Coelho R., Pauli H. R. 1992. The vertical distribution of zooplankton (Crustacea, Rotatoria, Ciliata) and their grazing over the diurnal and seasonal cycles in Lake Constance. *Ergebnisse der Limnologie,* 35: 79– 85.

Gilbert J. J. 1988. Suppression of rotifer populations by *Daphnia*: a review of the evidence, the mechanisms, and the effects on zooplankton community structure. *Limnology and oceanography,* 33: 1286–1303.

Gilbert J.J. 2011. Temperature, kairomones and phenotypic plasticity in the rotifer *Keratella tropica* (Apstein, 1907). *Hydrobiologia,* 678 (1): 179- 190.

Gillooly J.F., Brown J.H., West G.B., Savage V.M., Charnov E.L. 2001. Effects of size and temperature on metabolic rate. *Science,* 293(5538): 51- 2248.

Gliwicz M.Z., Pijanowska J. 1988. Effect of predation and resource depth distribution on vertical migration of zooplankton. *Bulletin of Marine Science,* 43: 695– 709.

Gotelli J. N., Ellison A. M. 2004. A Primer of Ecological Statistics. Sinauer Associates. 492.

Halvorsen G., Dervo B. K.., Papinska K. 2004. Zooplankton in Lake Atnsjøen 1985-1997. *Hydrobiologia,* 521: 149- 175.

Hanazato T. 1991. Pesticides as chemical agents inducing helmets formation in *Daphnia ambigua*. *Freshwater Biology,* 26: 419– 424.

Hanazato T. 1992. Insecticide inducing helmet development in *Daphnia ambigua*. *Archives in Hydrobiology,* 123: 451– 457.

Harris K. D. M., Bartlett N. J., Lloyd V. K. 2012. Daphnia as an emerging epigenetic model organism. Genetic Research International. ID 147892.

Hart R. C. 1994. Seasonal replacement in two calanoid copepods with equivalent adult dietary niches: The influence of temperature. *Verhandlungen des Internationalen Verein Limnologie,* 25: 2439– 2444.

Hebert P. D. N. 1982. Competition in zooplankton communities. *Annales Zoologici Fennici,* 19: 349- 356.

Horppila J., Malinen T., Nurminen L., Tallberg P., Vinni M. 2000. A metalimnetic oxygen minimum indirectly contributing to the low biomass of cladocerans in Lake Hiidenvesi – a diurnal study on the refuge effect. *Hydrobiologia,* 436: 81– 90.

Hudec I. 2010. Fauna Slovenska. Anomopoda, Ctenopoda, Haplopoda, Onychopoda (Crustacea, Brachiopoda). VEDA, Vydavatel'stvo Slovenskej akademie vied Bratislava. Pp. 496.

Irvine K., Moss B., Balls H. 1989. The loss of submerged plants with eutrophication II. Relationships between fish and zooplankton in a set of experimental ponds, and conclusions. *Freshwater Biology,* 22: 89-107.

Irvine K., Moss B., Stansfield J. 1990. The potential of artificial refugia for maintaining acommunity of large-bodied cladocera against fish predation in a shallow eutrophic lake. *Hydrobiologia,* 200/201: 379- 389.

Kačalova O., Laganovska R. 1961. Fish feed base in the Lakes of the Latvian SSR. Riga, The Latvian SSR Academy of Sciences publishing house (In Latvian).

Kaya M., Fontaneto D., Segers H., Altindag A. 2010. Temperature and salinity as interacting drivers of species richness of planktonic rotifers in Turkish continental waters. *Journal of Limnology,* 69: 297- 304.

Kessler K., Lampert W. 2004. Depth distribution of Daphnia in response to a deep-water algal maximum: the effect of body size and temperature gradient. *Freshwater biology,* 49: 392- 401.

Key to freshwater invertebrates of Russia and neighboring countries. Volume 2. Crustaceans. Zoological Institute of RAS. 1995. Pp. 627 (In Russian).

Key to zooplankton and zoobenthos of fresh water in European Russia. 2010. Volume 1. Zooplankton. The Partnership of Scientific Publications KMK, Moscow - St. Petersburg. Pp. 494 (In Russian).

Kizito Y.S., Nauwerck A. 1995. Temporal and vertical distribution of planktonic rotifers in a meromictic crater lake, Lake Nyahirya (Western Uganda). *Hydrobiologia,* 312/314: 303- 312.

Kotov A.A. 2006. Cladocera: Family Ilyocryptidae (Branchiopoda: Cladocera: Anomopoda). Leiden, Kenobi Productions, Ghent & Backhuys Publishers. Pp. 172.

Krauter D., Streble H. 1988. Das Leben im Wassertropfen. Mikroflora und Mikrofauna des Süβwassers. Stuttgart, Kosmos. Pp. 432.

Krebs J.Ch. 1999. Ecological Methodology. Second Edition. Addison Wesley Longman, Pp. 620.

Kutikova L.A. 1970. Fauna of Rotifera SSR. Leningrad, Nauka. Pp. 743 (In Russian).

Kutikova L.A., Starobogatov Ya.I. 1977. The key to freshwater European part of the USSR (plankton and benthos). Leningrad, Hydrometoizdat. Pp. 512 (In Russian).

Lampert W. 1987. Predictability in lake ecosystems: the role of biotic interactions. *Ecological Studies,* 61: 323- 346.

Larsson P., Dodson S. I. 1993. Chemical communication in planktonic animals. *Archiv für Hydrobiologie,* 129: 129- 155.

Lazareva V.I. 2010. Structure and dynamics of zooplankton of the Rybinsk Reservoir. Moscow, Association of Scientific Publications. Pp. 183 (In Russian).

Lepš N., Šmilauer P. 1999. Mulivariate Analysis of Ecological Data. University of South Bohemia Ceské Budejovice, Faculty of Biological Sciences. Pp. 110.

Lepš N., Šmilauer P. 2003. Mulivariate Analysis of Ecological Data. New York, United States of America by Cambridge University Press. Pp. 283.

Lieder U. 1996. Crustacea: Cladocera/ Bosminidae. Süsswasserfauna von Mitteleuropa, Bd. 8, H. 2-3, Stuttgart, Jena, Lübeck, Ulm, G.Fischer. Pp. 80.

Locke A., Sprules W.G. 2000. Effects of pH, food quality and quantity on survival and condition of *Bosmina longirostris* and *Daphnia pulex*. *Hydrobiologia,* 437: 187–196.

Loiterton B., Sundbom M., Vrede T. 2004. Separating physical and physiological effects of temperature on zooplankton feeding rate. *Aquatic Sciences,* 66: 123- 129.

MacArthur R.H. 1965. Patterns of species diversity. *Biological Reviews,* 40: 510-533.

Madin L. P., Horgan E. F., Steinberg D. K. 2001. Zooplankton at the Bermuda Atlantic Time series Study (BATS) station: diel, seasonal and international variation in biomass. *Deep-Sea Research,* 48 (8-9): 2063- 2082.

Malone B. J., McQueen D. J. 1983. Horizontal patchiness in zooplankton populations in two Ontario kettle lakes. *Hydrobiologia,* 99: 101- 124.

Manuilova E.F. 1964. Fauna of Cladocera of the SSR. Moscow, Nauka. Pp. 328 (In Russian).

Matsubara T. 1993. Rotifer community structure in the south basin of Lake Biwa. *Hydrobiologia,* 271: 1–10.

Mergeay J., Verschuren D., De Meester L. 2005. Cryptic invasion and dispersal of an American Daphnia in East Africa. *Limnology and Oceanography,* 50: 1278-1283.

Moore J. W. 1977. Some factors influencing the density of subarctic populations of *Bosmina longirostris*, *Holopedium gibberum*, *Codonella cratera* and *Ceratium hirundinella*. *Hydrobiologia,* 56: 199- 207.

Nogrady T., Segers H. 2002. Rotifera. Volume 6. Asplanchnidae, Gastropodidae, Lindiidae, Microcodidae, Synchaetidae, Trochospohaeridae and Filinia. Guides to the Identification of the Microinvertebrates of the Continental Waters of the World 18. Leiden, Backhuys Publishers.Pp. 264.

Paidere J., Škute R.. 2011. Rotifera and their fauna in Latvia. Daugavpils, Daugavpils University. Pp. 272 (In Latvian).

Pidgaiko M.P. 1984. Zooplankton of water bodies of the European part of USSR. Moscow, Nauka. Pp. 207 (In Russian).

Pinel-Alloul B. 1995. Spatial heterogeneity as a multiscale characteristic of zooplankton community. *Hydrobiologia,* 300/301: 17- 42.

Pontin R. M. 1978. A Key to the Freshwater Planktonic and Semi-planktonic Rotifera of the British Isles. *Freshwater Biological Association Scientific Publication*, 38: 178.

Quinn P.G., Keough M. J. 2002. Experimental Design and Data Analysis for Biologists

Cambridge University Press. Pp. 556.

Radwan S., Bielańska-Grajner I., Ejsmont-Karabin J. 2004. Wrotki (Rotifera). Fauna słodkowodna Polski. Polskie Towarzystwo Hydrobiologiczne. Łódź, Universytet Łódzki. Oficyna Wydawnicza Tercja. Pp. 447.

Reid G.K., Wood R.D. 1976. Ecology of inland waters and estuaries. Toronto, Ontario, D. Van Nostrand Co.138–146.

Rivier I.K. 1998. The predatory Cladocera (Onychopoda: Podonidae, Polyphemidae, Cercopagidae) and Leptodoridae of the world. Amsterdam, Backhuys Publ. Pp. 213.

Ruttner-Kolisko A. 1974. Plankton Rotifers. Biology and Taxonomy. Stutgart, Nägeleu. Obermiller. Pp. 146.

Saksgård R., Hesthagen T. 2004. A 14-year study of habitat use and diet of brown trout (*Salmo trutta*) and Arctic charr (*Salvelinus alpinus*) in Lake Atnsjøen, a subalpine Norwegian lake. *Hydrobiologia,* 521: 187- 199.

Schiel D.R., Steinbeck J.R., Foster M.S. 2004. Ten years of induced ocean warming causes comprehensive changes in marine benthic communities. *Ecology,* 85: 1833- 1839.

Schulze P.C., Folt C.L. 1990. Food resources, survivorship, and reproduction of the omnivorous calanoid copepod *Epischura lacustns*. *Ecology,*71: 2224- 224.

Scourfield D. J., Harding J. P. 1994. A Key to the British Species of Freshwater Cladocera, with Notes on their Ecology. *Freshwater Biological Association Scientific Publication*, 5: 55.

Seda J., Devetter M. 2000. Zooplankton community structure along a trophic radienti n a canyon-shaped dam reservoir. *Journal of Plankton Research,* 22 (10): 1829– 1840.

Segers H. 1995. Rotifera. Vol. 2. The Lecanidae (Monogononta). Guides to the Identification of the Microinvertebrates of the Continental Waters of the World 6. The Netherlands, SPB Academic Publishing. Pp. 226.

Segers H. 2007. Annotated checklist of the rotifers (Phylum Rotifera) with notes on nomenclature, taxonomy and distribution. *Zootaxa,* 1564: 1- 104.

Sharma B. K. 1998. In: Faunal diversity of India (Eds. J. R. B. Alfred, A. K. Das and A. K. Sanyal). *Zoological Survey of India, Environmental Centre*, 57- 70.

Sharma B.K., Dudani V.K. 1992. Rotifers from some tropical ponds in Bihar: species composition, similarities and trophic indicators. *The Journal of the Indian Institute of Science,* 72: 121-130.

Shurin J.B., Winder M., Adrian R., Keller W., Matthews B., Paterson A.M., Paterson M., Pinel-Alloul B., Rusar J.A., Yan N. 2010. Environmental stability and lake plankton diversity: contrasting effects of chemical and thermal variability. *Ecology Letters,* 13 (4): 453- 463.

Sloka N. 1981. A Key to Animals of the Latvian SSR. Fauna of the Cladocera and a key of Latvia. Riga, LVU. Pp. 146 (In Latvian).

Smirnov N.N. 1979. Carcinological analysis. In the book: Private methods of studying the history of modern ecosystems. Moscow, Science. Pp. 100 - 121 (In Russian) .

Smirnov N.N. 1996. Cladocera: the Chydorinae and Sayciinae. Amsterdam, Backhuys Publ. Pp. 197.

Sutela T., Huusko A. 1997. Food consumption of vendace *Coregonus albula* larvae in Lake Lentua, Finland. *Journal of Fish Biology,* 51: 939- 951.

Swadling K.M., Pienitz R., Nogrady T. 2000.

Zooplankton community composition of lakes in the Yukon and Northwest Territories (Canada): relation ship to physical and chemical limnology. *Hydrobiologia,* 431: 211- 224.

Tallberg P., Horppila J., Väisänen A., Nurminen L. 1999. Seasonal succession of hytoplankton and zooplankton along a trophic gradient in a eutrophic lake – implications for food web management. *Hydrobiologia,* 412: 81– 94.

Taylor B.E., DeBiase A. E., Mahoney D. L. 1993. Development of the zooplankton assemblage in a new cooling reservoir. *Archiv für Hydrobiologie,* 128: 129- 148.

Ter Braak C.J.F. 1994. Canonical community ordination, Part I: Basic theory and linear methods. *Ecoscience,* 1: 127- 140.

Tidriķis A. 1997. Lake Riču. The Nature of Latvia. Vol.4 Riga, Publishing house. Pp. 243- 244 (In Latvian).

Tidriķis A. 1998. Lake Svente. The Nature of Latvia. Vol.5 Riga, Publishing house. Pp. 180 (In Latvian).

Tilzer M. M. 2000. Control factors of planktonic population dynamics in freshwater: a review. *Advances in Limnology,* 55: 471– 491.

Urabe J. 1990. Stable horizontal variation in the zooplankton community structure of a reservoir maintained by predation and competition. *Limnology and oceanography,* 35: 1703–1717.

Urtāne L. 1998. Cladocera as types and trophic status indicators of Latvian Lakes. Thesis. Pp. 168. Not published (In Latvian).

Van den Brink P. J, Van den Brink N. W., Ter Braak C.J.F.. 2003. Multivariate analysis on ecotoxicological data using ordination: demonstrations of utility on the basis of various examples. *Australasian Journal of Ecotoxicology,* 9: 141- 156.

Viljanen M. 1983. Food and food selection of cisco (*Coregonus albula* L.) in a dysoligotrophic lake. *Hydrobiologia,* 101: 129-138.

Wagner A., Benndorf J. 2007. Climate-driven warming during spring destabilises a Daphnia population: a mechanistic food web approach. *Oecologia,* 151 (2): 351- 64.

Weglenska T., Ejsmont-Karabian J., Rybak J.I. 1997. Biotic interactions of the zooplankton community of a shallow, humic lake. *Hydrobiologia,* 342/343: 185–195.

Weider L. J., Pijanowska J. 1993. Plasticity of *Daphnia* life histories in response to chemical cues from predators. *Oikos,* 67: 385- 392.

Wetzel R. G. 2001. Limnology. Lake and River Ecosystems. 3rd edn. Academic Press. Pp. 1006.

Wetzel R. G., Likens G. E. 2000. Limnological Analyses. New York, Springer Science, Business Media. Pp. 429.

Williams D.D., Feltmate B.W. 1992. Aquatic Insects. Wallingford, CAB International. pp. 358.

Williamson C.E. 1983. Invertebrate predation on planktonic rotifers. *Hydrobiologia,* 104: 385- 396.

Williamson C.E., Butler N.M. 1986. Predation on rotifers by the suspension-feeding calanoid copepod *Diaptomus pallidus*. *Limnology and Oceanography,* 31: 393- 402.

Zar J.H. 1999. Biostatistical Analysis, 4th ed. New Jersey, Prentice Hall. Pp. 929.

http:// www.ezeri.lv/. database (accessed 30.03.2020)

Received: 01.06.2020.
Accepted: 15.07.2020.