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DIVERSITY SURVERY OF SAMPLES OF ROTIFERA GROUP IN LAKES SVENTE AND BRIGENE

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Lake Svente is the tenth deepest lake in Latvia, the average depth of which is 7.8 meters, but the maximum depth reaches 38 meters, but Lake Brigene is the twentieth deepest lake in Latvia, the average depth of wilich is 10 meters, but the maximum depth reaches 32 meters (Brigenes ezers, Sventes ezers www.ezeri.lv).

The samplings in the lakes were carried out in several different localities of the lakes whitch have different depth. Apstein plankton net was used for collecting the samples. During the research on Lake Svente and Lake Brigene 3 zooplankton groups were identified, i.e. Rotifera, Cladocera and Copepoda. The highest species diversity was registered in Rotifera group, followed by Cladocera and Copepoda groups. We have analysed individuals in Rotifera group which were collected in Lake Svente and Brigene.

During the analysis of the sample of Lake Svente, which were taken in 2007, eighteen species were determined in Rotifera group, but twenty-eight species were determined in Rotifera group on the samples which were taken in 2008. In its turn, during the analysis of the samples which were taken in 2008 twenty-eight species were determined in Rotifera group in Lake Brigene.

Key words: Lake Svente, Lake Brigene, zooplankton, Rotifera, Renkonen index, Shannon-Wiener index.

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INTRODUCTION

Lakes are natural bodies of water that occupy inland basins. They are widely distributed terrain feature in Latvia. There are approximately 40% of all Latvian lakes of Latgale Hills (Glazačeva 2004).

Using the structure of zooplankton it is possible to assess both the trophic status and ecological quality of the lake. The species or groups with indicator value that are significant here, respond to water body trophical status subtitution, i.e. frecuency of their occurrence decreoses or increases adding to the trophic of lake. The qualititative indices of zooplankton species and group show the process intensity in water body (Кутикова 1970). Rotiferas form one of fundamental stage in the food chain of water bodies, since they refer to the first food appliers.

This Rotifera serves as food for invertebrates, nematodes, crustaceans, caterpillars of insects.

Although the influence of various abiotic (pH, turbidity, conductivity, nutrient concentrations, iron concentration) and biotic (phytoplancton, macrophyte cover, macroinvertebrate densities) factors on deep-water lakes (pelagial, littoral area) is not homogeneous, it directly affects the structure of zooplankton populations.The biggest part of this factor variability is subject to seasonality. The following significant factors as light regime, temperature, oxygen, chlorophyll concentration, competition between species and the presence of predators change during the season (Beaver & Havens 1996, Berzins & Pejler 1989a, Berzins & Pejler 1989b, Cottenie et al. 2001, Dodson et al. 2009, Gilbert 2011, Green 2007, Grophen 2005, Hebert 1982, Jacobs 1977, Pinel-Alloul et al. 2004, Primicerio 2000). 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. the Rotifera 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). 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).

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).

Faunistical studies of Rotifera both in Latvian deep lakes and freshwater habitats are not so common, and therefore the information about the diversity of Rotifera fauna is often incomplete. In accordance with the most recent data (Paidere & Škute 2011) 279 Rotifera species have been identified in Latvia. 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 view of the abovementioned fact, the research was conducted on the diversity of Rotifera species in pelagic and littoral zones of Lake Svente and Brigene. Moreover, both lakes have different degree of trophy i.e Lake Svente is eutrophic (Tidriķis 1998), whereas Lake Briģene is mesotrophic (Eipurs 1994).

MATERIAL AND METHODS

Location of reseach

Lake Svente is located on Ilukste hills, 137 m asl., in the self-governing territory of Svente, Daugavpils district (D shore self governing territories of Kalkune and Medumi). Lake Svente is a part of Augshzeme (in Latvian Augšzeme) protected landscape area. Together they form a complex nature reserve (Tidriķis 1998). Lake Svente is the tenth deepest lake in Latvia, the average depth of which is 7.8 meters, but the maximum depth reaches 38 meters (Sventes ezers www.ezeri.lv) (Fig. 1). Lake Brigene is located on Augshzeme elevated plain, 147.9 m asl., in the self-governing teritory of Demene, between teritories of Demene (R) and Brigene (A), Daugavpils district (Eipurs 1994). Lake Brigene is the twentieth deepest lake in Latvia, the average depth of wilich is 10 meters, but the maximum depth reaches 32 meters (Brigenes ezers www.ezeri.lv) (Fig. 1).

Collection of zooplankton samples

For the study of samples of Rotifera in Lake Svente and Lake Brigene, zooplankton samples were taken in Lake Svente on July 12, August 3 and 30 and September 21 in 2007. And also on May 13 and 30, June 6, August 7 and 22 and September 2 in 2008. But zooplankton samples were taken in Lake Brigene on May 12 and

30, June 16, July 6, August 7 and 22 in 2008. The samplings in the lakes were carried out in several different localities of the lakes which have different depth. Apstein plankton net was used for collecting the samples. We have analysed individuals in Rotifera group which were collected in Lake Svente and Brigene. The samplings in Lake Svente were carried out in six different localities of the lake but in Lake Brigene on five different localities of the lake which have different depth.

Apstein plankton net was used for collecting the samples. Using the Apstein plankton net (65 µm mesh) the zooplankton samples were taken from 0.5 – 1 meter depth and 100 l of water were filtered. For our research we used the zooplankton samples which we collected on Lake Svente from the following depths in 2008 (Fig. 1):

- Locality No 1 - 1.2 m - the volume of filtered water is 100 l;
- Locality No 2 - 0.8 m - the volume of filtered water is 100 l;
- Locality No 3 – 1.2 m - the volume of filtered water is 100 l;
- Locality No 4 – 1.5 m - the volume of filtered water is 100 l;
- Locality No 5 - 1.2 m - the volume of filtered water is 100 l;
- Locality No 6 - 36 m - the volume of filtered water is 100 l.

At the locality No 6 we determined physical and chemical parameters of the water.

The zooplankton samples of Lake Svente were also collected from the following depths in 2007 (Fig. 1):

- Locality No 6 - 36 m - the volume of filtered water is 100 l;
- Locality No 7 - 13.5 m - the volume of filtered water is 100 l;
- Locality No 8 -7 m - the volume of filtered water is 100 l;

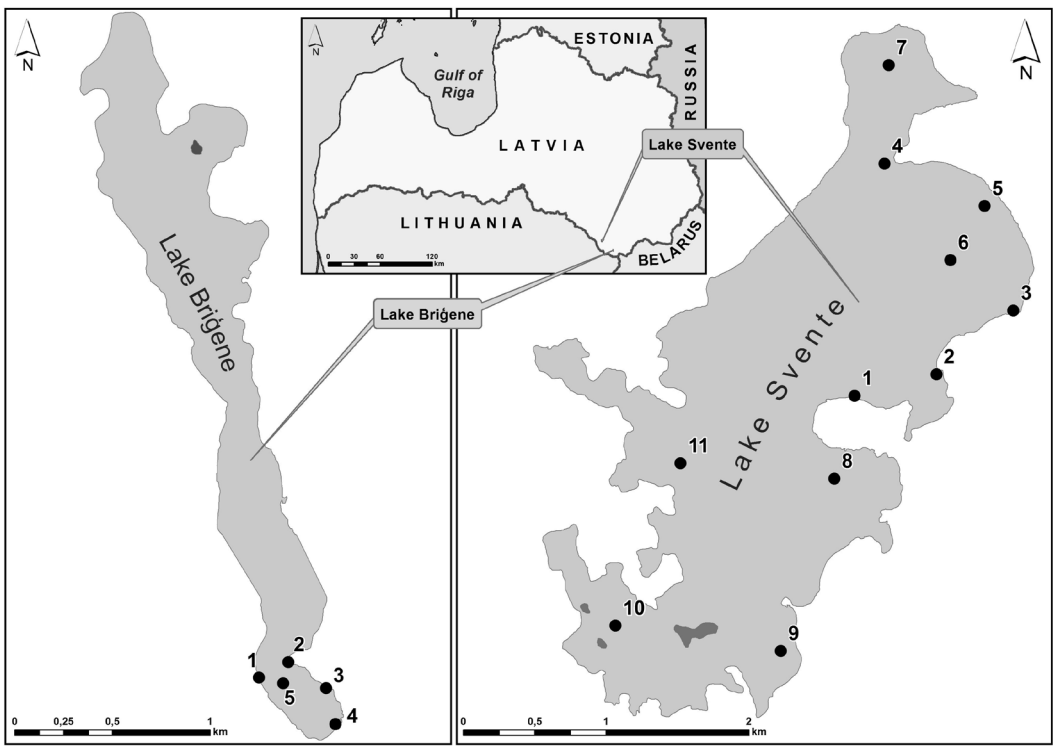

Fig. 1. Localities of Lakes Svente and Brigene.

- Locality No 9 – 7.3 m - the volume of filtered water is 100 l;
- Locality No 10 - 6.5 m - the volume of filtered water is 100 l;
- Locality No 11 - 6 m - the volume of filtered water is 100 l.

At the localities No 6 and No 7 we also determined physical and chemical parameters of the water.

In its turn the zooplankton samples of Lake Brigene were collected from the following depths in 2008 (Fig. 1):

- Locality No 1 - 1.2 m - the volume of filtered water is 100 l;
- Locality No 2 - 1.8 m - the volume of filtered water is 100 l;
- Locality No 3 – 1.4 m - the volume of filtered water is 100 l;
- Locality No 4 – 1.4 m - the volume of filtered water is 100 l;
- Locality No 5 - 32 m - the volume of filtered water is 100 l.

At the localities No 5 we determined physical and chemical parameters of the water.

Zooplankton samples are usually stored in 0.33l bottles. The collected samples are fixed with 37- 40% formaldehyde solution. One part of formaldehyde solution is added to nine parts of samples. As a result the sample is preserved with 4% formalin.

Physico-chemical measurements

Hydrometric measurements for the topographic map were performed with a GPS (satellite navigation) device - GPS Scout Master®. The precision of the site (location) in the Acute Locate regime is ±2 meters. The BioSonics DT-X Digital Echosounder System was used for the measurement of the depth and the bottom relief of Lake Svente and Lake Brigene. The sonde HYDROLAB HACH© DS5 was used to measure water temperature, pH, conductivity, dissolved oxygen, chlorophyll-α, turbidity. Physico-chemical measurements were taken from the deepest localities of each lake. The collection of zooplankton samples and their quantitative and qualitative analysis was performed using the APHA standard methods procedure for the analysis of water and wastewater (APHA 2005).

Analysis of zooplankton samples

The samples were studied in the light microscope *ZEISS Primo Star* with a magnification of 100-400x. Each sample is studied three times (Wetzel & Likens 2000). 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) (APHA 2005, Wetzel & Likens 2000). Having studied the samples in the light microscope the zooplankton organisms were then calculated and identified as species or families. We used the following zooplankton guides (Benzie 2005, Dagg 1977, Dussart & Defaye 2001, Dumont & Negrea 2002, Flössner 1972, Flössner 2002, Hudec 2010, Krauter & Streble 1988, Nogrady & Segers 2002, Paidere & Škute 2011, Pontin 1978, Radwan et al. 2004, Ruttner-Kolisko 1974, Scourfield & Harding 1994, Segers 1995, Segers 2007, Sloka 1981, Кутикова 1970, Кутикова & Старобогатов 1977, Мануйлова 1964, Алексеев & Цалохин 2010).

The following formula was used to calculate the number of organisms in a sample:

$N=(a \times b \times 1000) / (c \times d)$, where (1)

a - is a calculated number of organisms (average);

b - is a volume of concentrated sample;

c - is a sample volume;

d - is a volume of filtered water;

N - is a number of organisms per $1m^3$.

Statistical analysis of zooplankton samples

The similarity of the Rotifera group quantitative composition was verified using the percentage similarity Renkonen index (Renkonen 1938).

$$P = \sum minimum\ (p_{1i}, p_{2i}), \text{ where} \quad (2)$$

P - Percentage similarity between the samples 1 and 2;
p_{1i}- percentage of species i in community sample 1;
p_{2i}- percentage of species i in community sample sample 2.

The Shannon-Wiener function (H') was used to calculate as (Margalef 1958):

$$H' = -\sum_{i=1}^{S} (pi)(\ln pi), \quad (3)$$

H' is the index of species diversity,
S is the number of species, and
p_i is a proportion of the total sample belonging to i th species.

Since the resulting equation is a measure of bits, we used the following equation to move from the bits unit to the species unit (Krebs 1999; MacArthur 1965):

$$N_1 = e^{H'}, \quad (4)$$

where e is equal to 2.71828 (base of natural logs), H' - Shannon-Wiener function (calculated with base e logs), and N_1 - the number of equally common species that would produce the same diversity as H'.

Sampling distributions for the Shannon-Wiener index (H') have been determined by Good (1953) and Basharin (1959). Shannon-Wiener index (H') is used for the quality control of the environment in accordance wich bioindication by principle (Krebs 1999, Margalef 1958, Лебедева et al. 2004, Терешенко et al. 1994). In this case it does not evaluate condition of the environment parameters, but the reaction of organisms, that is caused by the environment changes. This index is particularly suitable for population description of the water body (Liepa et al. 1991).

The software Microsoft® Excel 2003 was used to calculate the number of Rotifera group organisms and to analyse physical and chemical parameters (Arhipova & Bāliņa 2003).

RESULTS AND DISCUSSION

During the research on Lake Svente and Lake Brigene 3 zooplankton groups were identified, i.e. Rotifera, Cladocera and Copepoda. The highest species diversity was registered in Rotifera group, followed by Cladocera and Copepoda groups. During the analysis of the sample of Lake Svente which were taken in 2007 eighteen species were determined in Rotifera group (Table 1), but twenty-eight species were determined in Rotifera group on the samples which were taken in 2008 (Table 2). Number of common species between all sampling places in 2007 is ten, it is a good index. Number of common species between all sampling places in 2008 is thirteen.We have observed here bigger diversity of species between sampling places. This can be explained with different biotopes, were collected the samples. We determined more than six species in the deepest locality of Lake in 2008. It is more than in 2007.That is explained with the fact collection of samples was longer than in 2007, there fore there was the bigger probability to determine bigger number of species. In its turn, during the analysis of the samples which were taken in 2008 twenty-eight species were determined in Rotifera group in Lake Brigene (Table 3). Number of common species between all sampling places is fourteen, it is also a good index. In all localities of the sampling *Polyarthra vulgaris*, *Asplanchna priodonta*, *Keratella cochlearis*, *Conochilus hippocrepis*, *Kellicottia longispina* and *Gastropus stylifer* were dominant species in the Rotifera group of Lake Svente samples which were taken in 2007, but in all localities of the sampling *Polyarthra vulgaris*, *Keratella cochlearis*, *Conochilus hipocrepis*, *Kellicottia longispina*, *Gastropus stylifer*, *Pompholux sulcata* were dominant species in the Rotifera group of Lake Svente samples which were taken in 2008. In all localities of the sampling *Polyarthra vulgaris*, *Keratella cochlearis*, *Pompholux sulcata*, *Trichocerca capucina* were dominant species in the Rotifera group of Lake Brigene samples which were taken in 2008. Differences in number and composition of species depend on a number of influencing factors, such as lake trophy, the

depth from which the sample is taken, water temperature, pH, water transparency, dissolved oxygen, vegetation, season and so on (Berzins & Pejler 1987, Berzins & Pejler 1989a, Berzins & Pejler 1989b, Field & Prepas 1997, Līne 1966, Paidere & Škute 2011).

According to literature data (Līne 1966) there are some Rotifera species, such as *Keratella cochlearis*, *Kellicottia longispina*, *Polyarthra remata, Filinia longiseta*, which are found in the lake throughout the year. Most Rotifera species are characterized by a wide range of temperature tolerance (Berzins & Pejler 1989a). Many studies have shown that the higher temperature variation over a specified period in lakes is, the greater is the species diversity (Shurin et al. 2010). Overall, Rotifera species have a wide temperature range (0 - 30 ^{0}C) at which the species can exist (Berzins & Pejler 1989a). However, the level of dissolved oxygen must be within the range 0 - 16 mg $^{-1}$ (Berzins & Pejler 1989b). As in our case the physico-chemical parameters were measured only at the deepest parts of the lakes, i.e in Lake Svente locality No. 6 and in Lake Brigene locality No. 5, we could speak about the intercorrelation of patterns of species and physico-chemical parameters on the basis of the samples which were collected in the deepest areas of lakes.

The water temperature in the upper layer (0-5 m) of Lake Svente ranged from 18.5 ^{0}C to 21 ^{0}C in May and August 2007. The level of dissolved oxygen ranged from 7.6 mg $^{-1}$ in late August to 8.6 mg $^{-1}$ in early August, but chlorophyll-α ranged from 0.6 μg^{-1} in May to 1.09 μg^{-1} in early August. By contrast, water temperature on the surface of Lake Svente was from 12.5 ^{0}C to 21 ^{0}C in May and August in 2008. The level of dissolved oxygen ranged from 7.6 mg $^{-1}$ in July / September to 11 mg $^{-1}$ in May, but the chlorophyll-α ranged from 0.6 μg^{-1} in August to 4.6 μg^{-1} in September.

The temperature of water in the surface layer (0-5 m) of Lake Brigene ranged from 13.8 ^{0}C to 21 ^{0}C in May and August in 2008. The level of dissolved oxygen ranged from 7.9 mg $^{-1}$ in early August to 10.8 mg $^{-1}$ in May, but chlorophyll-α ranged from 0.72 μg^{-1} in May to 1.84 μg^{-1} in August. If we compare the literature data with the data received during our research in the corelation of Rotifera species with water temperature and dissolved oxygen (Berzins & Pejler 1989a, Berzins & Pejler 1989b), we can conclude that the species determinated in our research coincides with the optimal temperature and dissolved oxygen range specified in the literature According to the samples of Rotifera species collected during our research such species as *Polyarthra major*, *Polyarthra vulgaris*, *Asplanchna priodonta*, *Kallicottia longispina*, *Keratella cochlearis*, *Trichocerca similis* have the highest range of dissolved oxygen i.e. 1-13 mg $^{-1}$ (Berzins & Pejler 1989b). By contrast, in according to the 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 (Berzins & Pejler 1989a).

Having studied the quantitative comparison indices (Renkonen index) (Table 5) of Lake Svente have found that the similarity between the localities of sampling in Lake Svente in 2007 is between 8% and 18%. The greatest similarity is between the locality No 10 and the locality No 11- 18%, then follows the locality No 8 and the locality No 9- 14%, the locality No 8 and the locality No 11- 14%. In its turn, having studied quantitative comparison indices (Renkonen index) of Lake Svente which were taken in 2008 (Table 4) we have found that the similarity between the localities of sampling is between 5% and 19%. The greatest similarity is between the locality No 5 and the locality No 3- 19%. The similar quantitative comparison indices are between the the locality No 4 and the locality No 5- 14% and between the locality No 4 and the locality No 6- 14%. While the lowest similarity is between the locality No 6 and the locality No 2- 5%, and also between the locality No 4 and the locality No 2-5%.

Having studied the quantitative comparison indices of Lake Brigene (Table 6), we have found that the similarity between the localities of sampling is between 17% and 28%. The greatest similarity is between the locality No 5 and No1-

28%. It testifies that samplings localities are similar alike in variety of species.

Since we usually speak about similarity if the percentage is higher than 50%, than in our case the similarity is insignificant though it is similarity. If analysing all zooplankton groups together, then this percentage of similarity along in sampling localities is bigger, but in our research, we are analying only the Rotifera group. In our case we are comparing the similarity between the sampling localities which is up to 30%. If to compare the qualitative composition of Rotifera group species (Tables 1; 2; 3), then the similarity is bigger between sampling places. Because there was reflected that, the specific species are met to in the specific sampling places generally, but in the quantitative composition we usually study only the percentage composition of specific species. Having studied there were no any considerable differences in the species composition between sampling places.

As can be concluded from the analysis of the average indices of Rotifera group species diversity (Shannon-Wiener index) in all six sampling localities in Lake Svente in 2007 are between 2.5 and 4 (Table 7). The greatest indices are in the locality No 1- 4 and No 3- 3.2, but the lowest biodiversity index of Rotifera group species diversity is in the locality No 5- 2.5. And also as can be concluded from the samples which were collected in 2008 (Table 8), the biodiversity index are between 3.45 and 4. The greatest indices are in the localities No 6- 4, No 3- 3.6 and in the locality No 2- 3.6, but the lowest index is in the locality No 4- 3.45.

The average index of Rotifera group species diversity was invariable in the samples which were collected in 2007 and 2008 in the locality with the biggest depth of Lake Svente.

In its turn, analysing the data on the biodiversity of Rotifera group species in the every locality, we have found that the biggest biodiversity of species in Lake Svente in 2007 (Table 7 and Fig. 2) was in the locality No 3- 3.86 and in the locality No 6- 4.10 on 3rd August. But in the locality No 4- 3.61 and in the locality No 5 – 3.78 on the 21 st September. Having studied the data of samples which were collected in 2008 (Table 8 and Fig.3) the greatest biodiversity of Rotifera group species was in the locality No 1- 5.48 on the 2nd September, in the localities No 2- 4.59 and No 6- 6.6 on the 22nd August, in the localities No 3 – 5.26 and No 5- 5.15 on the 16th June, but in the locality No 4- 4.98 on the 7th August.

As can be concluded from the analysis of the average indices of Rotifera group species diversity (Shannon-Wiener index) (Table 9) all

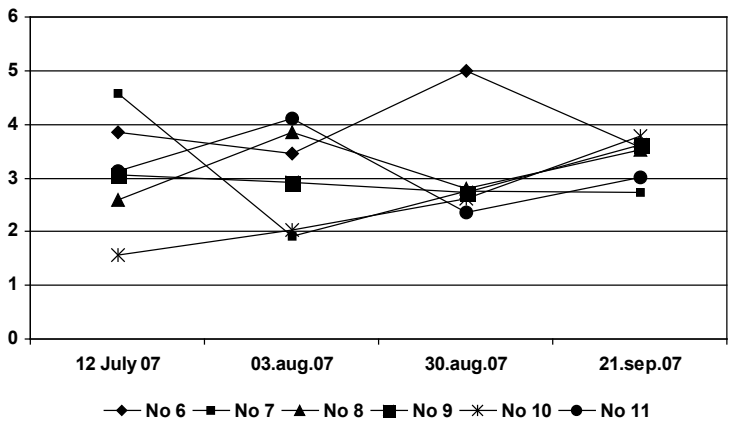

Fig.2. Biodiversity of the Rotifera species in Lake Svente (Shannon-Wiener index) in 2007.

five sampling localities in Lake Brigene in 2008 are between 2.5 and 3.6. The greatest indices are in the locality No 3- 2.5. If analysing the biodiversity data (Table 9 and Fig.4) of Rotifera group species in the every locality, then the biggest biodiversity of Rotifera species are in the localities No 1- 4.87 and No 3- 3.24 and also in the locality No 4- 3.14 on the 22nd August. In the locality No 2- 4.97 on the 7th August, but in the locality No 5- 3.75 on the 12th May. The results testify that the biodiversity of Rotifera group species differs considerably in different sampling places of the lakes.

CONCLUSION

Basing on the data got in the research, one can conclude:

1. In Lake Svente and Lake Brigene 3 zooplankton groups were identified, i.e. Rotifera, Cladocera and Copepoda. The highest species diversity was registered in Rotifera group, followed by Cladocera and Copepoda groups.

2. During the analysis of the sample of Lake Svente which were taken in 2007 eighteen species were determined in Rotifera group, but twenty-eight species were determined which were taken

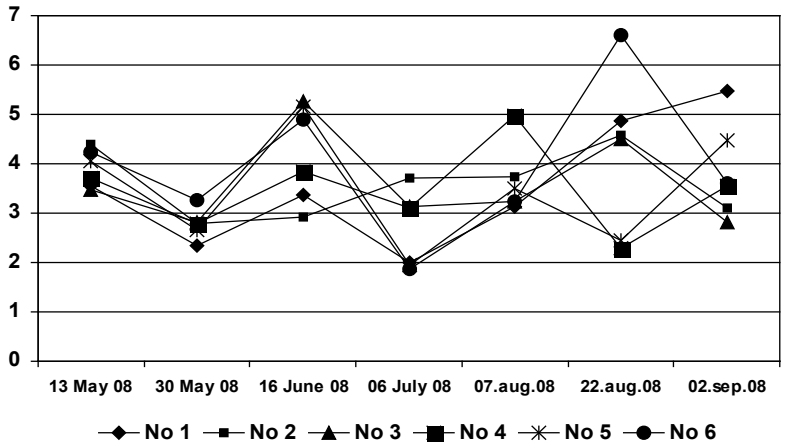

Fig.3. Biodiversity of the Rotifera species in Lake Svente (Shannon-Wiener index) in 2008.

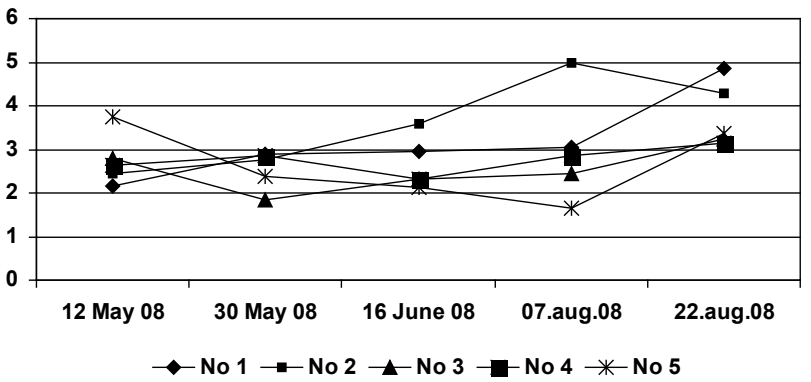

Fig.4. Biodiversity of the Rotifera species in Lake Brigene (Shannon-Wiener index) in 2008.

in 2008 of the samples in Rotifera group. In its turn, during the analysis of the samples which were taken in 2008 twenty-eight species were as well as in Rotifera group in Lake Brigene.

3. The quantitative comparison index (Renkonen index) of Lake Svente in 2007 is between 8% and 18%. But the quantitative comparison index (Renkonen index) of Lake Svente in 2008 is between 5% and 19%. The quantitative comparison index (Renkonen index) of Lake Brigene is between 17% and 28%.

4. The average indices of Rotifera group species diversity (Shannon-Wiener index) in all six sampling localities in Lake Svente in 2007 are between 2.5 and 4. And also the average indices of Rotifera group species diversity (Shannon-Wiener index) in all six sampling localities in Lake Svente in 2008 are between 3.45 and 4. The average indices of Rotifera group species diversity (Shannon-Wiener index) in all five sampling localities in Lake Brigene in 2008 are between 2.5 and 3.6.

REFERENCES

APHA. 2005. Standart methods for the examination of waters and wastewater. 21st edition.USA, D.C., American Public Health Association.

Arhipova I., Bāliņa S. 2003. Statistika ekonomikā. Risinājumi ar SPSS un Microsoft Excel. Rīga. Datorzinību centrs. 350.

Basharin G.P. 1959. On a statistical estimate for the entropy of a sequence of independent random variables. *Theory of Probability and Its Application*, 4: 333- 336.

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.

Benzie J.A.H. 2005. The genus Daphnia (including Daphniopsis) (Anomopoda: Daphniidae). Guides to the Identification of Microinvertebrates of the Continental Waters of the World 21. Coordinating editor: H.J. Dumont. Kenbi Productions: Ghent. 376.

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

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

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

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. 710.

Dodson S.I., Newman A.L., Will-Wolf S., Alexander M.L., Woodforf M.P., Van Egeren S. 2009. The relationship between zooplankton community structure and lake characteristics in temperate lakes (Northern Wisconsin, USA). *Journal of Plancton Research,* 31(1): 93-100.

Dumont H.J., Negrea V. 2002. Introduction to the class Branchiopoda. Guides to the Identification of the Microinvertebrates of the Continental Waters of the World 19. Backhuys Publishers. Leiden. 398.

Dussart B.H., Defaye D. 2001. Introduction to the Copepoda (2nd edition revised and enlarged). Guides to the Identification of the Microinvertebrates of the Continetal Waters of the World. 16 Backhuys Publishers: Leiden. 344.

Eipurs I. 1994. Briģenes ezers. Latvijas daba,

1.sēj. Rīga, Latvijas enciklopēdija.

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 Deutschl*, 60: 1-501.

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

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

Glazačeva L. 2004. Latvijas ezeri un ūdenskrātuves. Jelgava. 218.

Good I.J. 1953. The population frequences of species and the estimation of population parameters. *Biometrika,* 40: 237- 264.

Green J. 2007. Morphological variation of *Keratella cochlearis* (Gosse) in Myanmar (Burma) in relation to zooplankton community structure. *Hydrobiologia*, 593: 5-12.

Grophen M. 2005. Seasonal rotifer dynamics in the long-term (1969 - 2002) record from Lake Kinneret (Israel). *Hydrobiologia*, 546: 443- 450.

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

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

Jacobs J. 1977. Coexistence of similar zooplankton species by differential adaptation to reproduction and escape in an environment with fluctuating food and enemy densities. J.A Model. *Oceanologia*, 29(3): 233- 247.

Krauter D., Streble H. 1988. Das Leben im Wassertropfen. Mikroflora und Mikrofauna des Süßwassers Ein Bestimmugsbuch. Kosmos.429.

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

Liepa I., Mauriņš A., Vimba E. 1991. Ekologija un dabas aizsardzība. Rīga**.** Zvaigzne. 302.

Līne R. 1966. Latvijas PSR austrumu un centrālās daļas ezeru zooplanktona sastāvs, kvantitatīvā attīstība un perspektīvā izmantošana. Disertācija. Latvijas PSR Zinātņu akadēmijas Bioloģijas institūts. Rīga. 279.

Margalef D.R. 1958. Information theory in ecology. *General Systems,* 3**:** 36- 71.

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. Backhuys Publishers, Leiden. 264.

Paidere J., Škute R. 2011. Virpotāji (Rotifera) un to fauna Latvijā. Daugavpils, Daugavpils Universitāte. 272.

Pinel-Alloul B., Méthot G., Malinsky-Rushansky Z. 2004. A short- term study of vertical anhorizontal distribution of zooplankton during thermal stratification in Lake Kinneret, Israel. *Hydrobiologia*, 526: 85- 98.

Pontin, R.M. 1978. A key to the freshwater planctonic and semi-planktonic Rotifera of the British isles. *Freshwater Biological*

Association Scientific Publication, 38: 178.

Primicerio R. 2000. Seasonal changes in vertical distribution of zooplankton in a oligotrophic, subarctic lake (lake Takvatn, Norway). *Limnologica*, 30: 301- 310.

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

Renkonen O. 1938. Statisch-okologische Untersuchungen uber die terrestiche kaferwelt der finnischen bruchmoore. Ann. Zool. Soc. Bot. Fenn. *Vanamo,* 6:1-231.

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

Scourfield D.J., Harding J.P. 1994. A key to the British Freshwater Cladocera. *Freshwater Biological Association Scientific Publication,* 5: 61.

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

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

Shurin J.B., Winder M., Adrian R., Keller W., Matthews B., Paterson A.M., Paterson M., Pinel-Alloul B., Rusak 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. Latvijas PSR dzīvnieku noteicējs. Latvijas kladoceru fauna un noteicējs. Rīga. LVU. 146.

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.

Tidriķis A. 1998. Sventes ezers. Latvijas daba. 5.sēj. Rīga: Preses nams.180.

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

Алексеев В.Р., Цалохин С.Я. (ред.). 2010. Определитель зоопланктона и зообентоса пресных вод Европейской России. Том 1. Зоопланктон. Товарищество научных изданий КМК: Москва- Санкт-Петербург. 494.

Кутикова Л. А. 1970. Каловратки фауны СССР. Наука. Ленинград. 743.

Кутикова Л. А., Старобогатов Я.И. 1977. Определитель пресноводных европейской части СССР (планктон и бентос). Ленинград. Гидрометоиздат. 512.

Лебедева Н.В., Дроздов Н.Н., Криволуцкий Д.А. 2004. Биологическое разнобразие. Гуманит. 432.

Мануйлова Е.Ф. 1964. Ветвистоусые рачки фауны СССР. Москва. Наука. 328.

Терешенко В.Г., Терешенко Л.И., Сметанин М.М. 1994. Оценка различных индексов для выражения биологического разнобразия сообщества Биоразнобразие: Степенъ таксономической изученности. Москва. 86- 98.

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Table 1. Diversity of samples of Rotifera group in Lake Svente (the samples were taken in 2007)

Species (taxon)	Occurence of species (taxa) in the samplings localities						
	No 6 (36m)	**No 7 (13,5m)**	**No 8 (7m)**	**No 9 (7,3m)**	**No 10 (6,5m)**	**No 11 (6m)**	**Common species**
Ascomorpha ecaudis Perty, 1850	+	+	+	+	+	+	+
Ascomorpha saltans Bartsch, 1870	+						
Asplanchna priodonta Gosse, 1850	+	+	+	+	+	+	+
Brachionus angularis Gosse, 1851	+	+					
Conochilus hippocrepis (Schrank, 1803)	+	+	+	+	+	+	+
Euchlanis dilatata Ehrenberg, 1832	+	+	+	+	+	+	+
Filinia longiseta (Ehrenberg, 1834)	+			+			
Kellicottia longispina Kellicott, 1879	+	+	+	+	+	+	+
Keratella cochlearis Gosse, 1851	+	+	+	+	+	+	+
Keratella quadrata Müller, 1786	+	+	+		+		
Lecane luna (Müller, 1776)	+	+		+			
Polyarthra major Burckhardt, 1900	+	+	+	+	+	+	+
Pompholux sulcata Hudson, 1885	+	+		+	+	+	
Poyarthra vulgaris Carlin, 1943	+	+	+	+	+	+	+
Synchaeta tremula (Müller, 1786)	+	+		+			
Gastropus stylifer (Imhof, 1891)	+	+	+	+	+	+	+
Trichocerca capucina (Wierzejski & Zacharias, 1893)	+	+	+	+	+	+	+
Trichocerca similis (Wierzejski, 1893)	+					+	
Total:	**18**	**15**	**11**	**14**	**12**	**12**	**10**

Table 2. Diversity of samples of Rotifera group in Lake Svente (the samples were taken in 2008)

Species (taxon)	**Occurence of species (taxa) in the samplings localities**						
	No 1 (1,2m)	**No 2 (0,8m)**	**No 3 (1,2m)**	**No 4 (1,5m)**	**No 5 (1,2m)**	**No 6 (36m)**	**Common species**
Ascomorpha ecaudis Perty, 1850	+	+	+	+	+	+	+
Asplanchna priodonta Gosse, 1850	+	+	+	+	+	+	+
Cephalodella gibba (Ehrenberg, 1832)			+			+	
Conochilus hippocrepis (Schrank, 1803)	+	+	+	+	+	+	+
Euchlanis dilatata Ehrenberg, 1832	+	+	+	+	+	+	+
Filinia longiseta (Ehrenberg, 1834)			+		+	+	
Kellicottia longispina Kellicott, 1879	+	+	+	+	+	+	+
Keratella cochlearis Gosse, 1851	+	+	+	+	+	+	+
Keratella cochlearis tecta (Gosse, 1851)		+				+	
Keratella quadrata Müller, 1786	+	+	+	+	+	+	+
Lecane luna (Müller, 1776)	+	+	+	+		+	
Lecane lunaris (Ehrenberg, 1832)		+	+			+	
Ploesoma lenticulare Herrick, 1885				+		+	
Ploesoma triacanthum (Bergendal, 1892)						+	
Polyarthra dolichoptera Idelson, 1925	+	+	+	+	+	+	+
Polyarthra major Burckhardt, 1900	+	+	+	+	+	+	+
Polyarthra vulgaris Carlin, 1943	+	+	+	+	+	+	+
Pompholyx sulcata Hudson, 1885	+	+	+	+	+	+	+
Rotatoria sp. Scopoli, 1777			+	+		+	
Synchaeta pectinata Ehrenberg, 1832	+			+		+	

Species (taxon)	Occurence of species (taxa) in the samplings localities						
	No 1 (1,2m)	No 2 (0,8m)	No 3 (1,2m)	No 4 (1,5m)	No 5 (1,2m)	No 6 (36m)	Common species
Synchaeta tremula Ehrenberg, 1832		+	+	+	+	+	
Testudinella patina (Hermann, 1783)		+					
Gastropus stylifer (Imhof, 1891)	+	+	+	+	+	+	+
Trichocerca capucina (Wierzejski & Zacharias, 1893)	+	+	+	+	+	+	+
Trichocerca similis (Wierzejski, 1893)	+	+		+		+	
Trichotria pocillum (Müller, 1776)		+	+	+	+		
Total:	**16**	**20**	**20**	**20**	**16**	**24**	**13**

Table 3. Diversity of samples of Rotifera group in Lake Brigene (the samples were taken in 2008)

Species (taxon)	Occurence of species (taxa) in the samplings localities					
	No 1 (1,2m)	No 2 (1,8m)	No 3 (1,4m)	No 4 (1,4m)	No 5 (32m)	Common species
Ascomorpha ecaudis Perty, 1850	+	+	+	+	+	+
Asplanchna priodonta Gosse, 1850	+	+		+	+	
Conochilus hippocrepis Schrank, 1803	+	+	+	+	+	+
Euchlanis dilatata Ehrenberg, 1832	+	+	+	+	+	+
Filinia longiseta (Ehrenberg, 1834)		+			+	
Kellicottia longispina Kellicott, 1879	+	+	+	+	+	+
Keratella cochlearis Gosse, 1851	+	+	+	+	+	+
Keratella quadrata Müller, 1786	+	+	+	+	+	+
Lecane bulla (Gosse, 1851)	+	+	+			
Lecane luna (Müller, 1776)	+		+		+	

Species (taxon)	Occurence of species (taxa) in the samplings localities					
	No 1 (1,2m)	No 2 (1,8m)	No 3 (1,4m)	No 4 (1,4m)	No 5 (32m)	Common species
Lecane lunaris (Ehrenberg, 1832)		+	+	+	+	
Lepadella ovalis (Müller, 1786)			+	+		
Monommata longiseta (Müller, 1786)				+		
Mytilina mucronata (Müller, 1773)	+					
Notholca labis Gosse, 1887					+	
Ploesoma hudsoni (Imhof, 1891)	+					
Polyarthra dolichoptera Idelson, 1925			+		+	
Polyarthra major Burckhardt, 1900	+	+	+	+	+	+
Polyarthra vulgaris Carlin, 1943	+	+	+	+	+	+
Pompholux sulcata Hudson, 1885	+	+	+	+	+	+
Synchaeta oblonga Ehrenberg, 1832				+		
Synchaeta pectinata Ehrenberg, 1832	+	+	+	+	+	+
Synchaeta sp. Ehrenberg, 1832			+			
Synchaeta tremula (Müller, 1786)	+	+	+	+	+	+
Testudinella patina (Hermann, 1783)	+	+	+	+	+	+
Gastropus stylifer (Imhof, 1891)	+	+	+	+	+	+
Trichocerca capucina (Wierzejski & Zacharias, 1893)	+	+	+	+	+	+
Trichocerca cylindrica (Imhof, 1891)		+	+			
Trichocerca similis (Wierzejski, 1893)	+	+		+	+	
Total:	**20**	**20**	**21**	**20**	**21**	**14**

Table 4. Renkonen index (Lake Svente 2008)

Sampling place	No 1	No 2	No 3	No 4	No 5	No 6
No 1						
No 2	9					
No 3	12	7				
No 4	11	5	10			
No 5	10	9	19	14		
No 6	8	5	13	14	9	

Table 5.Renkonen index (Lake Svente 2007)

Sampling place	No 6	No 7	No 8	No 9	No 10	No 11
No 6						
No 7	8					
No 8	11	12				
No 9	9	13	14			
No 10	8	9	9	10		
No 11	8	12	14	12	18	

Table 6. Renkonen index (Lake Brigene 2008)

Sampling place	No 1	No 2	No 3	No 4	No 5
No 1					
No 2	25				
No 3	18	21			
No 4	24	23	22		
No 5	28	28	17	21	

Table 7. Shannon-Wiener index (Lake Svente 2007)

Date of samples taken	Locality of samplings places					
	No 6 (36m)	**No 7 (13,5m)**	**No 8 (7m)**	**No 9 (7,3m)**	**No 10 (6,5m)**	**No 11 (6m)**
12 July 07	3,86	4,57	2,60	3,07	1,57	3,12
03 Aug 07	3,45	1,91	3,86	2,91	2,04	4,10
30 Aug 07	4,99	2,75	2,79	2,72	2,61	2,36
21 Sep 07	3,57	2,73	3,53	3,61	3,78	3,02
Average:	**4,00**	**3,00**	**3,20**	**3,10**	**2,50**	**3,10**

Table 8. Shannon-Wiener index (Lake Svente 2008)

Date of samples taken	Locality of samplings places					
	No 1 (1,2m)	**No 2 (0,8m)**	**No 3 (1,2m)**	**No 4 (1,5m)**	**No 5 (1,2m)**	**No 6 (36m)**
13 May 08	3,56	4,39	3,48	3,72	4,04	4,24
30 May 08	2,34	2,78	2,82	2,80	2,66	3,27
16 June 08	3,36	2,92	5,26	3,83	5,15	4,89
06 July 08	1,99	3,71	3,14	3,11	1,94	1,87
07 Aug 08	3,14	3,73	3,25	4,98	3,49	3,24
22 Aug 08	4,87	4,59	4,50	2,29	2,46	6,60
02 Sep 08	5,48	3,11	2,82	3,55	4,48	3,60
Average:	**3,53**	**3,60**	**3,60**	**3,45**	**3,46**	**4,00**

Table 9. Shannon-Wiener index (Lake Brigene 2008)

Date of samples taken	Locality of samplings places				
	No1 (1,2m)	**No 2 (1,8m)**	**No 3 (1,4m)**	**No 4 (1,4m)**	**No 5 (32m)**
12 May 08	2,16	2,43	2,79	2,63	3,75
30 May 08	2,88	2,76	1,83	2,86	2,38
16 June 08	2,95	3,59	2,32	2,33	2,13
07 Aug 08	3,04	4,97	2,46	2,86	1,65
22 Aug 08	4,87	4,27	3,24	3,14	3,35
Average:	**3,2**	**3,6**	**2,5**	**2,8**	**2,7**

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