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SEASONAL DYNAMICS OF BENTHIC AND PLANKTONIC COMMUNITIES IN SHALLOW LAGOON BIRD LAKE ENGURE, LATVIA

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The seasonal changes in taxonomic structure, dynamics of number, and biomass of phytoplankton and zoobenthoss communities were studied in lake Engures from November 2011 to December 2012 in ten sampling sites surround all the lake aquatorium. At the present moment status of lake Engures is defined as macrophyte (Charophyte) type lake in clear water stage. Lake is characterised by low phytoplankton biomass and low number of cell. Twoo small phytoplankton development maximas were observed: spring maxima was formed by Diatoms, Chrysophytes and Cryptophytes. Summer maxima was formed by Cyanobacteria, Diatoms and unicellular Chlorophytes. Cyanobacteria blooms was not observed. Macrozoobenthoss is dominated by Chironomidae, Malacostraca and Ephemeroptera which formed good basis of food for fishes. Presence of Ephemeroptera in high numbers in all the investigation period shows satisfactory ammount of oxygen. Low phytoplankton biomasses, low number of cells and microalgae succession typical for clean environments allows to evaluate ecological status of Lake Engures as good.

Key words: zoobenthoss, plankton, shallow lagoon, bird lake.

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INTRODUCTION

Ramsar site Lake Engures is waterbird nesting site (Vīksne 1997). Lake ecosystem is under some natural eutrophication caused by impact from internal phosphorus sources such as waterbirds droppings and some antrophogenic impact from inflowing streams and agriculture. In lentic waters phytoplankton structure and changes in structure (qualitative and quantitative) indicate environmental changes in the water body, including eutrophication. Eutrophication is especially rapid in shallow lakes, such are as common in Latvia (Briede et al 2000, Springe et al. 2007, 2011). Eutrophication nowadays is expressed not only by phytoplankton development, but by extensive development of higher vegetation. Ramsar site – lake Engure is characterized by macrophytes typical for very shallow, hard water lakes (Springe et al. 2011). Overgrowth by higher vegetation is observed in in all the aquatory of the Lake Engures. Very

important rule in lakes clear water status plays lake's Engures geology , where a leading role is high concentration of calcium (hard water lake) and a low level of reactive phosphorus (Spriņģe et al. 2011). Lake Engures similary Lake Hornborga in Sweden is rich in macrophyte stands with charophytes. These very abundant macrophyte stands and cover of charophytes provide clear water state of the lake where large amounts of nutrients can be stored for a long period without availability for phytoplankton (Blindow 1991, Blindow et al. 1993, Spriņģe et al. 2011). Very important rule in lake's clear water status plays geology of Lake Engures , where a leading role is high concentration of calcium and a low level of reactive phosphorus (Spriņģe et al. 2011).

Aim of this study was to detect seasonal dynamics, development and peculiarities of phytoplankton and zoobenthoss communities and to evaluate ecological status and fish ration basis of Lake Engures.

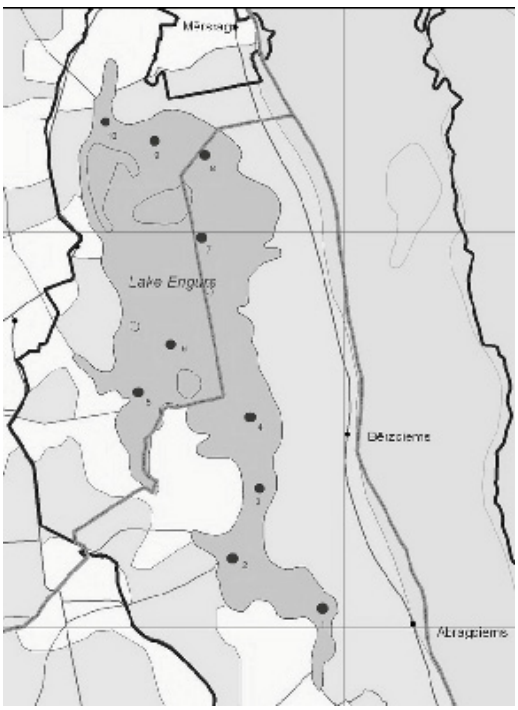

Fig. 1. Locality of sampling sites in the Lake Engures.

MATERIAL AND METHODS

Lagoon origin (lagoon type) lake Engures is formed by remaining Baltic sea in Lithorina period. Lake is situated on a moraine layer and its mean depth is about 1.0-1.5m. The shape of the lake is elongated with an even coastal line. The lake is submitted to winds facilitating a complete mixture of water layers. Studied lake is linked due canal with the Baltic sea and it is possible for sea brackish water to get into the lake.

Number and and locality of sampling station area were estimated according dimensions of investigated lake (Fig.1).

Phytoplankton and zoobenthoss samples were collected according APHA (1992). Sampling was implemented in the period November 2011 - December 2012. Phytoplankton was sampled by use of Ruttner type water sampler. Phytoplankton samples were preserved with Lugol's solution and analysed using the Utermöhl inverted microscope technique method (Paxinos & Mitchell 2000). Species composition, density, and cell dimensions were determined under a Leica DMIL microscope (200 and 400 fold magnification). Cell counts were converted to biovolumes (fresh weight mgl $^{-1}$), calculated using measured cell dimensions applied to simple geometrical shapes.

Macrozoobenthoss samples were collected with the Ekman-Berge sampler. Sieves with a mesh size of 0.5 mm were used, and samples were preserved in 4% formaldechyde solution.

RESULTS AND DISCUSSION

Phytoplankton of Lake Engures

Two small phytoplankton development maximas were observed in Lake Engures: small spring maxima mainly was formed by Diatoms, Chrysophytes and Cryptophytes. Summer maxima was formed by Cyanobacteria, Diatoms and Greens. Essential importance is in fact that

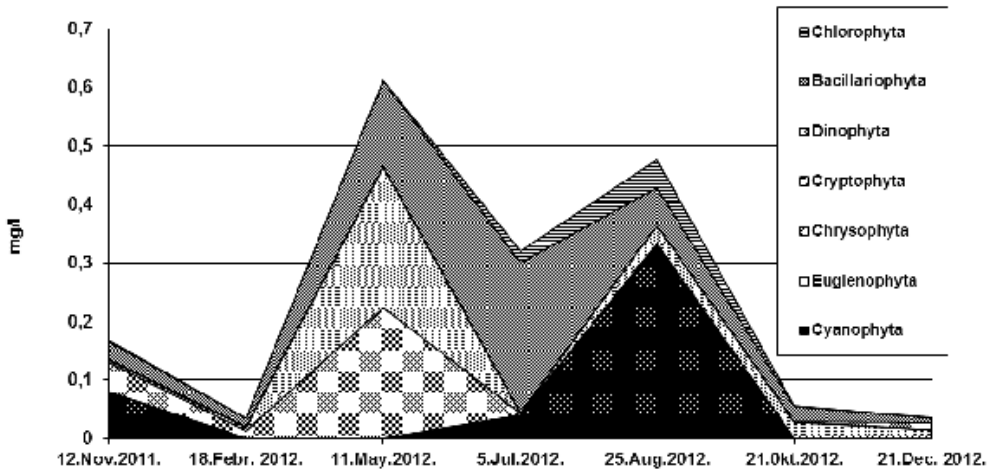

Fig. 2. Development of phytoplankton biomass (mg/l) forming algal groups in the Lake Engures (November 2011-December 2012).

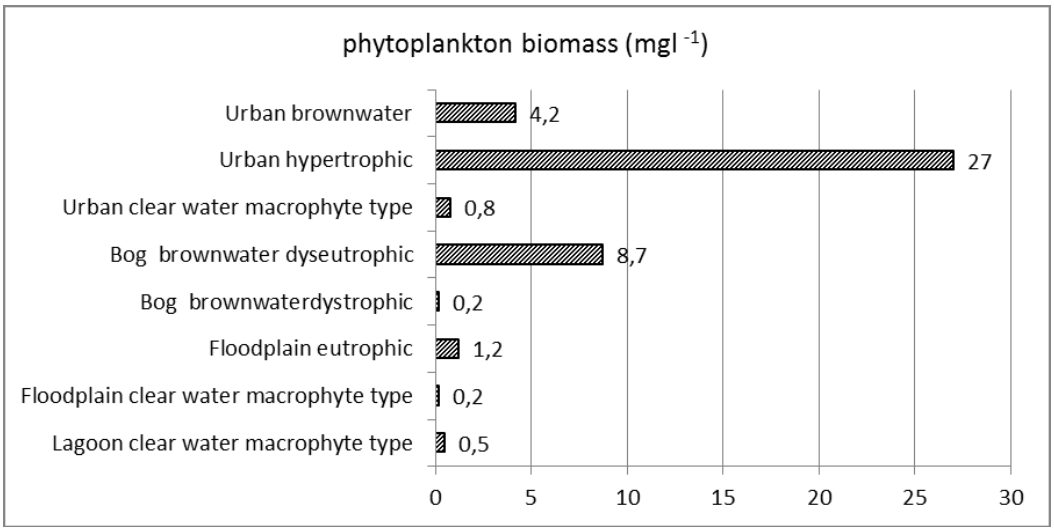

Fig. 3. Dynamics of medium phytoplankton summer biomass (mg l^{-1}) in several groups of shallow Latvia's lakes (Druvietis 2012) http://balwois.com/2012/USB/papers/580.pdf.

biomasses of both maximas are low (Fig. 2).

Seasonal succession characteristic for clear water stage macrophyte type lake and changes of algae species composition characteristic for clean water bodies was observed in the shallow Lake Engures (Table 1)

At the investigation period (November 2011-December 2012) in the aquatorium of Lake Engures in phytoplankton samples in total 88 taxa of algae (20 taxa of Cyanobacteria) were detetected (Table 2).

Most of Latvia's shallow lakes are eutrophicated or highly eutrophicated. Lake Engures is defined as morphometrically eutrophic clear water macrophyte type shallow lake. Biomass of summer phytoplankton shows eutrophication level of different type and origin shallow lakes.

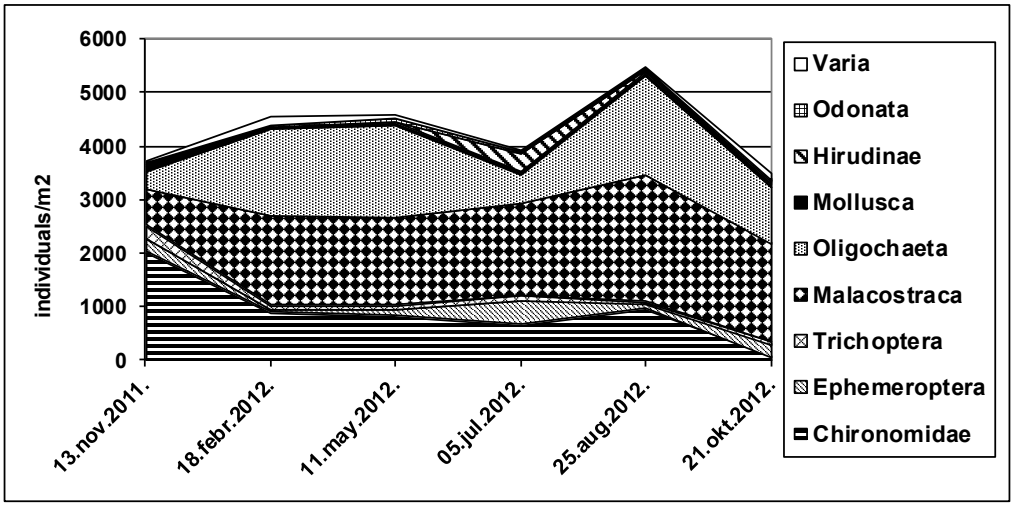

Fig. 4. Dynamics of Zoobenthoss groups forming number of individuals (ind./m2) in the Lake Engures (November 2011-October 2012).

Therefore it is possible to compare data of summer phytoplankton biomasses of shallow Lake Engures (Lagoon clear water macrophyte type lake) with common types of shallow lakes in Latvia (Druvietis 2012) (Fig.3.).

According to the results of this study and former studies (Spriņģe et al. 2007, 2011) it shows that there is a clearly distinguished relationship in biomass , taxonomic composition of phytoplankton, seasonal succession and changes of dominant phytoplankton species and trophic status of lakes. Low phytoplankton biomasses, low number of cells and microalgae succession typical for clean environments allows to evaluate ecological status of Lake Engures as good.

Zoobenthoss of Lake Engures

Zoobenthoss communities is dominated by *Asellus aquaticus*, *Caenis* sp. juv., *Cloeon dipterum*, *Oligochaeta*, *Chironomidae*, *Valvata piscinalis*, *Valvata cristata*, *Valvata naticina*, *Bithynia tentaculata*, *Viviparus contectus*, *Physa fontinalis*, *Planorbis planorbis* , *Gyraulus albus*, *Galba palustris*, *Acroloxus lacustris*, *Pisidium amnicum*, *Sphaerium corneum*, *Glassiphonia complanata*, *Piscicola geometra*, *Coenagrion vernale,* *Ischnura elegans*, *Lestes virens*, *Haliplus* sp., *Mystacides azurea*, *Cyrnus flavidus*, *Athripsodes aterrimus*, *Notonecta glauca*, *Sigara* sp.juv., *Acari* sp. Most of Macrozoobenthoss biomass (g/m^2) in Lake Engures is formed by Crustaceans, larva of Chironomids, Mollusca and Oligochaeta. Largest numbers of zoobenthoss community all the year period is formed by Crustaceans – *Asellus aquaticus* (660 ind./m^2– 2384 ind./m^2), then follows Oligochaeta (356 ind./m^2 – 1864 ind./m^2), then - larva of Chironomids (68 ind./m^2 – 2024 ind./m^2) and Mayflies (40 ind/m^2 – 436 ind/m^2).

Highest numbers of individuals (ind./m^2) and largest biomass (g/m^2) is observed in August (Fig. 4, Fig. 5).

At the investigation period (November 2011-October 2012) in the aquatorium of Lake Engures were detected macrozoobenthoss groups: Oligochaeta, Hirudinea, Isopoda, Odonata, Ephemeroptera, Heteroptera, Coleoptera, Trichoptera, Chironomidae, Ceratopogonidae, Gastropoda, Bivalvia, Plathelminthes and Hydrozoa. In total 60 taxa of macrozoobenthoss animals were detected (Table 3).

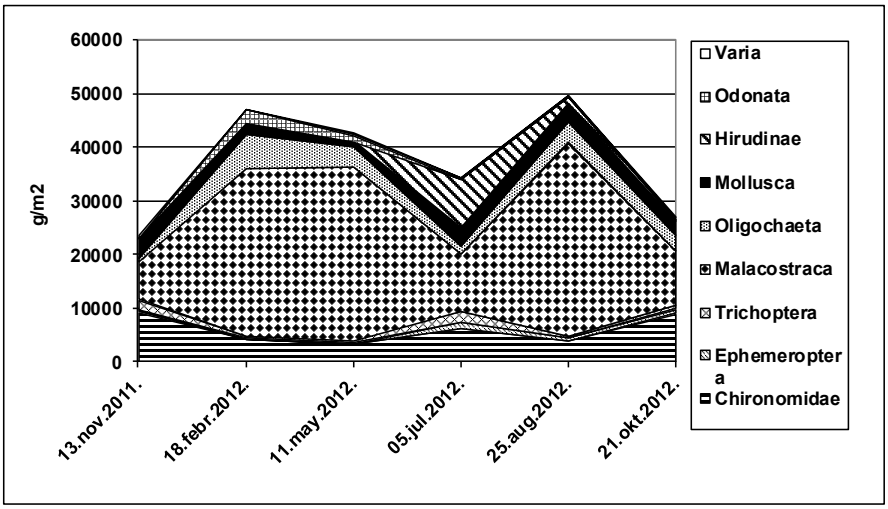

Fig. 5. Dynamics of Zoobenthoss groups forming macrozoobenthoss biomass (g/m^2) in the Lake Engures (November 2011-October 2012).

CONCLUSIONS

Low phytoplankton biomasses, low number of cells and microalgae succession typical for clean environments allows to evaluate ecological status of Lake Engures as good. Macrozoobenthoss dominated by Chironomidae, Malacostraca and Ephemeroptera formed good and healthy ration of food for birds fishes. Presence of Ephemeroptera in high numbers in all the investigation period shows satisfactory ammount of oxygen.

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Table 1. Seasonal succession and changes of dominant phytoplankton species (November 2011-December 2012)

12. nov. 2011. ⇨	18. febr. 2012. ⇨	11. may. 2012. ⇨	5. jul. 2012. ⇨	25. aug. 2012. ⇨	21. okt. 2012. ⇨	21. dec. 2012.
Dinobryon, Microcystis, Cryptomonas, Fragilaria, Navicula, Melosira, Botryococcus Scenedesmus	*Dinobryon, Melosira, Synedra, Pinnularia*	*Synedra, Navicula, Cocconeis, Synura, Rhodomonas, Cryptomonas*	*Aulacoseira, Anabaena, Microcystis, Dinobryon*	*Microcystis, Anabaena, Oscillatoria, Fragilaria, Nitzschia, Scenedesmus, Botryococcus, Cryptomonas*	*Cryptomonas, Rhodomonas, Dinobryon, Nitzschia*	*Cryptomonas, Gymnodinium, Cymbella, Navicula, Nitzschia*

Table 2. List of Phytoplankton taxa composition in the aquatorium of Lake Engures (November 2011-December 2012)

Taxa list	**Sampling stations**									
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**
Cyanophyta										
Anabaena flos-aquae (Lyngb.) Breb.		X			X	X				
Anabaena lemmermannii P. Richter	X	X	X	X	X	X	X	X	X	X
Anabaena sp.	X	X	X	X	X	X		X		X
Anabaena spiroides Klebahn.			X	X	X					
Aphanothece clathrata W.et G.S.West.	X	X	X			X	X	X		X
Chroococcus turgidus (Kützing) Nägeli							X	X	X	
Gloeocapsa sanguinea (C.Agardh) Kützing	X	X		X	X		X	X	X	X
Gloeocapsa sp.					X	X		X		
Gomphosphaeria aponina Kützing								X		
Gomophosphaeria lacustris Chodat	X	X	X	X	X	X	X	X		X

Taxa list	Sampling stations									
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**
Gomphosphaeria naegeliana (Unger) Lemmermann	X					X	X	X		X
Merismopedia eleagns Braun ex Kützing	X	X	X					X		
Merismopedia tenuissima Lemmermann						X		X		
Microcystis aeruginosa (Kützing) Kützing	X			X						
Microcystis pulverea (Wood) Forti			X	X		X	X	X		X
Microcystis viridis (A.Braun) Lemmermann	X	X					X	X		
Oscillatoria putrida Schmidle		X	X	X						
Oscillatoria princeps Vaucher			X	X						
Oscillatoria redeckei van Goor			X		X					
Oscillatoria tenuis C.Agardh	X			X	X				X	
Oscillatoria sp.								X	X	X
Chrysophyceae										
Dinobryon bavaricum Imhof			X	X	X	X		X	X	X
Dinobryon divergens O.E.Imhof	X					X		X		X
Dinobryon sertularia Ehrenberg	X	X	X	X	X	X	X	X	X	X
Mallomonas sp.		X	X							
Synura uvella Ehrenberg		X	X	X					X	X
Cryptophyta										
Cryptomonas marssonii Skuja			X					X	X	X
Cryptomonas ovata Ehrenberg									X	X
Cryptomonas sp.	X	X	X	X	X	X	X	X	X	X
Rhodomonas sp.	X	X	X	X	X	X	X	X	X	X
Bacillariophyceae										
Amphora ovalis (Kützing) Kützing	X	X		X	X			X	X	X
Asterionella formosa Hassall			X	X	X			X		
Aulacoseira italica (Ehrenberg) Simonsen	X	X	X	X	X	X	X	X	X	X
Aulacoseira italica var. tenuissima (Grunow) Simonsen			X	X					X	X
Aulacoseira islandica (O.Müller) Simonsen					X					
Cocconeis pediculus Ehrenberg	X	X	X	X	X	X	X	X	X	X
Cocconeis placentula Ehrenberg		X	X		X			X	X	X

Taxa list	Sampling stations									
	1	2	3	4	5	6	7	8	9	10
Cyclotella sp.	X			X	X			X		X
Cymbella sp.	X		X	X	X	X	X	X		X
Diatoma elongata(Lyngbye) C.A. Agardh				X						
Diatoma vulgare Bory de Saint-Vincent	x				X			X		X
Ellerbeckia arenaria (Moore) R.M. Crawford				X	X					
Fragilaria capucina Desmazières		X		X					X	X
Fragillaria crotonensis Kitt.							X	X	X	X
Fragillaria construens (Ehrenberg) Grunow										
Fragilaria sp.			X	X				X	X	X
Gomphonema sp.				X	X		X	X	X	X
Gyrosigma acuminatum (Kützing) Rabenhorst	X			X						X
Gyrosigma sp.				X					X	X
Melosira varians C.Agardh	X	X	X	X		X		X	X	X
Meridion circulare (Greville) C.Agardh	X		X		X				X	
Navicula cryptocephala Kützing	X				X	X				X
Navicula gracilis Ehrenberg	X		X	X	X		X		X	X
Navicula sp.	X	X	X	X	X	X	X	X	X	X
Nitzschia acicularis (Kützing) W.Smith	X		X	X	X	X	X			
Nitzschia sp.	X		X	X	X	X	X	X		X
Pinnularia gibba Ehrenberg			X	X						
Pinnularia sp.	X	X	X	X	X	X	X	X	X	X
Rhiocosphaenia curvata (Kützing) Grunow		X								
Surirella sp.	X	X								X
Synedra ulna (Nitzsch) Ehrenberg	X	X	X	X	X	X	X	X	X	X
Synedra acus Kützing	X	X	X	X			X	X	X	X
Synedra sp.	X						X	X		
Tabellaria flocculosa (Roth) Kützing	X	X								
Euglenophyceae										
Euglena acus (O.F.Müller) Ehrenberg				X						
Euglena sp.	X									X

Taxa list	Sampling stations									
	1	2	3	4	5	6	7	8	9	10
Phacus pleuronectes (O. F. Müll.) Dujardin									X	X
Phacus sp.	X		X	X						X
Dinophyceae										
Glenodinium sp.			X							X
Gymnodinium aeruginosum F.Stein								X	X	
Gymnodinium sp.	X	X	X	X	X	X	X	X	X	X
Peridinium sp.		X	X	X	X		X	X	X	X
Peridinium willey Huitfeldt-Kaas	X									X
Ceratium hirudinella (O.F.Müller) Dujardin			X	X		X				X
Chlorophyta										
Ankistrodesmus falcatus (Corda) Ralfs		X	X					X		X
Ankistrodesmus sp.	X	X	X	X	X	X	X	X	X	X
Botryococcus braunii Kützing	X	X		X	X		X	X		X
Closterium moniliferum Ehrenberg ex Ralfs									X	X
Closterium sp.	X	X		X				X	X	
Coelastrum microporum Nägeli	X				X	X	X	X		
Coelosphaerium kuetzingianum Nägeli								X		
Cosmarium sp.	X	X								
Cruccigenia fenestrata (Schmidle) Schmidle								X		
Cruccigenia sp.	X	X					X	X		X
Crucigenia tetrapedia (Kirchner) Kuntze				X						
Desmidium sp.									X	X
Dictyosphaerium pulchellum Wood			X	X		X				
Oocystis lacustris Chodat							X		X	
Pediastrum tetras (Ehrenberg) Ralfs			X		X	X				
Pediastrum boryanum (Turpin) Meneghini	X	X	X	X	X	X	X	X	X	X

Taxa list	Sampling stations									
	1	2	3	4	5	6	7	8	9	10
Rhizosolenia longiseta O.Zacharias			X			X				
Scenedesmus acuminatum (Lagerh.) Chodat		X	X							X
Scenedesmus arcuatus (Lemmermann) Lemmermann	X	X	X	X	X	X	X	X	X	X
Scenedesmus bijugatus Kützing			X						X	X
Scenedesmus quadricauda (Turpin) Brébisson		X	X							X
Tetraedron minimum (A.Braun) Hansgirg				X	X					X
Tetraedron sp.	X									X

Table 3. List of macrozoobenthos taxa composition in the aquatorium of Lake Engures (November 2011-October 2012)

Taxa	Sampling stations									
	1	2	3	4	5	6	7	8	9	10
Oligochaeta	X	X	X	X	X	X	X	X	X	X
Hirudinea										
Erpobdella octoculata (Linnaeus, 1758)										X
Haemopis marginata (O.F.Müller, 1774)				X						
Helobdella stagnalis (Linnaeus, 1758)		X	X	X	X			X	X	
Piscicola geometra (Linnaeus, 1758)	X							X	X	
Glossiphonia complanata (Linnaeus, 1758)	X	X	X	X	X		X	X	X	X
Isopoda										
Asellus aquaticus (Linnaeus, 1758)	X	X	X	X	X	X	X	X	X	X
Gammarus lacustris G.O.Sars 1863	X		X				X	X		X
Odonata										
Aeshna grandis Linnaeus, 1758)							X			
Caenagrion puchellum (Vander Linden, 1825)	X						X			
Coenagrion armatum (Charpentier, 1840)			X		X					

Taxa	Sampling stations									
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**
Coenagrion hastulatum (Charpentier, 1825)					X					
Cordulia aenea Linnaeus, 1758								X		
Lestes virens (Charpentier, 1825)								X		
Lestes sponsa (Hansemann, 1823)							X	X		
Ischnura elegans (Vander Linden, 1820)									X	
Sympetrum danae (Sulzer, 1776)	X		X							
Ephemeroptera										
Baetis rhodoni Leach, 1815	X									
Baetis sp.	X									
Caenis horaria Stephens, 1835	X	X	X	X	X	X	X	X	X	X
Caenis robusta Jensen C.F., 1956		X	X	X			X	X	X	X
Caenis macrura, Stephens,1835					X		X			X
Caenis sp.	X	X	X	X	X	X	X		X	X
Cloeon dipterum (Linnaeus, 1761)	X	X	X		X	X	X	X	X	
Heteroptera										
Corixa sp.	X									
Sigara sp.										X
Notonecta glauca (Linnaeus, 1758)	X									
Coleoptera										
Haliplus sp.									X	X
Trichoptera										

Taxa	Sampling stations									
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**
Cyrnus flavidus McLachlan, 1864	X	X	X	X			X	X	X	X
Molana angustata Curtis, 1834									X	
Mystacides longicornis (Linnaeus, 1758)	X									
Mystacides azurea Linnaeus, 1761		X							X	
Phryganea bipunctata Retzius 1783										X
Plectrocnemia conspersa (Curtis, 1834)					X				X	
Athripsodes atterimus (Stephens, 1836)					X	X	X	X		
Athripsodes cinereus (Curtis, 1834)			X	X						
Triaenodes bicolor (Curtis, 1834)			X				X		X	
Chironomidae	X	X	X	X	X	X	X	X	X	X
Ceratopogonidae										
Culicoides sp.		X					X			
Gastropoda										
Anisus vortex (Linnaeus, 1758)										X
Acroloxus lacustris (Linnaeus, 1758)						X				X
Bithynia tentaculata (Linnaeus, 1758)	X	X	X	X			X	X	X	X
Bithynia leachii (Sheppard, 1823)		X			X					
Galba palustris (O.F. Müller, 1774)					X					
Gyraulus albus (O.F. Müller, 1774)					X					
Physa fontinalis (Linnaeus, 1758)	X						X		X	
Valvata piscinalis (Müller, 1774)	X			X	X		X		X	
Valvata cristata (O.F. Müller, 1774)							X			
Valvata naticina Menke, 1845							X			
Segmentina nitida (O.F. Müller, 1774)									X	

Taxa	Sampling stations									
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**
Viviparus contectus (Millet, 1813)							X			X
Bivalvia										
Pisidium amnicum(O.F. Müller, 1774)		X				X				
Sphaerium corneum (Linnaeus, 1758)		X	X			X		X	X	
Plathelminthes										
Planaria torva Müller OF, 1776			X						X	X
Euplanaria lugubris (Schmidt, 1861)			X							
Dendracoelum lacteum (Müller, 1774)		X								
Hydrozoa										
Hydra sp.				X						
Arachnida										
Acari sp.	X	X			X	X		X	X	X

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