

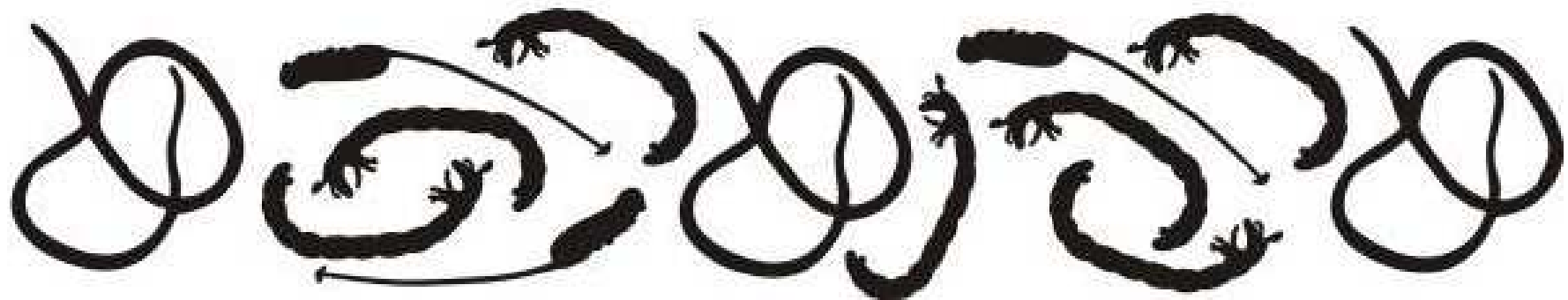
Evaluation of the ecological status of Lake Durowskie by macrozoobenthos taxa



2010



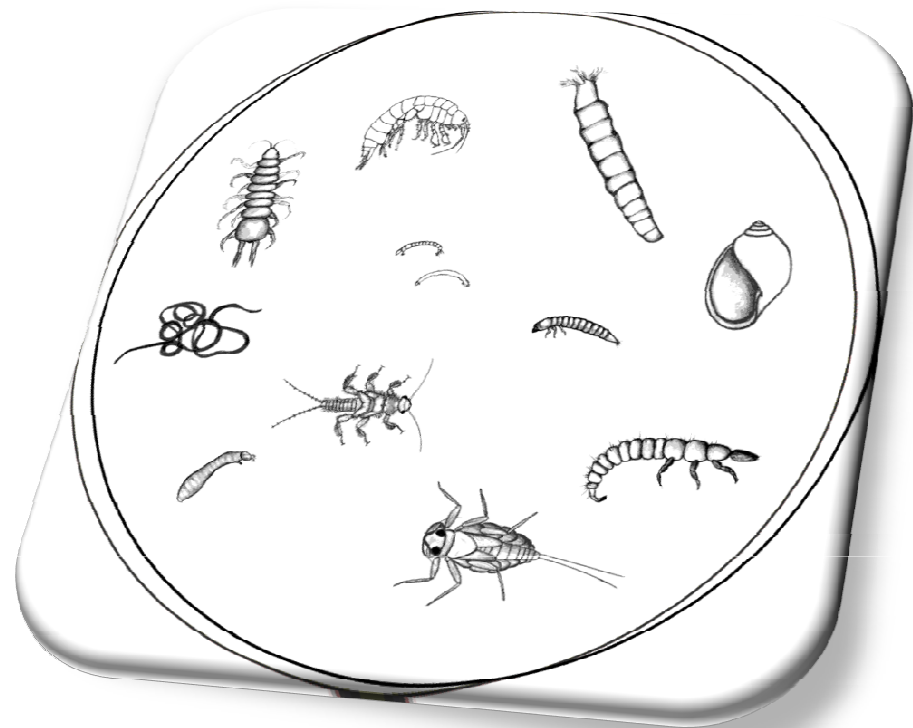
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Plan of presentation

1. Introduction
 - Macrozoobenthos
 - Benthic macroinvertebrates as indicators
2. Methodology
3. Results and Discussion
4. Conclusion



Introduction

Wprowadzenie



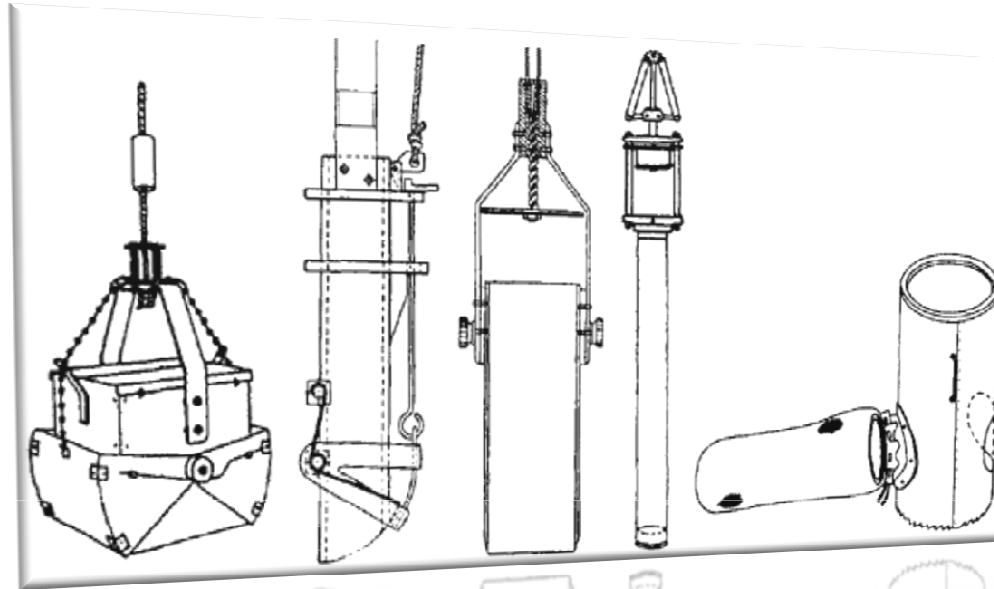
Macrozoobenthos

- Group of large organisms which live at the bottom
- They include: *Annelida*, *Crustacea*, *Insecta*, *Mollusca* and many other.
- Benthic macroinvertebrates are the most common group of organisms used to assess water quality.




Benthic macroinvertebrates as indicators

- long-lived group
- live in the water for all or most of their life
- wide range of geographic occurrence
- react strongly to human influences on aquatic systems
- easy identification and cheap collection
- have limited mobility



Methodology

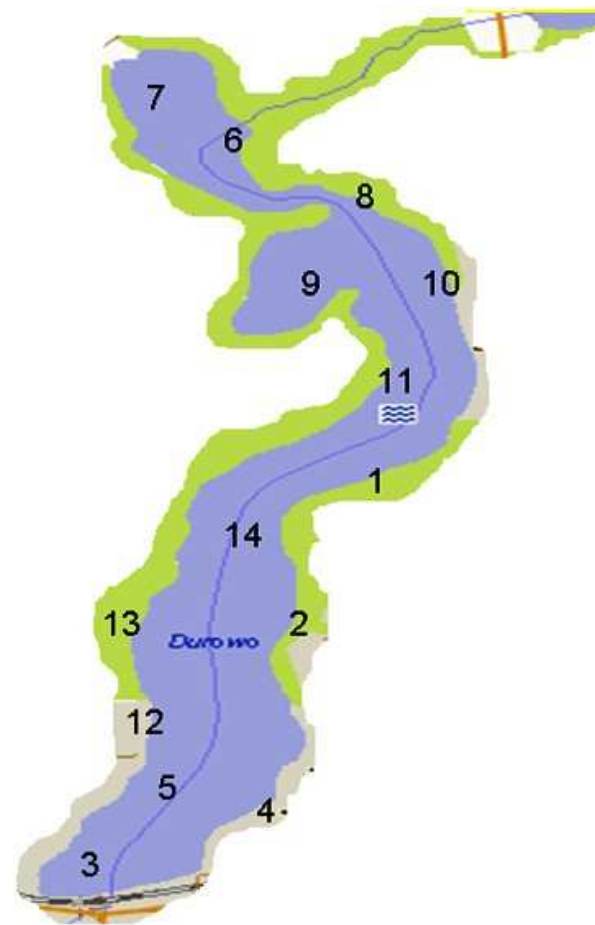
Metody badań

- 
- Number of sites: 14
 - Period: 5 – 10.07.2010
 - The 14 sampling sites of the lakes were assigned to 4 different categories:
 - ✓ Pelagial – 4 samples
 - ✓ Aerators zones – 2 samples
 - ✓ Litoral (forest) – 5 samples
 - ✓ Litoral (urban) – 3 samples

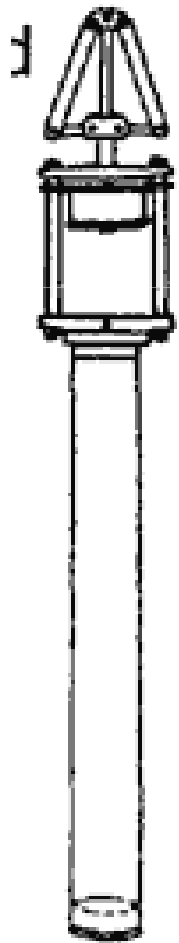
Location of sampling sites

Lokalizacja punktów poboru prób

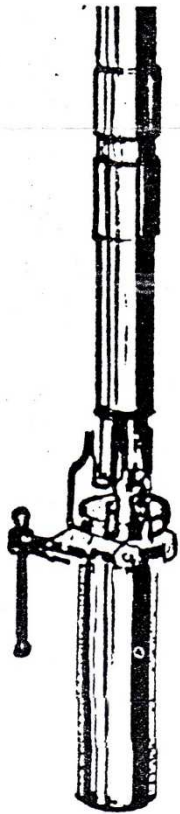
1. Littoral with reed near forest cover
2. Littoral near urban area
3. Pelagial near dam
4. Littoral near urban area
5. Pelagial (Aerator I)
6. Littoral near Struga Gołaniecka River
7. Pelagial
8. Littoral (Bulrush near forest cover)
9. Pelagial
10. Pelagial (aerator II)
11. Littoral with reed
12. Littoral near urban area
13. Littoral with reed near forest cover
14. Pelagial



Step 1: Sample collection from deeper parts of the lake with “Kajak” sampler



Step 2 : Sample collection from the sediments in shallow waters with “Czapla” sampler







Step 3: Washing of zoobenthos samples using a sieve



Step 4: Sorting of macroinvertebrates



Step 5: Identified macroinvertebrates taxa



Step 6: Estimation of biomass






Data Analysis

Measurement of Diversity

- **Shannon-Wiener index (H)**– shows which area has the greatest diversity
- **Equitability (E)** or Evenness - a measure of biodiversity which quantifies how equal the community is numerically
- **Diversity index (d)** or Margalef's index – provides a measure of species richness

- 
- **EPT Index** – proportion of pollution-sensitive individuals of *Ephemeroptera*, *Plecoptera* and *Trichoptera* orders found in the sample. A high variety is good
 - **Ratio of EPT and *Chironomidae*** - dividing the sum of the total number of individuals classified as *Ephemeroptera*, *Plecoptera*, and *Trichoptera* by the total number of individuals classified as *Chironomidae* (indicators of poor water quality).

Standard table of BMWP-PL		
	Families	Score
Ephemeroptera Trichoptera Diptera	<i>Ameletidae</i> <i>Glossosomatidae</i> , <i>Molannidae</i> , <i>Beraeidae</i> , <i>Odontoceridae</i> , <i>Leptoceridae</i> <i>Blephariceridae</i> , <i>Thaumaleidae</i>	10
Ephemeroptera Plecoptera Odonata Trichoptera	<i>Behningiidae</i> <i>Taeniopterygidae</i> <i>Cordulegastridae</i> <i>Goeridae</i> , <i>Lepidostomatidae</i>	9
Crustacea Ephemeroptera Plecoptera Trichoptera Diptera	<i>Astacidae</i> <i>Oligoneuriidae</i> , <i>Heptageniidae</i> (only genus <i>Epeorus</i> and <i>Rhithrogena</i>) <i>Capniidae</i> , <i>Perlidae</i> , <i>Chloroperlidae</i> <i>Philopotamidae</i> <i>Athericidae</i>	8
Ephemeroptera Plecoptera Odonata Trichoptera Coleoptera Heteroptera Gastropoda Bivalvia	<i>Siphonuridae</i> , <i>Leptophlebiidae</i> , <i>Potamanthidae</i> , <i>Ephemerellidae</i> , <i>Ephemeridae</i> , <i>Caenidae</i> , <i>Perlodidae</i> , <i>Leuctridae</i> <i>Calopterygidae</i> , <i>Gomphidae</i> , <i>Rhyacophilidae</i> , <i>Brachycentridae</i> , <i>Sericostomatidae</i> , <i>Limnephilidae</i> <i>Elmidae</i> <i>Aphelecheiridae</i> <i>Viviparidae</i> <i>Unionidae</i> , <i>Dreissenidae</i>	7
Hirudinea Crustacea Ephemeroptera) Plecoptera Odonata Trichoptera Diptera Gastropoda	<i>Piscicolidae</i> <i>Gammaridae</i> , <i>Corophiidae</i> <i>Baetidae</i> , <i>Heptageniidae</i> (except for genus <i>Epeorus</i> and <i>Rhithrogena</i>) <i>Nemouridae</i> <i>Platycnemididae</i> , <i>Coenagrionidae</i> <i>Hydroptilidae</i> , <i>Polycentropodidae</i> , <i>Ecnomidae</i> <i>Limoniidae</i> , <i>Simuliidae</i> , <i>Empididae</i> <i>Neritidae</i> , <i>Bithyniidae</i>	6
Crustacea Trichoptera Coleoptera Heteroptera Diptera Gastropoda	<i>Cambaridae</i> <i>Hydropsychidae</i> , <i>Psychomyidae</i> <i>Gyrinidae</i> , <i>Dytiscidae</i> , <i>Halplidae</i> , <i>Hydrophilidae</i> <i>Mesoveliidae</i> , <i>Veliidae</i> , <i>Nepidae</i> , <i>Naucoridae</i> , <i>Notonectidae</i> , <i>Pleidae</i> , <i>Corixidae</i> <i>Tipuliidae</i> <i>Hydrobiidae</i>	5
Diptera Gastropoda Bivalvia	<i>Ceratopogonidae</i> <i>Valvatidae</i> , <i>Planorbidae</i> <i>Sphaeriidae</i>	4
Hirudinea Crustacea Megaloptera Diptera Gastropoda	<i>Glossiphonidae</i> , <i>Eropodellidae</i> , <i>Hirudinidae</i> <i>Asellidae</i> <i>Sialidae</i> <i>Chironomidae</i> <i>Ancylidae</i> , <i>Physidae</i> , <i>Lymnaeidae</i>	3
Oligochaeta Diptera	All Oligochaeta <i>Culicidae</i>	2
Diptera	<i>Syrphidae</i> , <i>Psychodidae</i>	1

- The **BMWP-PL** (Biological monitoring working party index adopted to Polish Conditions)



Tabel 1. The 5 ecological according to the water framework directive classification

Tabela 1. 5- cio stopniowa skala klasyfikacji stanu ekologicznego wód (wg RDW)

Ecological Status	Class
Very Good	I
Good	II
Moderate	III
Poor	IV
Bad	V



Results and Discussion

Wyniki i dyskusja

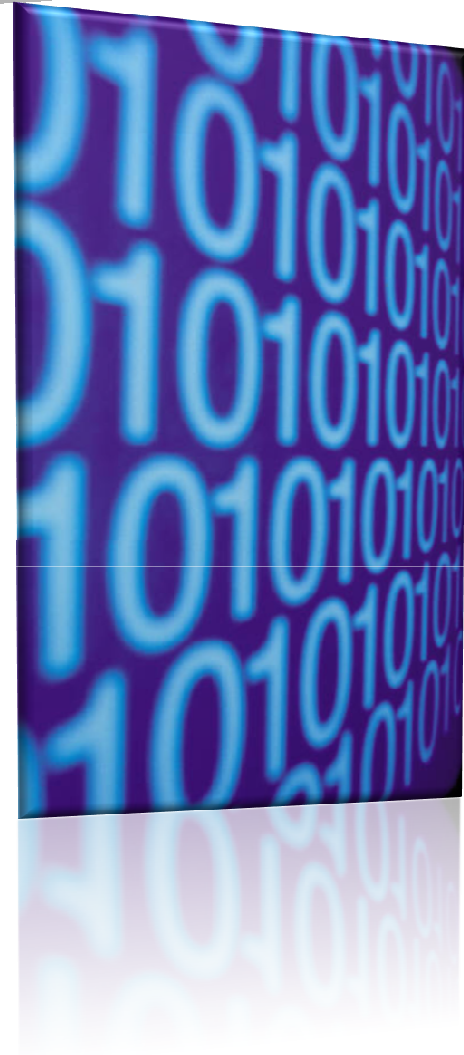


Fig 1. Total number of species and individuals identified in 2009 and 2010 sampling season in Lake Durowskie.

Fig 1. Liczba gatunkow i organizmow na poszczegolnych stanowiskach w latach 2009-2010

2009 site 2

- 15 taxa

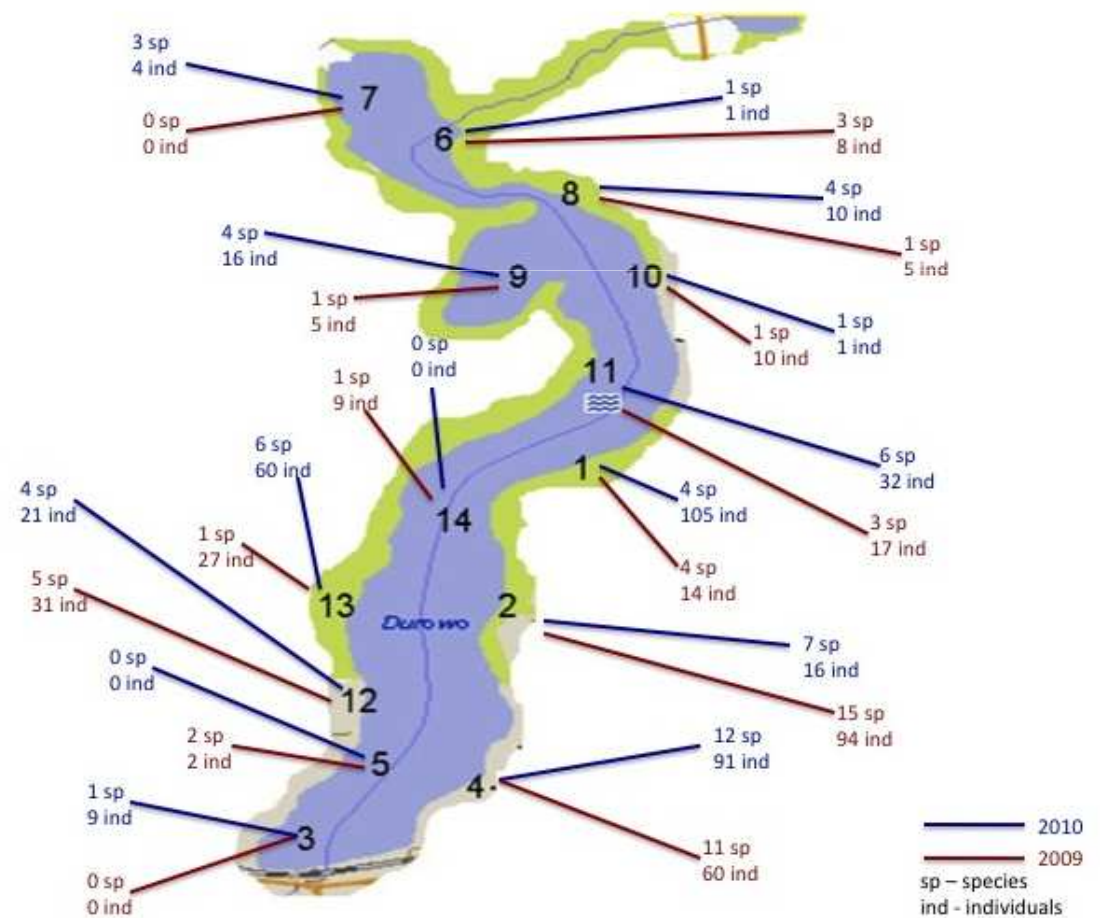
2010 site 4

- 12 taxa

2009 sites 3 and 7

2010 sites 5 and 14

- 0 taxa



19 taxa were identified.

Littoral zones contain more species

Pelagial zone consist of only 5 taxa

- *Tubifex tubifex*
- *Ceratopogonidae*
- *Chaoboridae*
- *Chironomidae*
- *Hydracarina*

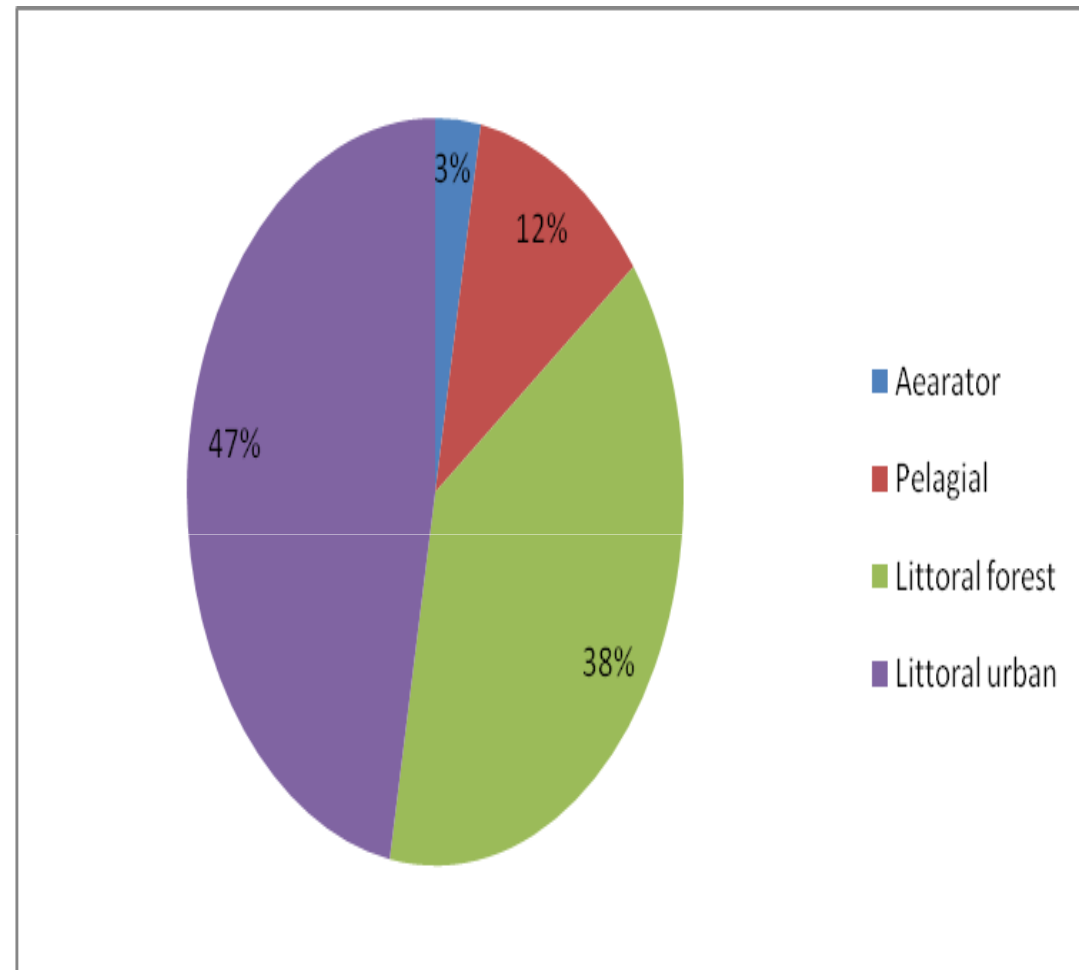


Fig 1. The distribution of species in the 4 different zones of lake Durowskie.

Fig 1. Udział procentowy taksonów w poszczególnych partiach jeziora Durowskiego.

17859 individuals /m²

- littoral forest -57%
- littoral urban 35%
- pelagial zones 8%
- Aerator <0.1%

Site 4 -12 taxa

Sites 5 and 14 - 0 taxa

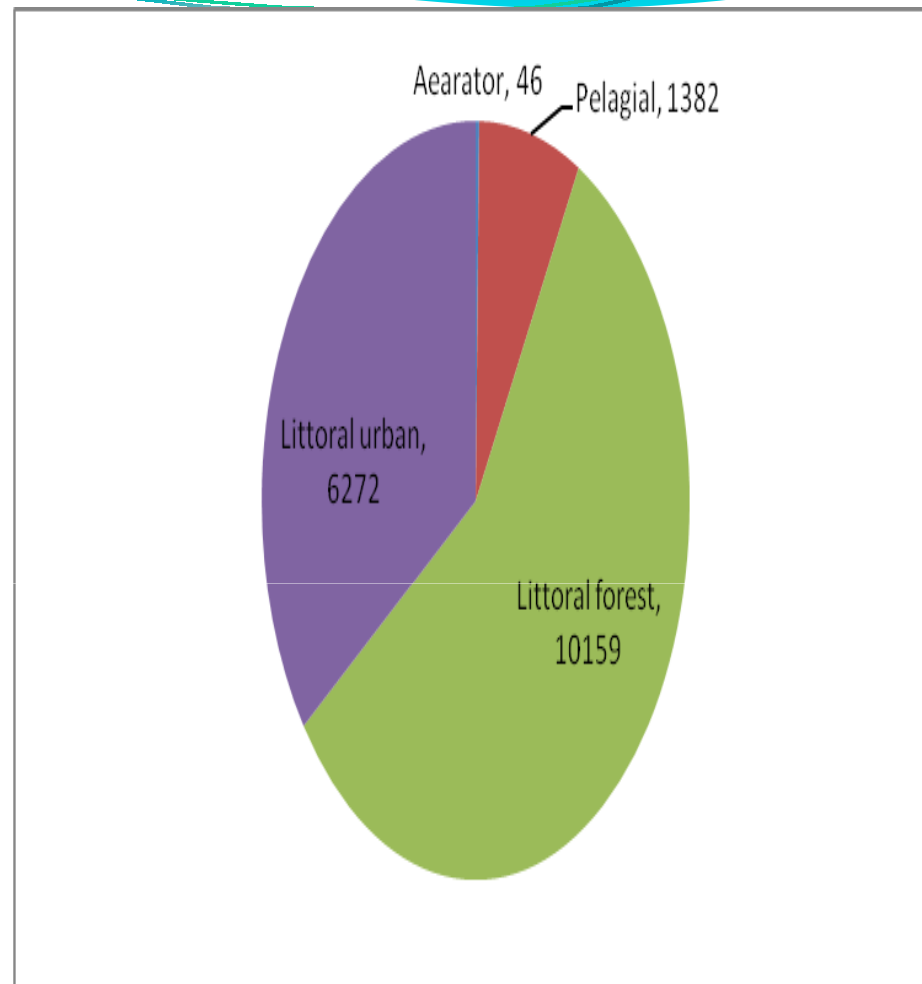


Fig 2. Total number of individuals collected at the four different sampling zones of lake Durowskie.

Fig 2. Całkowita liczba organizmów zebranych w poszczególnych partiach jeziora Durowskiego.

Table 2. Indices and BMWP scores of macroinvertebrates taxa of Lake Durowskie (1m²)

Tabela 2. Wartości obliczonych indeksów makrobezkręgowców w Jeziorze Durowskim (1m²)

Indices	1	2	3	4	5	6	7	8	9	10	11	12	13	14
<i>Shannon index</i>	0,34	0,724	0	0,709	0	0	0,452	0,518	0,449	0	0,592	0,246	0,251	0
<i>Evenness index</i>	0,565	0,857	0	0,657	0	0	0,946	0,861	0,746	0	0,761	0,409	0,322	0
<i>EPT</i>	0	49	0	539	0	0	0	46	0	0	392	0	49	0
<i>EPT/Chironomidae</i>	0	0.17	0	0.22	0	0	0	0.25	0	0	0.5	0	0.02	0
<i>BMWP</i>	12	28	0	50	0	0	4	12	5	0	26	15	15	0
<i>Diversity index</i>	1.078	2.07	0.38	3.29	0	0.6	1.3	1.502	1.38	0.6	1.88	1.328	1.73	0



EPT /Chironomidae	1	2	3	4	5	6	7	8	9	10	11	12	13	14
2009	0.09	0.13	0	0.176	0	0	0	0	0	0	0	0	0	0
2010	0	0.17	0	0.22	0	0	0	0.25	0	0	0.5	0	0.02	0

Odonata family was not collected during this year

Hydracarina taxa was not found during last year sampling

The taxa composition of Lake Durowskie has not changed much

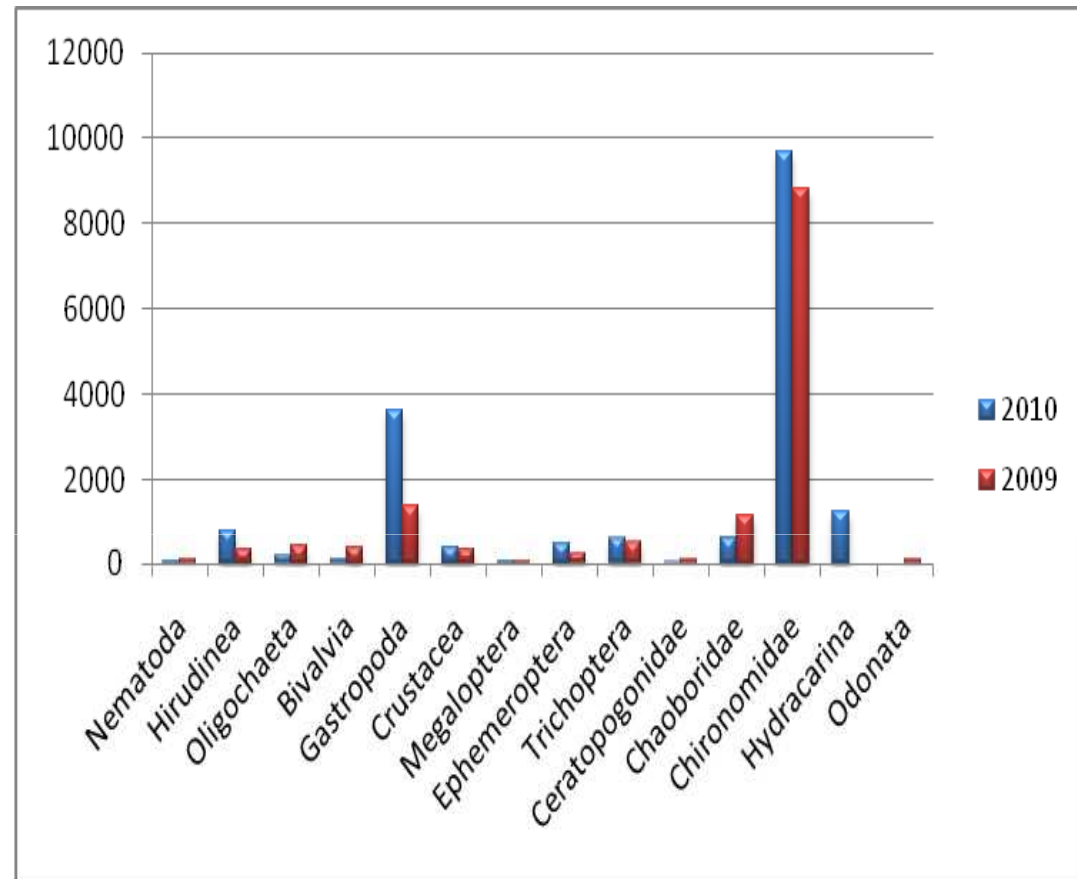


Fig 3. Macroinvertebrates taxa identified in 2009 and 2010 sampling season in Lake Durowskie.

Fig 3. Zestawienie taksonów zidentyfikowanych w jeziorze Durowskim w latach 2009 i 2010.

Cluster analysis

Highest similarity

- sites 6 and 10

Highest dissimilarity

- sites 1 and 3

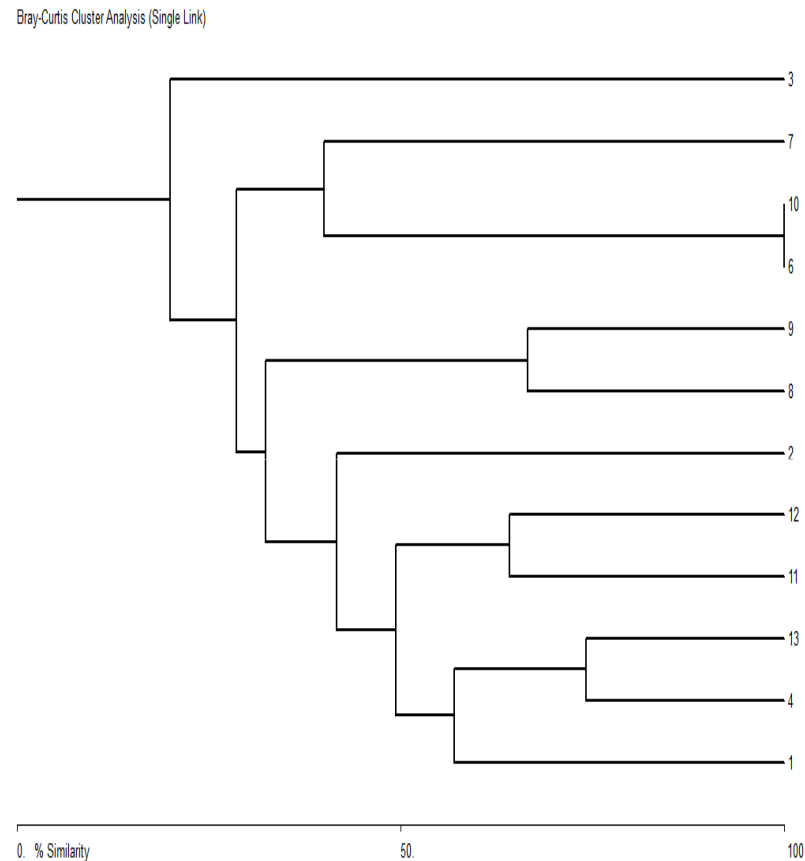


Fig 4. The hierarchical clustering of sampling sites using macroinvertebrate taxa composition.

Fig 4. Hierarchiczna analiza klastrowa punktów poboru prób w oparciu o podobieństwo taksonów

PCA analysis

PCA analysis discriminated the sampling sites

Sites 3,10 and 6

dominance of Chaoboridae

Sites 7

- dominance of Ceratopogenidae and chaoboridae taxa

sites 4

- high proportion of Hellobdella taxa

Site 13 upper right corner

- high abundance of *Hydracarina*

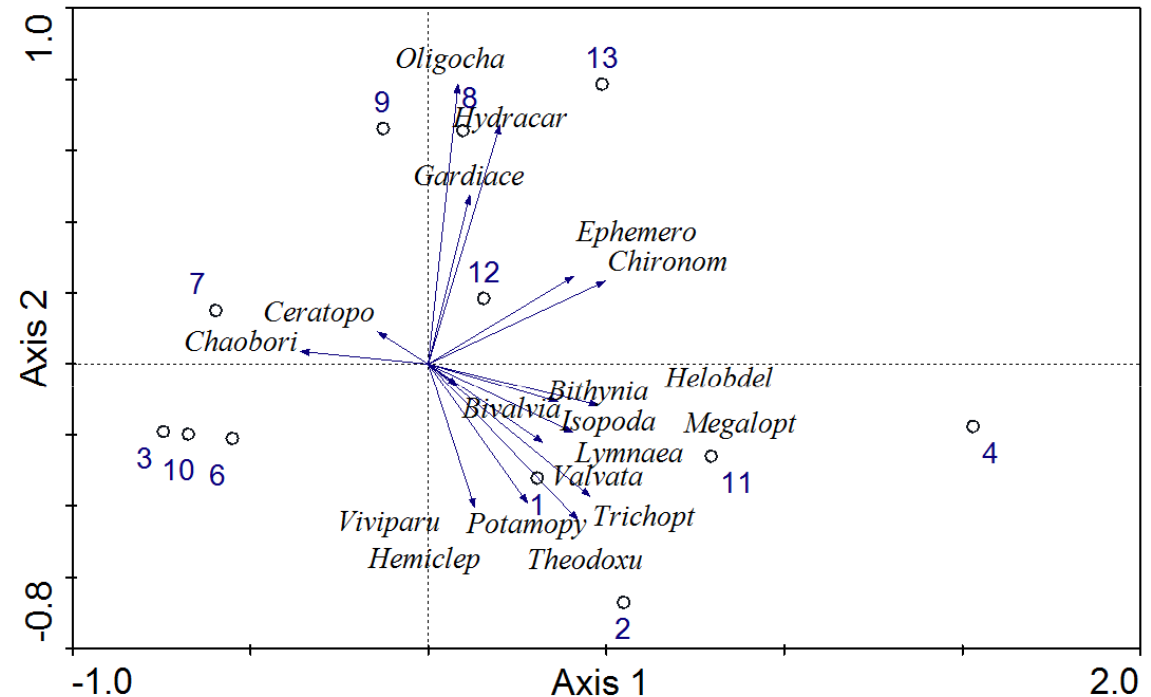


Fig 5. PCA biplot of samples and macroinvertebrates based on the first two axes.

Fig 5. Analiza czynnikowa punktów poboru prób na podstawie obecności poszczególnych taksonów.



BMWP score

Highest BMWP

- site 4 (50) -moderate condition
- sites 1,2,7,8,9,12 and 13 - poor status
- remaining sites - bad condition

Table 3. Summary of the BMWP scores for the sampling sites of Lake Durowskie.

Tabela 3. Stan ekologiczny poszczególnych stanowisk w oparciu o wartości BMWP.

Sampling site	BMWP score	Class	Ecological status
4	50	III	Moderate
1,2,7,8,9,12,13	10-39	IV	Poor
3,5,6,10,11,14	<10	V	Bad

Diversity index

The diversity index of site 4 is the highest-moderate condition

Similar result with the BMWP score

The diversity index also indicated the poor condition of the lake status

Table 4. Summar of diversity index for the sampling sites of Lake Durowskie.

Tabela 4. Status ekologiczny poszczególnych stanowisk na podstawie indeksu bioróżnorodności.

Sampling site	Diversity index	Class	Ecological status
4	2.5-3.9	III	Moderate
1,2,7,8,9,11,12,13	1-2.4	IV	Poor
3,5,6,10,14	<1	V	Bad



Conclusion

A total of 19 taxa consisting of 17859 individuals

Site 4 (littoral urban) has the highest species richness with 12 taxa

The pelagial zone consist of only 5 taxa (*Tubifex tubifex*, *Ceratopogenidae*, *Chaoboridae*, *Chironomidae* and *Hydracarina*)

- Littoral forest consist of a higher number of species (57%)
- Pelagial zone constitute 8%
- Aerator consisted <0,1% of the species

The highest Shannon index was calculated for site 2 (Littoral near urban, 0.724)

Sites 7, 2, 8, 9 and 11 relatively higher equitability index



The highest number of EPT individuals was found at sampling site 4 (539)

The BMWP score and diversity index

- site 4 has the highest value (moderate condition)

The BMWP score and diversity index indicate the poor condition of lake Durowskie.

The northern part of the lake contained lower species and individuals than the southern part of the lake, what might be connected with the inflow of Struga Gołaniecka, which carry a lot of nutrients and sediments.



- **Summary**

- **Phytoplankton, peryphiton, macrophytes and macrozoobenthos – southern part of lake is in better condition than a northern**
- **Struga Gołaniecka river still has influence for lake-high number of cyanobacteria**
- **Visibility improves**
- **Biomanipulation has impact on the trophic status of this lake**
- **For bigger and better effect we should arm ourself with patience and continue the hard work**



Thank you
Dziękujemy

