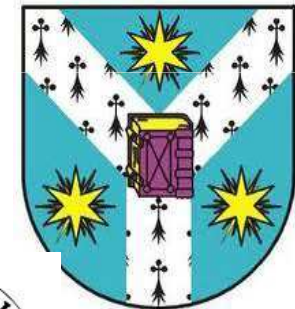


Ecological state of the Lake **Durowskie** during restoration measures according to macro-invertebrates survey



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Introduction

- Various human activities = Continuous threats
- Changes in land use, increasing leisure activity
- Eutrophication → Water quality: Oxygen, Nutrients
- Toxic chemicals, habitat change
- Reduced benefits
- Regular monitoring



Introduction

- All animal species
≥ 1 mm
In or on aquatic substrate



<http://www.epa.gov/bioiweb1/html/benthosclean.html>

Introduction

- Macroinvertebrates = Biological indicators
 - Life in water
 - Easy to collect
 - Different tolerance
 - Easy to identify
 - Long life
 - Limited mobility
 - Integrators of environmental condition
 - Rapid recovering
 - High variety of species

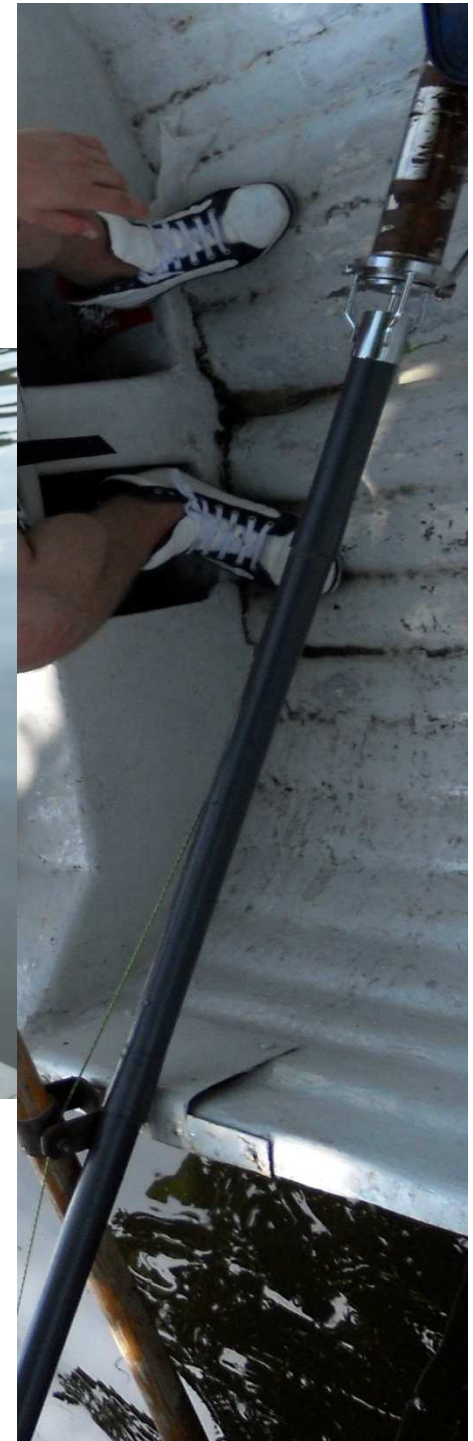
Introduction

- Water Framework Directive
- Three categories
 - High status = disturbance-sensitive species, pristine conditions
 - Good status = most sensitive species
 - Moderate status = species indicating pollution

Introduction

- Investigation of the current status
 - Different species of macroinvertebrates and their abundance
 - Different sampling sites, previous years
 - Trend
- Recommendation for the lake management

Methodology



Location of sampling sites



Number of sites	Sites description
1	Littoral with reeds near forest cover
2	Littoral near urban area
3	Pelagial near dam
4	Littoral near urban area
5	Pelagial (aerator 1)
6	Littoral near Struga Golaniecka River
7	Pelagial
8	Littoral (bulrush near forest cover)
9	Pelagial
10	Pelagial (aerator 2)
11	Littoral with reeds
12	Littoral near urban area
13	Littoral with reeds near forest cover
14	Pelagial

- Number of sites :14
- Period: 2nd -7th of July 2012
- The 14 sampling of the lakes were assigned to 6 different categories:
 1. Pelagial : 4 sampling sites
 2. Aerator I & II zones: 1 sampling sites each
 3. Littoral (forest): 5 sampling sites
 4. Littoral (urban): 3 sampling sites

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



Step 1: B) Sample collection from shallow parts of the lake with the “Czapla” sampler



Step 2 : Sieving the samples



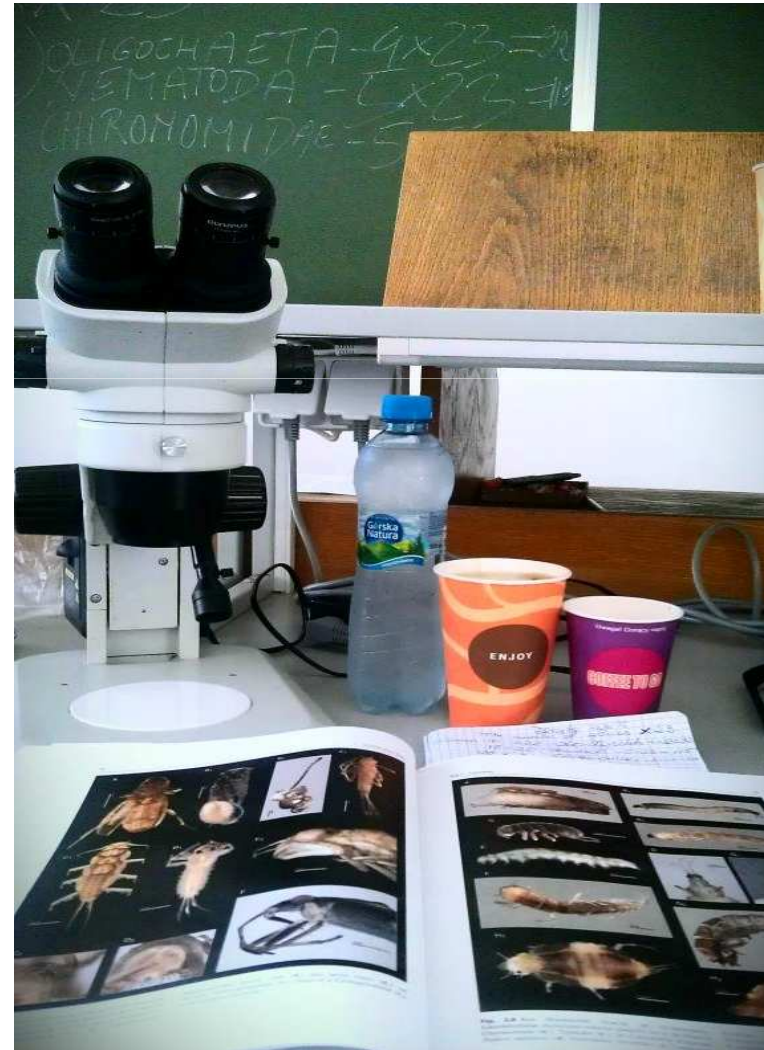
Step 3: Sorting the macroinvertebrates



Step 4: Weighting the macroinvertebrates



Step 5: Identification of the species/groups of macroinvertebrates



Species found:



***Anodonta anatina* (L.)**



***Caenis* sp.**



***Chaoborus*
*flavicans***



***Bitynia tentaculata* (L.) &
Potamopyrgus antipodarum
(E.A. Smith)**



***Sialis fuliginosa*
Pictet**



Valvata piscinalis
(O.F. Müller)

Data analysis

Indices that were used to measure the biodiversity:

- **Shannon-Wiener Index**
- **Equitability (E) or evenness Index**
 - **Margalef Index**
 - **Simpson Index**

- **The Shannon-Wiener Index:** calculated from the abundances of each species

$$H' = - \sum_{i=1}^S p_i \ln p_i$$

- **Equitability (E) or evenness :**

$$E = \frac{H'}{H_{\max}} = \frac{- \sum p_i \times \log(p)}{\log(S)}$$

- **Margalef Index - species diversity:** calculated from the total number of species present and the abundance or total number of individuals

- **The Simpson index** represents the probability that two randomly selected individuals in the habitat will not belong to the same species.

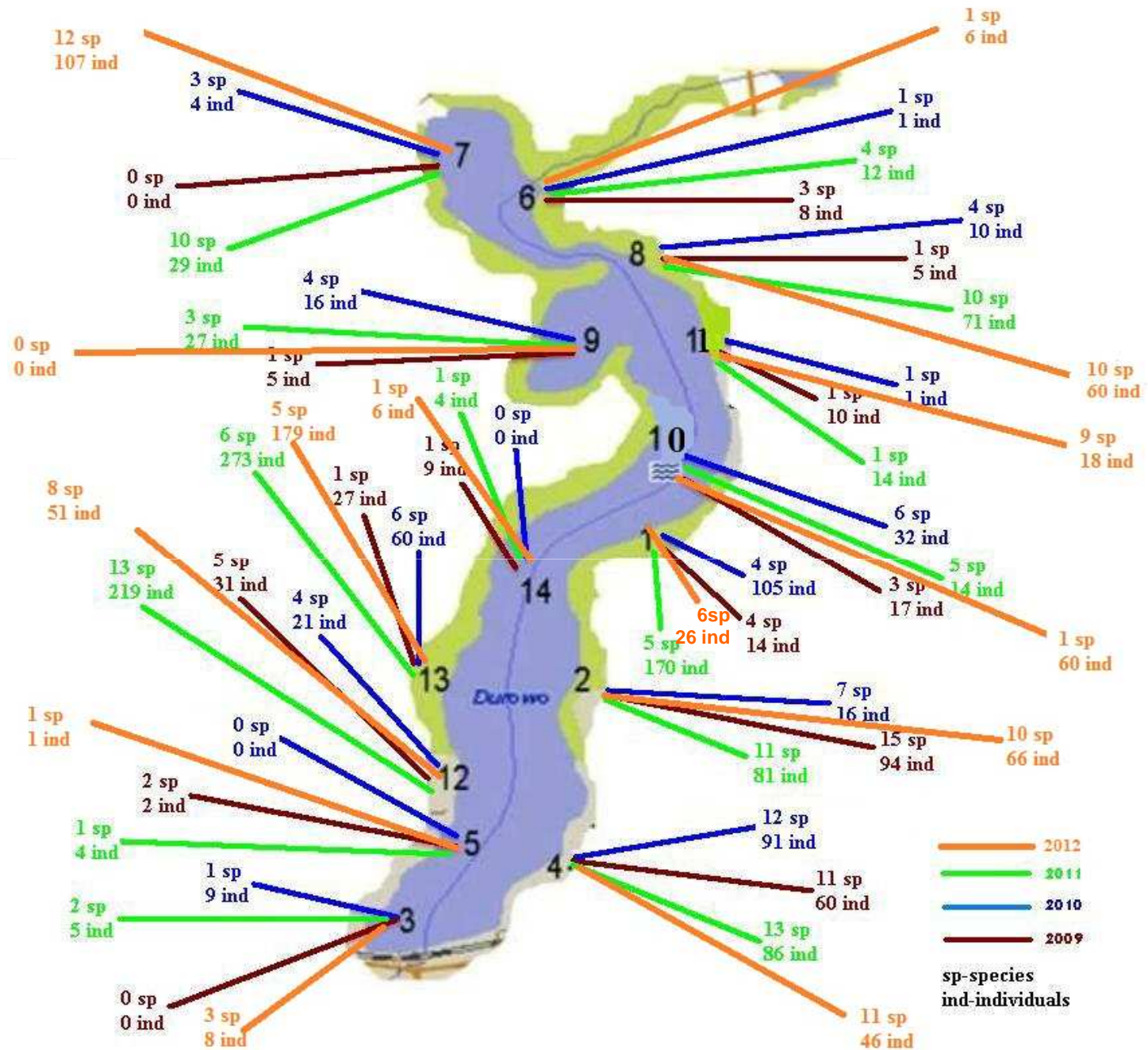
$$\hat{D} = \frac{\sum_{i=1}^S n_i(n_i - 1)}{N(N - 1)}$$

- **The EPT Indexis** named for three orders of aquatic insects that are common in the benthic macroinvertebrate community: Ephemeroptera Plecoptera and Trichoptera.
- **Ratio of EPT and Chironomidae:** calculated by dividing the sum of the total number of individuals classified as Ephemeroptera, Plecoptera, and Trichoptera by the total number of individuals classified as Chironomidae

- **BMWP**: a procedure for measuring water quality using species of macroinvertebrates as biological indicators.
- Different aquatic invertebrates have different tolerances to pollutants

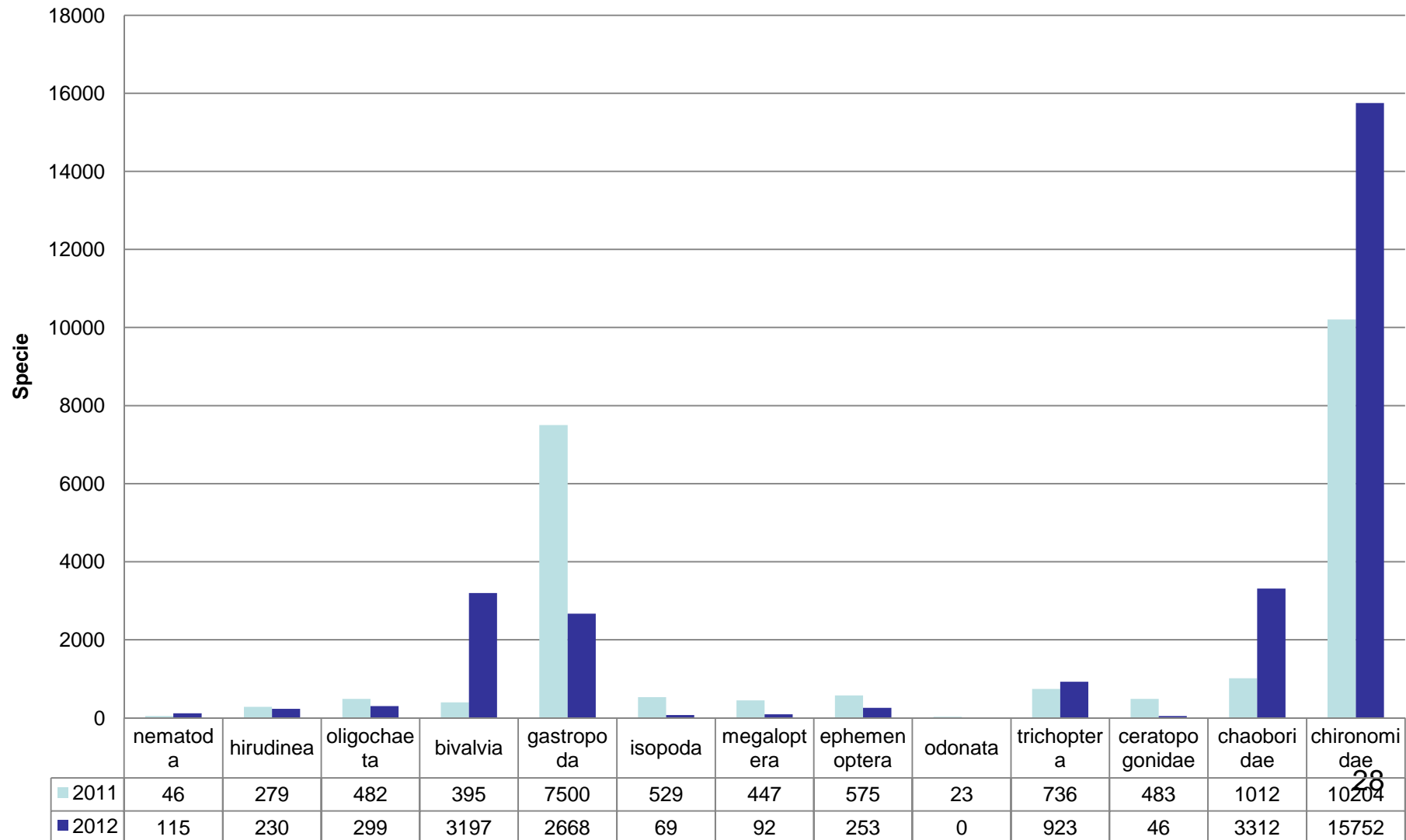
Families		Score
Ephemeroptera Trichoptera Diptera	<i>Ameletidae</i> <i>Glossosomatidae, Molannidae, Beraeidae, Odontoceridae,</i> <i>Leptoceridae</i> <i>Blephariceridae, Thaumaleidae</i>	10
Ephemeroptera Plecoptera Odonata Trichoptera	<i>Behningiidae</i> <i>Taeniopterygidae</i> <i>Cordulegastridae</i>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

RESULTS AND CONCLUSIONS

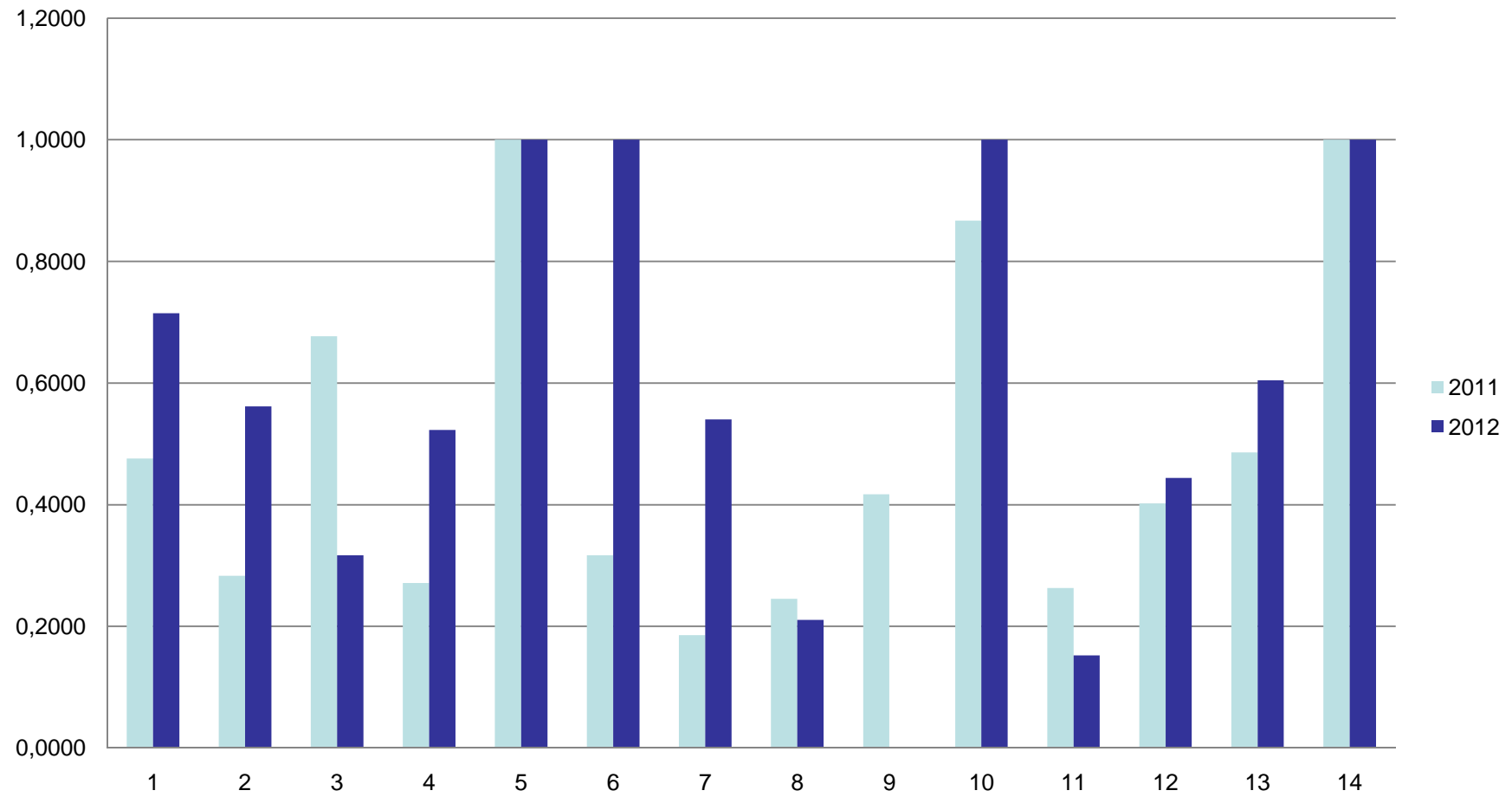


- Total number of species and individuals identified in 2009, 2010, 2011, 2012 sampling season in Lake Durowskie

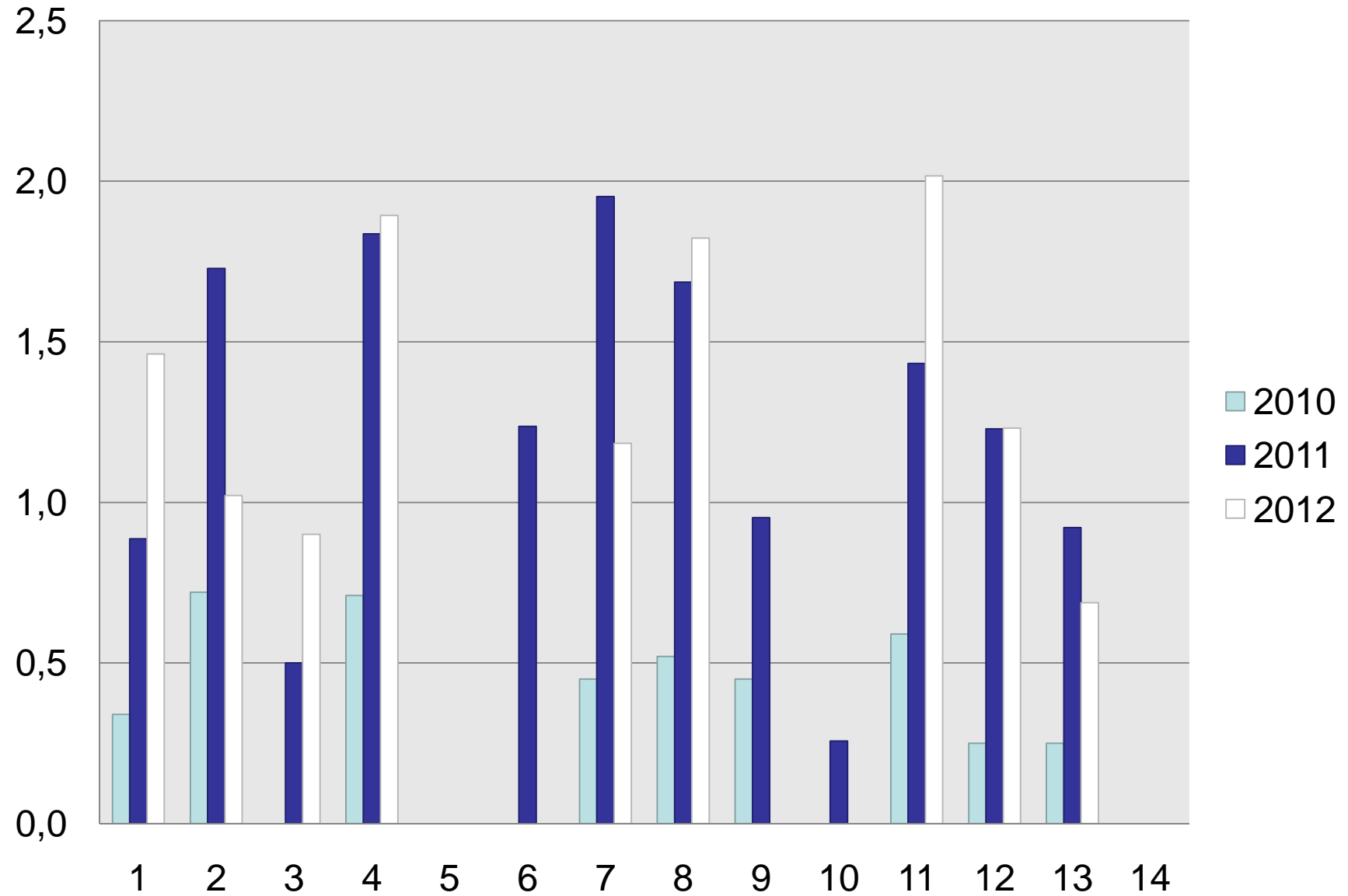
- The abundances of macroinvertebrates identified in 2011 and 2012 in Lake Durowskie



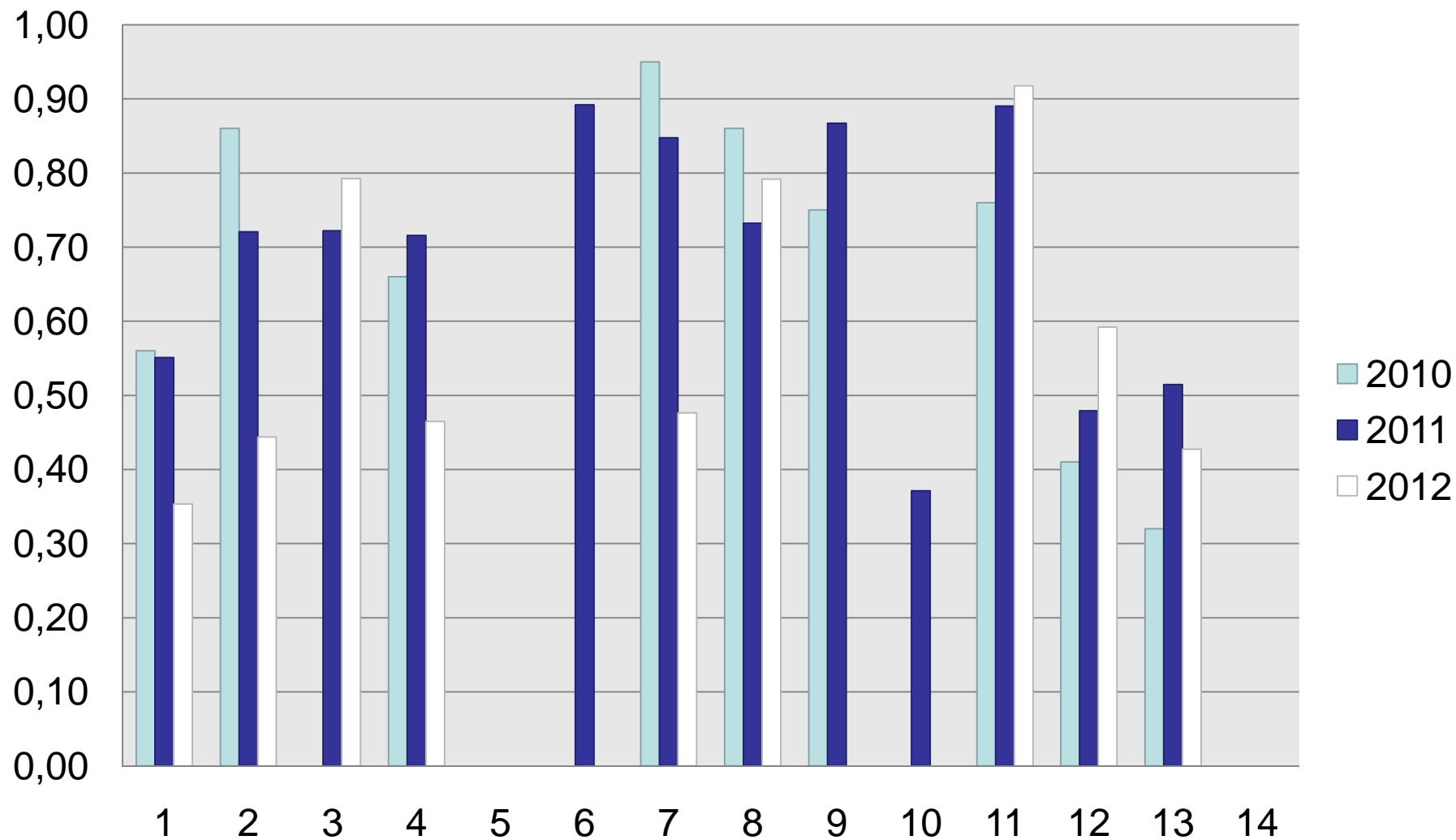
Simpson index



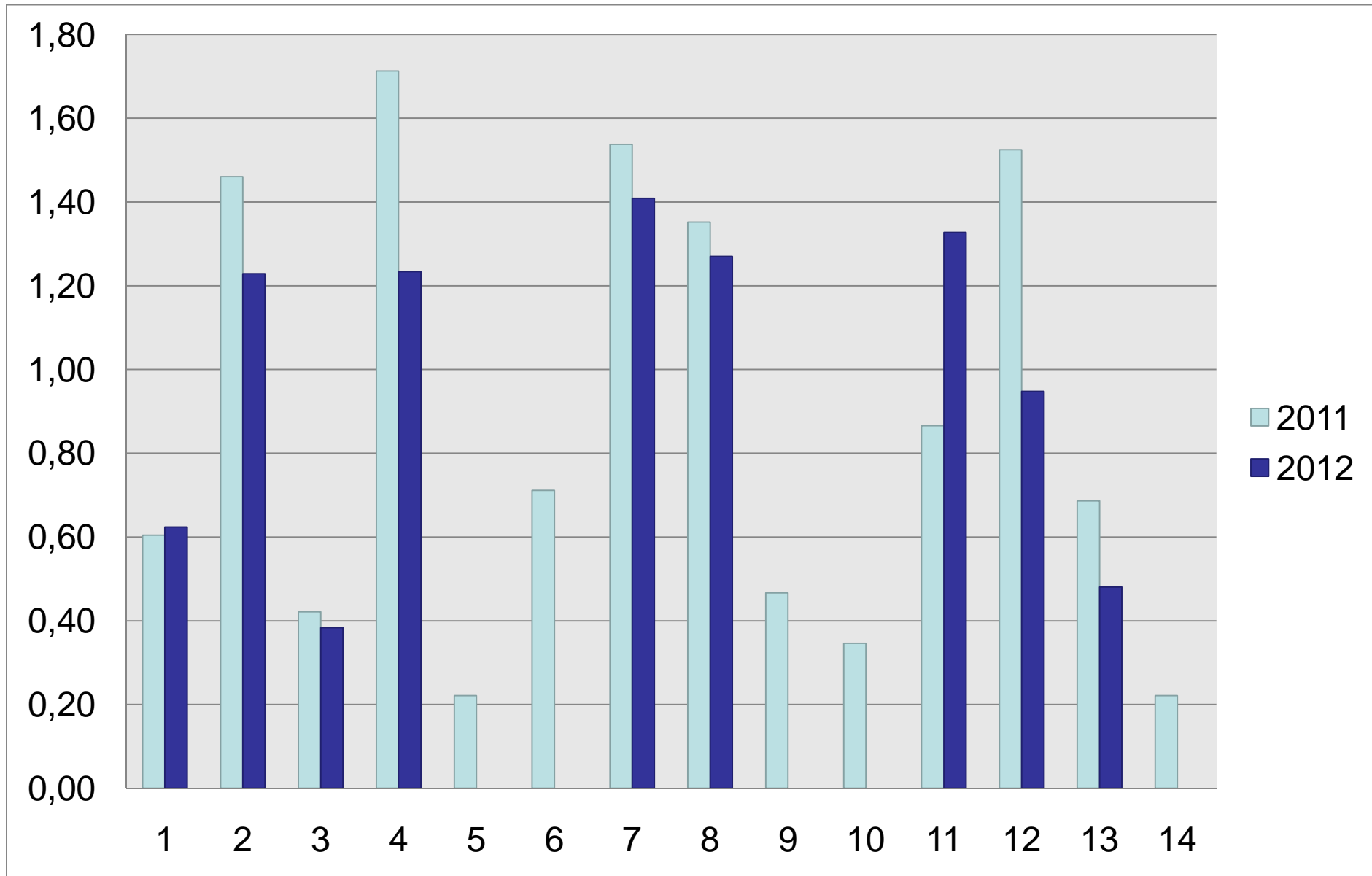
Schannon-Wiener index



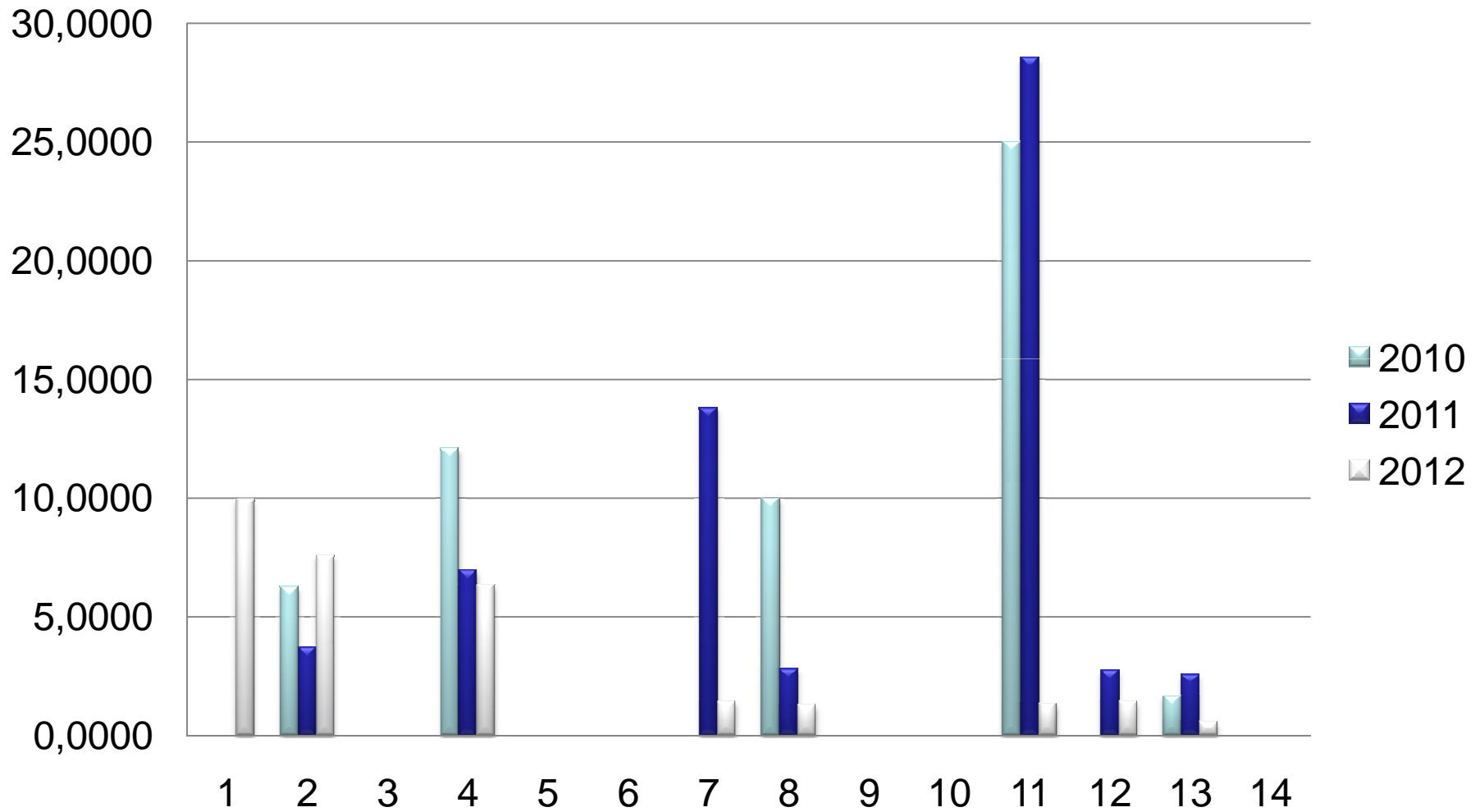
Species evennes



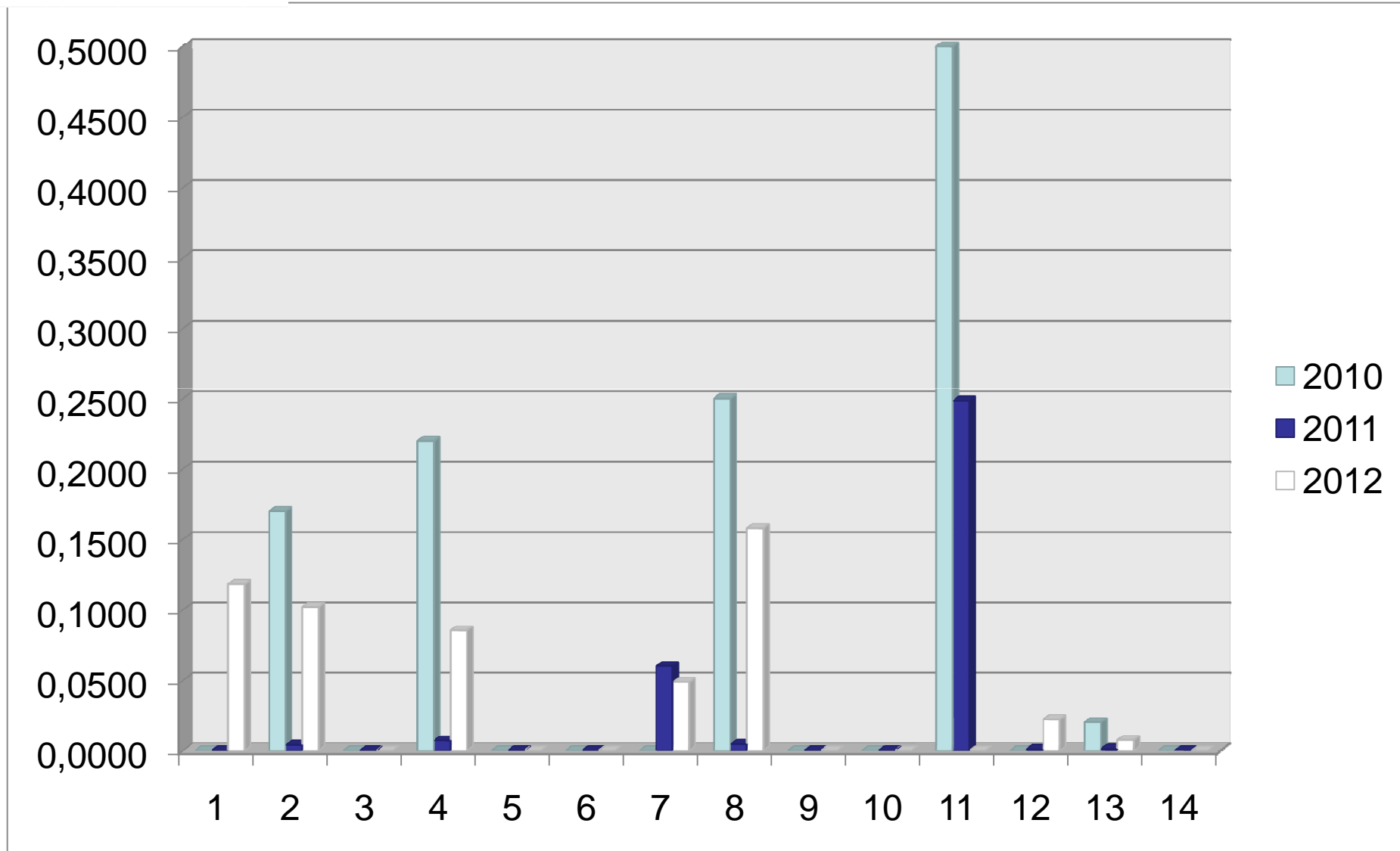
Margalef



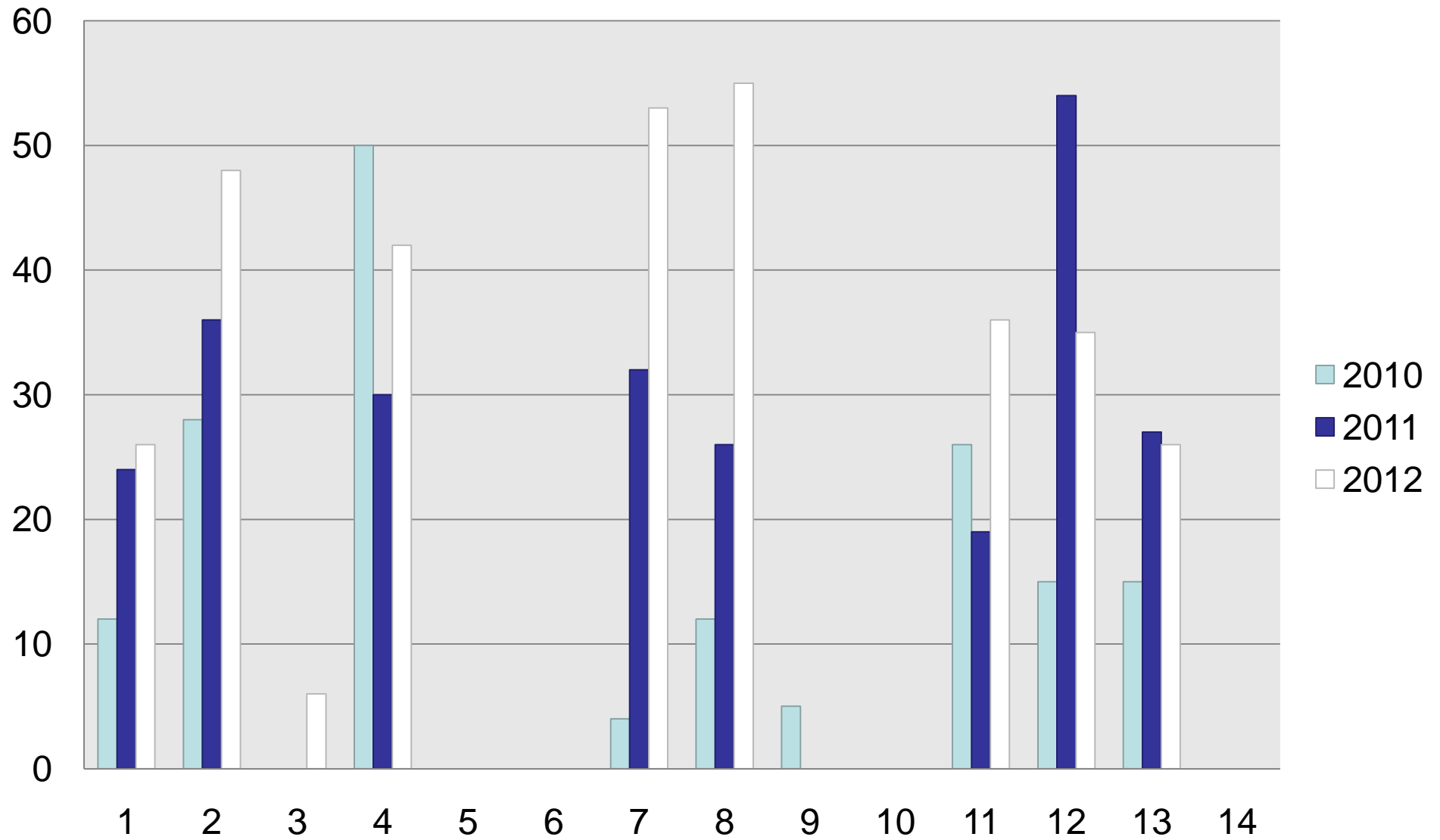
EPT%



EPT Chironomidae



BMWP



Conclusions:

- The biodiversity has increased to 28 species in 2012 compared to 26 taxa in 2011 and 19 taxa in 2010.
- In the littoral stations the diversity is bigger than in pelagic and aerators stations.
- In the 3 stations of Littoral urban area was found the highest number of species (20 species)
- Although in Littoral urban area the number of species is higher, many of them are adapted to more polluted ecosystems (Hirudinea) so we can say that Littoral near forest area has the most important biodiversity.

- Species evenness is higher and this indicates that the samples were properly collected.(Evenness)
- In station 11 ,4, 8, 1,3 the abundance is higher this year than last year and in stations 2,7 ,13 it's lower.(**The Shannon-Wiener Index**)
- In station 1, 11 the diversity increased in 2012 and in stations 2, 3, 4, 12 ,13 decreased.
(Margalef)
- In station 1, 2 the pollution decreased and in stations 4, 7 ,8,11,12,13 the pollution increased
(Ept index)
- The probability of the bioindication species has been increased since the last year.(BMWP)

- In the littoral area with reeds near forest cover (station number one) we can see how the number of species has grown and the number of individuals has lowered from 2011 to 2012.

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- In the area near the littoral urban area the number of species is higher and we have found fewer individual than 2011 (station 2) . In that littoral near urban area(station 4) we have found fewer species and individuals.

- In the pelagial area near dam we have found one species more and more species than the previous year. In the pelagial (aerator 2 area –station number 10) we found fewer species and more individuals. In the litoral area with reeds (station number 11) we found more species than the other year and more individuals.

- In the pelagial area (station 7) the number of species as well as the number of individuals is continuously increasing over the years.
- In the pelagial area (station 9) after an increase in the number of species and in the number of individuals from 2009 to 2010, it decreases until 2011. In 2012 there were no organisms found in the samples.

- In the pelagial area (station 14) the data show little variety in the number of individuals, the number of species does not change from 2010 to 2012.

- The number of Trichoptera is higher this year and this is an indicator that the quality of the water from lake Durowskie is higher.
- In second place the high abundance of Bivalves is an indicator for a good quality water but in the same time the number of Isopoda and Ephemeroptera has dropped since last year and that shows us how the quality of water may have lowered since last year in certain places.

- The high number of Chaoboridae identified in our analysis has showed us that the water is much more polluted in station 10 near aerator 2. Also the number of Gastropodes has lowered since last year and that's a sign that that water pollution is higher.