Ecological state of Lake Durowskie during restoration measures: Macroinvertebrate Analysis 2016

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Outline of presentation

- Introduction
- Research question
- Study site
- Methodology
- Results & Discussion
- Conclusions
- Recommendations

Introduction

- In 2008, Lake Durowskie had large cyanobacterial water blooms due to internal and external phosphorus loading.
- Aim of Water Framework Directive (WFD): protecting and restoring clean water across Europe and securing its long-term, sustainable use.

- Three main restoration measures implemented in the lake in 2009:
- (i) Oxygenation of hypolimnetic waters with two wind driven aerators
- (ii) Iron treatment using small doses of coagulant
- (iii) Biomanipulation by stocking the lake with pike and pikeperch fry

Introduction cont.

- Quality of water determined by biological or physiological monitoring

- Macroinvertebrates (benthic) great bio-indicators to assess environmental quality because

1. narrow range of environmental requirements
2. a sizeable geographic distribution
3. relatively long life cycle
4. relatively easily recognizable for identification purposes

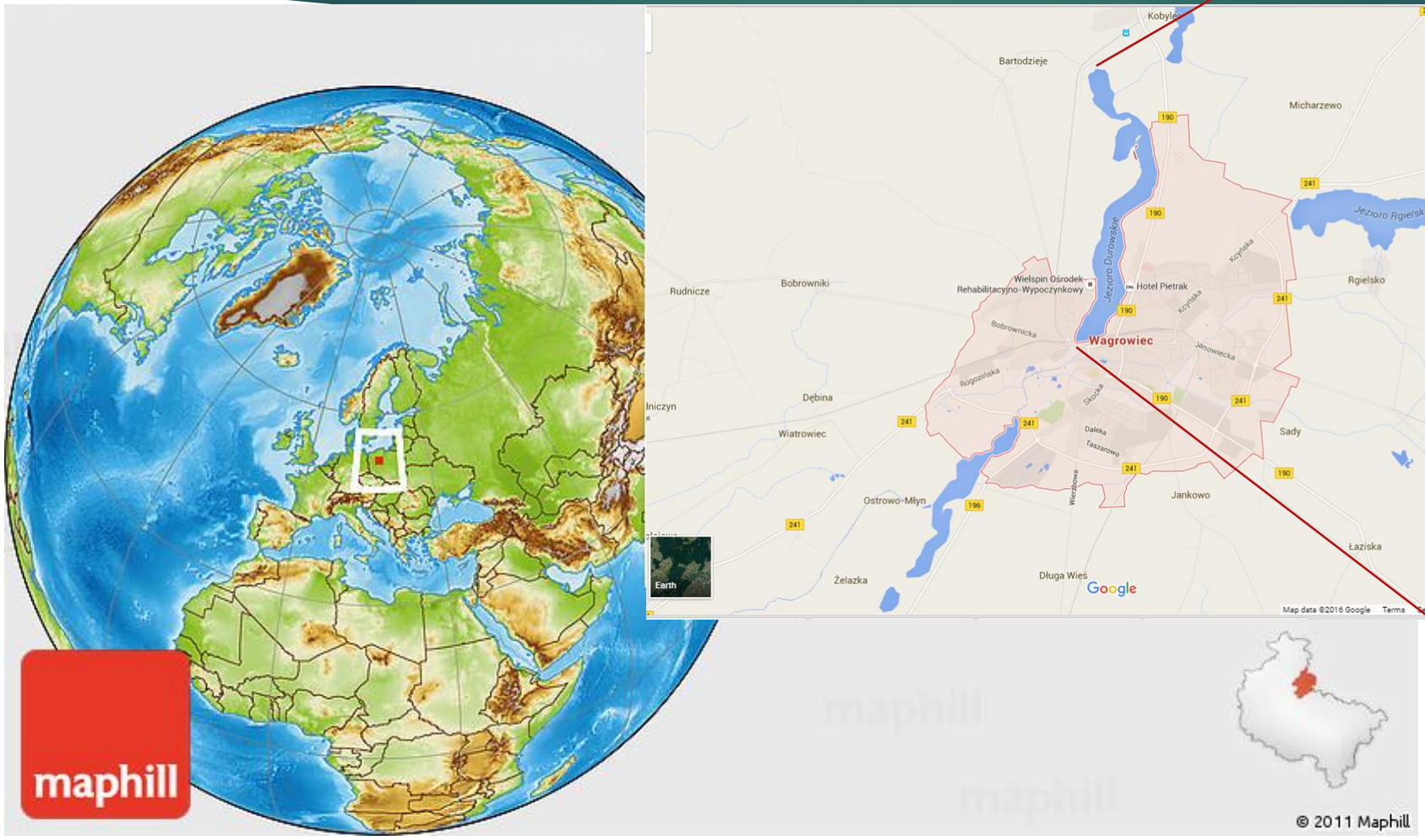
- Abundance and diversity strongly related to water quality because they have comparatively limited movement than fish and respond rapidly to pollutants such as nutrients and sediment.

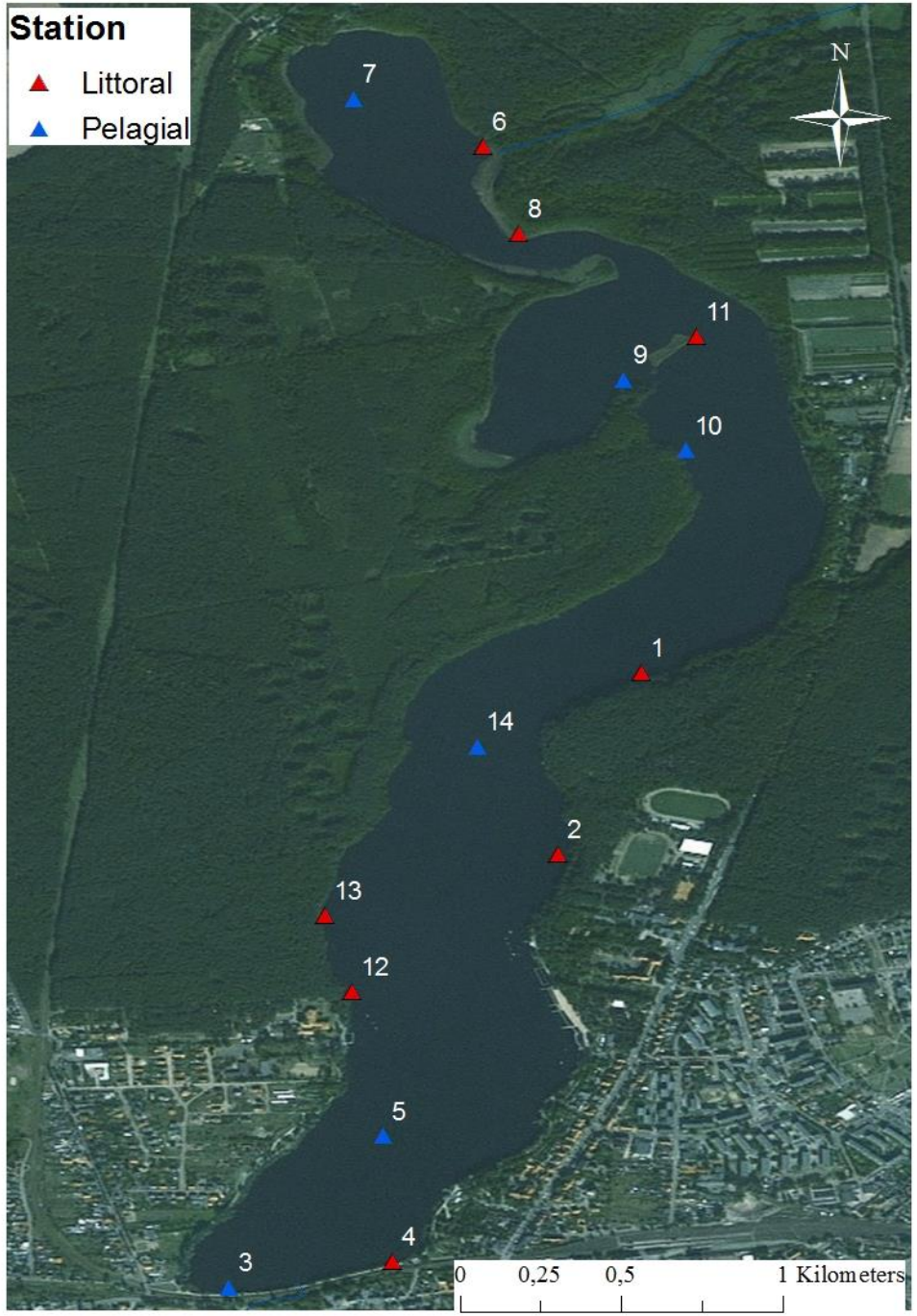
Research Question

- Overall aim of the research: To assess and evaluate the current ecological state and long-term trend of Lake Durowskie, based on the assessment of macroinvertebrates as indicators.

Study site

Lake Durowskie in Wągrowiec, Wielkopolska region of Poland





Study site

Characteristic	Unit/Parameter
Surface area	143,7 ha
Maximum depth	14,6 m
Mean Depth	7,9 m
Catchment area	236,1 km²

Methodology

Kajak Sampler

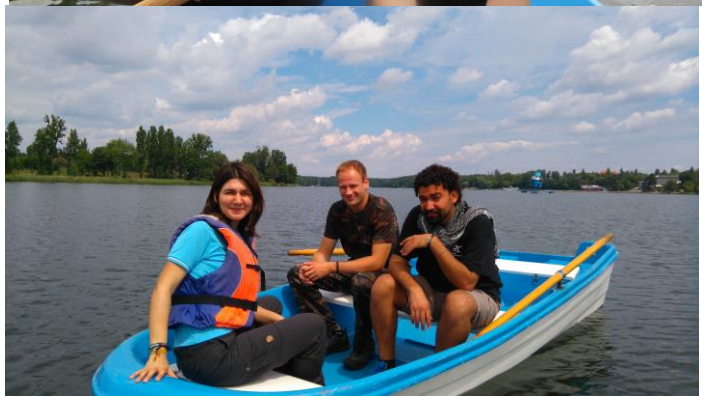
- Diameter 7.2mm
- For collecting pelagic samples
- > 2m depth

Wooden Sieve

- Mesh size 4µm

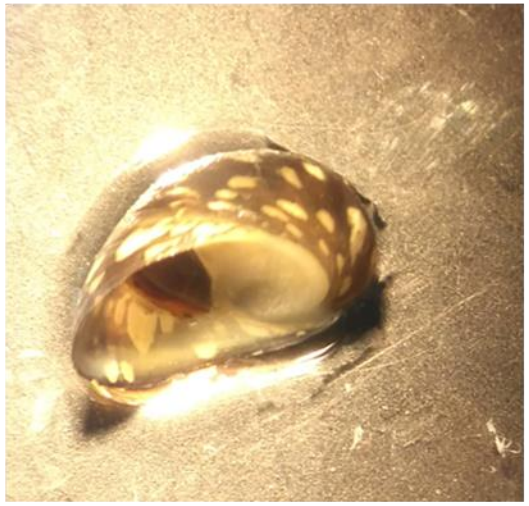
Czapla Sampler

- Diameter 5.6mm
- For collecting littoral samples
- < 2m depth



Methodology cont.

Results: Identified macroinvertebrate species



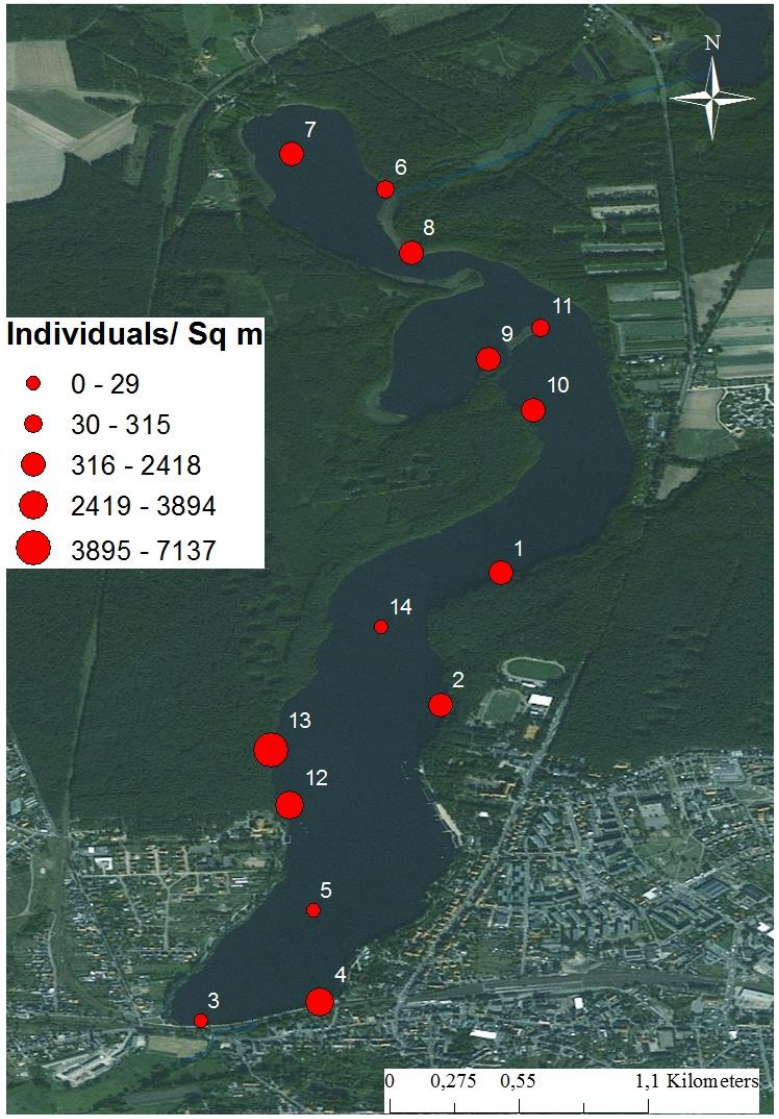
Theodoxus fluviatilis (L.)

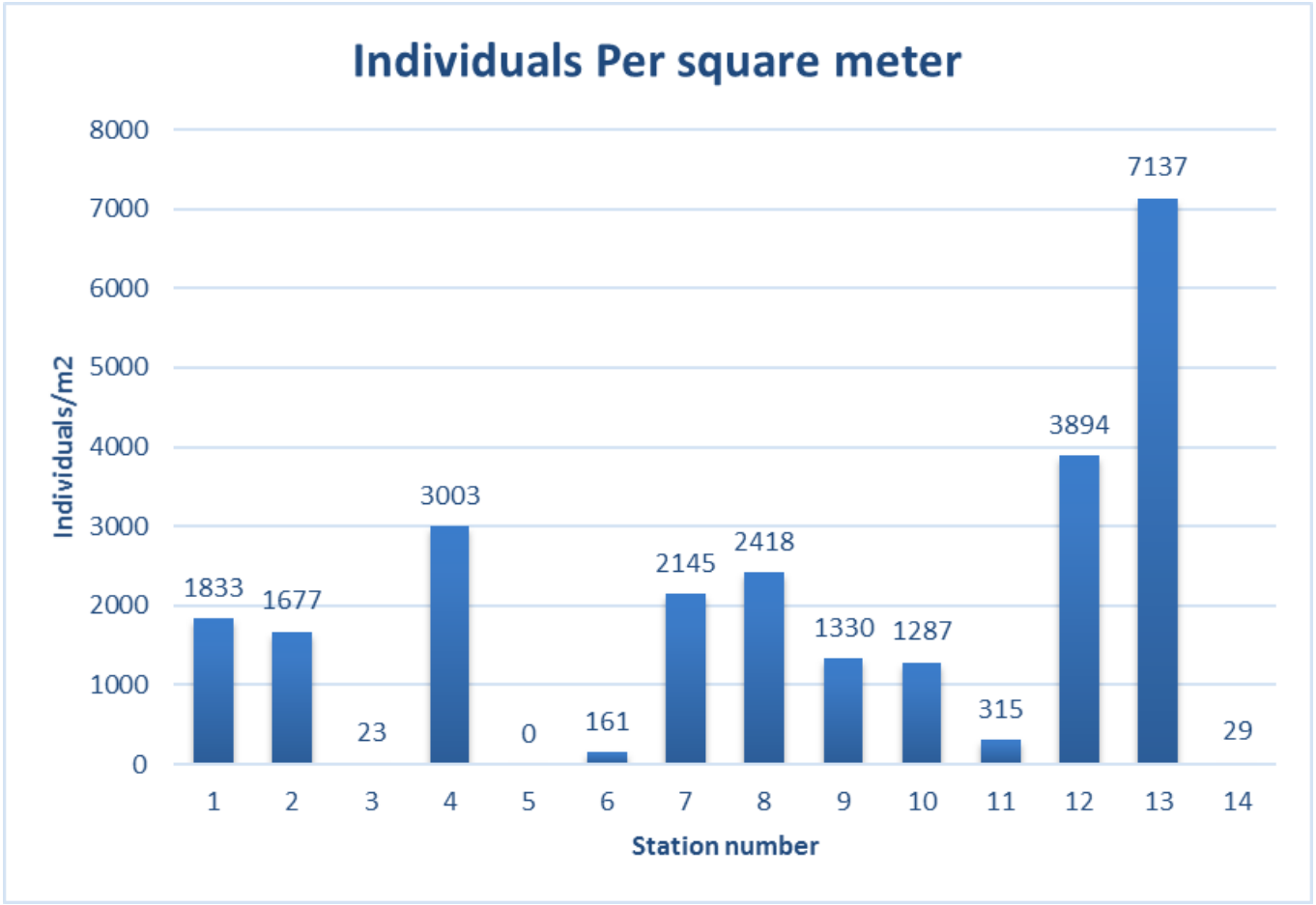
Chaoborus flavicans

Viviparus viviparus (L.)

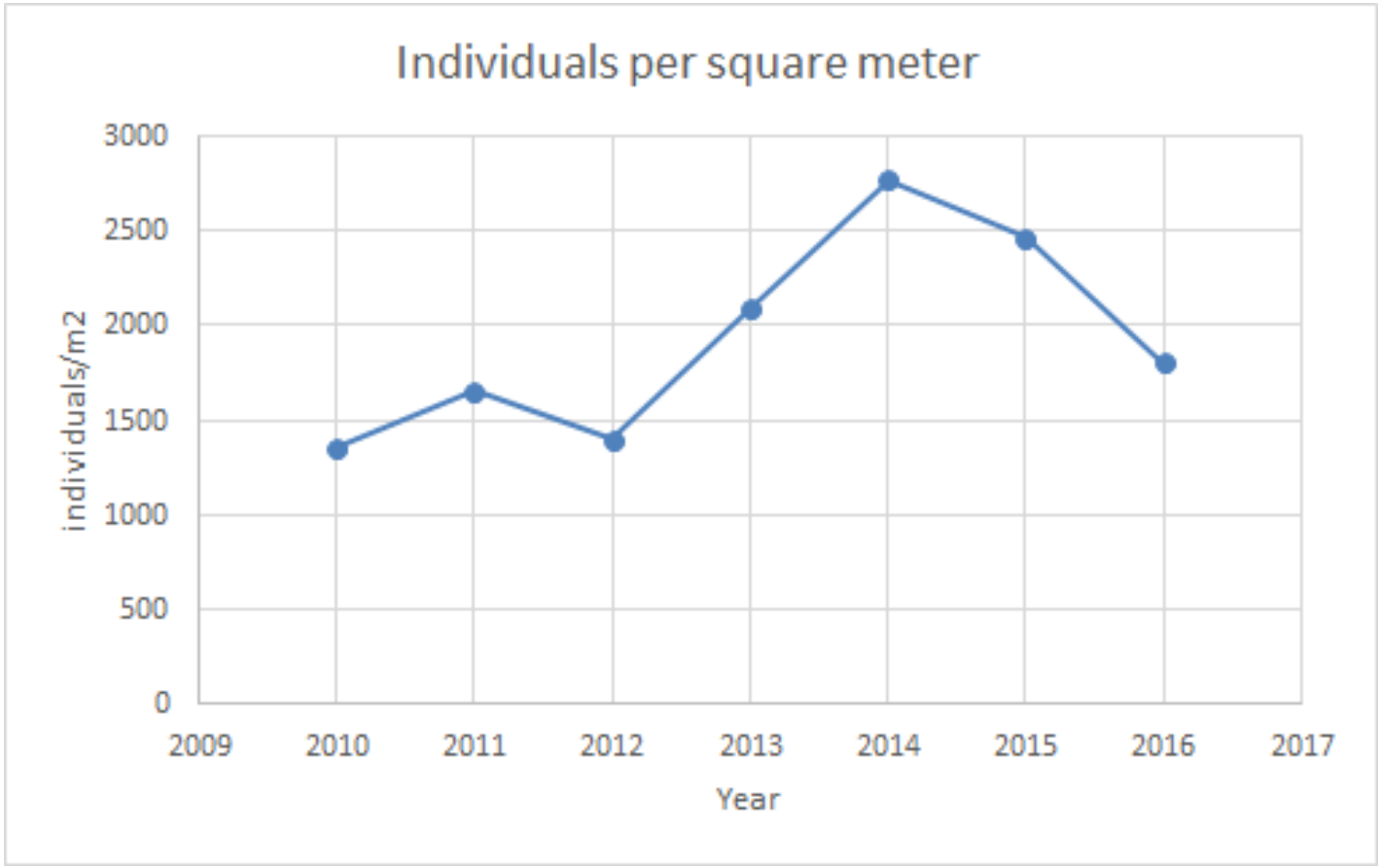
Glossiphonia complanata

Results: Individuals per square meter

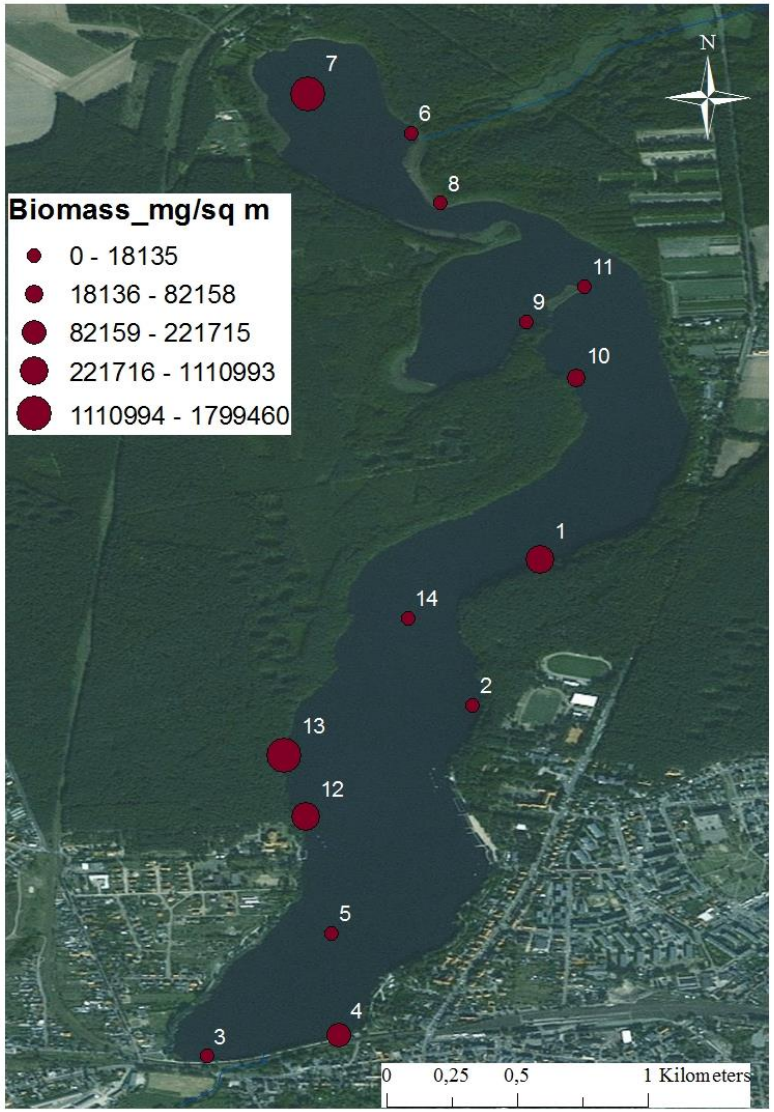


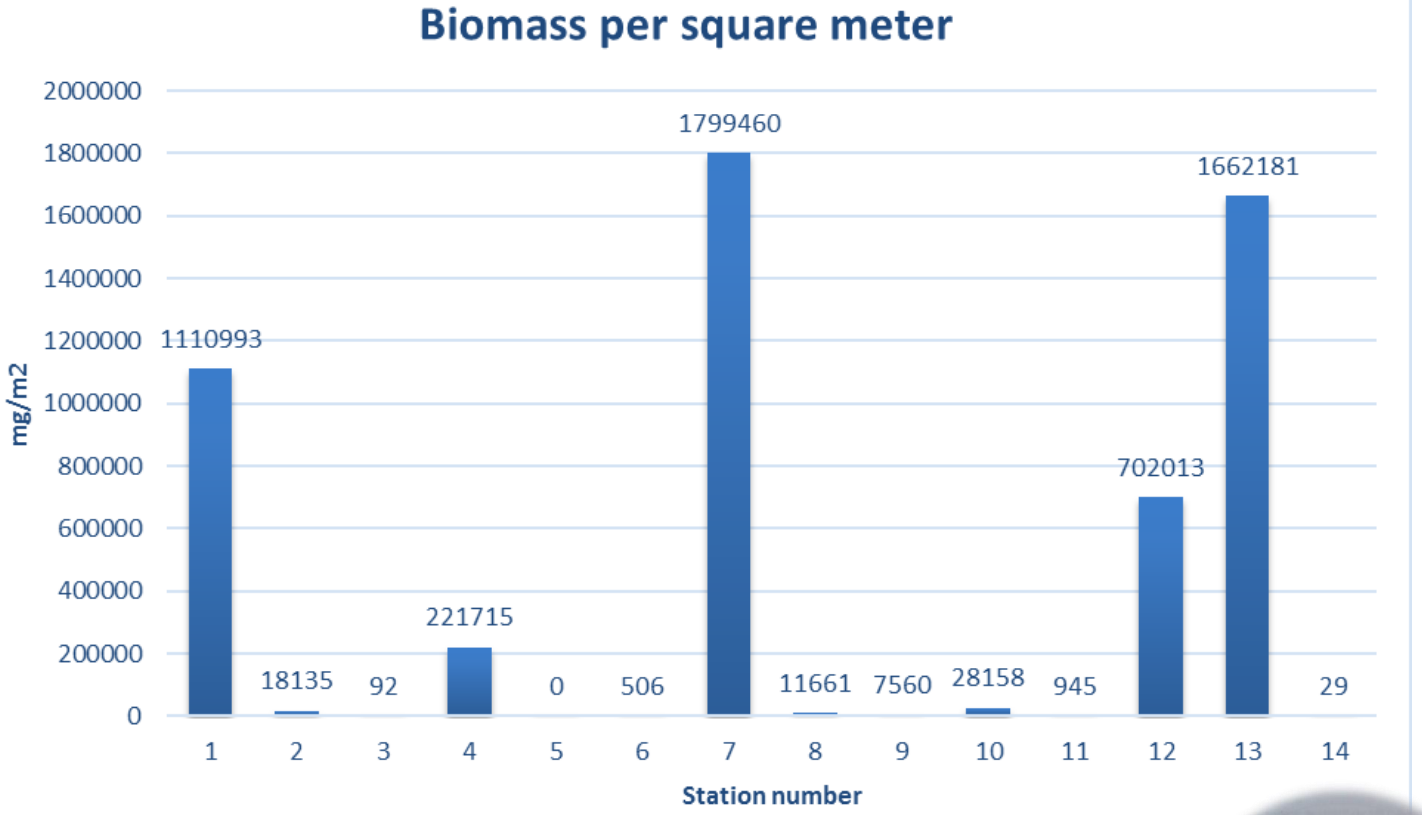


Results: Individuals per square meter



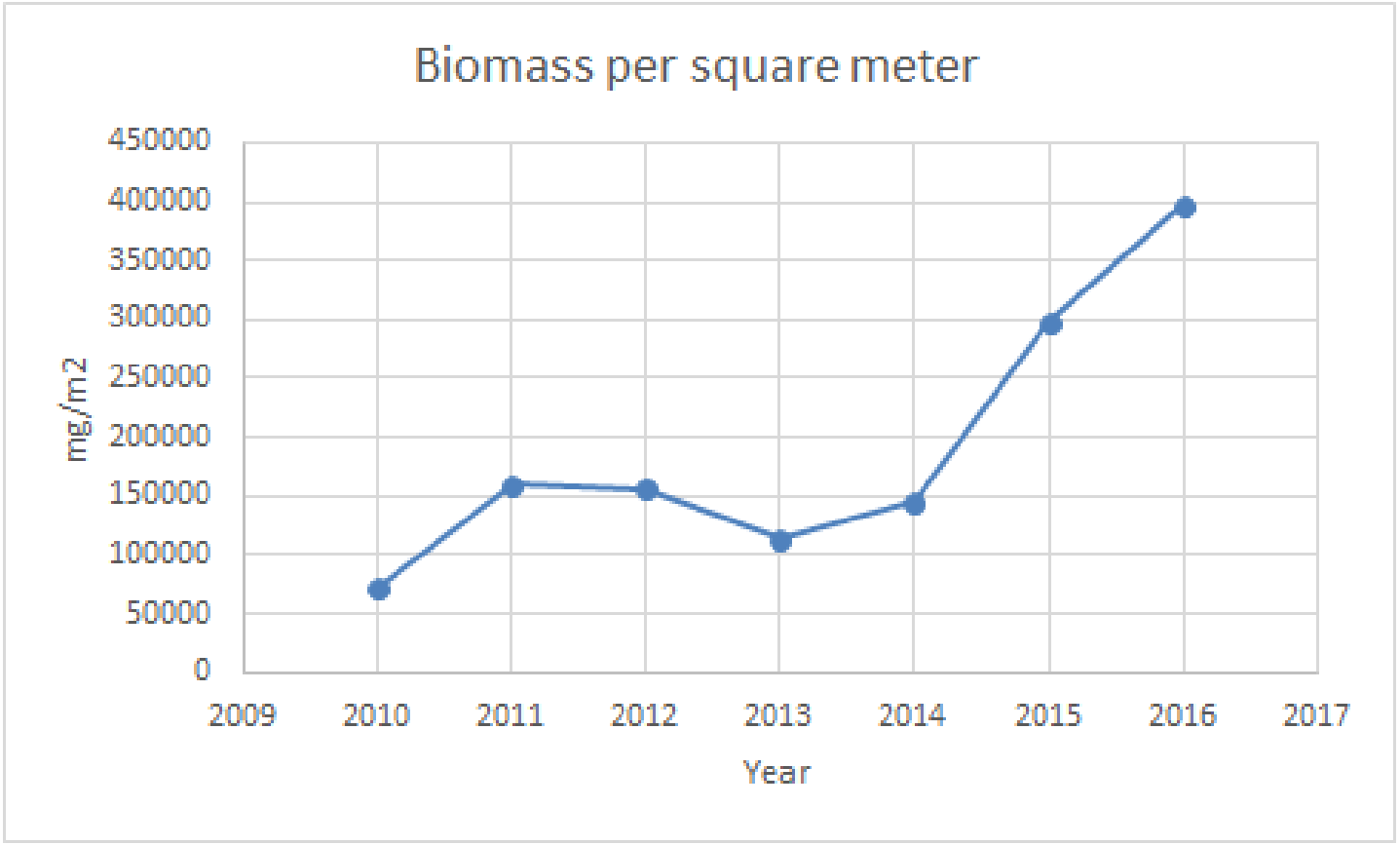
Results: Biomass per square meter



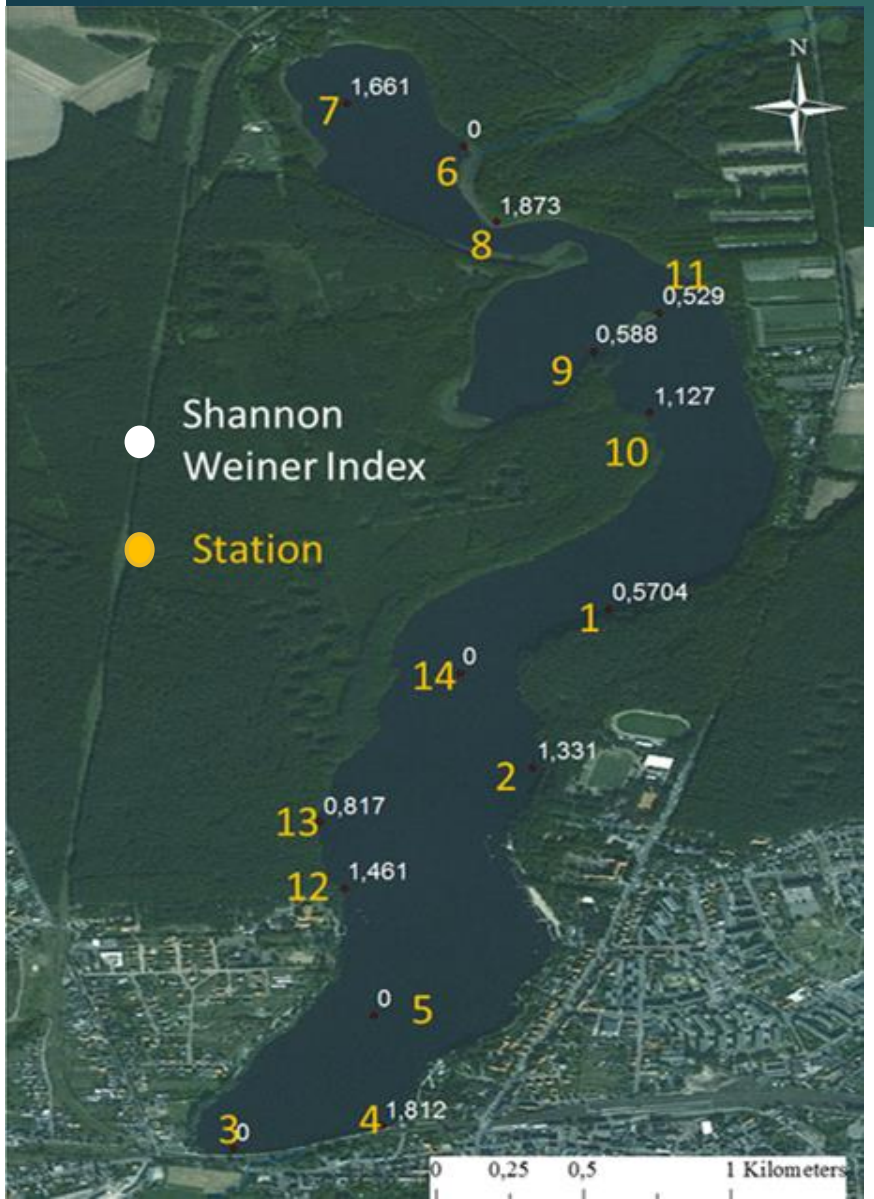


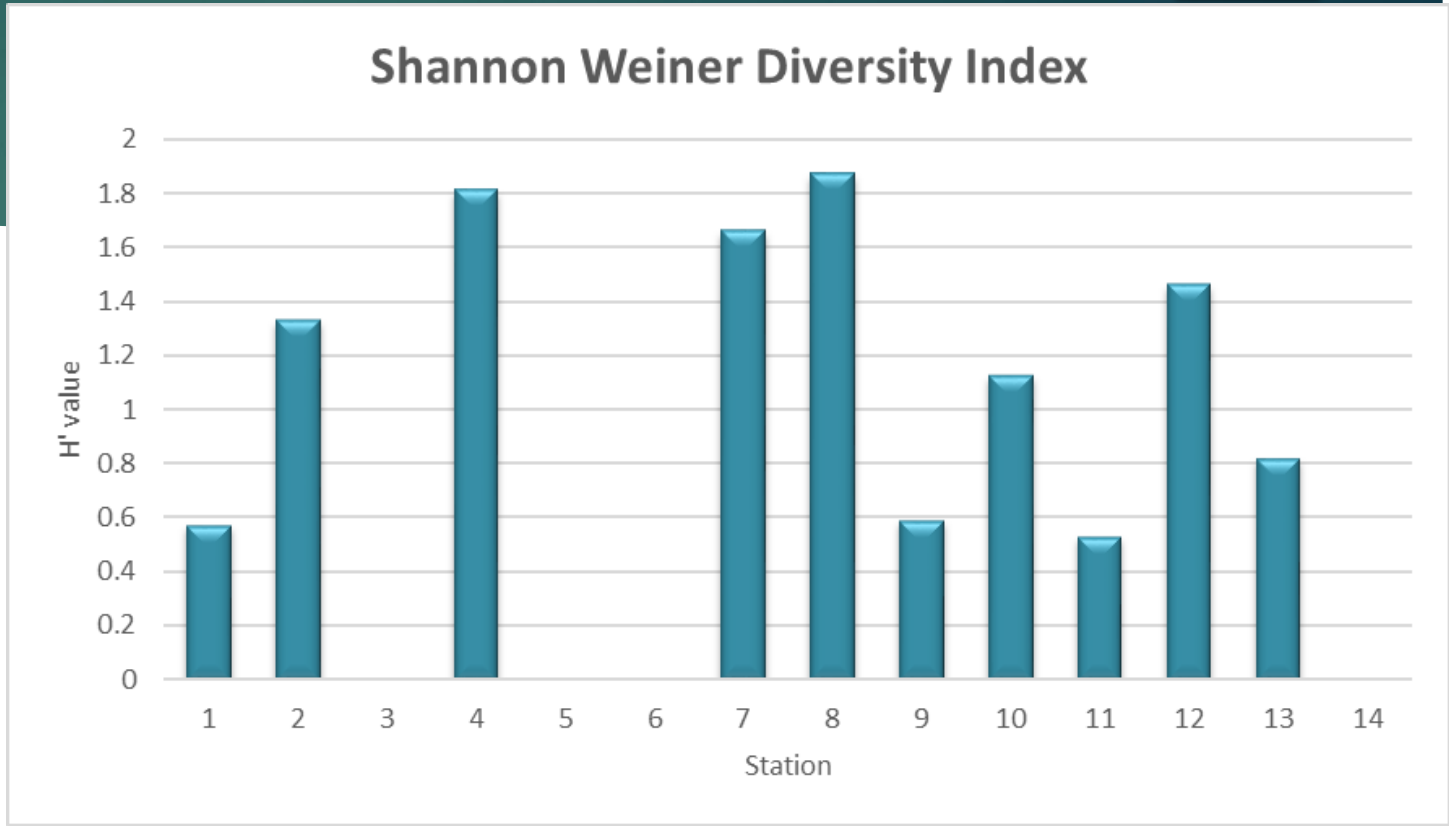
- Stations 1, 7, 12 & 13 had the greatest biomass.
- Greatest proportion of biomass contributed by bivalves.
- Four different families of Bivalvia found in these four stations.

Results: Biomass per square meter



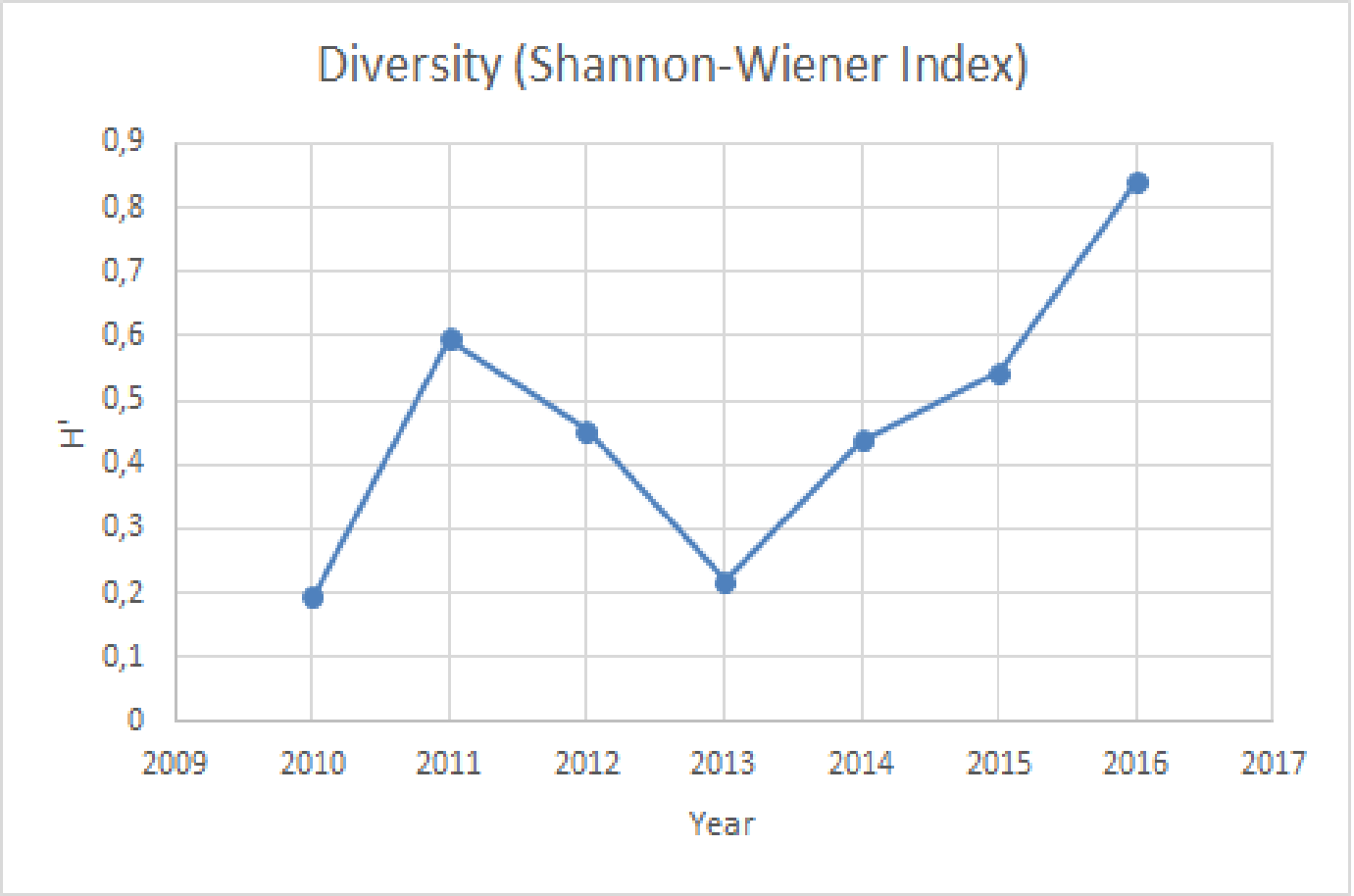
Diversity: Across stations





- Index (H') used to determine the diversity of the lake.
- The greater the H' value, the greater the biodiversity of the area, it takes the number of species as well as evenness into account.

Results: Long-term diversity trends



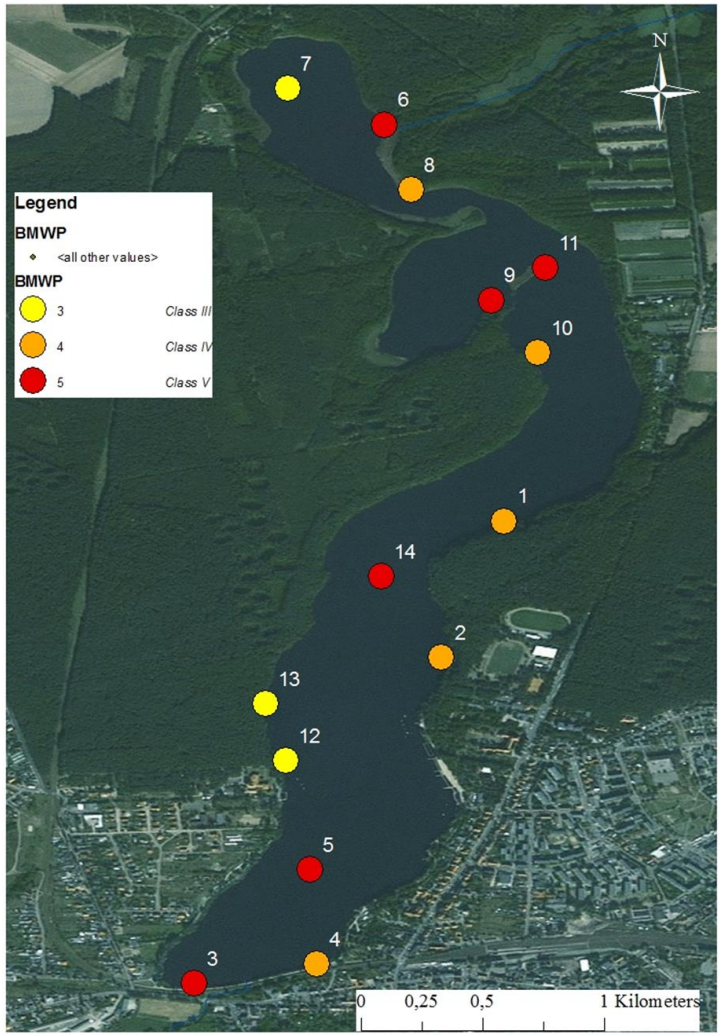
The Biological Monitoring Working Party (BMWP)

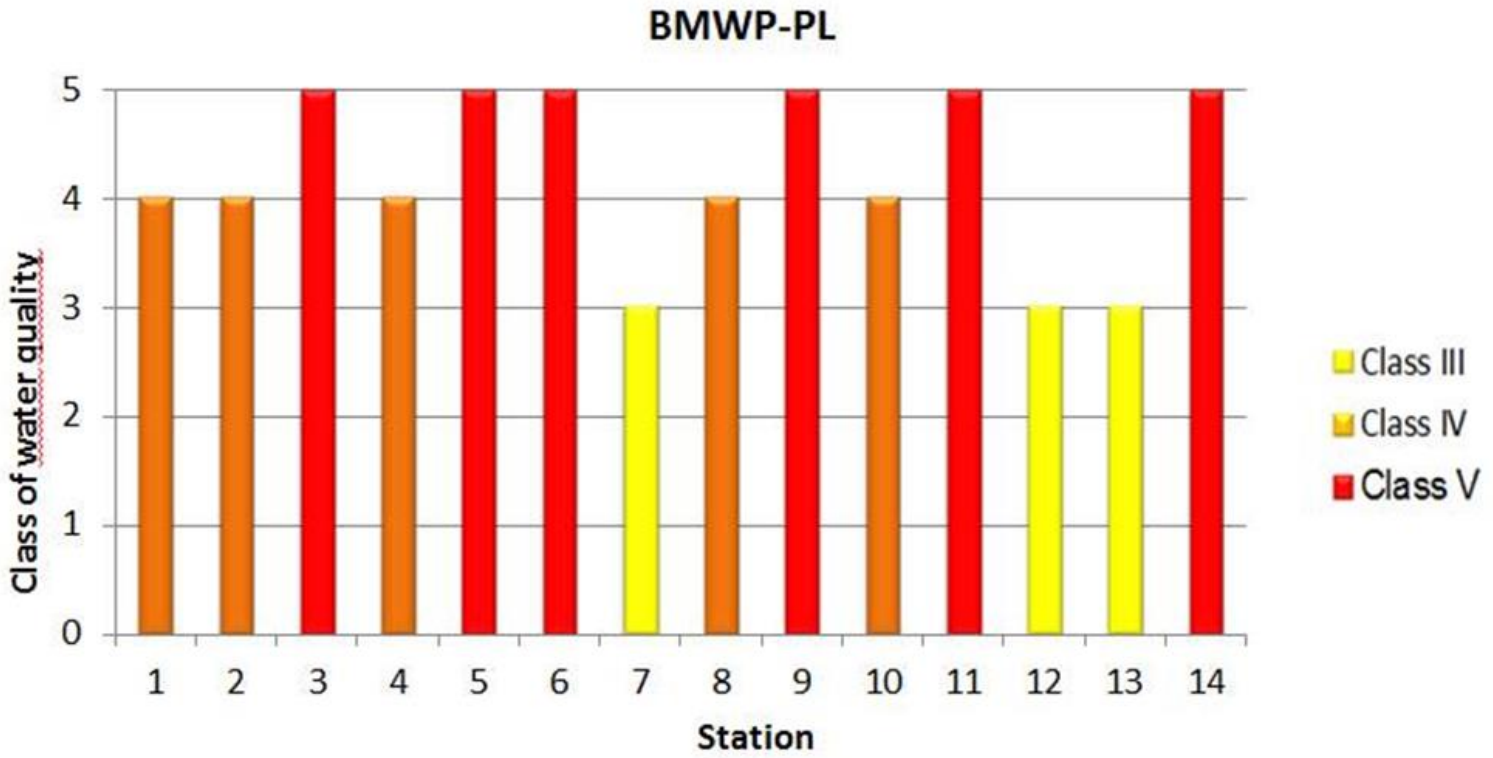
Group	Families	Score
Mayflies	Siphlonuridae, Heptageniidae, Leptophlebiidae, Ephemerellidae, Potamanthidae, Ephemeridae	10
Stoneflies	Taeniopterygidae, Leuctridae, Capniidae, Perlodidae, Perlidae, Chloroperlidae	
River bug	Aphelocheiridae	
Caddisflies	Phryganeidae, Molannidae, Beraeidae, Odontoceridae, Leptoceridae, Goeridae, Lepidostomatidae, Brachycentridae, Sericostomatidae	
Crayfish	Astacidae	8
Dragonflies	Lestidae, Agriidae, Gomphidae, Cordulegasteridae, Aeshnidea, Corduliidae, Libellulidae	
Caddisflies	Psychomyidae, Philopotamiidae	
Mayflies	Caenidae	7
Stoneflies	Nemouridae	
Caddisflies	Rhyacophilidae, Polycentropidae, Limnephilidae	
Snails	Neritidae, Viviparidae, Ancylidae	6
Caddisflies	Hydroptilidae	
Mussels	Unionidae	
Shrimps	Corophiidae, Gammaridae	
Dragonflies	Platycnemididae, Coenagriidae	
Waterbugs	Mesoveliidae, Hydrometridae, Gerridae, Nepidae, Naucoridae, Notonectidae, Pleidae, Corixidae	5
Water beetles	Haliplidae, Hygrobiidae, Dytiscidae, Gyrinidae, Hydrophilidae, Clambidae, Helodidae, Dryopidae, Elminthidae, Chrysomelidae, Curculionidae	
Caddisflies	Hydropsychidae	
Craneflies	Tipulidae	
Blackflies	Simuliidae	
Flatworms	Planariidae, Dendrocoelidae	
Mayflies	Baetidae	4
Alderflies	Sialidae	
Leeches	Piscicolidae	
Snails	Valvatidae, Hydrobiidae, Lymnaeidae, Physidae, Planorbidae	3
Cockles	Sphaeriidae	
Leeches	Glossiphoniidae, Hirudidae, Erpobdellidae	
Hoglouse	Asellidae	
Midges	Chironomidae	2
Worms	Oligochaeta (whole class)	1

- Taxa are assigned a value of 1-10 based on sensitivity to pollution
- 1 = least sensitive (tolerant to pollution)
- 10 = most sensitive (intolerant to pollution)

Murakudharan 2016

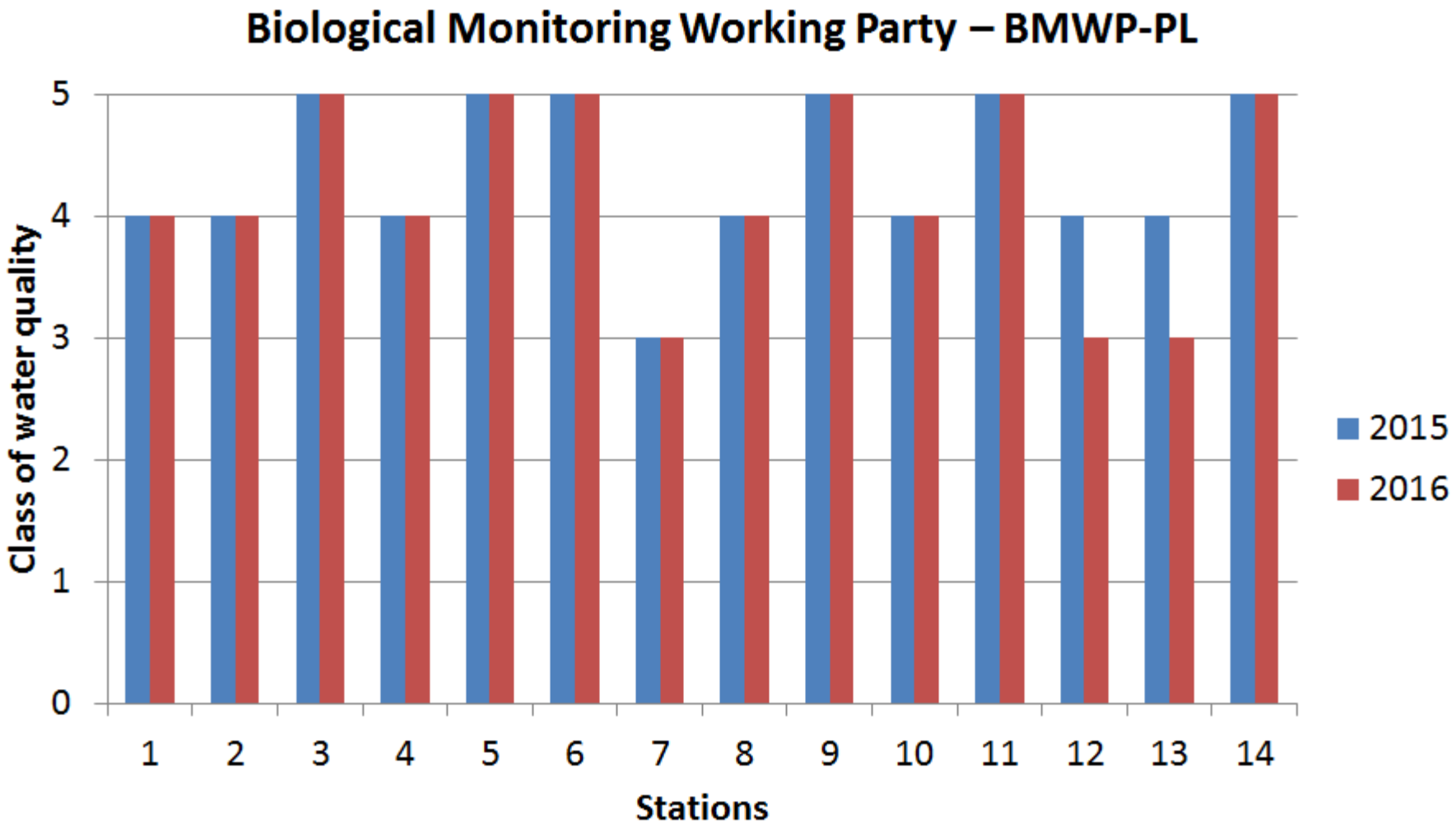
The Biological Monitoring Working Party (BMWP)





Station 7 best quality: BMWP score 50. In private area.
Station 12 & 13, scores 44 & 40 respectively (close to cut off point of class 4)

Biological Monitoring Working Party (BMWP)



Conclusion

- Number of individuals decreased but biomass increased. Attributed to large biomass of mussels
  - Stations 1, 7, 12, &13 have ***Bivalvia*** species:
    - *Anodonta anatina (L.)*
    - *Unio tumidus Philip*.
- According to BMWP score
  - Water quality best in Station 7, private area. Highest BMWP score 50.
  - Water quality improved in stations 12 & 13 compared to that of 2015.
  - All other stations remained at the same level.

Recommendations

- **Biomanipulation of *Dreissena* (Zebra Mussel) as an additional management strategy.**
  - Mussel species such as *Dreissena* are filter feeders with a high filtration potential, filtration rates reach 3000-4000 $1m^{-2}d^{-1}$.
  - Feed on algae, more importantly cyanobacteria.
  - Mussels could be cultivated, thus providing an additional source of income.
  - Cautionary measures should taken when introducing a new species into the ecosystem.
  - Therefore, native mussels species should be considered.

Recommendations

- **Biomanipulation – stocking of fish as a lake restoration method**
  - When stocking fish, juvenile individuals are preferable.
  - It is necessary to re-stock with fish for the first few years of lake resotration, at least until macrophytes re-grow.
  - In order to achieve the best results, it is recommended to use a large number of hatchery pike fries.
  - Fish recommended to have a length exceeding 10 cm, because at this stage of development pike is piscivorous.

Dziękuję!
Any questions?