Restoration of Lake Durowskie
Macroinvertebrate analysis
2019

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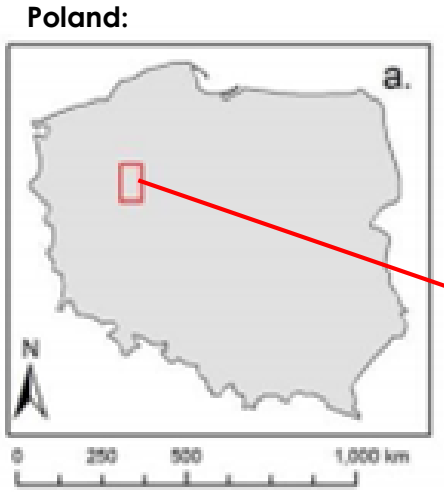
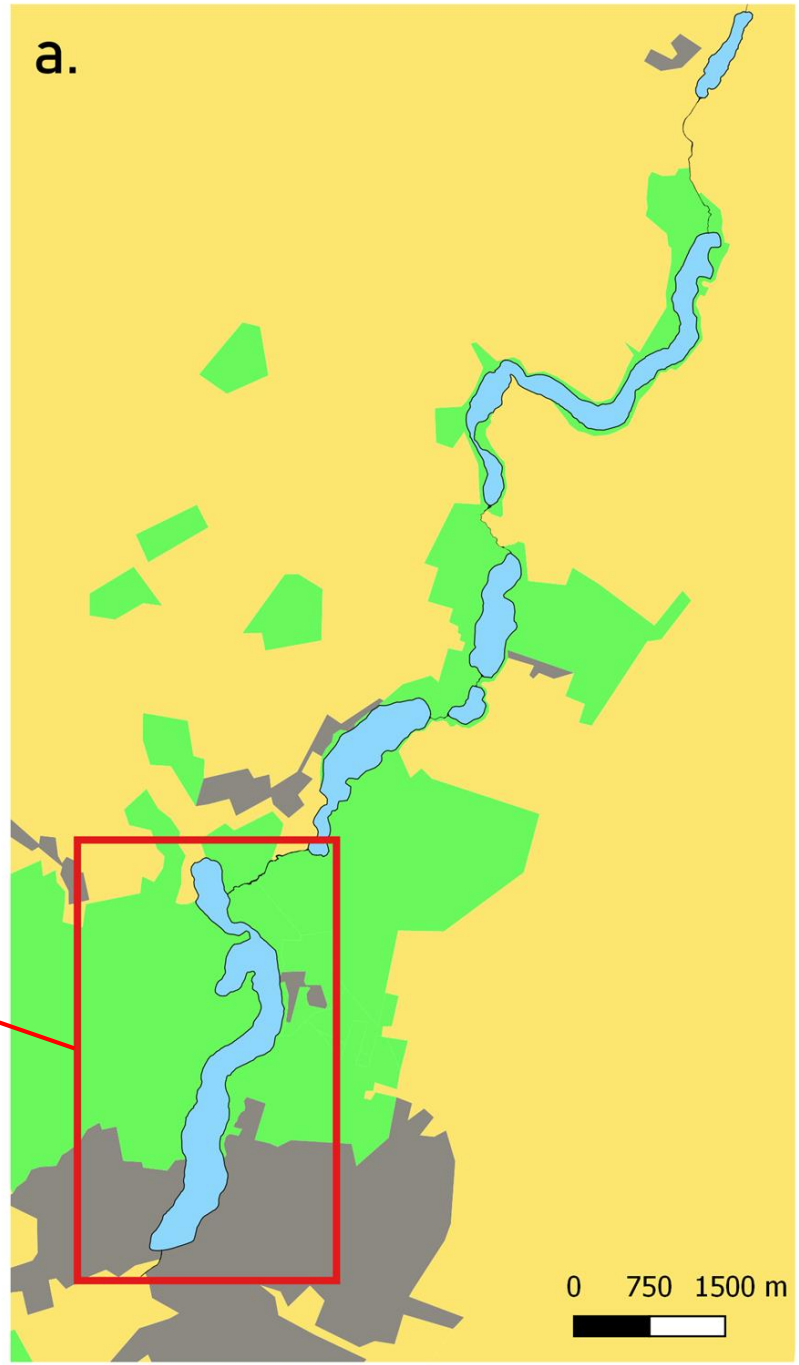
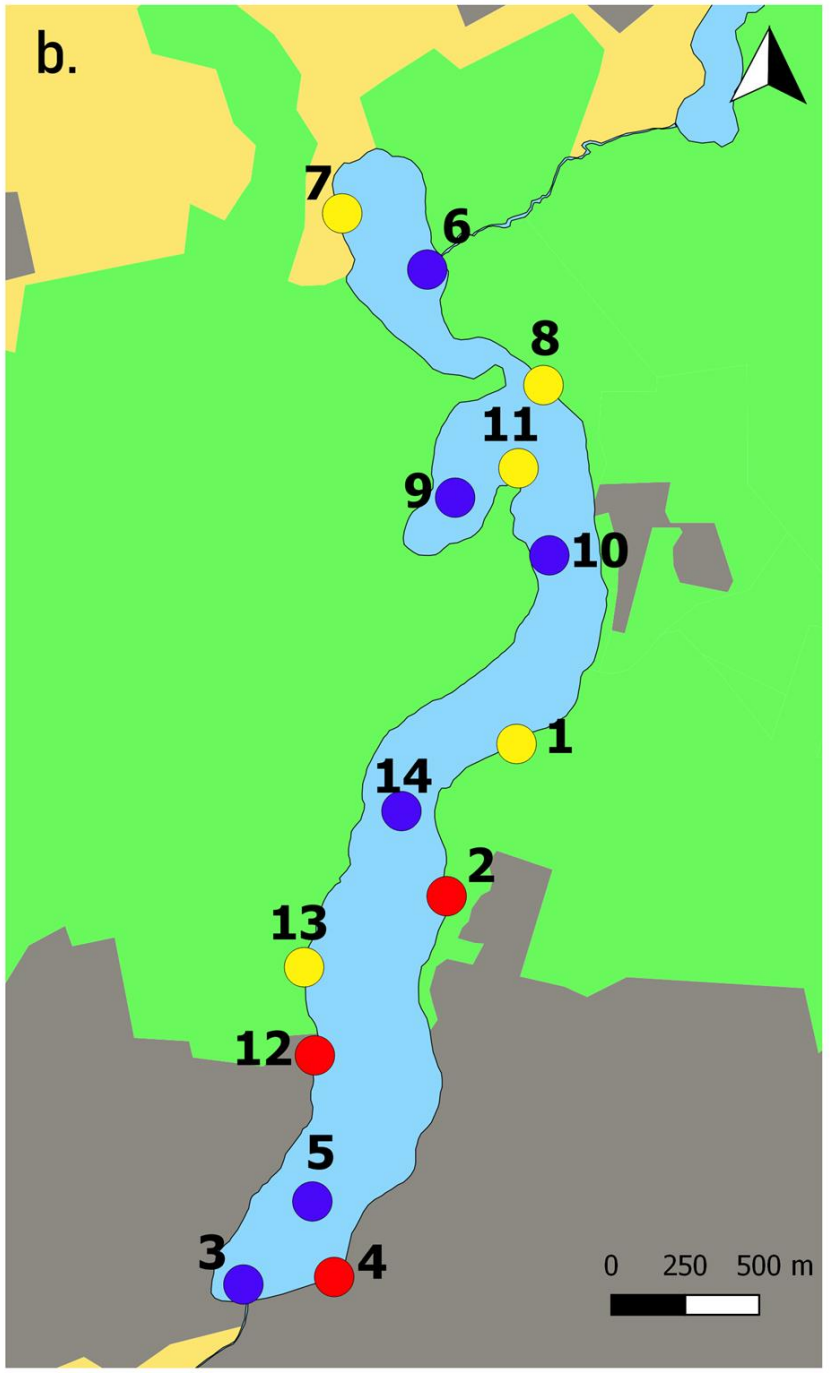
Study Area


Poland:
a.
N
0
250
500
1,000 km


a.
0
750
1500 m


b.
7
6
8
11
9
10
1
14
2
13
12
5
3
4
0
250
500 m
Stations
littoral-forest
littoral-urban
profundal
Land use
agriculture
forest
urban area
water

Ecosystem Services

Environmental services

- Habitat
- Biodiversity
- Carbon sequestration
- Regulate water flow and quality
  - Sediments
  - Nutrients

Human-value services

- Safe drinking water
- Tourism
- Recreation - fishing, kayaking, swimming, etc.

Pressures

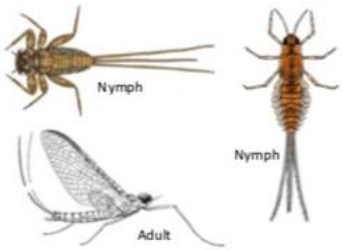
- Land use intensification
  - Agriculture
  - Urban development
- Run-off
  - Eutrophication
  - **Significant algae blooms in 2008**
- Increased temperatures (heat wave this year)
  - Reduces the mixing of water
  - Reduces oxygen
  - Anoxic conditions

Aim:

To determine current ecological status of Lake Durowskie, using macroinvertebrates as indicators

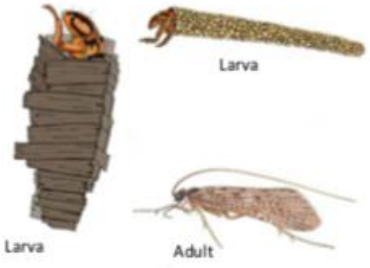
Contribute to the greater monitoring program that encompasses other environmental indicators and will assess the overall success of the restoration project so far.

Macroinvertebrates



Ephemeroptera - very sensitive

Acarina - sensitive



Trichoptera - very sensitive

Bivalvia - moderately tolerant

Nematoda - moderately tolerant

Oligochaeta - very tolerant

Hirudinea - very tolerant

Gastropoda - very tolerant

- Diverse - species and function
- Different sensitivities to pollution
- Relatively easy & inexpensive to sample

Restoration plan

- Restoration techniques currently implemented
  - Wind Aerators
  - Biomanipulation of predatory fish
  - Phosphorus inactivation
- Biomonitoring plan (in accordance with the European Water Framework Directive)
  - Yearly monitoring of the lake by students of the International Summer School
  - Monitoring of
    - Physical and chemical parameters
    - Algae
    - Macrophytes
    - Macroinvertebrates

Materials and methods

Period: Samples were collected from 24 to 29 June 2019 in 14 different sites.

- Two core samplers were used to collect the sediment samples.

  1) 'Czapla' in shallow waters (littoral part of the lake) with maximum depth of 2 meters.

  2) 'Kajak' in deeper parts of the lake, with the maximum depth of 14,6 meters.

- Samples of zoobenthos from all places were washed directly in the field using a sieve

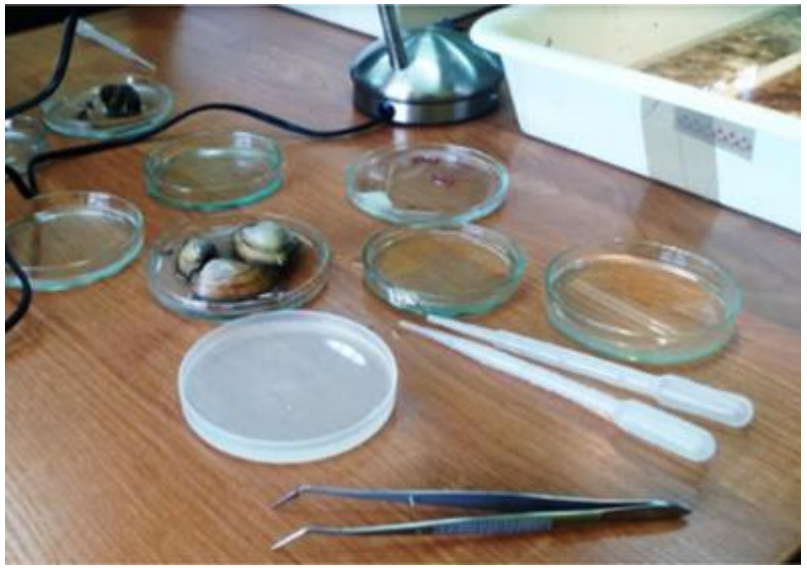
Equipment used for sampling

Kajak Sampler
diameter 6,0 cm

Czapla Sampler
diameter 5,6 cm

Sieve
mesh 0,4 cm

Equipment used in the laboratory



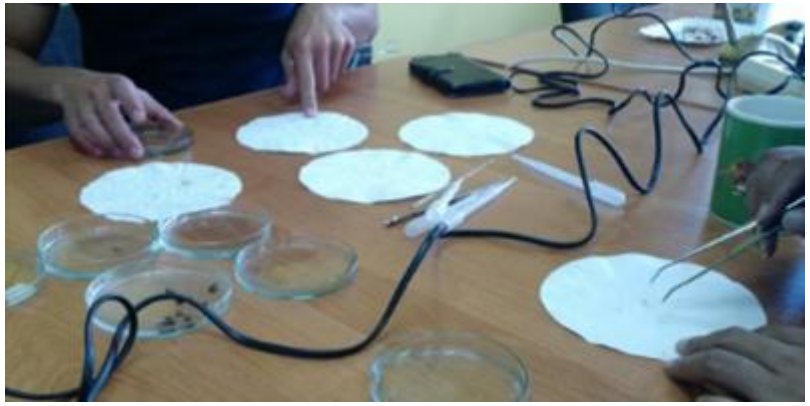
Tweezers

Pipette

Crepe paper

Scale

Microscope/stereoscope



Activities in laboratory

Field laboratory:

- Searching for animals in samples
- Separating them by family groups
- Weighting

Poznań laboratory:

- Classifying the species
- Summing the individuals and their biomass
- Converting to m^2

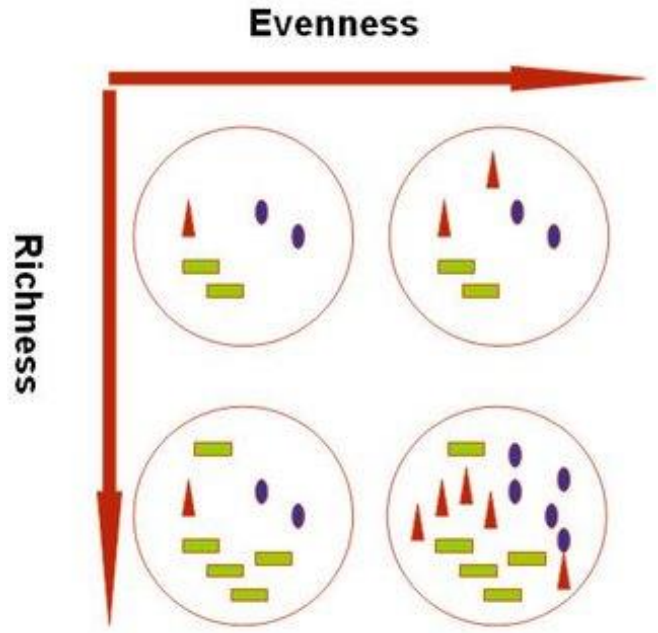
Indices used

Diversity indices measure the diversity of the spieces in a community - focus on community composition, less on species richness (*e.g.* number of species present).

- Shannon-Wiener Index
- Simpson Index

Other Indices

- Jaccard Index
- Biological Monitoring Working Party (BMWP)



Biodiversity assessment

- Shannon-Wiener Index

$$H = -\sum_{i=1}^{s} p_i \ln(p_i)$$

H = ln(S)

p_i - the number of individuals in the species divided by the total number of individuals.

High Shannon entropy means high diversity and low Shannon entropy means low diversity.

- Simpson Index

$$D = \sum (n / N)^2$$

Index = 1-D

n_i - the total number of organisms of a particular species.

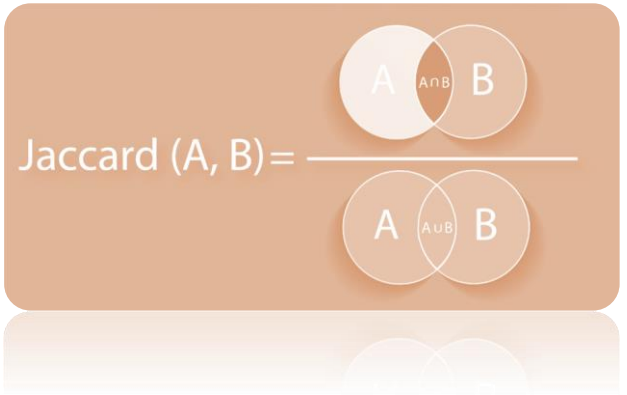
N - the total number of organisms of all species.

Measures the probability that two individuals, randomly selected from a sample, will belong to the same species. Ranges from 0 to 1.

Other Indices used to measure water quality

Jaccard Index

- Compare sites (populations) by determining what percent of organisms identified were present in both of them.
- Range 0 - 100%. The higher the percentage means higher similarity.



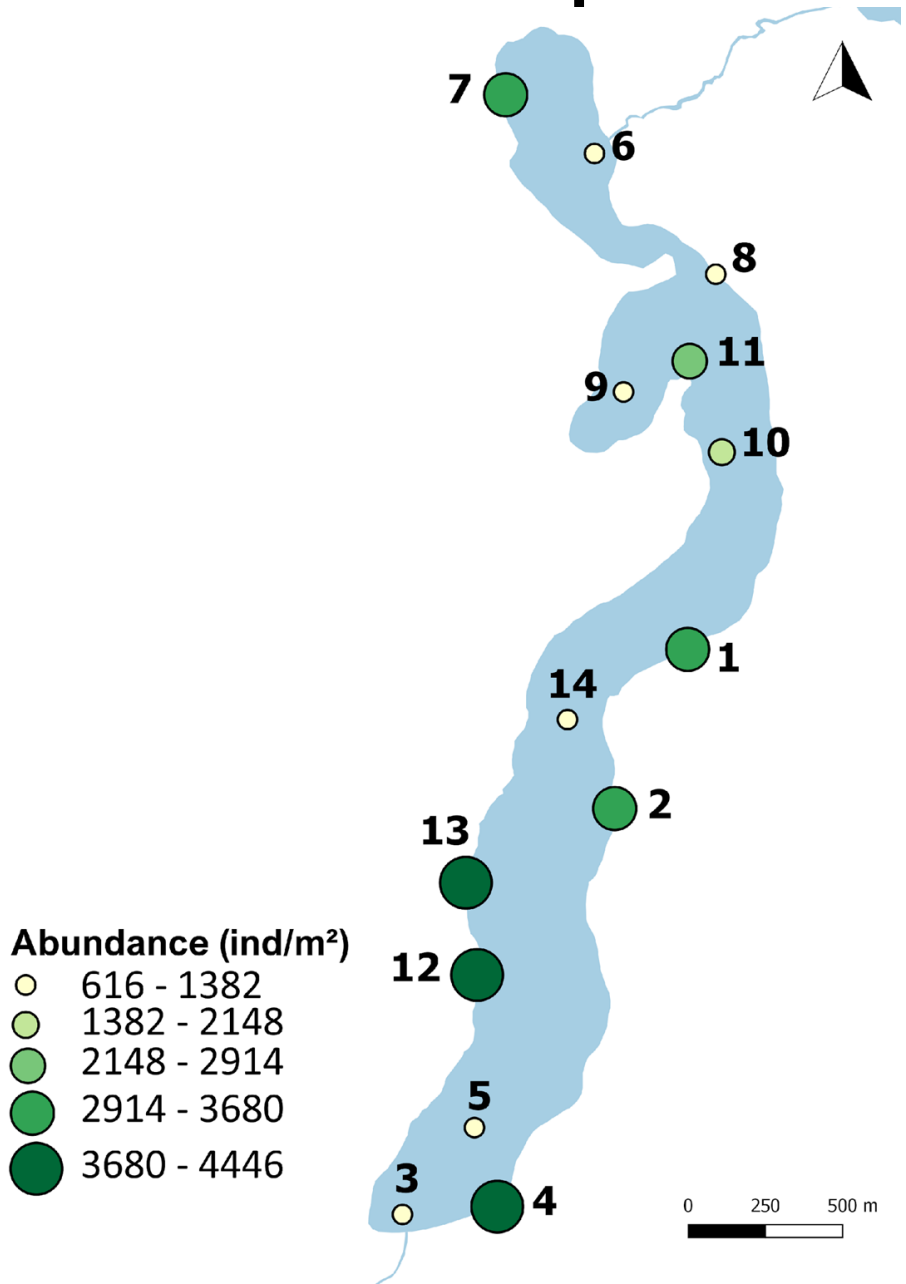
Biological Monitoring Working Party (BMWP)

- Measuring water quality using the presence of species of macroinvertebrates (Tolerances to pollutants)
- Score 1 – 10

Limitations

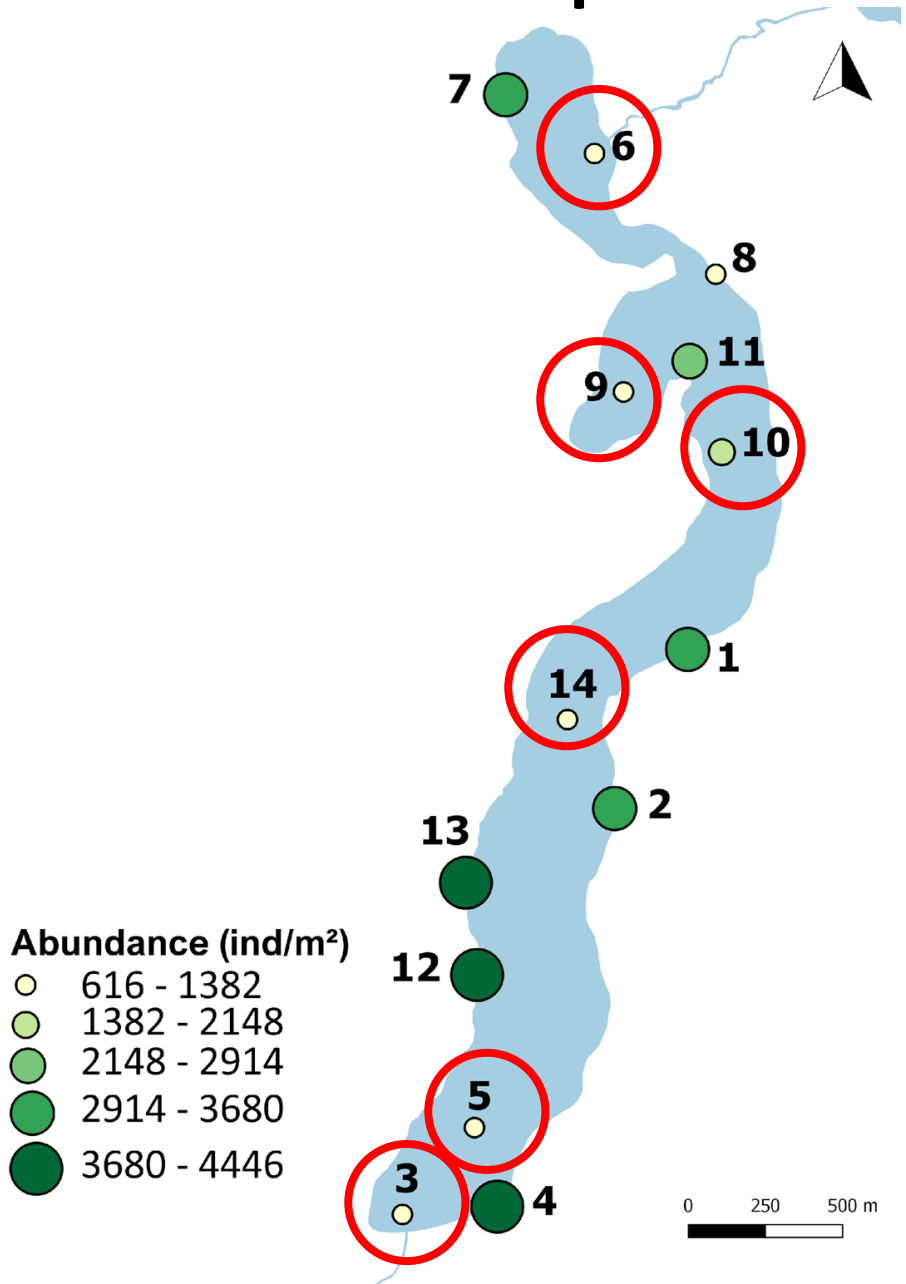
- Sensitive not only to pollution but also other environmental factors
- This system was developed for European macroinvertebrate families
- This index takes into account only the presence of families but not their abundance

Number of individuals per m^2



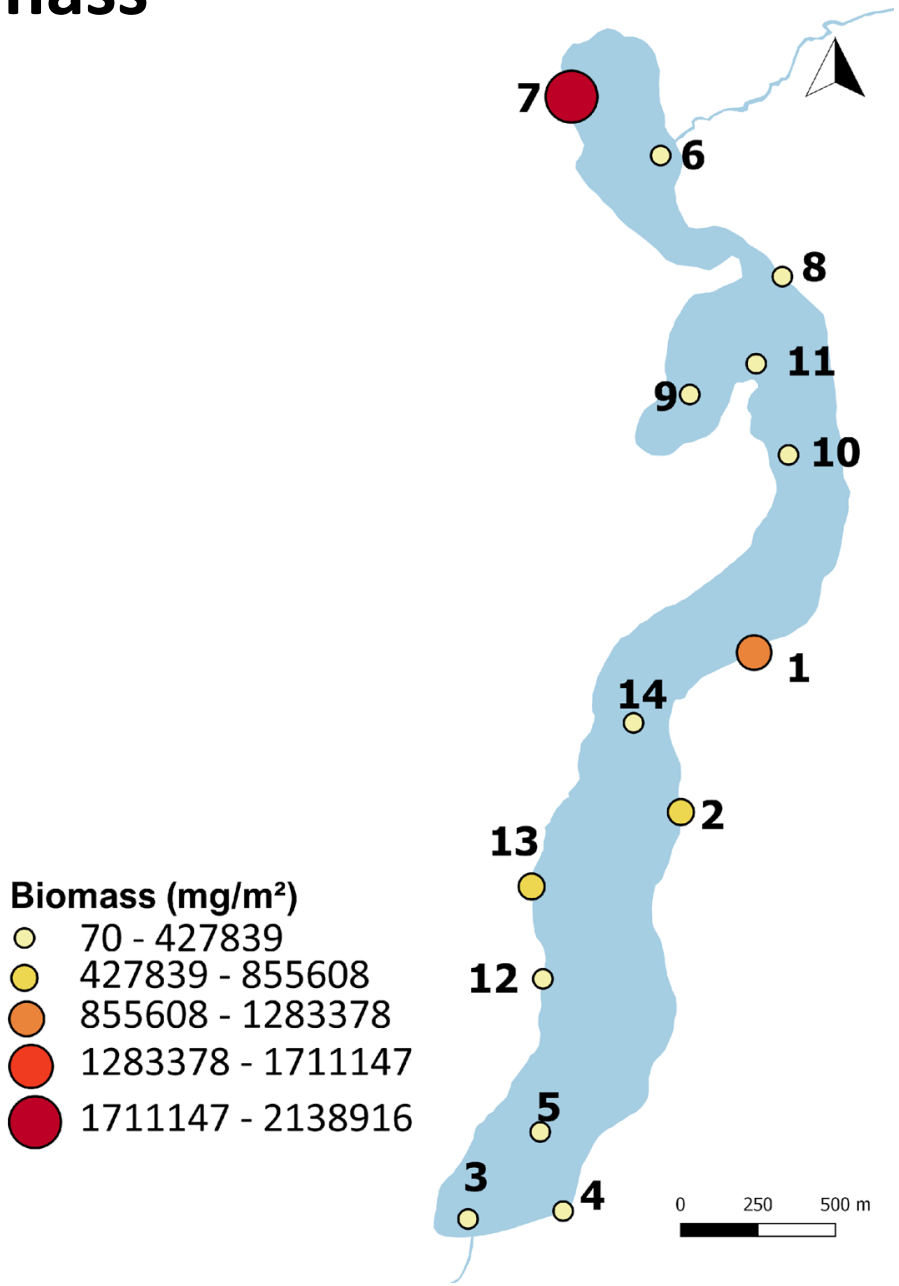
- Abundance ranges from 616 ind/m^2 (station 5) to 4446 ind/m^2 (station 13)
- The lowest abundances of individuals are mostly found in the pelagic stations (stations 3, 5, 6, 9, 10 and 14)

Number of individuals per m^2



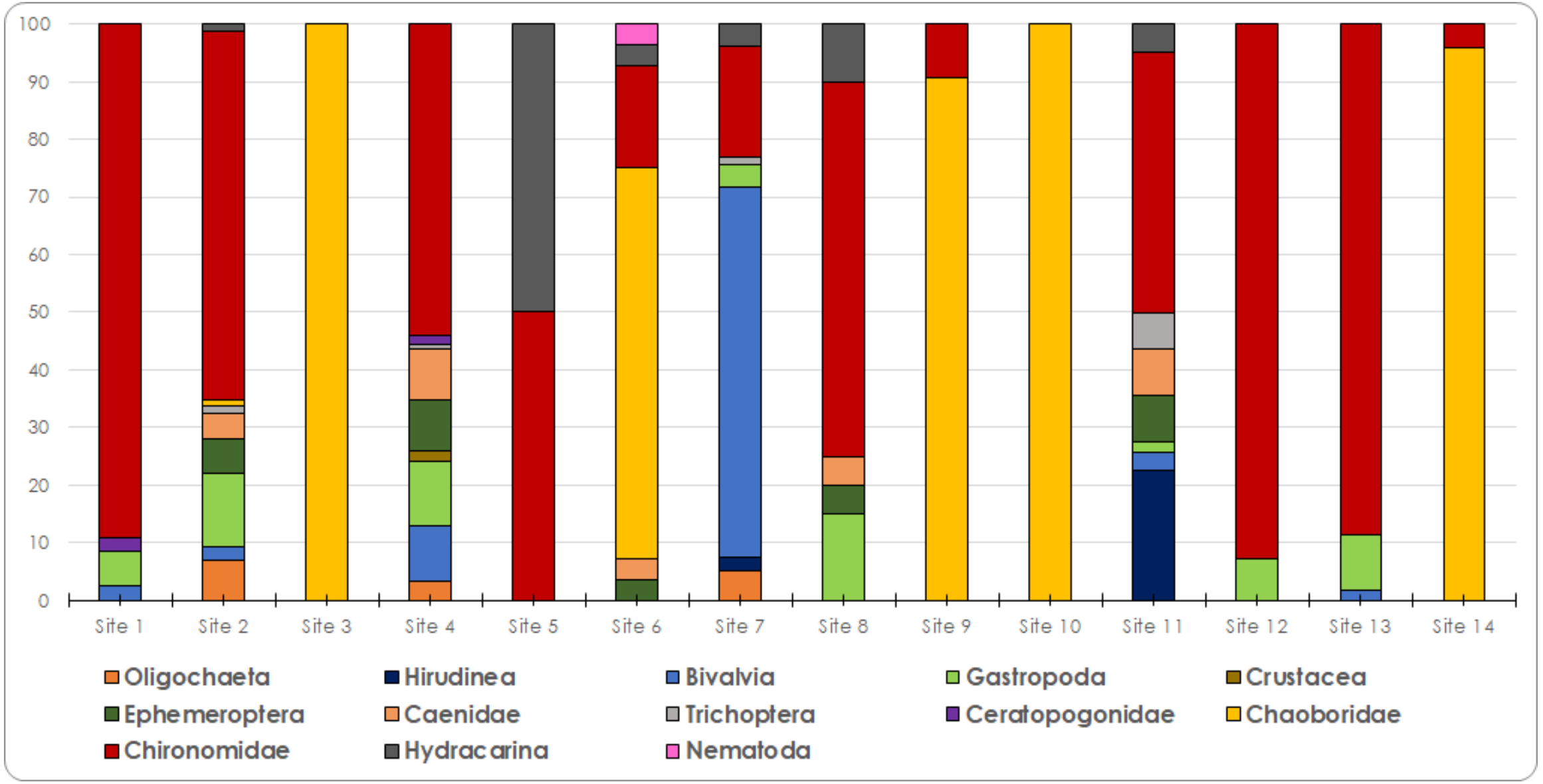
- Abundance ranges from 616 ind/m^2 (station 5) to 4446 ind/m^2 (station 13)
- The lowest abundances of individuals are mostly found in the pelagic stations (stations 3, 5, 6, 9, 10 and 14)

Biomass



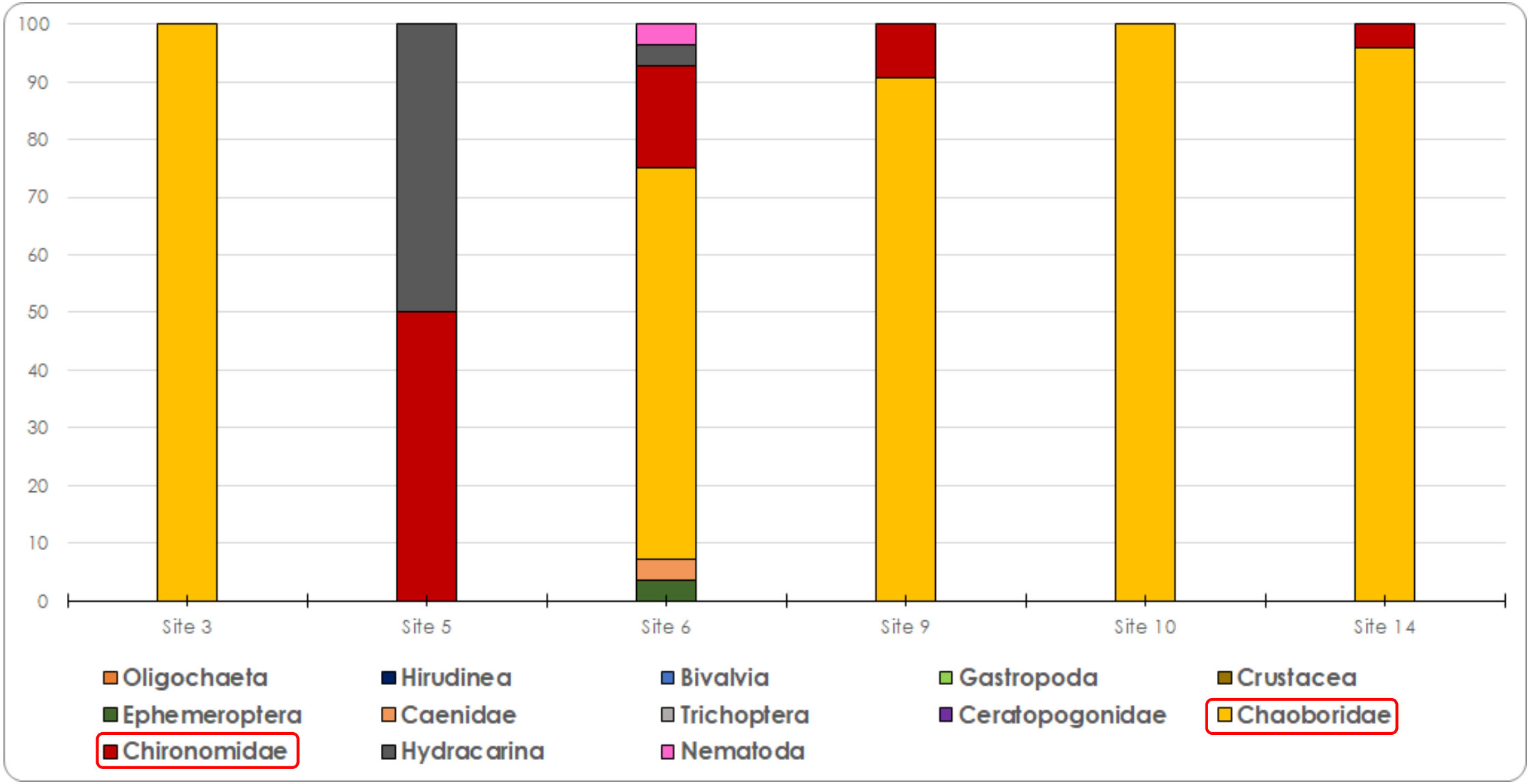
- Biomass ranges from 2138916 mg/m^2(station 7) to 70 mg/m^2 (station 5)
- All the pelagic sites showed very low value of biomass: absence of Bivalvia and Gastropoda

Overall percentage of abundance in all sites

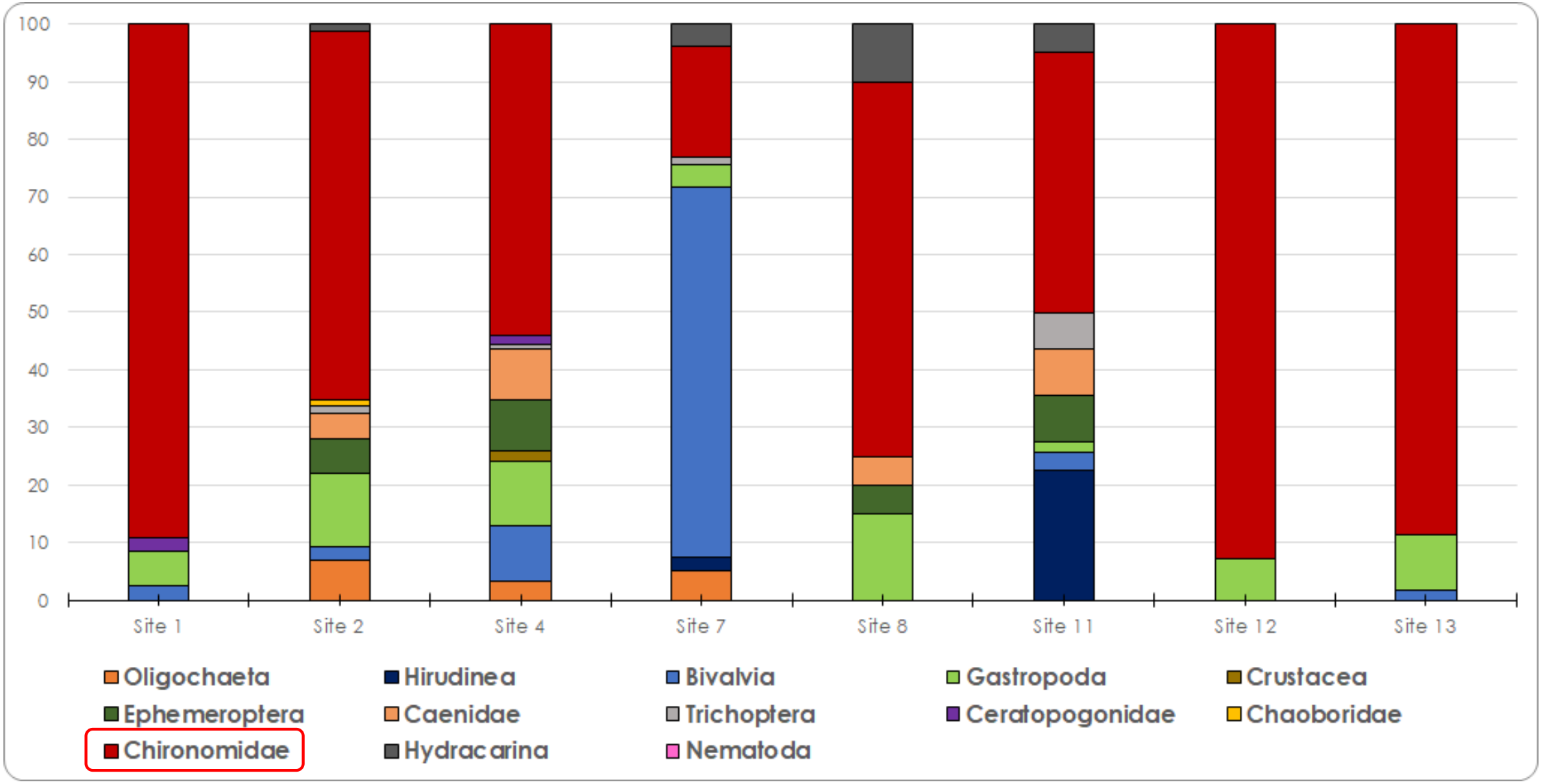


Overall percentage of abundance in all sites

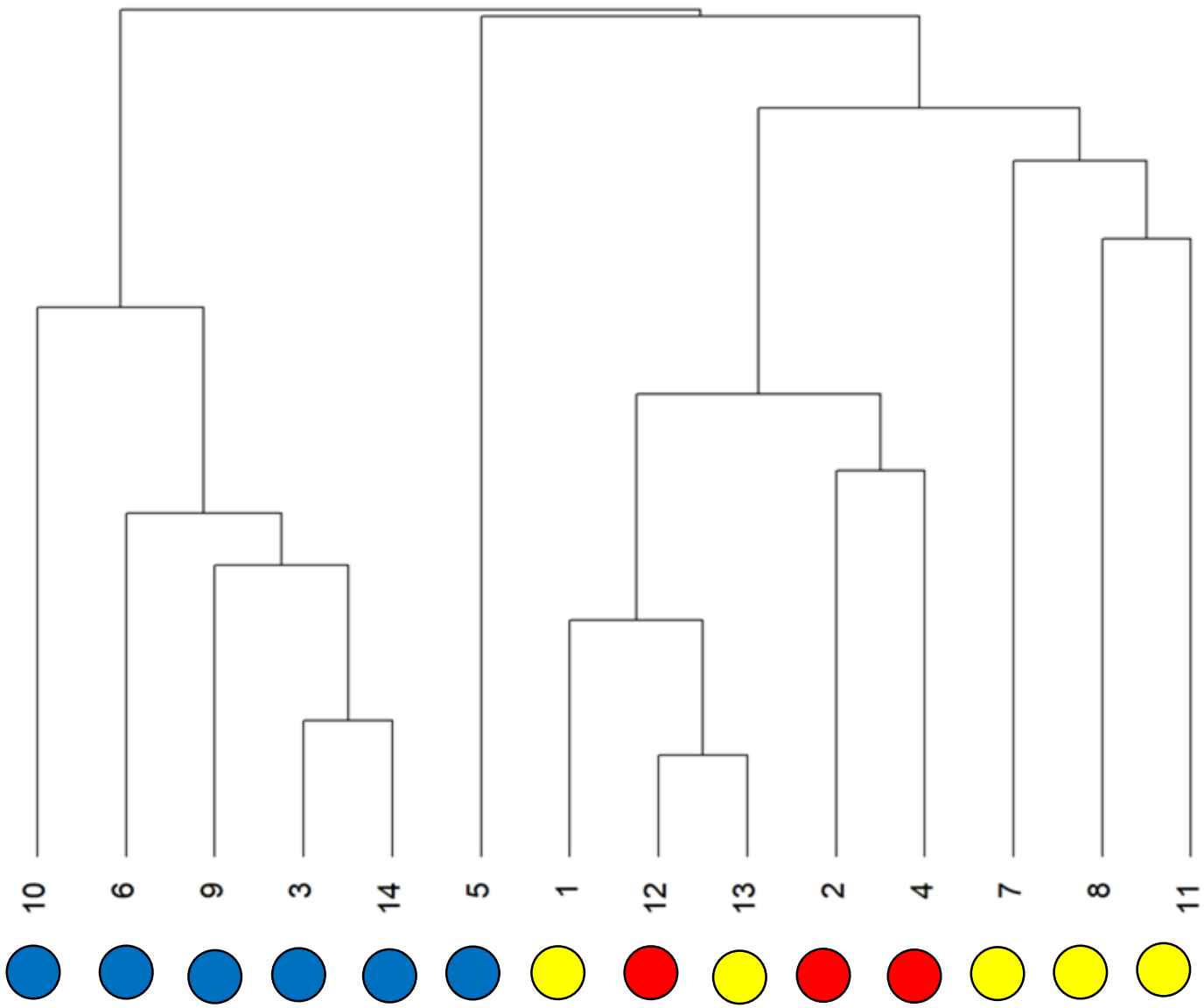
PROFUNDAL STATIONS

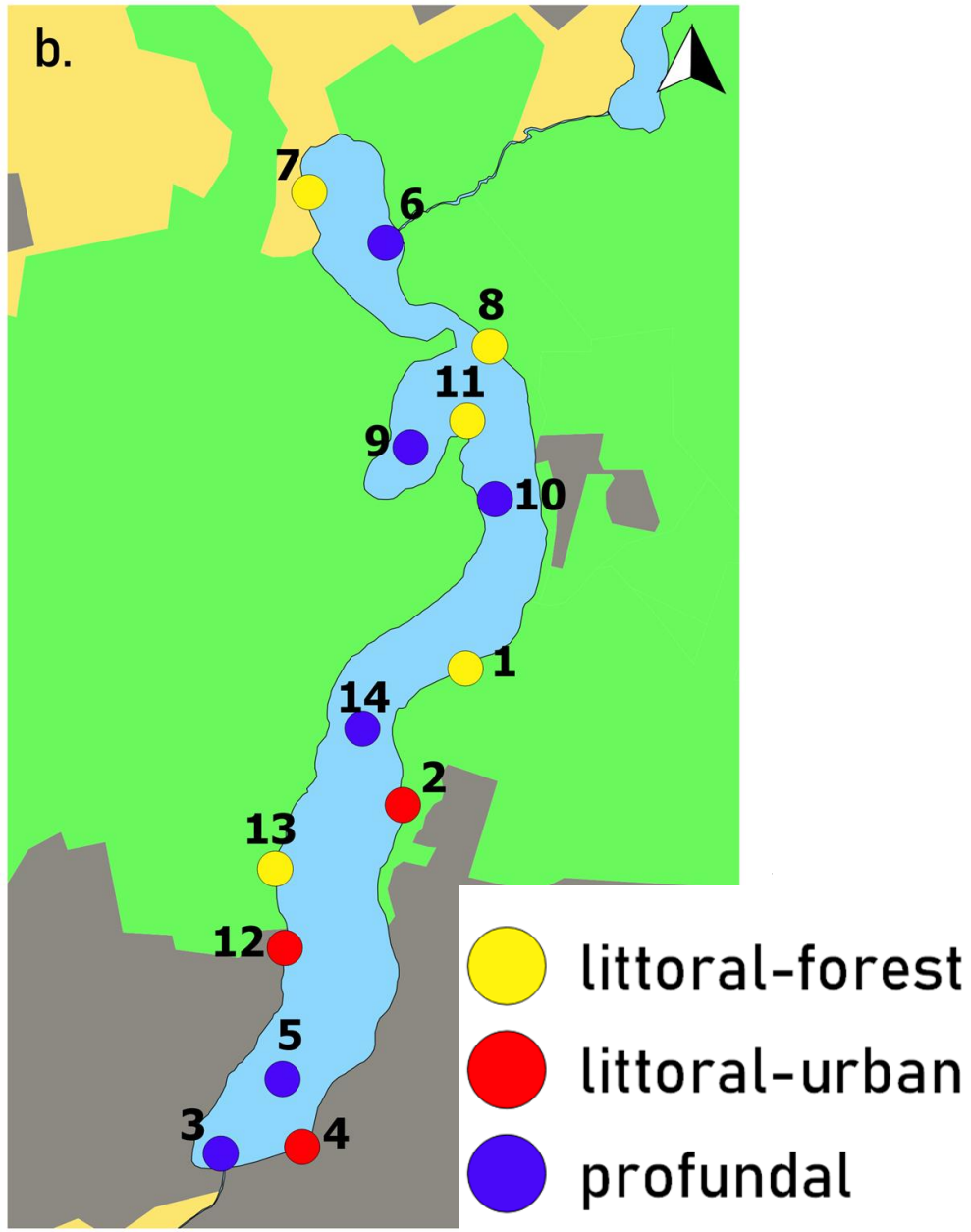


Overall percentage of abundance in all sites

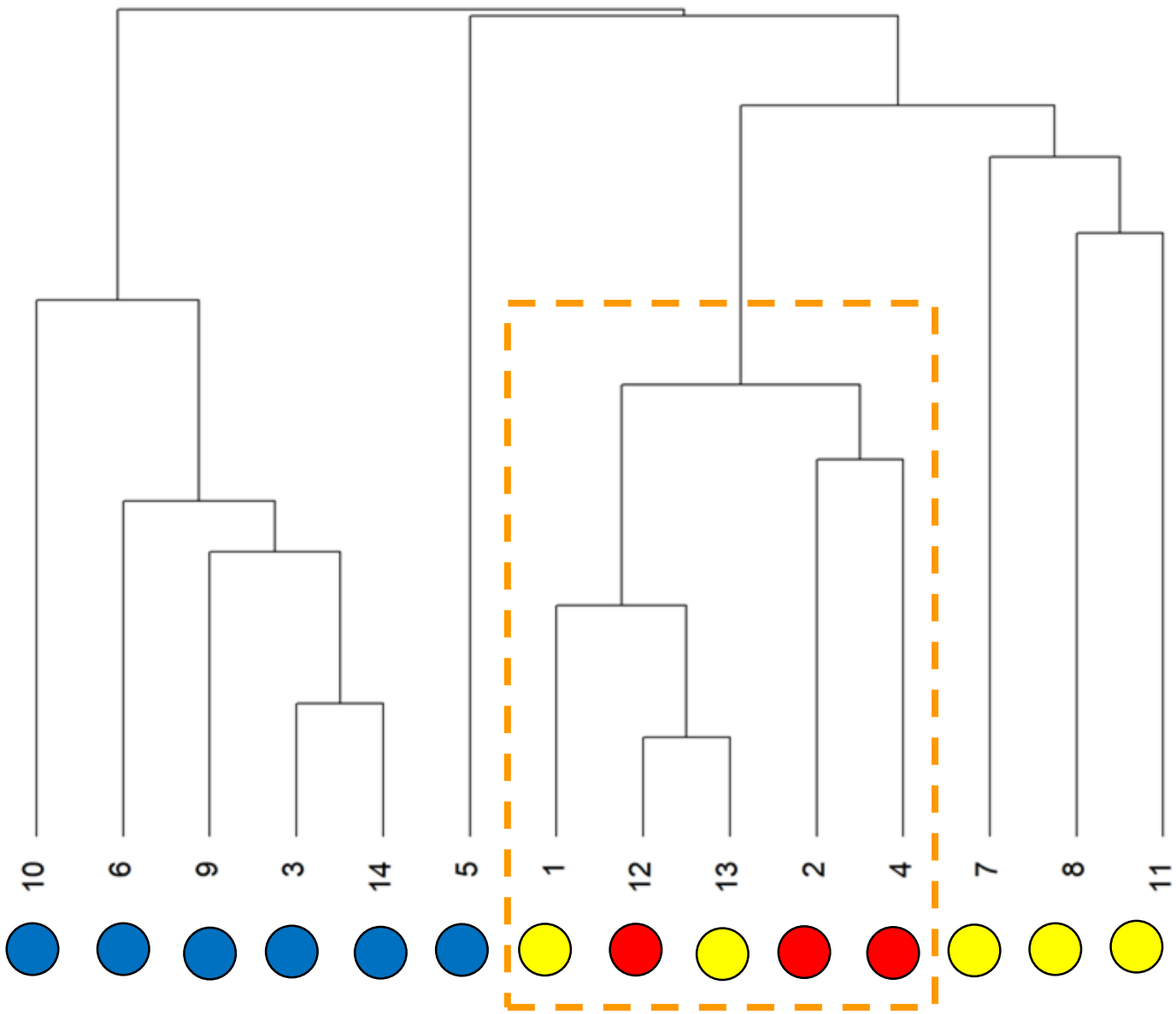


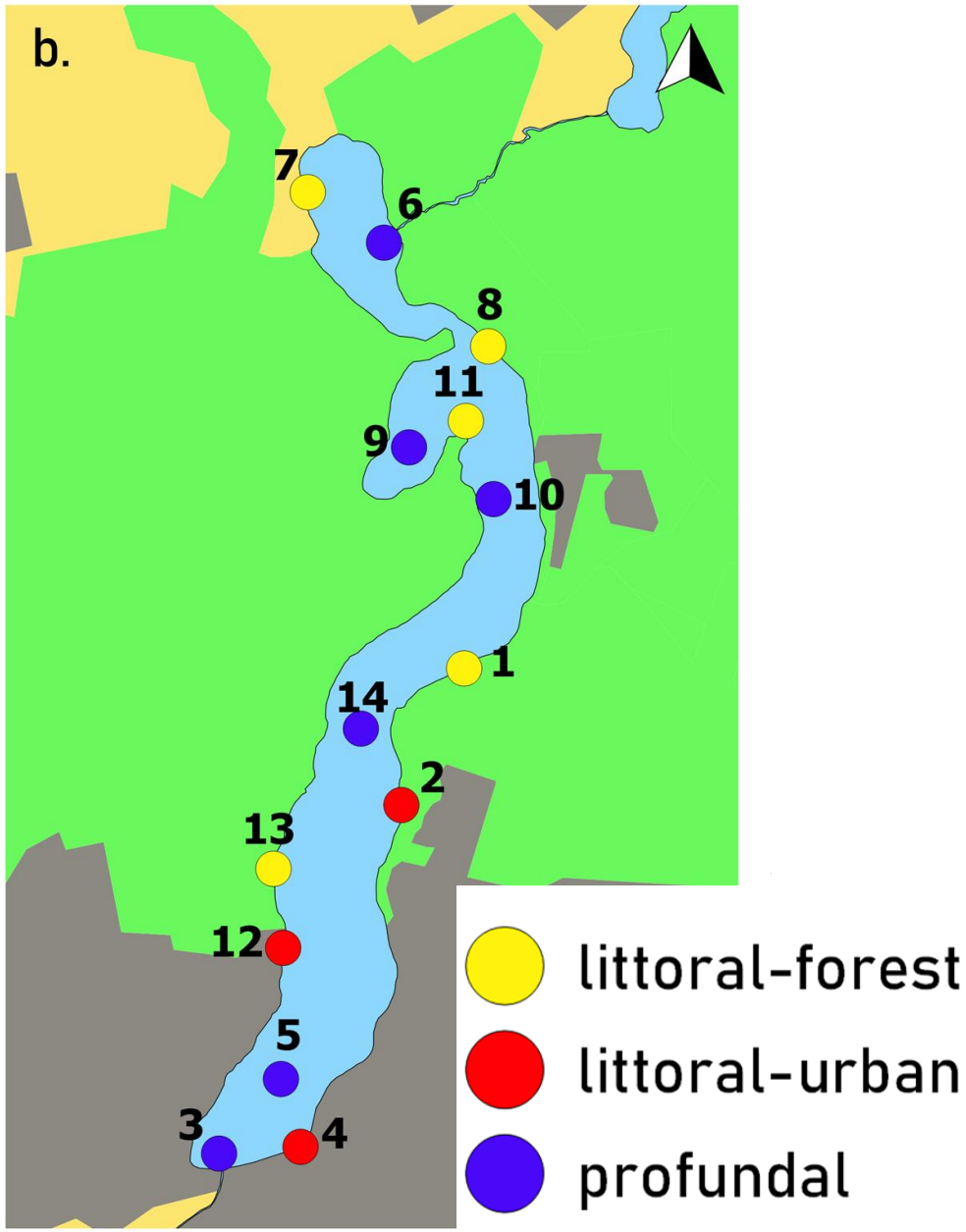
Jaccard Similarity Index



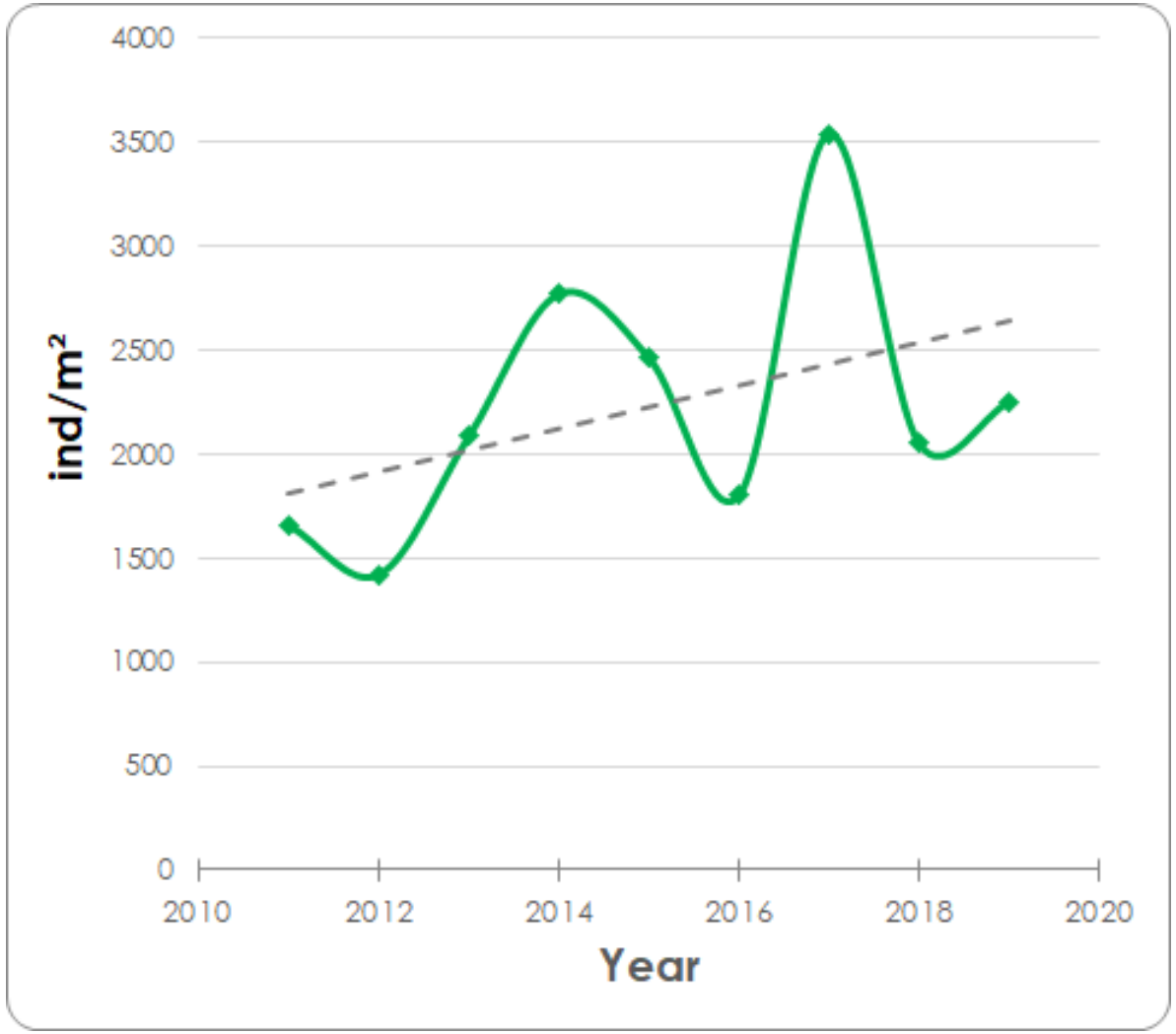


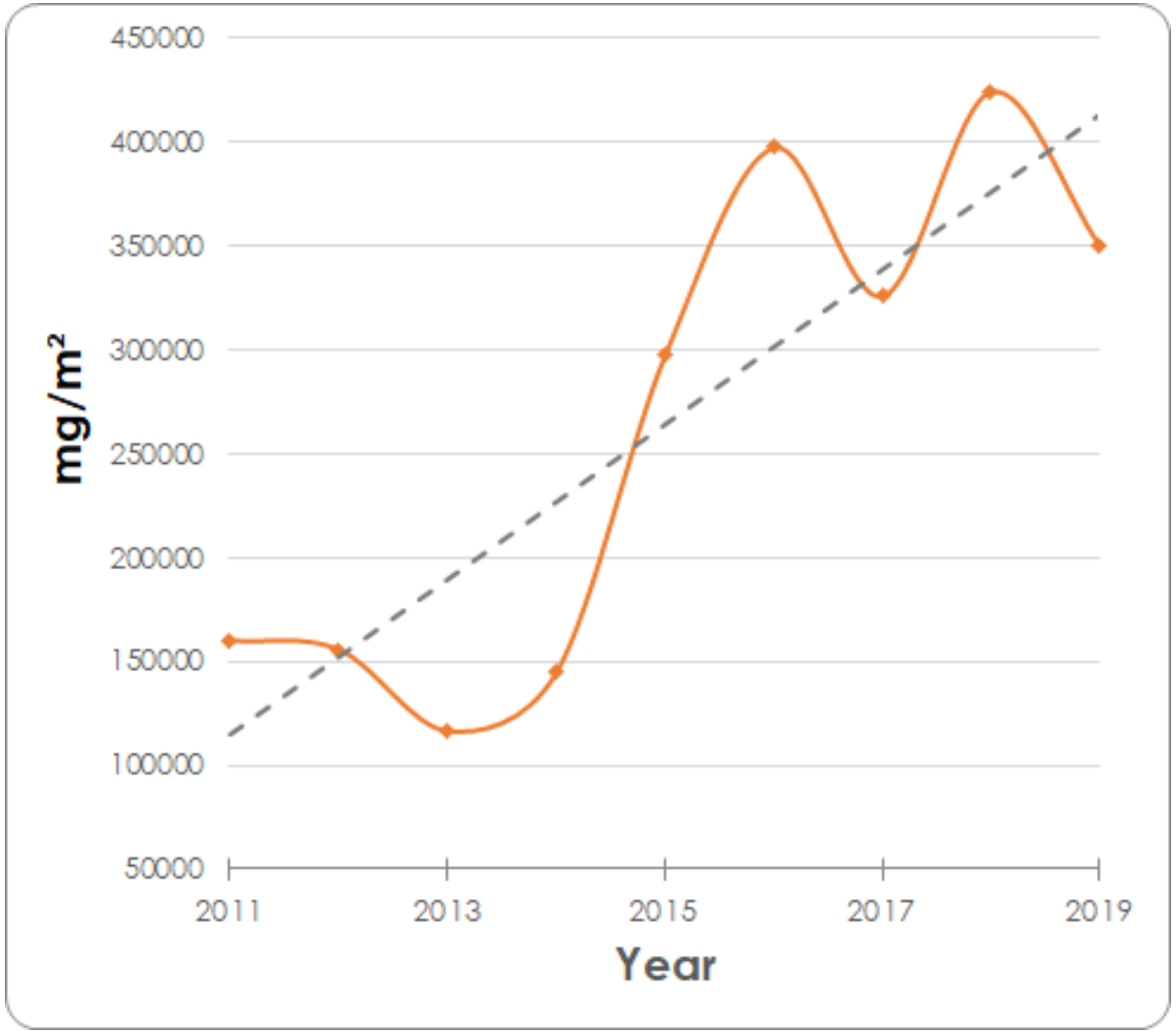
Jaccard Similarity Index





Temporal trend for abundance and biomass



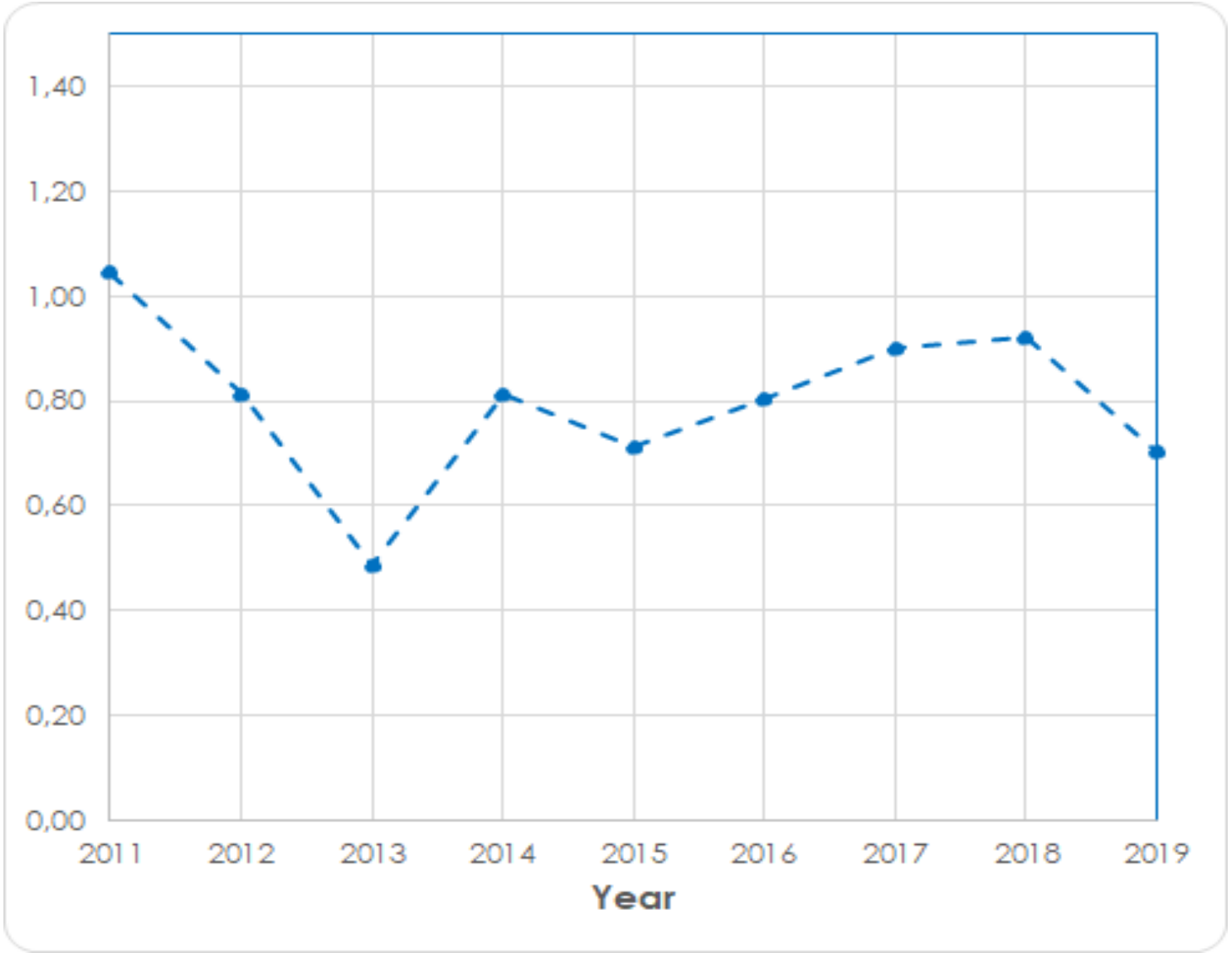


Shannon-Wiener index

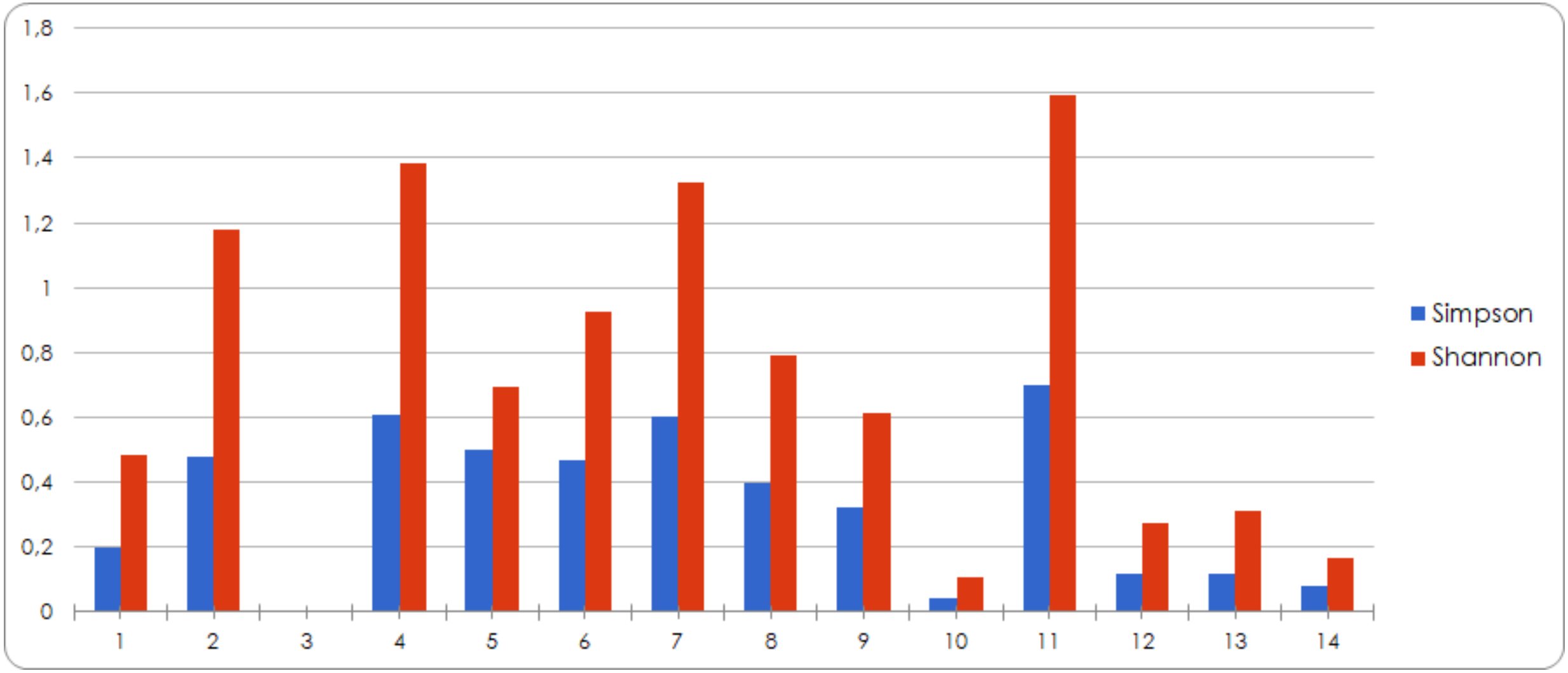
Site 1	0,48
Site 2	1,18
Site 3	0,00
Site 4	1,38
Site 5	0,69
Site 6	0,92
Site 7	1,32
Site 8	0,79
Site 9	0,61
Site 10	0,10
Site 11	1,59
Site 12	0,27
Site 13	0,31
Site 14	0,17

Shannon-Wiener index

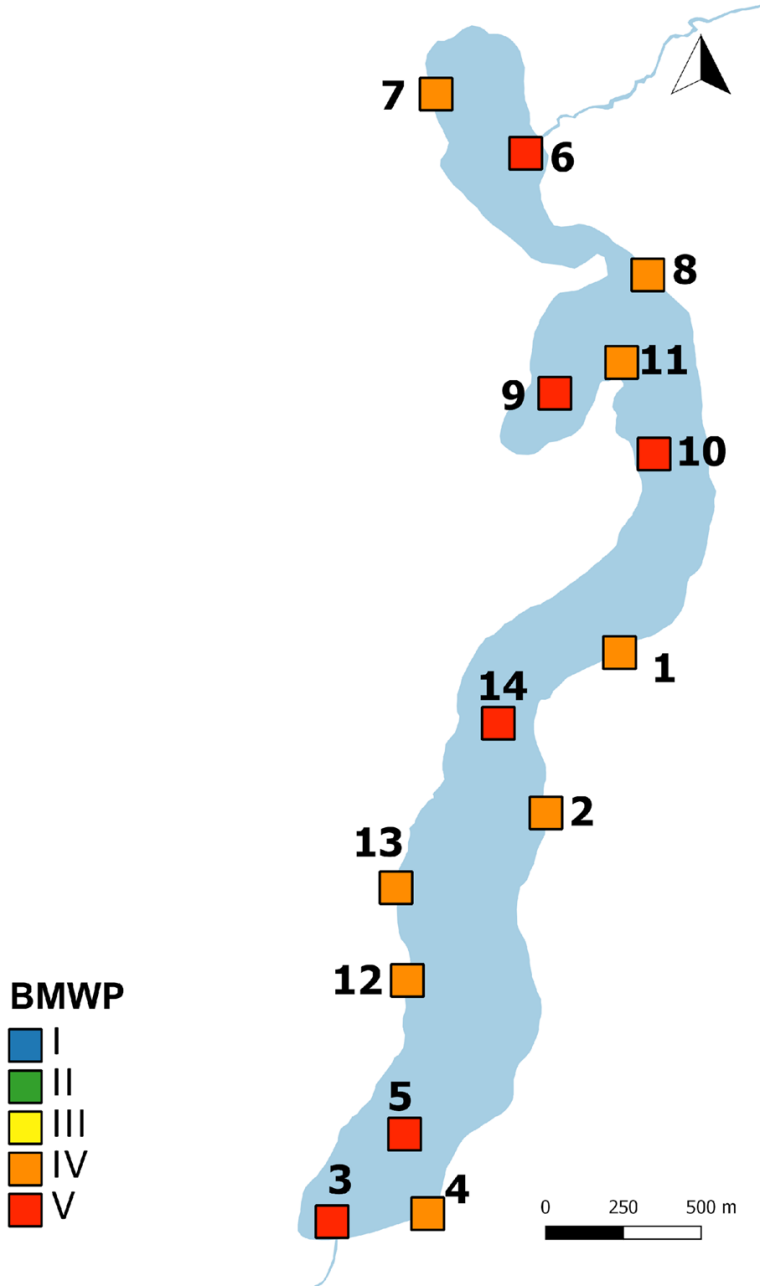
Site 1	0,48
Site 2	1,18
Site 3	0,00
Site 4	1,38
Site 5	0,69
Site 6	0,92
Site 7	1,32
Site 8	0,79
Site 9	0,61
Site 10	0,10
Site 11	1,59
Site 12	0,27
Site 13	0,31
Site 14	0,17



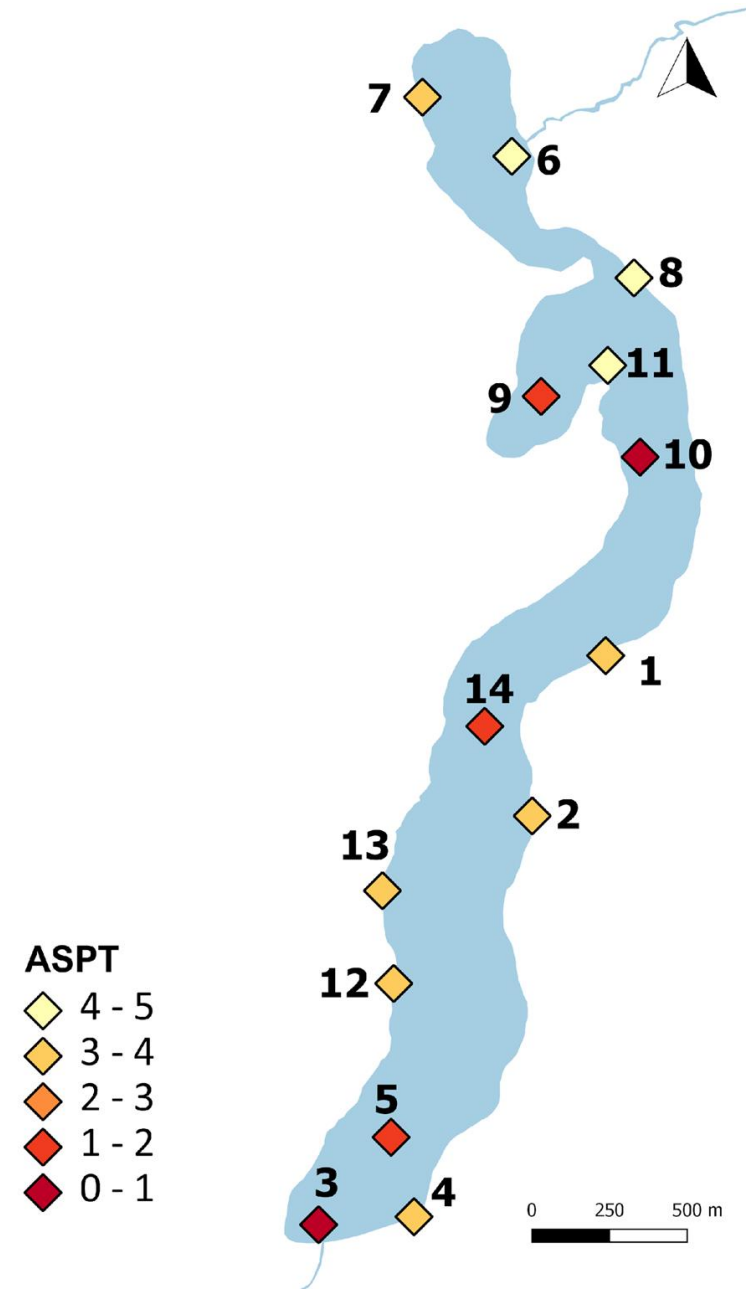
Shannon-Wiener and Simpson indices comparison



BMWP


7
6
8
11
9
10
1
14
2
13
12
5
3
4
0
250
500 m
BMWP
I
II
III
IV
V

ASPT


7
6
8
11
9
10
1
14
2
13
12
5
3
4
0
250
500 m
ASPT
4 - 5
3 - 4
2 - 3
1 - 2
0 - 1

Summary

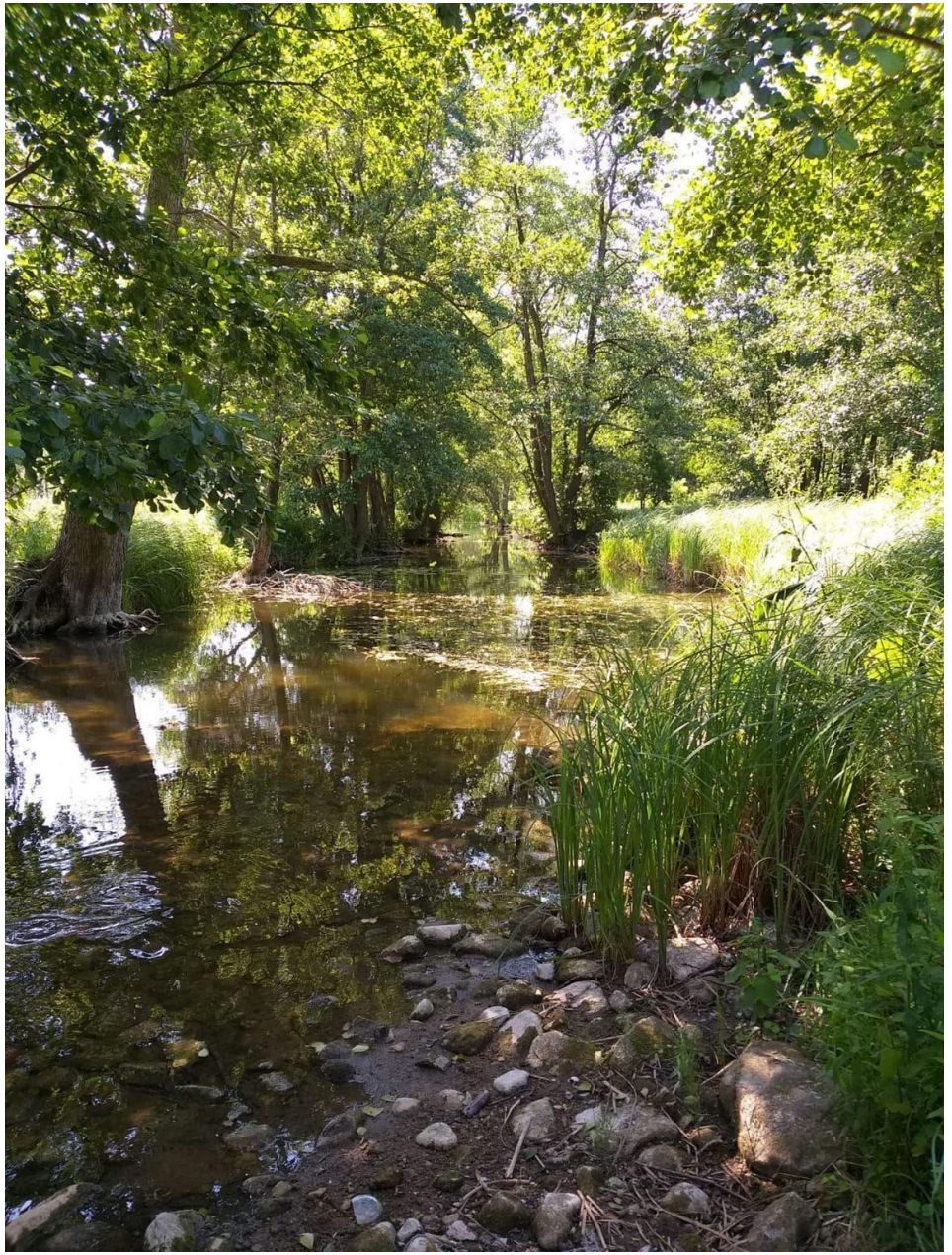
- General decrease in the biodiversity indices compared to previous years
- Poor-Bad quality (BMWP score)
- Dominance of tolerant taxa
- Not on target for European Water Framework Directive objectives
- General positive trend – abundance and biomass; fluctuations
- Possible causes
  - Heat wave (April and June, 2019)

Recommendations

- Macrophyte revegetation
- Improve the quality of lakes upstream
- Reduce sources of pollution
  - Agriculture
  - Urban
- Install more aerators
- Biomanipulation of filter feeders

Future research

- Integrate parameters
  - Physical and chemical, algae and macrophytes
- Samples from inflow and outflow rivers
- Analyse pelagic and littoral zones separately



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THANK YOU FOR YOUR ATTENTION!
Questions?