



Summer School
Wągrowiec – Poznań
2019





Summer School
Wągrowiec – Poznań
2019



Macrophytes as an indicator of environmental change in Durowskie Lake, Poland

Marcin Remlein, Adam Berezowski, Marek Kilon, Magdalene Behrens

Prof. Dr. hab. Ryszard Gołdyn



Summer School
Wągrowiec – Poznań
2019



Contents

- Introduction
- Material and methods
- Results & Discussion
- Conclusions & Recommendations



Summer School
Wągrowiec – Poznań
2019



Introduction



Summer School
Wągrowiec – Poznań
2019



Area of study

Durowskie Lake

Location	Commune and district of Wągrowiec
Surface	143.7 ha
Volume	11 322 900 m ³
Maximum depth	14.6 m
Average depth	7.9 m
Main tributary	Struga Golaniecka
Surface in direct catchment area	1.581 ha
Share of agricultural area	58.26 %
Share of forests	33.52 %
Urban areas	8.25 %



Source: openstreetmap.org

From *Macrophytes report 2017*.



Summer School
Wągrowiec – Poznań
2019



Macrophytes

- Macrophytes have a significant impact on the water quality of lakes
 - Long-term uptake of nutrients
 - Provision of good conditions for filtration from catchment sediments
 - Stabilisation of surface of the beds
 - Provision of a huge surface area for attached periphyton growth
 - Transfer of oxygen to rhizosphere by leakage from roots
 - Provision of habitat for zooplankton, fish and other wildlife species
 - Aesthetical contribution

(Brix, 1994)



Summer School
Wągrowiec – Poznań
2019



Objectives

- What macrophyte associations are growing in and at the shoreline of Lake Durowskie?
- What size is each association constituting?
- What proportion are the submerged species constituting?
- Comparison to previous years
- What information can be drawn from changing sizes of indicator associations?
- Are the restoration treatments for improving the lake's water quality effective?



Summer School
Wągrowiec – Poznań
2019




Methods & Materials



Summer School
Wągrowiec – Poznań
2019





Data Collection

- Date: 24.-29.07.2019
- Identification of plant associations acc. to Braun-Blanquet
- Estimation of size
- Mapping with GPS device
- By boat and by foot
- Anchor for submerged species

Data analysis

- With QGIS, ArcGIS and MS Office
- Size and amount of plant areas
- Calculation of the ESMI and MIR indices
- Total percentage areas



Summer School
Wągrowiec – Poznań
2019



ESMI

Ecological State Macrophyte Index

- H – diversity index of phytocenosis
- n_i – area of polygons one of association in percent per cover
- N – all cover of macrophytes
- H_{max} – coefficient of variation of the theoretical maximum
- S – number of associations
- Z – occupancy index
- isob2.5m – area of littoral limited by isobath 2.5 m
- P – area of the lake

$$ESMI = 1 - \exp \left[-\frac{H}{H_{max}} \cdot Z \cdot \exp \left(\frac{N}{P} \right) \right]$$

$$H = - \sum \frac{n_i}{N} \cdot \ln \frac{n_i}{N}$$

$$H_{max} = \ln S$$

$$Z = \frac{N}{P_{isob2.5}}$$



Summer School
Wągrowiec – Poznań
2019



MIR – Macrophyte Index of Rivers

$$\text{MIR} = \frac{\sum L_i * W_i * P_i}{\sum W_i * P_i} * 10$$

- L and W are indicator values for each species
- P = percentage coverage (split into discrete categories) for that species



Summer School
Wągrowiec – Poznań
2019



Results & Discussion



Summer School
Wągrowiec – Poznań
2019



Name association	Total [m ²]	% area
<i>Phragmitetum communis</i>	64758,94	49%
<i>Fontinaletum antipyreticae</i>	38945,9	29%
<i>Typhetum angustifoliae</i>	11937,49	9%
<i>Myriophylletum spicati</i>	10597,54	8%
<i>Nupharo-Nymphaeetum</i>	4146,796	3%
<i>Acoretum calami</i>	669,3275	1%
<i>Potametum perfoliati</i>	462,7843	0%
<i>Ceratophylletum demersi</i>	398,954	0%
<i>Caricetum ripariae</i>	379,117	0%
<i>Sparganietum erecti</i>	292,7012	0%
<i>Scirpetum lacustris</i>	83,40309	0%
<i>Glycerietum maximae</i>	80,36526	0%
<i>Thelypteridi-Phragmitetum</i>	50,0866	0%
<i>Butometum umbelati</i>	45,79725	0%
<i>Cicuto-Caricetum pseudocyperii</i>	16,63538	0%
<i>Typhetum latifoliae</i>	16,58997	0%
<i>Potametum lucentis</i>	14,0287	0%
<i>Eleocharitetum palustris</i>	13,0189	0%
<i>Najadetum marinae</i>	5,697873	0%
<i>Iridetum pseudacori</i>	3	0%
<i>Phalaridetum arundinaceae</i>	2,5887	0%
<i>Charetum tomentosae</i>	0	0%
<i>Caricetum acutiformis</i>	0	0%
<i>Nitellopsidetum obtusae</i>	0	0%
<i>Charetum contrariae</i>	0	0%
Total	132522	100%



Phragmitetum communis and *Typhetum angustifoliae*

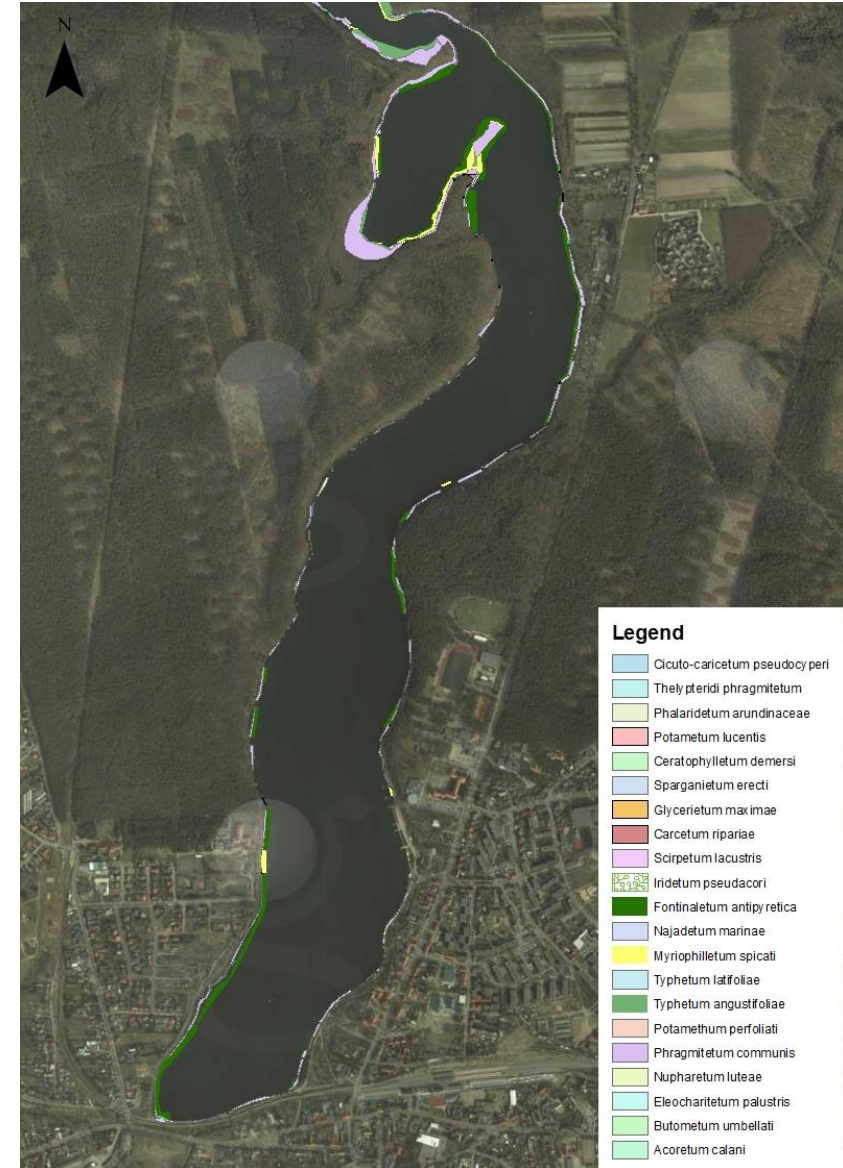
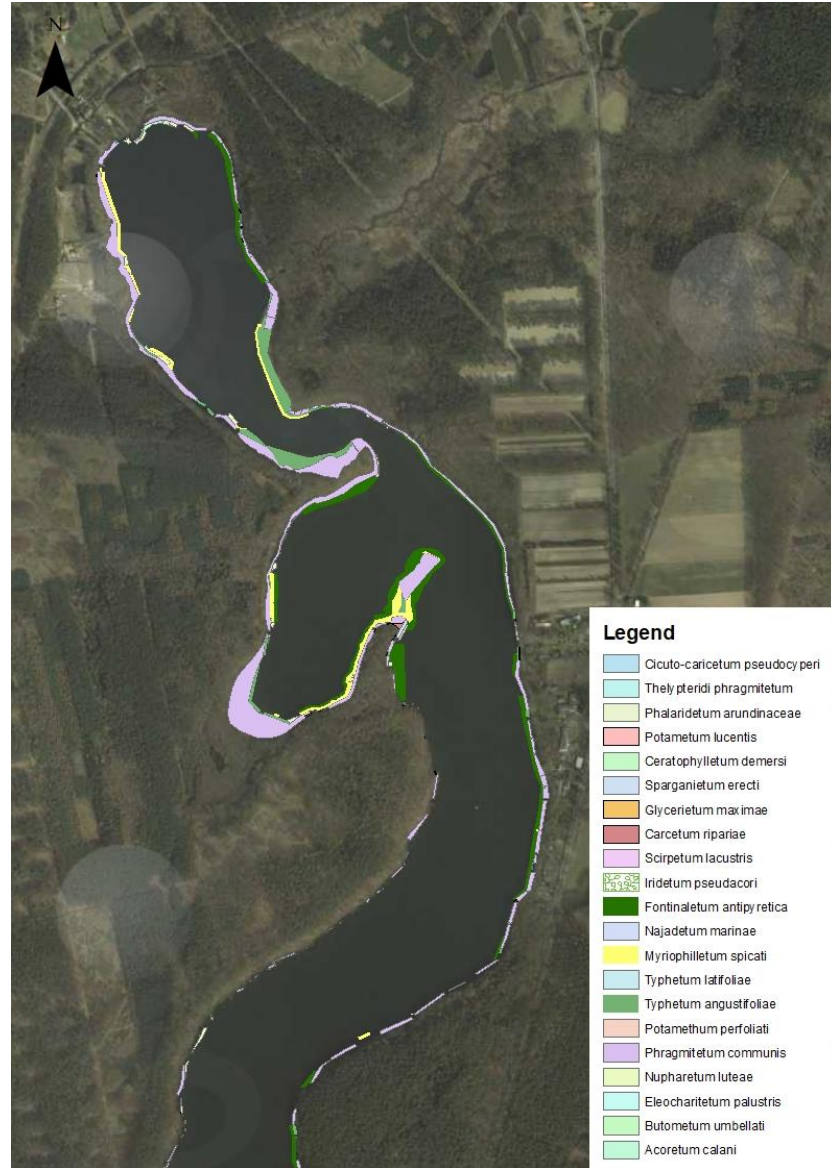


Fontinaletum antipyreticae

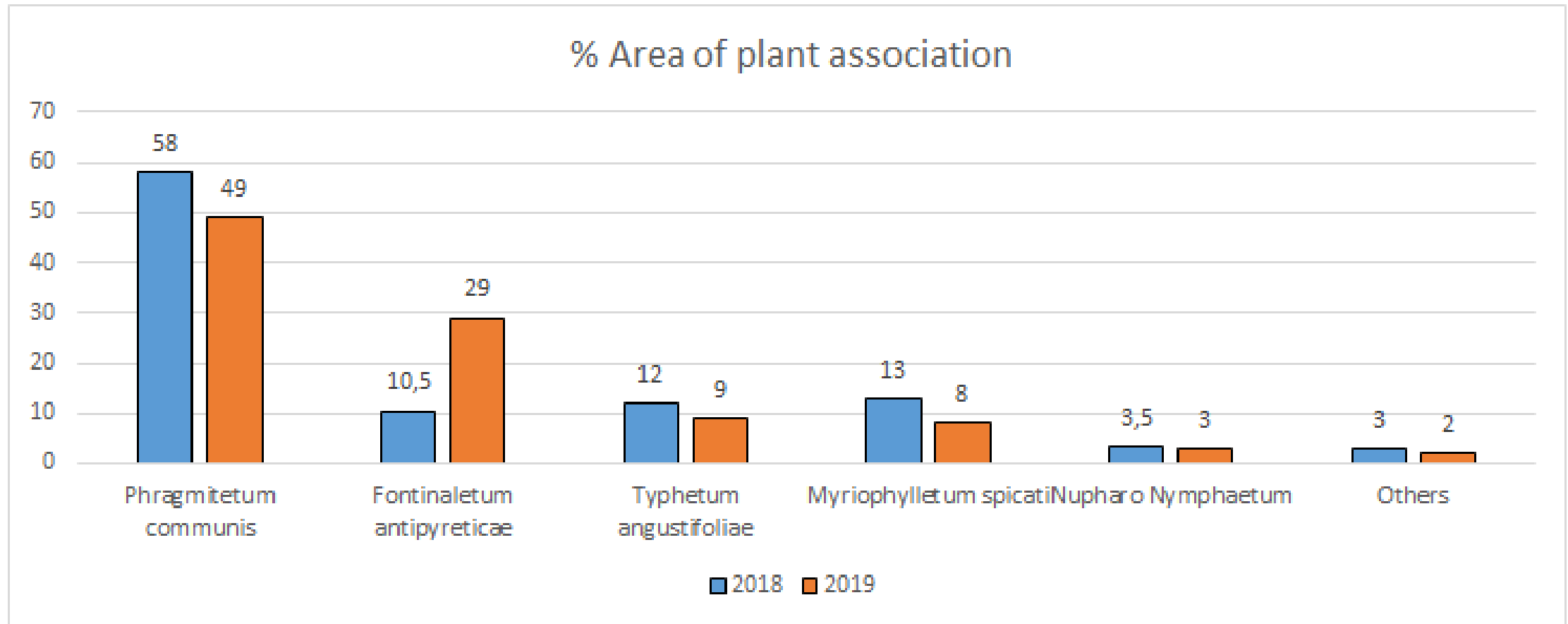


Nupharo-Nymphaetum

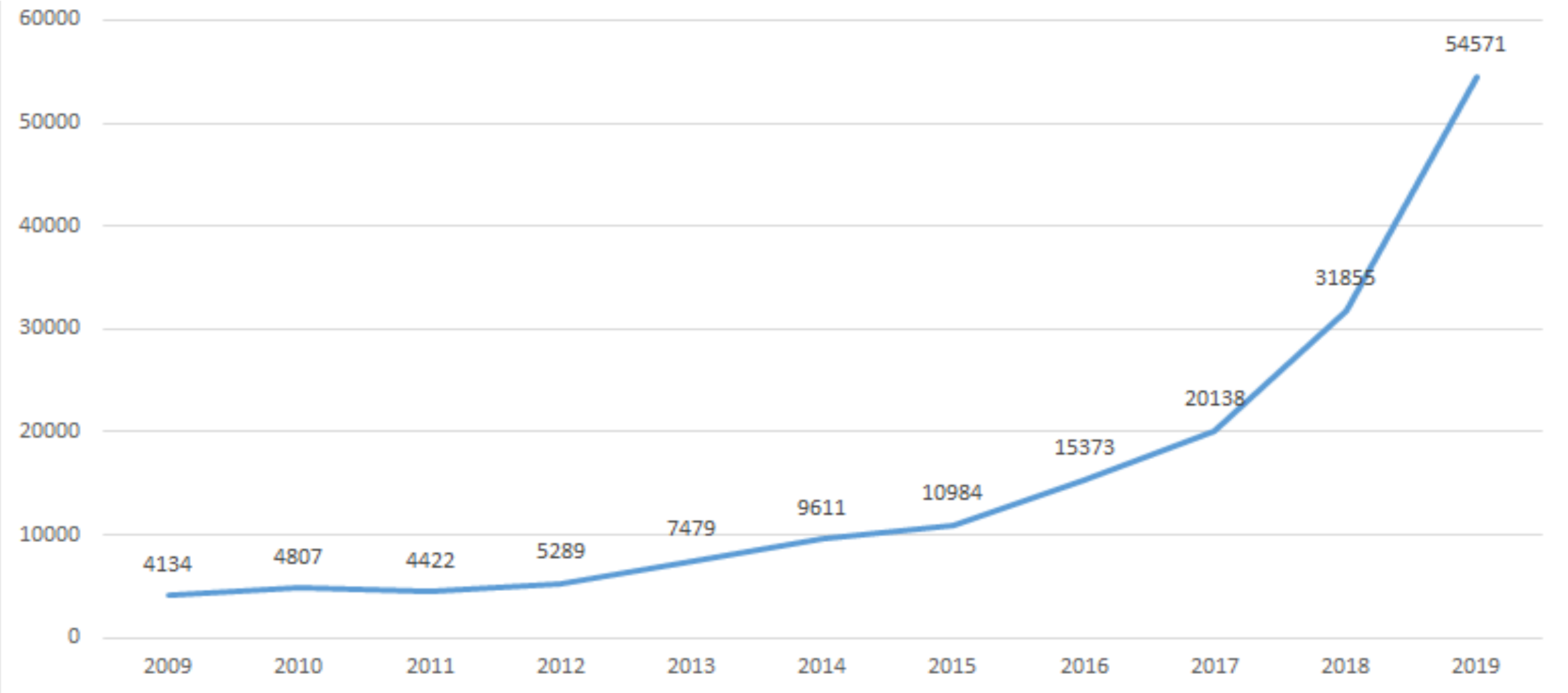
Source: summer school 2018



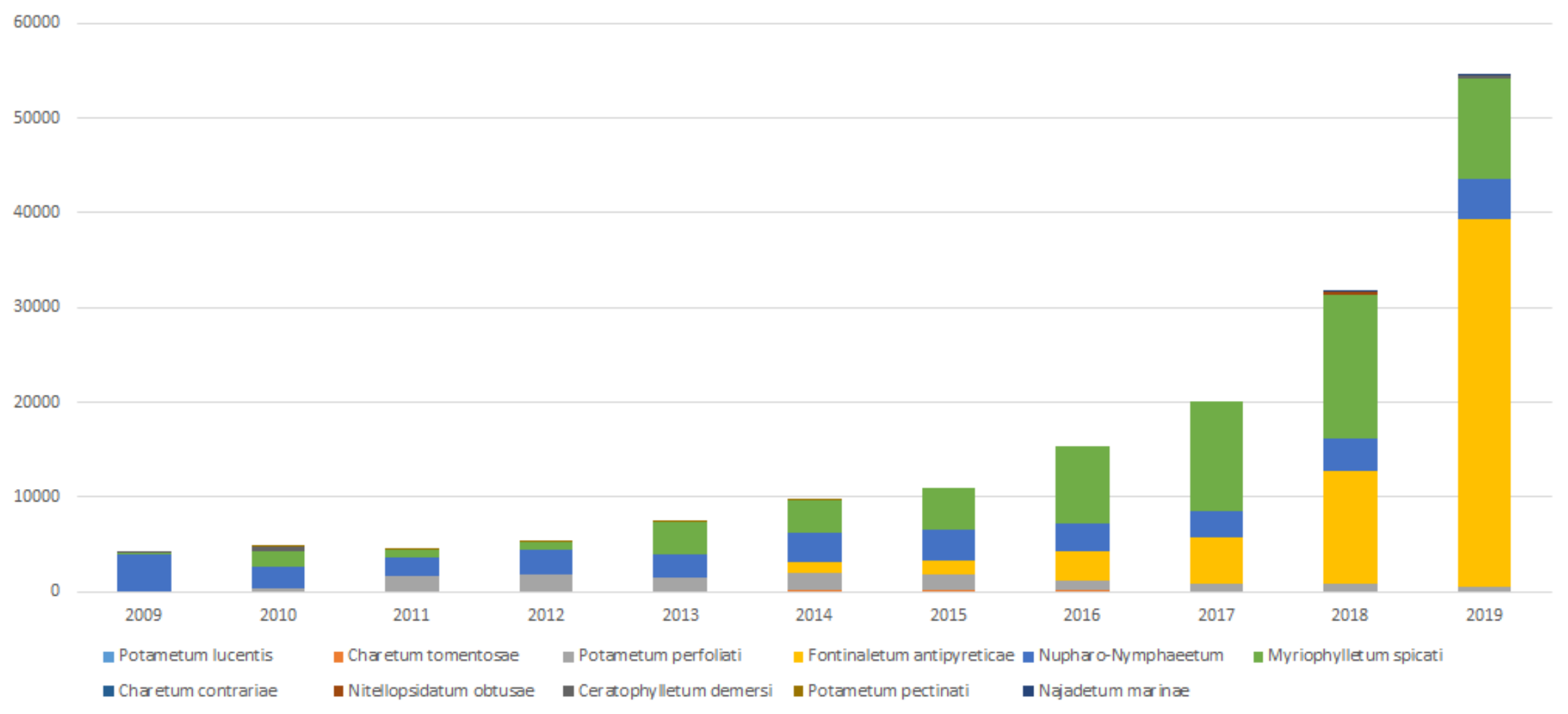
Comparison 2018 and 2019 of five most represent plant associations



Total area of submerged macrophyte associations



Comparison of area occupied by submerged macrophytes (2009-2019)

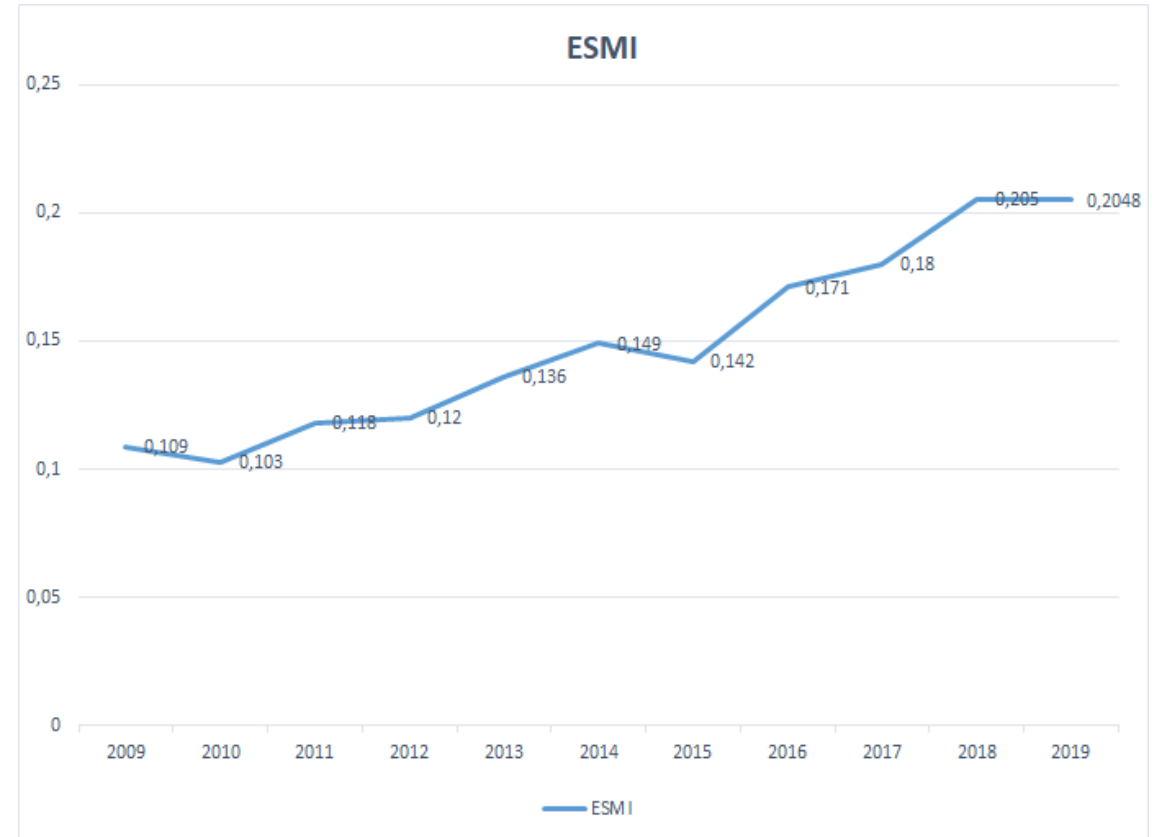
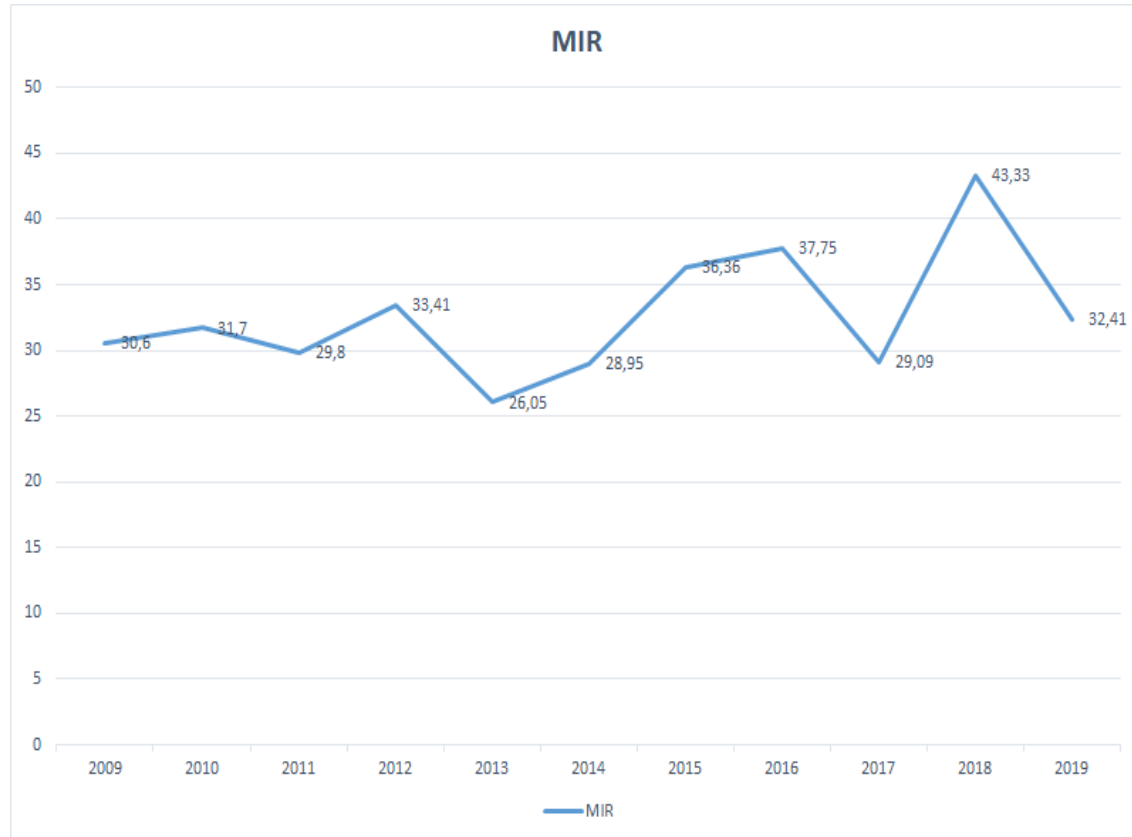


ESMI in 2019:
0,2048

MIR in 2019:
32,41

Ecological status	ESMI Index	MIR Index
Very good	$\geq 0,680$	≥ 44.5
Good	$\geq 0,410$	44.5-35.0>
Moderate	$\geq 0,205$	35.0-25.4>
Poor	$\geq 0,070$	25.4-15.8>
Bad	$< 0,070$	< 15.8

Development of MIR and ESMI



Conclusions & Recommendations



Summer School
Wągrowiec – Poznań
2019



- Lake in poor ecological status acc. to ESMI
- *Ceratophylletum demersi* appeared
- Charophytes associations disappeared
- Submerged species increased
- Restoration treatments work to a certain amount; climate conditions (temperature and precipitation) might have a changing effect on water quality
- Further improvement of water transparency is necessary
- Minimising or stopping sewage inflow → checking new houses
- Acc. to MIR river in bad conditions
 - Cleaning river from rubbish
 - Restoration of rain water basin at outflow



Summer School
Wągrowiec – Poznań
2019





Summer School
Wągrowiec – Poznań
2019





Summer School
Wągrowiec – Poznań
2019





Summer School
Wągrowiec – Poznań
2019



References



Summer School
Wągrowiec – Poznań
2019



Annex



Summer School
Wągrowiec – Poznań
2019



