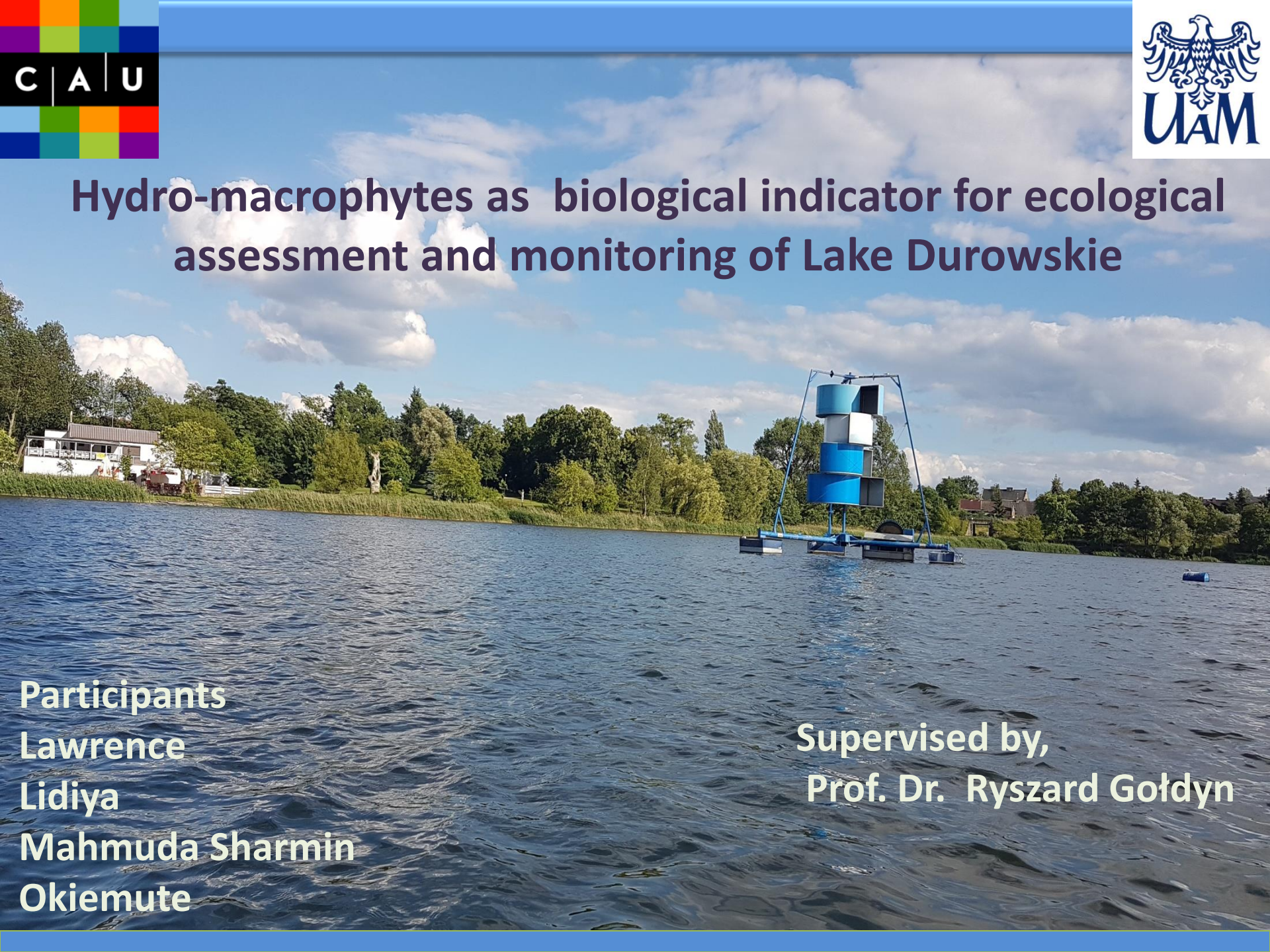
Hydro-macrophytes as biological indicator for ecological assessment and monitoring of Lake Durowskie



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Supervised by,
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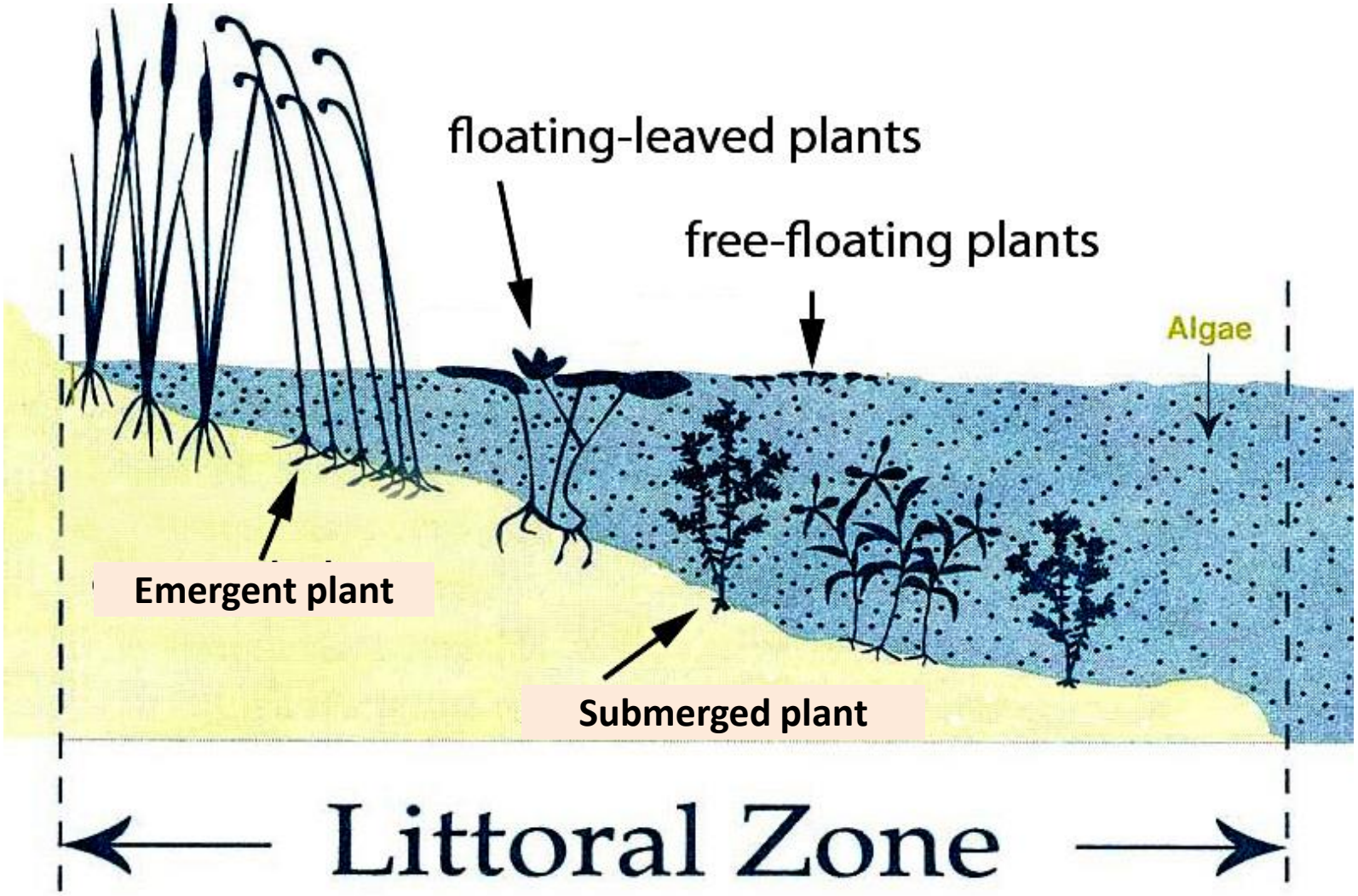
Introduction

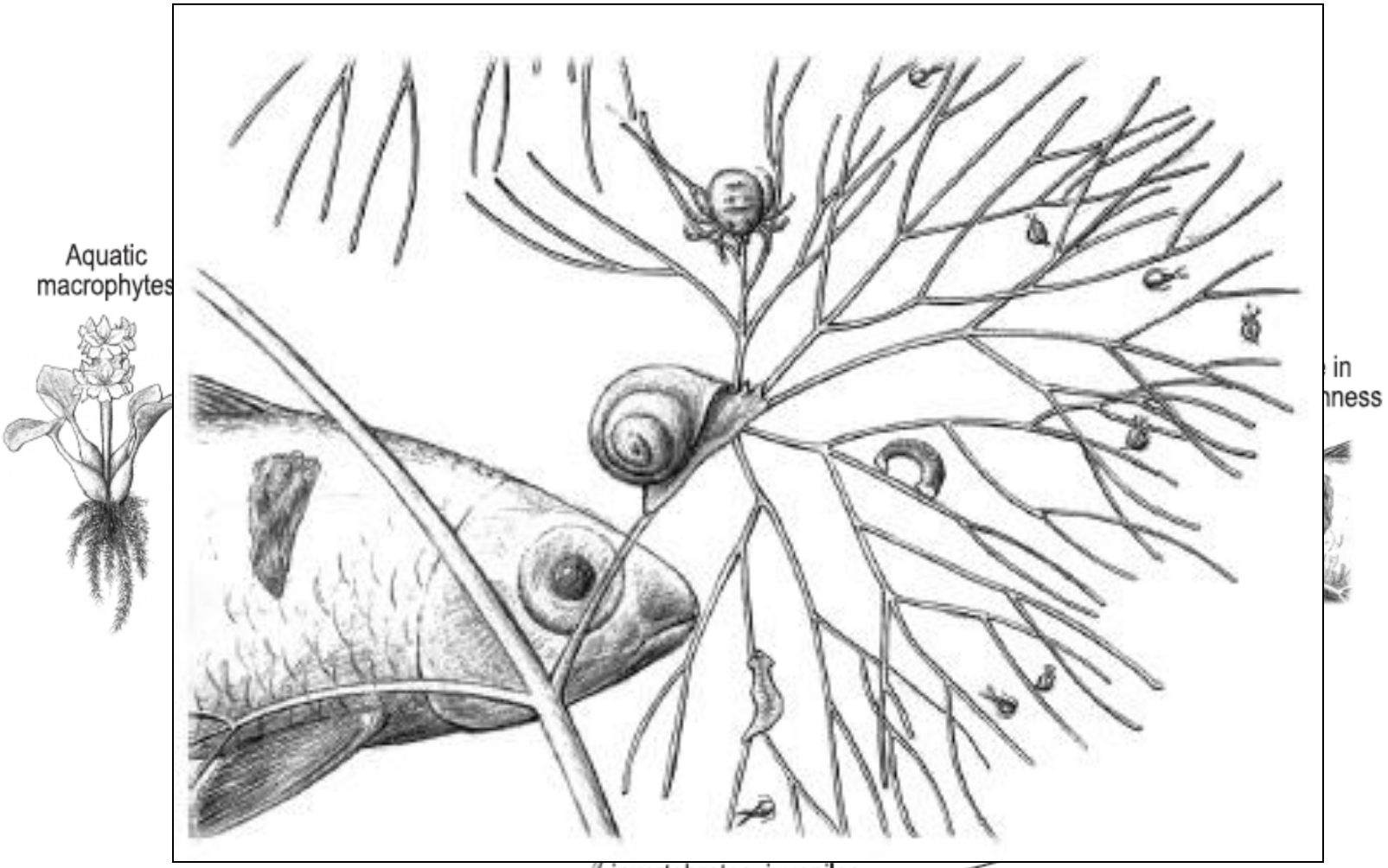
Why lake restoration?

Macrophytes??



Plant.ifas.ufl.edu

Importance of hydro-macrophytes in the lake ecosystem

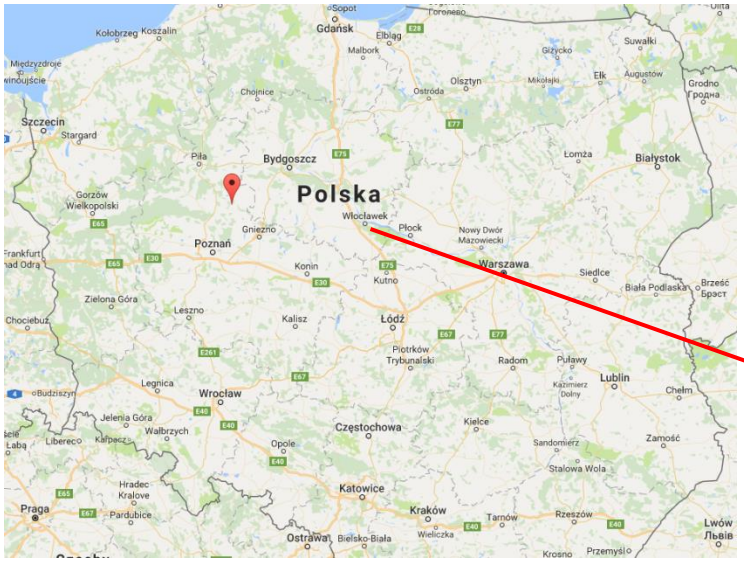


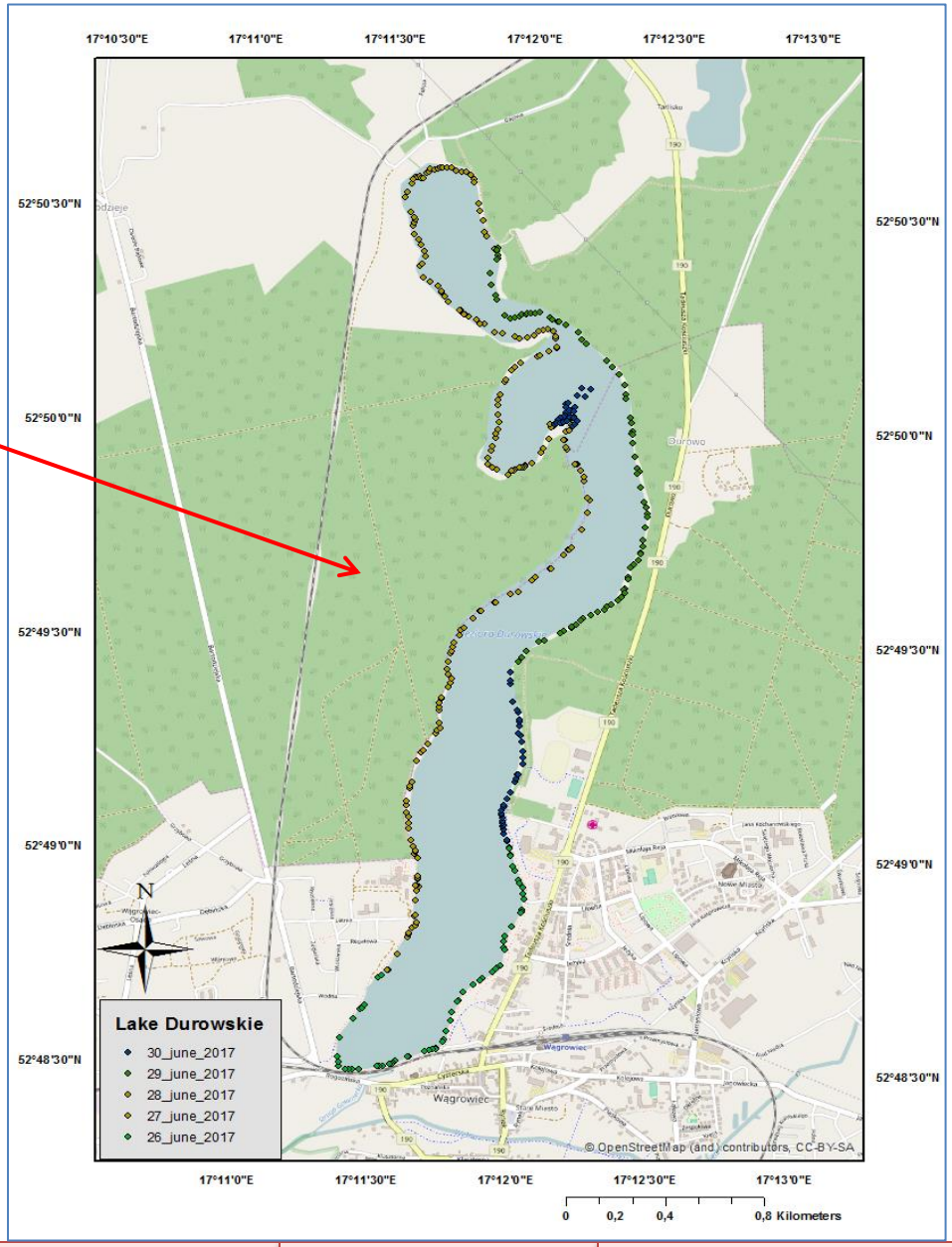
Thomas and Ribeiro da Cunha, 2010

Objectives

- To map all associated macrophytes present in the littoral zone of the Lake.
- Compare macrophyte associations and their share in the vegetation of the lake with previous years.
- To assess the Ecological status of the lake and the outflow.

Study site





Total area	**143.7ha**
Volume	**11322.9 m3**
Maximum depth	**14.9m**
Average depth	**7.9 m**
Main tributary	**Struga Gołaniecka**

Field work Or Boat work???

- Determination of plant associations of the lake and the outflow.
- Taking coordinates and coverage of plants associations.
- Measuring maximum depth of the presence of macrophytes.

Data analysis

ESRI ArcGIS

QGIS

Data analysis

Water Framework Directive (WFD, 2000)

- **Ecological State of Macrophyte Index (ESMI)**

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

Ecological status	ESMI Index
Very good	0.680-1.000
Good	0.340-0.679
Moderate	0.170-0.339
Poor	0.090-0.169
Bad	<0.090

- **Macrophyte Index for River (MIR)**

$$MIR = \frac{\sum L_{i*} W_{i*} P_i}{\sum W_{i*} P_i} * 10$$

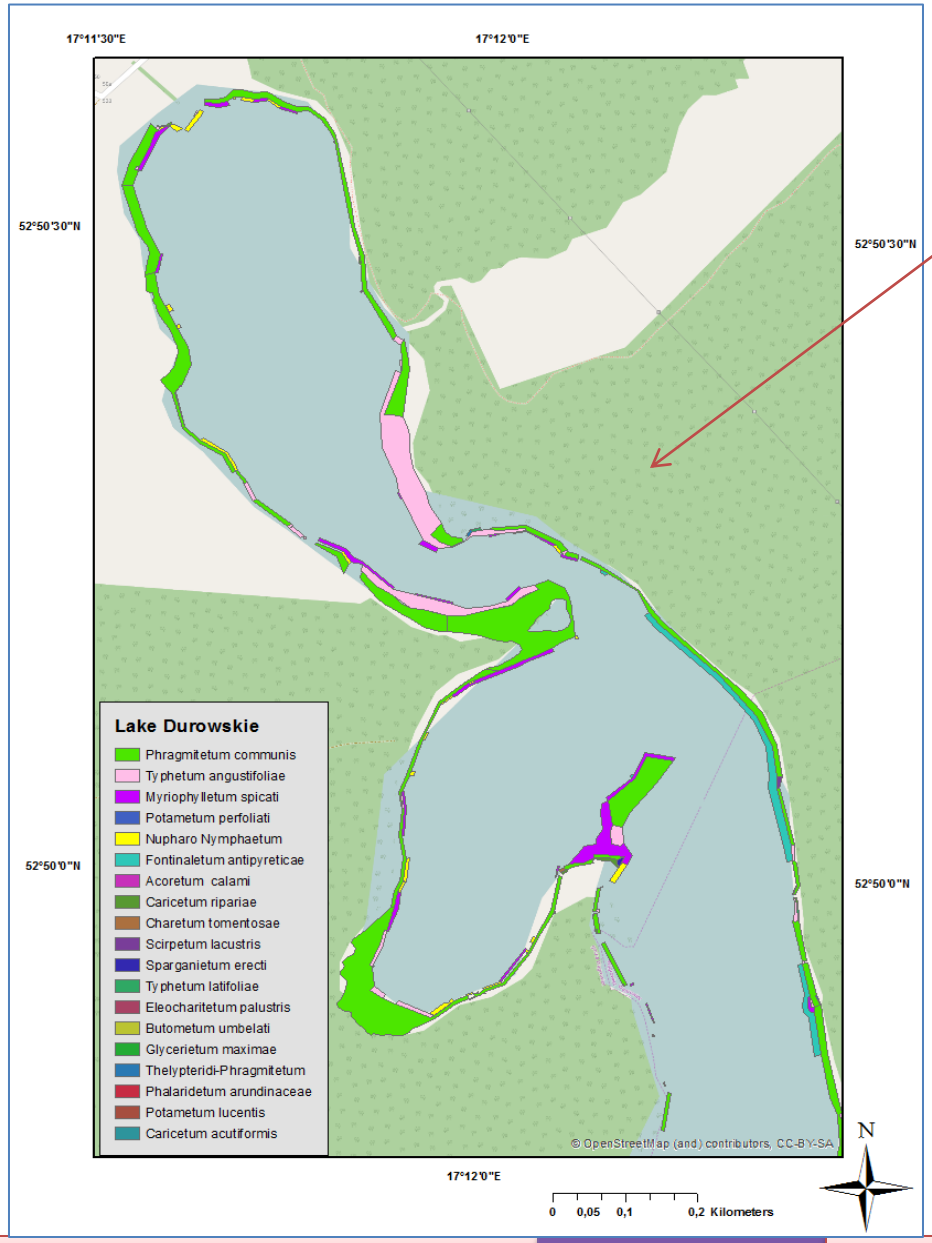
Ecological status	MIR Index
Very good	≥44.5
Good	(44.5-35.0>
Moderate	(35.0-25.4>
Poor	(25.4-15.8>
Bad	<15.8

Ciecierska & Kolada, 2014; Kuhar et al., 2011

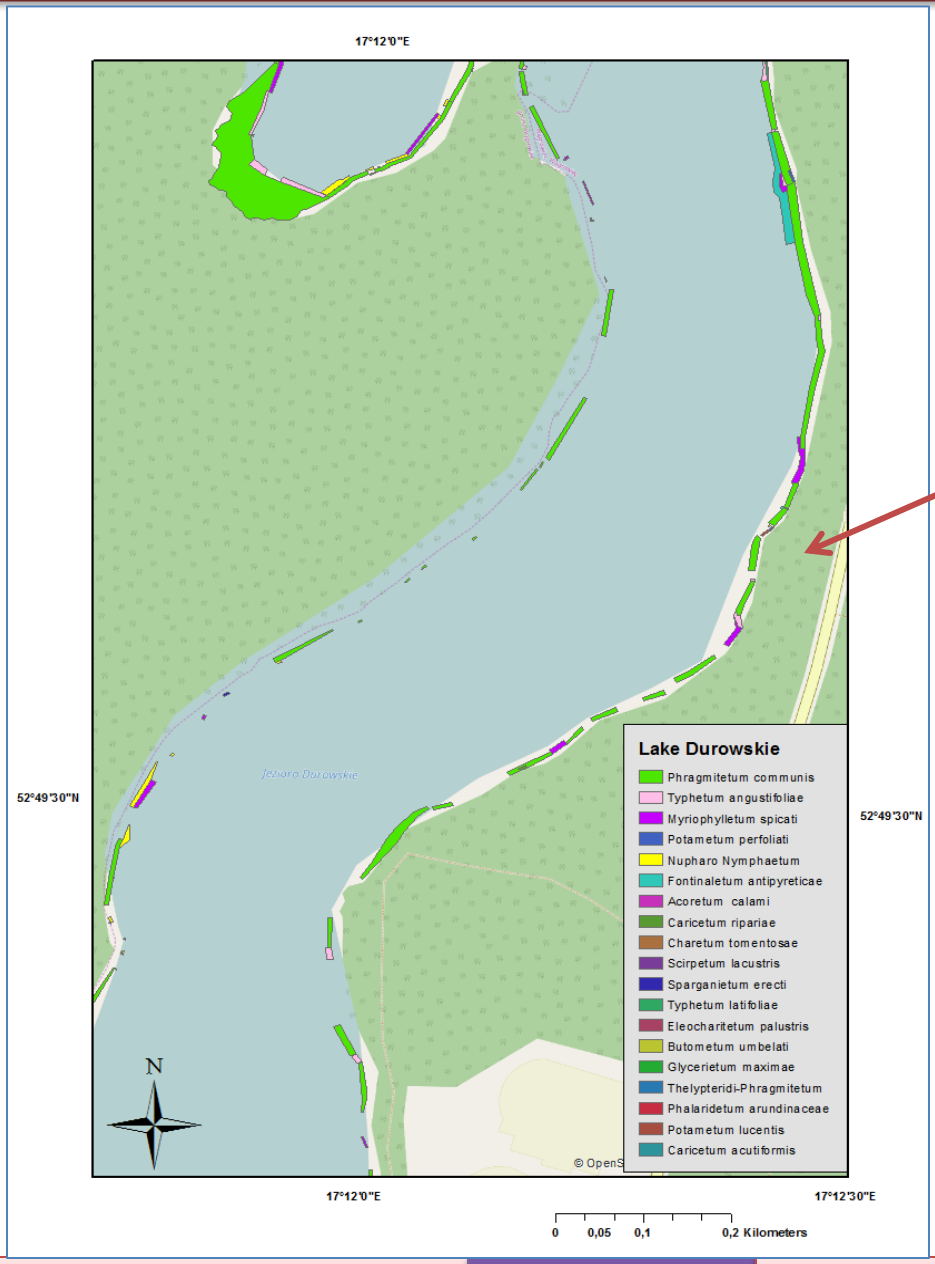
Results

- 19 associations of the hydro-macrophytes were identified.
- Total area covered by macrophytes is 96,611.8 m^2.
- *Phalaridetum arundinaceae* reappear in the lake after 2012.

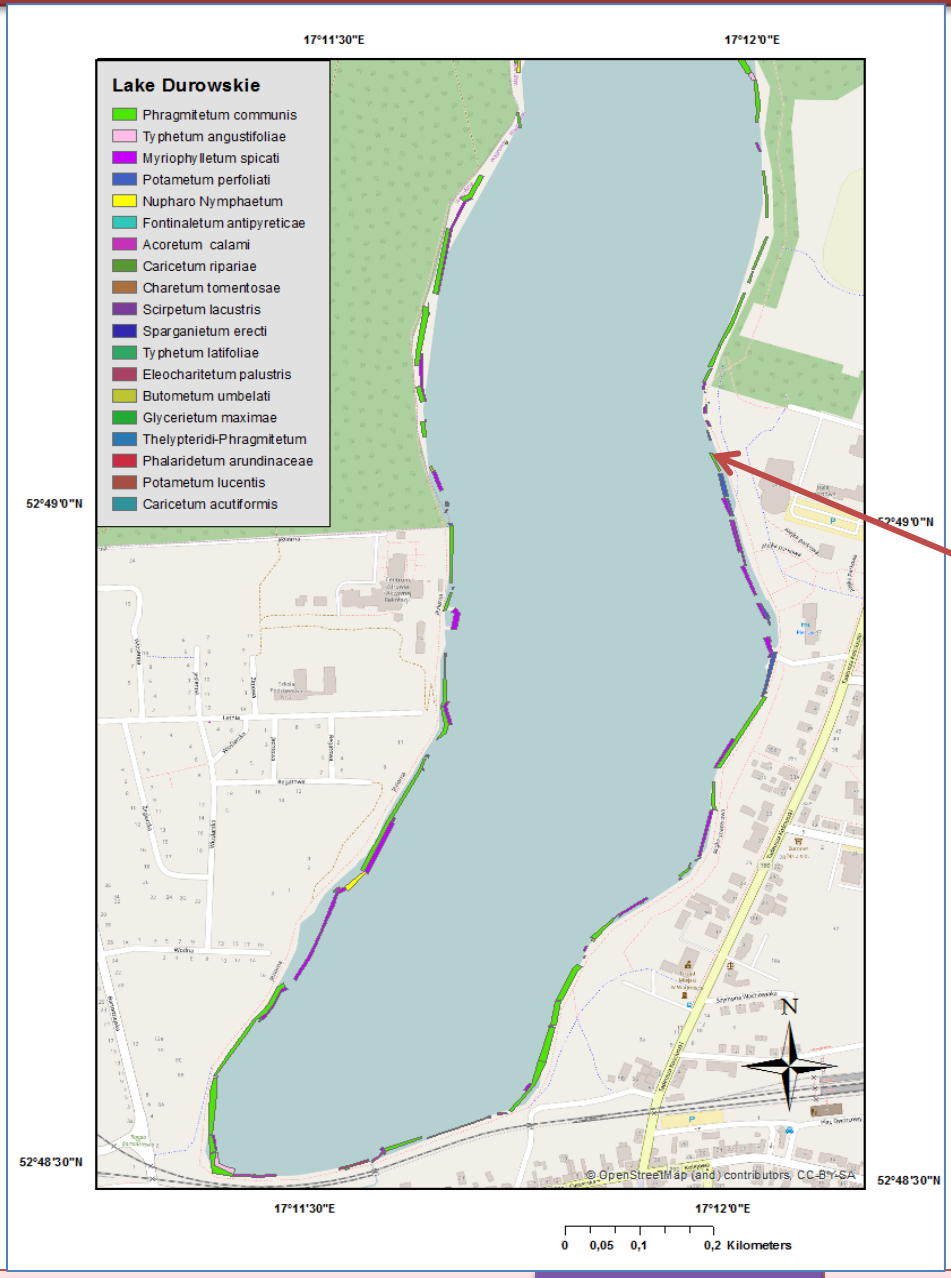
Northern part of the Lake



Middle part of the Lake Durowskie



Southern part of the lake



Phragmitetum communis

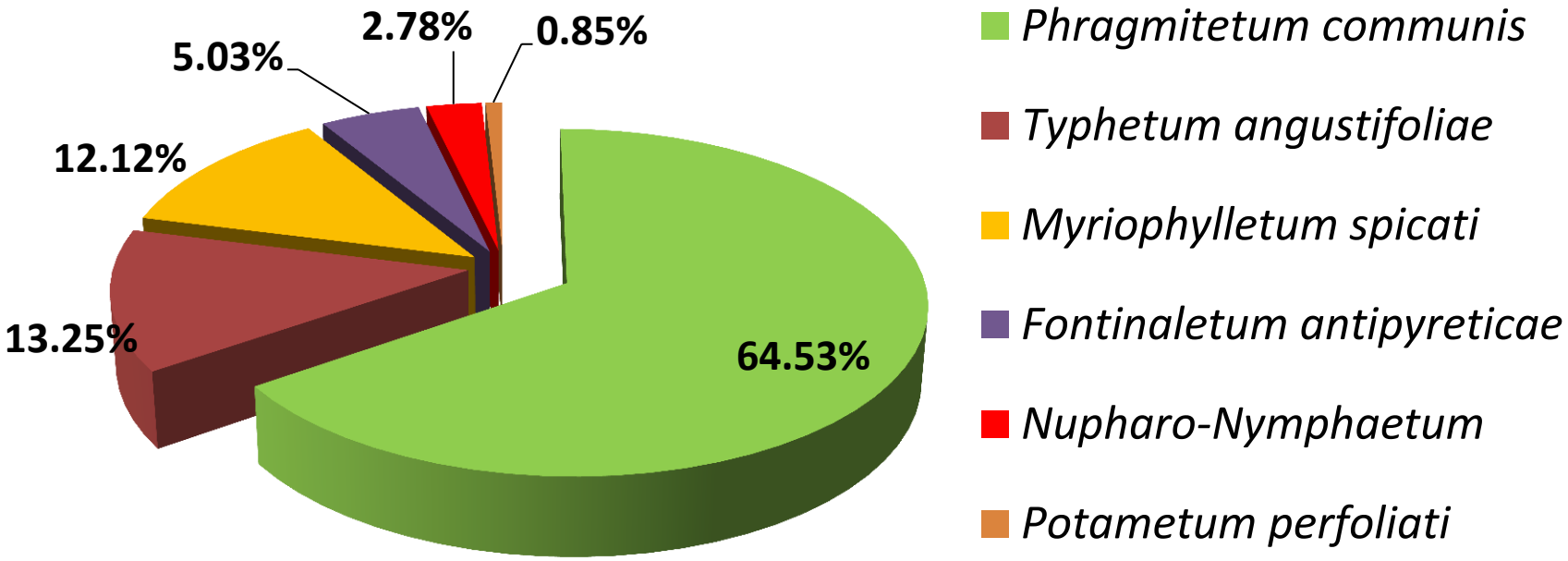
Typhetum angustifoliae

Myriophylletum spicati

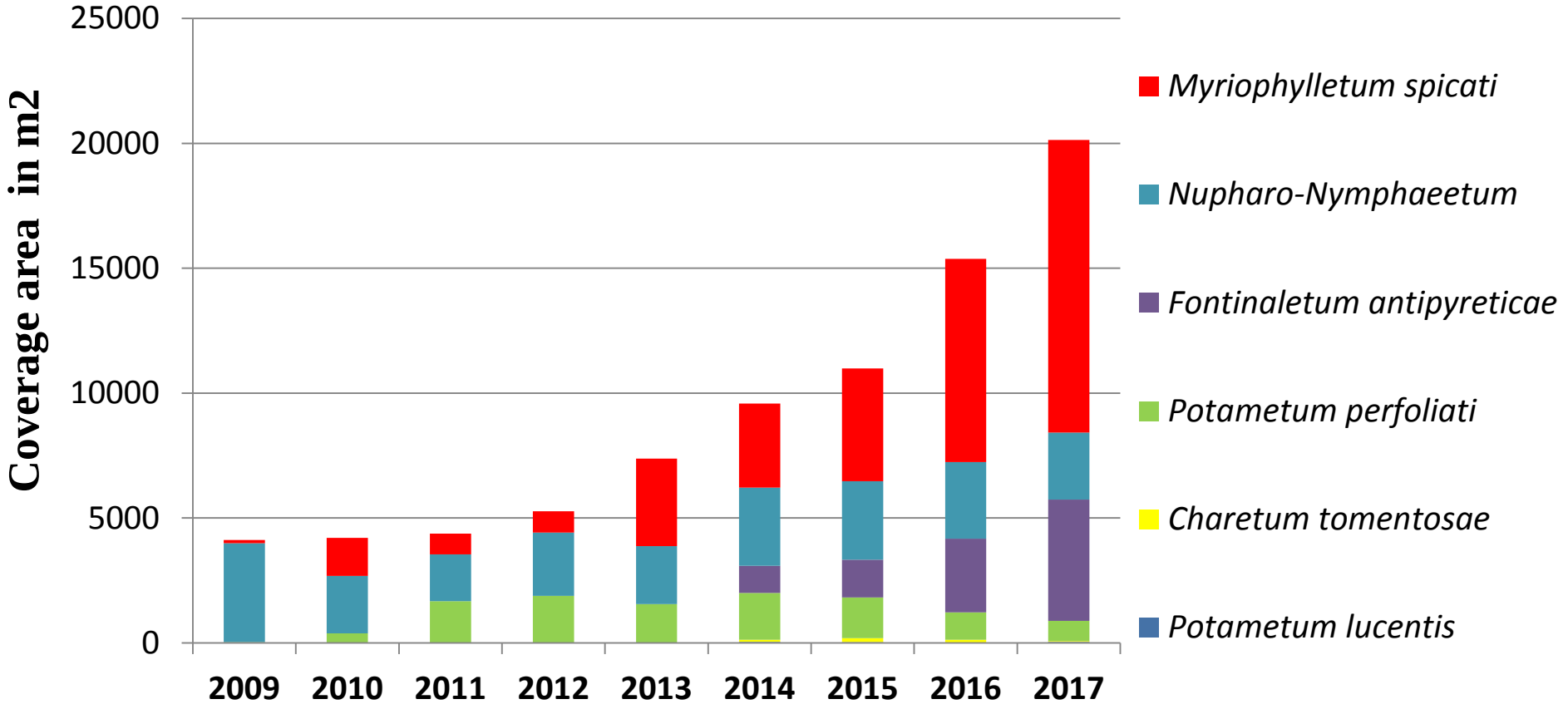
Fontinaletum antipyreticae

Nupharo-Nymphaeetum

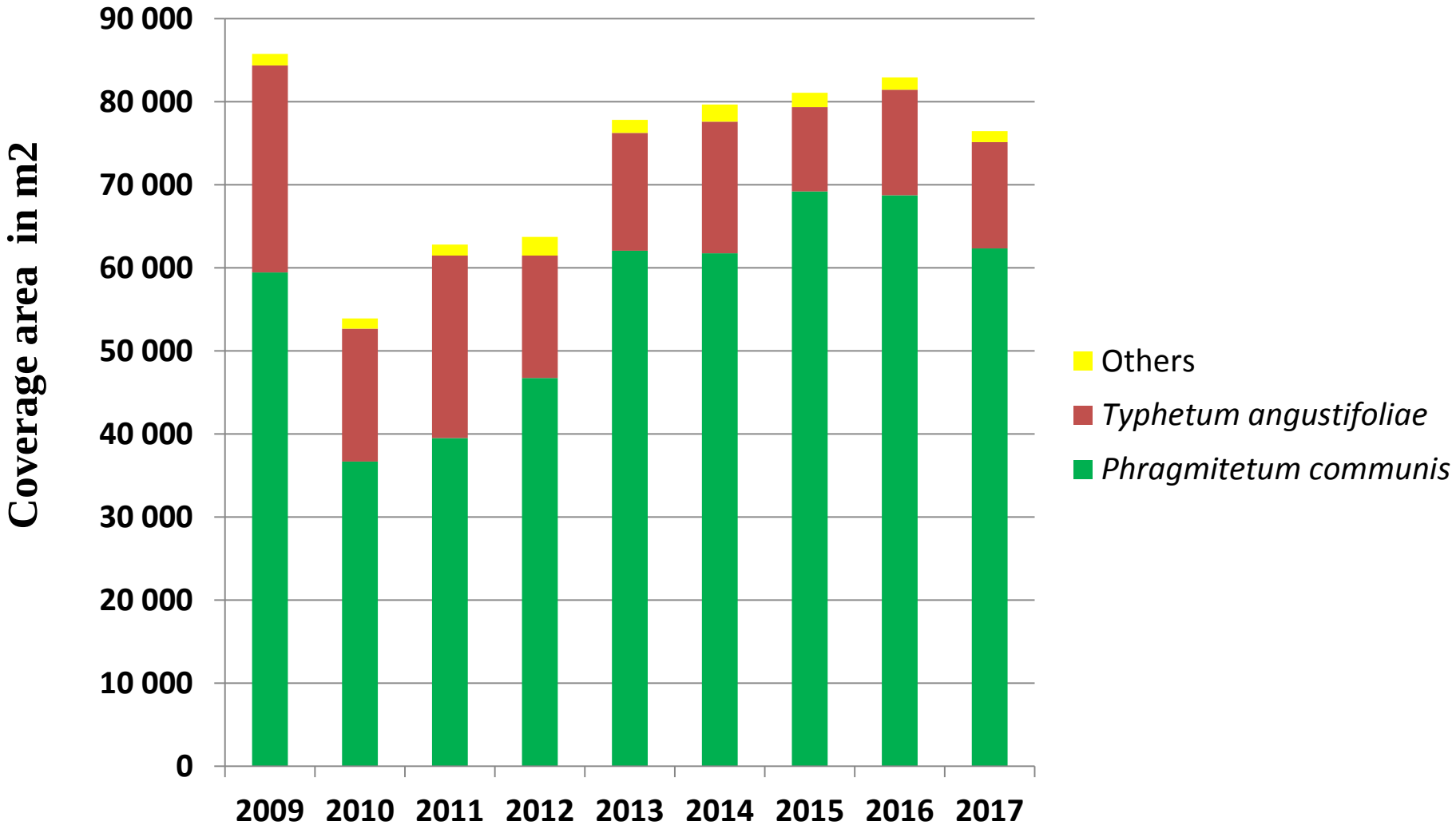
Dominant associations of macrophytes in percentage coverage



Comparison of submerged association's cover area (2009-2017)



Comparison of emergent association's cover area (2009-2017)



Comparison of ESMI and MIR with previous years

Index	2009	2010	2011	2012	2013	2014	2015	2016	2017
ESMI	0,109	0,103	0,118	0,12	0,136	0,149	0,142	0,171	0,18
MIR	30,6	31,7	29,8	33,41	26,05	28,95	36,36	37,75	29.09

Ecological status	ESMI Index	MIR Index
Very good	0.680-1.000	≥44.5
Good	0.340-0.679	44.5-35.0>
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Poor	0.090-0.169	25.4-15.8>
Bad	<0.090	<15.8

Species Composition in the outflow

16 plant species along with two algae species

Plant species	Coverage (%)
Butomus umbellatum	25
Acorus calamus	1,5
Phalaris arundinacea	2
Potamogeton pectinatus	3
Myriophyllum spicatum	4
Mentha aquatica	1
Alage	
Cladophora glomerata	8
Hildenbrandia rivularis	1

Discussions

- Decrease in total coverage area by about **2%** from 2016
- Submerged plants increased by **23%**
- *Phragmatitum communis* decreased by **10%**
- *Myriophylletum spicati* increased by **3.8%**

- Increased ESMI value from **0,17** to **0,18** although classes remained constant.

- MIR value decreased from **37,75** to **29,09** and classes from good to moderate.

- Macrophytes may also respond slowly due to season and shadow effects from trees.

Recommendations

- Replant Chara species in different part of the lake.
- Disperse submerged species in different part of the lake with Turions.
- Ensure the protection of littoral zone of the Lake Durowskie.
- Take restoration initiatives for the upstream lakes.
- Develop proper code of conduct for establishing jetty for angling.

Use hydro-macrophytes as a method for lake restoration (Xu et al 2014).

- eg. mowing and removal of small patches of emergent macrophytes in the littoral zone.
- Winter season is most appropriate considering the effect of trampling

Thank you all..