

ECOLOGICAL STATE OF LAKE DUROWSKIE

Algae as an assessment indicator

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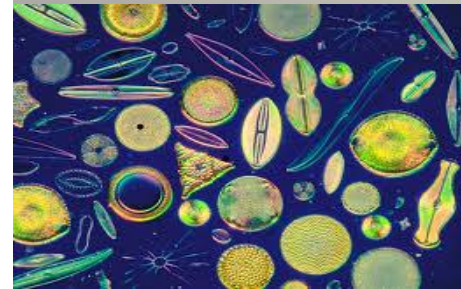
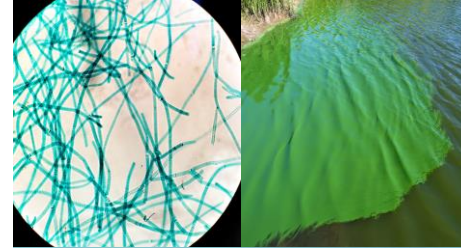
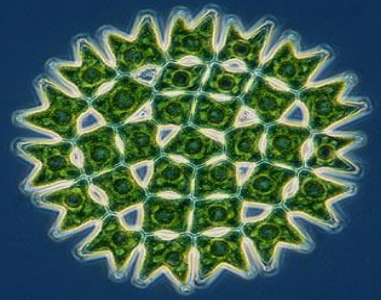
Contents

- Introduction
- Methods
- Key findings
- Bio-manipulation
- Conclusion

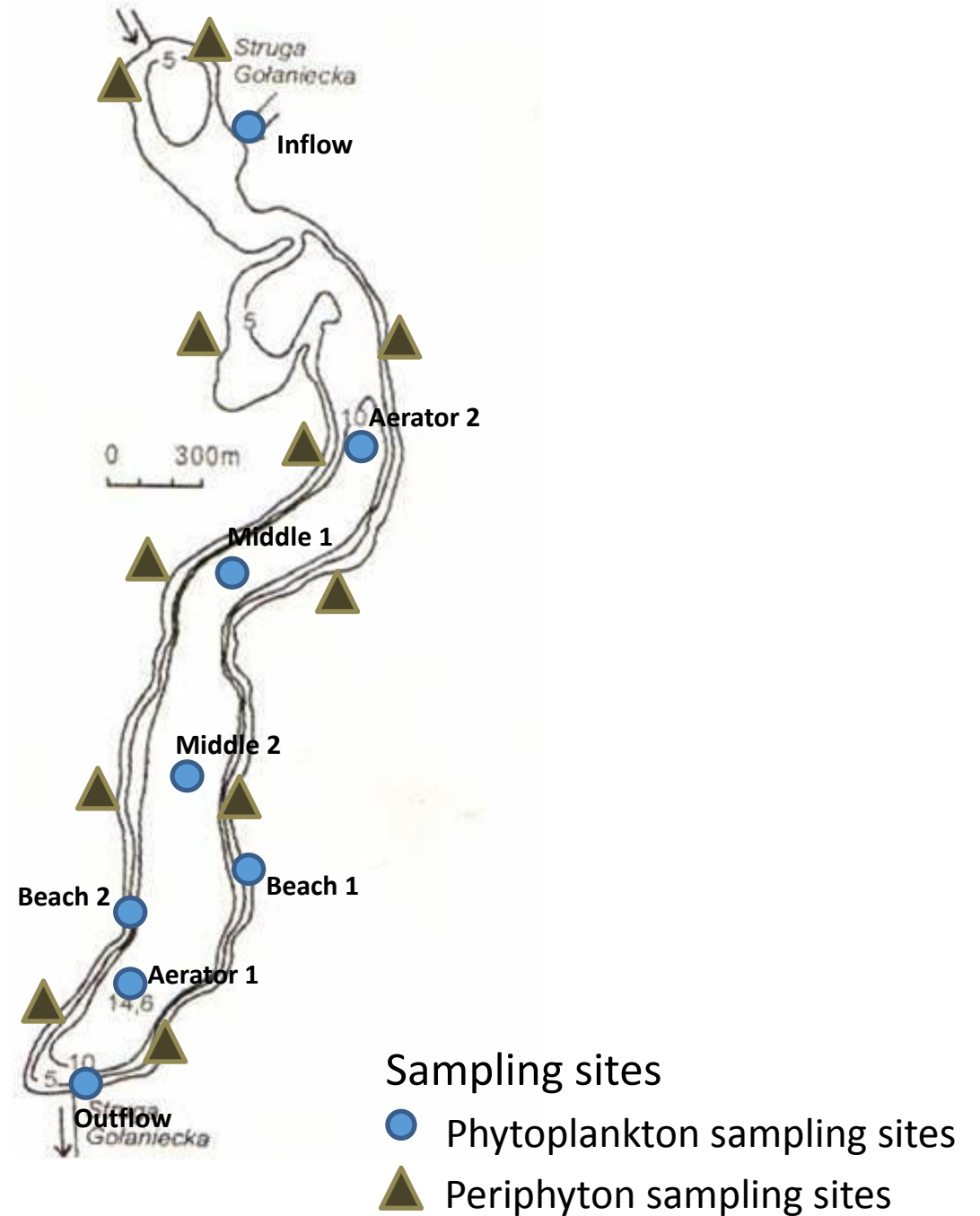
Introduction

Aim

- Investigating trophic state of Lake Durowskie
- Assessment Methods
 - Phytoplankton analysis
 - Periphyton analysis
 - Bio-manipulation
- Why phytoplankton
 - Sensitive indicator for eutrophication and pollution
 - Environmental adaptive features in freshwater ecosystem
 - Primary producers for freshwater ecosystem



Study area



Method

Periphyton

Sampling



Identification

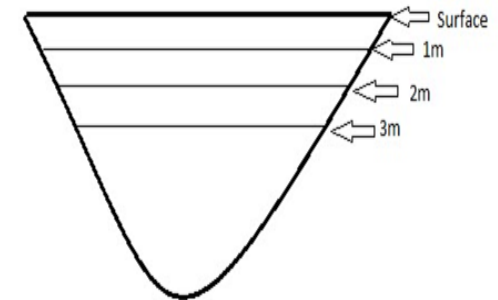
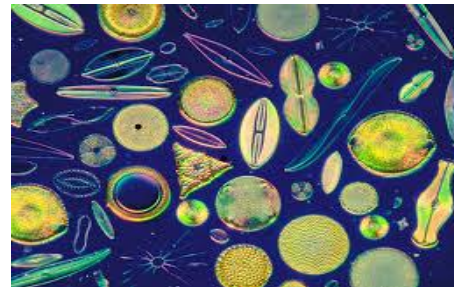


Data Analysis

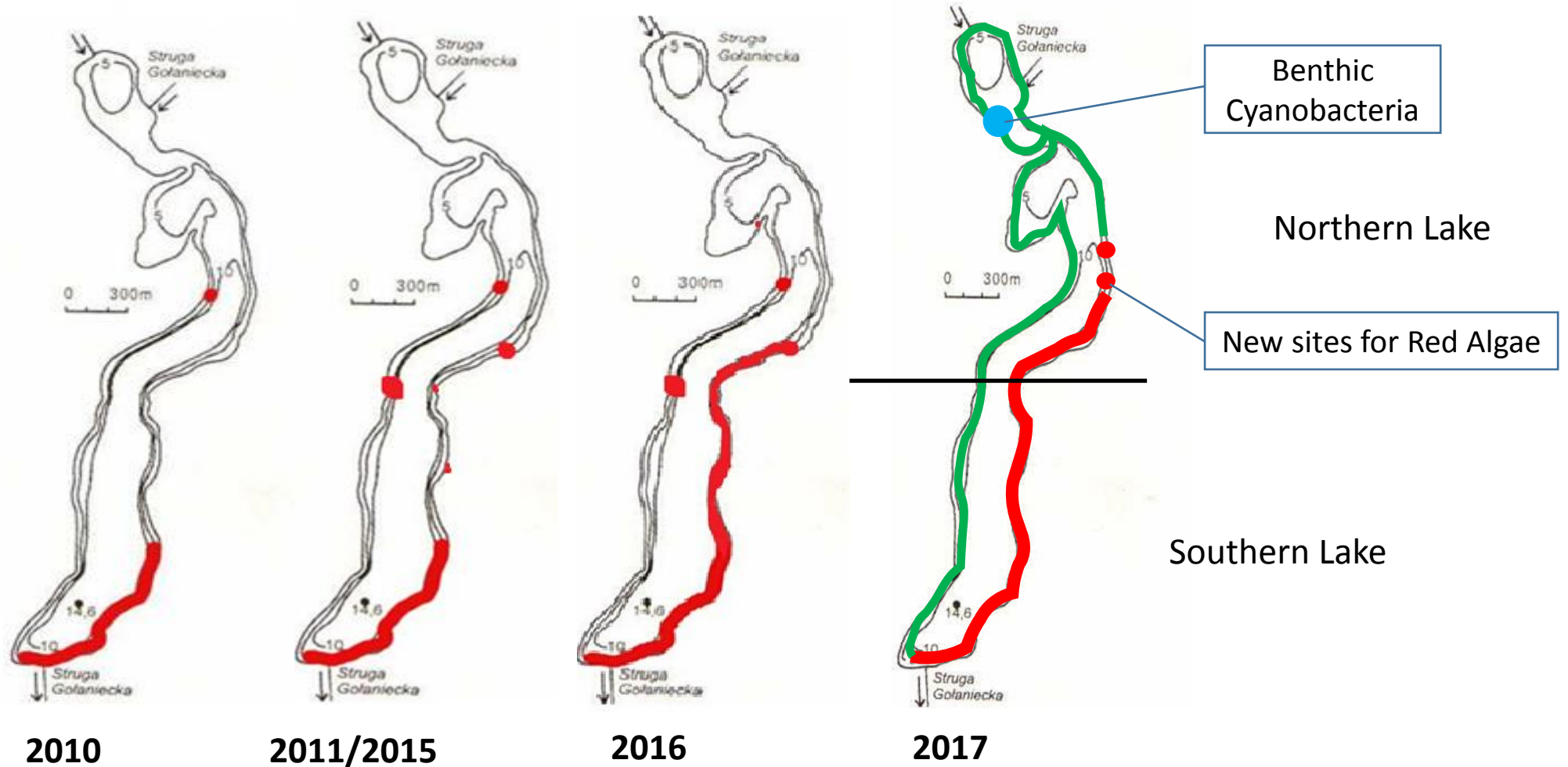
DIATOME INDEX

>0,83	Very good
0,55 - 0,82	Good
0,30 - 0,54	Moderate
0,15 - 0,29	Poor
<0,15	Bad

Phytoplankton



Results - Periphyton

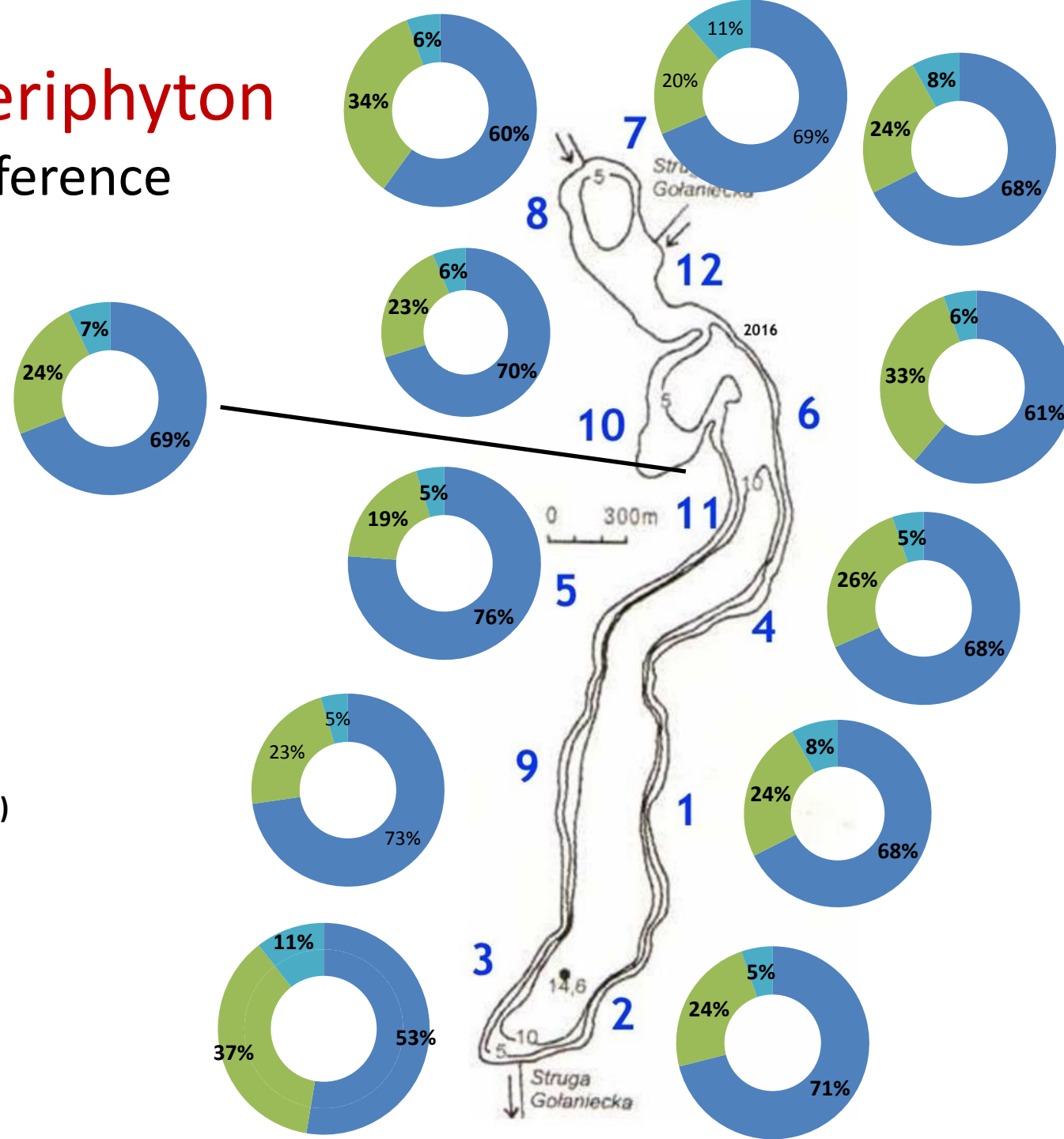


Red Alga – *Hildebrandia rivularis*
Green Algae – *Cladophora glomerate*
Cyanobacteria – *Lyngbya, Phormidium*

Results – Periphyton

Species O₂ preference

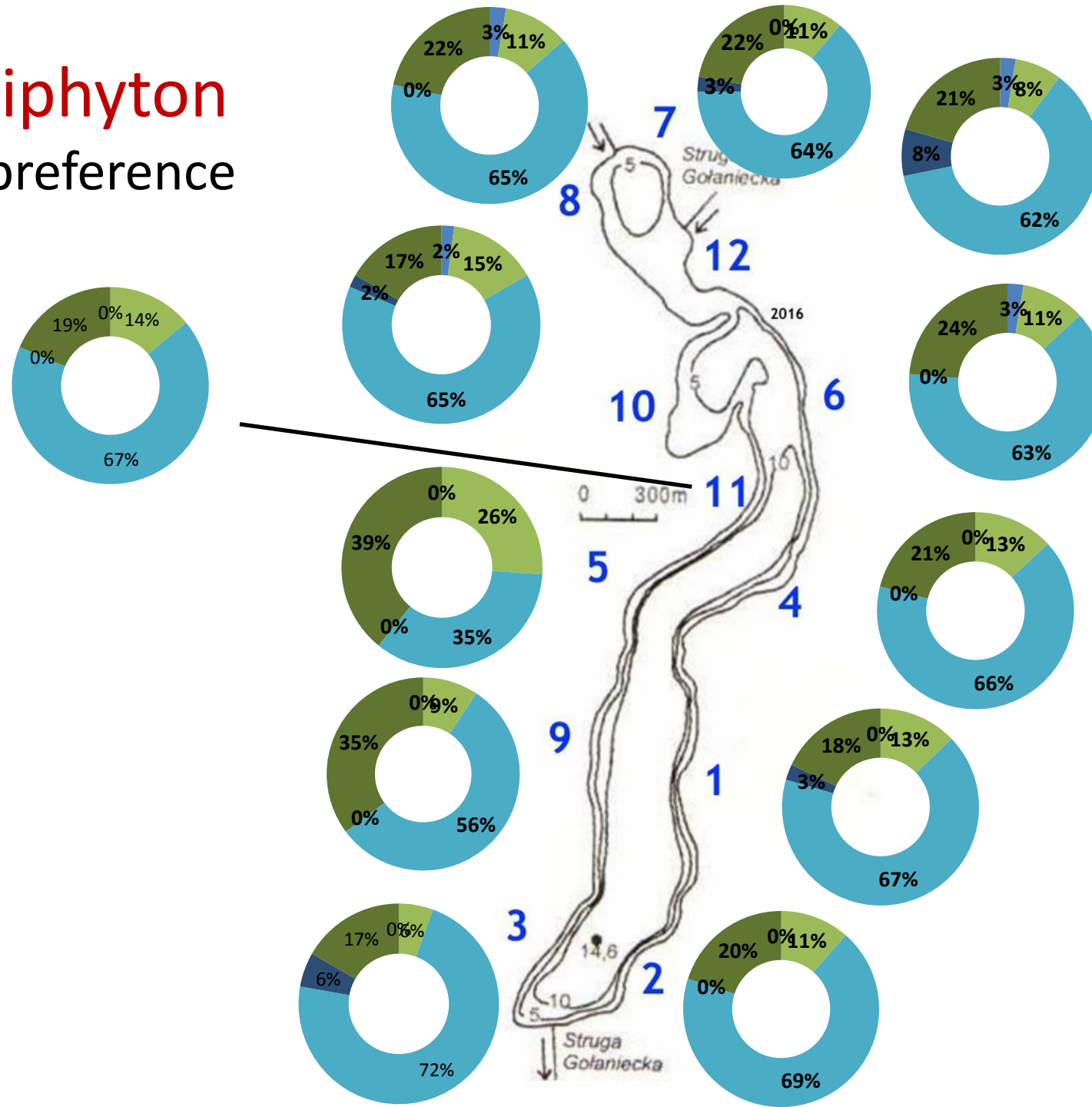
- High (75%-100%)
- Middle (50%-75%)
- Low (<50%)



Results – Periphyton

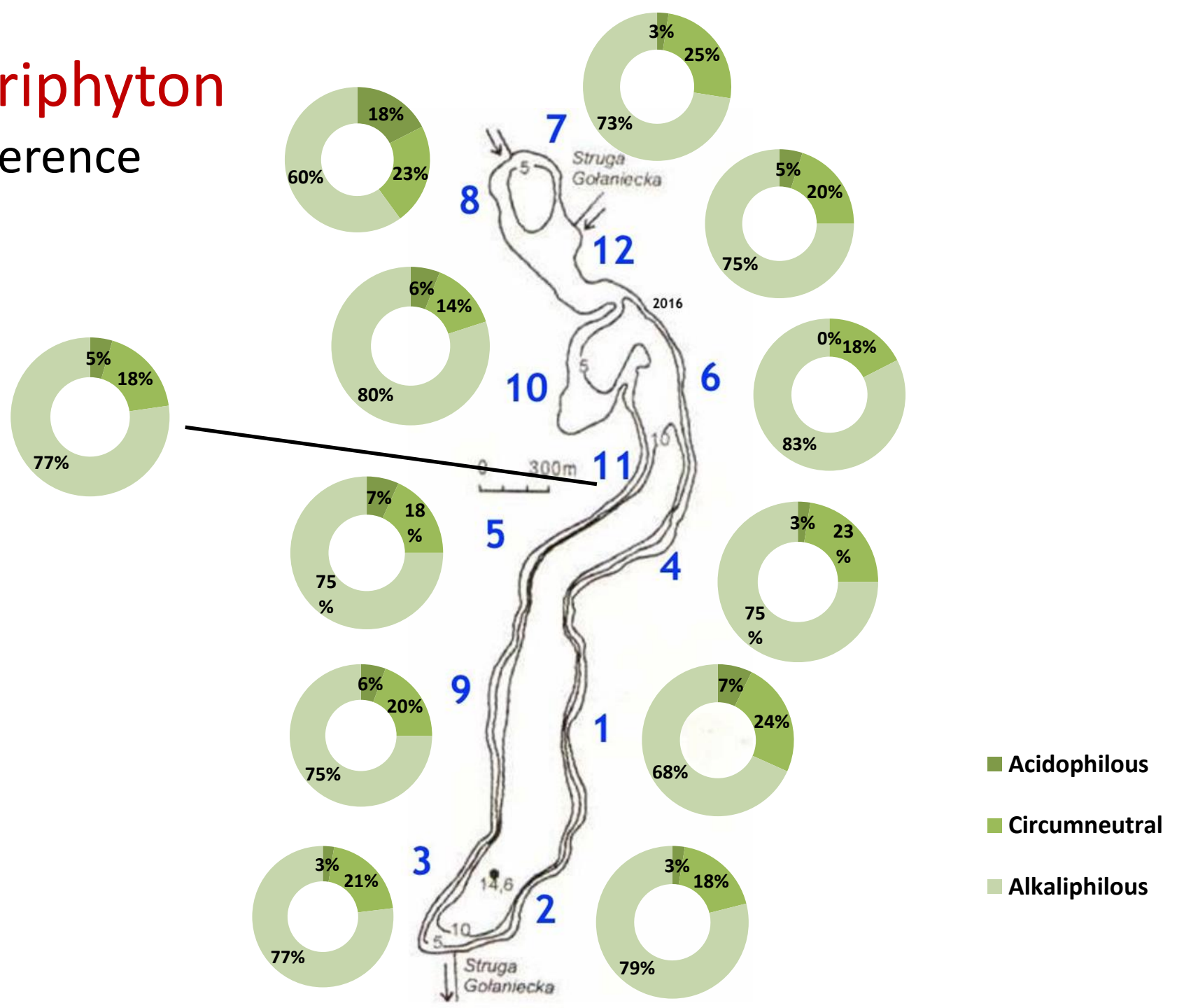
Species trophic preference

- Oligotrophic
- Mesotrophic
- Eutrophic
- Hypertrophic
- Others

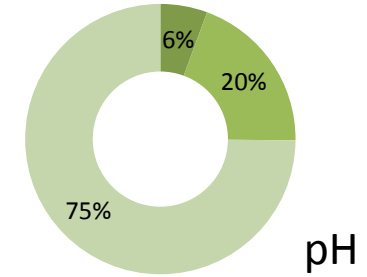
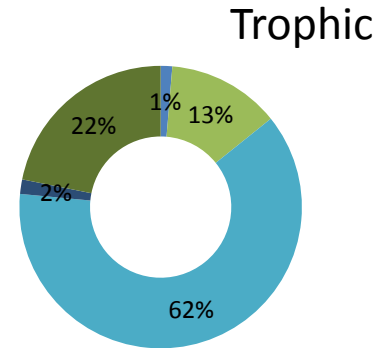
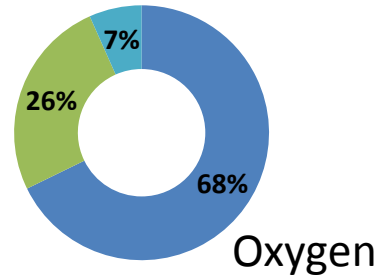
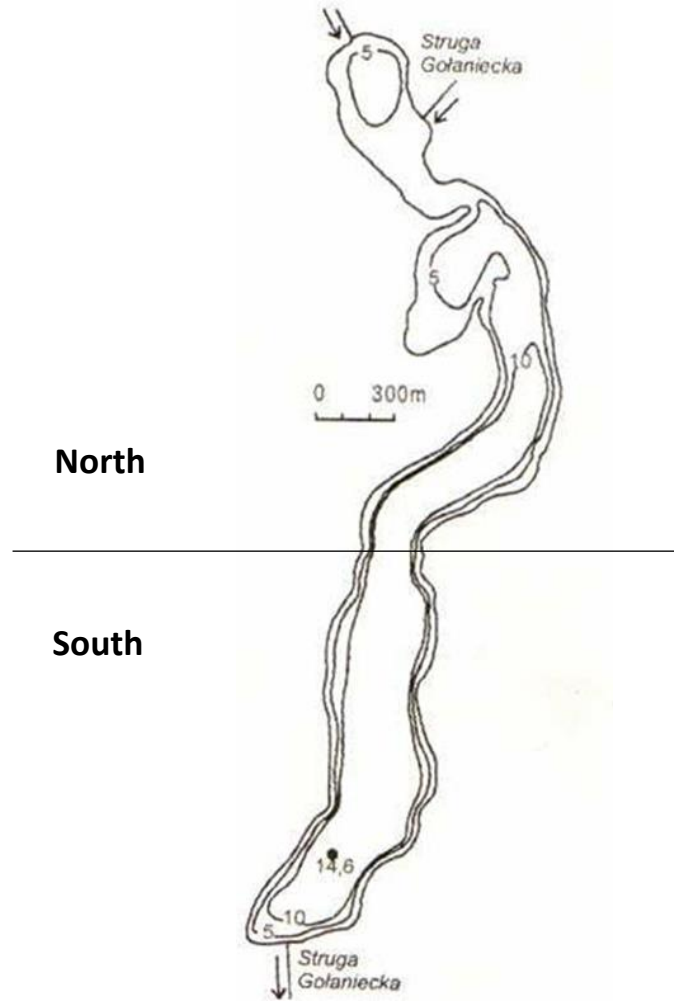


Results – Periphyton

Species pH preference



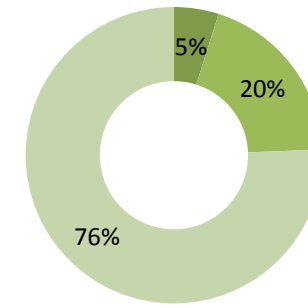
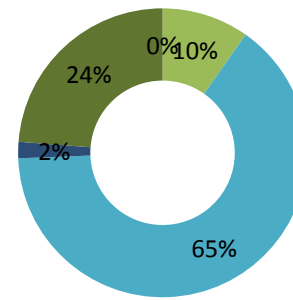
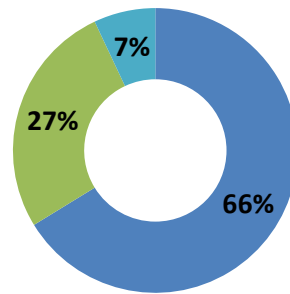
Results – Periphyton



- High (75%-100%)
- Middle (50%-75%)
- Low (<50%)

- Oligotrophic
- Mesotrophic
- Eutrophic
- Hypertrophic
- Others

- Acidophilous
- Circumneutral
- Alkaliphilous



Oxygen

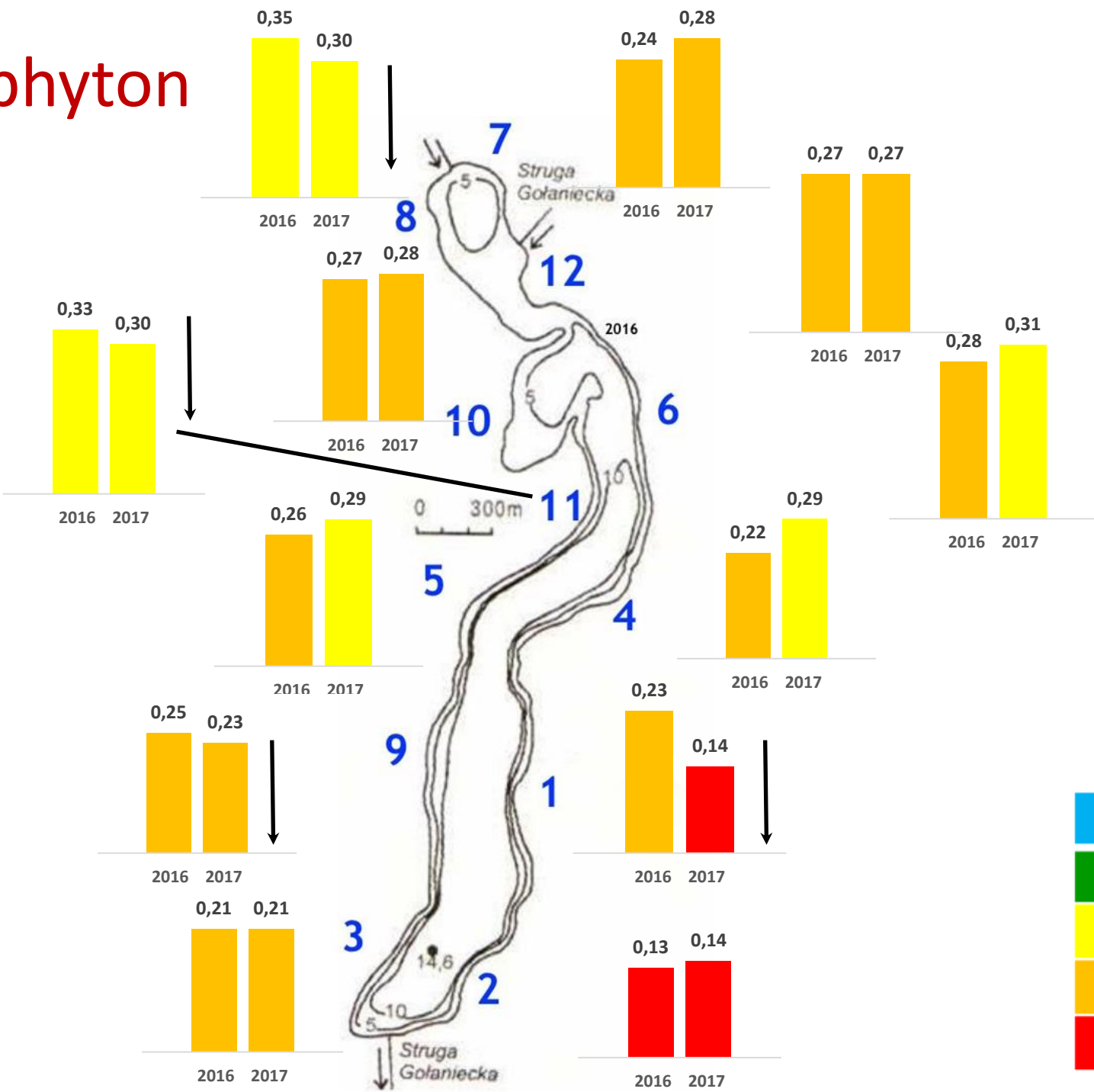
Trophic

pH

No major differences

Results – Periphyton

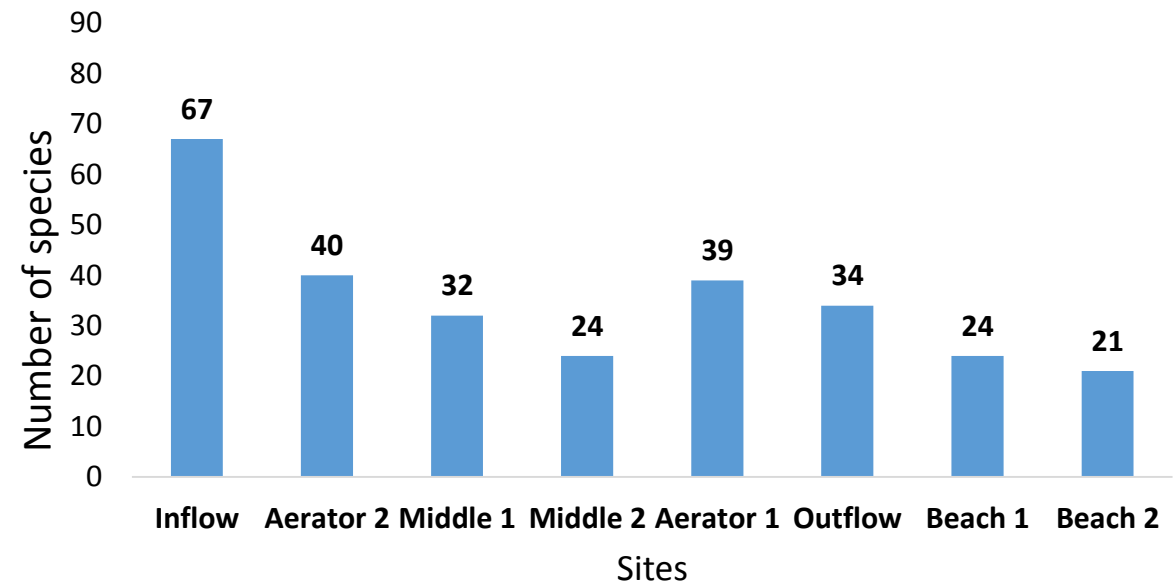
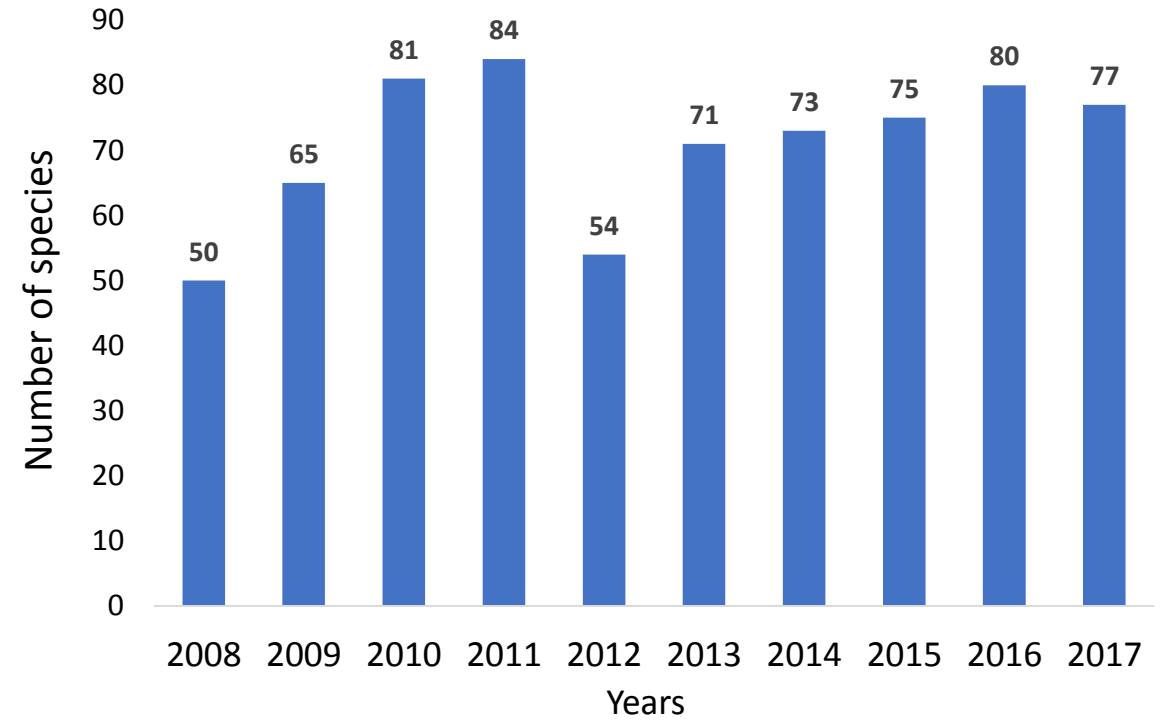
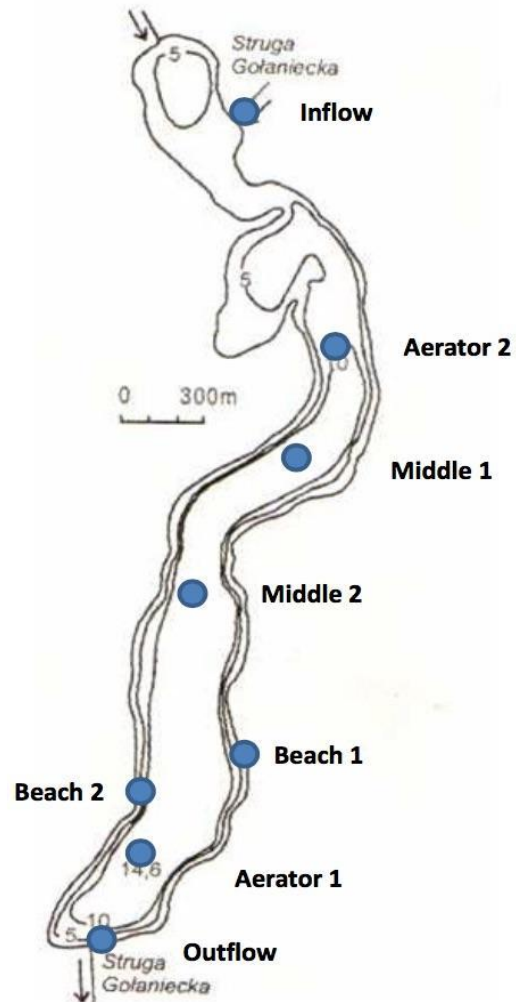
Diatom Index



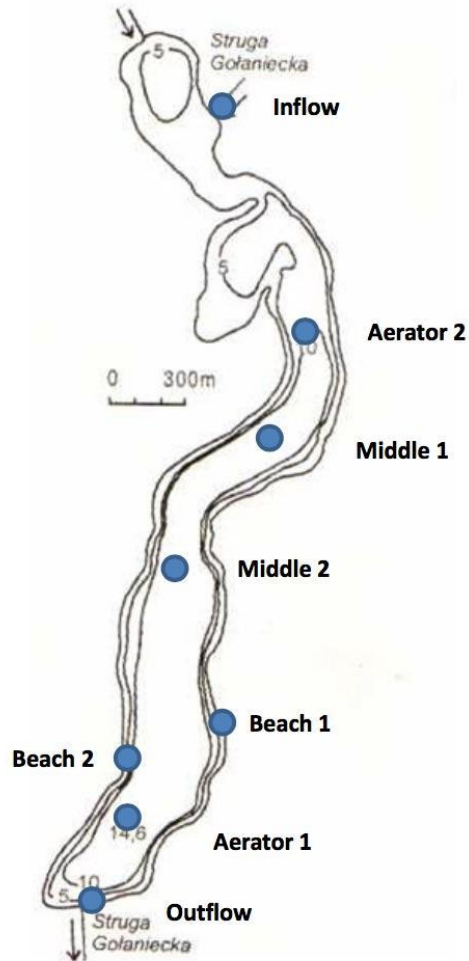
>0,83	Very good
0,55	Good
0,30	Moderate
0,15	Poor
<0,15	Bad

Results – Phytoplankton

Number of species



Results – Phytoplankton



Jaccard Index- % Similarity

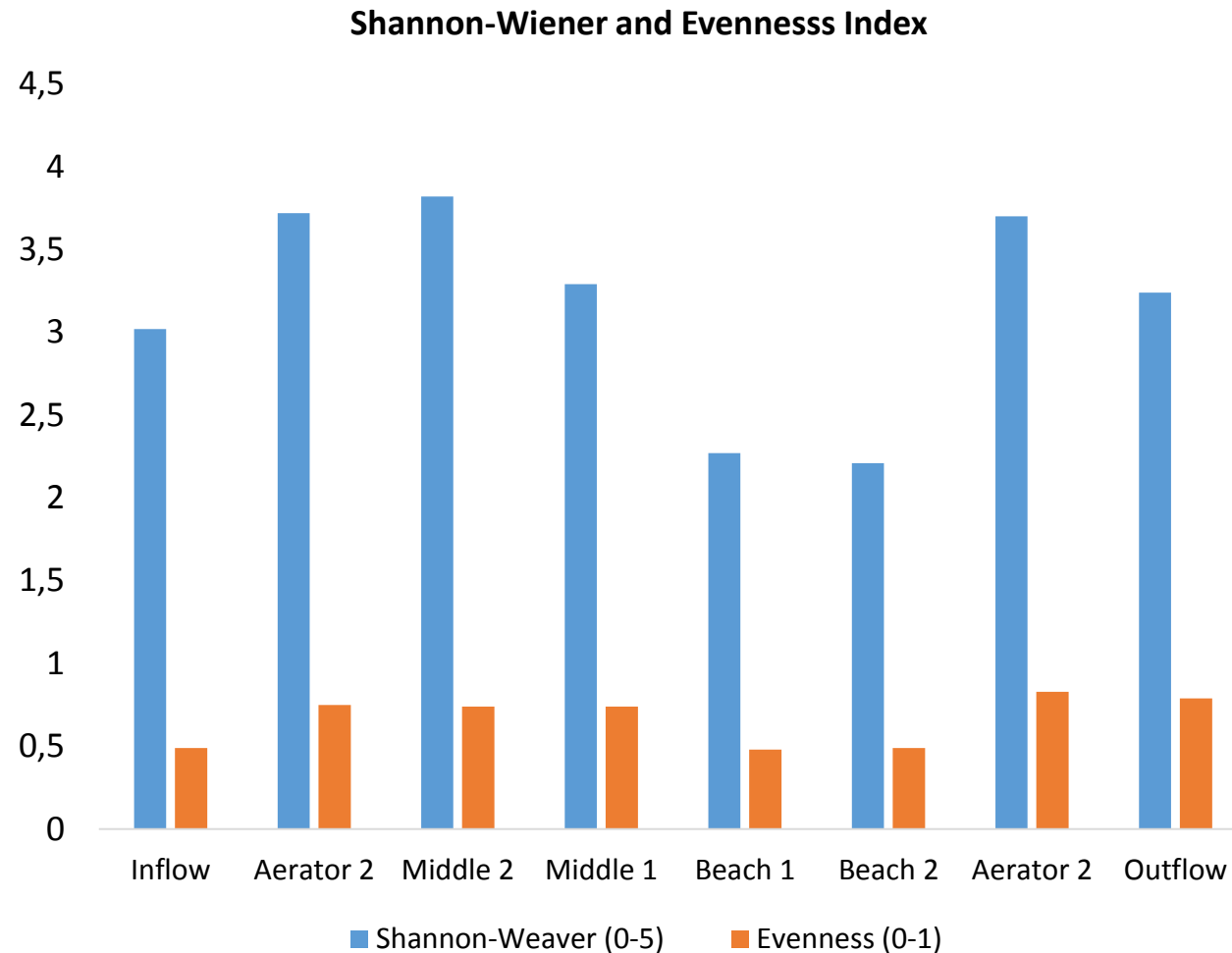
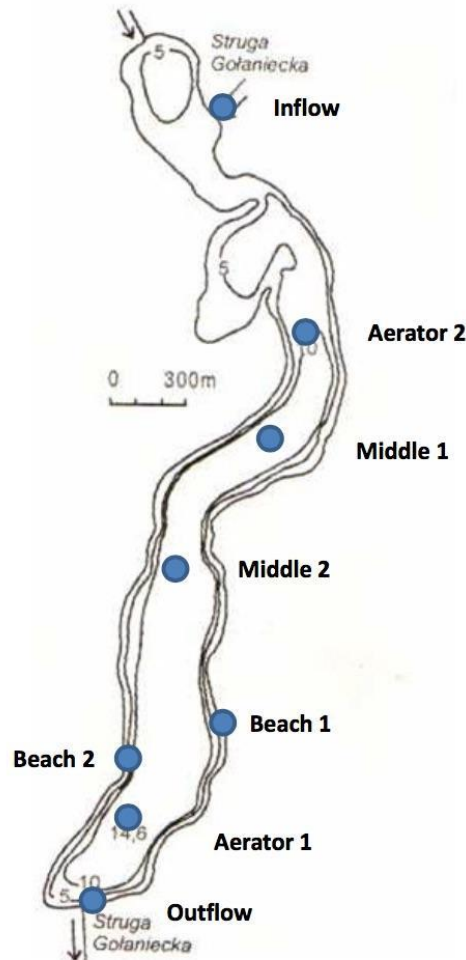
YEAR	2009	2010	2011	2012	2013	2014	2015	2016	2017
2008	84	51	43	33	40	52	82	35	40
2009	-	48	28	20	29	35	39	13	34
2010	-	-	42	42	62	47	37	35	38
2011	-	-	-	34	58	47	50	40	38
2012	-	-	-	-	77	49	59	47	38
2013	-	-	-	-	-	52	78	45	46
2014	-	-	-	-	-	-	57	40	48
2015	-	-	-	-	-	-	-	43	47
2016	-	-	-	-	-	-	-	-	42

Differences in species b/n

+58 %

Results – Phytoplankton

Species diversity



Results – Phytoplankton

Mixed Index of Nygaard

$$Q = (\text{Cyanobacteria} + \text{Chlorococcales} + \text{Centric diatoms} + \text{Euglenoids}) / \text{Desmids}$$

Station \ Year	2009	2010	2011	2012	2013	2014	2015	2016	2017
Inflow	-	1.8	17	9	19	3.8	17	7	9
Aerator 2	26	11.5	5	8	14	20	4.3	12	8
Middle 1	9	12.5	13	3	5.5	11	4.8	7.7	6
Middle 2	-	8.3	18	9	7.5	20	4	8.5	6
Beach 1	-	-	3	9	7	5	5.5	-	3
Beach 2	-	-	-	5	6	10	12	-	5
Aerator 1	16	8.3	9	7	8	9	6.7	-	7
Outflow	-	6.5	5	-	12	8	8	14	5

Dystrophy	0.0 - 0.2
Oligotrophy	0.2 - 1.0
Mesotrophy	1.0 - 3.0
Eutrophy	3.0 - 5.0
Hypertrophy	5.0 - 43.0

Results – Phytoplankton

PMPL Index

$$\text{PMPL} = [\text{YCh} + \text{YBm} + \text{YCy}] / 3$$

where:

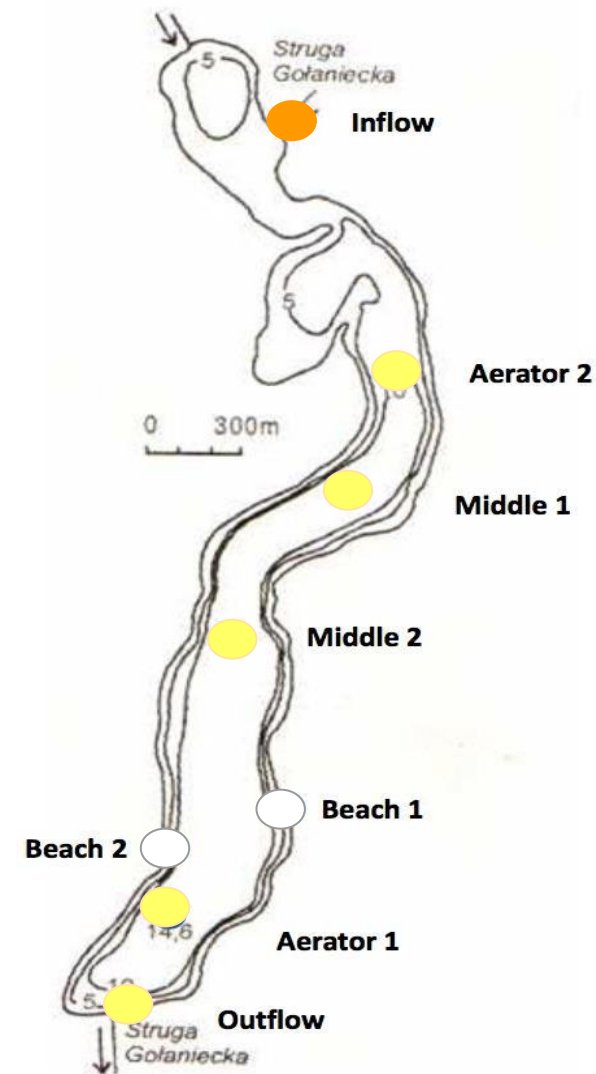
YCh - Chlorophyll-a concentrations

YBm - General biomass of phytoplankton

YCy - Biomass of cyanobacteria

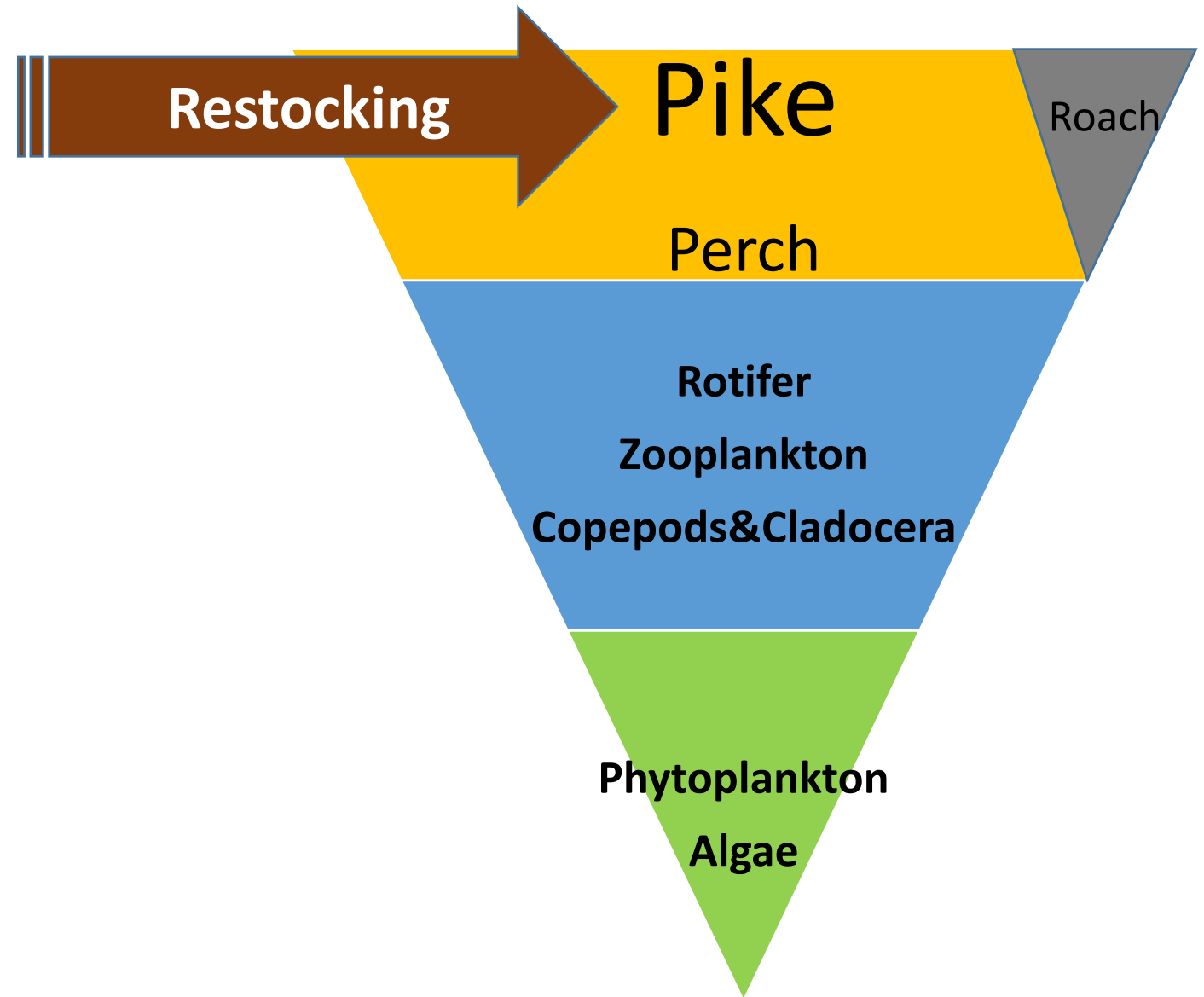
	PMPL					
	Inflow	A2	M1	M2	A1	Outflow
2017	3.40	2.74	2.78	2.78	2.78	2.50
2016	3.70	2.78	2.76	2.76	2.67	2.53

Ecological status	PMPL
very good	0,0 - 1,0
good	1,01 - 2,0
moderate	2,1 - 3,0
poor	3,1 - 4,0
bad	4,01 - 5,0

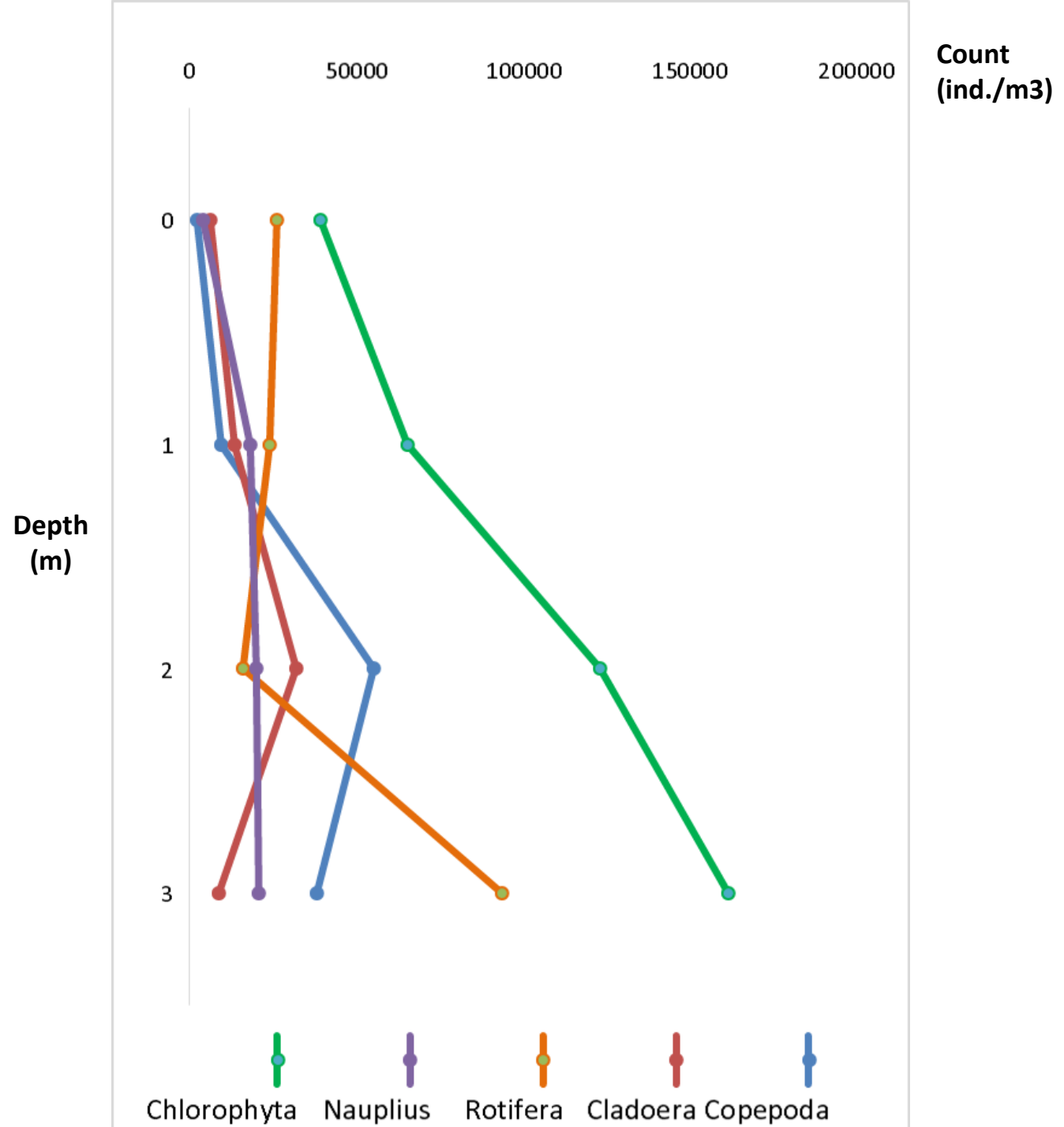


Bio-manipulation

- Top down system
- Size and quantity
- Restoring pattern



Bio-manipulation



Conclusion

- Trophic state : remain eutrophic with improvements
- Diatom index : poor -> moderate
(remark: SE bank of the lake – recreational activities)
- No. of species remain in stable condition
- Inflow receives the greatest amount of species and strong concentration of Cyanobacteria

Highlights from this year

- 4 new species
- Cyanobacteria shifts to aerators
- Benthic cyanobacteria present at NW of the lake
- Red algae is growing northern along the bank (implicator of healthy state)
- No major difference between north and south for O₂ preference, pH and trophic state
- Species diversity ↑
- Bio-manipulation effectiveness ↓

Take Home Message

- Evidence of moderate water quality
- Management needed
 - Consistency
 - Coordinated effort
- More work needs to be done to prevent the return of cyanobloom in Lake Durowskie

Thank you

