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Lake Durowskie Water Quality Assessment: Physico-Chemical Properties

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Wągrowiec 2019

Outline

1. Introduction
2. Study site
3. Objectives
4. Methods
5. Results
6. Conclusions
7. Recommendations



Study site



Town: Wągrowiec, central Poland

District: Wielkopolska

Population: 25 648 people

Lake: Durowskie lake

Study Site: Lake morphology



(Google maps)

Lake area: 143.7 ha

Lake volume: 11,322,900 m³

Average depth: 7,9m

Maximum depth: 14,6m

Perimeter: 10,9 km

Catchment area: 1581 ha

Ecosystem Services on Lake Durowskie

Human-value services

- Tourism
- Recreation - fishing, kayaking, swimming, etc.



Environmental services

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



Environmental Pressures on Lake Durowskie

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



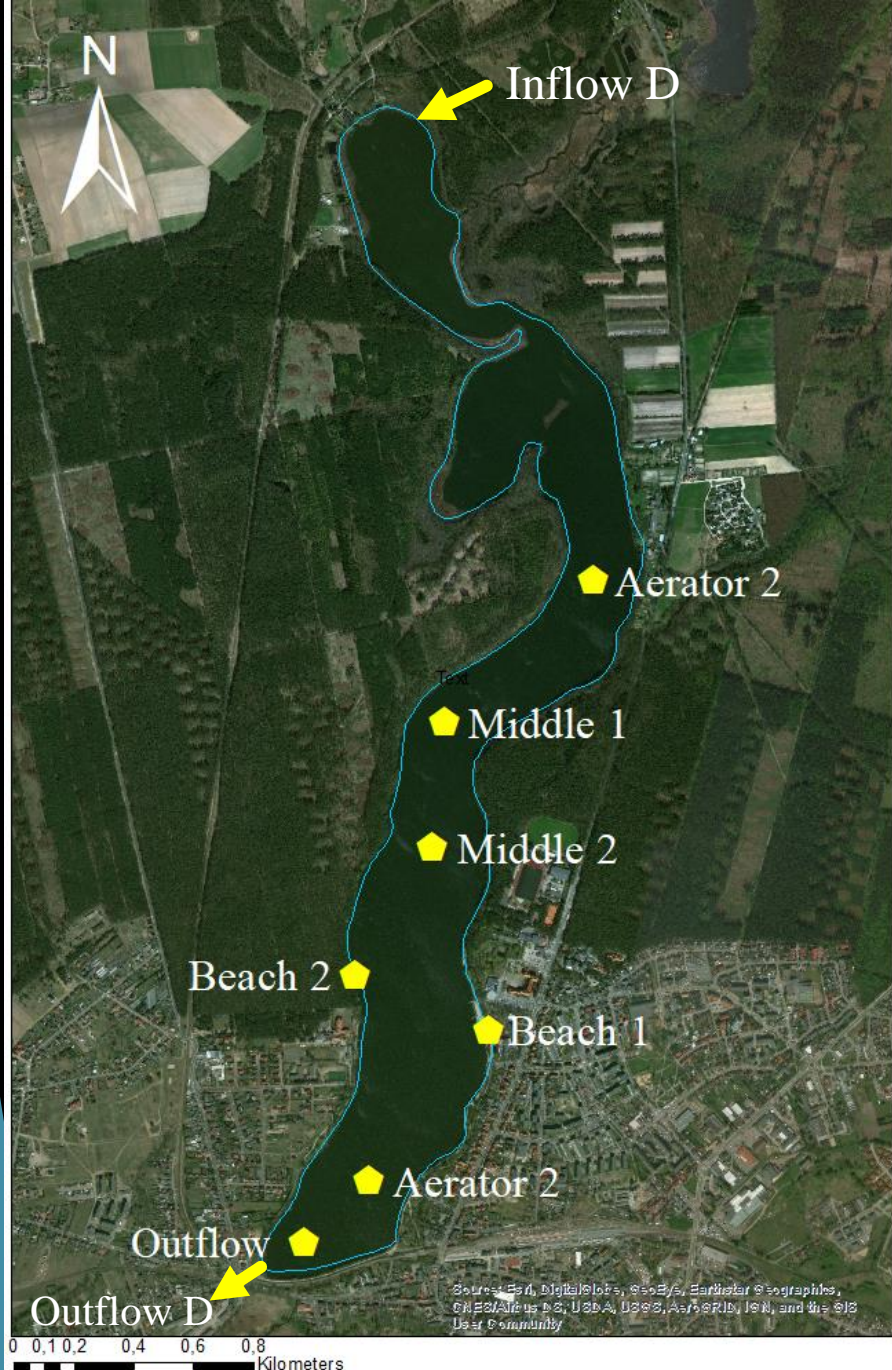
Lake Durowskie Restoration

- Restoration techniques currently implemented:
 - Wind Aerators
 - Biomanipulation with predatory fish
 - Phosphorus inactivation
- Yearly monitoring of the lake:
 - Physical and chemical parameters
 - Algae
 - Macrophytes
 - Macroinvertebrates

Physico-Chemical Objectives

1. Determine the spatial distribution of the physico-chemical properties and the trophic states to map the water quality.
2. Analyze the nutrient load in lake Durowskie, including the inflow and outflow streams.
3. Assess previous year's data to determine the temporal change in the water quality.





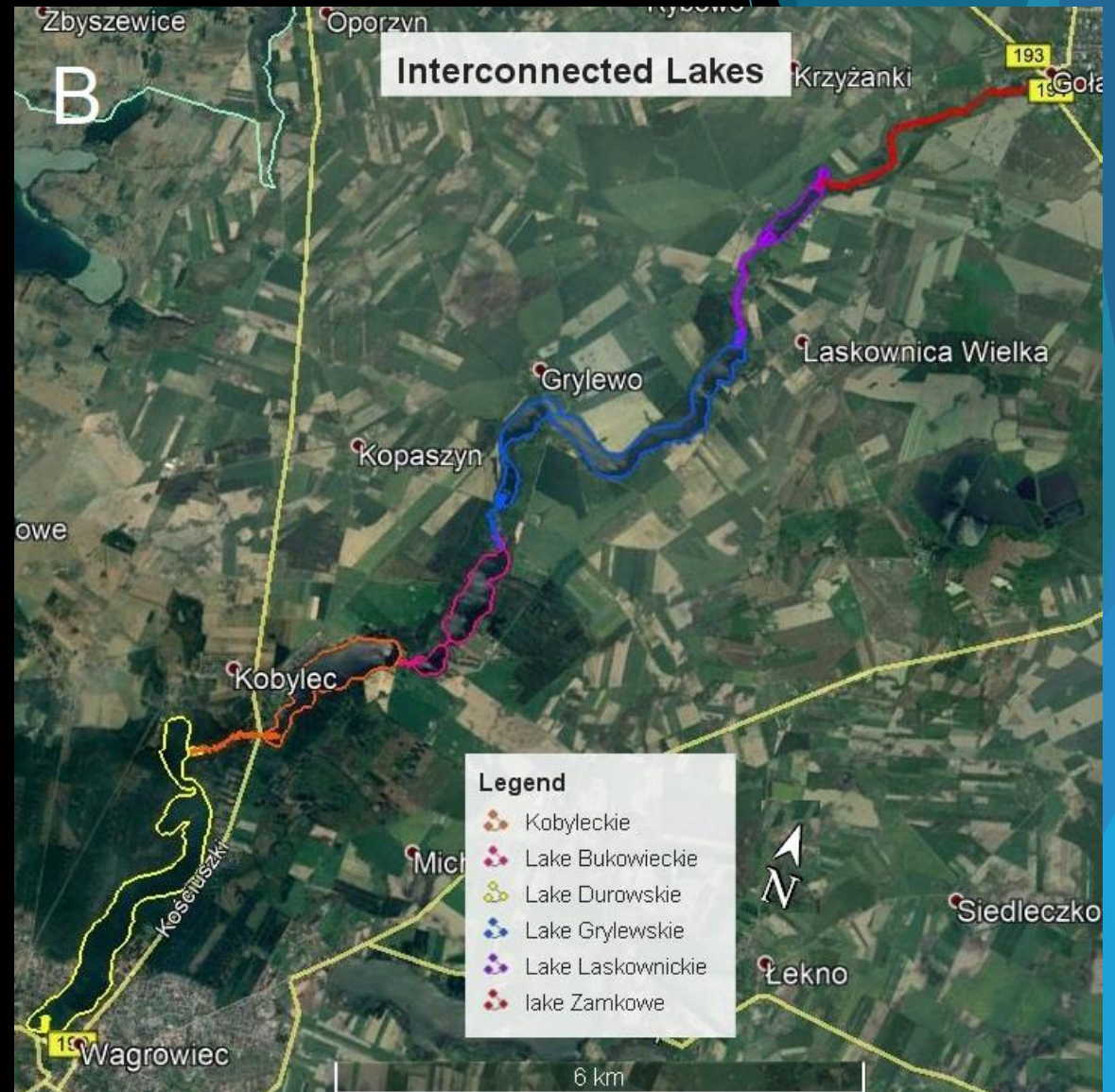
(Google maps)

Methods

- Physico Chemical parameters:
 - pH
 - Temperature
 - Oxygen
 - Electrical Conductivity
- Lake nutrient content and nutrient input/output:
 - Total P
 - Ammonia
 - Nitrate
 - Nitrite
 - Discharge volume

Lake System Sampling

- ▶ Also collected nutrients and physico-chemical parameters from:
 - ▶ Zamkowe Lake
 - ▶ Laskownickie Lake
 - ▶ Grylewskie Lake and Inflow
 - ▶ Bukowieckie Lake and inflow
 - ▶ Kobyleckie Inflow



(Google maps)

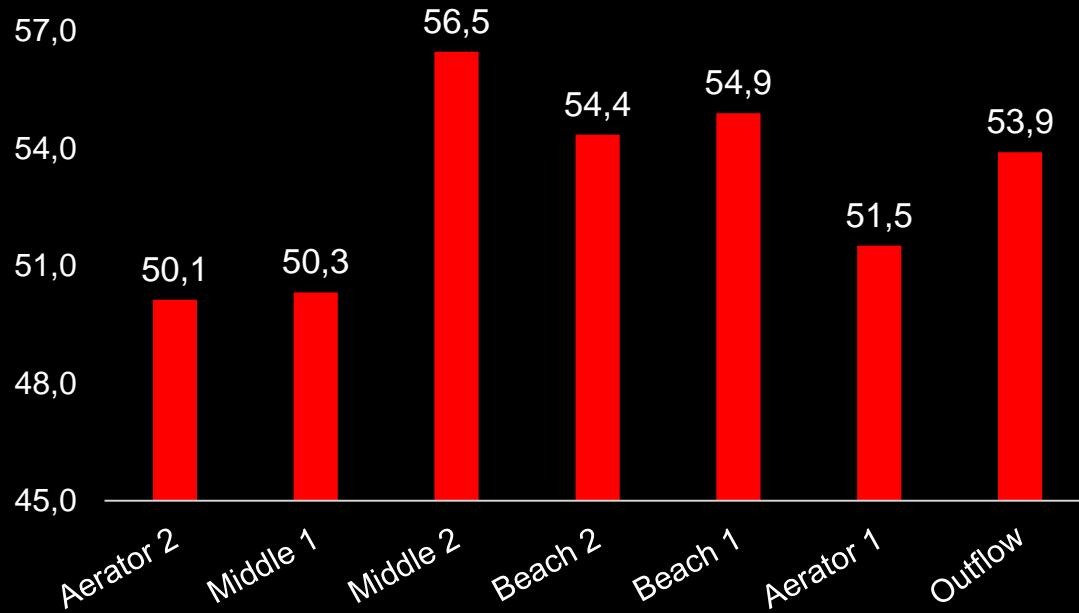
Methods

- Trophic State Index (TSIM):
 1. Chlorophyll a - photosynthetic biomass
 2. Transparency/SD - visible depth in meters
 3. Total P

| Trophic Class | Chla ($\mu\text{g/L}$) | Total P ($\mu\text{g/L}$) | Sd (m) | TSI _M |
|---------------|--------------------------|-----------------------------|--------|------------------|
| Oligotrophic | 0-2.6 | 0-12 | 4-8 | <30-40 |
| Mesotrophic | 2.6-7.3 | 12-24 | 2-4 | 40-50 |
| Eutrophic | 7.3-56 | 24-96 | 0.5-2 | 50-70 |

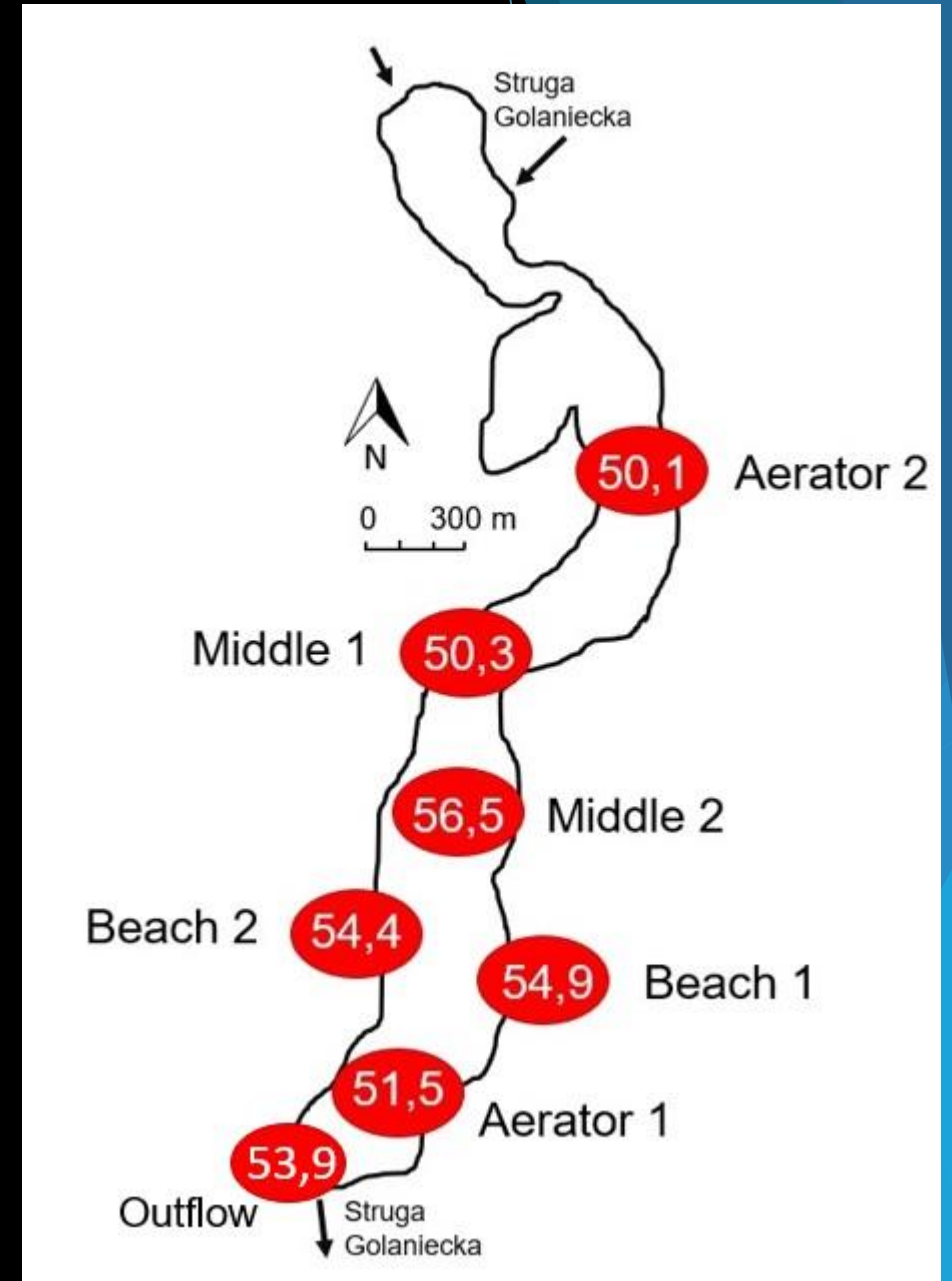
2019 Results: TSI_M

TSI_M Lake Durowskie



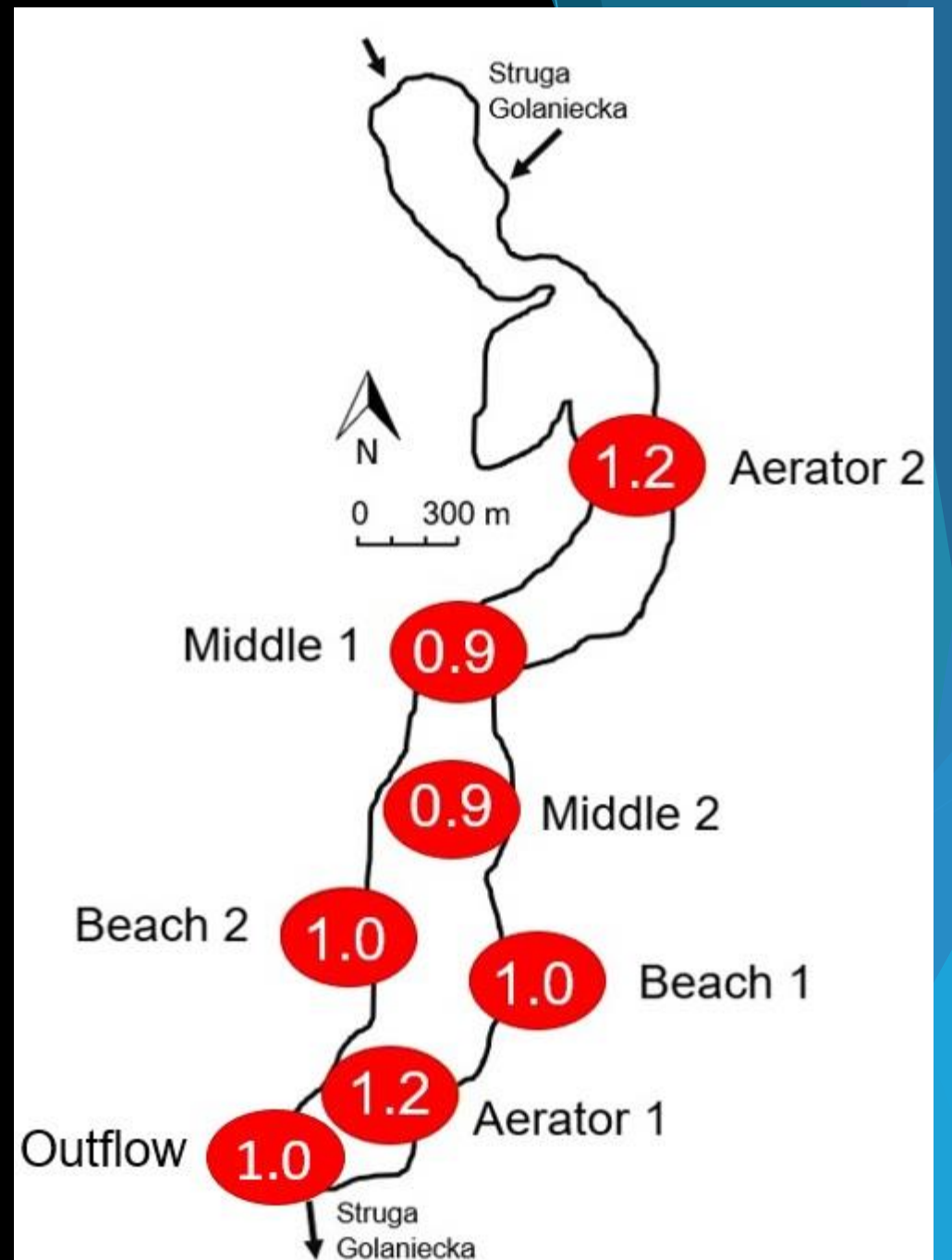
| TSI _M | Trophic State |
|------------------|---------------|
| <30-40 | Oligotrophic |
| 40-50 | Mesotrophic |
| 50-70 | Eutrophic |

2019 Lake Durowskie average TSI_M: 53.1



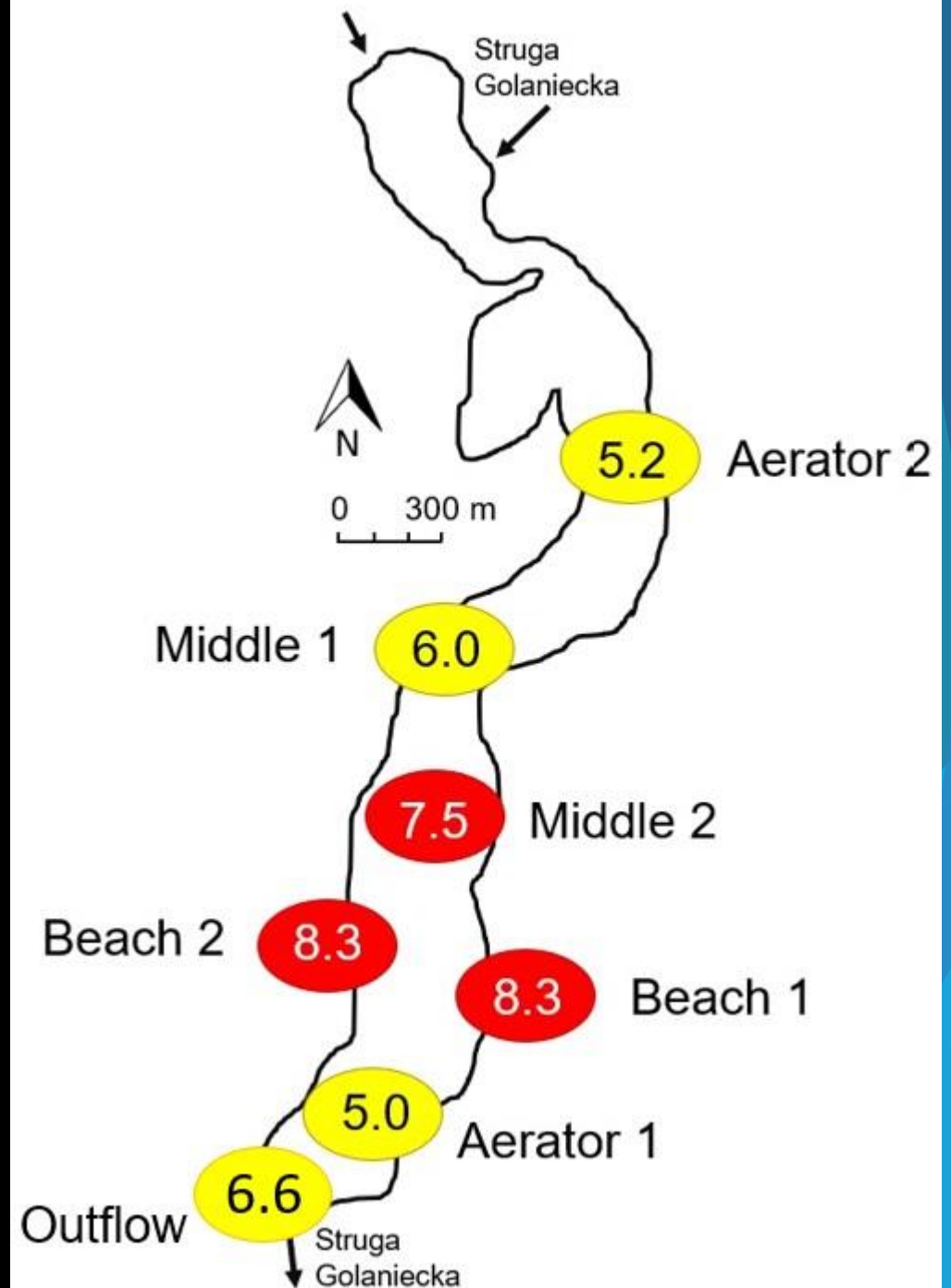
2019 Results: Transparency/SD

| SD (m) | Trophic State |
|---------|---------------|
| 4 - >8 | Oligotrophic |
| 2 - 4 | Mesotrophic |
| 0.5 - 2 | Eutrophic |



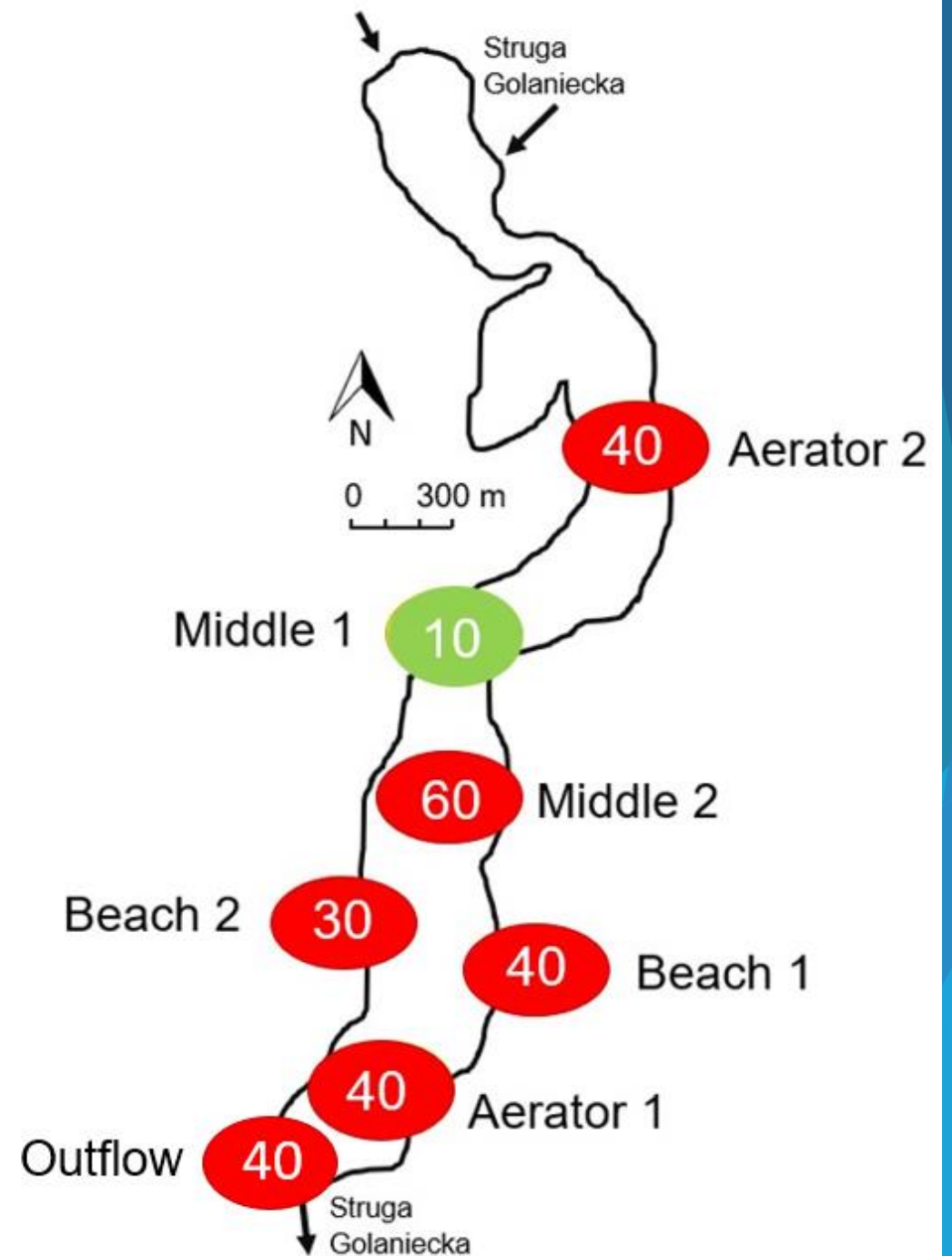
2019 Results: Chlorophyll a

| Chl a ($\mu\text{g/L}$) | Trophic State |
|---------------------------|---------------|
| 0-2.6 | Oligotrophic |
| 2.6-7.3 | Mesotrophic |
| 7.3-56 | Eutrophic |

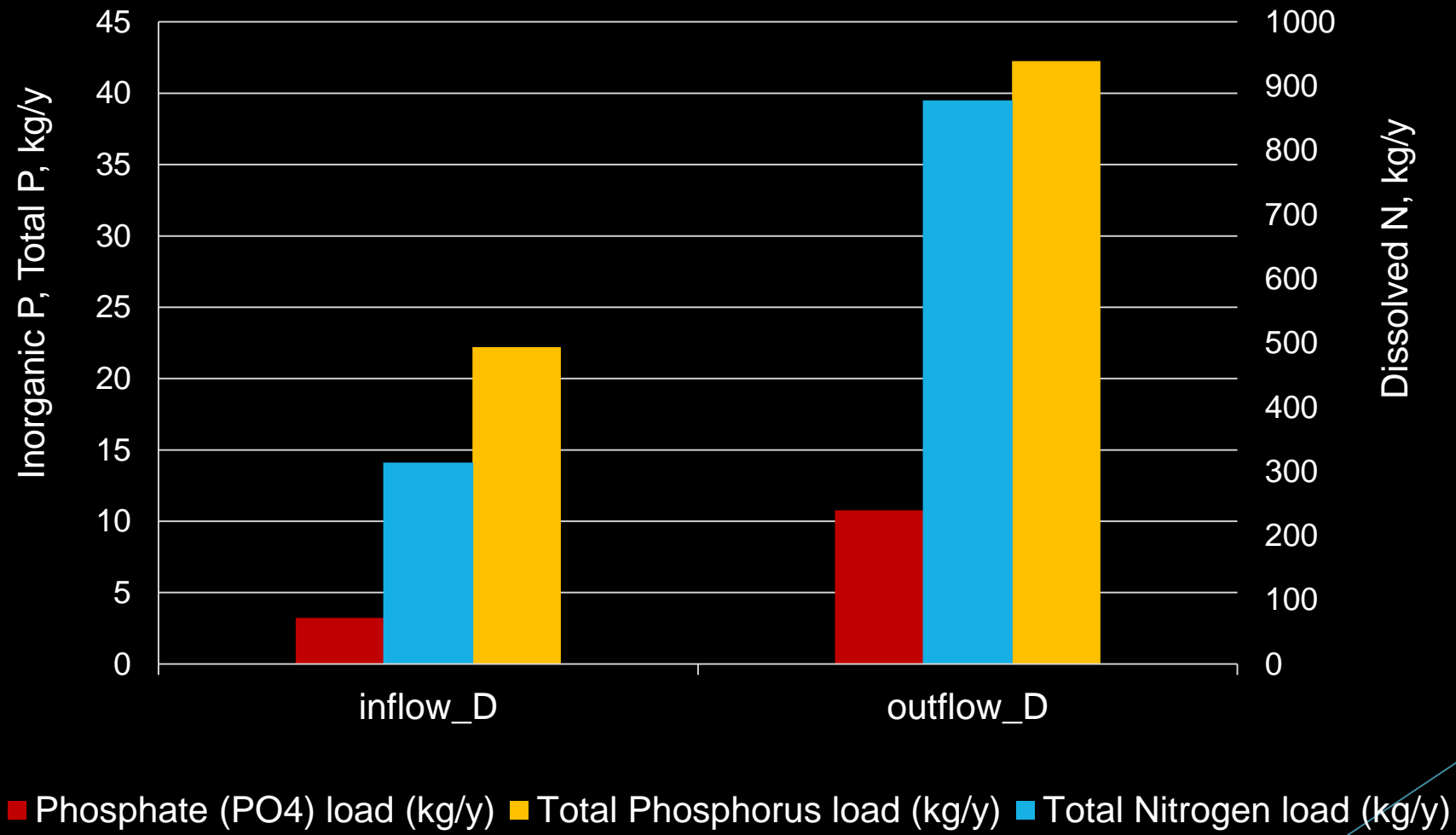


2019 Results: Total P

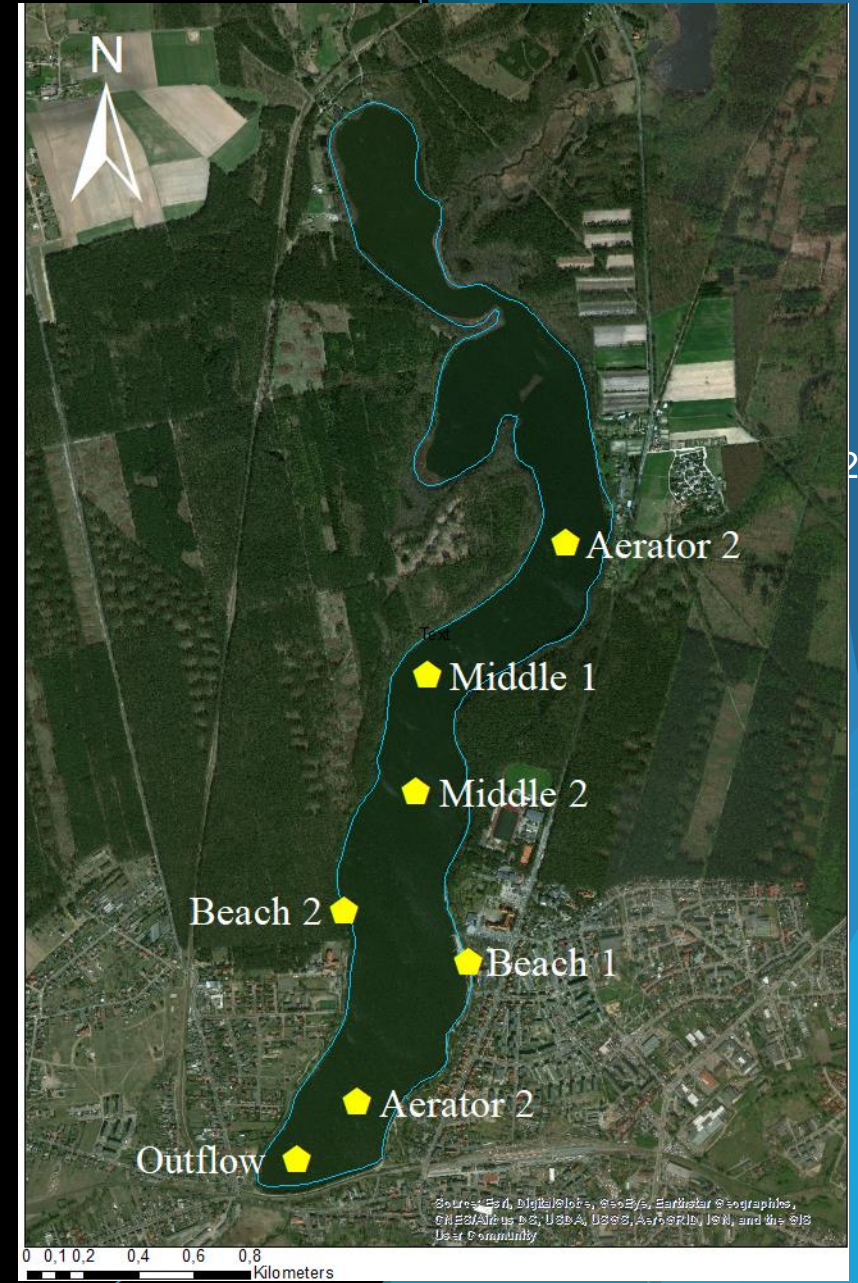
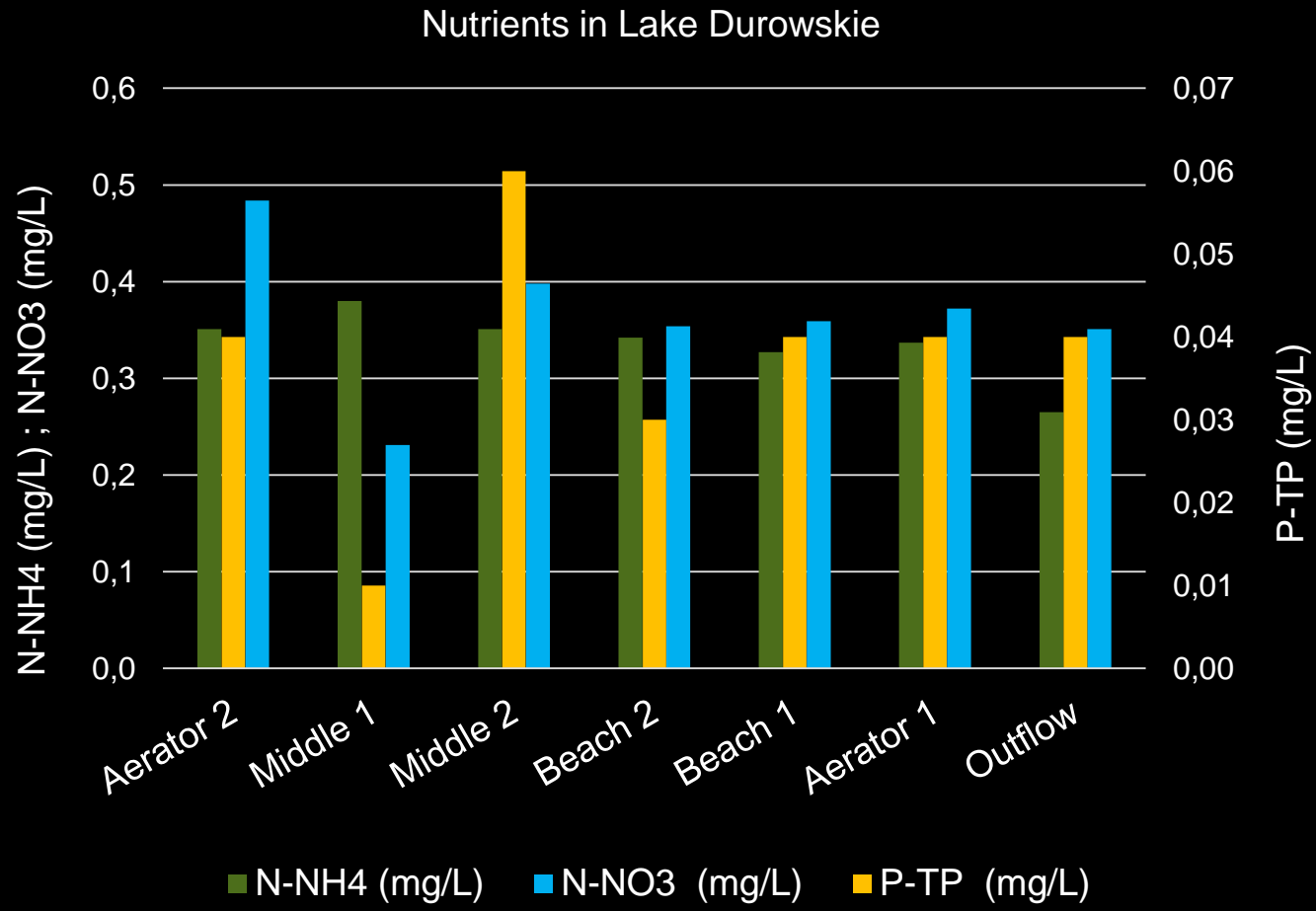
| Total P ($\mu\text{g/L}$) | Trophic State |
|-----------------------------|---------------|
| 0 - 12 | Oligotrophic |
| 12 - 24 | Mesotrophic |
| 24 - 96 | Eutrophic |



Nutrient loads: Inflow and outflow of Durowskie lake

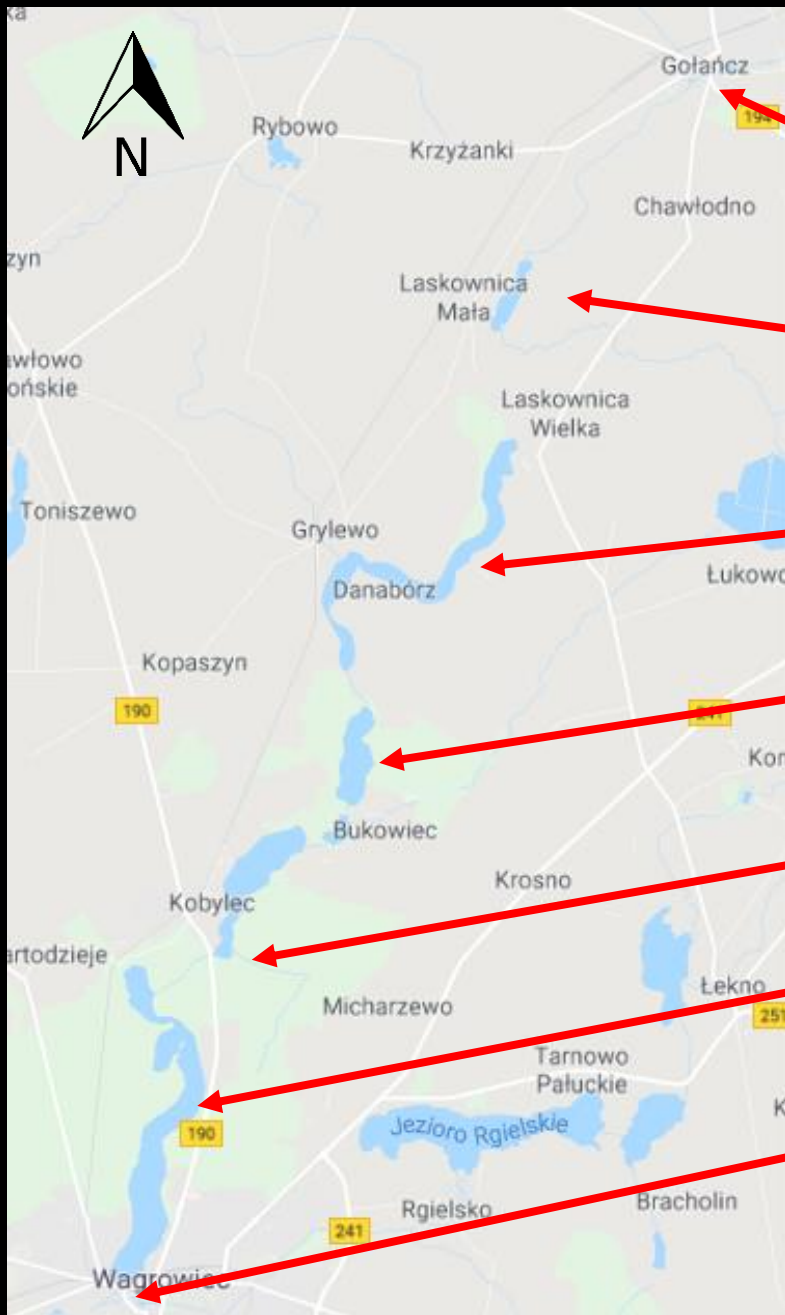


2019 Nutrients: Lake Durowskie

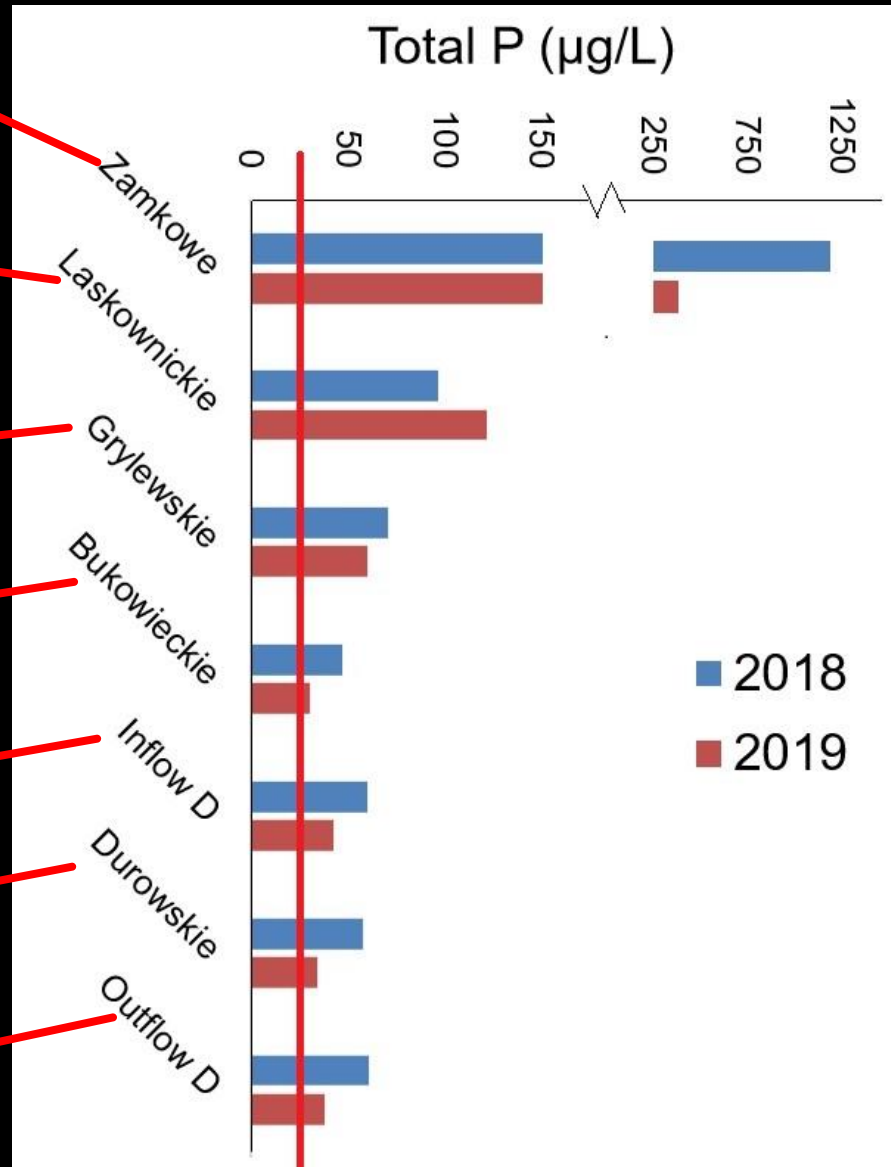


(Google maps)

Total P: 2018 vs. 2019

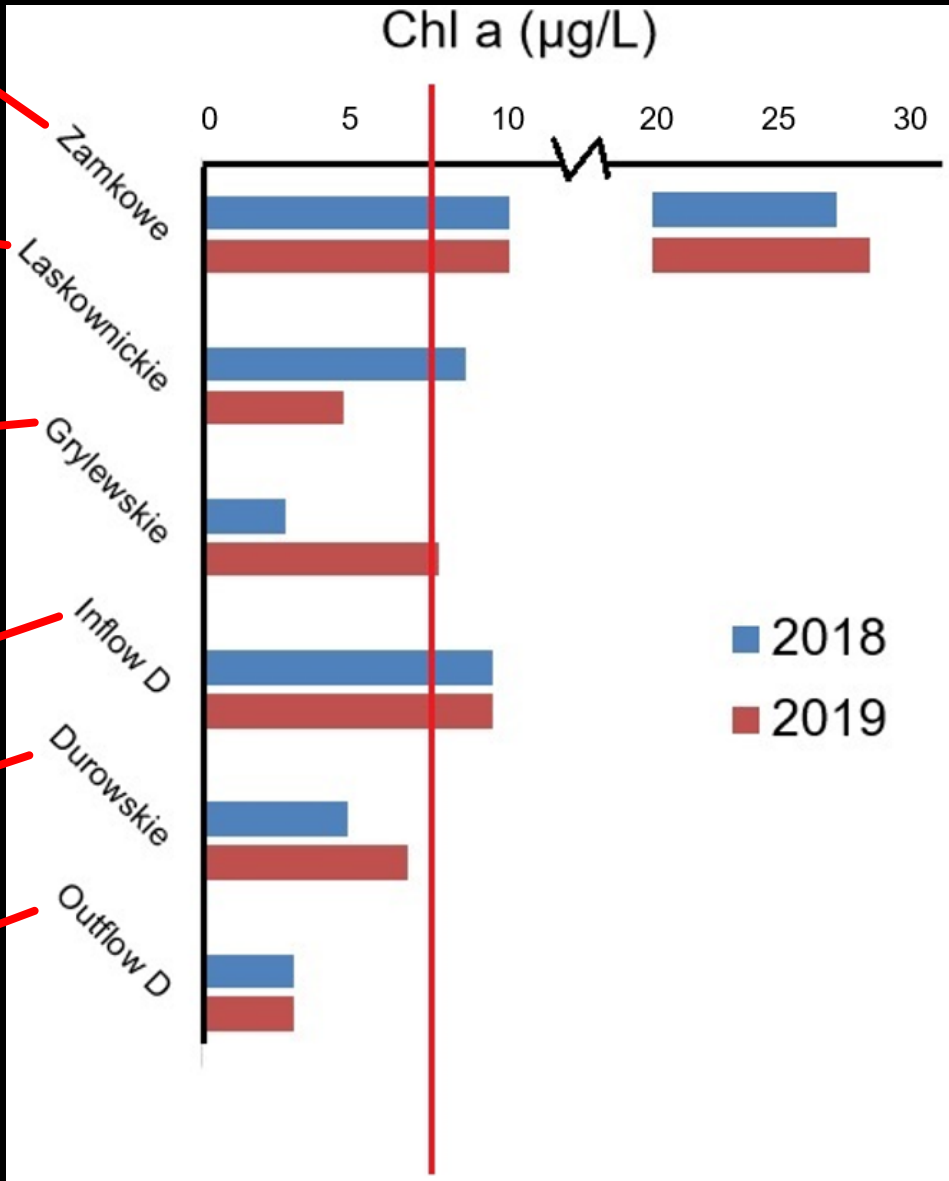
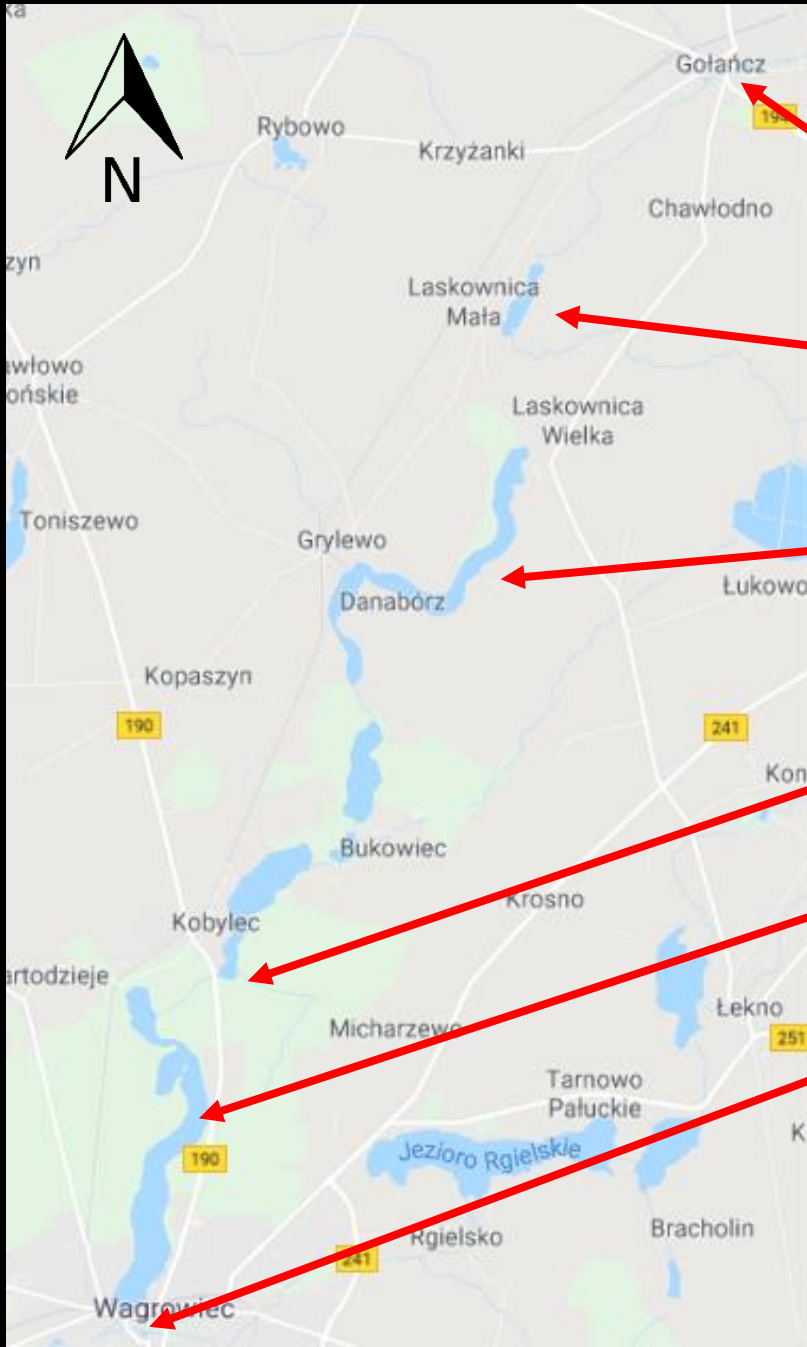


(Google maps)



Mesotrophic < 24.9 µg/L TP < Eutrophic

Chl a: 2018 vs. 2019

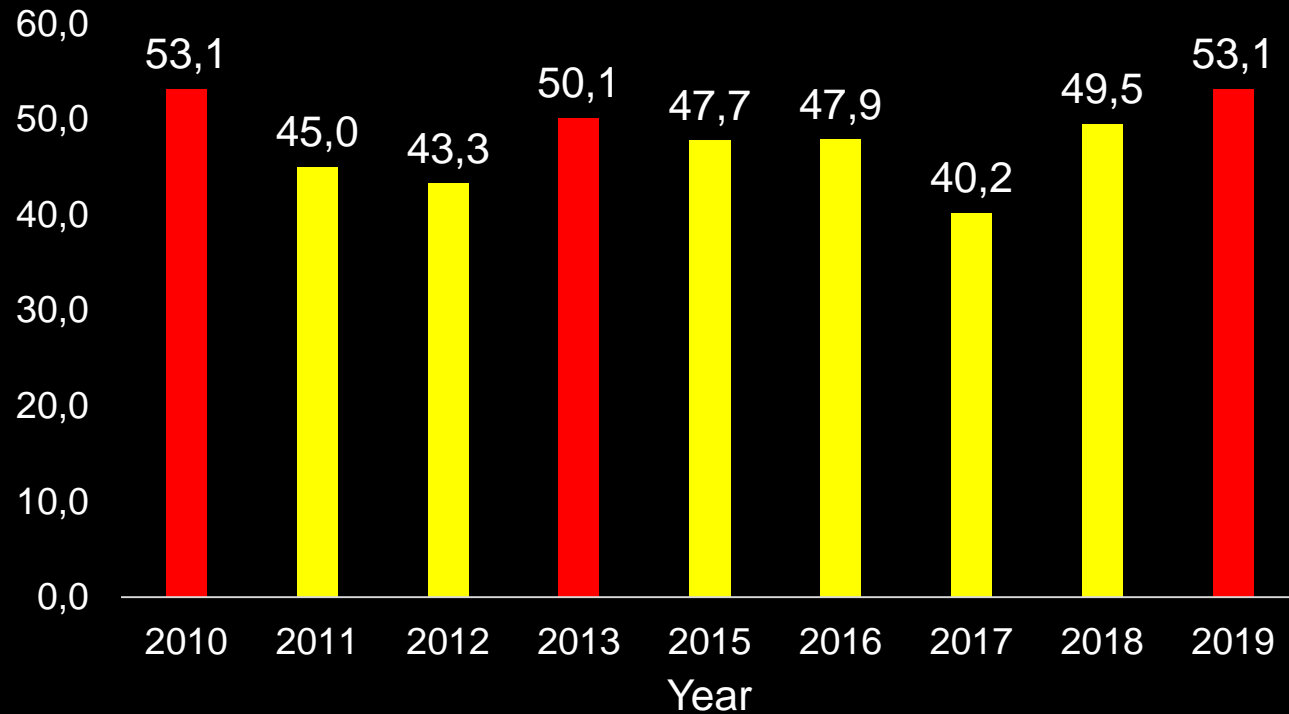


Mesotrophic < 7.3 µg/L Chl a < Eutrophic

(Google maps)

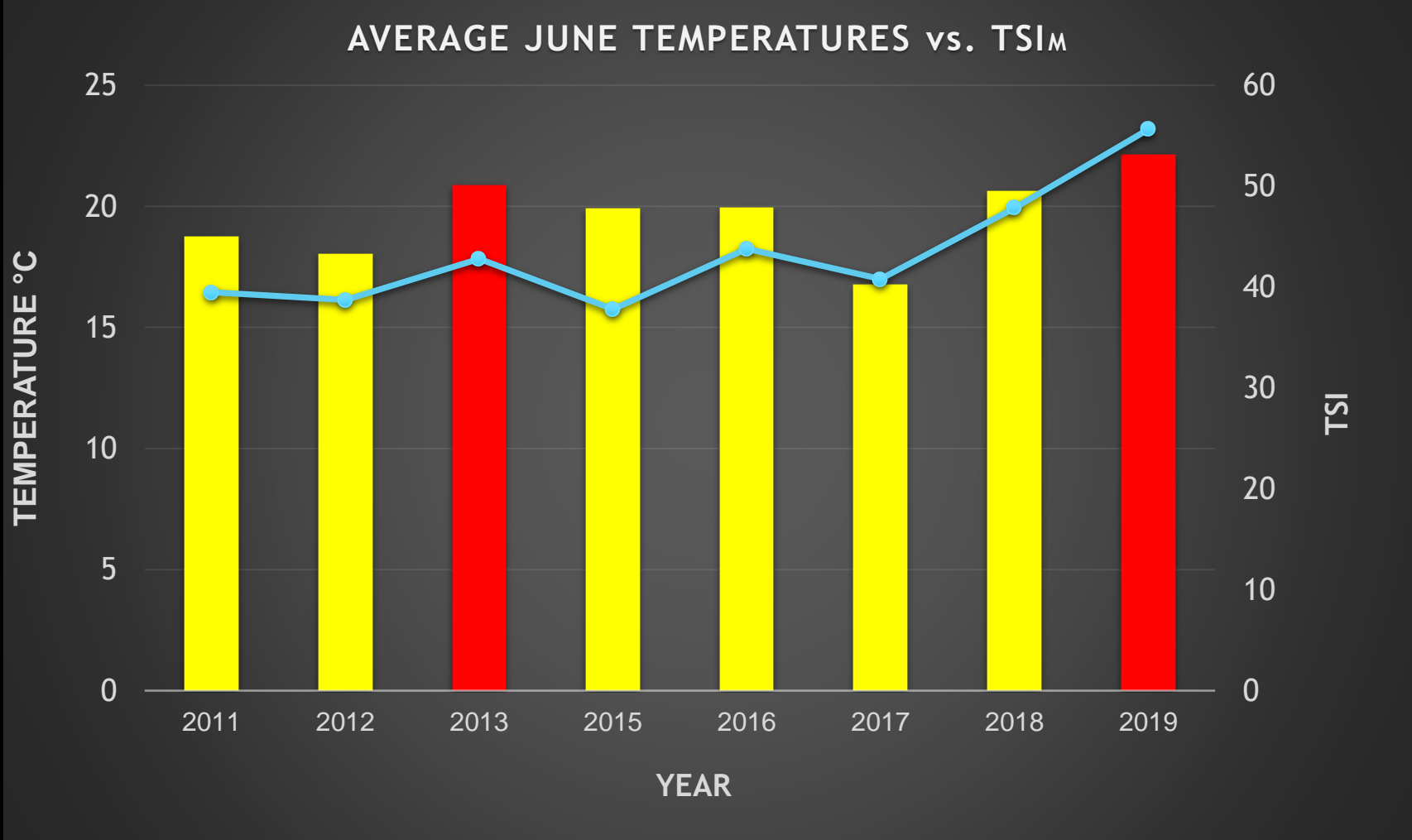
Results: TSI_M Time-series analysis

Trophic State Index of Durowskie lake



| TSI _M | Trophic State |
|------------------|---------------|
| <30-40 | Oligotrophic |
| 40-50 | Mesotrophic |
| 50-70 | Eutrophic |

Results: TSI_M & Temperature



Conclusions

- ▶ Temporal: Lake Durowskie has the highest TSM since 2010. Not good!
 - ▶ Lake still eutrophic
- ▶ Spatial: Water quality appears to be better near Aerator 2
 - ▶ Recreation and urban development in South
- ▶ Spatial: High outflow of nitrogen and phosphorus from Lake Durowskie
 - ▶ Possible anthropogenic pollution
 - ▶ Possible re-suspension of total phosphorus

Recommendations

- ▶ Pollution source needs to be investigated
 - ▶ Agriculture
 - ▶ Waste water
 - ▶ Urban development
 - ▶ Consider pollution in all lakes watershed
- ▶ Consider impacts of climate change in restoration measures
- ▶ Stakeholder involvement

Thank you for your attention!

Any questions?