University of Belgrade
Institute of Chemistry, Technology and Metallurgy
National Institute of the Republic of Serbia

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Acronym: BIOLAWEB Boosting Institute of Chemistry, Technology and Metallurgy in Water Biomonitoring

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Type of action: HORIZON Coordination and Support Actions (HORIZON - CSA)

Duration: 36 months

eDNA Workshop

Aquatic macrophytes as indicators

for the ecologal status of lakes

Belgrade, October 2023

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presentation

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the European Union

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What are aquatic macrophytes?

Definition

- Macrophytes: aquatic plants growing in or close to the water.

- semi-aquatic plants (helophytes) (1)
- and aquatic macrophytes (hydrophytes)

- The **aquatic macrophytes** are submerged plants or plants with floating leaves.

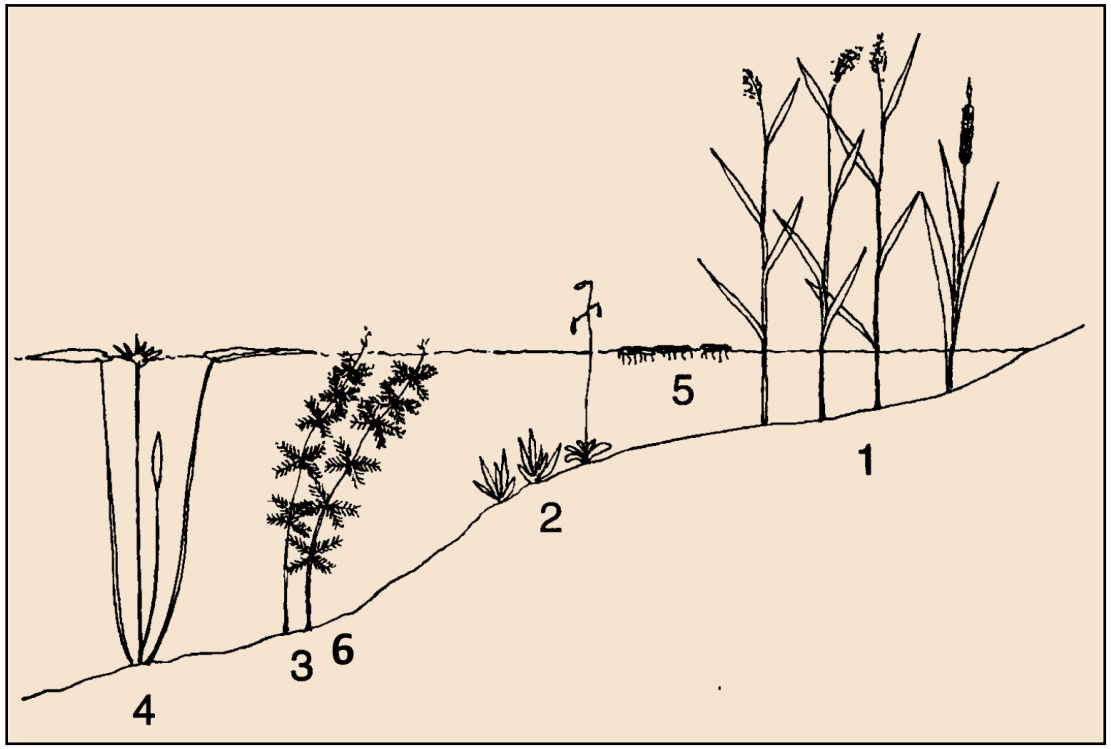
  (2) isoetids

  (3) elodeids

  (4) nymphaeids

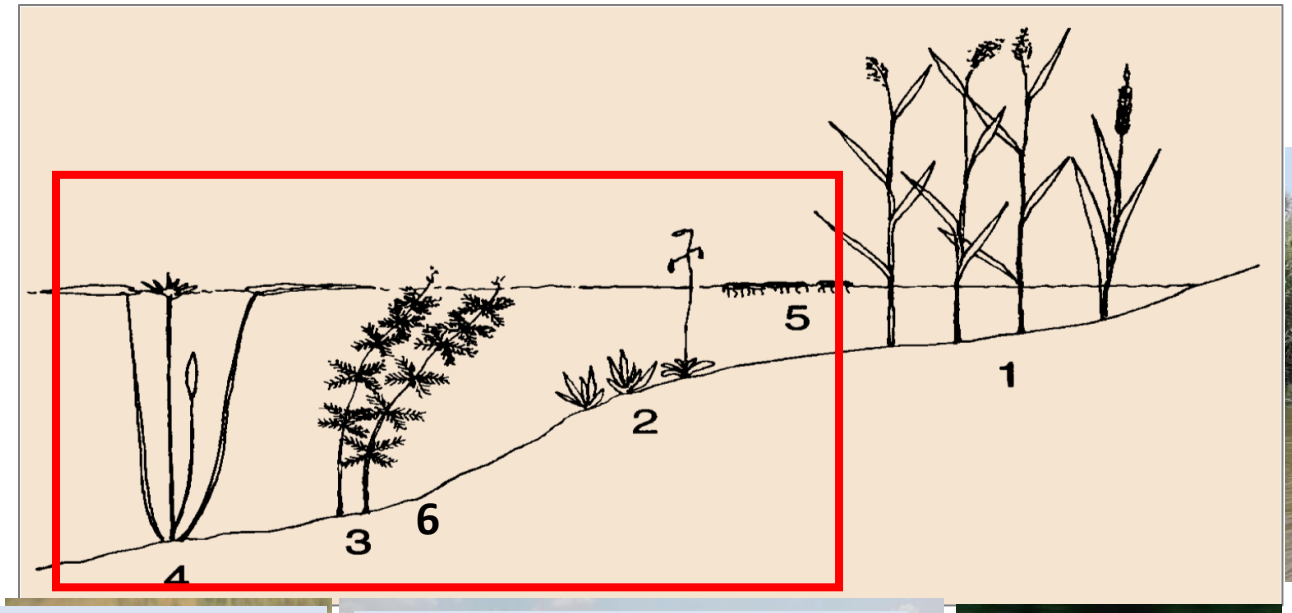
  (5) lemnids

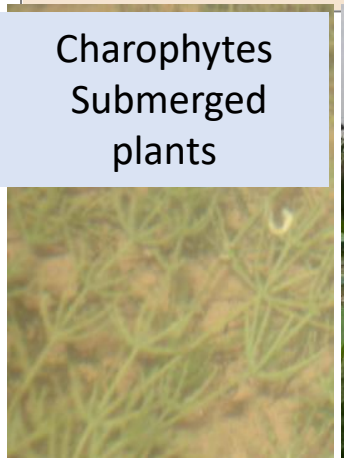
  (6) charophytes (large macro-algae)



- **In this project, we focus on Charophytes.**

Aquatic macrophytes





Elodeids

A stem plant that completes its entire life cycle submerged, or with only its flowers above the waterline

Potamogeton lucens
(photos: A. Ballot)

Ceratophyllum demersum (photo: A. Ballot)

Nechamandra alternifolia (photo: A. Ballot)

Nymphaeids

A plant rooted in the bottom, but with leaves floating on the water surface.

Trapa natans(photo: A. Ballot)

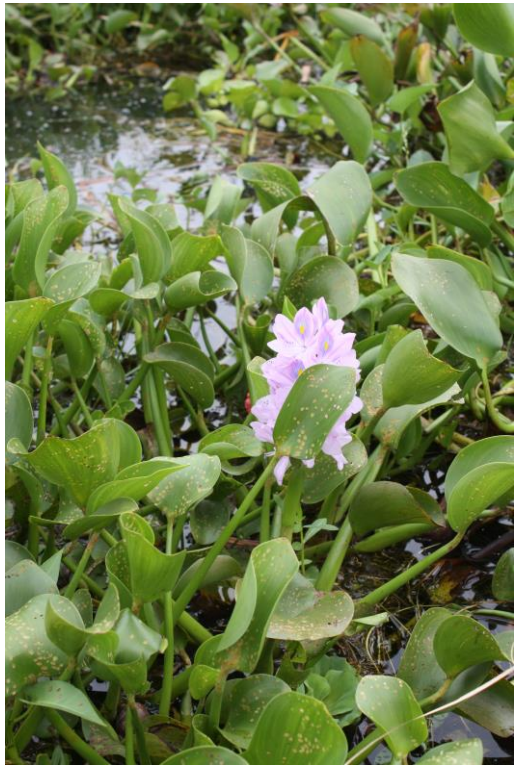
Nelumbo nucifera (photo: A. Ballot)

Euryale ferox (photo: M. Mjelde)

Nymhoides indica (photo: A. Ballot)

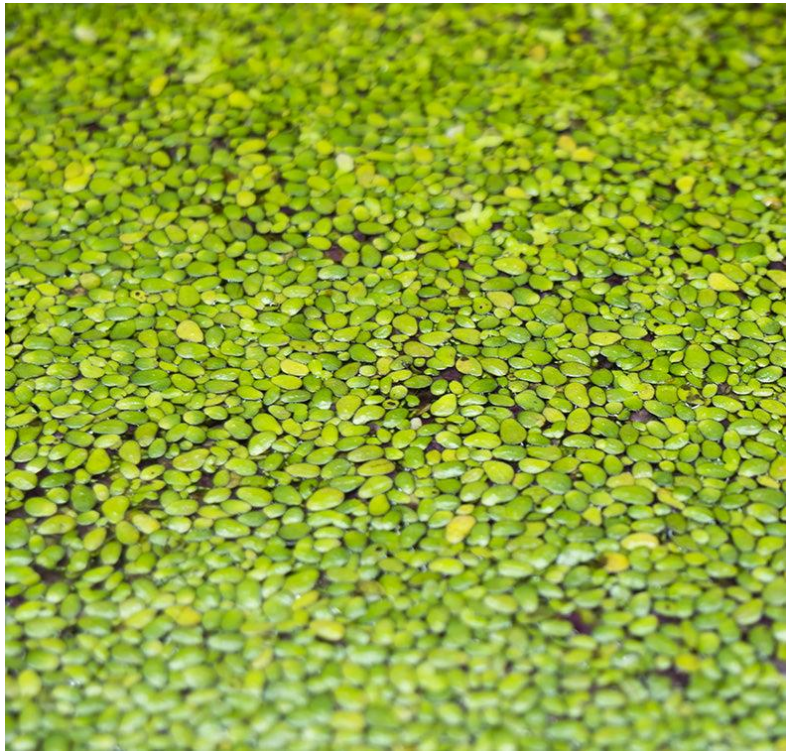
Free floating plants

These plants float freely on the water surface.



Eichhornia crassipes

Salvinia natans

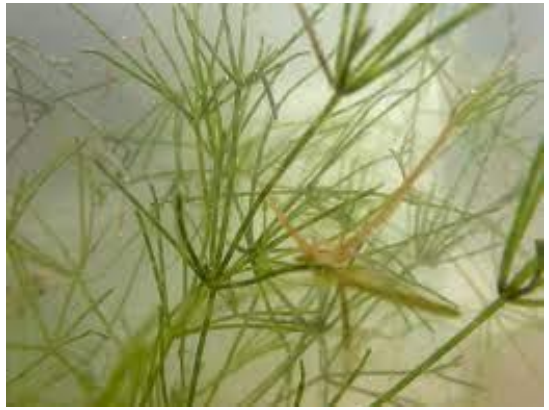


Lemna minor

Charophytes

Charophytes (stoneworts) are macrophytes (green algae) growing entirely submerged in freshwater and brackish water

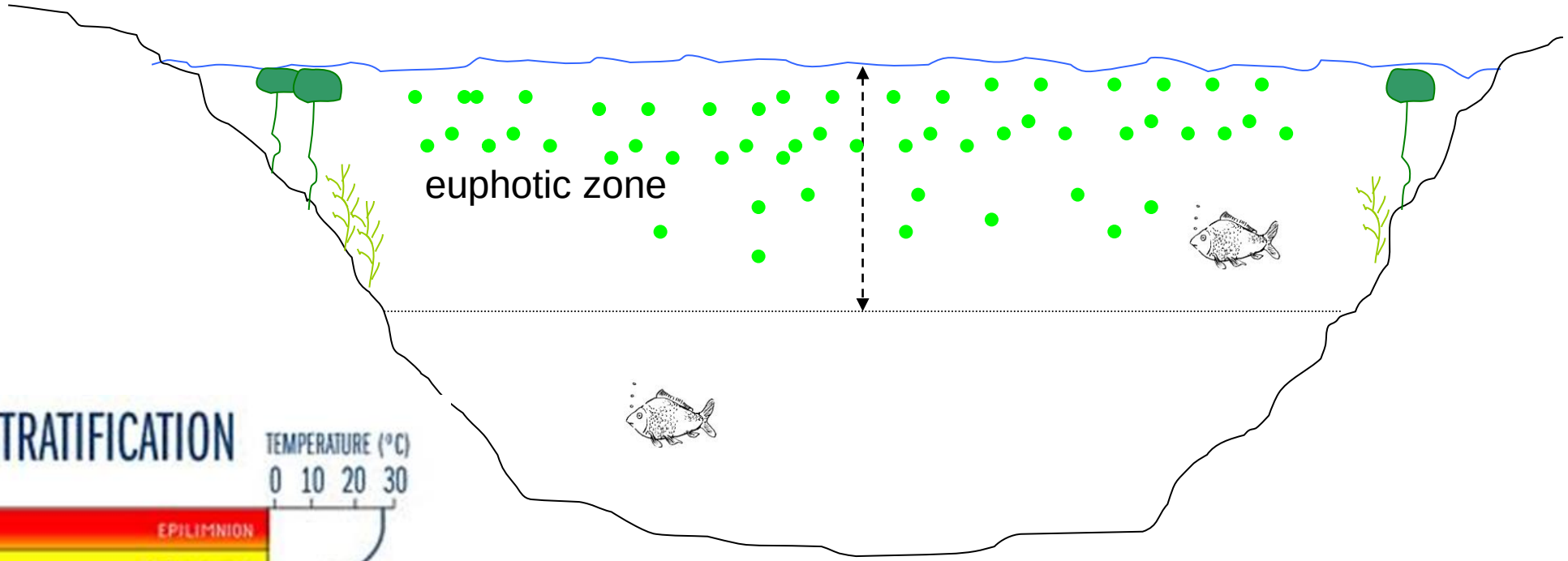
Chara cf. *zeylanica*

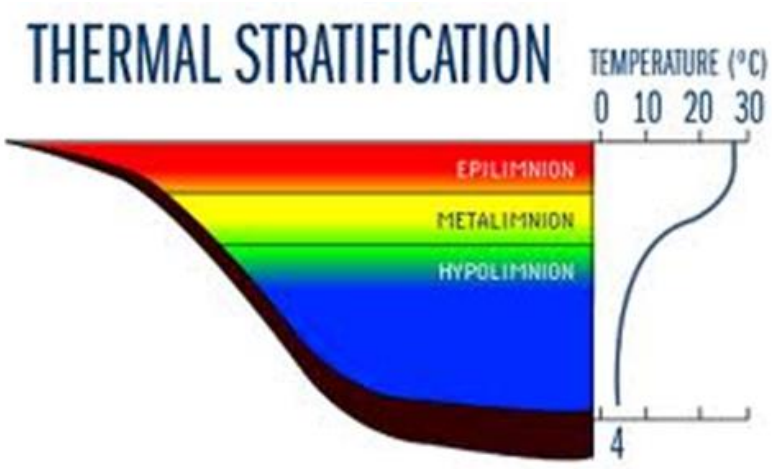


Nitellopsis obtusa

Tolypella intricata

deep lake


euphotic zone


THERMAL STRATIFICATION
TEMPERATURE (°C)
0 10 20 30
EPILIMNION
METALIMNION
HYPOLIMNION
4

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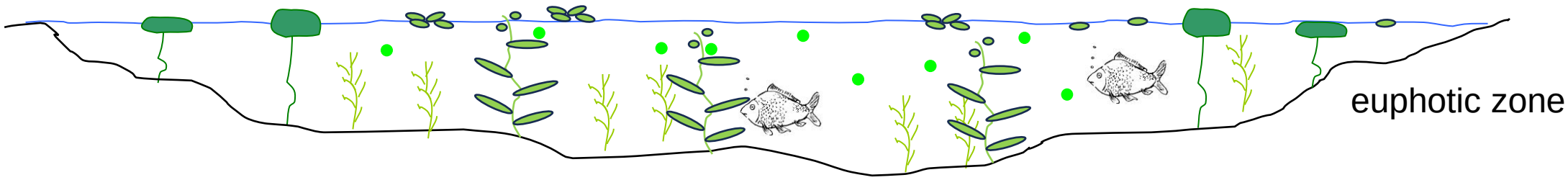
Shallow lake macrophyte dominated



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Shallow lake macrophyte dominated

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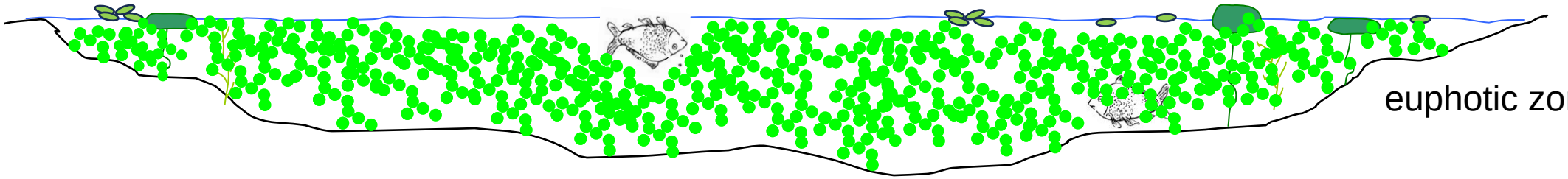
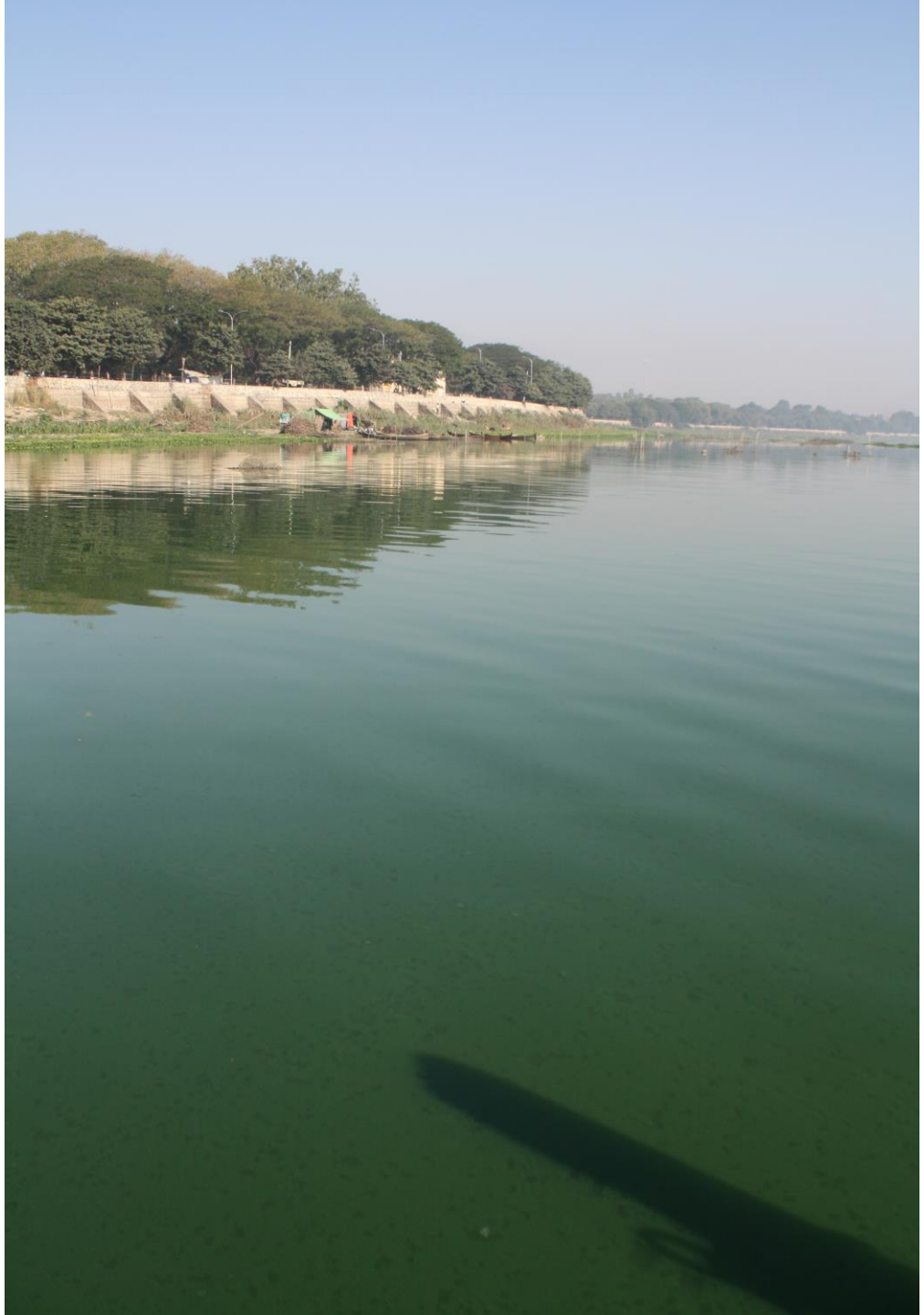
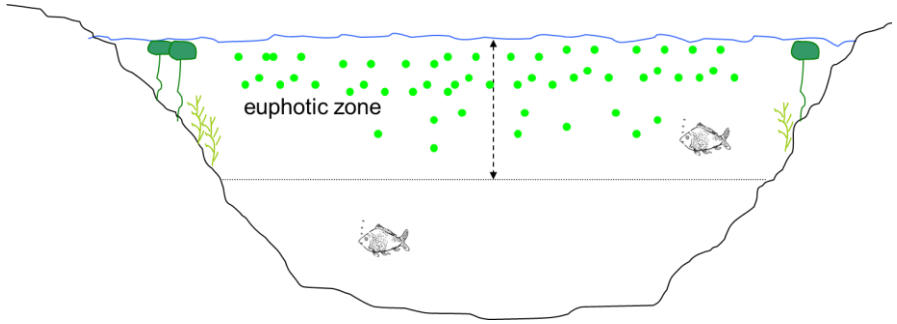
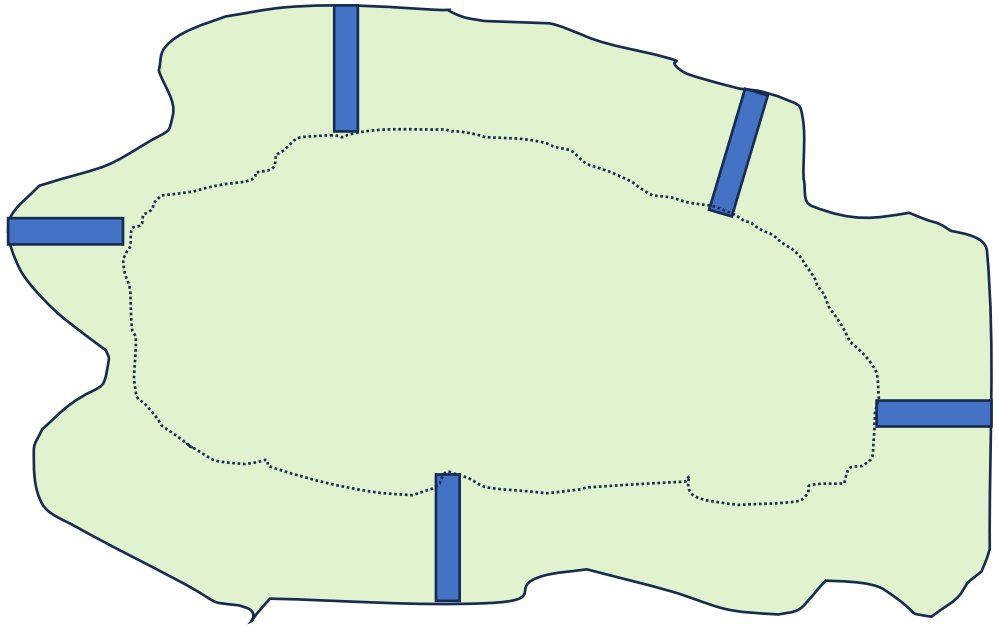
Shallow lake plankton dominated

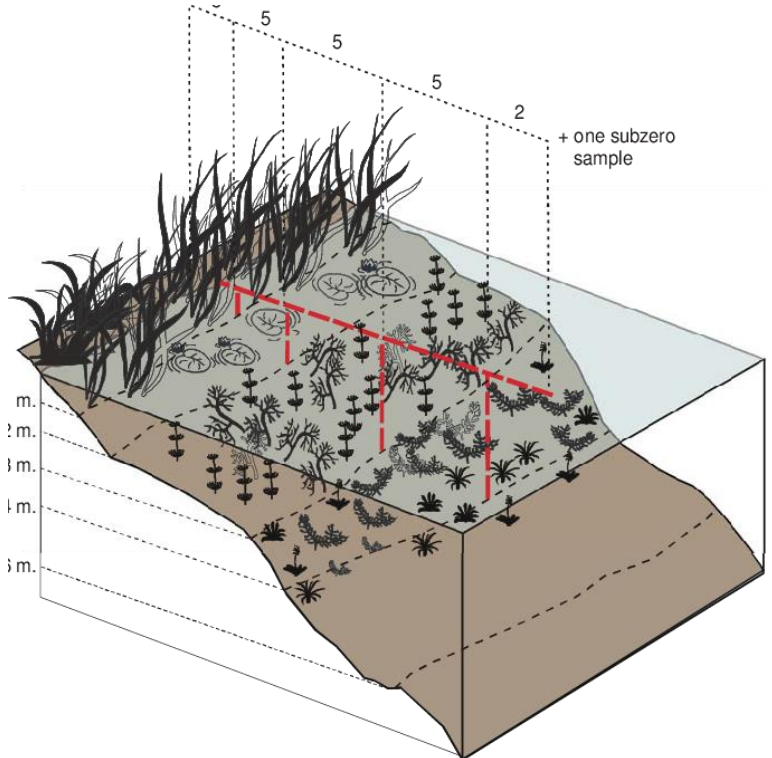




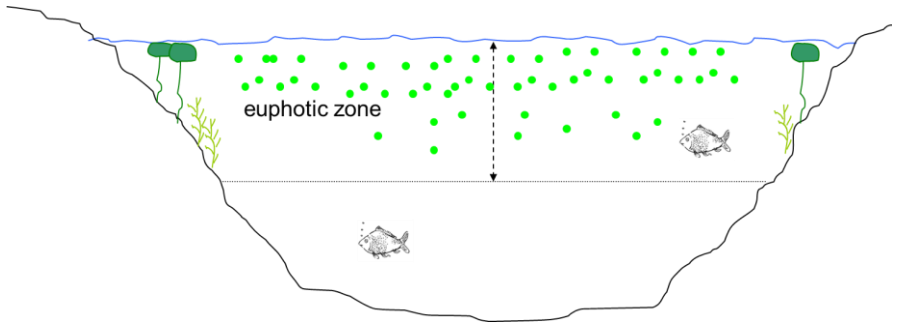
Sampling of aquatic macrophytes (deep lakes)







Sampling of aquatic macrophytes (deep lakes)



Semiquanitative method

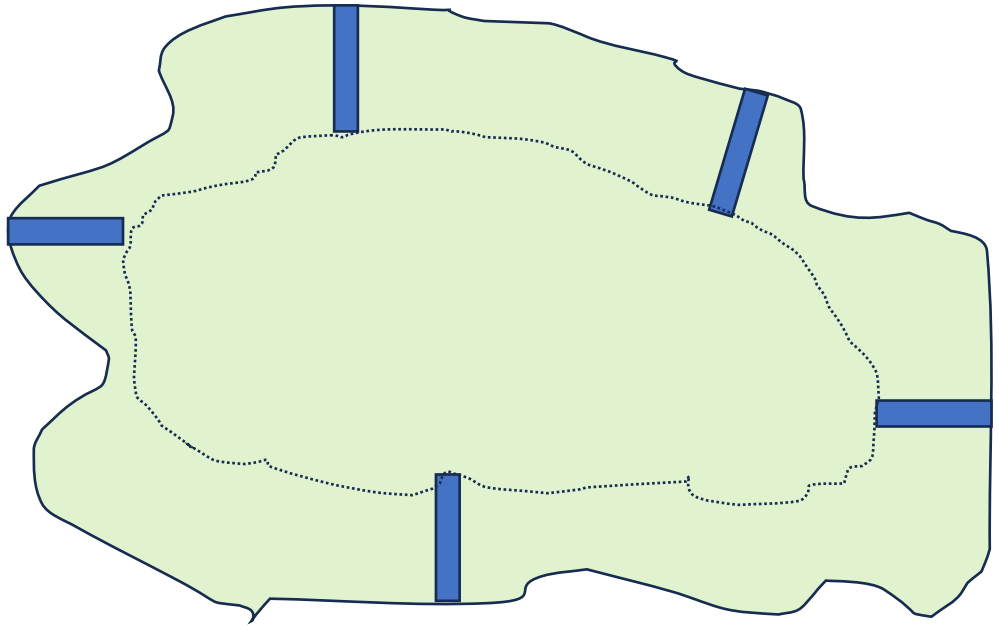
1 = rare (<5 individuals of taxon)

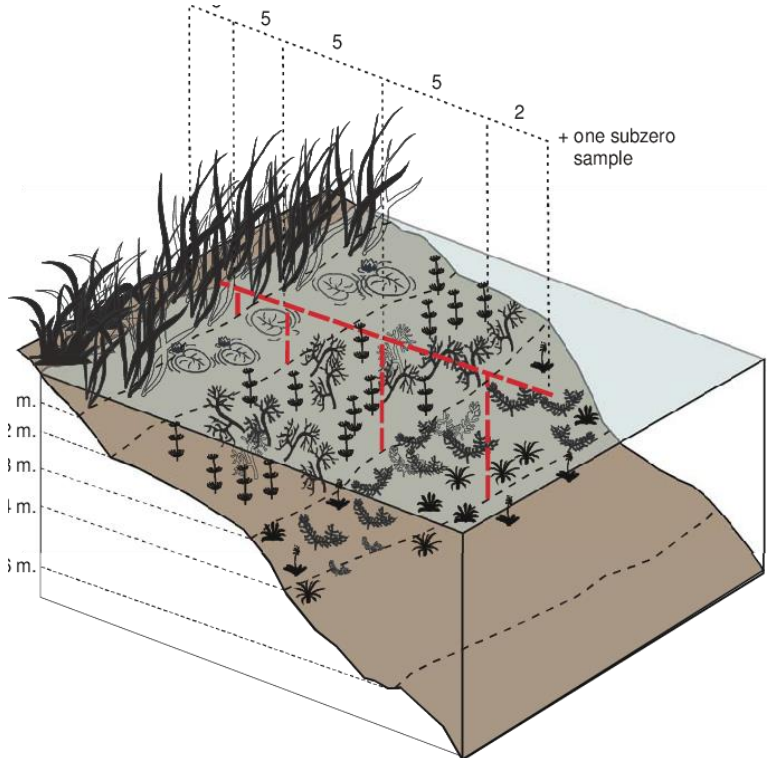
2 = scattered,

3 = common

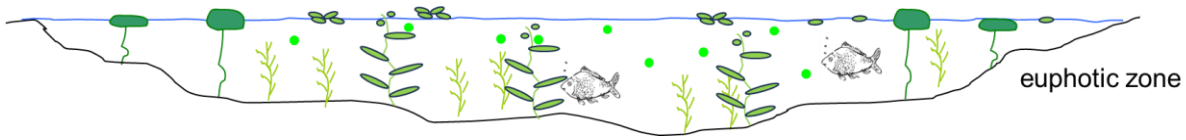
4 = locally dominant,

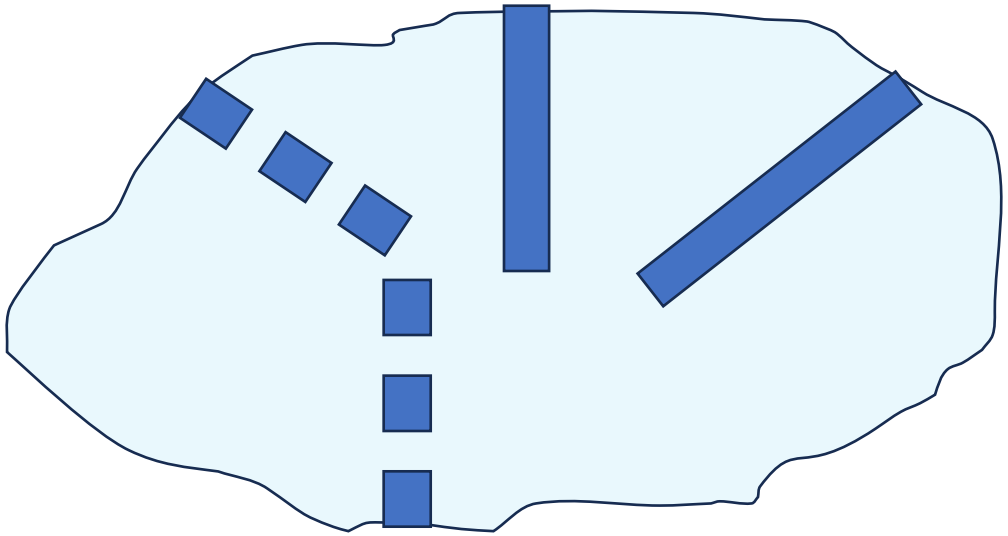
5 = dominant





Sampling of aquatic macrophytes (shallow lakes)





Semiquanitative method

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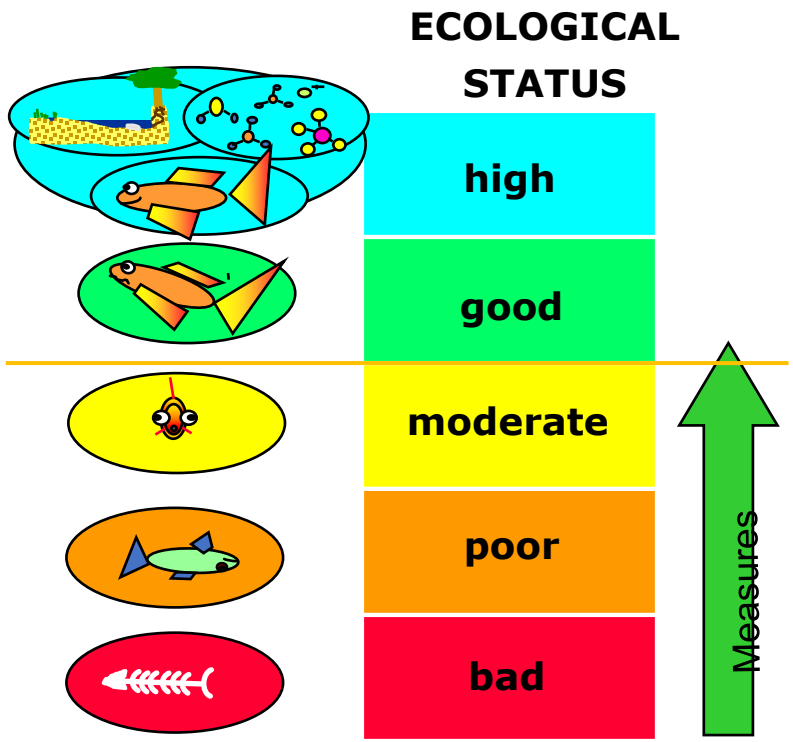
Status assessment of lakes

The use of phytoplankton and **aquatic macrophytes** for status assessment of lakes (EU-WFD)



Choice of quality elements - lakes

Quality elements	Reference	Lakes and resevoirs
Physico-chemical	X	X
Hydromorphological	(X)	(X)
Phytoplankton, chlfa, biovolume, taxon.comp.	X	X
Benthic algae, taxon.comp.	-	-
Macrophytes, taxon comp, abundance	X	X
Zooplankton, biomass, taxon comp.	(X)	(X)
Benthic fauna, taxon.comp.	(X)	(X)
Fish, abundance (CPUE), age structure, taxon. comp.	-	-

In addition

- Cyanotoxins in water and isolated strains
- Phylogeny of cyanobacteria

Trophic index (TIc)

Based on the relationship between sensitive and tolerant species in a lake

$$TIc = \frac{N_S - N_T}{N} \times 100$$

N_S - number of sensitive species in the lake

N_T - number of tolerant species

N - total number of species

Calculate one value for each lake. Can vary between +100, if all species are sensitive, and -100 if all are tolerant

The trophic index requires country-based information about species tolerance, i.e. knowledge about taxonomy, species ecology and distribution in the country.

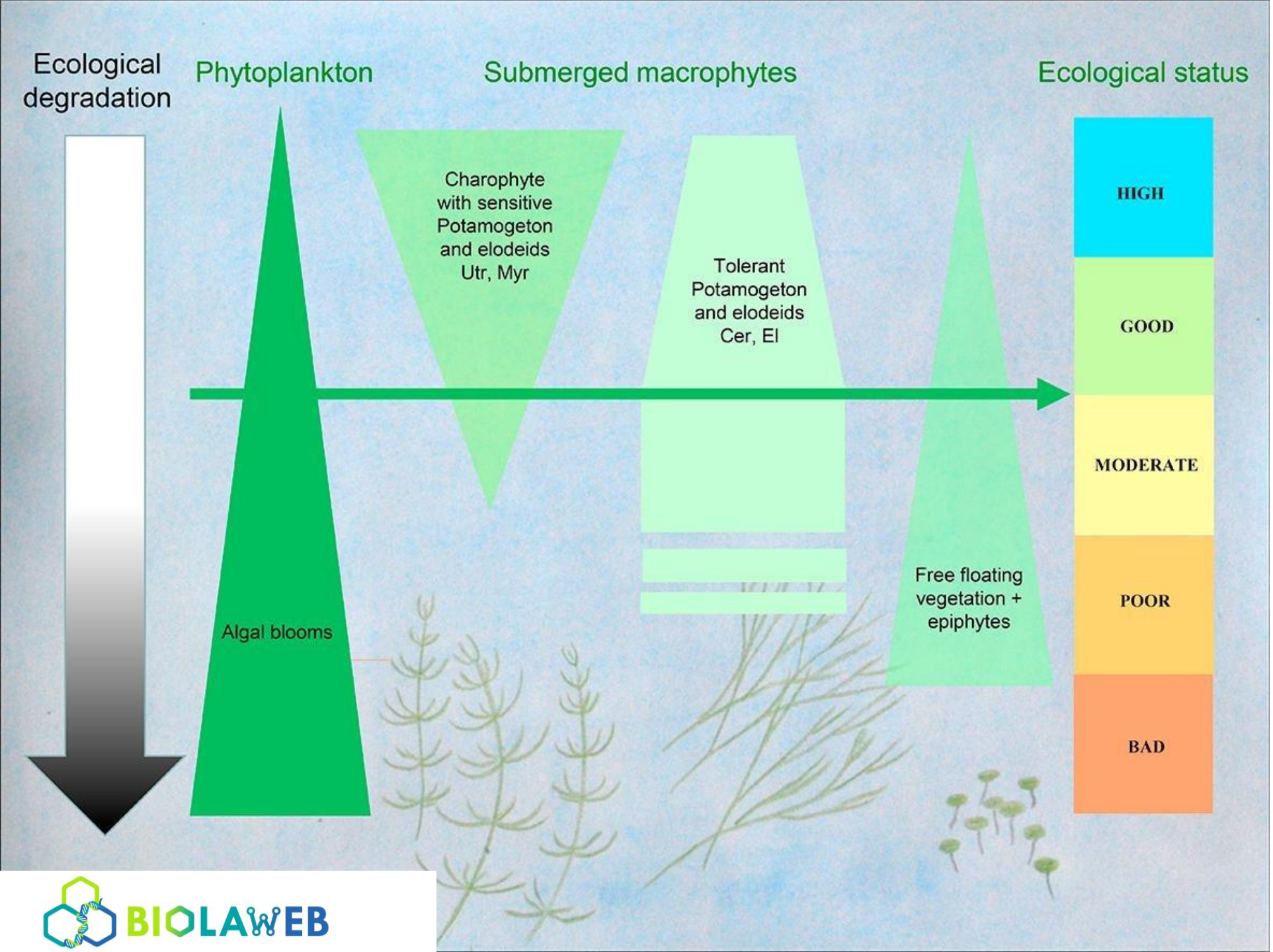
This index is expected to give the most correct status for most of the lakes.

Relative abundance index

Based on the relationship between the two groups:

- Charophytes (submerged species) - sensitive to eutrophication
- Lemnids (free-floating species) - tolerant to eutrophication

The index requires knowledge about species in each of the two groups.



Poikane et al. 2018
Ecological Indicators 94, 187-195

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Investigated lakes

Plava Banja

Pečena Slatina

Sava (Savsko) Lake

Marcovačko Lake

In the BIOLAWEB project we focus on **Charophytes**

Chara cf. *zeylandica*

Nitellopsis obtusa

Tolypella intricata

Nitella gracilis

Charophytes found in Sava lake with classical observations (10)

CHAROPHYTES Species name	BIOLAWEB sampling April	BIOLAWEB sampling July	Prior to BIOLAEWEB
Chara virgata	+		+
Chara contraria	+	+	+
Chara globularis	+	+	+
Chara connivens		+	+
Nitellopsis obtusa		+	+
Nitella gracilis	+*		+
Nitella sp.	+		
Nitella mucronata			+
Nitella flexilis			+
Tolypella intricata		+?	+

Other macrophyte taxa observed: *Myriophyllum spicatum, Elodea nuttallii, Potamogeton c.f. nodosus, Potamogeton pusillus*, Potamogeton pectinatus,Ranunculus trichophyllus, Najas minor, Najas marina, Ceratophyllum demersum,*

Charophytes found in PEČENA SLATINA with classical observations (1)

Species name	BIOLAWEB sampling April	BIOLAWEB sampling July	Prior to BIOLAWEB
Chara canescens			+

Other taxa observed: *Stuckenia pectinata*

Charophytes found in PLAVA BANJA with classical observations (1)

Species name	BIOLAWEB sampling April	BIOLAWEB sampling July	Prior to BIOLAWEB
Chara canescens			+

Other macrophyte taxa observed: *Stuckenia pectinata*

Charophytes found in MARKOVAČKO LAKE with classical observations (1)

Species name	BIOLAWEB sampling April	BIOLAWEB sampling July	Prior to BIOLAWEB
Chara vulgaris		+	

Other taxa observed: *Myriophyllum spicatum, Potamogeton trichoides, Stuckenia pectinata,Lemna minor, Ceratophyllum demersum, Elodea nuttallii, Green algae* +

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Thank you for your attention

Acknowledgement

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