



Shifts in community composition and abiotic conditions in an effluent receiving artificial wetland

The waterharmonica-experiment

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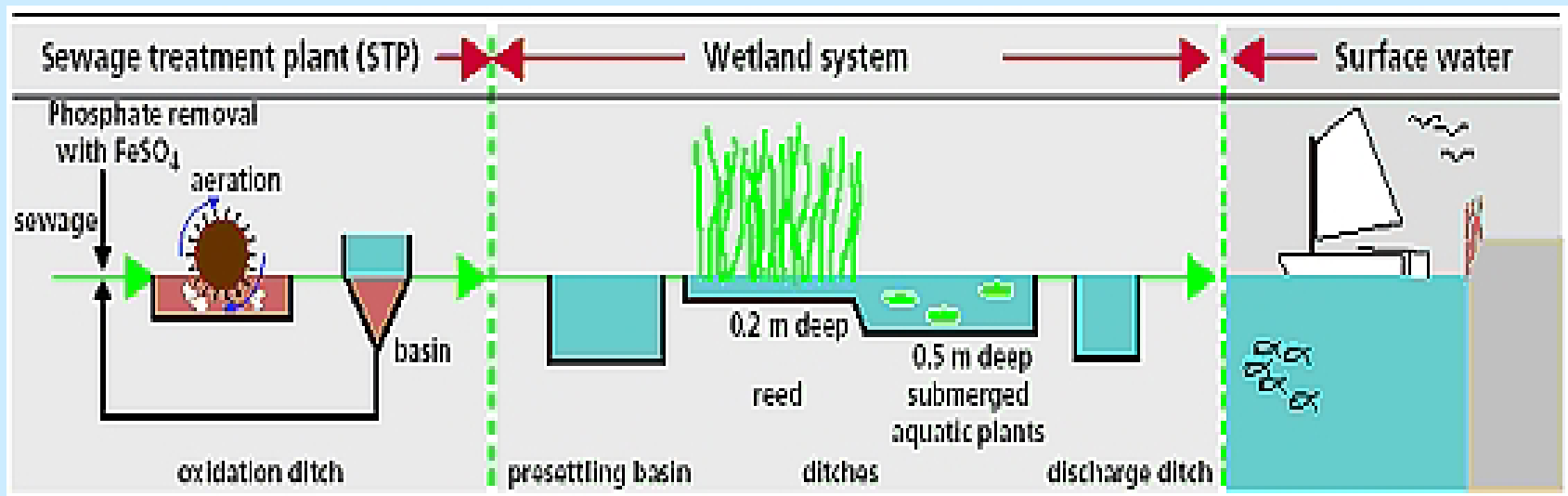
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 - Changes abiotic factors
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 - Changes Macrofauna
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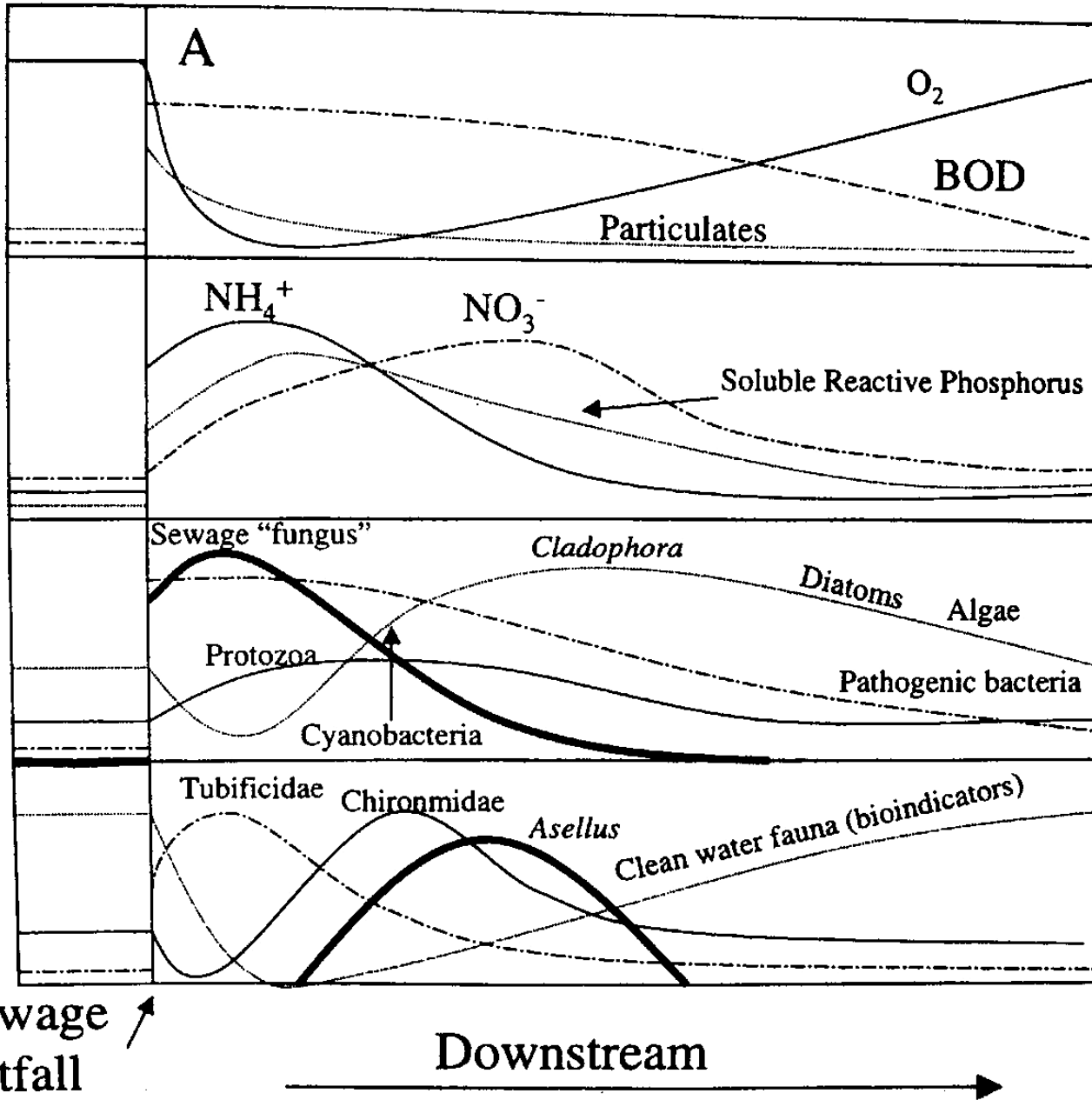


Introduction

'Waterharmonica' concept

- Run-off water from domestic wastewater treatment plants is eutrophic water which is low on oxygen
- Lead the water through different (biological) systems to reduce nutrients and increase oxygen





Commonly accepted model from Hynes, 1960

Question

- Does the artificial wetland receiving effluent show the same dynamics as the model of Hynes?

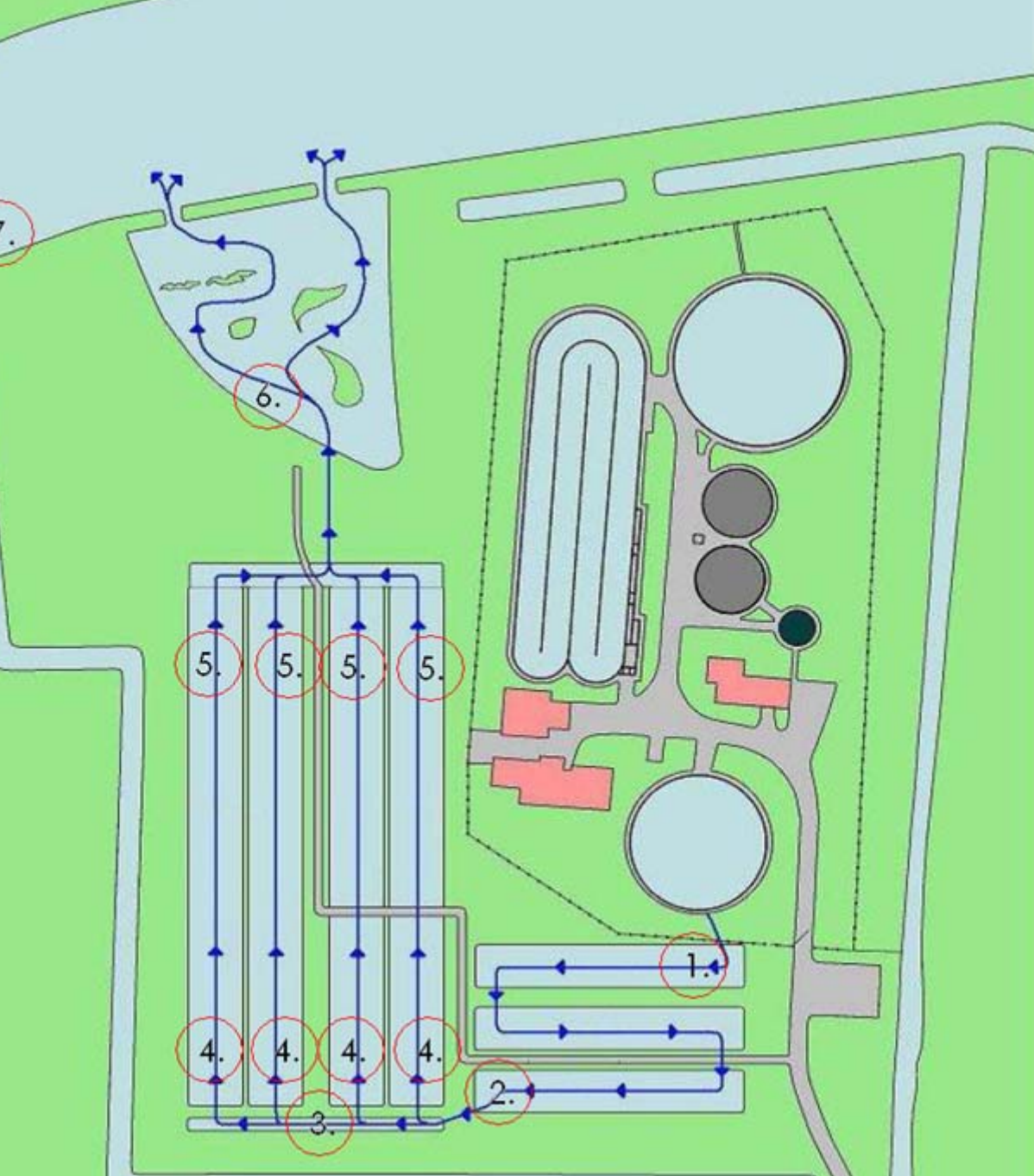
Hypothesis

Expected changes alongside the gradient:

- Change of composition of periphyton and macrofauna
- Increase of biodiversity
- Increase of bioindicator species
- Increase of oxygen level
- Decrease of phosphate
- Decrease of nitrogen

Materials and Method





Sample Sites:

1. Start *Daphnia*-pond
2. End *Daphnia*-pond
3. Division Ditch
4. Start Reed Ditches
5. End Reed Ditches
6. Spawning Pond
7. Flowing Surface Water

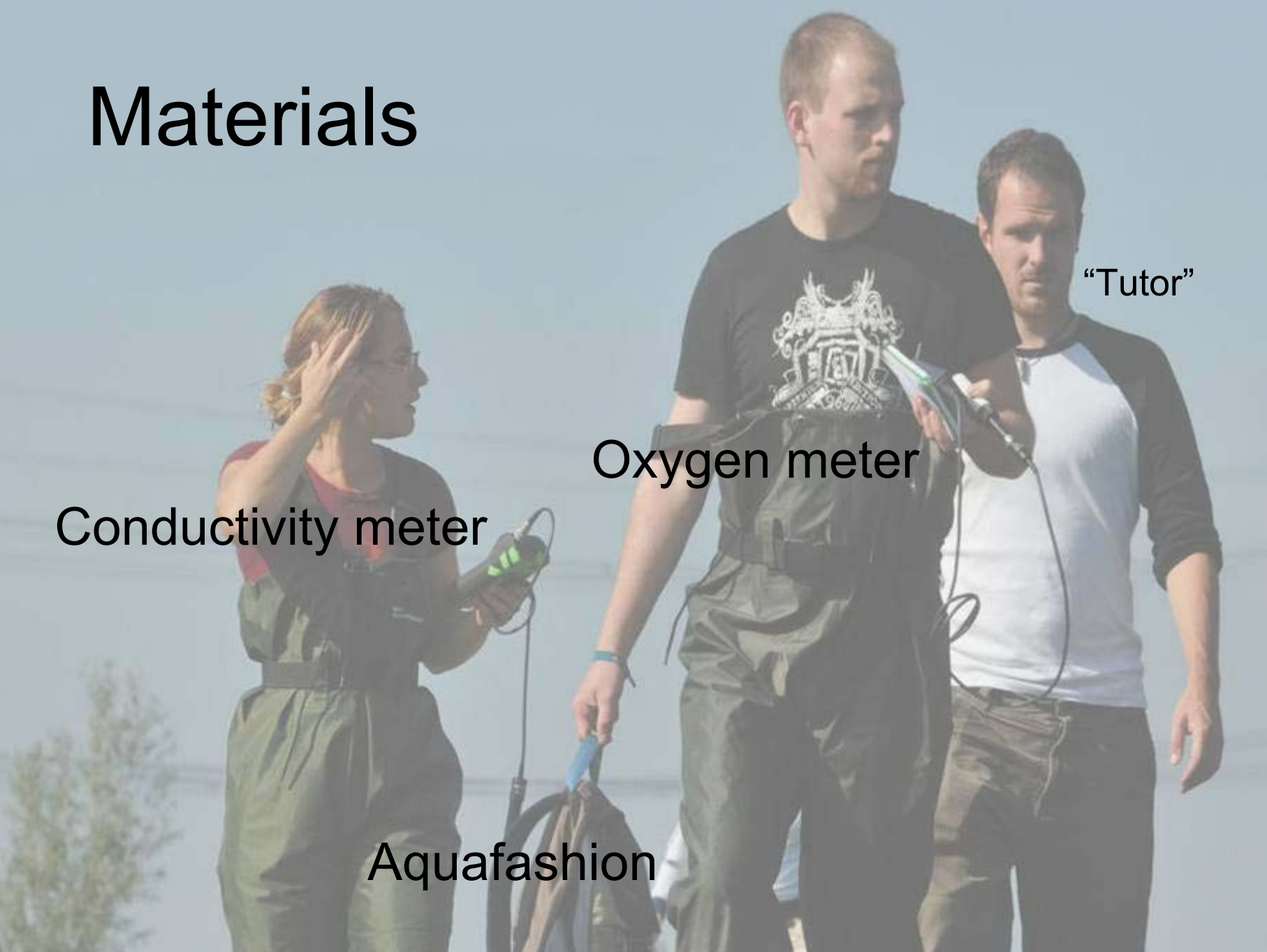
Materials

“Tutor”

Oxygen meter

Conductivity meter

Aquafashion



Macrofauna collection method:



Water Sweepnetting

Periphyton collection method

No standardized method

Substrate:

-reed

-mud

-submerged
terrestrial plants

Knife or toothbrush to
sample periphyton



Determined to sort out the species



Calculation of indices

Shannon diversity index = $\Sigma p_i \ln(p_i)$:

- Takes Evenness into account

Margalef diversity index = $(S-1)/\ln(N)$:

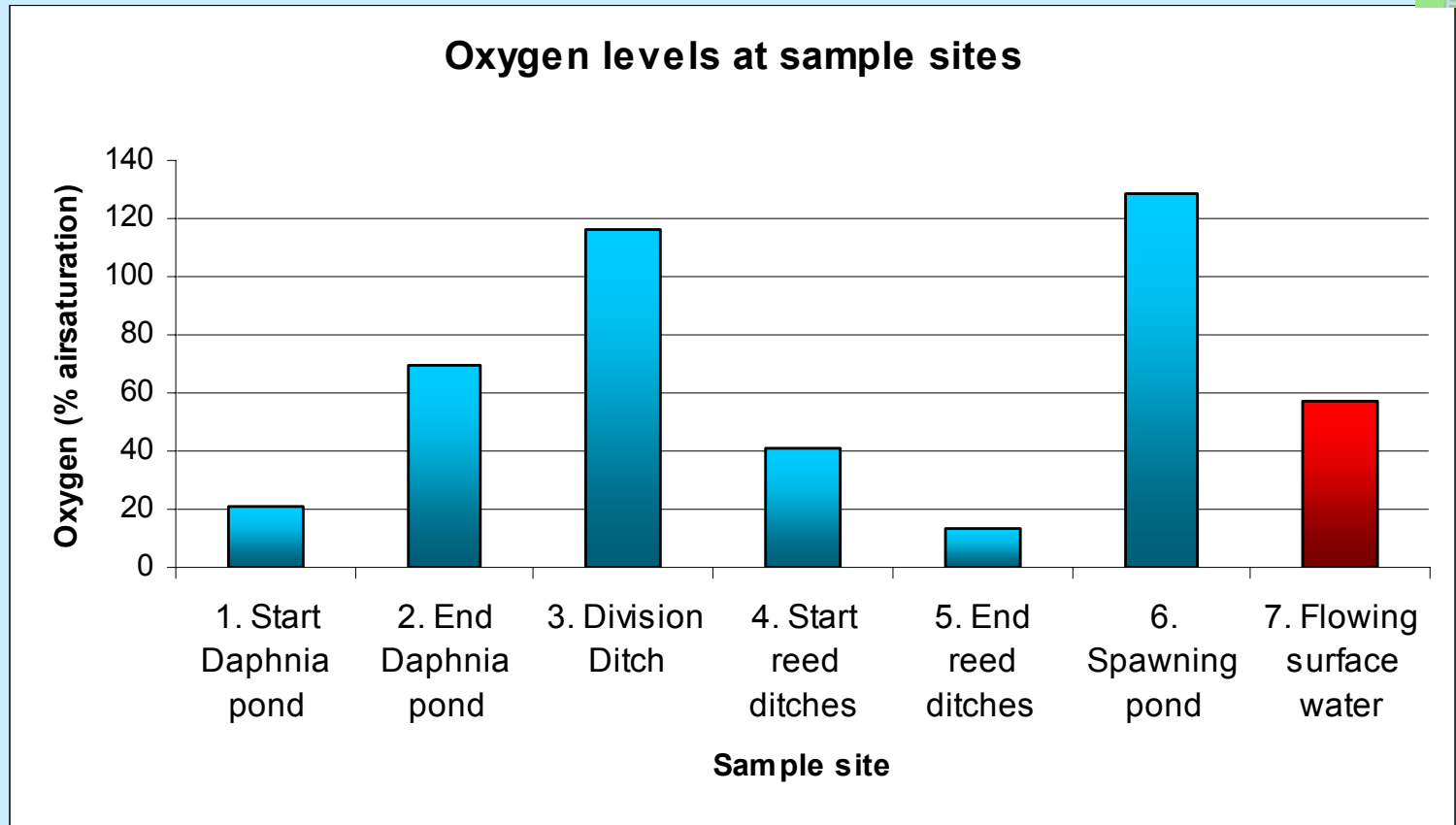
- Does not take Evenness into account

Generic Diatom Index

- Each Diatom Genus has it's own Sensitivity and Value
- After calculation with these values you get a final value between 1 (pollutant) and 5 (clean).

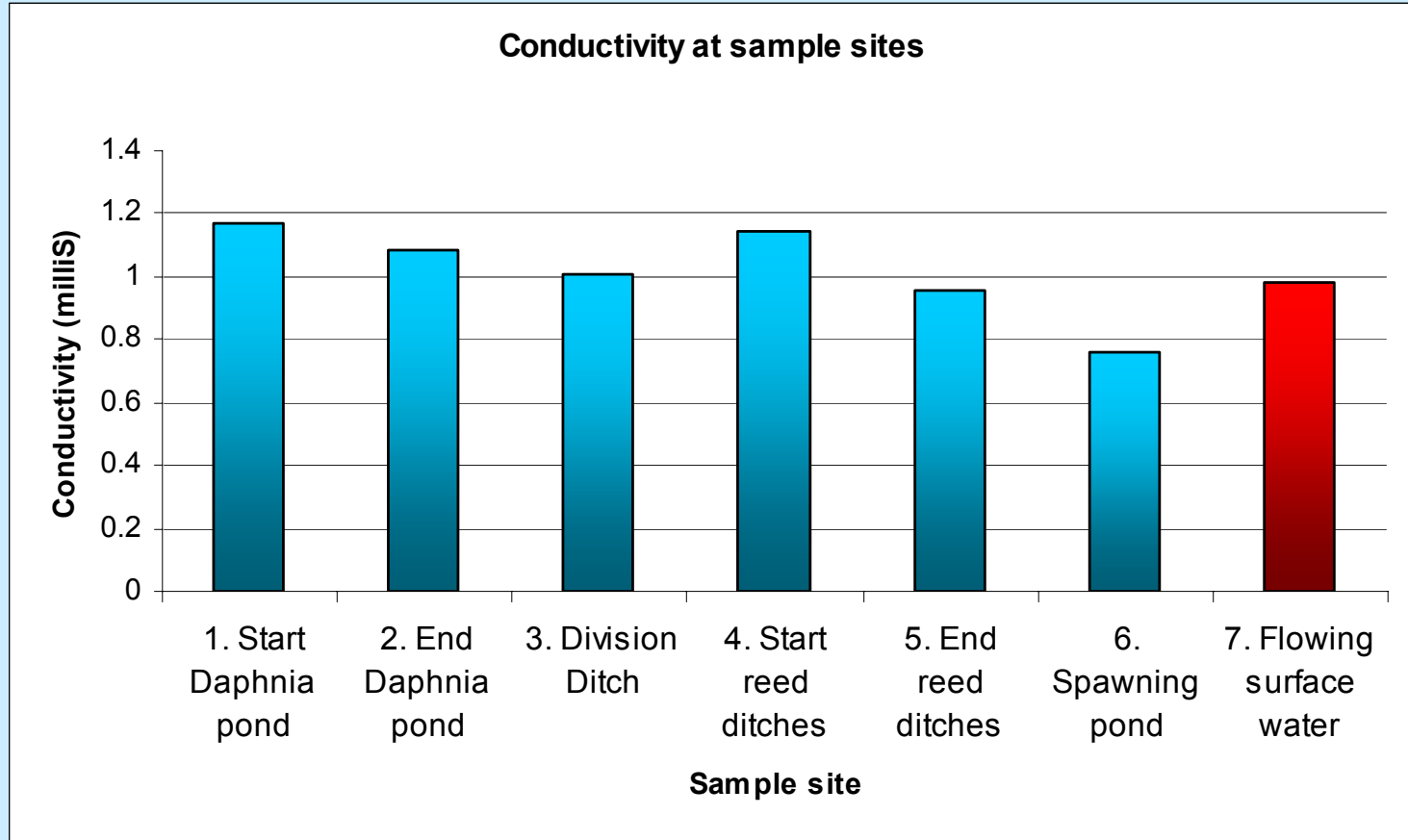
Results

Abiotic



General increase in oxygen level, with exception of sample sites 4 & 6.

Abiotic

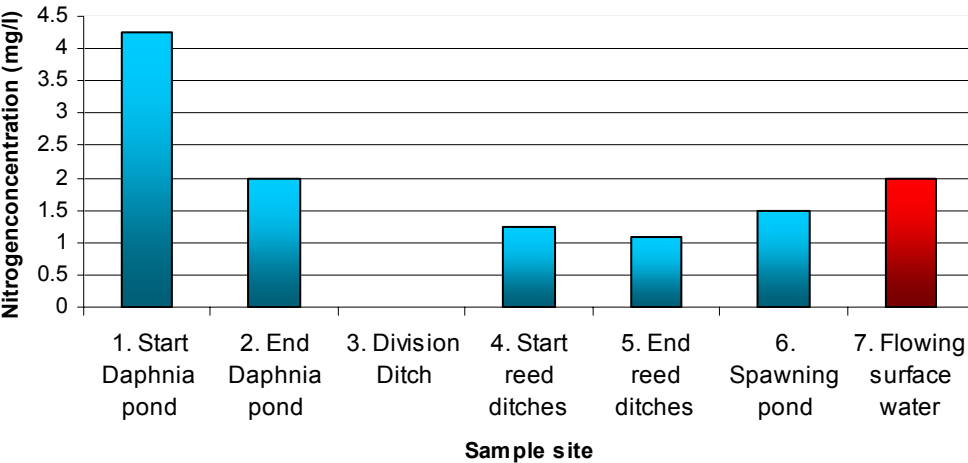


General decrease in conductivity.

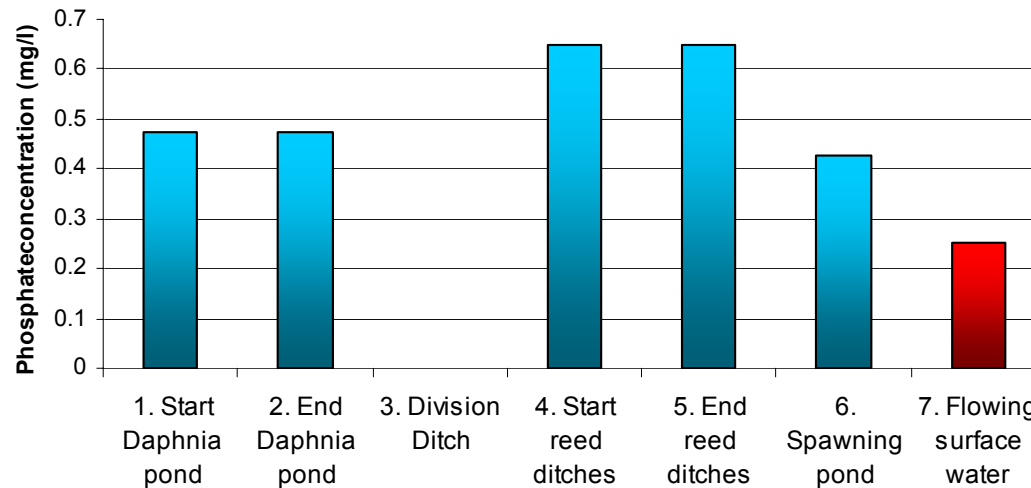
Abiotic



Nitrogenlevel at sample site



Phosphate at sample site



van der Burgh, L. 2008 *Van effluent naar een 'natuurlijk' oppervlaktewater*

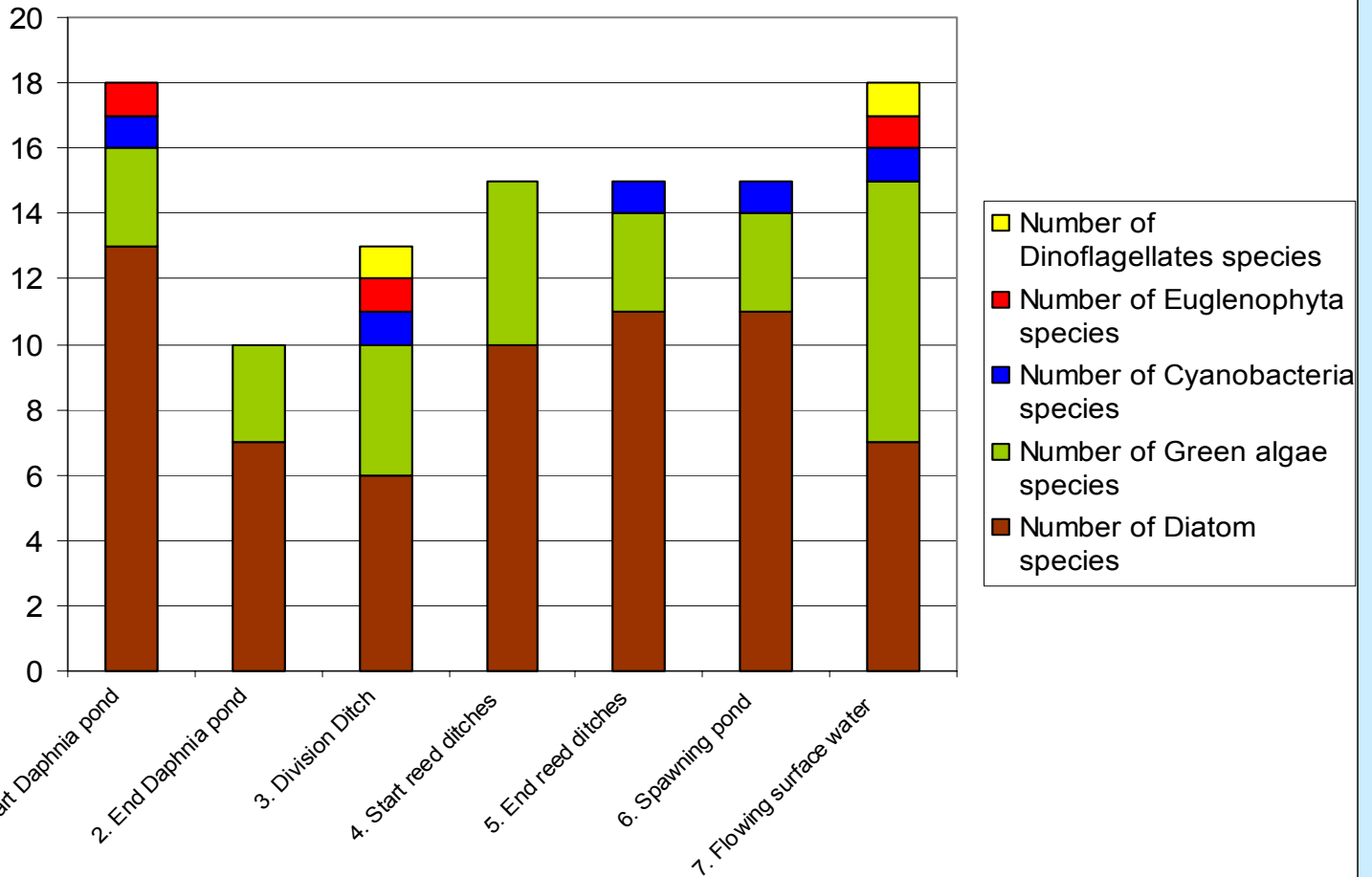
General decrease in nitrogen and fluctuating phosphate levels.

van der Burgh, L. 2008 *Van effluent naar een* Sample site

Periphyton



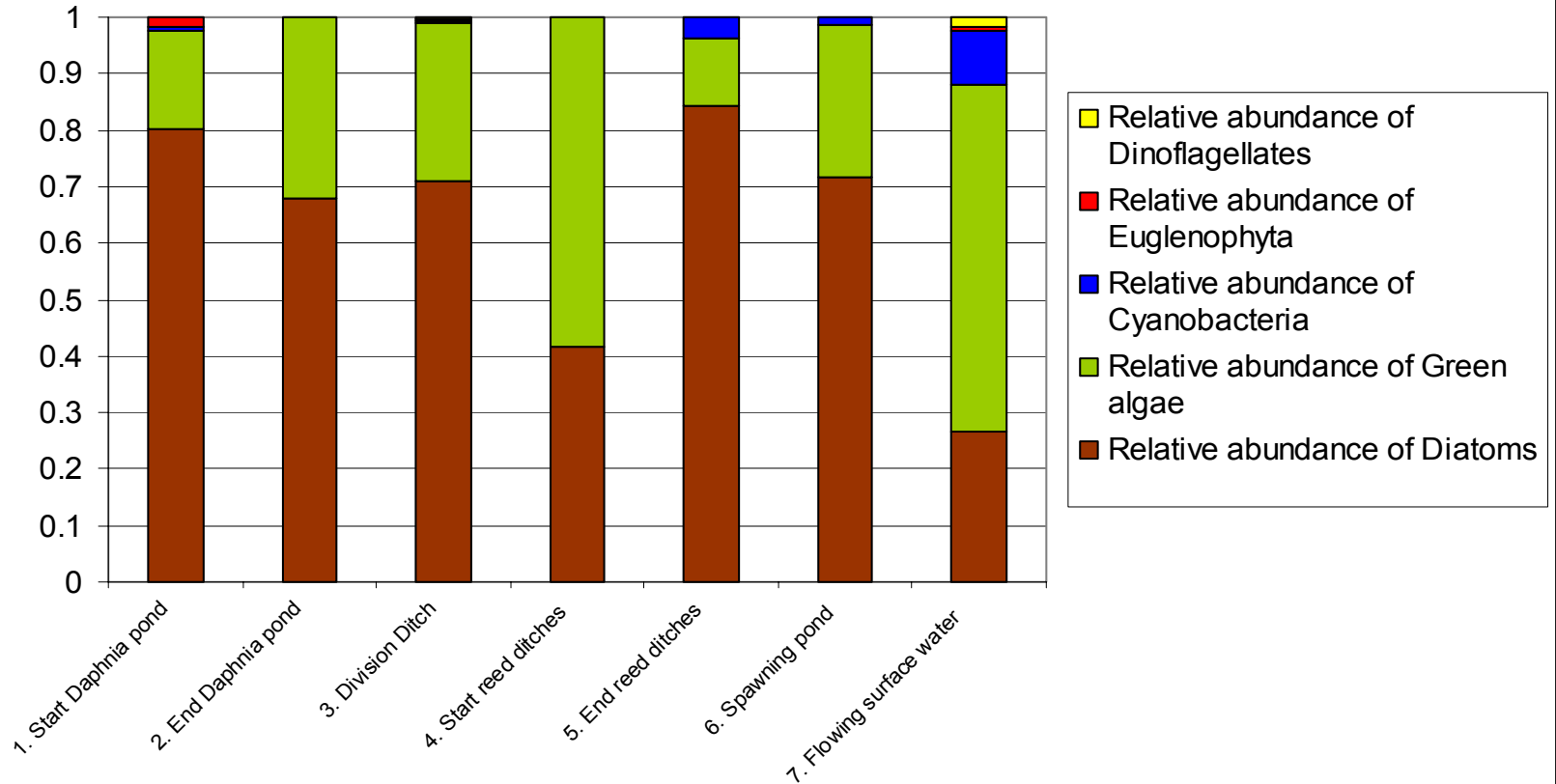
Number of Periphyton species at each sample site



Periphyton



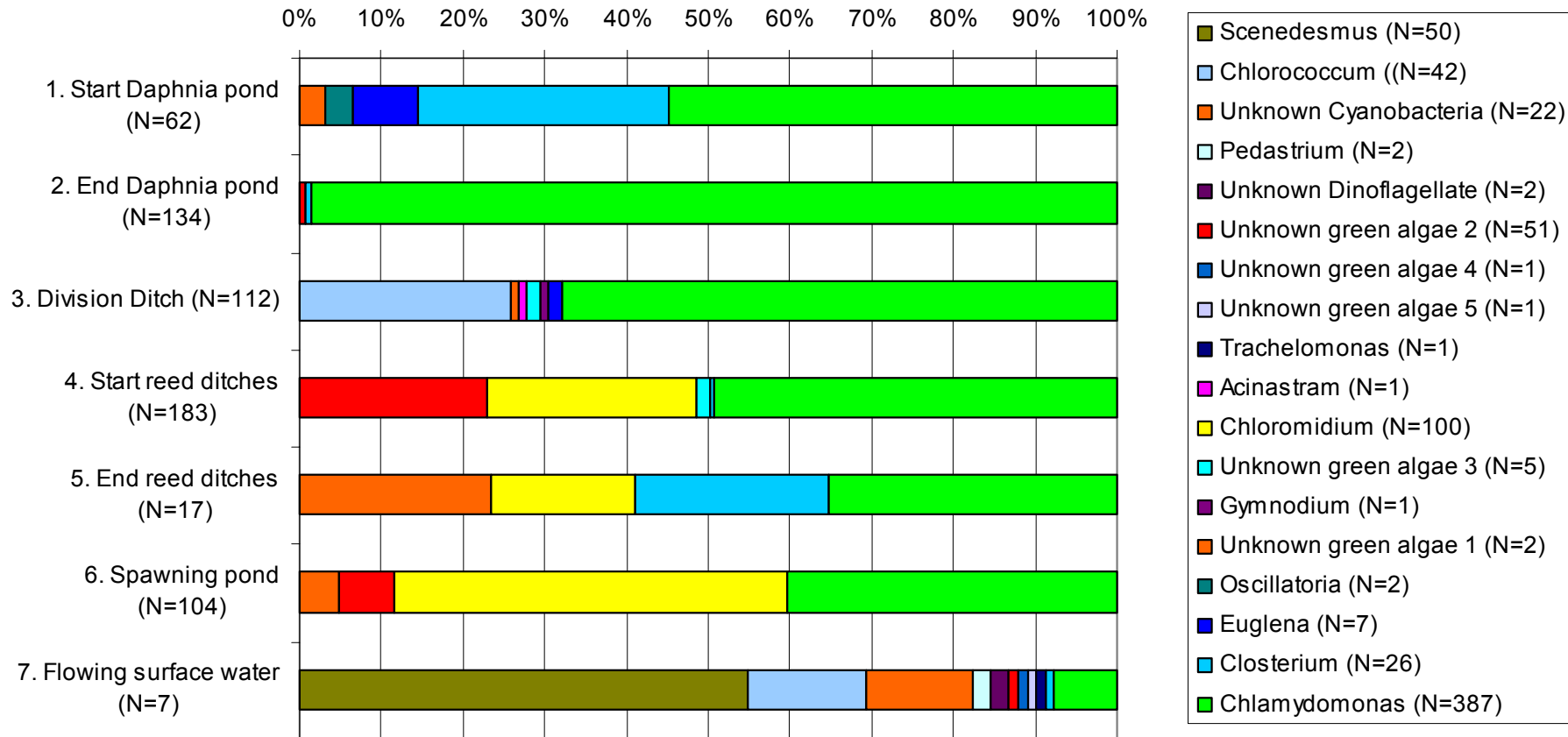
Relative abundance of Periphyton species at each sample site



Periphyton



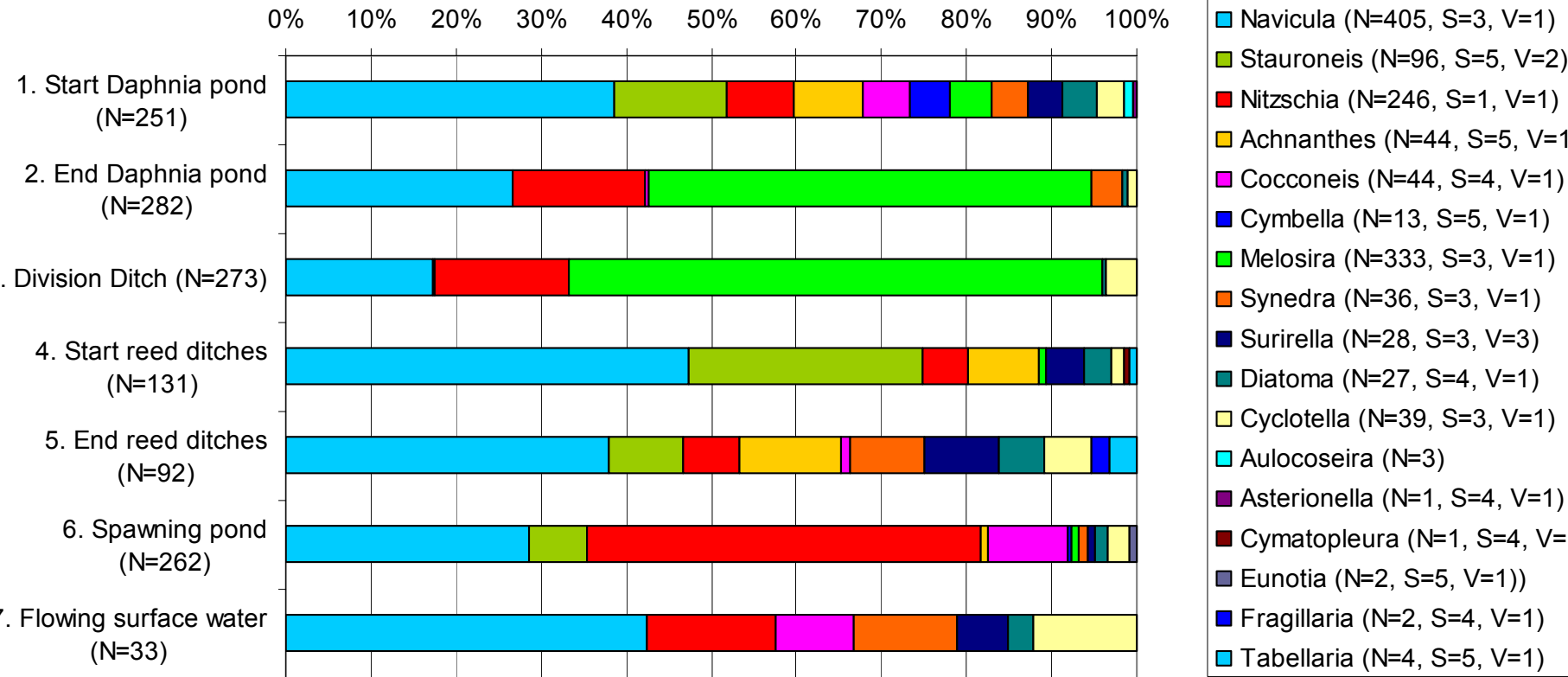
Relative distribution of Green algae, Cyanobacteria, Euglenophyta and Dinoflagellates at each sample site



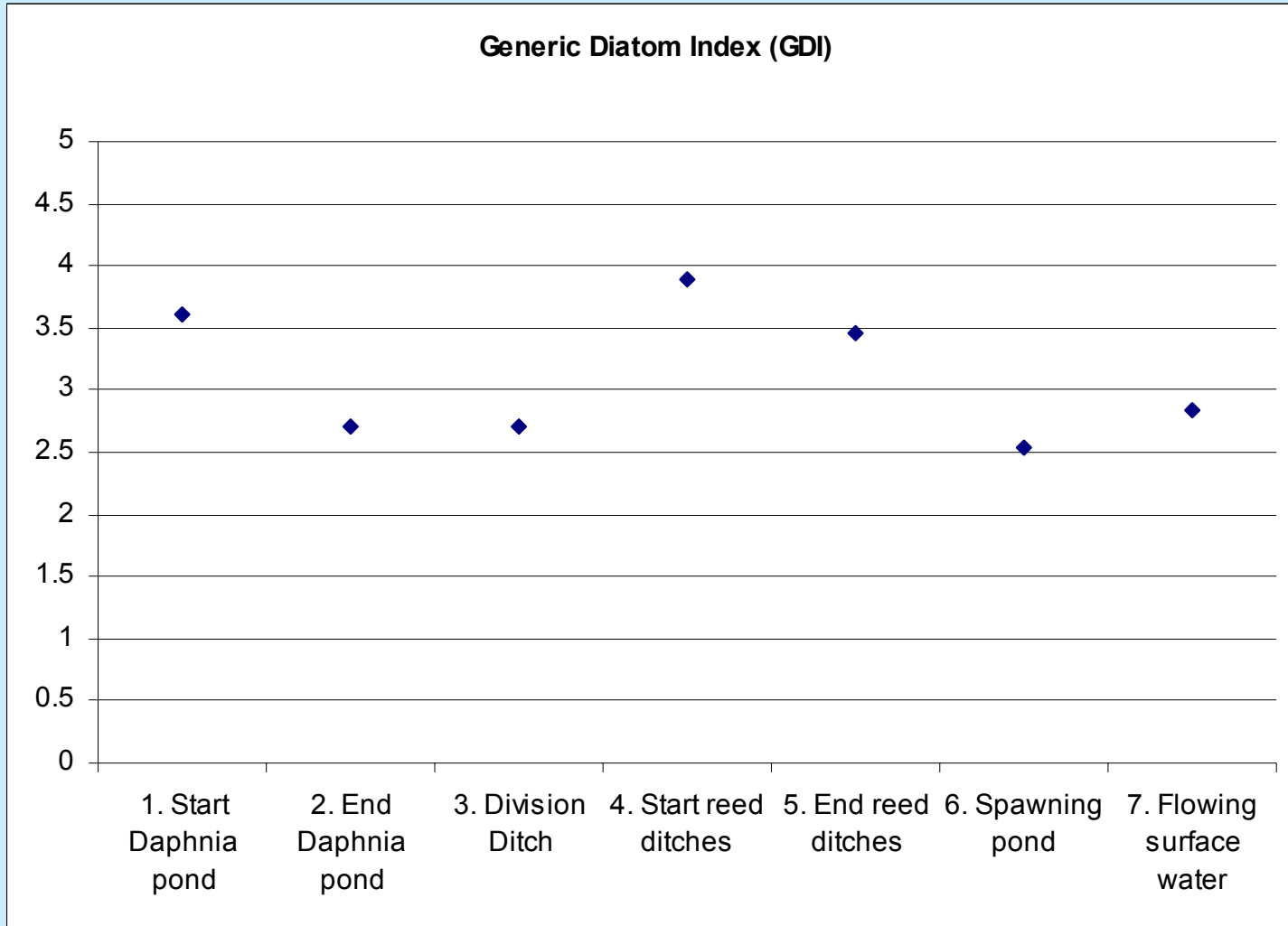
Periphyton



Relative distribution of Diatom species at each sample site



Periphyton

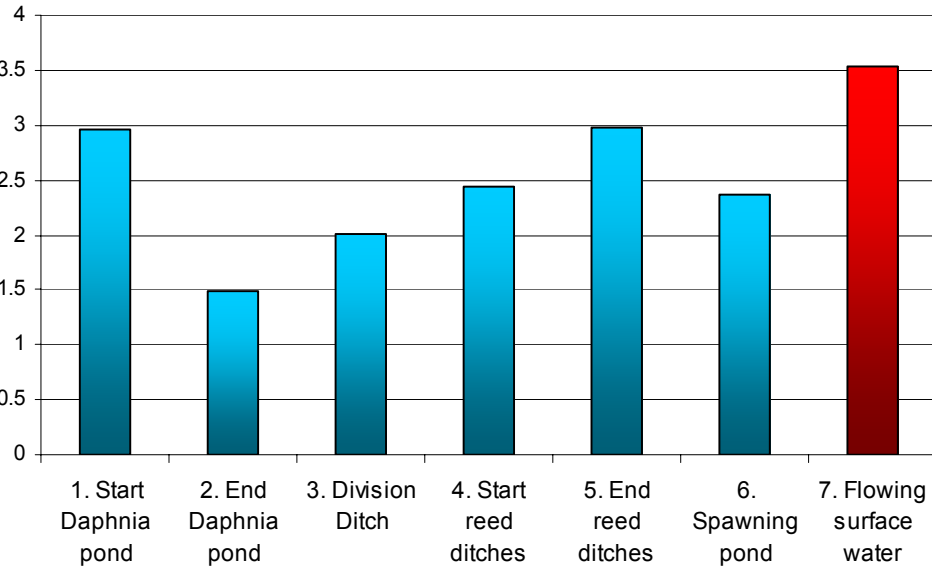


No trend, but high GDI values

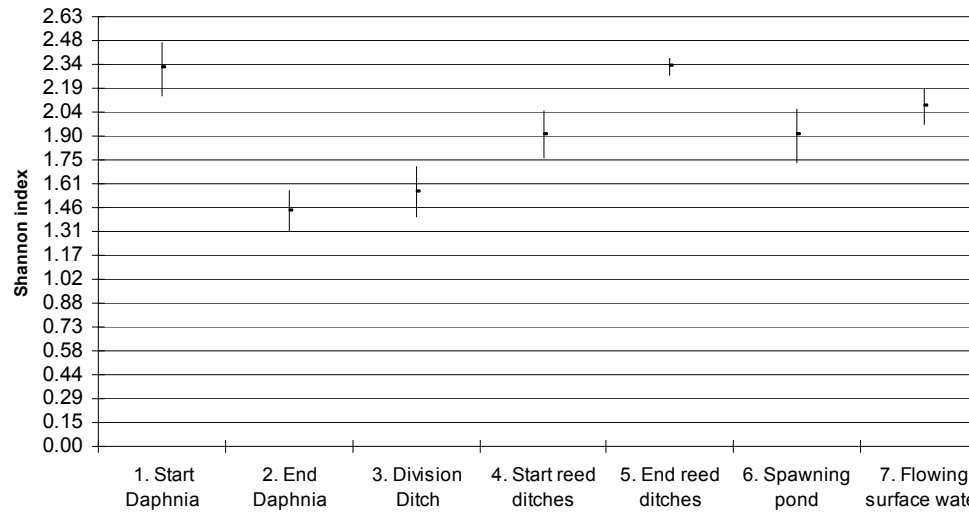
Periphyton



Biodiversity index of Periphyton (Margalef)



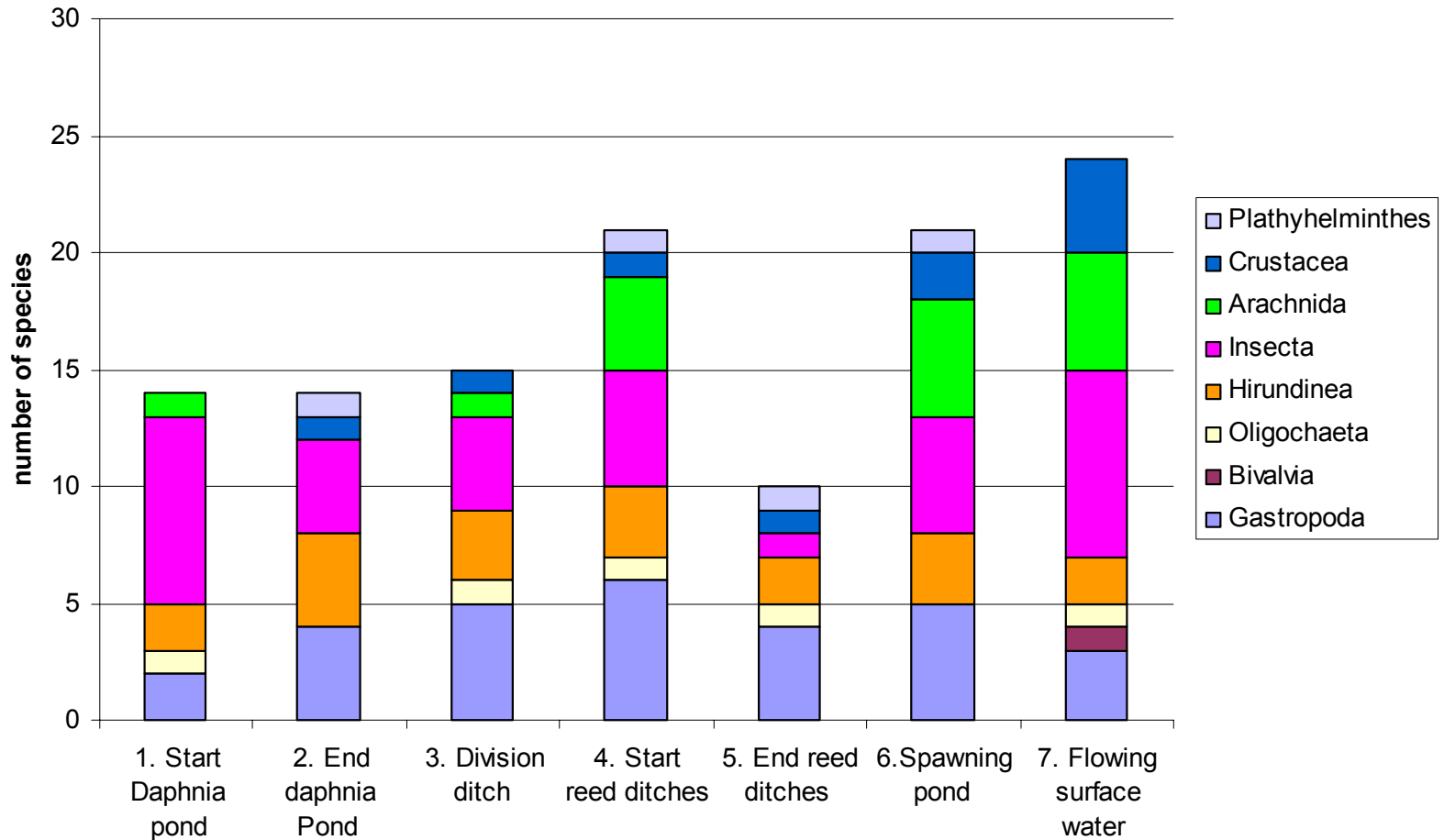
Biodiversity index of Periphyton (Shannon)



Macrofauna



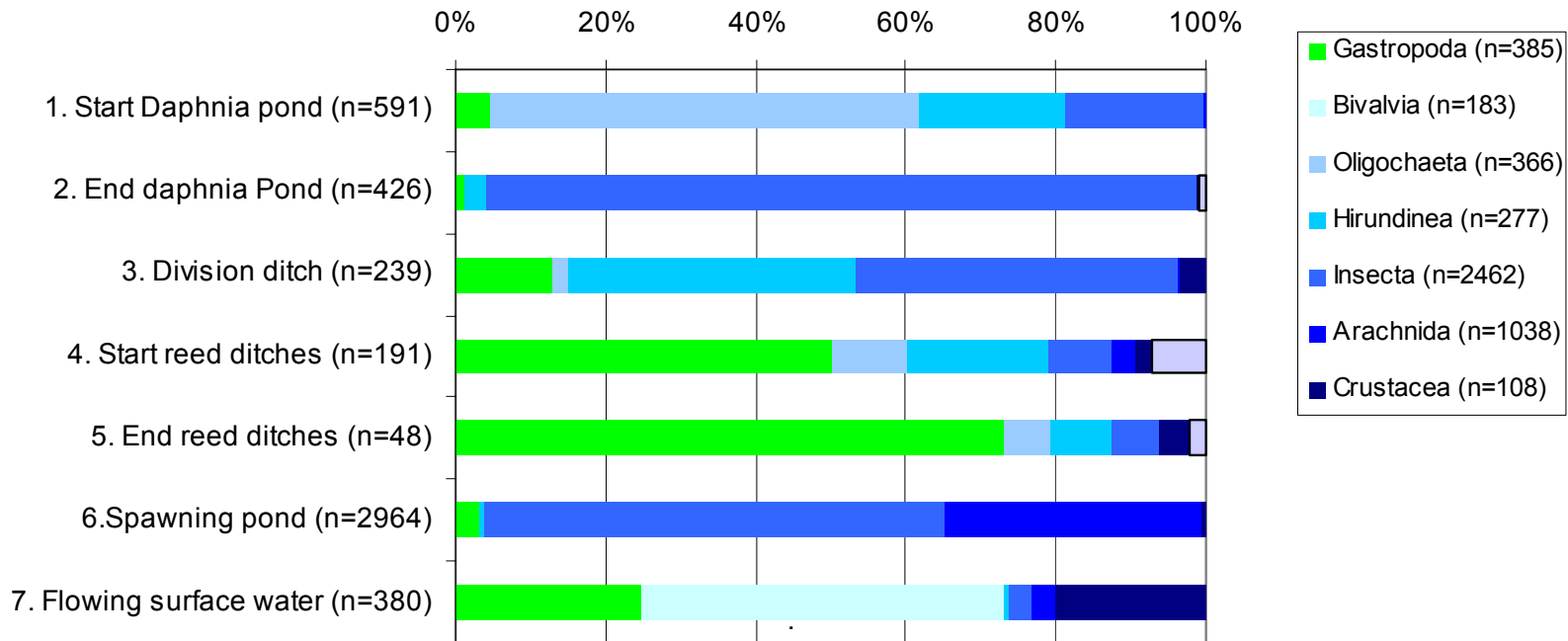
Number of Macrofauna species at each sample site



Macrofauna



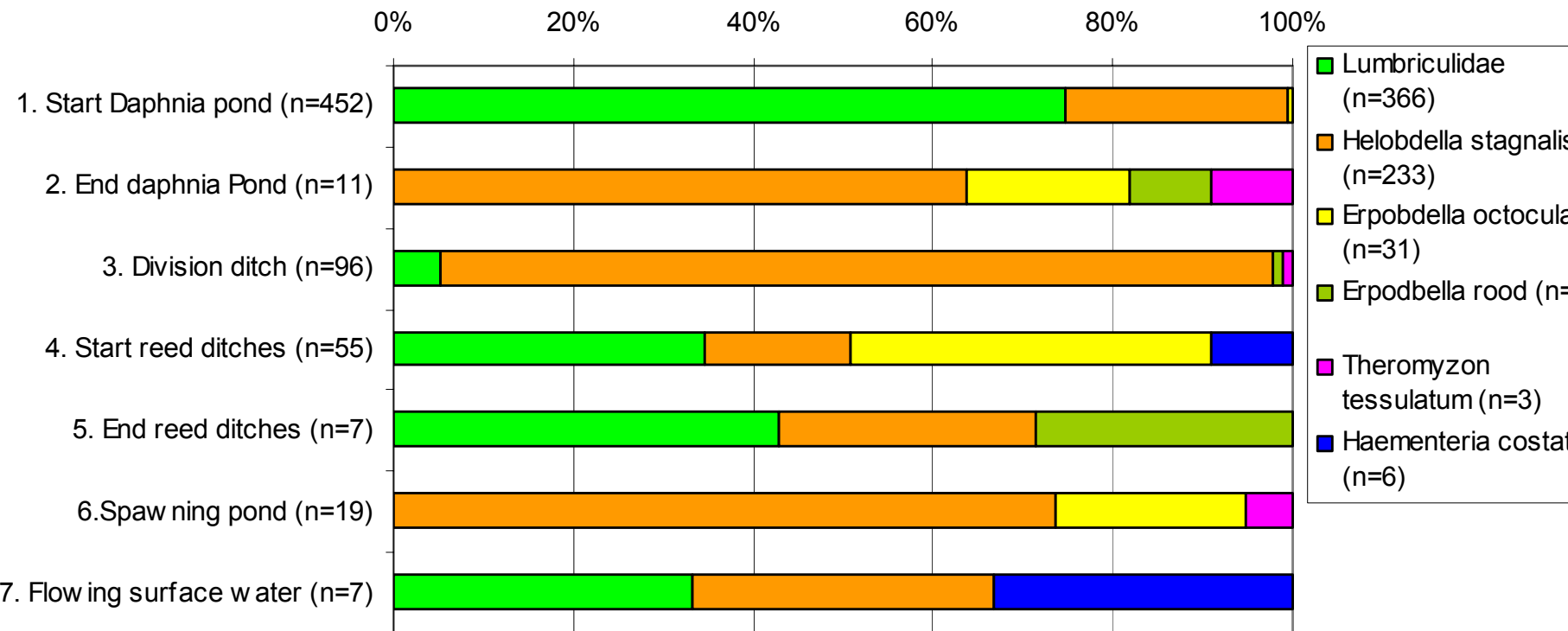
Relative occurrence of the macrofauna orders at each sample site



Macrofauna



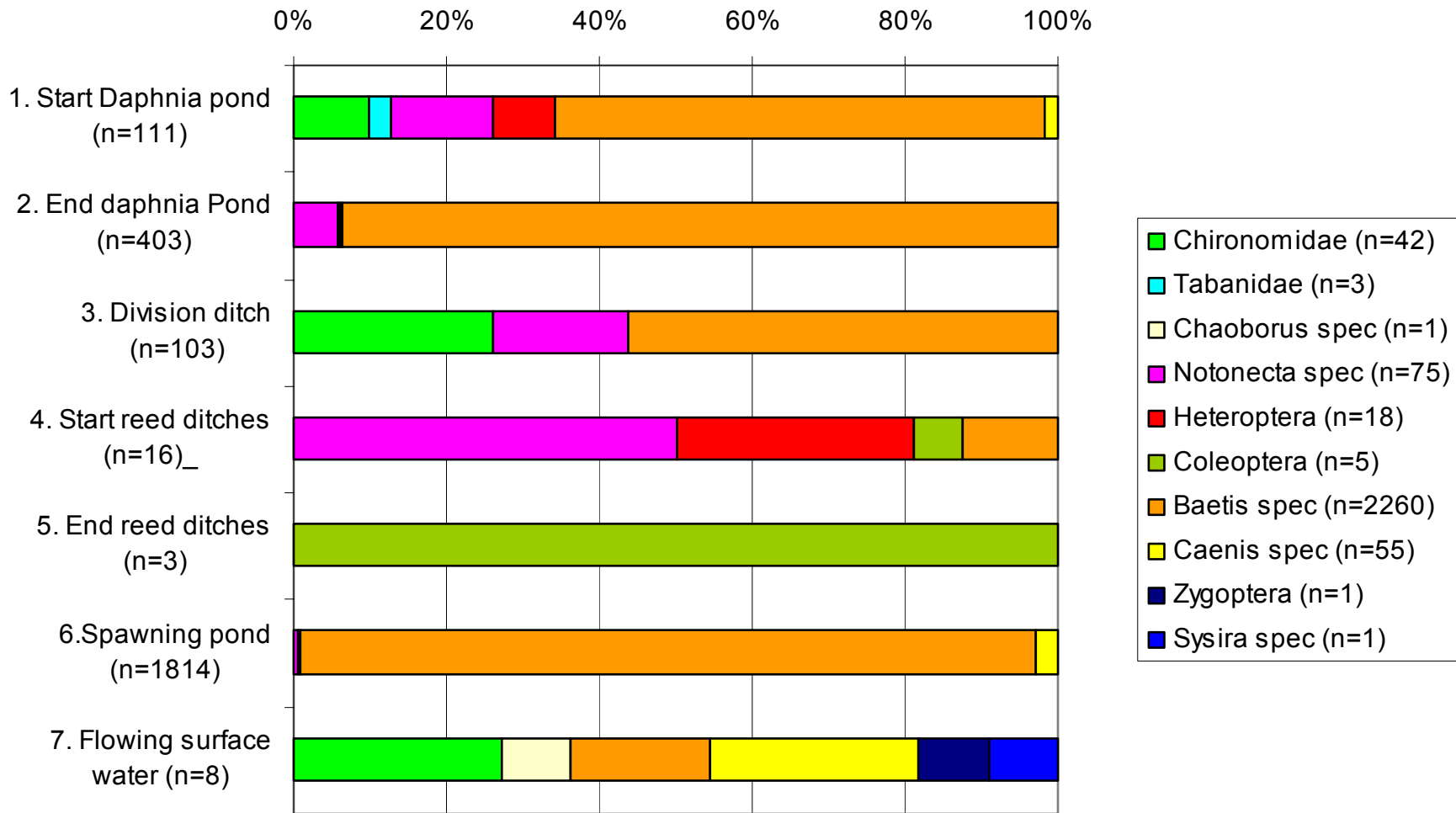
Relative occurrence of the Annelida at each sample sites



Macrofauna



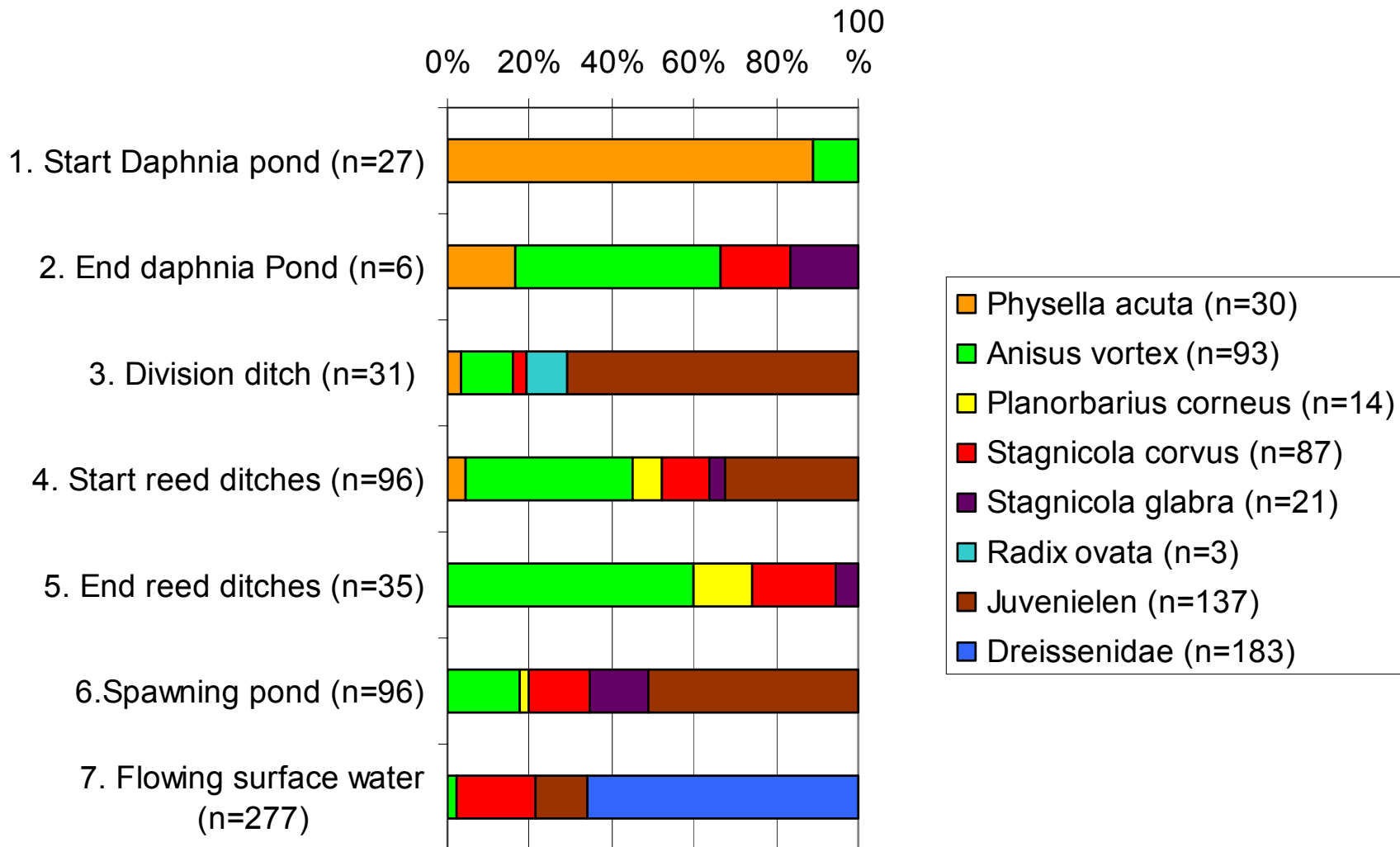
Relative occurrence of the Insecta at each sample site



Macrofauna



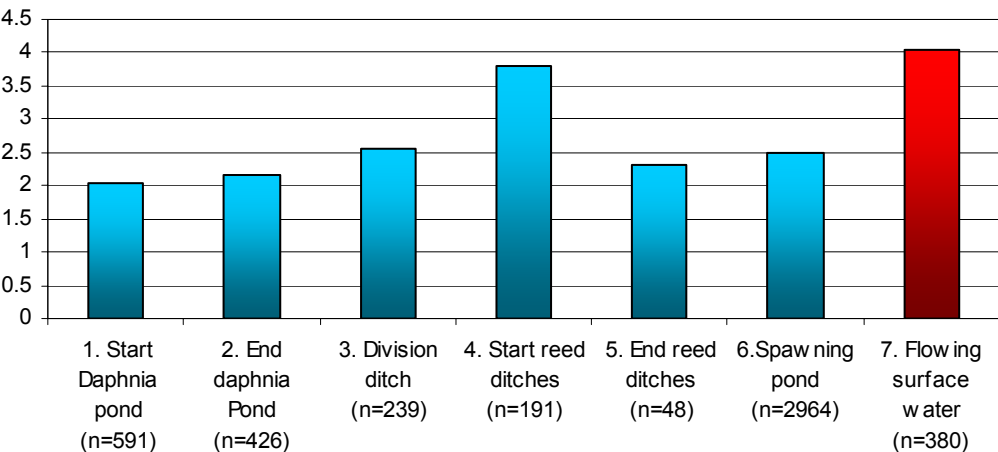
Composition of the Mollusca at the sample sites



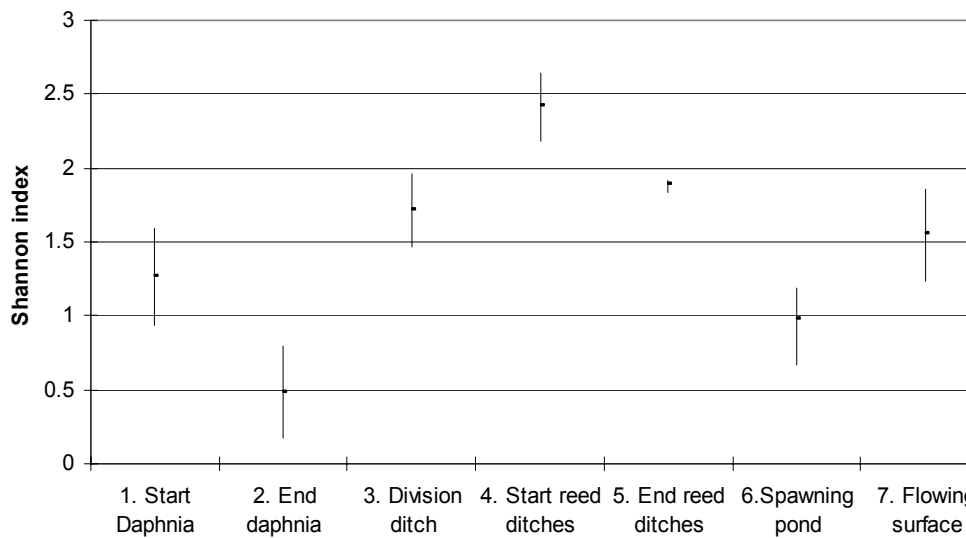
Macrofauna



Biodiversity of macrofauna at each sample site (Margalef)



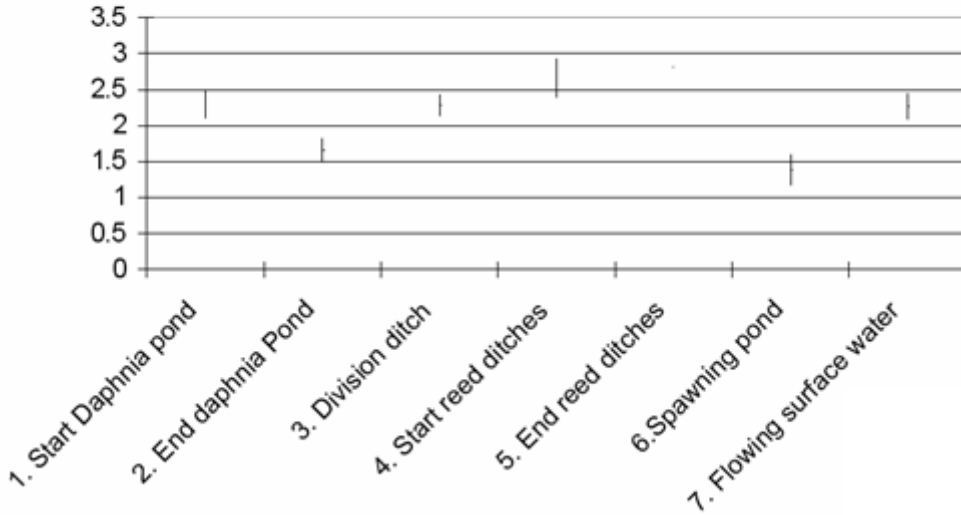
Biodiversity of macrofauna (Shannon)



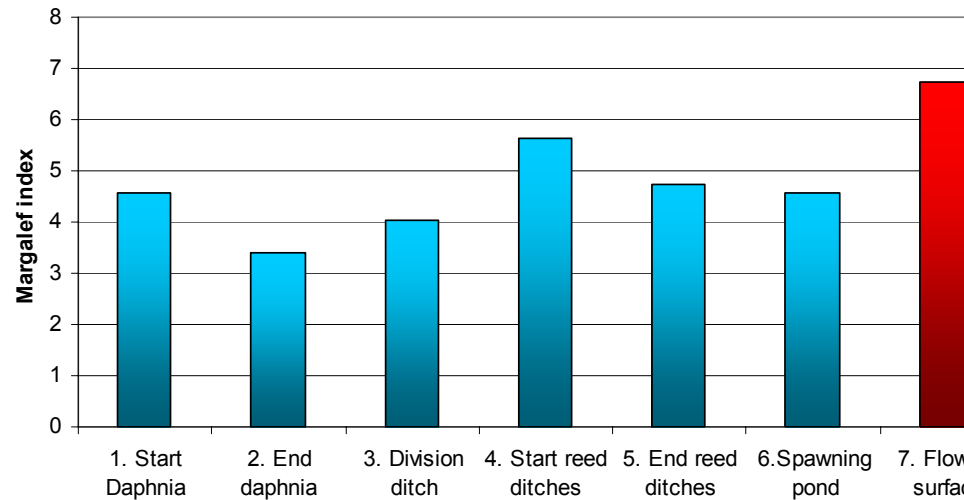
Periphyton and Macrofauna



Biodiversity of macrofauna and periphyton at each sample site (Shannon)

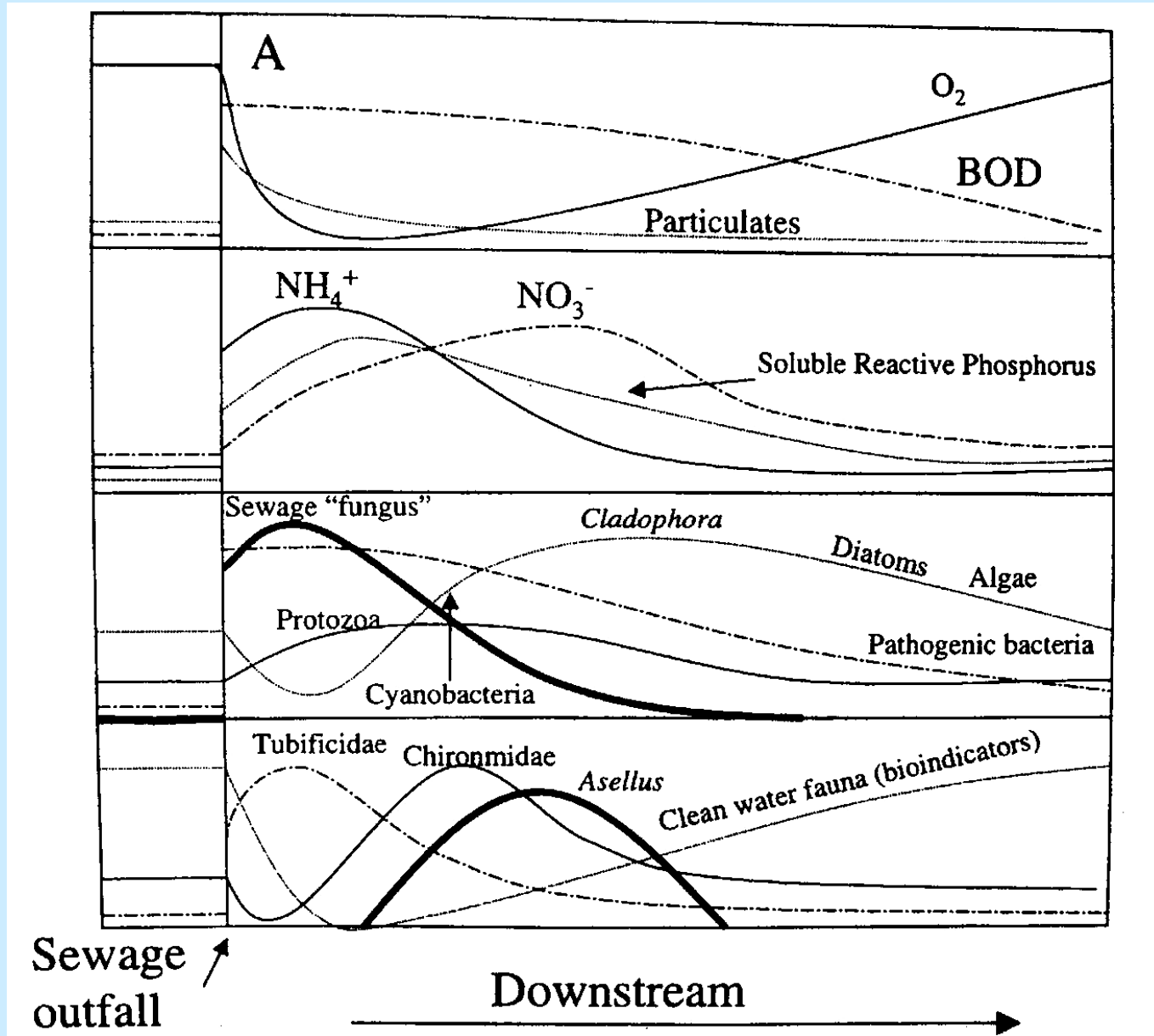


Biodiversity of macrofauna and periphyton at each sample site (Margalef)



Discussion

Comparison to Hynes' model



Biodiversity

- Shifts in biodiversity, depending on habitat and conditions
- Prenta & Gallardo-Mayenco (1996) found that diversity increased away from pollution source (stagnant vs. river)
- Artificial system?

Prenta & Gallardo-Mayenco: Self-purification, temporal variability and the macroinvertebrate community in small lowland Mediterranean streams receiving crude domestic sewage effluents, *Archiv fur Hydrobiologie*, 136 (2), pp. 159-170, 1996

Species shift

- High diatom richness found in location 1
Kelly (1998) also found high nutrient concentration → diatom richness
- Less green algae found
- Kelly (1998-2): Oxygen regime key factor in influencing distribution of macrofauna

M.G. Kelly: Use of the trophic diatom index to monitor eutrophication in rivers, *Wat. Res.* Vol. 32, No. 1, pp. 236-242, 1998.

M.G. Kelly: Biological monitoring of eutrophication in rivers, *Hydrobiologia* 384: 55-67, 1998.

Generic Diatom Index

- No relation found between GDI-species and location
- The presence of taxa which are very tolerant to organic pollution does not always indicate the presence of organic pollution (Van Dam et.al., 1994)
- GDI is based on natural ecosystems, maybe not applicable on artificial systems

Habitat

- Presence of natural shores and environment, provides possibility for high biodiversity

Improvements of study

- Use artificial substrate
- Sample through all seasons
- Nutrient measurements during sampling

Conclusion

- The assembly of species and abiotic conditions “waterharmonica-system” change, in according to the Hynes model
- Changes in communities do not always reflect changes in water quality
- Habitat is a key factor, providing the basis for a diverse biological system in structure and in function.

Acknowledgements



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