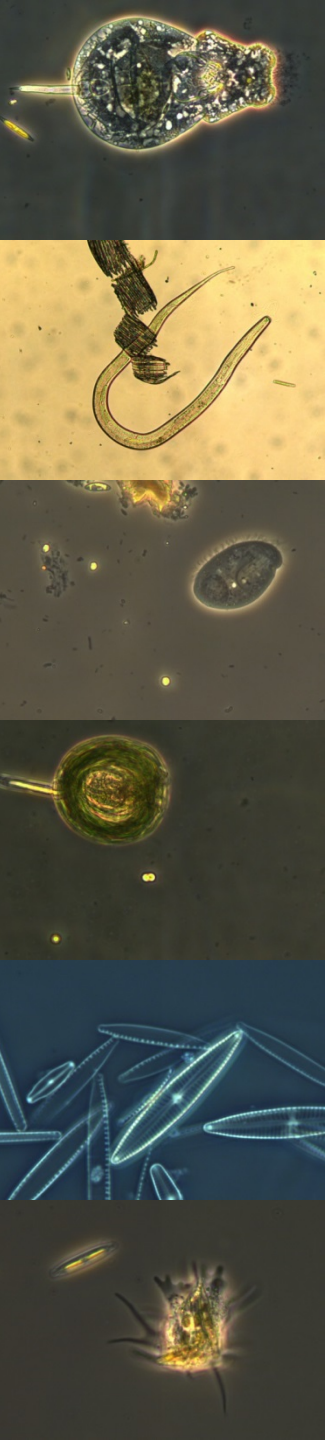
Who eats who in biofilms? Exploring the drivers of microalgal and micro-meiofaunal abundance

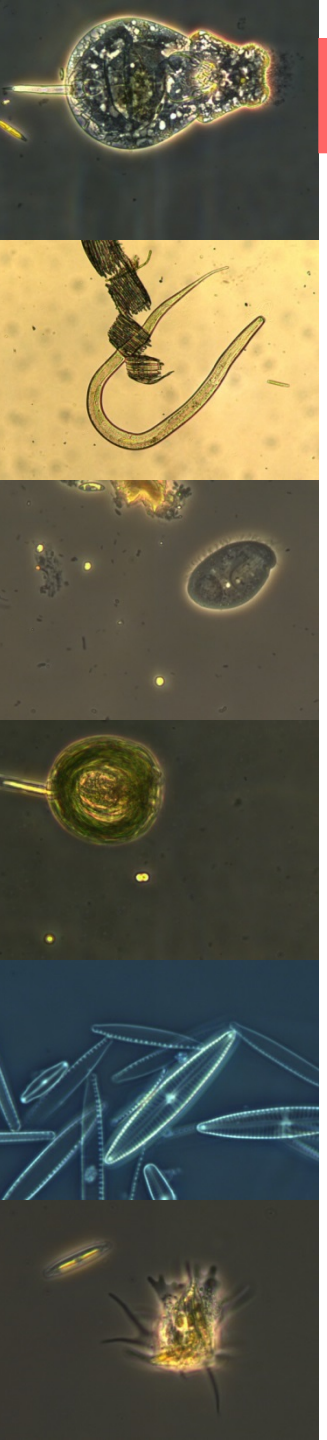
Julie Neury-Ormanni, Jacky Vedrenne, Soizic Morin



Who eats who in biofilms?

Exploring the drivers of microalgal and micro-meiofaunal abundance

Julie Neury-Ormanni
Jacky Vedrenne
Soizic Morin



Context

Aquatic biofilms and periphytic organisms

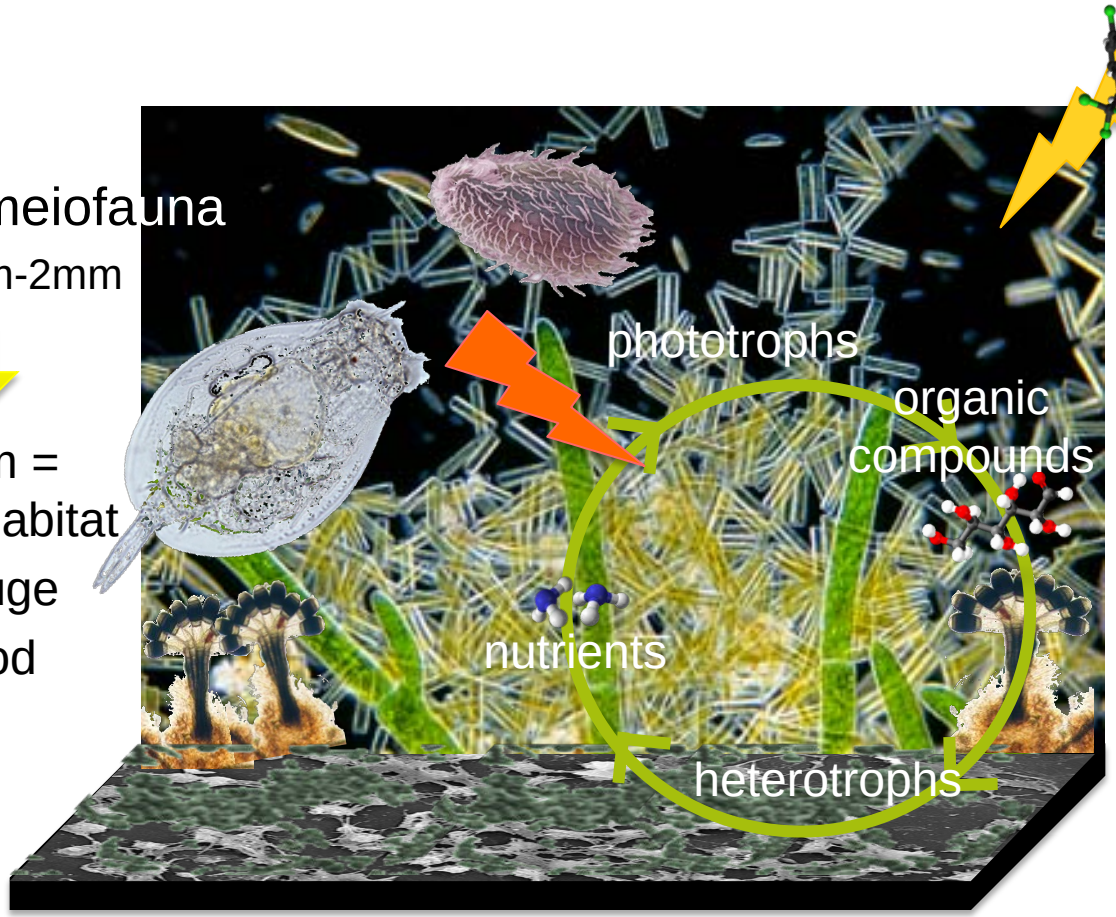
- Microbial loop in fluvial biofilms

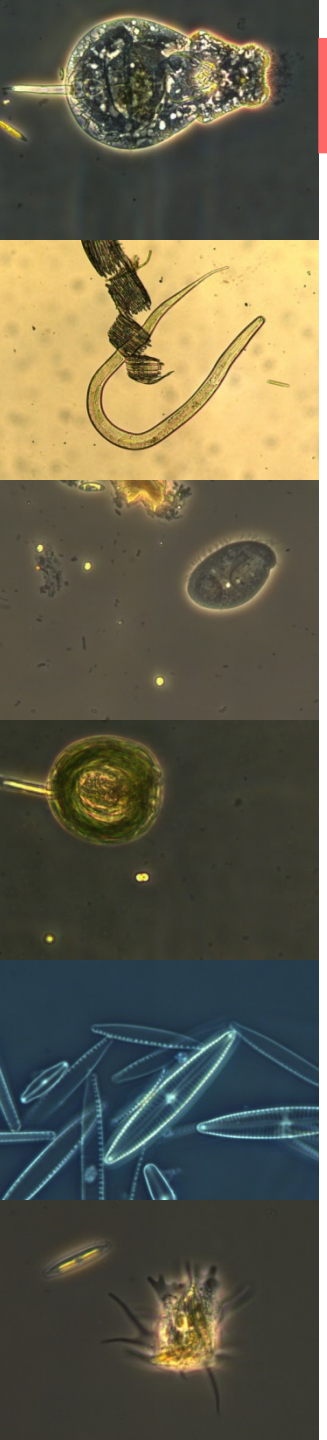
Micro-meiofauna

2µm-2mm

Biofilm = perfect habitat

- Refuge
- Food





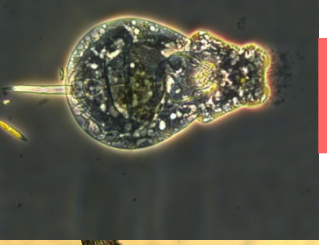
Context

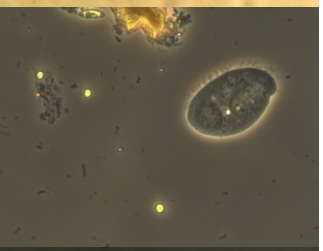
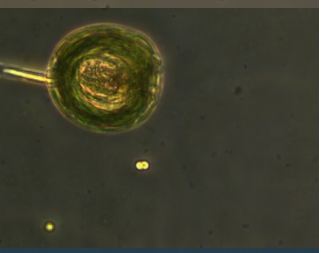
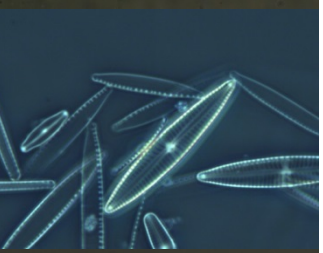
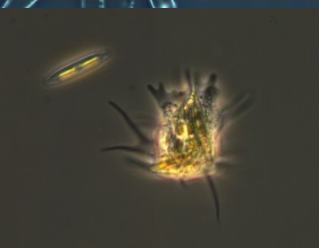
Aquatic biofilms and periphytic organisms

- Biodiversity of periphytic micro-meiofauna in natural systems?
- Influence of anthropogenic contamination ?
- Grazing relationships?

***In situ* sampling**

Lab experiment



Hypotheses

In situ sampling

Biodiversity of microalgae and micro-meiofauna is shaped by environmental factors (local pool of species, contamination...)

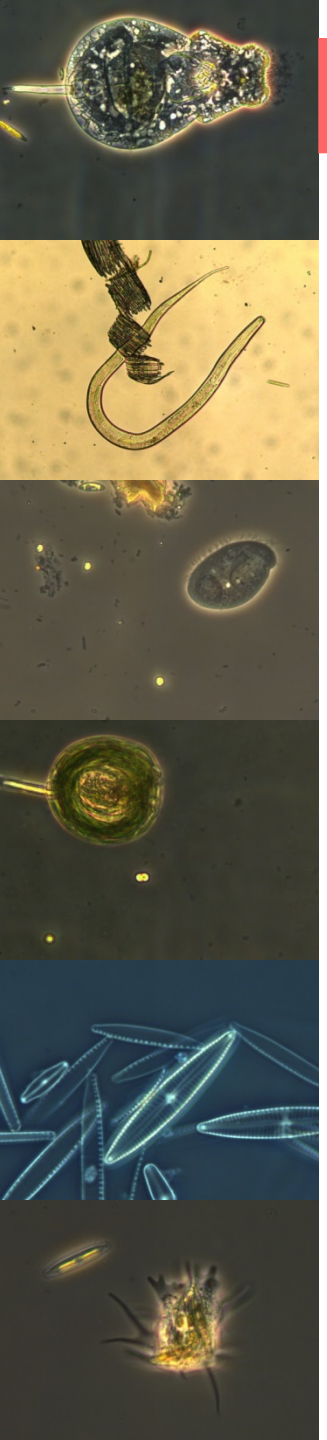
Quantitative importance of micro-meiofauna

Direct and indirect impacts of toxicants on biofilm structure

Lab experiment

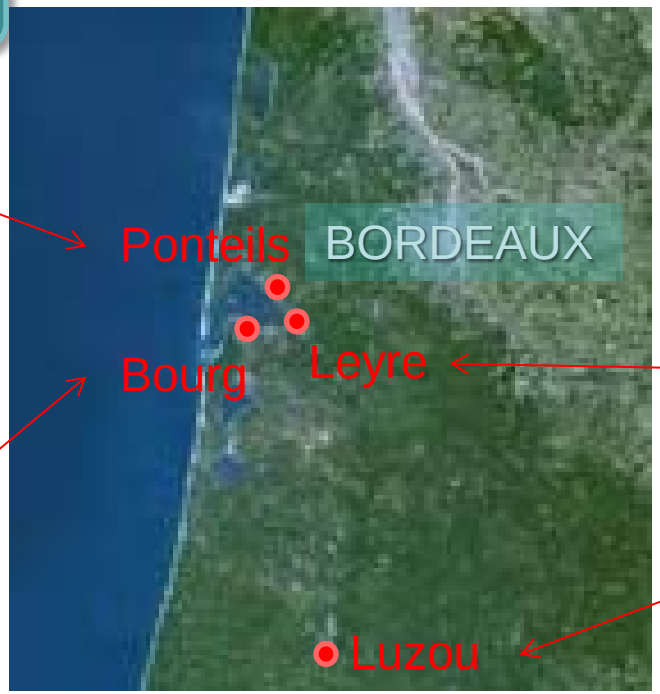
Prey and predator densities and relationships are function of the inital ratios between algae and grazers

Prey-predator relationships under simplified conditions



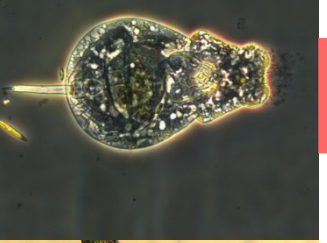
Materials and Methods

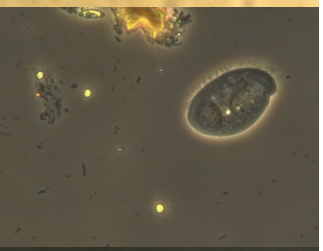
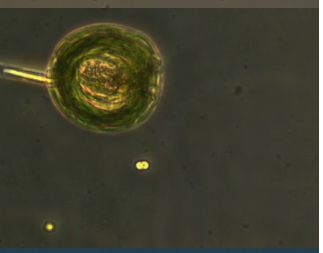
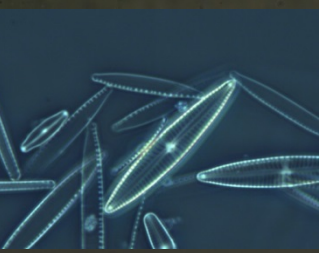
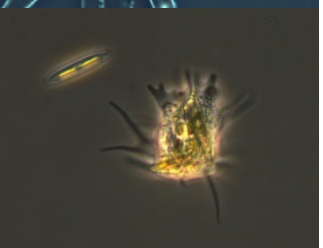
***In situ* sampling**



- Typical rivers from Landes ecoregion (sandy substrate, slightly acidic waters)

- Diverse contaminations between rivers, up-to downstream gradients

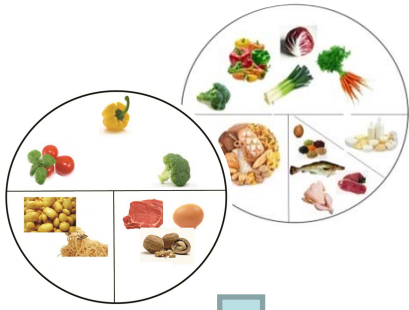


Materials and Methods

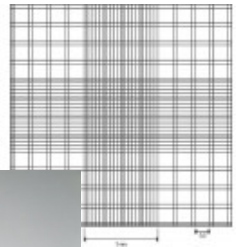
***In situ* sampling**

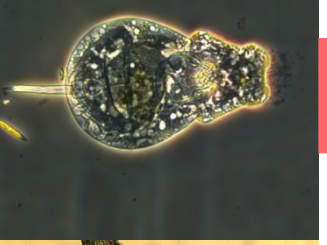
Grazing rates taken from literature data

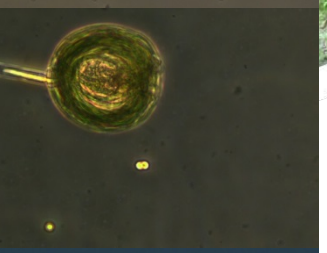
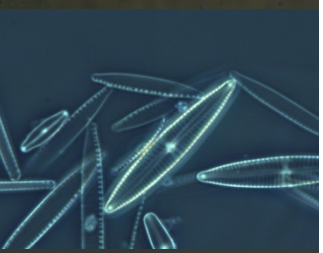
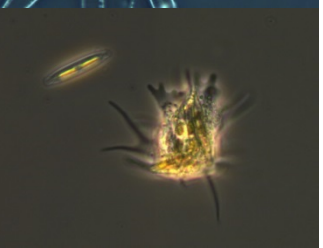


30 days

Identification, quantification





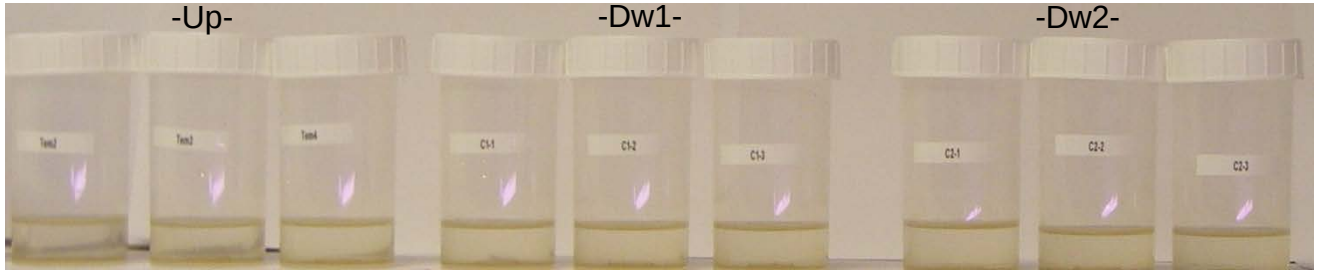





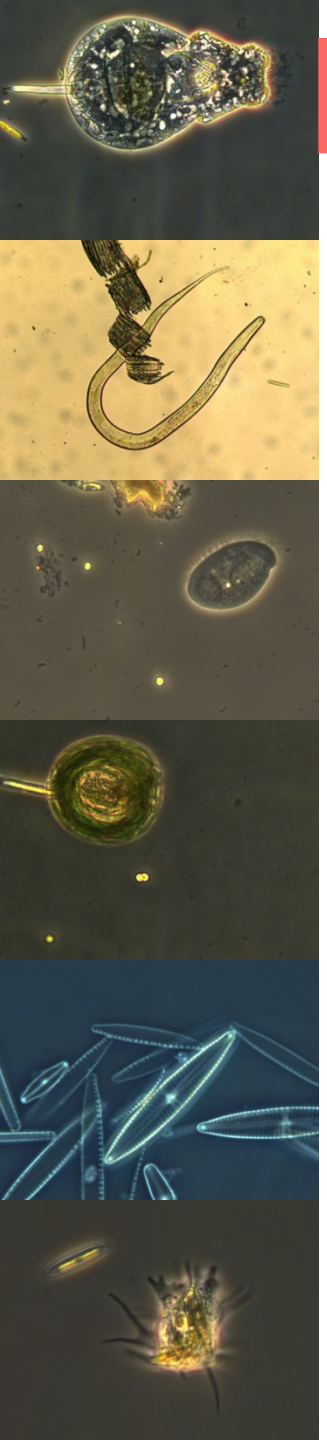
Materials and Methods

Lab experiment

- Mature biofilms from 3 sites of Luzou river (upstream industry, dowstream, further downstream)
- Diverse compositions in predators and preys

Laboratory cultures: 18 days



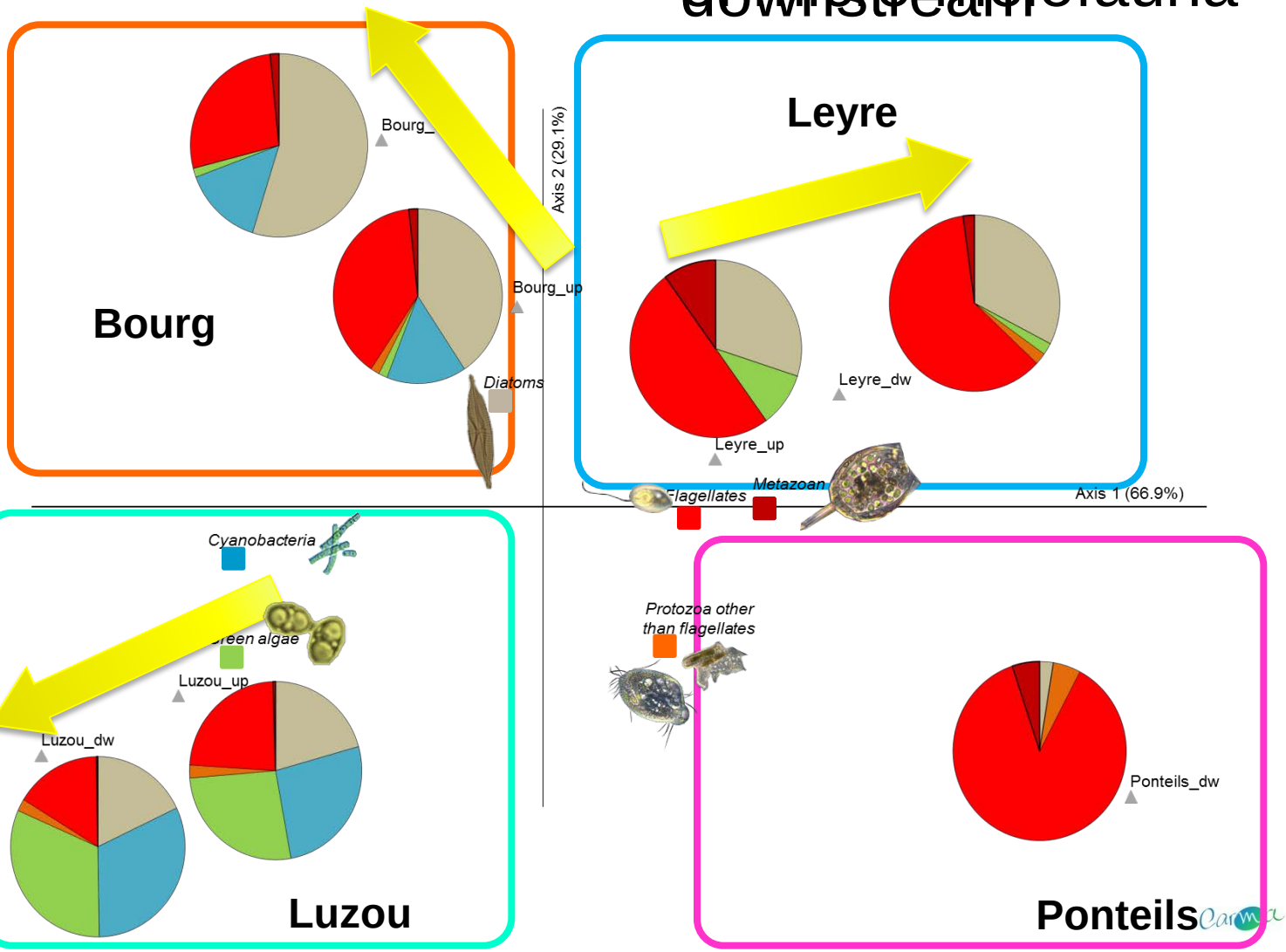


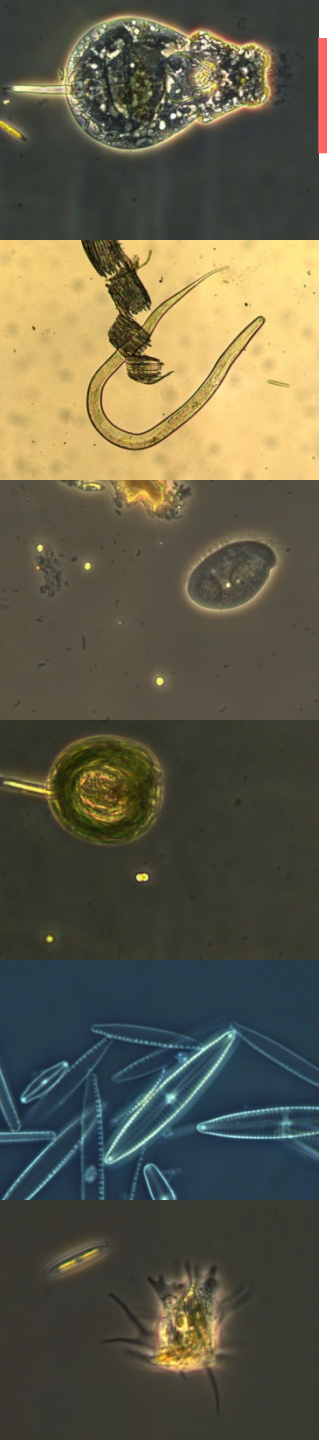
Results: Community composition

In situ

Relative abundances

Stage-specific changes in the proportions of micro-meiofauna downstream

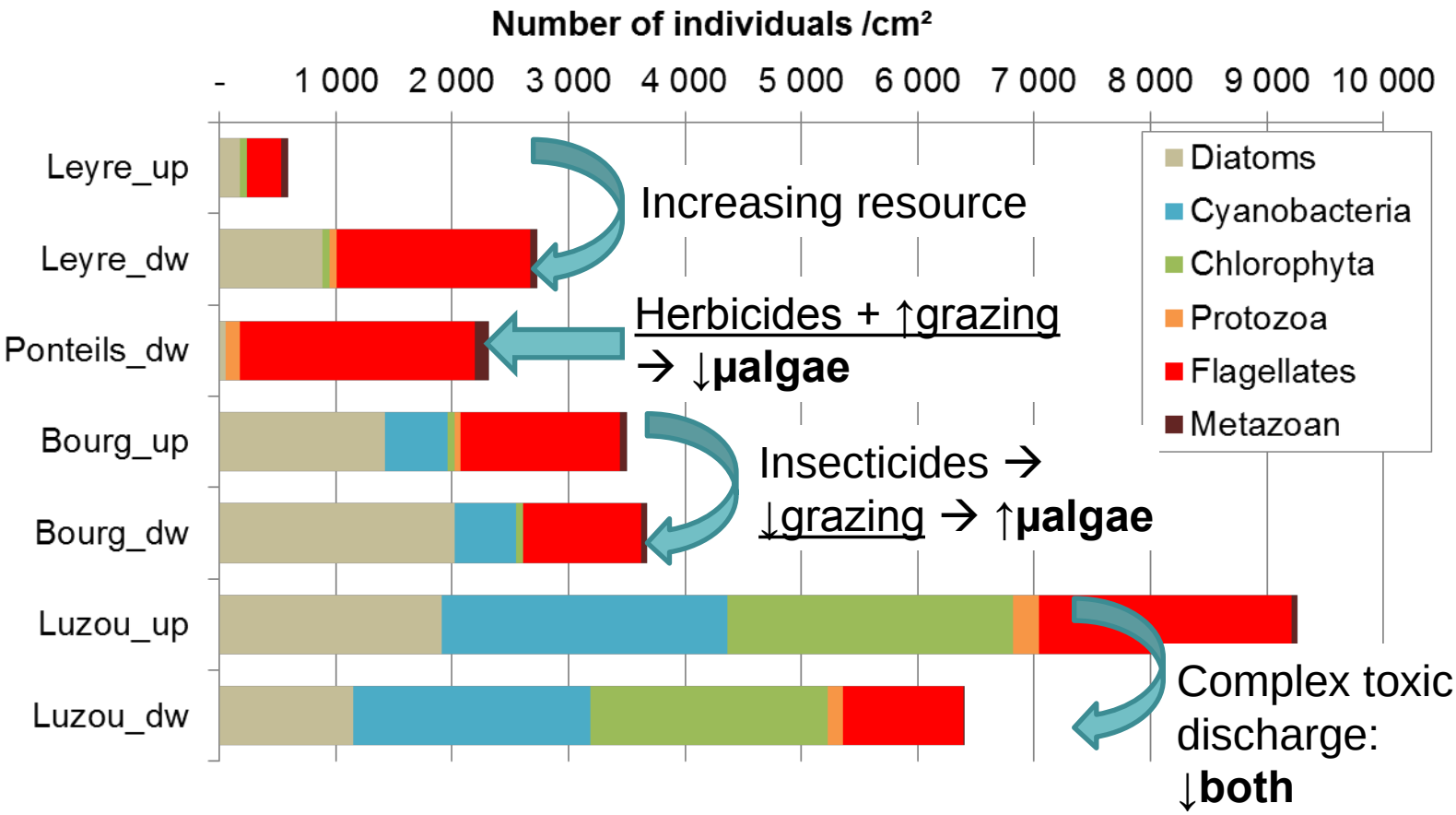




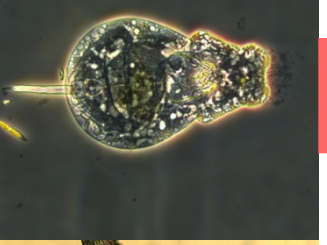
Results: Community composition

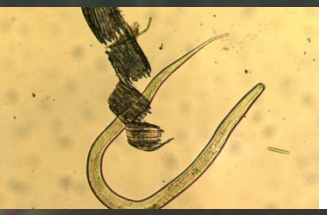
In situ

Organisms densities



- Combined contamination and grazing shape the community, hardly predictable for indirect impacts



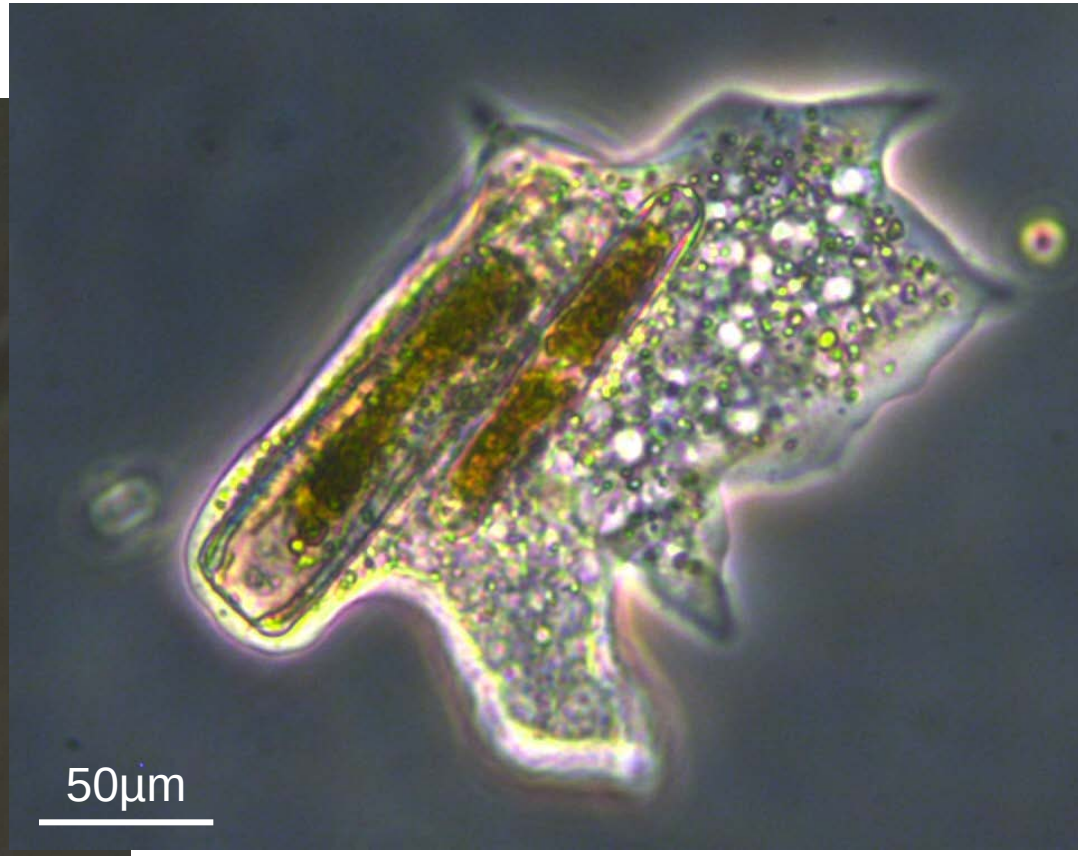


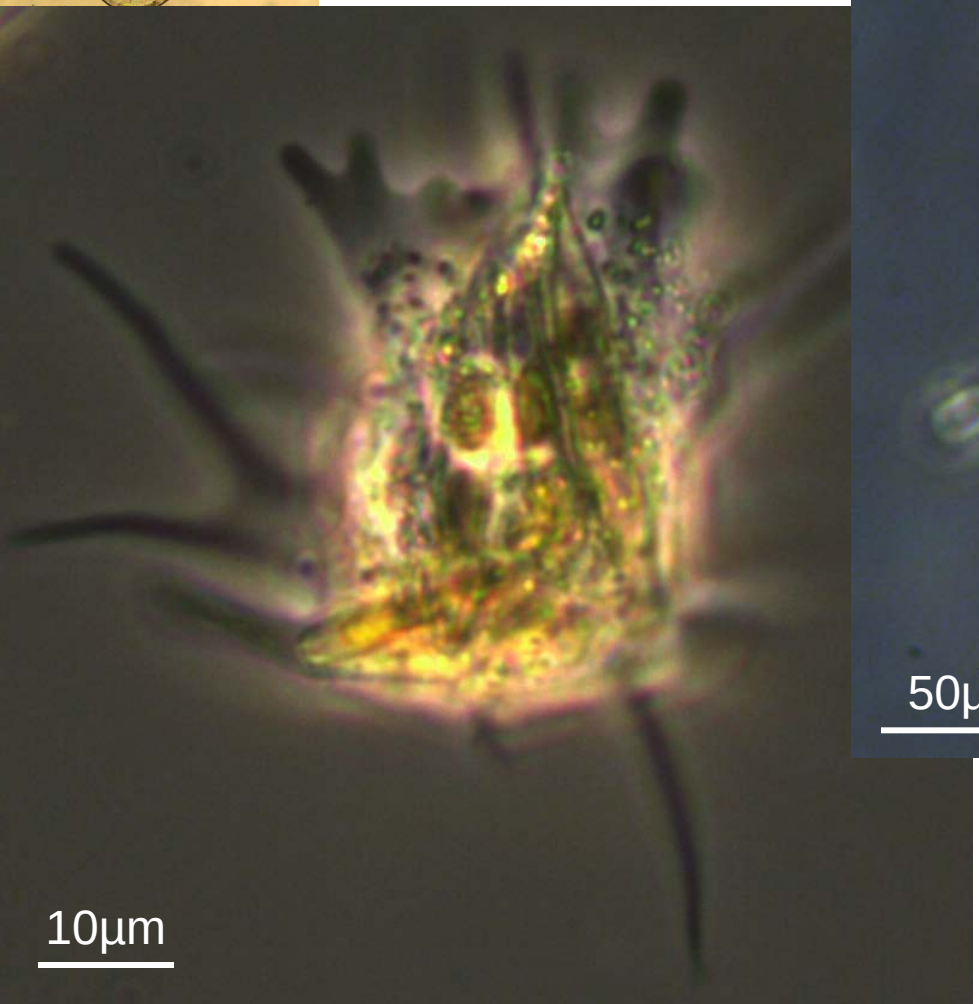
Results: Potential grazing

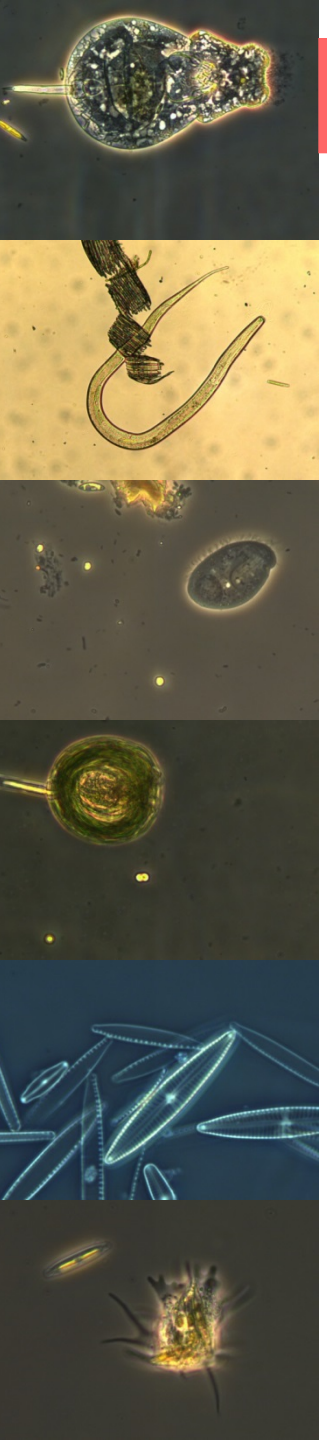
In situ

Grazing observations

- Amoeba





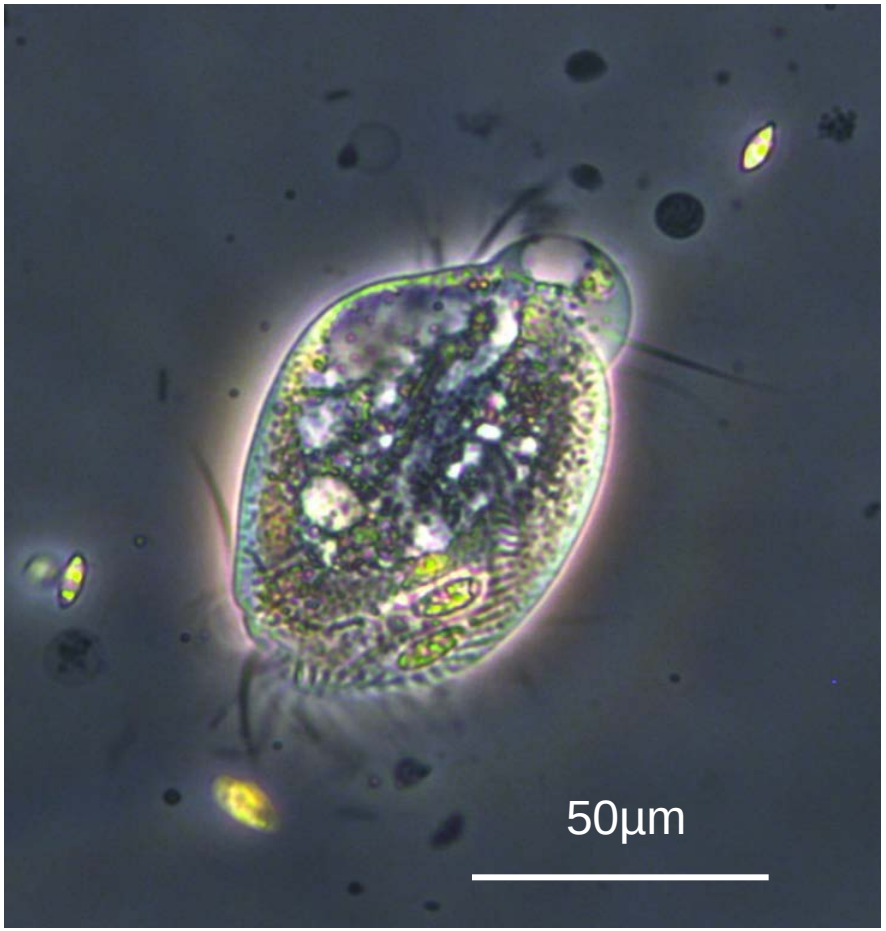


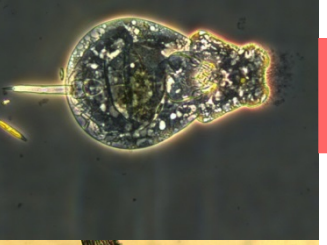
Results: Potential grazing

In situ

Grazing observations

- Amoeba
- Ciliates



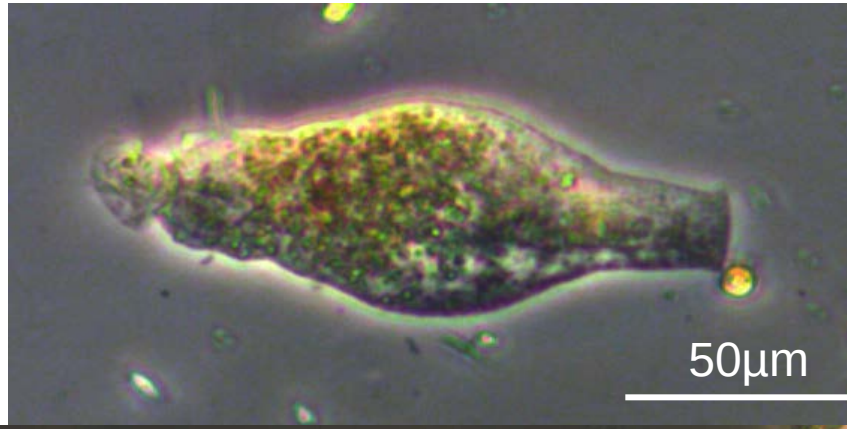


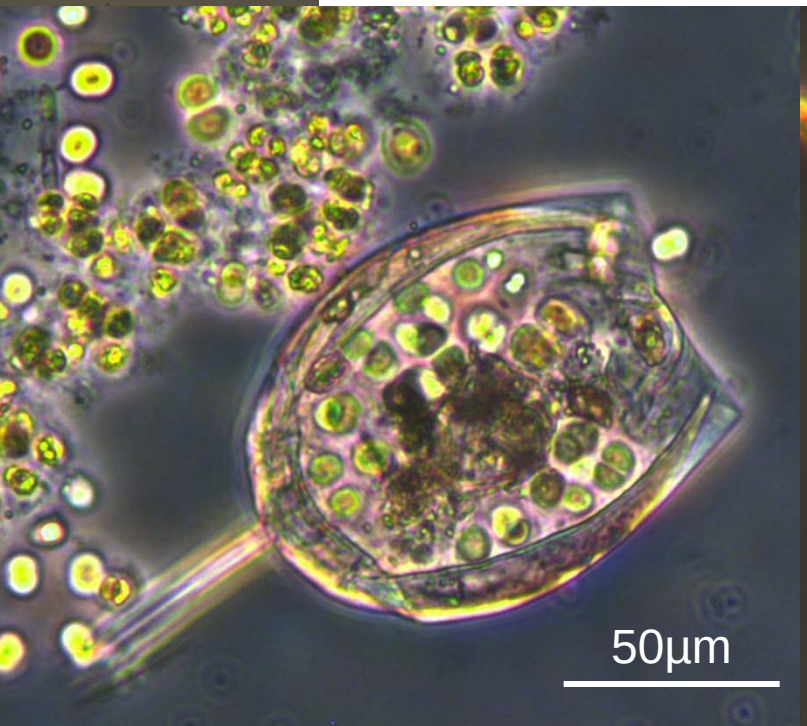
Results: Potential grazing

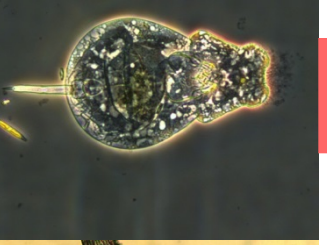
In situ

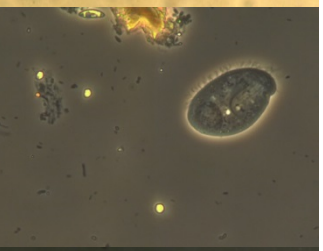
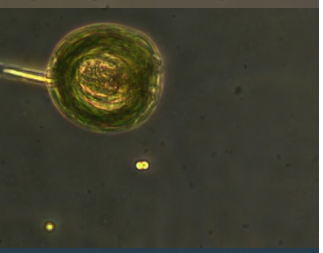
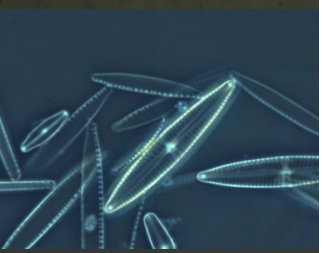
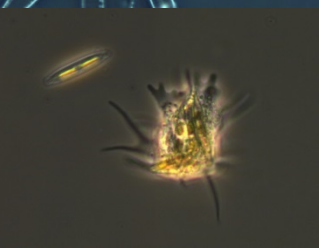
Grazing observations

- Amoeba
- Ciliates
- Rotifers







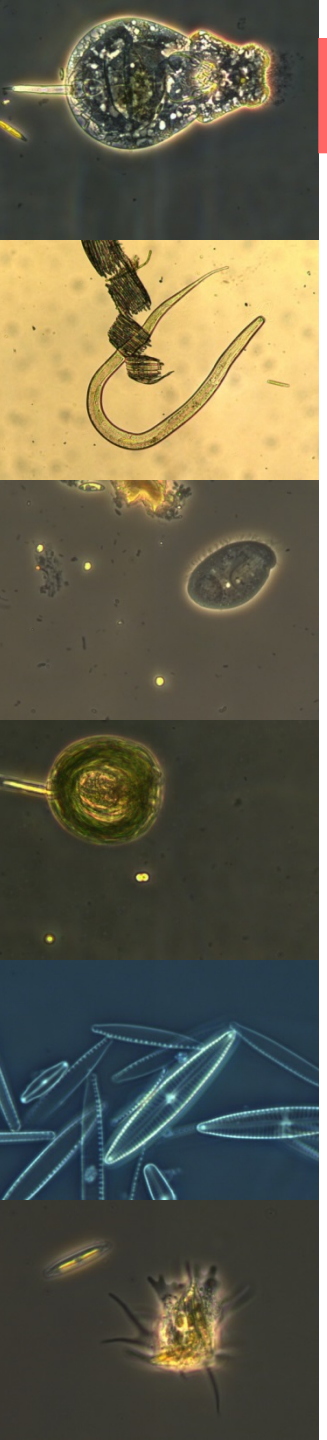
Results: Potential grazing

In situ

Ingestion rates from literature:

Brouteur	Habitat	Méthode	diatomées.p*-1.h-1	bactéries. p*-1.h-1	Autres informations	Auteurs
Ensembl Chilodonell Trithigmos cucullulus + p sp (Sarcod					0.1% of algal standing	McCormick (1991)
Prorodon						Epstein & iaris (1992)
Microflagellé sp, Monas Oikomona						Fenchel (1975)
Rotifère	des ruisseaux	marquées par fluorescence	(a=0 ; b=13,5) (p* = rotifères)	rotifères)	5 expériences	orchardt & Bott (1995)
Nématodes	Argile blanche des ruisseaux	FLD ou FLB	0 (p* = nématodes)	6 - 320 (p* = nématodes)	Intervalle de moyenne de 5 expériences	Borchardt & Bott (1995)
Méiofaune	Argile blanche des ruisseaux	Changement de densité	3-37 (p* = animaux)	3513 - 8981 (p* = animaux)	Les ciliés et les rotifères sont co-dominants	Borchardt & Bott (1995)

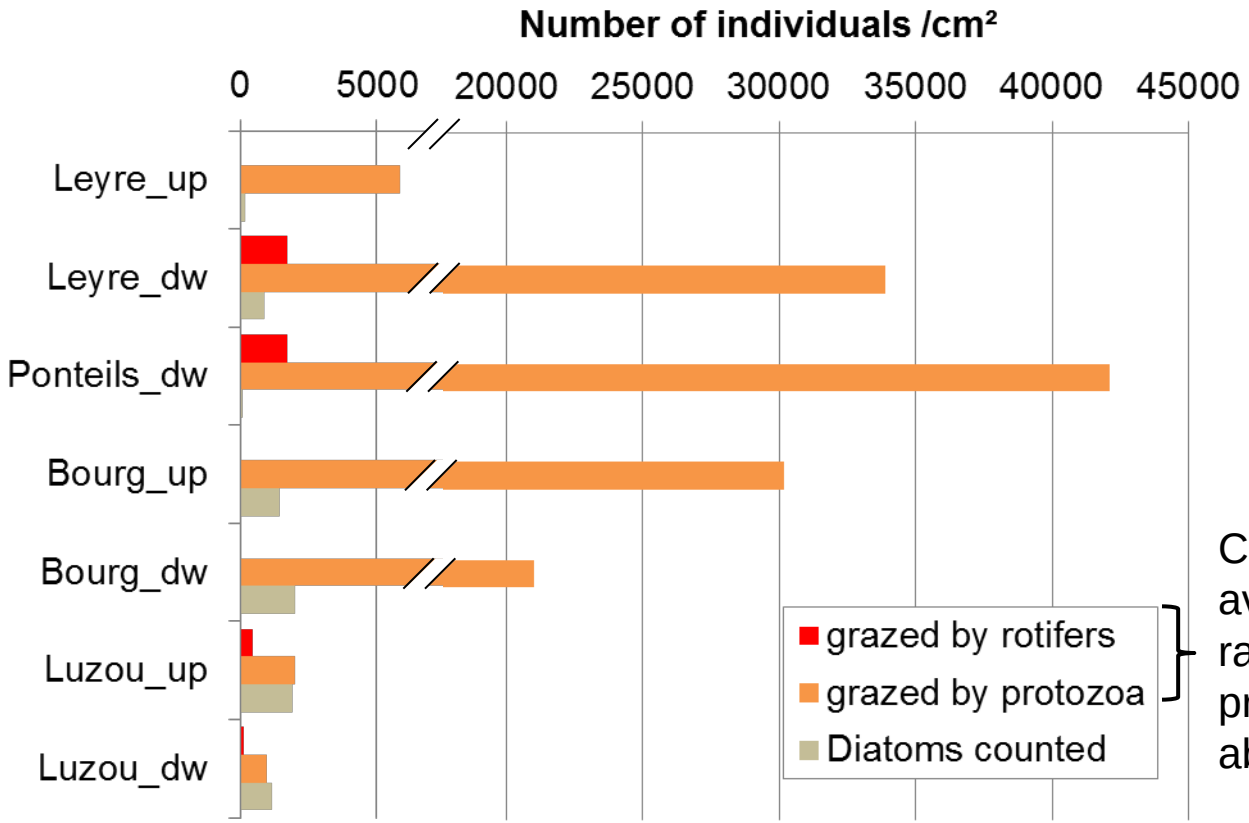
Grazers	Diatoms.p*-1.h-1	Authors
Ciliates: **Chilodonella sp +** **Trithigmostoma cucullulus +** **Pelomyxa sp (Sarcodines)**	**3 - 6** (p* = ciliates)	McCormick (1991)
Rotifers	**0 - 13,5** (p* = rotifers) depending on the morphotypes	Borchardt & Bott (1995)



Results: Potential grazing

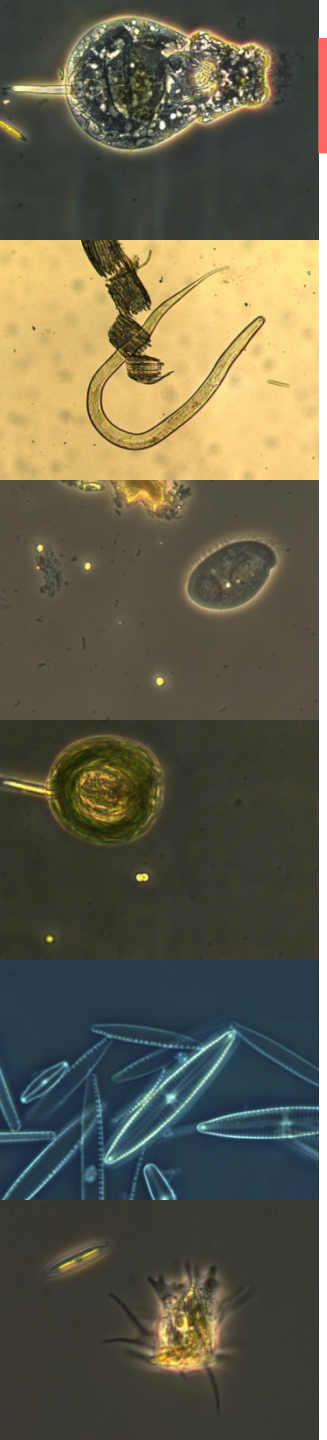
In situ

Potentially grazed diatoms over 30 days



Calculated from average grazing rates and predators abundances

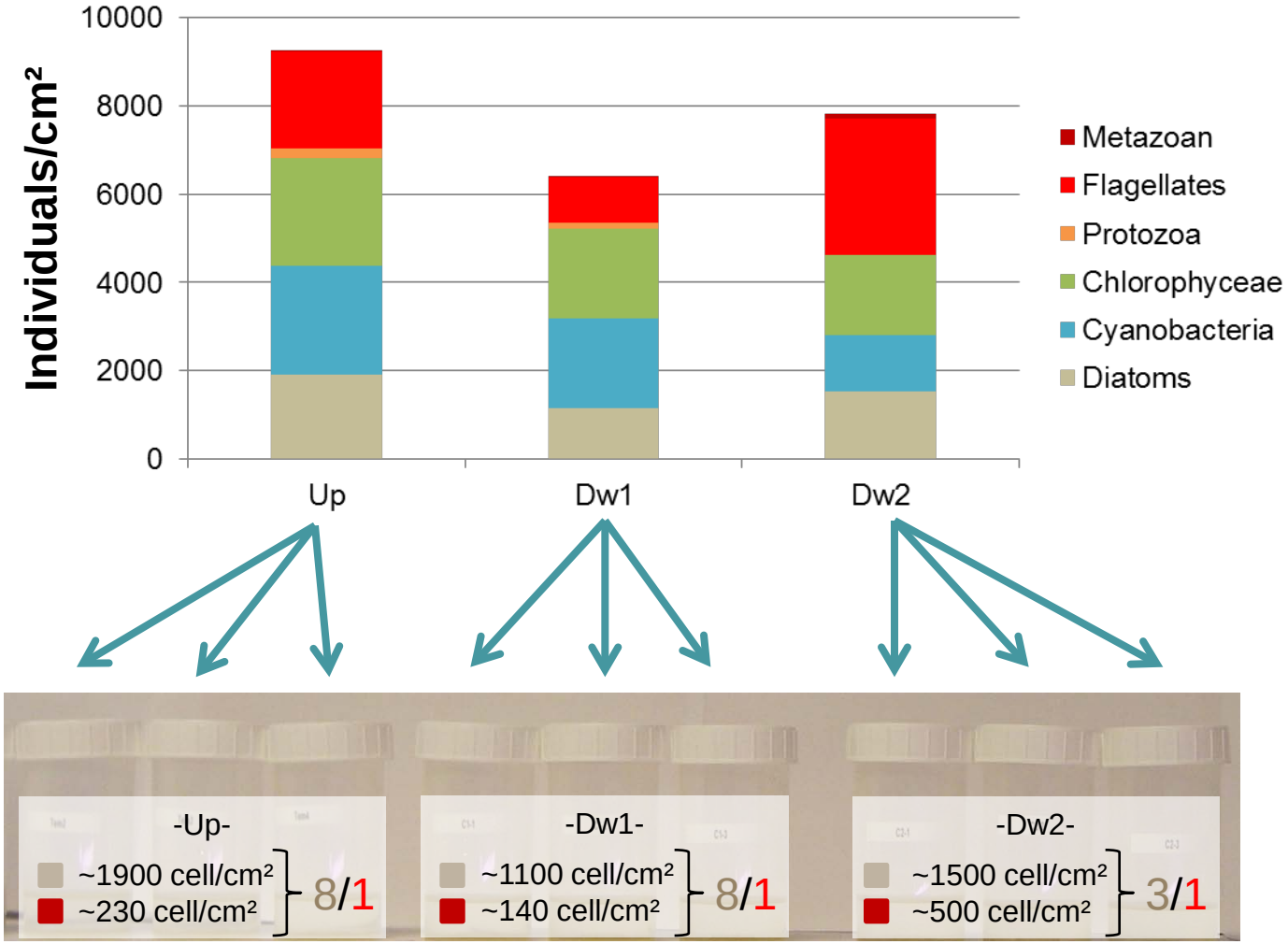
- Potentially grazed diatom quantities can exceed of several orders the real numbers of diatoms counted
- Probable overestimation → need for more grazing data



Results: Initial community composition

Lab

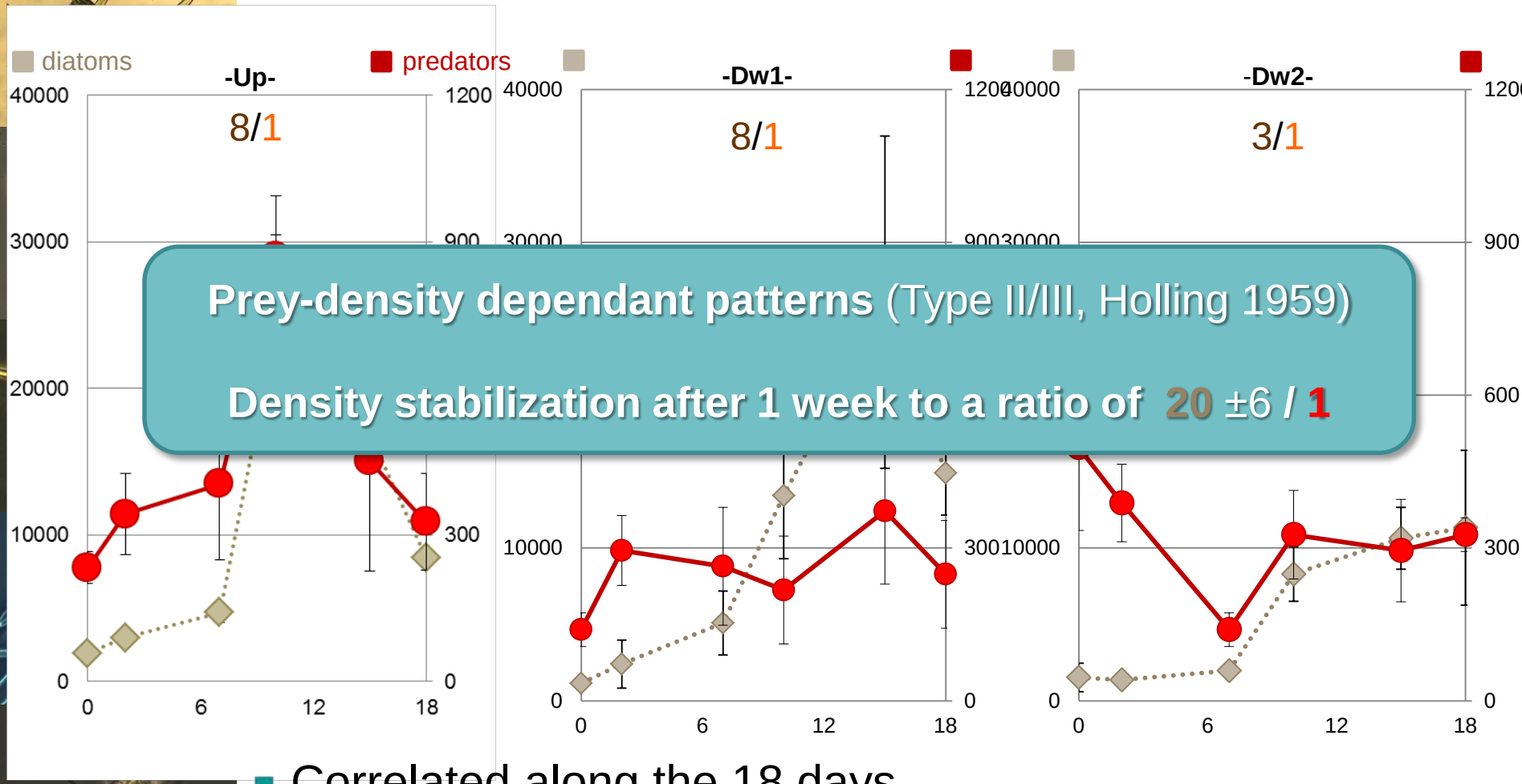
Organisms densities (t0 = 1-month old biofilms)



Results: Temporal evolution

Lab

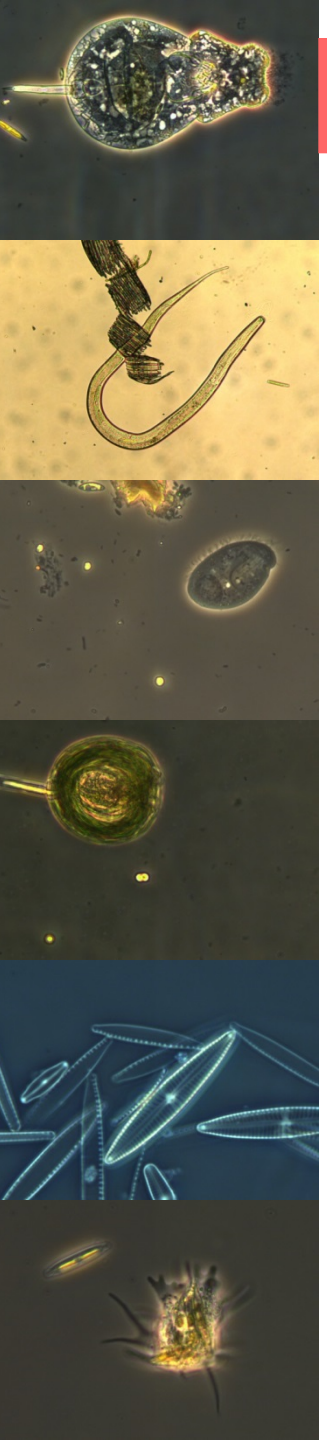
Diatom and predator densities



Prey-density dependant patterns (Type II/III, Holling 1959)

Density stabilization after 1 week to a ratio of 20 ±6 / 1

- Correlated along the 18 days
- Decrease in predators in the 1st week

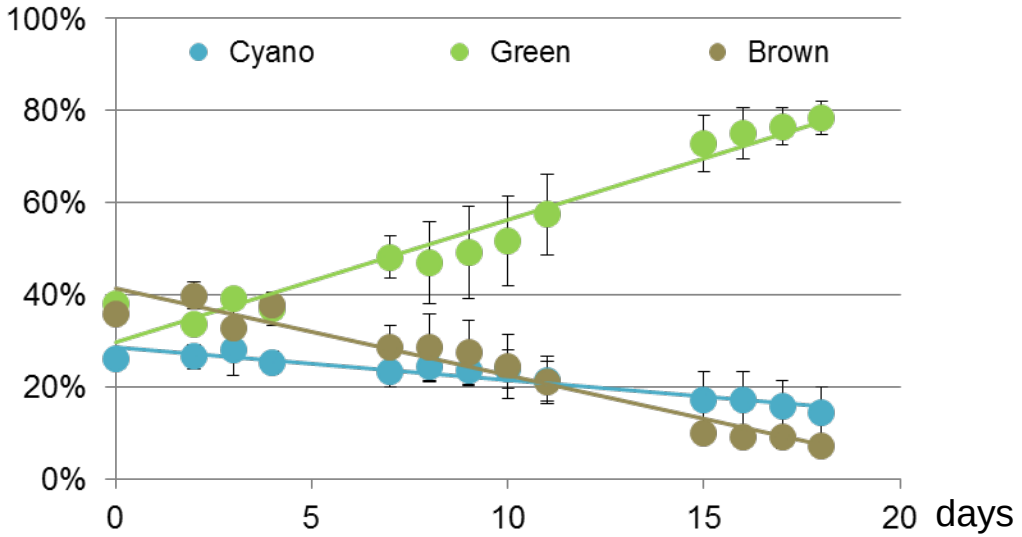


Results: Temporal evolution

Lab

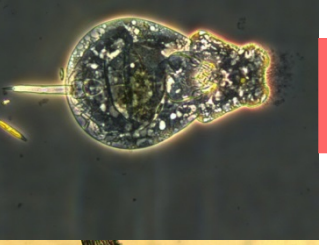
Other organisms

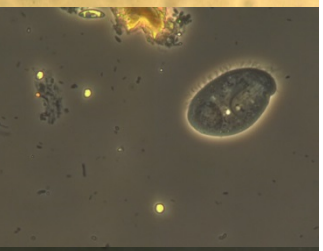
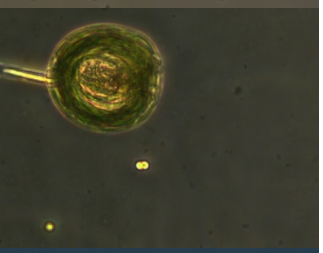
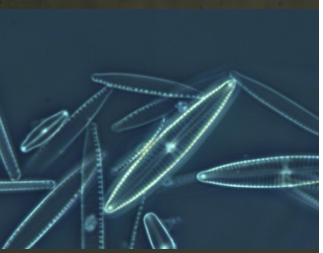
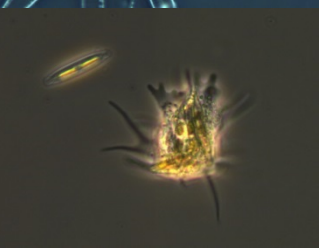
- Other algae: competitive exclusion or selective grazing?



- Non-predatory micro-meiofauna not taken into account

But 8-10 fold more numerous → competition for resource and space?



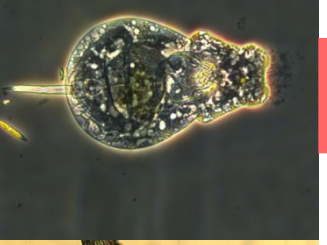
Conclusions

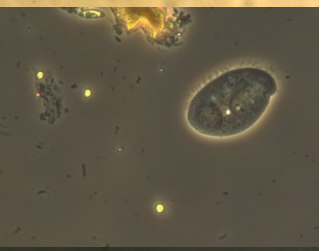
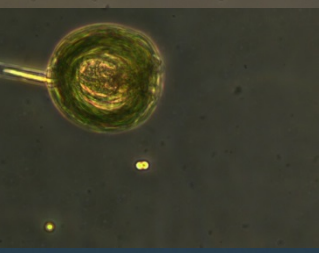
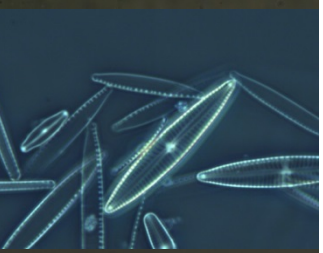
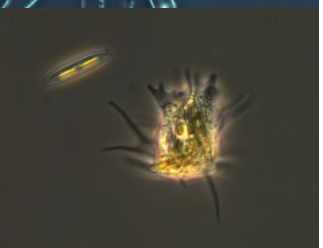
In situ experiment

- Micro-meiofauna is quantitatively important in biofilms
- The balance between periphytic microflora and –fauna
  - depends on local environmental conditions
  - may provide evidence for toxic pollution type

Laboratory experiment

- Grazing relationships are prey-density dependent
- Stabilization around 20 diatoms/potential predator



Perspectives

In situ

- Characterize the diversity of micro-meiofauna in other freshwater environments / ecoregions
- Assess the seasonality of micro-meiofauna communities

Laboratory

- Elucidate prey-predator relationships specifically for each taxonomic group (amoebae, ciliates, rotifers)
- Determine the drivers for prey selectivity (if any)
  - algal group (diet)
  - prey morphology (size, shape, presence of spines…)
  - behaviour (escape, excretion of allelopathic subst.)
  - predator traits

https://www.youtube.com/watch?v=1nltVl_-So4

Questions?

More details in Neury-Ormanni et al. (2016, *Botany Letters*)

This study was carried out with the financial support of
- the French National Research Agency (ANR) in the framework of the "Investments for the Future" programme, within the Cluster of Excellence COTE (ANR-10-LABX-45)
- the Adour-Garonne Water Agency (convention 310 33 0075, 2012-2014).

Thanks for help in field and laboratory work to

Juliette Rosebery
Vincent Fauvelle
Mélissa Eon
Karine Madarassou

Thank you for your attention