

Global changes incidence on phytoplankton, with special reference to cyanobacteria, in the R. Loire (France)

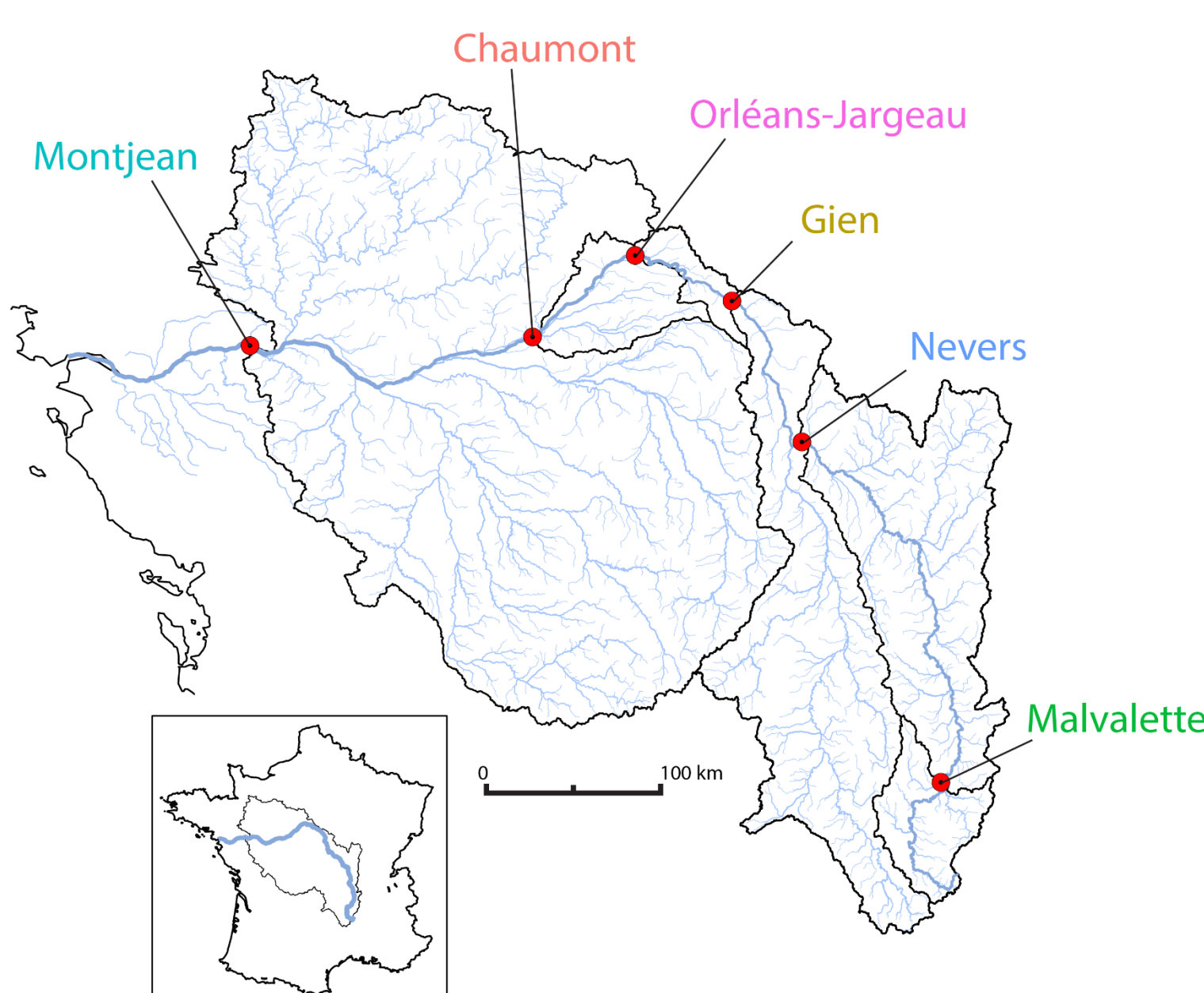
Impact des changements globaux sur le phytoplancton et les cyanobactéries de la Loire (France)

Introduction

- Climate change and eutrophication are expected to affect phytoplankton growth, with an increased risk of potentially **harmful cyanobacterial blooms**
- Few papers reported an increase of cyanobacterial abundance in rivers, that could be related to climate change
- In this study, based on phytoplankton monitoring data, we examine **long-term trends in phytoplankton** development in the R.Loire, with a focus on the **contribution of cyanobacteria** to total phytoplankton biomass

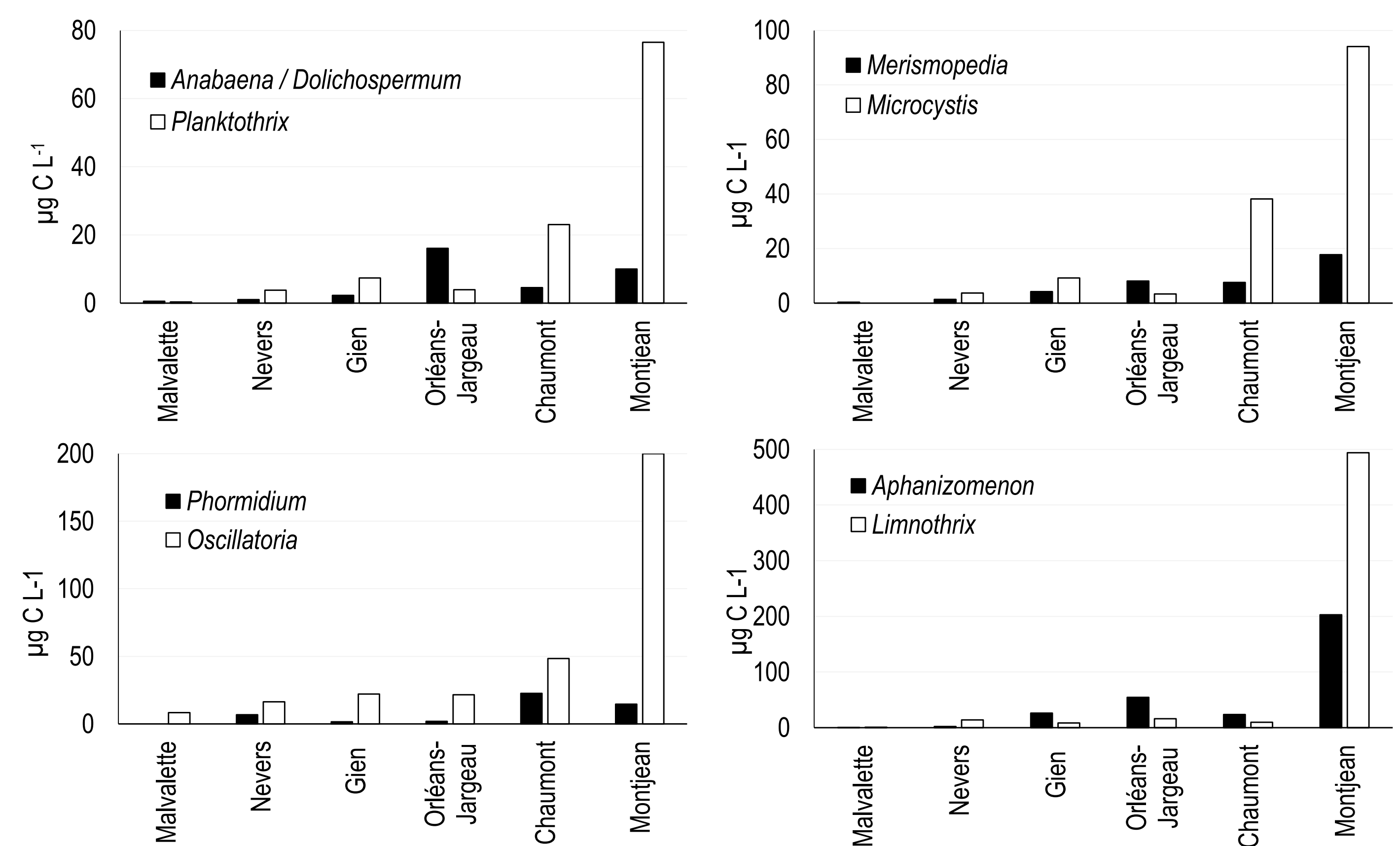
Material & Methods

- Loire : 6 stations** (km 138 – km 830)
- Monthly sampling: 1991 – 2011 (monitoring Loire-Bretagne Agency)
- Chemical analysis: standard methods
- Phytoplankton: Utermöhl & biovolume for biomass
- Phytoplankton samples: n = 1 024
- Biomass calculated when the taxon > 4 individuals (>1% counting)
- Trends of nutrients** were analysed **in parallel with phytoplankton**

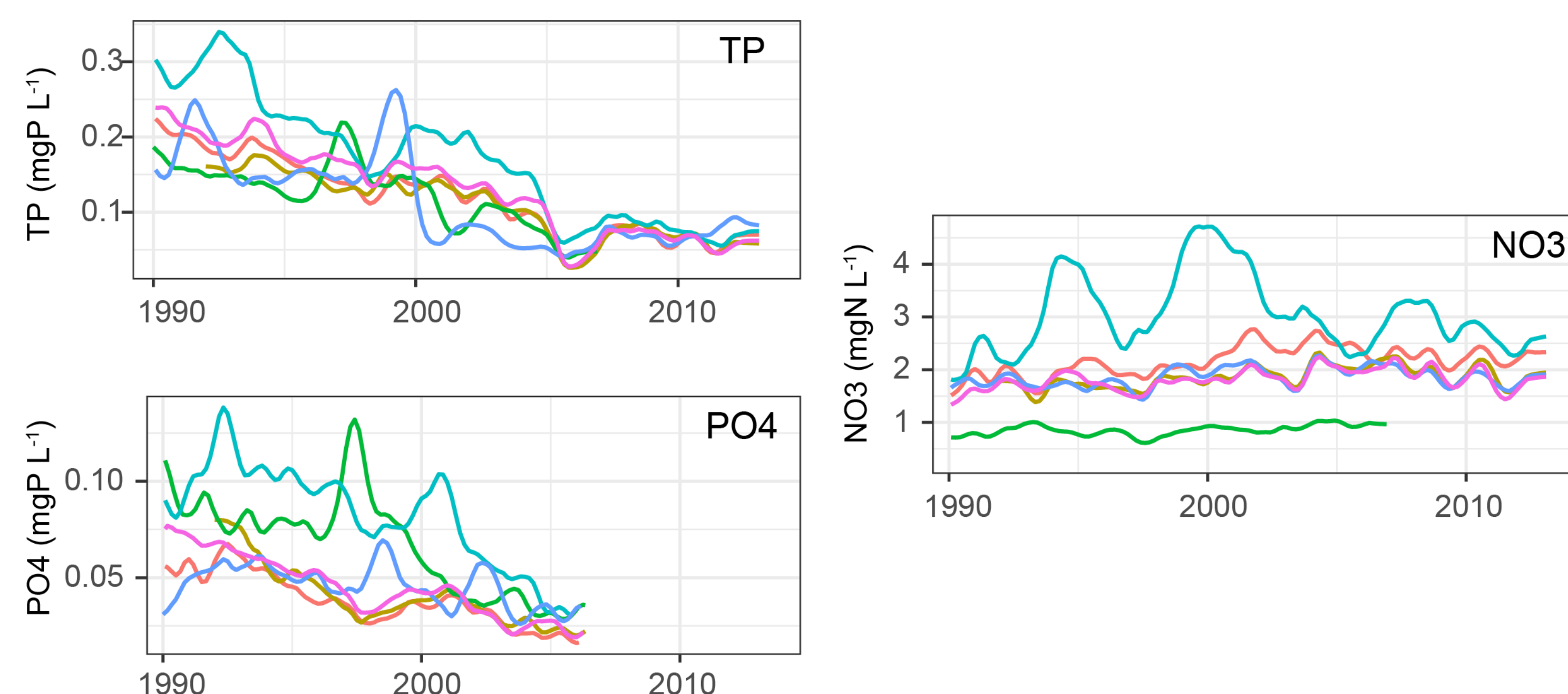


- 8 main significant genera with the highest biomass contribution of *Limnithrix*, *Oscillatoria* and *Aphanizomenon*

Longitudinal change in the mean annual biomass of the main cyanobacteria taxa (1991-2011)

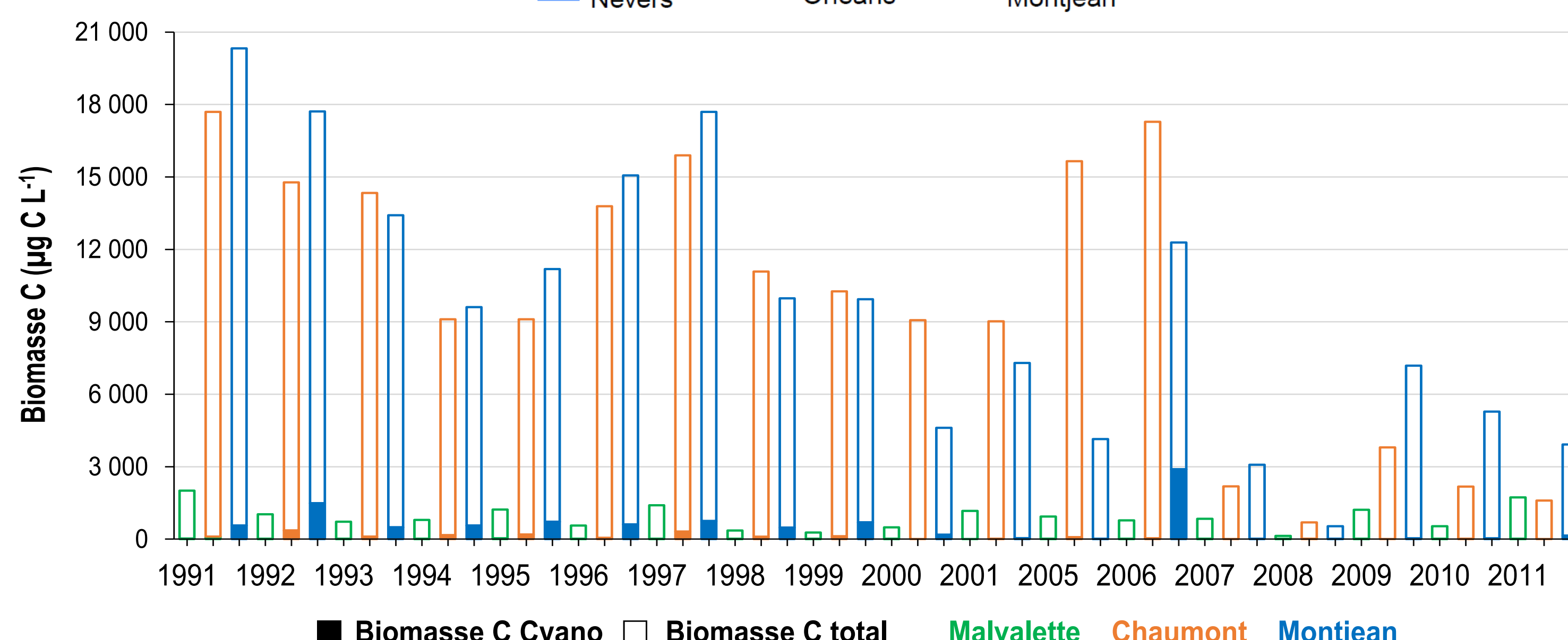
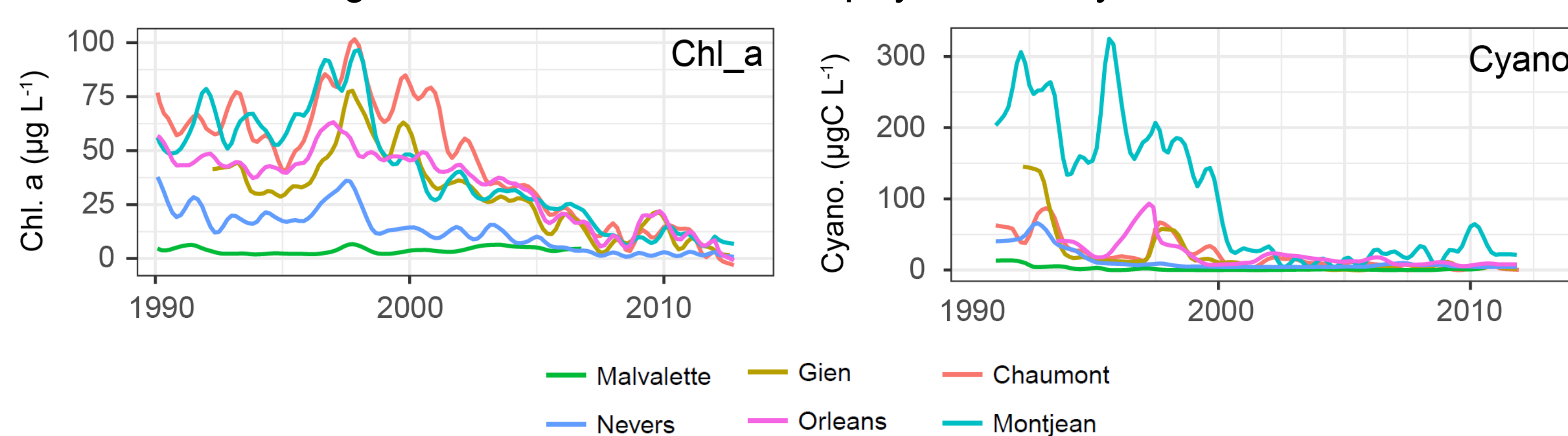


- Possible relationships with physical-chemical parameters
- Rising water temperature, decreasing P, stable NO_3^-



Results

- Overall long term decrease of chlorophyll-a and cyanobacteria biomass



- Total **phytoplankton biomass decreased** highly since late 90's
- Cyanobacteria biomass occurred in 38% of the samples
- Cyanobacteria** were most of the time a very **small fraction of total phytoplankton** (~1%), except on rare occasions
- 63 cyanobacteria taxa ; 2/3 of them have filamentous morphology
- Cyanobacteria were the most abundant in downstream station (Montjean)

Discussion

- Time scale - phytoplankton biomass decreased along the years together with cyanobacterial contribution.
- Longitudinal scale – cyanobacteria biomass increased along the Loire: consequence of increased residence time, water temperature and lateral inputs from slow flow tributaries
- Planktic cyanobacteria do not form blooms in the R. Loire, contrary to earlier reports (Larroudé et al, 2013). On rare occasions, some cyanobacteria reached high abundance in the main river, but they were exported from slow-flowing tributaries
- Although part of the phytoplankton decrease may be explained by significant P-limitation of growth, it is likely that predation by benthic filter-feeders, particularly the invasive Asiatic clams (*Corbicula* spp.), has been a key loss process for phytoplankton in the R. Loire. This has been the case in other large European rivers.
- More investigations are still necessary to tell apart the effects of increased temperature, discharge variations, reduced eutrophication and predation by invasive species on the phytoplankton of the River Loire

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