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TEMPORAL EVOLUTION OF MACROPHYTE COMMUNITIES RELATED TO ENVIRONMENTAL CHANGES IN TWO FRENCH LARGE RIVERS

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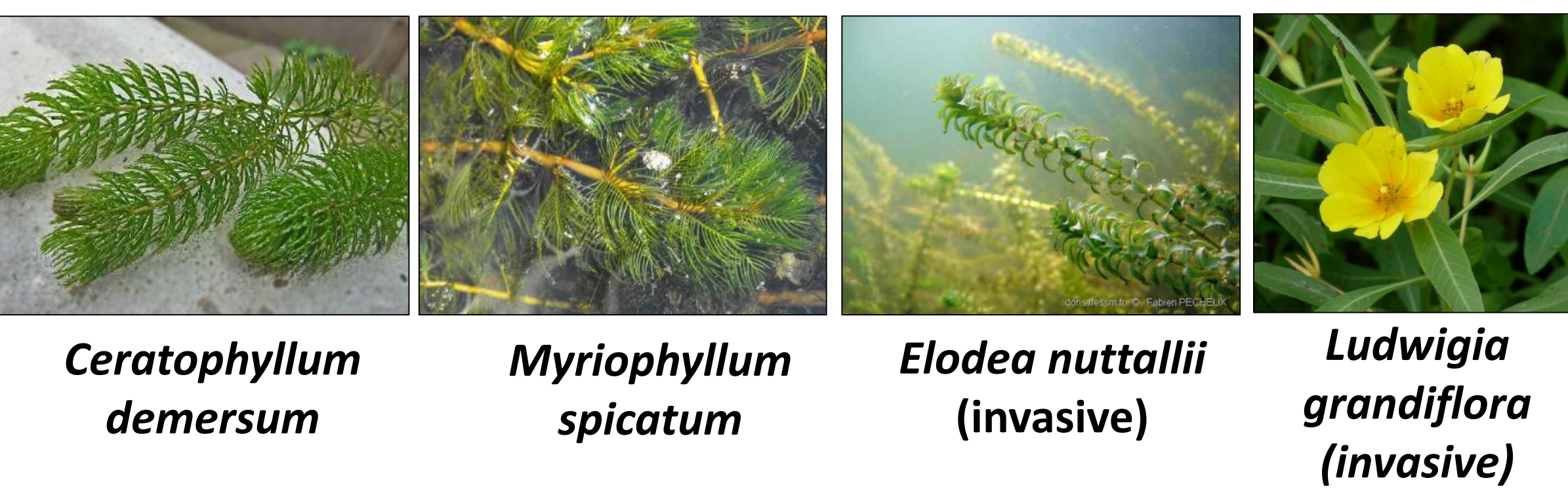
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Introduction

➤ French large rivers are impacted by multiple stressors (e.g., chemical disturbance, hydrological regulation, eutrophication, and climate change), which can influence the structure and evolution of macrophyte communities.

➤ Spatial and temporal dynamics of the macrophyte communities in interaction with environmental parameters (temperature, discharge, nutrients, etc.) were analyzed on several stations located on two large rivers in France (Rhône River and Garonne River).

➤ The goal of this study is to determine the key environmental factors impacting the annual growth, abundance and diversity of the macrophyte community.



Material and Methods

➤ Studied sites on the Garonne River and the Rhône River (Fig. 1)

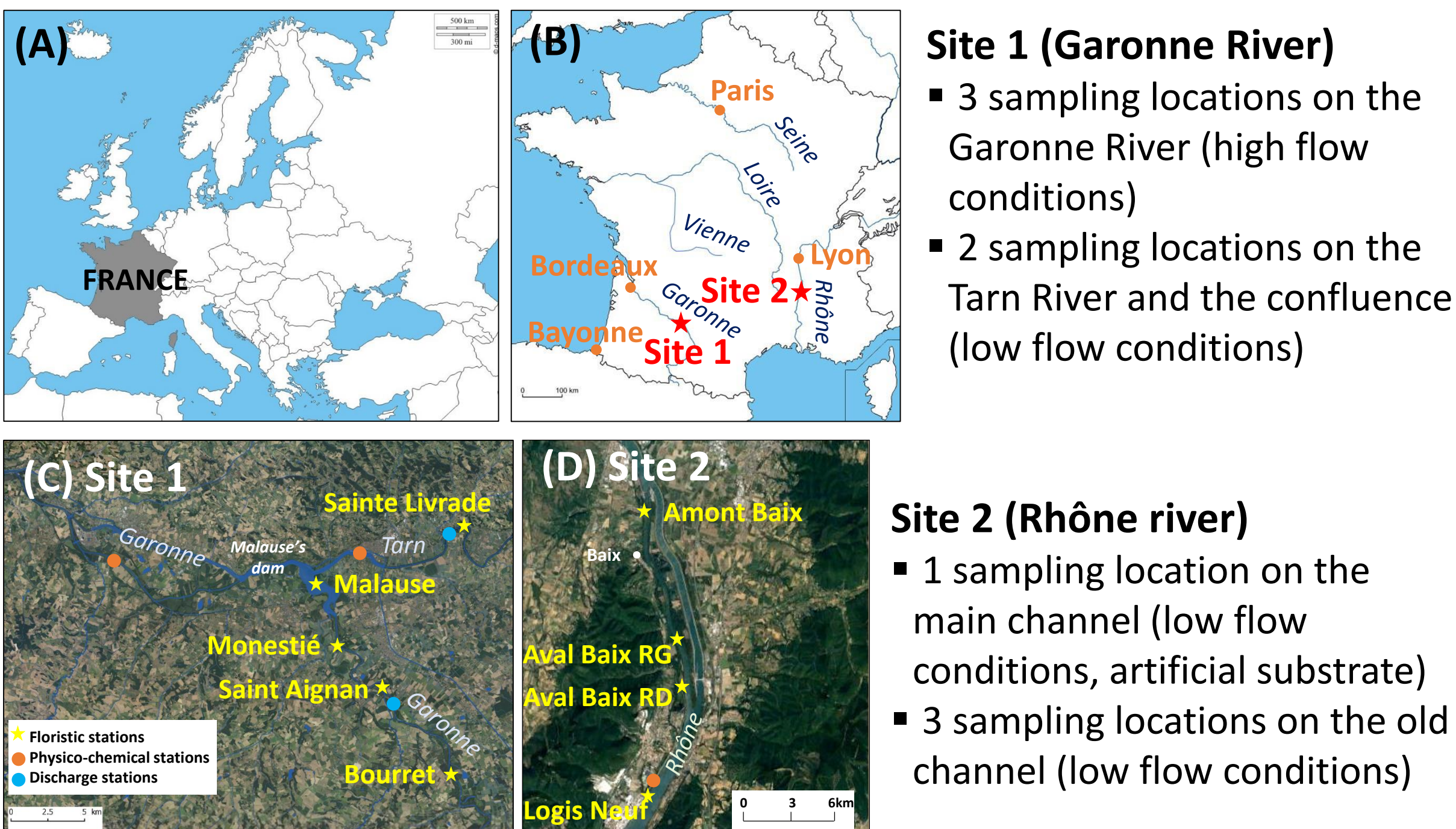


Figure 1. Location of the studied sites in (A) Europe, (B) France, (C) site 1 on the Garonne River, and (D) site 2 on the Rhône River.

Data collection

➤ Macrophyte coverage (%) using the transect method and biomass (Kg of wet mass) on 1 m² sampling points (Fig. 2)



Figure 2. Macrophyte sampling for coverage and biomass.

➤ Environmental parameters (water temperature, discharge, and water physico-chemistry)

Data analyses

➤ Temporal evolution of the macrophyte community abundance and diversity at each site

➤ Search of metrics for water temperature and discharge affecting annually the magnitude of macrophyte abundance.

Conclusions

➤ Our results showed that higher water temperature during the early growing season (e.g., spring) were positively correlated with the macrophyte abundance and especially the increasing abundance of exotic species.

➤ Variations of river discharge also affected macrophyte abundance but was modulated by the intensity, duration, and seasonality of flood events.

➤ Our study highlights the need for long-term monitoring data to determine the spatial and temporal evolution of macrophyte communities related to environmental changes such as temperature rise, flood events or eutrophication.

Results

Site 1 (Garonne River)

- High macrophyte abundance in Sept. 2012, sharp decrease in Sept. 2013 and 2014 (e.g., for Monestié only), and high abundance in Aug. 2015 and 2016 (Figs. 3A & 3B).
- Higher floristic abundance and diversity in the Malause Station (i.e., low flow conditions and fine substrate) compared to the Monestié Station (i.e., high flow conditions and coarse substrate).

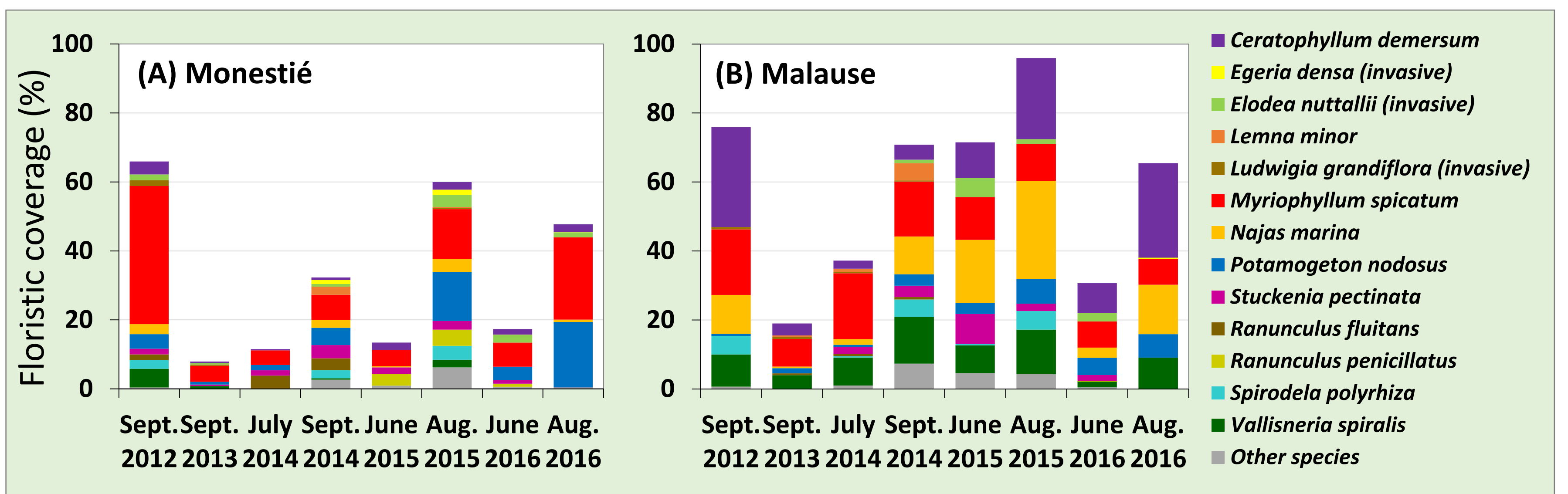


Figure 3. Floristic abundance and diversity in (A) Monestié and (B) Malause stations on the Garonne River.

- Positive linear trend between the macrophyte coverage (%) and the accumulated water T°C > 15°C during the growing season (spring) and negative linear trend between % coverage and deviation from average water discharge (Figs. 4A & 4B).
- Warm T°C and low flow conditions in the spring => key factors affecting annually the maximum abundance of macrophytes during the summer.

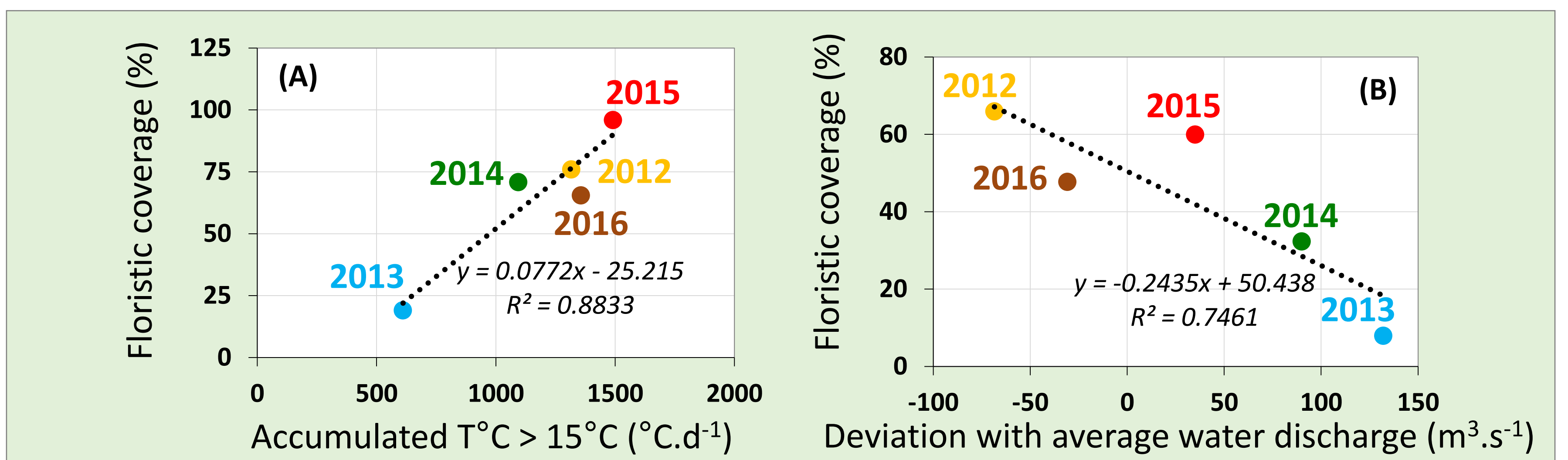


Figure 4. Relationships between (A) floristic coverage and accumulated water T°C > 15°C in the spring at Malause station (B) floristic coverage and deviation with average water discharge at Monestié station.

Site 2 (Rhône River)

- Peak of floristic abundance in Sept. 2011, sharp decrease in 2013 and the following years (Fig. 5A)
- Positive linear correlation between floristic coverage in summer and accumulated water T°C during the growing season (Fig. 5B).
- As for the Garonne River, warm water T°C and low discharge during the growing period (spring) can affect the intensity of annual macrophyte abundance on the Rhône River.

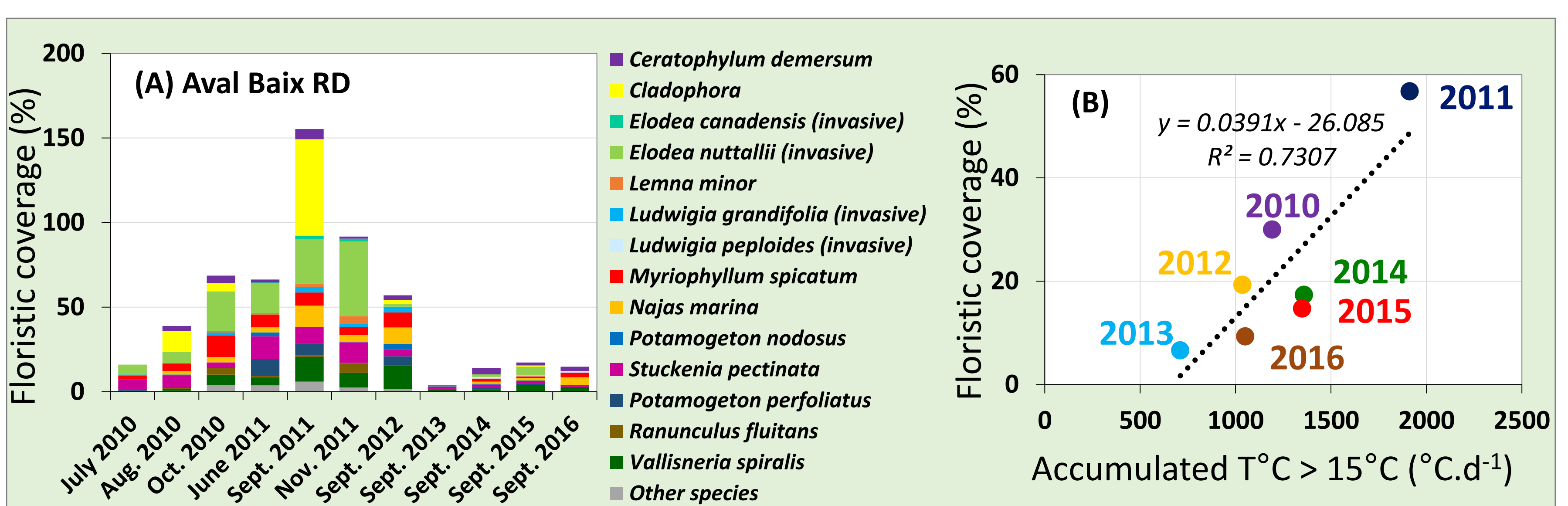


Figure 5. (A) Floristic abundance and diversity in Aval Baix RD station and (B) relationships between floristic coverage and accumulated water T°C > 15°C in the spring on the Rhône River.