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Response of riparian vegetation to the restoration of lateral connectivity: the case of the dismantling of old groyne fields on the Rhône River

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Introduction

Massively developed with dams and dykes, many rivers have a freedom space reduced to a single channel, morphologically homogeneous. Aware of the links between water quality, hydro-sedimentary dynamics and biodiversity, several restoration projects aim to give rivers a greater space of freedom. By dismantling historical dikes that limit the expression of hydro-geomorphological processes, beneficial effects on biodiversity are expected.

The Rhône is a powerful river that has been highly degraded by two development phases:

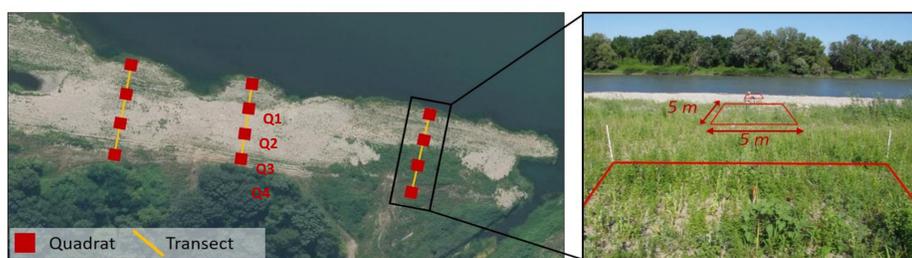
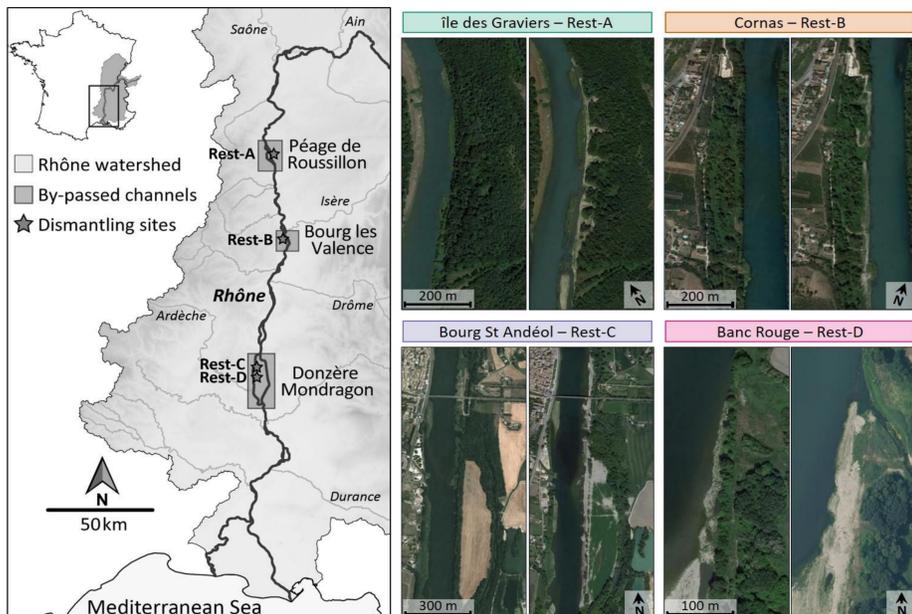
- A rectification phase in the 19th century, characterized by the building of a vast system of dikes in the main channel (called casiers Girardon),
- A derivation phase in the 20th century, characterized by the construction of a series of lateral canals, running parallel to the natural Rhône River channel.

To restore the hydro-geomorphological processes, as well as the ecological functioning of some sections of the Rhône bypassed sections, the dismantling of a portion of the historic lateral protection structures, i.e. groyne fields, was initiated in 2017. The work consisted of dismantling the old infrastructures and redesigning the banks to promote contrasting topographic profiles and allow erosion. To assess the effects of these works on riparian vegetation, a monitoring program of the restored sites has been set up.



Materials and Methods

- System: Rhône (length = 810 km, catchment = 96,500 km², mean flow = 1,700 m³/s);
- Sampling design: 4 sites restored since 2017 in bypassed sections where the banks were reprofiled following the dismantling of several hundred meters of groyne fields;
- Vegetation data: study of communities within quadrats along the flooding gradient + plant survey according to the Braun-Blanquet abundance-dominance methodology;
- Environmental data: soil texture (thickness and percentage of fine sediments) + topographic (distance and relative elevation from the waterline) measurements.

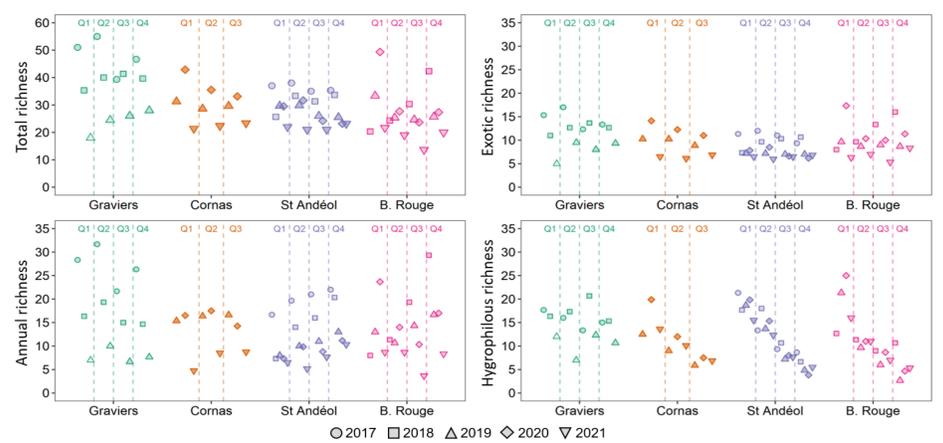


Location of study reaches along the Rhône River, aerial photos of the dismantled sites before and after the work, and sampling design used to study riparian vegetation

Results

Restored sites were quickly recolonized by many riparian plants, with an average of 33 species per quadrat (minimum = 16, maximum = 66) but high variation between years:

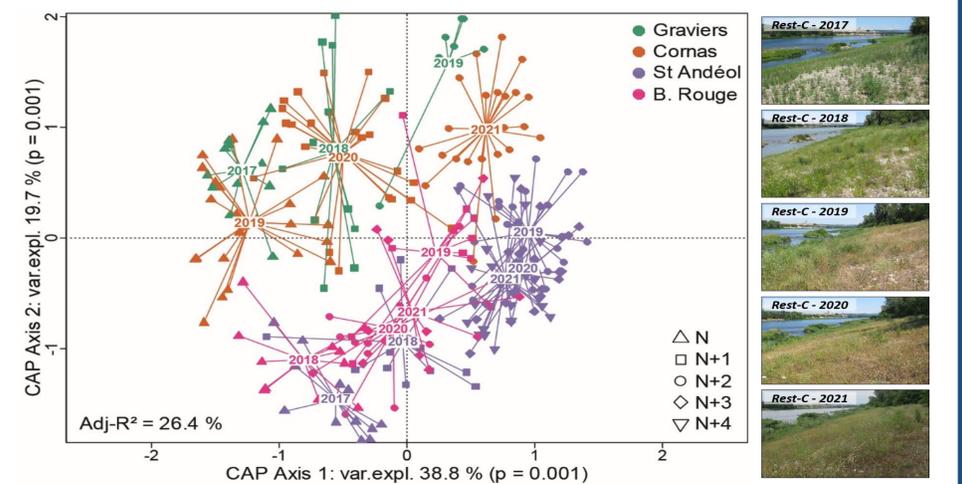
- Many annual species from the soil seed bank initially colonized the recreated surfaces (*Artemisia annua*, *Chenopodium album*, *Echinochloa crus-galli*) and then declined due to the establishment of perennial species (*Phalaris arundinacea*, *Phragmites australis*);
- Secondary succession has benefited several exotic species (*Ambrosia artemisiifolia*, *Cyperus eragrostis*, *Artemisia verlotiorum*) that tend to decline over time;
- Variations in hygrophilous species richness, depending on the position of the quadrat, illustrate the progressive structuring of riparian communities along the flood gradient;
- The strong decrease in species richness in 2021, mainly annuals species, reflects the response of communities to the July five-year flood of the Rhône.



Variations in mean species richness for each site and year, depending on the position of the quadrat along the flooding gradient

Changes in species composition between years reveal consistency in the successional trajectories followed by riparian communities between the 4 restored sites:

- The first axis is related to the time spent since the works and shows that the composition varies in the same direction despite a lag in the dismantling of the sites;
- The second axis is related to the position along the river corridor, with a clear structuring of communities between the northern and southern sites;
- At the St Andéol site, community dynamics stabilize after three years, suggesting an equilibrium between the species and the recreated environmental conditions;
- At the Banc Rouge site, a regressive succession occurred between 2019 and 2020, reflecting community response to plowing operations conducted by Rhône managers.



Canonical analysis of principal coordinates testing changes in species composition for each site as a function of time since completion

Conclusion

- By removing the riprap and reprofiling the banks, the dismantling works recreated diverse environmental conditions that supported a wide diversity of plant species;
- By reconnecting the margins to the river, the works have favored hygrophilous communities rich in annual pioneer species (*Persicaria* spp, *Bidens* spp, *Cyperus* spp);
- The surfaces were also colonized by numerous exotic species and competitive clonal plants with high covers, which may lead to a homogenization of communities over time;
- Restoring the functionality of riparian zones in highly anthropized rivers requires a more integrative approach, including the reactivation of the river erosive capacities and channel mobility, associated with bedload transport.

Financial support



References

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