Dismantling lateral river structures to restore biodiversity: short-term effects on riparian plant communities

Démanteler des ouvrages latéraux en rivière pour restaurer la biodiversité : effets à court terme sur les communautés de plantes riveraines

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Introduction - Objectives

Rivers and floodplains are biodiversity hotspots. Human activities disrupt hydro-sedimentary dynamics, causing habitat homogenization and biodiversity loss. We studied the response of riparian plant communities to process-based restoration aiming to reactivate erosion processes following dyke removal and bank reprofiling at five sites (Fig. 1), in the first three years after work completion, along the regulated Rhône river. Two main questions were addressed :

- Do restored sites show environmental and biotic conditions similar to reference or control sites ?
- When accounting for local conditions, do plant communities resemble those of reference or control sites ?

Figure 1. *illustration of the five sites at the end of the work in the bypassed sections of the Rhône.*

Materials and Methods

- The Rhône, a large and highly regulated and channelized river (length = 810 km, catchment = 96,500 km², mean flow = 1,700 m3/s) ;
- 25 sites (n quadrats = 486) along a 250 km north-south corridor : 5 restored sites, 12 control sites (relict and fixed bars) and 8 reference sites (dynamic bars) (Fig. 2) ;
- Biotic response: plant communities within quadrats positioned along transects + survey with Braun-Blanquet abundance-dominance methodology ;
- Abiotic data: thickness and percentage of fine sediments; distance and relative elevation from the waterline ;
- Analysis of variations in abiotic and biotic conditions between restored, control and reference sites + analysis of biotic response at the quadrat scale, controlling for differences in abiotic conditions between sites.

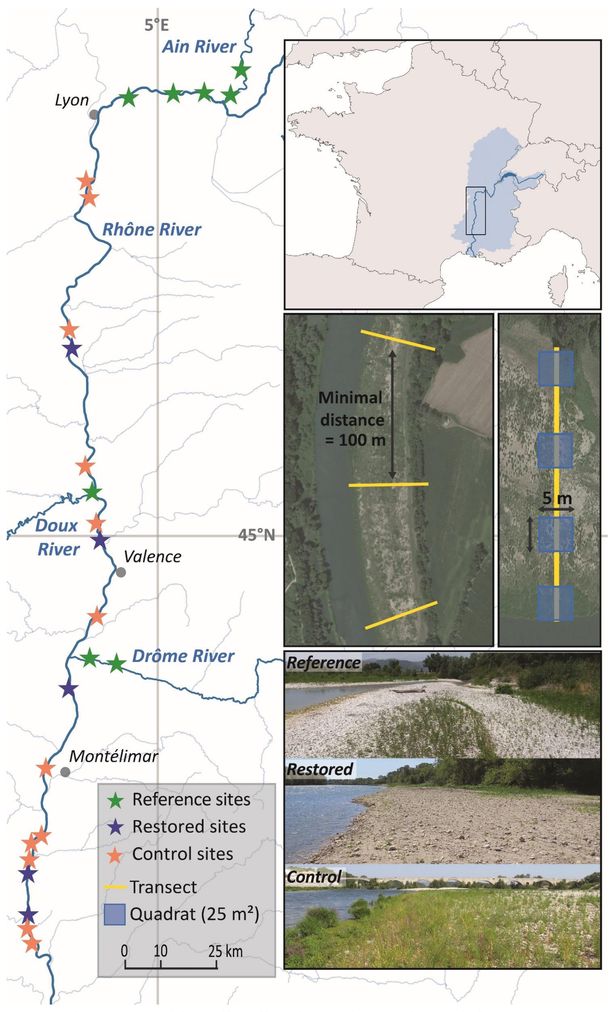

Figure 2. *Site distribution along the Rhône and tributaries and form of the sampling design.*

Results

Overall, the restored sites were steeper, closer to the water line and had higher amounts of fine sediments compared to control and reference sites (Fig. 3).

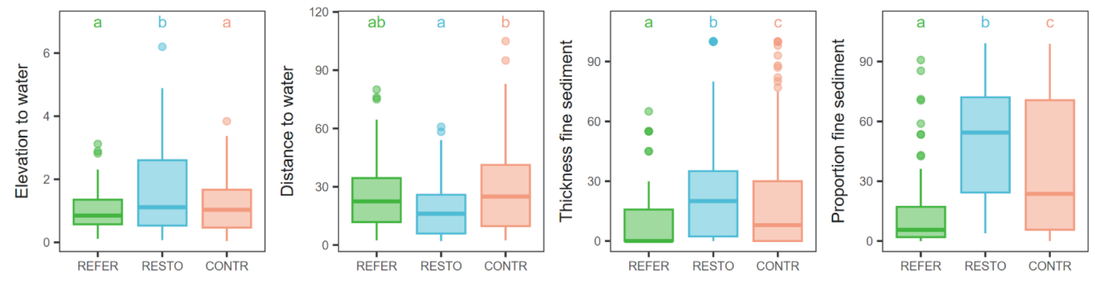

Figure 3. *Variations in abiotic conditions between reference, restored and control sites.*

Total and alien species richness were significantly higher at restored sites during the first two years following dyke removal, but declined thereafter and reached levels comparable to those observed at control/reference sites. In contrast, cumulative vegetation cover at restored sites increased continuously over the study period and exceeded that of both control and reference sites after three years. In terms of species' traits, the restored sites experienced pronounced temporal shifts. Light-demanding and tap-rooted pioneer species declined steadily, indicating a transition towards stable species assemblages. Concurrently, species with clonal growth, perennial life cycles and higher water requirements increased significantly, reflecting a gradual adaptation of plant communities to stable flows on the Rhône (Fig. 4).

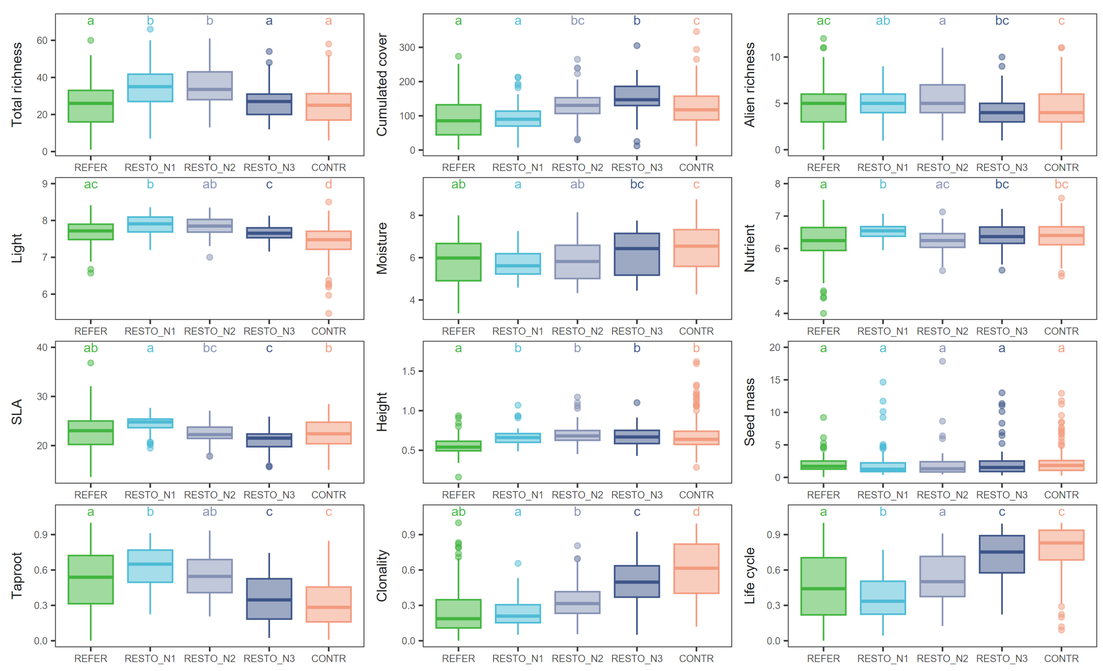

Figure 4. *Variations in taxonomic metrics and mean values of ecological, morphological and life-history traits between reference, restored and control sites.*

In addition, six clusters of quadrats sharing similar abiotic conditions between the three sites types were identified, ranging from strongly connected quadrats with coarse sediments to disconnected quadrats with thick layers of fine sediments. Despite controlling for difference in abiotic conditions, quadrats in restored sites followed similar temporal trajectories to those observed at site scale. This includes, for all cluster, a shift from communities in restored quadrats to those in control quadrats, marked in particular by a decline in traits reflecting species adaptation to frequent disturbance.

Conclusion

Dyke removal initially enhance biodiversity. However, plant communities at restored sites diverged rapidly from reference conditions and stabilized within three years. This is undoubtedly linked to the regulation and stabilization of flows on the Rhône, and illustrates the importance of re-establishing dynamic fluvial processes in restoration actions.

Financial support

This work is part of RhônEco, an interdisciplinary scientific program to monitor the restoration of the Rhône
https://www.rhoneco.fr

Suivi scientifique de la restauration du Rhône

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