30 years of restoration works on the two sides of the Upper Rhine River: feedback and future challenges

30 ans de travaux de restauration sur les deux rives du Rhin supérieur : retour d'expérience et défis futurs

Schmitt L.[1], Trémolières M.[2], Blum C.[3], Dister E.[4], Pfarr U.[5] et al.

[1]Université de Strasbourg, LIVE ERL 7230 CNRS, Faculté de Géographie, 3 rue de l'Argonne, 67083 Strasbourg cedex, France (laurent.schmitt@unistra.fr). [2]Université de Strasbourg, Laboratoire d'Hydrologie et de Géochimie de Strasbourg (LHYGES), Institut de Botanique, 28 rue Goethe, 67083 Strasbourg, France. [3]Région Alsace, Direction de l'Environnement et de l'Aménagement, Service préservation des ressources naturelles, 1 Place Adrien ZELLER, BP 91 006, 67070 Strasbourg cedex, France. [4]Karlsruher Institut für Technologie, Institut für Geographie und Geoökologie, Bereich WWF-Auen-Institut, Josefstraße 1, 76437 Rastatt, Deutschland, [5]Regierungspräsidium Freiburg, Referat 53.3, Bissierstraße 7, 79114 Freiburg, Deutschland.

RÉSUMÉ

Le Rhin Supérieur a été lourdement impacté par les aménagements successifs, avec notamment une simplification morphologique, d'importantes altérations écologiques et une accentuation du risque d'inondation en aval du tronçon canalisé. Dans ce contexte, de nombreux projets de restauration ont vu le jour depuis environ 30 ans. La plupart d'en eux concerne des travaux de reconnexion de chenaux et/ou de ré-inondation de compartiments de la plaine alluviale, lesquels ont été développés dans certains cas dans le cadre d'un programme de rétention de crue. Dans beaucoup de cas, mais pas de façon systématique, les sites restaurés ont fait l'objet de suivis environnementaux aux fins d'évaluer si les objectifs de restauration ont été atteints et de caractériser les évolutions des sites. Le présent travail apporte un retour d'expérience international et interdisciplinaire des résultats des suivis et de ce qu'il est possible d'en déduire sur les tendances évolutives à court et long termes. Il met également en exergue les défis futurs dans la perspective de promouvoir une vision globale de la restauration du Rhin Supérieur. La création d'une base de données partagée et des échanges d'expériences apparaissent particulièrement utiles pour le développement de futures restaurations intégrant les diverses fonctions de l'hydrosystème.

ABSTRACT

As the Upper Rhine River Valley has been heavily impacted by engineering works (morphological simplification, important ecological alterations, increase of flood risk downstream the canalized reach…), it has been concerned since about 30 years by many restoration projects. Most of them concern lateral channel re-connection and/or floodplain compartments re-flooding, and sometimes they have been developed in the frame of a flood retention program. In many cases, but not in all, the restored sites have been monitored in order to evaluate if the restoration objectives are reached and to assess the evolution trend of the sites. This paper gives an international, interdisciplinary feedback on the monitoring results and on what we can learn from them concerning short and long term evolutions. It also highlights future challenges in order to promote a global view of the restoration of the Upper Rhine. The creation of a shared data base and exchanges of experiences appear particularly useful for future restorations integrating the multiple functions of the hydrosystem.

MOTS CLES

30 years long restoration works, feedback, French and German sides, future challenges, Upper Rhine.

1 INTRODUCTION AND OBJECTIVES

The Upper Rhine River Valley has been heavily impacted by engineering works, since the middle of the 19th century until 1977 (end of the power plant and lock constructions). Between Basle and Karlsruhe, the area concerned by our studies, the former channel pattern exhibited a strong downstream evolution from braiding (Basle-Breisach, but also further downstream), anastomosing (mostly from Breisach to Strasbourg) to meandering (progressively downstream Strasbourg) (Carbiener and Schnitzler, 1990). Hydrological regime and processes of sediment transport and deposition have been strongly impacted, in the main channel, the lateral channels as well as in the floodplain. This induced a drastic simplification of the pattern, the disconnection of anastomosing and braiding channels and important ecological alterations. The canalization increased also significantly flood risk downstream Iffezheim which is the downstream end of the canalized section.
For about three decades many restoration projects have been developed at both river sides aiming at reconnecting the main channel to anastomosing channels or former braiding channels, re-flooding some former compartments of the floodplain, etc. Some projects were developed in the frame of an international flood retention program (French-German Convention, 1982), considering that hydrological and ecological objectives are not mutually exclusive but can offer a mutual benefit (Dister *et al*., 1990). In many cases, but not in all, the restored sites have been monitored in order to evaluate if the restoration objectives are obtained and to assess the evolution trend of the site.
After a brief presentation of the restoration projects that have been carried out and an overview of the different implemented monitoring programs, this paper (i) gives a feedback on the monitoring results and of what we can learn from them concerning short and long term evolutions and (ii) highlights future challenges in order to promote a global, interdisciplinary view of restoration measurements of Upper Rhine River, which integrates the river's multiple functions.

2 METHODS

This approach is based on the elaboration of an international data base of the different restoration and monitoring programs. Expert opinion from managers and scientists concerned by the restoration of the Rhine is also needed.

3 RESULTS – DISCUSSION - CONCLUSION

Many restorations have been carried out since about 1980, and some are presently developed (fig. 1). On the French side some examples are following: projects from the City of Strasbourg in the suburban forests of the Robertsau and the Neudorf-Neuhof (≈1978-1990), restorations performed in the frame of the "Sandoz Funds" (≈1986-1995), restorations concerning the French nature reserves, restorations implemented in the frame of the "Polder of Erstein" (2004), the European LIFE project "Rhin Vivant" (2002-2006), the European project INTERREG IIC IRMA, etc. On the German side, we can also quote many projects: the large hydrological and ecological « Integrated Rhine Program » (since 1996), the European INTERREG project "Revitalisation of Taubergiessen" (2006-2007), the European project LIFE Program Lebendige Rheinauen bei Karlsruhe (2004-2010), etc. The Interreg-IVA project "Redynamization of the Old-Rhine" (2009-2012) concerns the main channel and its both French and German banks.
While the first restorations were frequently little and not followed by environmental monitoring, more recent projects are generally more ambitious, in terms of spatial extend and natural processes which are restored, and encompass monitoring. For example, the restoration measurements in the Erstein polder, which included re-flooding and channel re-connection, were followed by a scientific monitoring with an interdisciplinary approach over a relatively long period (six years). It combines hydrology, hydromorphology, hydrogeology, water chemistry and studies of different biological compartments (Schmitt *et al*., 2009). Nevertheless, the important number of different managers and actors concerned by restoration makes it difficult to have an overview of what is done and of which goals could be shared. Feedback from the implemented monitoring programs seems also insufficiently developed.
Some recent projects like the European project LIFE+ "Restauration de la dynamique des habitats alluviaux rhénans sur l'île du Rohrschollen" appear particularly innovative for the French side because they aim at restoring active morphodynamics in an anastomosing channel, despite some hydraulic constraints; learning from the planed monitoring of this restoration will be particularly instructive in the future. More generally, the German experience of some ambitious restorations of anastomosing rivers (restoration of active in-channel morphodynamics), and monitoring, is potentially helpful for the French side, where such kind of restoration is only emerging. Furthermore, the INTERREG project "Redynamization of the Old-Rhine" (see also the papers presented by Arnaud *et al*. and Beal *et al*.) is

a first international program aiming to define scenarios in order to restore bedload transport and morphodynamics in the main channel.
We promote for the future an international view of the restoration of the Rhine River and its floodplain, the comparison of monitoring results, the creation of a shared data base, in order to accumulate and exchange experiences from the past to improve future restorations and to rehabilitate more effective and sustainable fluvial processes. An international and interdisciplinary network of managers and scientists concerned with the restoration of the Upper Rhine could provide good practice advices for existing and future restorations along the Upper Rhine, notably in the frame of the designation of both sides of the Upper Rhine River as an international Ramsar site.

LIST OF REFERENCES

Carbiener, R. and Schnitzler, A. (1990). Evolution of major pattern models and processes of alluvial forest of the Rhine in the rift valley (France/Germany). *Vegetatio*, 88 (2), 115-129.

Dister, E., Gomer, D., Obrdlik, P., Petermann, P. and Schneider, E. (1990). Water management and ecological perspectives of the Upper Rhine's floodplains. *Regulated Rivers. Research and Management*, 5(1), 1-15.

Schmitt, L., Lebeau, M., Trémolières, M., Defraeye, S., Coli, C., Denny, E., Beck, T., Dillinger, M., Dor, J.C., Gombert, P., Gueidan, A., Manne, S., Party, J.P., Perrotey, P., Piquette, M., Roeck, U., Schnitzler, A., Sonnet, O., Vacher, J.P., Vauclin, V., Weiss, M., Zacher, N., Wilms, P. (2009). Le « Polder » d'Erstein : objectifs, aménagements et retour d'expérience sur cinq ans de fonctionnement et de suivi scientifique environnemental (Rhin, France). *Ingénieries Eau-Agriculture-Territoires*, n° spé., 67-84.

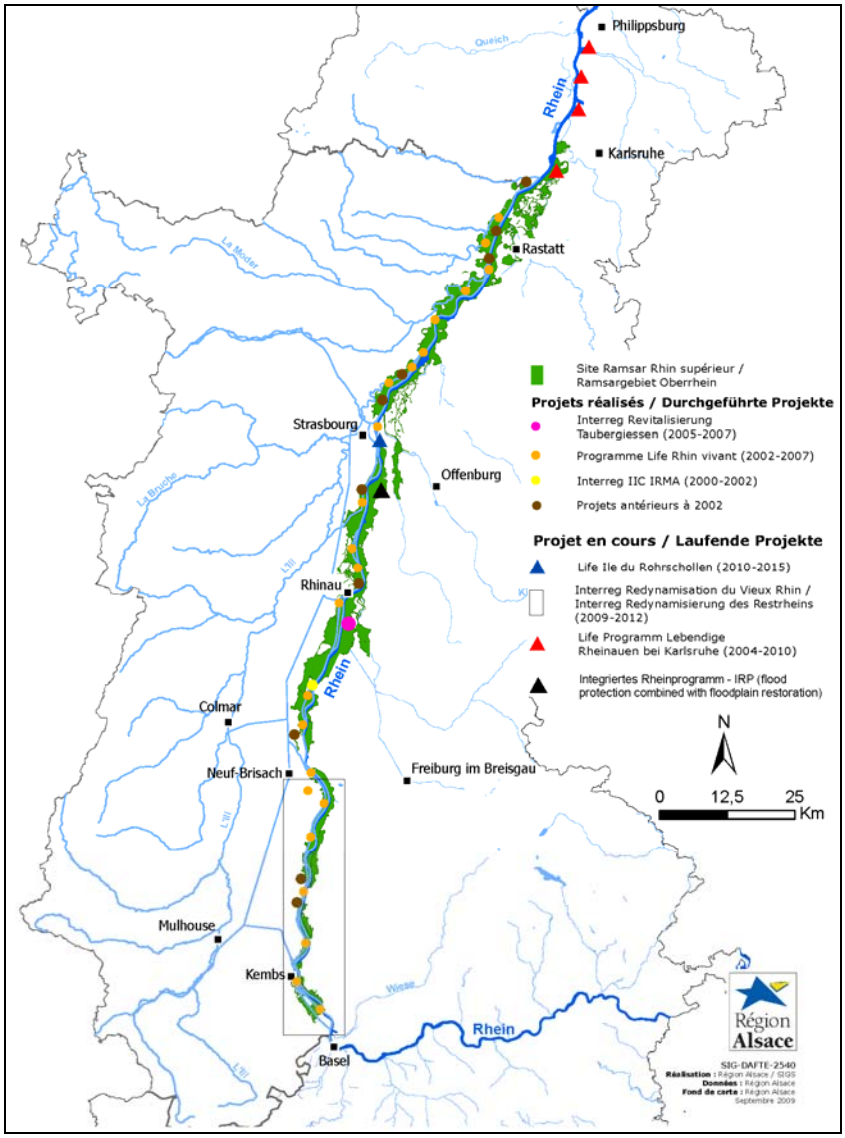

Figure 1: Map of the past and present restoration projects on the French and German sides of the Upper Rhine River (© Région Alsace).