The non-indigenous aquatic macroinvertebrates in the French Upper-Rhône floodplain: distribution, modelling and impact of restoration works.

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SUMMARY

European aquatic ecosystems undergo nowadays several threats including invasions by non-indigenous macroinvertebrates and the construction of man-made structures such as dams and dykes. The Upper-Rhône floodplain (France) is an example of such modifications. It is also currently subjected to an hydrological and ecological restoration program, which started in 2003.

The aims of this study are to inventory the non-indigenous species in two sectors of the French Upper-Rhône floodplain (Belley and Brégnier-Cordon) and to assess their distribution in these sectors. Moreover, the influence of environnemental variables on these species is examined with modelling tools. An other purpose is to assess the effects of restoration on two floodplain waterbodies and to determine if the spread of the non-indigenous species is facilitated by the rehabilitation of these waterbodies.

Habitat variables, together with the invertebrate samples, were collected according to a standardized method in 25 floodplain waterbodies of the two sectors between 2002 and 2005.

The analyses carried out brought to light several points: hydrological connectivity increased and the taxonomic composition of the community changed in the two waterbodies after restoration. The non-indigenous species spread over due to the change in environmental condition. 8 non-indigenous species were identified in the two sectors: the gastropods *Physella acuta*/*heterostropha*, *Gyraulus parvus* and *Potamopyrgus antipodarum*, the bivalves *Corbicula fluminea* and *Dreissena polymorpha*, the amphipods *Crangonyx pseudogracilis* and *Dikerogammarus villosus* and the decapod *Orconectes limosus*. The Generalized Additive Models (GAMs) calculated for the 4 most frequent species (the three gastropods and *Corbicula fluminea*) did not reveal shared caracteristics among these non-indigenous species. Nethertheless, these models and the knowledge that we have on non-indigenous species enabled us to locate 6 of the 8 species along the gradient of transversal dynamic of the Upper-Rhône floodplain. The Rhône River is the main vector of spread of these species. However, an other mean of dispersion has been highlighted for *Gyraulus parvus* which colonizes aquatic biotopes that are disconnected from the river.

It is important to monitor the changes of non-indigenous species in the Upper-Rhône floodplain waterbodies since these species could strongly influence the indigenous communities in this area. Especially, it is worth paying a special attention to the little Planorbid Gastropod *Anisus vorticulus* listed in the European Habitat Directive, which is present in some waterbodies of the Upper-Rhône floodplain and potentially under threat due to the locally massive expansion of *G.parvus*.

Keywords: invasive species, non-indigenous species, restoration, floodplain, modelling, Upper-Rhône, river.