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The nursery function of artificial floodplain habitats in the lower Rhine and Meuse for riverine fish

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Introduction

Natural river-floodplain ecosystems exhibit a hydrodynamic gradient from the main channel to inundation-free areas. A wide variety of riverine habitats exists along this gradient, in space and time, created by the dynamic interaction of water, sediment and biota, leading to high biodiversity (Ward et al., 2002; de Nooij et al. 2006). The ecological status of the lower Rhine and Meuse has declined severely, reaching an all-time low status during the ’80 of the 20th century due to water pollution and habitat modifications which reduced the spatial heterogeneity (Aarts et al., 2004), as well as the variation in hydrodynamic conditions along the lateral gradient in the floodplain (e.g. the construction of dikes, dams, groynes and weirs, conversion of floodplains to agricultural land).

Water quality has improved during the last two decades and this resulted in the first signals of recovery for various fish species, including river lamprey (*Lampetra fluviatilis*), ide (*Leuciscus idus*), common nase (*Chondrostoma* nasus) and barbell (*Barbus barbus*) (Admiraal et al., 1993; Grift et al. 2003). Despite water quality improvements, there is little space to restore suitable habitat within the main channel, due to constraints resulting from safety and navigation. Habitats present within the main channel consist of wave exposed sand, gravel and/or stone-blocks. Lack of suitable habitat could constrain further rehabilitation of riverine fish populations. In contrast, outside the main channel, both rivers provide good opportunities to restore riverine habitats within the floodplains (Bij de Vaate et al. 2006; Verberk et al. 2009). Various habitat rehabilitation projects have been realized within the Rhine and Meuse river floodplains during the last twenty years that resulted in new shallow water habitat types such as secondary side channels and oxbow lakes.

Earlier studies found high densities of juvenile riverine fish within some of these habitats (Grift et al., 2003), illustrating their potential as nursery habitat for juvenile fish. The last two decades have seen a rapid increase in the number of rehabilitation projects. This enabled us to evaluate and generalize the value of different types of artificial floodplain habitats (two types of secondary side channels and two types of oxbow lakes, Fig. 1)) for juvenile fish in comparison with habitats in the main channel (exposed sand, gravel and/or stone-blocks).

Methods

An extensive field survey in 2009 on 28 locations in the rivers Rhine and Meuse was undertaken (Dorenbosch et al. 2011) to examine habitat utilization of these habitats by

juvenile riverine fish (i.e., densities and species composition) and how habitat use depends on spatial configuration, substrate type, hydromorphology and various other (a)biotic variables. Fish sampling was conducted by seine-netting and electrofishing.

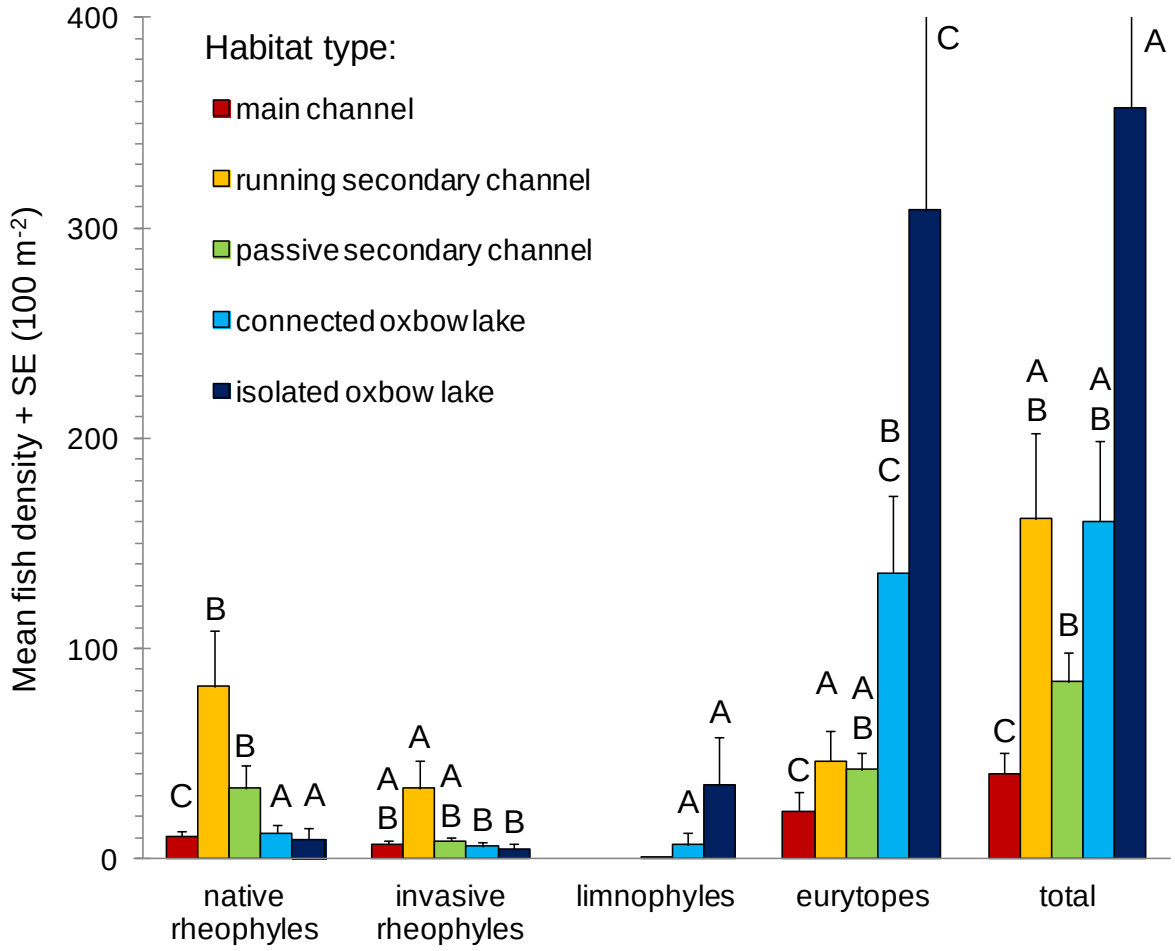

Figure 1. Mean fish densities (species pooled in functional groups) based on seine-netting data in the five investigated habitat types (n=28) in the lower Rhine and Meuse.

Results and conclusions

Fish densities were highest in oxbow lakes, and lowest in exposed habitats in the main channel. Densities for native rheophilic fish were highest in secondary side channels (Fig. 1). Ide profited most from the habitat restoration, while Dace and Chub profited less. The size of secondary channels proved important: larger channels harbor higher densities and number of species, possibly because larger channels incorporate a higher diversity of habitats (higher internal heterogeneity). Recommendations for improvement are to ensure a minimum base flow, create more internal heterogeneity within newly created floodplain habitats and within a river reach aim to create different types of habitats.

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