Modeling invasive alien plant species in river systems: Interaction with native ecosystem engineers and effects on hydro-morphodynamic processes (van Oorschot et al 2017) [1]

Invasive alien plant species negatively impact native plant communities by out-competing species or changing abiotic and biotic conditions in their introduced range. River systems are especially vulnerable to biological invasions, because waterways can function as invasion corridors. Understanding interactions of invasive and native species and their combined effects on river dynamics is essential for developing cost-effective management strategies. However, numerical models for simulating long-term effects of these processes are lacking. This paper investigates how an invasive alien plant species affects native riparian vegetation and hydro-morphodynamics. A morphodynamic model has been coupled to a dynamic vegetation model that predicts establishment, growth and mortality of riparian trees.

We introduced an invasive alien species with life-history traits based on Japanese Knotweed (Fallopia japonica), and investigated effects of low- and high propagule pressure on invasion speed, native vegetation and hydro-morphodynamic processes. Results show that high propagule pressure leads to a decline in native species cover due to competition and the creation of unfavorable native colonization sites. With low propagule pressure the invader facilitates native seedling survival by creating favorable hydro-morphodynamic conditions at colonization sites. With high invader abundance, water levels are raised and sediment transport is reduced during the growing season. In winter, when the above-ground invader biomass is gone, results are reversed and the floodplain is more prone to erosion. Invasion effects thus depend on seasonal above- and below ground dynamic vegetation properties and persistence of the invader, on the characteristics of native species it replaces, and the combined interactions with hydro-morphodynamics.

Editor's Highlight: This paper proposes a modelling approach to include the main interactions between native and invasive species, and the processes that determine the effects of the vegetation on the river morphology. This is based in the coupling of two pre-existing models, one ecohydrological model that allows the prediction of plant dynamics, and one hydro-morphological that sets the morphodynamics of the stream. Linking ecological-hydrological-morphological processes in modelling approaches is an interesting prospect that could lead to possibilities for improvement. The results suggest that alien species characteristics (e.g., low or high propagule diffusion) may help native vegetation towards coexistence or lead to its decline, respectively. This is the first paper that proposes such a comparison.

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[1] https://reformrivers.eu/modeling-invasive-alien-plant-species-river-systems-interaction-native-ecosystem-engineers-and
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