Plants as river system engineers (Gurnell 2014) [1]

Plants growing within river corridors both affect and respond to fluvial processes. Their above-ground biomass modifies the flow field and retains sediment, whereas their below-ground biomass affects the hydraulic and mechanical properties of the substrate and consequently the moisture regime and erosion susceptibility of the land surface.

This paper reviews research that dates back to the 1950s on the geomorphological influence of vegetation within fluvial systems. During the late twentieth century this research was largely pursued through field observations, but during the early years of the twenty-first century, complementary field, flume and theoretical/modelling investigations have contributed to major advances in understanding the influence of plants on fluvial systems. Flume experiments have demonstrated the fundamental role of vegetation in determining river planform, particularly transitions from multi- to single-thread forms, and have provided insights into flow–vegetation–sediment feedbacks and landform building, including processes such as channel blockage and avulsion. At the same time, modellers have incorporated factors such as moisture-dependent plant growth, canopy and root architecture and their influence on flow resistance and sediment/bank reinforcement into morphodynamic models. Meanwhile, field investigations have revealed that vegetation has a far more important and complex influence on fluvial systems than previously realized.

It is now apparent that the influence of plants on river systems is significant across space scales from individual plants to entire forested river corridors. Small plant-scale phenomena structure patch-scale geomorphological forms and processes, and interactions between patches are almost certainly crucial to larger-scale and longer-term geomorphological phenomena. The influence of plants also varies continuously through time as above- and below-ground biomass change within the annual growth cycle, over longer-term growth trajectories, and in response to external drivers of change such as climatic, hydrological and fluvial fluctuations and extremes.

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