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Biogeomorphic feedbacks within riparian corridors: the role of positive interactions between riparian plants

Dov Corenblit, Johannes Steiger, and Irène Till-Bottraud
University Clermont Auvergne, France (dov.corenblit@univ-bpclermont.fr)

Riparian vegetation affects hydrogeomorphic processes and leads to the construction of wooded fluvial landforms within riparian corridors. Multiple plants form dense multi- and mono-specific stands that enhance plant resistance as grouped plants are less prone to be uprooted than free-standing individuals. Riparian plants which grow in dense stands also enhance their role as ecosystem engineers through the trapping of sediment, organic matter and nutrients. The wooded biogeomorphic landforms which originate from the effect of vegetation on geomorphology lead in return to an improved capacity of the plants to survive, exploit resources, and reach sexual maturity in the intervals between destructive floods. Thus, these vegetated biogeomorphic landforms likely represent a positive niche construction of riparian plants. The nature and intensity of biotic interactions between riparian plants of different species (inter-specific) or the same species (intra-specific) which form dense stands and construct together the niche remain unclear. We strongly suspect that indirect inter-specific positive interactions (facilitation) occur between plants but that more direct intra-specific interactions, such as cooperation and altruism, also operate during the niche construction process. Our aim is to propose an original theoretical framework of inter and intra-specific positive interactions between riparian plants. We suggest that positive interactions between riparian plants are maximized in river reaches with an intermediate level of hydrogeomorphic disturbance. During establishment, plants that grow within dense stands improve their survival and growth because individuals protect each other from shear stress. In addition to the improved capacity to trap mineral and organic matter, individuals which constitute the dense stand can cooperate to mutually support a mycorrhizal fungi network that will connect plants, soil and ground water and influence nutrient transfer, cycling and storage within the shared constructed niche. During post-establishment, the probability of finding functional natural root grafting between neighbour trees increases, which could represent a biomechanical and physiological advantage for anchorage and nutrient acquisition and exchange. These stands remain dense on alluvial bars until a threshold of landform construction and hydrogeomorphic disconnection is reached. We suggest that intra-specific competition for resources then increases and induces a density reduction in the stand (i.e. self-thinning), linked not only to competition but potentially also to altruism. This may be due to a grafted root system and the death of aboveground stems of some of the grafted individuals, resulting in more space for the development of the tall competitive individuals, whereas the initial riparian biogeomorphic landform turns more and more into a terrestrial biogeomorphic landform.