Can an alternate biogeomorphological state be triggered by short-term hydrological fluctuations in modified monsoon-driven river systems?

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Abstract

Over the last decade, rapid vegetation colonization and changes in channel morphology have been observed in the Naeseongcheon Stream in South Korea, which were linked to short-term hydrological fluctuations under a changing monsoon climate. The surface area covered by vegetation has been increasing; this increase intensified after the 2014–2015 drought, which provided a window of opportunity for vegetation establishment. During the drought, pioneer herbaceous vegetation densely colonized the lower floodplains, including bare sandbars and temporarily exposed riverbed. Although the colonized lower floodplain and river banks were partially rejuvenated by several subsequent floods, succession to woody vegetation continued, resulting in stable vegetation cover in areas that had previously been bare. Moreover, sediment carried by flood water was deposited on and around the vegetated areas, and the low-water channel was incised, causing vertical development of river topography. In addition, the main channel width decreased in previously relatively wide sites, and secondary channels formed. The results of this study show that river rejuvenation by floods may decrease owing to systemic changes in the river system. Therefore, we concluded that the Naeseongcheon watershed was primed by human-induced changes, which made the river system more susceptible to changes in rainfall and discharge due to climate change. Furthermore, after the initial vegetation colonization, changes in nutrients and temperature created a positive feedback loop, which reinforced vegetation establishment.

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