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Towards a better understanding of past biotic drivers of river and floodplain geomorphology

Annegret Larsen[1], Tony Reimann[1], Christoph Sperisen[2], Vincent Robin[3], and Stuart N Lane[4]
[1]Wageningen University and Research, Soil Geography and Landscape, Soil Geography and Landscape, Wageningen, Netherlands (annegret.larsen@wur.nl)
[2]Waldböden und Biogeochemie, Eidgenoessische Forschungsanstalt WSL, Switzerland
[3]Laboratoire Interdisciplinaire des Environnements Continentaux UMR 7360 CNRS, Université de Lorraine, France
[4]Institute of Earth System Dynamics, Université de Lausanne, Lausanne, Switzerland

Geomorphology has long considered the role of abiotic factors in geomorphic processes, including tectonics, geology, climate and relief, as well as humans impact upon them. Biotic factors however, including not only plants but also bacteria and protists, biofilms, fungi, insects, invertebrates, and animals are increasingly recognized as governing geomorphic processes on many spatial and temporal scales. We argue that if fauna are important as geological agents, then understanding the complex response of geomorphic systems to fauna is necessary to understand the past, present and future of the fluvial environment. It is not surprising that studies of the Late Quaternary evolution of fluvial morphodynamics have largely focused upon changes in the sedimentary soil-sediment sequences that result from climate change; (ii) vegetation change; and/or (iii) human impacts. Reconstruction of vegetation and climate from pollen and other records facilitates these analyses. But if animals are shown to be an important influence on geomorphic processes today, then it is quite possible that they were also important historically. For example, conclusive interpretation of Holocene river changes may be limited because of an incomplete or partial account of the presence and/or absence of data on the role of ecosystem engineers in modifying the riparian and aquatic ecosystems, including hydro-geomorphic processes. DNA found within historical deposits may be used to constrain the role of past ecosystem engineers. Analysis of ancient environmental DNA up to date includes palaeo-environmental DNA from sedimentary deposits (sedaDNA) from disseminated genetic material found within sedimentary archives, including paleo-dietary ancient DNA. Here, we use an analogue study investigating the present hydro-geomorphic and biogeochemical changes that the ecosystem engineer beaver (Castor fiber) creates at four sites in central Europe to better understand and quantify the effects of beaver ecosystem engineering on a seasonal to decadal scale. We utilize these results to interpret the chrono-stratigraphy of two Holocene beaver sites, including macro-fossil and sedaDNA sampling, and test for the first time if sedaDNA can support the investigation of beaver-induced palao-environmental conditions in river floodplains. We find that sedaDNA data and other palaeo-botanical proxies complement each other showing wider diversity of species than if the methods are used separately. However, care must be taken with regards of experimental setup, and further investigation into the effects of transport processes

and/or quantitative representativeness is needed.