

A global review on the influence of beavers (*Castor fiber*, *Castor canadensis*) on river and floodplain dynamics

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Beavers (*Castor fiber*, *Castor canadensis*) have the ability to actively engineer their habitat, which they can do most effectively in lower order streams and their floodplains. Hence, this engineering has the potential to alter the hydrology, geomorphology, biogeochemistry, and ecology of river systems and the feedbacks between them. Thus, the beaver is often referred to as an 'ecosystem engineer' and is reflected in their recognition as a key species when restoring ecosystems. This capacity to engineer low order streams also shapes a range of positive and negative perceptions on their influence. On the one hand they may be perceived as capable of undermining existing river engineering schemes and the land use of associated floodplains, and on the other hand beavers may provide an alternative to traditional 'hard' engineering, potentially improving river restoration success.

The aim of this review is to summarize research to date on the impacts of beavers on stream and floodplain hydrology, geomorphology, water-quality and ecology, and the feedbacks between them. Our review shows that: (1) research has been focused heavily on North American streams, with far less research outside this North American context; (2) there is a tendency to investigate beaver impacts from the perspective of individual disciplines, to the detriment of considering broader process feedbacks, notably at the interface of hydro-geomorphology and riparian ecology; (3) it remains unclear to which extent beavers genuinely engineered streams prior to human impact, pointing to the need for longer term (millennium scale) studies on how beavers have changed river-floodplain systems. Crucially, we conclude that the investigation of the effects of beavers on streams and floodplains, especially in a longer-term, and their use for river restoration can only be understood through the thorough investigation of antecedent hydro-geomorphic conditions which takes account of the ways in which beavers and humans have interacted together over many centuries.