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MES Academic Writing Sample

Expanding Beaver Habitat as a Systemic Approach to Stream Restoration

Introduction

Prior to the colonization of North America by Europeans, the North American beaver was a common fixture in riparian ecosystems across their historical range, which spanned the entirety of the present day United States and Canada, with the exception of the arctic, peninsular Florida, and the Great Basin of Nevada and California (Pollock et al., pp.1, 2003). Since European colonization, beavers have been removed from their native habitat in staggering numbers. The total beaver population in North America sharply dropped from an estimated 60-400 million prior to the 19th century, to today's present populations of 10-15 million. Their disappearance from the landscape has largely been attributed to trapping for the fur trade and as a removal measure to expand arable plots and maximize agricultural production.

As a result, riparian ecosystems that had once depended on their stewardship have been fundamentally weakened through the effects of uninhibited channel incision (Bouwes et al. 2016). In recent decades, there have been growing efforts to restore beavers to their native reaches in an attempt to remediate these ecosystems and hydrologic regimes, and mitigate the compounding effects of climate change and decades of poor watershed management. The effects of beaver dams, beaver dam analogs (BDAs) (human made structures that mimic beaver dams in form and function), and other low tech process-based restoration methods (LTPBR) have generally been observed to reap tangible benefits for riparian ecosystems over relatively short periods of time, though the studies on the matter report variable data from case to case, as the unique hydrologic, geomorphic, and ecological conditions of stream reaches shape the effects of intervention differently.

The careful appraisal of stream conditions are crucial to selecting an appropriate restoration response. While beaver reintroduction can provide benefits toward stream restoration in the long term, BDAs may be a necessary preliminary step to modify stream morphology and encourage riparian plant growth to ensure that beaver colonies can persist. In the case of severely incised streams and/or degraded ecosystems, BDAs may not be sufficient for reversing the cycle of degradation, and a more intensive, form-based approach is warranted. This paper will attempt to describe the conditions for which a meaningful restoration response can be initiated.

Beaver driven methods for restoration

Beaver reintroduction can be an attractive method for riparian restoration due to their ability to take on much of the labor associated with the construction and maintenance of stream altering structures. That said, many conditions must be met for beavers to choose to colonize and persist in a given area. Any area where beavers are released must contain ample food supply and building materials, and must offer favorable stream morphology for dam construction.

Reach profiles within a given stream are important to identify in order to maximize the effectiveness of restoration efforts on a system wide level. Different reaches play specific roles in the process of transporting water and sediment based on their geomorphic characteristics. As such, beaver release as a restoration measure should be limited to reaches that provide suitable conditions for habitat formation and where the effect of such a modification will be most ecologically beneficial. A quantitative study of 365 reaches of 61 streams in Colorado showed that beavers tended to colonize low gradient streams (0-7%) with wide, unconfined valleys (greater than 45m) (Pollock et al., pp. 5, 2003; Retzer et al., 1956). The slower moving water found in low gradient streams allow for the deposition of fine substrates which beavers use to anchor their dams and construct lodges (Dittbrenner et al., 2018). When beavers colonize streams fitting this profile, aggradation accelerates, and sediment transition zones can become deposition zones. These reaches are typically primed for floodplain reconnection, yield the highest potential for the creation of multi threaded channels and wetland complexes, and can help reestablish anastomosing stream profiles over time. Beaver release represents a good strategy for converting single thread streams with slight to moderate levels of incision into more ecologically productive multithreaded stream networks so long as there are stable populations of woody shrubs and trees available for forage.

Land use practices have major impacts on a site's suitability for beaver reintroduction. Livestock grazing of riparian vegetation represents a particularly common barrier to beaver colony establishment. If left to their own devices, livestock favor grazing in riparian zones in hotter and drier periods, as they allow for the greatest access to water, green forage, and shade (Charnley, pp. 10, 2019). At sites within and adjacent to ranches where livestock grazing patterns have gone unrestricted, riparian zones rapidly become denuded as foraged plants are not given an opportunity to recover. This makes it virtually impossible for beavers to take hold in these reaches, as their source of food and shelter are not present. In areas where ranchers and land managers have implemented a policy of reducing duration and intensity of riparian grazing in the hot season, such as has been implemented by BLM and some ranchers in Elko County, Nevada, riparian vegetation has been reestablished to a level sufficient for beavers to colonize, resulting in the long term establishment of beaver colonies. This sets in motion a positive feedback loop of greater water availability, riparian plant growth and increased ecological complexity. Furthermore, ranchers who participated in this grazing management initiative noticed an increase in animal weight at harvest time due to the increased availability of quality food sources for livestock later into the warmer months (Charnley, pp. 27, 2019).

Beaver dam analogs

While limiting pressures on beaver populations may be all that is needed to generate the conditions for successful beaver reintroduction, many reaches are degraded to the point where human intervention is necessary for beaver colonies to find purchase. A study conducted by Bouwes et al. (2016) in the Bridge Creek watershed in Eastern Oregon reported an eightfold increase in beaver dams on reaches where BDAs were constructed over pre manipulation dam numbers. “The substantial increase in natural beaver dams occurred two years following the manipulation, primarily outside the treatment reaches suggesting the manipulation may have created a source of beavers for dispersal into unmanipulated areas” (Bouwes et al. 2016). In this instance, the BDAs were observed to facilitate favorable conditions for dam building, as their increased structural integrity allowed for the persistence and proliferation of beaver dam complexes through adverse flooding conditions compared to beaver dams in control reaches.

Where human intervention is necessary to create favorable conditions for beaver colonization, BDAs can serve as a cost effective alternative to more intensive grading and replanting methods that may be required to reestablish conditions that beavers need to thrive in the long term. LTPBR “typically cost between $50,000 and $100,000 per mile, while hard engineered, form based restoration approaches cost between $600,000 and $1million / mile” (Corday, pp.15-16, 2022; Wheaton, 2021). It is also worth noting that the dynamic nature of streams make the success of restoration attempts variable in nature. The economic risks associated with LTPBR are much lower in the event that restoration efforts do not yield their intended results.

Process-based methods

The environmental impact of BDA and beaver dam construction is considerably lower than more intensive methods for stream restoration. “Because LTPBR typically involves utilizing native, locally sourced materials and little equipment, it is gentler on the land and has lower impacts on the stream corridor than form-based methods that involve moving tons of soil, boulders, and large wood with large machinery such as bulldozers and excavators” (Corday, pp. 16, 2022). As such, one potential drawback of using LTPBRs such as BDAs is that there needs to be a critical amount of wood, brushy vegetation, and mud present at sites where they are implemented (Luberto, 2023). In locations where these conditions are not met, such as extremely incised channels or barren landscapes, it may be necessary to employ more intensive measures to manipulate the landscape geomorphology and vegetative cover to give riparian habitats a foothold from which they can recover.

Conclusions

As climate change disrupts weather patterns across the world, the need for measures to mitigate the subsequent imbalances that disturb stream equilibria becomes increasingly important. Unfortunately, the past two centuries have seen the wholesale decline of stream ecology and geomorphology as a result of pernicious land use practices. This two pronged affront to historical stream conditions have initiated a vicious cycle of increased velocity of water through streams, higher erosional potential of flow patterns, decrease in hyporheic flow, and habitat destruction. Beavers have been recognized as a potential partner in mitigating these issues due to their ability to rapidly create the conditions suitable for the very habitat these processes threaten. In cases where conditions are not suitable for beaver habitation, human intervention can directly modify the environment to create habitat for beaver, who can, in turn, take the lead from that point. The nature of such responses are highly dependent on the conditions present in a given stream, and as such any effort to remediate these streams must be tailored to each individual case.

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