TECHNICAL NOTES

U.S. Department of Agriculture Natural Resources Conservation Service

Biology – 26

Spokane, Washington
August, 2013

Beavers as Agents of Watershed Management and Environmental Health

Kat Hall, Conservation Programs Director
Joe Cannon, Beaver Project Senior Ecologist

The Lands Council
25 Main Ave Suite 222
Spokane, WA 99201

PURPOSE

The purpose of this Technical Note is to provide background in regard to using beavers as a management tool for environmental health projects, riparian buffers, and wetland management, restoration, enhancement or creation.

INTRODUCTION

The beaver is the second largest rodent in the world next to the capybara of South America. There are two extant species of beaver: the North American beaver (*Castor canadensis*), and the European beaver (*Castor fiber*). Beavers are semi-aquatic and nocturnal (crepuscular). Their diet is entirely herbivorous, subsisting mostly on herbaceous plants and the inner bark or trees (Muller-Schwarze, 2011). Beavers alter their environment more than any other species except humans. They have a wide distribution in North America, and show only slight variations for such an extensive distribution (Bailey1927). Beavers were hunted extensively, almost to extinction, in the contiguous states during the height of the fur trade up until the 1900's. While creating their habitat, beavers clear forests and impound water from streams. Beavers are considered keystone species and ecosystem engineers because of the large number of species which depend on beaver habitat ecosystems for part of their life cycle (Jones et al., 1994).

DESCRIPTION

Adult beavers typically weight between 45 and 60 lbs. On rare occasions they weigh over 100lbs (Whitaker, 1980). They are usually dark brown, but occasionally light brown to black. Beavers have poor eyesight, but keen senses of smell and hearing. They have a large flat tail and webbed hind feet. The front feet have small limber digits suited for grasping branches while chewing. They live up to 25 years in the wild, but more commonly 5-10 years (WDFW, 2011).

RANGE

Beavers are distributed throughout North America, except Florida, some of California, and most of Nevada (Whitaker, 1980). Since the last Ice Age nearly 15,000 years ago, beavers were the predominant manager of streams and wetlands throughout North America. Prior to the colonization of North America by European settlers and European trapping expeditions, it is estimated that beaver numbered close to half a billion, with a range from the Arctic tundra south to the deserts of Mexico. Beavers were present in every watershed and directly influenced the annual hydrograph through dam construction and water storage (Allen 1983).

HABITAT AND LIFE HISTORY

Beavers do not hibernate, but stay active for most of the year. They pair for life, mate during winter, and typically produce a litter of 1-8 kits four months later. Their food preference in the spring and summer is grasses, leaves, and aquatic vegetation. They prefer bark and cambium of hardwood trees during winter months. (CDFG 1990). Aspen, willow, cottonwood, and alder are preferred in western states. Many of these hardwoods are suited for coexisting with beavers such as cottonwood and other coppicing trees and shrubs. Some trees have even proven to benefit physiologically from herbivory such as from beavers (Alstad, Welker, Williams, & Trlica, 1999). Beavers are semi-aquatic, and need pooled water or large streams to escape predators and store food, especially in regions further north. To this end, beavers dam smaller streams to create ponds. Beavers have multiple strategies for shelter. They often build "lodges", either on the bank or near the bank, out of intricate stacking of sticks and mud. On larger streams they burrow into the bank- usually at multiple locations, to facilitate a variety of escape routes (WDFW, 2011).

ECOLOGICAL SIGNIFICANCE

Beaver have a long history in the Northwest of storing water and maintaining healthy watersheds. The history of beaver trapping in North America and the Columbia Basin provides critical insight into the number of beaver that once inhabited this region, their role in maintaining healthy watersheds, and how politics and the value of beaver pelts led to their near-extinction (Muller-Schwarze and Sun 2003, Ott 2003).

Sediment trapped by beaver dams can help repair incised streams and control bank erosion. Channel beds are raised closer to their floodplain, which restores and increases the frequency of overbank flooding, provides for aquifer recharge, and reduces flood erosion. Beaver dams create wetlands, which foster natural biogeochemical processes that sequester phosphorus and convert nitrogen to nitrate. Lower flow velocities allow phosphorus and other suspended solids to settle out of the water column and bind to bottom sediments, improving water quality. Nitrogen conversion to nitrate and ammonium in the anaerobic conditions of pond sediments produces nitrogen-rich soils and facilitates the creation of productive meadows when ponds drain and aerobic conditions return. Beaver-created wetlands also enhance wildlife habitat and populations. Deer and elk forage on shrubby plants found along beaver ponds, weasels and other small mammals hunt prey along the marshy edges of ponds, and migratory waterfowl use beaver ponds as nesting areas and rest stops. Increased stream complexity caused by beaver dams results in pools and braided channels used by fish for predator evasion, spawning, and rearing.

Because beaver livelihood requires significant ecosystem and landscape manipulation, they face a great threat from urban interface situations. As human settlements expand into natural areas, beaver habitat building often causes conflict with human land management strategies, resulting in an urgent need for conciliation. The Lands Council makes a priority of handling beaver situations at the point of conflict, followed by strategies leading to increased watershed health and wetland restoration.

The Lands Council has developed and successfully carried out procedures for revitalizing beaver populations and the accompanying ecosystem services in Eastern Washington, using contemporary science and traditional knowledge as foundations for our beaver program. Beavers have proven to be natural agents of riparian restoration and watershed stewards as described above. Done properly,

harnessing beaver activity for watershed maintenance and wetland creations is significantly more natural, self-perpetuating, and cost effective than most alternative methods. However, the appropriate guidelines need to be followed to achieve intended results at each site, and retain a predictable, controllable design. We've developed strategies to accommodate various stages of restoration, on a trajectory involving adaptive management.

ESTABLISHING BEAVERS AT WATERSHED RESTORATION OR ENHANCEMENT SITES:

- **Select appropriate sites for suitable beaver reintroductions.** Sites must have suitable habitat for an expanding habitat, and low probability for conflict. Ideal sites have perceivable historic beaver activity- i.e. remnant chewed stumps, along with recovered hardwood stands. These sites must also have buffers from

- **Build habitat for beavers on stream reaches not yet suitable be beaver colonization**. Through tree plantings, seeding, and hydrology management. This step would increase likelihood that introduced beavers would stay at the site, and perform ecosystem services.

- **Introduce beavers if habitat is suitable for establishment and reasonable expansion**. Beavers will be trapped by adequately equipped personnel (TLC staff), and taken from areas where they have become displaced, or causing irreconcilable harm to property and have exceeded their resources. The beavers would then be relocated to restoration sites as intact families when possible.

EXAMPLES OF BEAVER MANAGEMENT SITE CATEGORIES:

Initial Conditions (beaver are absent)	**Beaver Management Approach**	**Conservation Practices**
Established beaver pond with ample riparian vegetation and hardwood communities. Abandoned recently (1 to 4 years ago)	-Introduce family of beavers. Minimal subsidizing of habitat for stabilization. Beavers will naturally build and maintain a pond, wetlands, and hardwood forests.	659 -Wetland Enhancement 658 -Wetland Creation 391 -Riparian forest buffer 644- Wetland Wildlife Habitat Management
Remnant beaver pond, still holding water but depleted of resources i.e. hardwood communities.	-Subsidize habitat with tree plantings/ willow wattles. Introduce beaver after several years when hardwood communities have reestablished. -OR leave as an early successional stage; possibly apply native seed mix to edge out reed canary grass and invasives. Let system recover; don't introduce beavers.	647 - Early Successional habitat development/management 659 –Wetland Enhancement 658 -Wetland Creation 390 - Riparian Herbaceous cover 643 - Restoration and management of declining habitats 644- Wetland Wildlife Habitat Management

Perennial stream with proficient hardwood communities, but no pond.	-Introduce family of beavers. Beavers will naturally build and maintain a pond and wetlands. -If buffer zone is minimal, subsidize habitat by pooling water, adding shelter, adding food cache to keep beavers in a specific location.	658 -Wetland Creation 659- Wetland Enhancement 643 - Restoration and management of declining habitats 644- Wetland Wildlife Habitat Management
Perennial stream without adequate food and building materials (hardwood communities).	-Set timeline for future beaver introduction. Subsidize site with multiply years of plantings and enhancement. Add tree protection until restoration zone has matured.	658- Wetland Creation 659- Wetland Enhancement 390- Riparian Herbaceous cover 643- Restoration and management of declining habitats 644- Wetland Wildlife Habitat Management
Beaver are on the site, but causing problems for property owners.	-Try to appease property owners with, tree protection, pond leveling, culvert protecting, or easement options. Keeping beavers on site means enabling them to perform ecosystem services. -Option to replenish food and building supply with replanting and seeding.	659- Wetland Enhancement 658- Wetland Creation 391- Riparian forest buffer 643- Restoration and management of declining habitats 644- Wetland Wildlife Habitat Management

Limiting Factors:

- Limited habitat available which is suitable for extended beaver family and expansion.
- Increased urban interface
- Water Rights Issues. The fear from property owners of the change in water distributions.
- The potential and perceived potential for beavers to be carriers of diseases (WDFW, 2011).
- Lack of education and awareness of the beaver's role in managing hydrology, and ecosystem services.
- Inadequate policy of beaver census, management, and protection.
- Need to limit grazing, especially in terms of livestock and other high- impact land management practices.

References:

Allen AW. 1983. Habitat suitability index models: Beaver. U.S. Fish & Wildl. Serv. FWS/OBS-82/10.30 Revised. 20 pp.

Alstad, K. P., J.M. Welker, S.A. Williams, and M.J. Trlica. 1999. "Carbon and water relations of *Salix monticola* in response to winter browsing and changes in surface water hydrology: an isotopic study using d13C and d18O." *Ecologia* 120: 375-385.

Bailey, V. 1927. Beaver habits and experiments in beaver Culture. U.S. Dept. Agr. , Tech. Bull 21, 39pp.

Jones, C. G., Lawton, J. H., & Shachak, M. 1994. Organisms as ecosystem engineers. *Oikos*, *69*, 373-386.

Muller-Schwarze, D. 2011. *The Beaver: It's LIfe and Impact*. 2nd ed. Ithaca, NY: Cornell University.

Ott J. 2003. "Ruining" the rivers in the Snake Country: The Hudson Bay Company's fur desert policy. Oregon Historical Quarterly. 104(2): 166-195

WDFW. 2011. Living With Wildlife: Beavers. *Living With Wildlife: Beavers*. http://wdfw.wa.gov/living/beavers.html#preventingconflicts.

Whitaker, John O. 1980. *National Audobon Society Field Guide to North American Mammals*. USA: Alfred A. Knopf Inc. http://zotero.org/support/quick_start_guide.

Muller-Schwarze D, Sun L. 2003.The Beaver: Natural history of a wetlands engineer. Ithaca, NY. Comstock Publishing Associates. 190 p.