



Beaver-Related Wetland and Stream Restoration

Supporting Resources

Introduction

Reintroduction of beavers and the use of beaver mimicry are techniques increasingly being employed to accomplish stream, wetland, and floodplain restoration. By constructing dams that impound water and retain sediment, beaver (or beaver biomimicry projects) substantially alter the physical, chemical, and biological characteristics of the surrounding river ecosystem. These restored systems create new, more complex habitat in degraded systems and provide greater benefits to plants, fish, and wildlife.

The Association of State Wetland Managers (ASWM) and the Bureau of Land Management (BLM) collaborated to gather information from beaver restoration professionals on experiences, questions, and needs encountered while undertaking beaver restoration projects. A national dialogue on beaver-related restoration was initiated to facilitate peer to peer sharing around beaver restoration approaches. Information was gathered for use by ASWM and BLM to identify successful strategies, areas of common need, and beneficial resources to support future planning and restoration activities. The following content was largely collected through the ASWM-BLM national dialogue process.

Types of Beaver-related Restoration

- **Beaver Dam Analogs:** Beaver Dam Analogues (BDAs) are hand-built bioengineering structures designed to mimic the function of natural beaver dams¹. BDAs can accelerate recovery of incised streams and riparian and wet meadow habitats by reducing water velocities, increasing sediment deposition and aggradation, enhancing floodplain connectivity, raising groundwater tables, and increasing habitat complexity. The desired outcome is to initiate restoration of natural processes that self-sustain riparian and wet meadow habitats.
- BDAs are perhaps the [fastest-growing stream restoration technique in the U.S. West](#). Federal agencies such as the U.S. Forest Service, nonprofits such as The Nature Conservancy, and even private ranchers have installed the structures to return life to deeply eroded streams and, in some cases, to help re-establish beavers in long-abandoned territories. In Wyoming, BDAs are creating wet meadows for a vulnerable bird. In Oregon, they're rebuilding salmon streams. In Utah, they're helping irrigate pastures for cattle.
- **Restoration to Attract Beaver** – If an area has habitat undesirable to nearby beaver populations, work is conducted to restore habitat such that it attracts regional beaver naturally to target area.
- **Beaver Reintroduction** – Once suitable habitats that are lacking beavers are found, beavers are relocated to these new areas and allowed to build dams and alter the area's hydrology.
- Some related mitigation techniques include **pond levelers, culvert guards and tree protection**.

¹ Source: [NRCS](#)



Why Undertake Beaver-related Restoration Work?

A growing body of research and practice is demonstrating that when properly cited and resourced, beaver-related restoration activities can produce many benefits. Commonly documented benefits of this restoration approach include higher water tables; reconnected and expanded floodplains; more hyporheic exchange; higher summer base flows; expanded wetlands; improved water quality; greater habitat complexity; more diversity and richness in the populations of plants, birds, fish, amphibians, reptiles, and mammals; and overall increased complexity of the riverine ecosystems.

- higher water tables,
- reconnected and expanded floodplains, with significantly reduced flooding,
- more buffered gradient,
- slowed stream speed (serve as “speed bumps” on the delivery of water)
- more structural stability in the headwater stream geomorphology,
- more hyporheic exchange,
- recharge water tables,
- higher summer base flows,
- expanded wetlands,
- reduced erosion,
- reduced suspended sediments in the water column,
- improving nutrient cycling,
- removing and storing contaminants,
- improved water quality,
- greater habitat complexity,
- stabilize stream temperatures (streams are warmer in winter and cooler in summer),
- Greater stability of the thermocline, which increases the productivity of the habitat,
- more biodiversity and richness in the populations of plants, birds, fish, amphibians, reptiles, and mammals, and
- overall increased complexity of the riverine ecosystems.

Participants also stated that there is a significant need for additional scientific literature and case studies to share the benefits of these restoration approaches. Some useful resources identified by participants that document these various benefits include:

- [Ecosystem Services Provided by Beavers *Castor spp.*](#)
- [Beaver power provides year-long water to Idaho ranch](#)
- [Beaver dams attenuate flow: A multi-site study](#)
- Ecosystem services provided by beavers *Castor spp*
- [Using Beaver Dams to Restore Incised Stream Ecosystems](#)
- [Ecosystem experiment reveals benefits of natural and simulated beaver dams to a threatened population of steelhead \(*Oncorhynchus mykiss*\)](#)

- [Beavers Improve Habitat | Mid-Columbia Fisheries Enhancement Group \(midcolumbiafisheries.org\)](#)
- [Using remote sensing to assess the impact of beaver damming on riparian evapotranspiration in an arid landscape](#)
- [Water Talk: Beaver Hydrology and Management](#) (Emily Fairfax)
- [Partnering with Beaver: Nature's Hydrologists and Ecosystem Engineers](#) (USU, 2015)
- [The Beaver: Ecosystem Restoration Engineer](#) (Learning Tree, 2021)

Common Challenges Associated with Beaver-related Restoration

Conflicts can arise from an overlap of preferred habitats by both humans and beavers, misunderstandings of how beavers modify their habitats, and a lack of planning or use of adaptive management on restoration projects. Participants in the national dialogue identified the following common conflicts and some specific considerations:

Lack of Awareness/Misunderstandings/Unfamiliarity with Practices

- Lack of public and agency awareness of the importance of beavers to biodiversity, climate resilience and watershed health.
- Perception that beaver are problematic and not useful.
- Perception that beaver are not historically part of the region or watershed or that they are currently already there in sufficient numbers.
- Cultural resistance to restoration work involving beaver.
- Simple resistance to change because it is “new”.
- Use of installed flow devices seen as “draining a wetland”.
- A belief that rivers and streams ought to be simple static channels that perfectly balance water and sediment flow and that complex beaver systems are seen as unnatural or something that needs to be fixed.
- Lack of understanding that beaver restoration requires hardwood trees (beaver do better in early and mid-successional forests, but focus is on old growth forests with bias towards growing large conifer trees within 200 feet of streams for in-stream fish structures).
- Lack of understanding of what a “fully beavered landscape” looks like – belief that beaver will make flooding worse.
- Beaver restoration does not create something that fits into some people’s concept of human design for the wetland.
- Even Sierra Club, Trout Unlimited, state river organizations, Ducks Unlimited and others do not understand and appreciate the potential for beaver restoration.
- Don’t understand the hydrology of watersheds and how restoring beaver-created wetlands can significantly reduce peak flows (50-60%).
- Belief held by some state and federal agency biologists and permittees that beaver were not historically in a watershed.



Issues with Other Birds and Wildlife

- Concerns about whether beaver dams create fish passage barriers for anadromous fish populations.
- Misinformation about the impacts of beaver on cold-water communities.
- Damming of warm water sloughs can lead to freezing over so that wintering waterfowl habitat is reduced.

Beaver Management – Nuisance Species, Trapping Concerns and Conflicting Management Goals

Nuisance Species

- Beavers managed as a nuisance species and small game animal rather than as a keystone ecological partner.
- Landowners not realizing that there are viable co-existence alternatives to removal for managing conflicts.
- Game management agencies view beaver only as a nuisance. California state wildlife laws, which consider beaver to be pests. Oregon has declared beavers to be nuisance rodents or furbearers – their official status is “predator.” Beavers on public land are legally considered pests in Oregon.

Trapping Concerns

- Concerns that protecting strategic colonies will take away trapping opportunities.
- Having beavers trapped out – meaning that trapping removed the population of beaver.
- Agencies unwilling to put trap closures in place.
- Unlimited recreational and commercial harvest of beaver allowed even where beaver restoration projects are funded and allowed to support endangered salmon and other ecosystem services.

Conflicting Management Goals

- Beavers cause problems with roads when they plug culverts.
- Resistance among grazing permittees not wanting swampy areas.
- Some anglers unwilling to adapt their fishing practices to more complex habitat.
- Trying to manage beaver restoration in the face of development.

Logistical Issues

- Complexities of getting beaver moved into potential restoration sites.

Training and Guidance on Beaver-related Restoration Techniques

Participants in the national dialogue shared that a growing literature exists to support professionals and researchers exploring the effectiveness of beaver-related restoration activities. They reported that training is needed at many levels, including federal, tribal, state, regional/watershed, and local (municipal) government, as well as with landowners and in academia (high school and college). Participants also commented that training needs to be targeted to groups such as decision makers, volunteers, watershed groups etc., and recommended the following training resources for beaver-related restoration planners and practitioners:

Restoration Handbooks and Guides

- [The Beaver Restoration Guidebook](#) (Version 2.01)
- [Low-Tech Process-Based Restoration of Riverscapes: Design Manual](#)
- [The Low-Tech Process Based Restoration of Riverscapes Pocket Guide](#)

Beaver-related Restoration Training, Webinars and Online Modules

- [Introductory PBR Workshop Modules](#)
- [Beaver Institute: Beaver Training for Wetland Professionals](#)
- [Beaver Dam Flow Device Training Video](#)
- [BeaverCorps Professional Training Program](#)

Beaver-related Restoration Literature Compilations

- [Beaver Literature \(joewheaton.org\)](#) – More than 500 literature citations for beaver restoration-related documents (unsorted) compiled by Joe Wheaton (Utah State University)
- [Beaver Articles Webpage](#) (Beavers Wetlands and Wildlife)
- [An Annotated Bibliography of Beaver Literature](#) (Oregon DFWS Beaver Working Group)
- [Beaver Institute Research Library](#)

Examples of Beaver-related Restoration

In addition to learning proper techniques and in-the-field experience, peer-to-peer sharing of restoration successes and lessons learned can be effective learning tools. National Dialogue participants identify the following examples of beaver-related restoration work as useful for others seeking to understand the methods and impacts of this work:



Photo Credit: Wikimedia Commons Finchlake2000

- [Methow Beaver Project](#) (WA)
- [Birch Creek Restoration](#) (ID)
- [Burnt Beaver Watershed Restoration](#) (UT)
- [Hydrological Impact of Beaver Habitat Restoration in the Milwaukee River Watershed](#) (WI)
- [Using Beaver Dam Analogues for Fish and Wildlife Recovery on Public and Private Rangelands in Eastern Oregon](#) (OR)
- [Experimenting with Beaver Dam Analogues in the Scott River Basin, California](#) (CA)

- [Low-tech Riverscape Restoration Practices Improve Riparian Wetland Health](#) (Northern Great Plains)
- [Going with the Flow: Beaver-focused Stream Restoration on Western Rangelands](#) (Western US)
- [Beavers in the Desert? The Potential for Translocated Beavers to Serve as Restoration Tools in Desert Rivers](#) (UT)
- [If You Build It, They Will Come: Ranching, Riparian Revegetation, and Beaver Colonization in Elko County, Nevada](#) (NV)
- [Smokey the Beaver: Beaver-dammed Riparian Corridors Stay Green during Wildfire throughout the Western United States](#) (Western US)
- [Advancing Efforts to Restore Beavers for the Benefit of Montana Watersheds 2020 Strategy Meeting Report and Action Plan](#) (MT)
- [Eager: The Surprising, Secret Life of Beavers and Why They Matter](#) (National/Historic)

Modeling and Determining Placement for Beaver-related Restoration

One of the greatest challenges facing beaver-related restoration planners is where to place these projects. Understanding the suitability of habitat, potential conflicts with humans and infrastructure all play a key role in project success. Participants share the following as a list of useful modeling and placement resources for planners and practitioners:

- [Beaver Restoration Assessment Tool](#) (BRAT) – Utah State University
- [BRAT Storymaps](#)
- [Utah Riparian Condition Assessment Toolbox](#)
- [Beaver Restoration Feasibility Assessment for the North Fork Kern River Drainage](#)
- [Beaver Restoration Feasibility Assessment for Olema Creek Watershed](#)
- [Defenders of Wildlife New Mexico Beaver Habitat Suitability Model](#)
- [Modeling intrinsic potential for beaver \(*Castor canadensis*\) habitat to inform restoration and climate change adaptation](#)
- [A Stream Evolution Model: Integrating Habitat and Ecosystem Benefits](#)

Planning and Permitting Low-tech, Process-based Restoration Projects

One of the key lessons learned shared by participants was the importance of time and resources invested in planning and ensuring permitting is effectively in place for beaver-related restoration projects. Participants identified the following resources as useful to informing the planning and permitting elements of projects. Beaver protections and reclassification are still needed in many states but can meet resistance.

- [Considerations Checklist for Using Low-Tech Structures to Enhance or Restore Riparian and Wet Meadow Habitats](#)
- [A Stream Evolution Model: Integrating Habitat and Ecosystem Benefits](#)
- [Permitting Your Stream Restoration Projects in Utah – Webinar Series for Project Managers](#)
- [NRCS Restoration of Rare or Declining Natural Communities: Beaver Dam Analogues for Riparian and Wet Meadow Areas](#) (Conservation Practice 643)
- [Great Expectations: Deconstructing the Process Pathways Underlying Beaver-Related Restoration](#)
- [Beaver Recruitment Strategy for Tasmam Koyom](#)

Lessons Learned

Throughout the national dialogue process, ASWM captured lessons learned that were shared by participants. Many of these lessons learned are included in the prior report sections. The insights listed below are beyond the scope of those other sections:

Site Work

- Do not release beaver into a watershed or waterway where they are not welcome. If you don't know, find out ahead of time.
- Focus on restoring beaver food along low gradient streams and areas where risks to roads are manageable.
- Don't assume that one dam means that there is a sustainable beaver population.
- Pursue options that will allow restoration professionals to keep beaver where they are by constructing mitigation structures, if possible.
- Don't assume your project will not have relocated beaver trapped – get administrative protections prior to your project start.
- Where beaver can occur naturally across the state, folks can augment habitat for them and they can move when populations are good (especially areas away from urbanization).
- By focusing on headwater streams and by carefully documenting the pre-disturbance condition (to assure folks we are restoring wetland that has been lost and not creating it) we have been able to get a lot of restoration done with little conflict.

Measuring Impact

- Carefully document the pre-disturbance condition to assure folks that the focus is on restoring a wetland that has been lost and not creating one where it was not before.
- Focus on increases in riparian health (in addition to or instead of hard to measure stream flow changes).
- Focus on Clean Water Act requirements around water quality (temperature, nutrients) and water quantity (timing) – in addition to agricultural watershed improvement actions.
- Keep a six-year/long-term record of the project (if the project is gone after one season, it is not a success).

Communications and Messaging

- Make sure to share BOTH the upsides (riparian health, streamflow, etc.) and the downsides (economic loss – maintaining road systems, etc.) of working with beaver.
- Bring irrigators and canal companies into the conversation around watershed health.
- Environmental organizations are not seen by some landowners or decision makers as trusted sources
- Communicate that protecting beaver in one location is kind of like keeping some seed to plant the following year – the young will disperse in 2 years, providing more beaver for recreational trapping in the area
- There may be some opportunities through the following funding programs, including USDA RCPP Funding and FEMA hazard mitigation programs seeking nature-based solutions.