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# Science FINDINGS

INSIDE



*"Science affects the way we think together."*
*Lewis Thomas*

# Are You a Beaver Believer? Reasonable Expectations for Beaver-Related Restoration

*A work party builds a beaver dam analog in Bridge Creek, Oregon, a tributary of the John Day River. Beaver-related restoration tactics are being used to restore riparian areas, expand wildlife habitat, and improve forage for livestock. USDA Forest Service photo.*

**IN SUMMARY**

*Recruiting beavers—or building structures that mimic beaver dams—is an increasingly popular method for restoring streams and floodplains in the American West. Doing so can boost the growth of vegetation for cattle forage and improve habitat for fish and wildlife.*

*But with a nature-based solution for stream restoration, anything can happen.*

*Gordon Grant and Susan Charnley, scientists with the USDA Forest Service Pacific Northwest Research Station, studied beaver-related restoration projects throughout the U.S. West. This research revealed uncertainties and unintended consequences involved with beaver projects, providing a reality check for anyone wanting to invest in this type of restoration. With their colleague, Caroline Nash and others, Grant and Charnley devised a framework that identifies the processes that must occur to achieve commonly desired outcomes.*

*The framework is a useful communication tool, and the resulting conversations are helping landowners, land management agencies, and others adjust their expectations for such projects. Human goals are not always compatible with nature's processes. Beavers are wild animals, after all, and they have their own ideas.*

*The process-based framework has informed several initiatives involving multiple stakeholders, including climate-resilience efforts in the Colorado River Basin and ongoing planning and implementation of restoration projects in Montana, Wyoming, and Arizona.*

*"Nature, to be commanded, must be obeyed."*

—Francis Bacon

Since they first arrived in the 1600s, European settlers have had a fickle relationship with the North American beaver (*Castor canadensis*). Over the next four centuries, beaver were trapped for their valuable fur or simply killed for being a nuisance. Either way, beaver removal contributed to dramatic changes in stream systems.

But over the past decade, some ranchers, land managers, and others in the arid American West have begun seeing beaver as a possible resource for restoring and reconnecting streams to floodplains. By encouraging the presence of beavers, or by building artificial structures that mimic beaver dams, beaver-related restoration projects aim to make beneficial ecological changes to streams and watersheds.

Beaver-related restoration is an example of process-based restoration, in which practitioners promote healthy ecosystem conditions by

*Caroline Nash and Gordon Grant examine an incised streambed on the Silvies Valley Ranch in eastern Oregon. Beaver dams can raise water levels and help reconnect streambeds to their natural floodplains. USDA Forest Service photo by Susan Charnley.*

employing natural hydrogeomorphic and ecological processes to improve stream conditions—processes that may have been disrupted by human interventions.

Letting nature do the work of restoration, however, means that nature may follow its own course in ways that don't always align with the original restoration goals.

Research hydrologist Gordon Grant and research social scientist Susan Charnley, with the USDA Forest Service Pacific Northwest (PNW) Research Station, along with their research collaborators, most notably hydrologist and geomorphologist Caroline Nash, developed a framework to systematically consider the unexpected contingencies of beaver-related restoration projects.

Rather than setting static goals at the outset of a project and evaluating its effectiveness at the end, this framework can be used to document what happens as a project proceeds, including the point at which it may deviate from initial expectations, and the subsequent direction it may take.

In essence, the researchers removed beaver restoration from the "black box" of vague expectations and wishful thinking and developed a way to better understand the steps needed to achieve those goals, determine if the underlying assumptions are realistic, and assess potential alternative project trajectories.

"We're recommending that people deconstruct their expectations about what they want these restoration tactics to achieve and look at it from a more process-oriented viewpoint," Grant says.

With this process-oriented view, Grant and Charnley are providing a reality check to beaver restoration projects. This approach helps landowners, practitioners, and agencies understand that having fixed goals at the start of such projects is perhaps less useful than having broader intentions. The latter allows for contingencies over which project implementers have little or no control.

Instead of just evaluating a project in terms of "success" or "failure," this process-based approach promotes a greater understanding of why beaver restoration projects are or are not effective in meeting the intended goals—and whether those goals are even appropriate for a given watershed. This understanding can also help identify adaptive management measures if a project unfolds differently than initially expected.

"This kind of documentation can be a rich source of information for future projects because it compares expectations with what actually happens, and it shows the kinds of adaptive measures that can be taken when things deviate," Charnley says.

Grant and Charnley's work in developing a systematic framework for understanding these projects is timely. Investment in beaver-related restoration projects is expanding in the American West. At the same time, policymakers are being challenged to develop policy guidelines for these types of projects without a full understanding of their consequences as the science and monitoring associated with them continues to develop.

## Beavers and Humans

The beaver fur trade began in the eastern part of North America in the early 1600s and expanded to the west by the 1800s, decimating beaver populations. Meanwhile, the construction of dikes, canals, and levees to support farming and grazing led to extensive ecological changes in the streams and watersheds of the American West.

Beaver populations began to recover by the mid-1800s but were still often viewed as a nuisance throughout the 20th century. Beaver dams can flood fields and block irrigation structures; the animals can also damage crops and trees valued for timber and fruit production.

Now, beavers—and artificial structures that mimic beaver dams—are increasingly viewed as a relatively affordable, process-based solution for restoring streams.

"Ranchers, in particular, can benefit from the presence of beavers," Charnley says.

She cites a study in which California ranchers experienced economic benefits from beaver

*An example of a human-constucted beaver dam analog in the Scott River Basin, California. USDA Forest Service photo by Susan Charnley.*




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dams, including greater vegetation growth in meadows and riparian areas, which increased livestock forage; prolonged streamflows in the summer, enabling livestock to use previously marginal upland grazing areas; and higher water tables, which reduced the need for irrigation water to produce hay. Charnley's own research with ranchers involved with beaver-related restoration projects in Nevada and California found similar benefits.

## Types of Beaver-Related Restoration

Three common approaches to beaver-related restoration are (1) beaver translocation, (2) human construction of beaver dam-like structures, and (3) restoration of riparian vegetation. These tactics share a common goal: promote dam building by beavers themselves.

Beaver translocation is the most reported tactic in the Western United States. It involves capturing nuisance beavers and moving them to areas where their dams could help achieve human goals, such as increasing water-storage capacity on floodplains. For this this to work, the beavers must survive, remain in target locations, and build dams.

Success rates vary. Documented cases show that less than 50 percent of translocated beavers usually survive, in part, because of predation within the first week of release. Beavers also commonly move away from their release sites. Grant and Charnley cite a study in eastern Oregon in which 78 percent of relocated beavers moved away. Another study in Wyoming found that half of the 114 translocated beavers moved more than 6 miles away. A study in the Oregon Coast Range found that not all of the surviving, translocated beavers built dams, and none of the dams that were built survived high winter water discharges.

*Beaver translocation: where permitted by state law, nuisance beavers may be captured and relocated to areas where dams are desired. USDA photo by Anson Eaglin.*

### KEY FINDINGS

- Beavers modify stream environments by building dams, yet the effectiveness of these dams, or their artificial analogs, for stream restoration varies by watershed setting, expected outcome, and beaver life history.
- Surveys of recent beaver-related restoration projects reveal that the expected outcomes are diverse and not always explicitly stated. They indicate that it is often implicitly assumed that beavers will "make streams better" without clearly articulating how this will happen.
- Initially identifying specific, desired outcomes and plausible links among geomorphic, hydrologic, and ecological processes facilitates better understanding and predictions of project outcomes.
- A new process-based framework is available to help practitioners establish reasonable expectations for what beavers can and cannot do in different geographic and ecological settings.

The second tactic—building artificial structures—involves installing a variety of human-made constructions to either act like beaver dams or attract beavers so they can maintain the structures and build their own dams. Of the five projects studied that used this tactic, the researchers found that four showed an increase in beaver activity. At six restoration sites in California's Scott River basin, for example, beavers maintained five out of 18 artificial structures, and built their own dams at one site. On an eastern Oregon ranch, beaver presences increased over the decade following construction of artificial structures.

The third tactic—riparian vegetation restoration—involves planting shrubs and trees near streams and rivers to promote beaver colonization and dam building, or changing land-use practices to allow natural regeneration of vegetation. Fencing may be needed to protect the new plantings from livestock, deer, and other herbivores. The few documented cases using this tactic suggest positive results. But even then, Grant and Charnley say it's unclear what accounted for the increase in beaver activity: Do rates of dam building increase because the number of beavers increase, the existing beavers start building more dams, or the existing dams stop getting removed?

## Gathering Data

Grant, Charnley, and their research collaborators compiled case studies of beaver-related restoration projects, examining the evolution of these projects from inception through outcomes as they occurred.

*This riparian area in eastern Oregon is fenced off to protect the riparian vegetation from grazing and encourage colonization by beaver. USDA Forest Service photo by Susan Charnley.*

This review filled an information gap for these kinds of projects. Comprehensive monitoring is rare. Monitoring costs can exceed project costs, but without information about conditions before and after a project, it's hard to assess if project goals have been met. Defining success also requires defining objectives going into the project.

The researchers interviewed 105 people involved with beaver-related restoration projects across six sites and four states, including ranchers, landowners, and staff with government agencies and nongovernmental organizations.

One case study focused on the Silvies Valley Ranch in eastern Oregon: 40,000 acres of private land with roughly 54 miles of degraded stream channels in need of restoration. Grant, Nash—then with Oregon State University—and colleagues with the Oregon Natural Desert Association, worked with the ranch owner to monitor 640 human-made, artificial beaver dams on the ranch.

The owner wanted to restore degraded and incised waterways on the property, increase beaver populations, promote fish recovery, and improve wildlife habitat and livestock forage.

The monitoring revealed that the project was largely successful. The artificial beaver dams slowed the water, resulting in higher instream water levels which reconnected the stream channels to their floodplains, improving the quantity and quality of forage plants for grazing. The project also decreased the steepness of streambanks, making them less hazardous to cattle. And it encouraged the natural return of beavers to the area, along with other wildlife species.

A project in Elko County, Nevada, involved restoring riparian vegetation by changing the frequency and duration of summer cattle grazing in riparian areas. This was done primarily to protect and improve the habitat of two threatened trout species. The result was the natural recolonization of beaver. As the beavers did their work, they created landscapes that benefitted both trout and wildlife, including sage grouse. As with the Silvies Valley Ranch, the increase in plant growth also provided a rich source of food for cattle and supported increased diversity of observed grassland and wetland bird species.

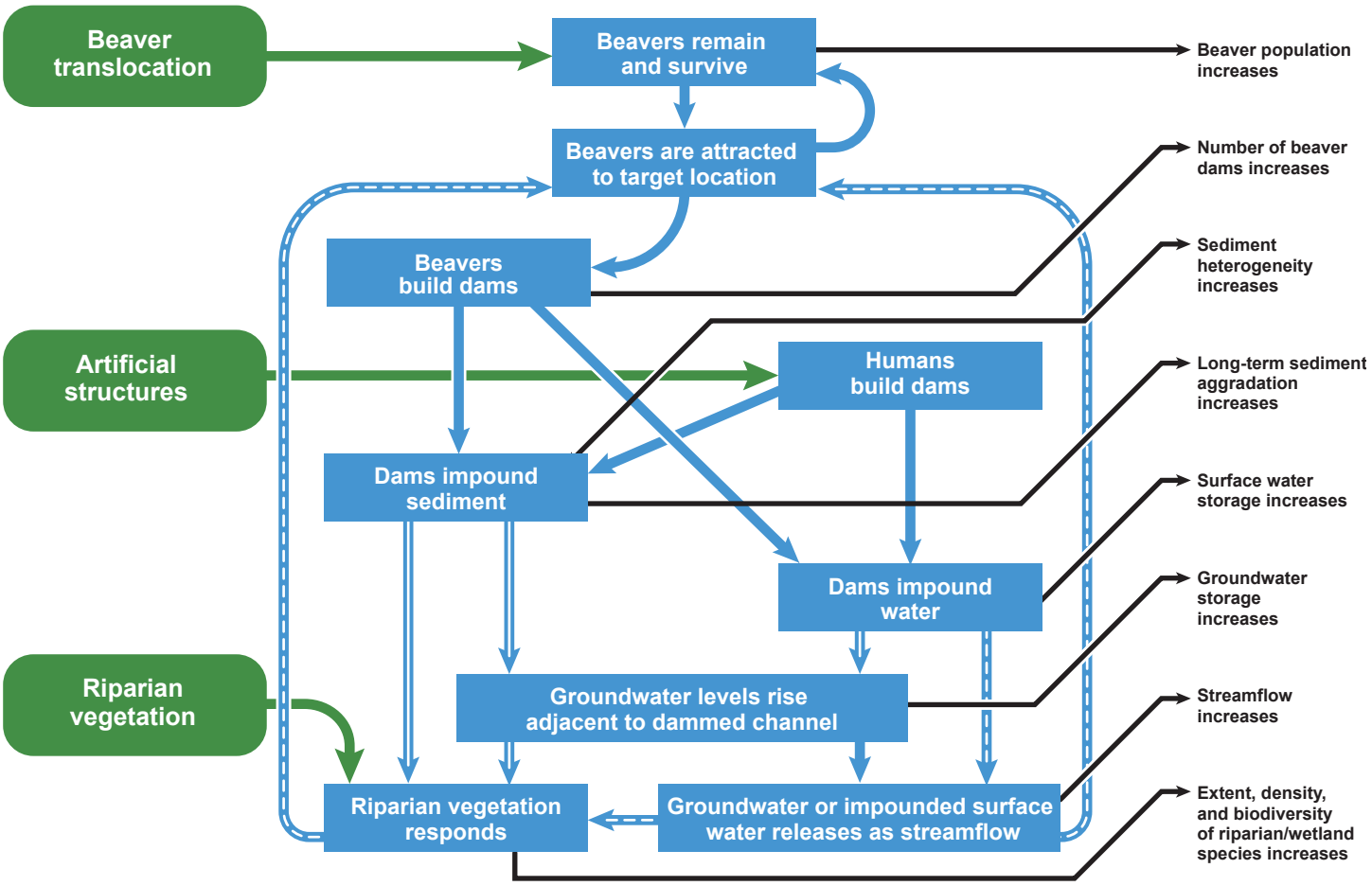
Both projects successfully attracted beaver, but in both cases, that came at a cost. Beaver dams sometimes led to clogged road culverts and irrigation systems, which in turn caused roads and trails to wash out and hayfields to flood. The increase in water led to more forage for cattle but at times created muddy, overly wet fields that made it cumbersome for ranchers to move cattle, build fences, and perform maintenance. Beavers also cut down trees that the ranchers would have preferred to keep.

## A Communication Tool

The case studies of beaver-related restoration projects were funded largely by the USDA Northwest Climate Hub, an interagency organization linking USDA research and programs to support regional, climate-informed decision making. Its coordinator, Holly Prendeville, gives outreach presentations to enhance climate-informed decision making and shares this framework on beaver-related restoration.

"These case studies provide great value in showing both the positive and negative aspects of beaver-related restoration," Prendeville says.

The process-based framework developed by Grant, Charnley, Nash, and collaborators identifies links that need to be present for certain outcomes to occur. It can also




*Flow chart documenting the sequence of processes (boxes and arrows with solid lines) that must occur for each beaver-related restoration tactic (green boxes) to achieve commonly expected outcomes (black text). ⟹ lines indicate that one of two mechanisms can lead to the next step while a ⟹ line indicates that the preceding step can amplify the following step, but it is insufficient to lead to changes on its own. Adapted from Nash et al. (2021).*

help explain the kinds of contingencies demonstrated in the case studies. For people considering beaver-related restoration projects, the framework can facilitate discussions about the natural processes involved in achieving project goals. Clarifying the processes involved and using the framework to anticipate potential outcomes may also help users set reasonable reporting expectations with funders and describe these relatively novel types of projects to permitting agencies.

"When we were starting this research in 2016–2017, beaver-related restoration was relatively new. Because it is somewhat experimental, state agencies were not always willing to give permits for installing structures in streams with threatened fish species," Charnley says. "But agencies will likely become more flexible over time when they see documented results. The framework can help them anticipate alternative outcomes and how to consider them in the regulatory process."

Nash, who led the project along with Grant and Charnley, says she is using the process framework in her role as one of the leaders of CK Blueshift, LLC, a Boise, Idaho-based consulting group working at the intersection of water and climate. The company works with agencies, ranchers, municipalities, and others on issues such as watershed restoration, many of whom are interested in using beaver-related restoration approaches.

Nash uses the framework to help better communicate with different audiences. As she describes it, there is the "I've got a hunch that I'd like to do a beaver restoration project," group. And there is the "I have a vision" group, for example "I want this valley to be lush and green."

For the first group, the conversation will flow from the question, "If you brought beavers in, what do you think is going to happen?" From there, they talk about all the different possible contingencies.

"For the visionary group, the conversation will start with something like 'OK, you want this valley to be lush and green. What do you see as the limiting factors that are keeping that from happening?'" Nash says.

Through repeated conversations, the clients' expectations become more explicit, with the added benefit of knowing the possible contingencies.

"When it comes time to pursue funding for these projects, the grants we write may contain the words 'with the hope' or 'with the expectation' that something will happen. But really, anything can happen," she says.

One of the things that can happen is that a landowner, agency, or organization will build an artificial structure with the intention that beavers will move in and add to or maintain the structure. But sometimes the beavers don't come, so money needs to be budgeted for maintenance of the structures.

Nash explains that the framework was used to develop possible strategies for enhancing climate resilience in the Colorado River Basin; create the BlueCommons ReBeaver Fund, a nonprofit organization developing innovative funding models to address water scarcity; and inform the ongoing planning and implementation of restoration projects in Montana, Wyoming, and Arizona.

## LAND MANAGEMENT IMPLICATIONS

- Understanding how beaver-related restoration tactics are likely to affect key hydrogeomorphic and ecological processes is critical to designing projects that align human objectives with beavers' behavior and life histories.

In theory, beaver-related restoration holds a lot of promise—which is why there has been a growing interest in doing it. But as Grant and Charnley's work demonstrates, it needs to be done with a view to potential alternative outcomes.

"We're putting this out to a community that likes the idea of restoring nature with nature. In a sense we're saying, 'Not so fast.' We're bringing a perspective that doesn't oppose what people are doing, but it is a cautionary tale," Grant says.

*"The world is mud-luscious and puddle-wonderful."*

—E.E. Cummings

## For Further Reading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## Writer's Profile

*John Kirkland has been writing about science, higher education, and business for more than 20 years. He lives in Portland, Oregon.*

*Cattle gather near a pond created by an artificial beaver dam on the Silvies Valley Ranch in eastern Oregon. The dam has helped increase forage plants for grazing. USDA Forest Service photo by Susan Charnley.*

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