Not Stepping in the Same River Twice:
Making Strides in Ecological Restoration through Dam Removal

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Widespread dam removal would have been unthinkable in the mid-20th century, when government-sponsored dam construction was at a fever pitch. Six thousand new large federal projects diverted, restrained, and impounded rivers across America between 1930 and 1970. These dams carried the banner for a modern vision of society using technology to harness and exploit natural processes. They fed agricultural production, encouraged development in arid climates, and powered wartime industries. Meanwhile, more widespread smaller dams steadily stopped up water flows on private property. As many as 2.5 million dams are still in place, though perhaps not for long. The dams are old, many nearing or beyond their usable life, and the cost of maintaining or replacing them often outweighs their benefit. Safety standards, too, dictate that the failing infrastructure has to go, and there is a growing awareness of the ecological benefits of dam removal. The U.S. Geological Survey reports that dam removal has outpaced dam construction in every decade since the mid-1970s. In essence, dams have become obstacles signaling where river restoration should go next. The challenges, lessons, and opportunities afforded by dam removal offer promising insights and best practices for aspiring restoration projects. This article looks at each of these in turn, focusing on the gamut of dam removal considerations, the availability of data tracking dam removal results, and the many opportunities that dam removal opens for restoration practice.

Dammed cranberry bog restoration in process in the Childs River. This SNEP-funded project aims to restore this bog to its natural state as a wetland. Click the photo for more information. Photo credit: Carriage Shop RD Pond Stream Diversion, courtesy of Dennis Martin

Scientists are increasingly called upon to evaluate the impacts of dams and their potential removal. Several landmark studies in recent decades have indexed the adverse biological, chemical, and physical effects dams have on rivers and watersheds. One of the most commonly cited effects is the limits dams place on fish passage. Dams block rivers and constrain migration patterns. Even when dams are passable, the river's flow can be altered from the seasonal variations fish and other species depend upon for timing their growth and reproduction cycles. There are also upstream and downstream habitat effects. Sediments, logs, rocks, and other important features of a river get caught behind the dam, smothering the impounded area and depriving the rest of the river of material it needs to maintain its ecological integrity. Water quality can also decrease in a dammed river, due to abnormal fluctuations in temperature, nutrient and oxygen levels.

While these effects are understood in general terms, each dam removal project is different. The challenges associated with each project need to be identified on a case-by-case basis, guided by restoration objectives. Rivers are complex systems and exhibit considerable variation in the sequence, timing, extent, and magnitude of their response to changes affecting them. Dam removal, fortunately, is

a relatively controllable change to a river system, so scientists have been able to test and refine their understanding of what is possible in terms of restoration. Accounting for factors like the size of the dam, the kind of stress it has imposed on the river, and how it operates can help inform predictions about restoration outcomes. Ecological context matters, too. The amount of valuable habitat that already exists up or downstream from the dam will affect how plant and animal species respond to the change, as will the kind of habitats that are reconnected and where they are located in the river. How closely the dam is located to other development, how intense that development is, and the effects of its removal on health, safety, and the economy are all related social concerns.

The Massachusetts Division of Ecological Restoration (DER) evaluates projects on these terms using its Restoration Potential Model Tool. The tool tracks the characteristics of all 3,000+ dams in the Commonwealth. It models how effective a dam removal can be in terms of providing ecological benefits. DER has also made some of its dam removal data available for download, including the economic, safety, and environmental monitoring findings. The practice of post-removal evaluation is still limited but is on the rise as dam removal increases in popularity. The U.S. Geological Survey, working with the nonprofit American Rivers, now tracks scientific studies on the outcomes of dam removal and visualizes the data in the Dam Removal Information Portal (DRIP). The portal not only tracks and maps projects, it links users to the associated studies for further details. DRIP reports the salient characteristics that get weighed early in removal decisions, including essential details about the dam. The cataloged reports include studies of tradeoffs, whether social, economic, or with respect to impact on other infrastructure. Physical and biological outcomes are also commonly reported. DRIP is not comprehensive—not all dams are tracked, and not all studies are included—but it is as close to a one-stop-shop for dam removal information as has been achieved to date.

Dam removal also provides many opportunities that do not get indexed in databases but relate to other social and ecological trends. Increased demand for renewable energy sources, for example, puts the transition from fossil fuels in conflict with the prospect of removing hydropower producing dams. It is not uncommon for such facilities to operate as “peaker” plants, which come online at times of peak energy demand and can be highly disruptive to river flows. To minimize the harms from such plants, criteria have been developed for certifying projects as low-impact, and changes to how the dams operate can be negotiated when owners must renew their licenses, as has been done recently for dams in the Connecticut River. Where ponding behind a dam is desirable, Beaver Dam Analogs have been employed to mimic the kind put in place by beavers themselves. This ecological alternative provides numerous benefits, including naturalistic flow regulation, fish passage, and habitat creation. These analogs can even be designed in a way that beavers will maintain them on their own.

The work ahead is significant. Dam removals still number in the low thousands nationally, but the trend favors retiring old, potentially unsafe infrastructure in favor of more ecological alternatives. In fact, SNEP has supported similar efforts such as those in the Childs River restoration project. Further studies are needed to gain a holistic understanding of dam removal’s potential, both at the site level and at scale. The steady shift away from damming contrasts with the 20th-century notion that society benefits from controlling rivers. Perhaps it also promises a 21st-century vision of restoring the capacities of rivers, the diverse benefits of which we can all enjoy.