The Brownsville Dam Removal

The Brownsville Dam was constructed in the 1880s as a summer diversion structure for a local woolen mill in the forested and agricultural Calapooia River watershed of the Willamette Valley, Oregon. The small dam, 33.5m (110ft) in width, raised the level of the Calapooia River by 1.8m (6ft) during the high-flow season extending from October to May. During summer months, removable flashboards were installed, raising the river level to 3.4m (11ft) above its historic elevation. The Calapooia Watershed Council coordinated removal of the Brownsville Dam in the summer of 2007 to improve passage for steelhead and spring Chinook, which are listed on the National Endangered Species Act (ESA). To advance the science of dam removal, researchers from Oregon State University, directed by Dr. Desiree Tullos, characterized the changes to sediment dynamics, channel morphology, aquatic communities, and human social networks that have occurred over the course of the removal.

To characterize changes to geomorphology, the longitudinal profile of the channel was surveyed, and cross sections were placed at the heads, tails, and evenly spaced within geomorphic units, such as riffles and pools. Depositional features were mapped and substrate of bars and riffles was characterized by bulk and pebble count sampling. Habitat surveys and invertebrate sampling were also completed. To identify response reaches, the wetted channel and exposed bars were delineated and compared over nine orthorectified aerial photos taken between 1994 and 2006. From this analysis, a downstream response reach (20 channel lengths or 670 m) was identified as the region where changes were most likely to occur, due to proximity to dam, and mostly likely to be observed, due to low natural variability.

Uncharacteristic Results

Biophysical Monitoring

At the time of removal, local stakeholders were concerned that the sediment release following dam removal would result in a decline in quality of downstream aquatic habitat. However, detailed analyses of baseline conditions suggested that the coarse gravel stored in the reservoir was in fact likely to improve habitat complexity in the sediment-deficient reaches below the dam. One year after dam removal, monitoring data from reaches below the dam and reference reaches upstream confirmed that median particle sizes in riffles and bars below the dam had increased as the channel substrate shifted from hardpan to become dominated by coarse gravel (Figures 1 and 2). Sediment evacuated from the reservoir deposited into bar features, increasing bar area in the reach downstream by nearly 600% and, contrary to conventional wisdom of dam removal, percentages of fine materials in riffles and bars decreased (Figure 3).

Social Impact Assessment

To characterize the socioeconomic impact of the Brownsville dam removal, a research group of social scientists, led by Dr. Denise Lach of Oregon State University, interviewed approximately 30 community members from the various stakeholder groups involved in the community decision-making process. Community members who were opposed to the decision as well as those in favor have been interviewed. From the interviews, the *a priori* template design from the existing literature on social impacts has been expanded (see Table 1).

Learning from the Brownsville Dam Removal

Baseline Data Collection

A lesson learned at Brownsville is that a thorough baseline survey can guide monitoring efforts. Baseline data documents pre-removal conditions, but may also direct formulation of research hypotheses and allow for prioritized monitoring plans. At Brownsville, baseline data collection informed simple predictive models regarding how and when sediment would move and where channel changes were likely to be detected. This information allowed researchers to target monitoring within anticipated response reaches, and to focus broad conceptual models to create detailed study hypotheses based upon spatially explicit data.

Model Evolution

Conceptual models are articulations of our understanding of relationships and processes in the ecosystem and how our interventions are likely to change ecosystem processes and conditions. The outcomes of the Brownsville dam removal were somewhat contradictory to results predicted by the current conceptual models of dam removal that constitute the underpinnings of many effectiveness monitoring studies (Figure 4). The results of the Brownsville dam removal provides an example as to why monitoring data should be used to constantly evaluate and validate conceptual models to enhance learning as the science and practice of dam removal progresses. We suggest that researchers investigating dam removals employ a scientific process that includes comparison of actual results to outcomes projected by detailed and conceptual models (Figure 5) in order to promote evolution of the tools used in dam removal research.

For more information and results from the Brownsville Dam Removal, see the OSU monitoring website:
http://rivers.bee.oregonstate.edu/Brownsville/BrownsvilleDamRemoval.html
and the Calapooia Watershed Council website:
http://www.calapooia.org/projects/brownsville-dam-removal/

Figure 1. D50 in bars and riffles of the response reach (DS) and reference reach (US) before and after dam removal. US data points represent a composite of four samples.

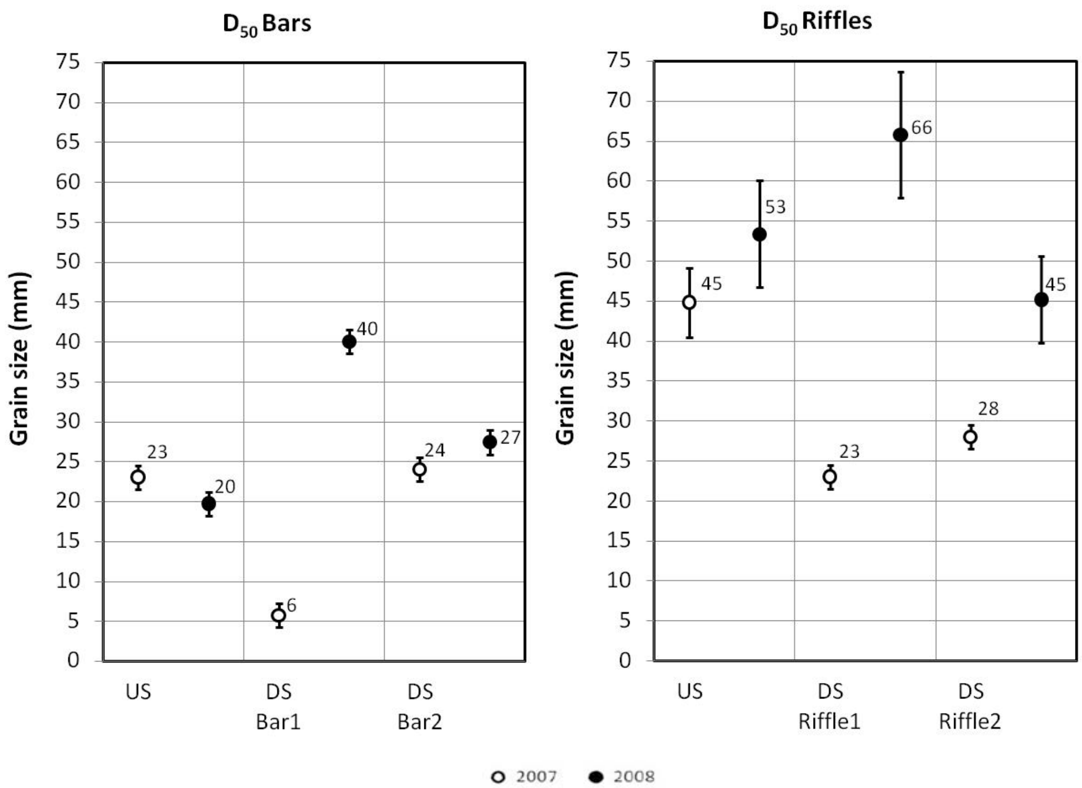

Figure 2. Substrate size class composition by percent in the response reach (DS) and reference reach (US) before and after dam removal.

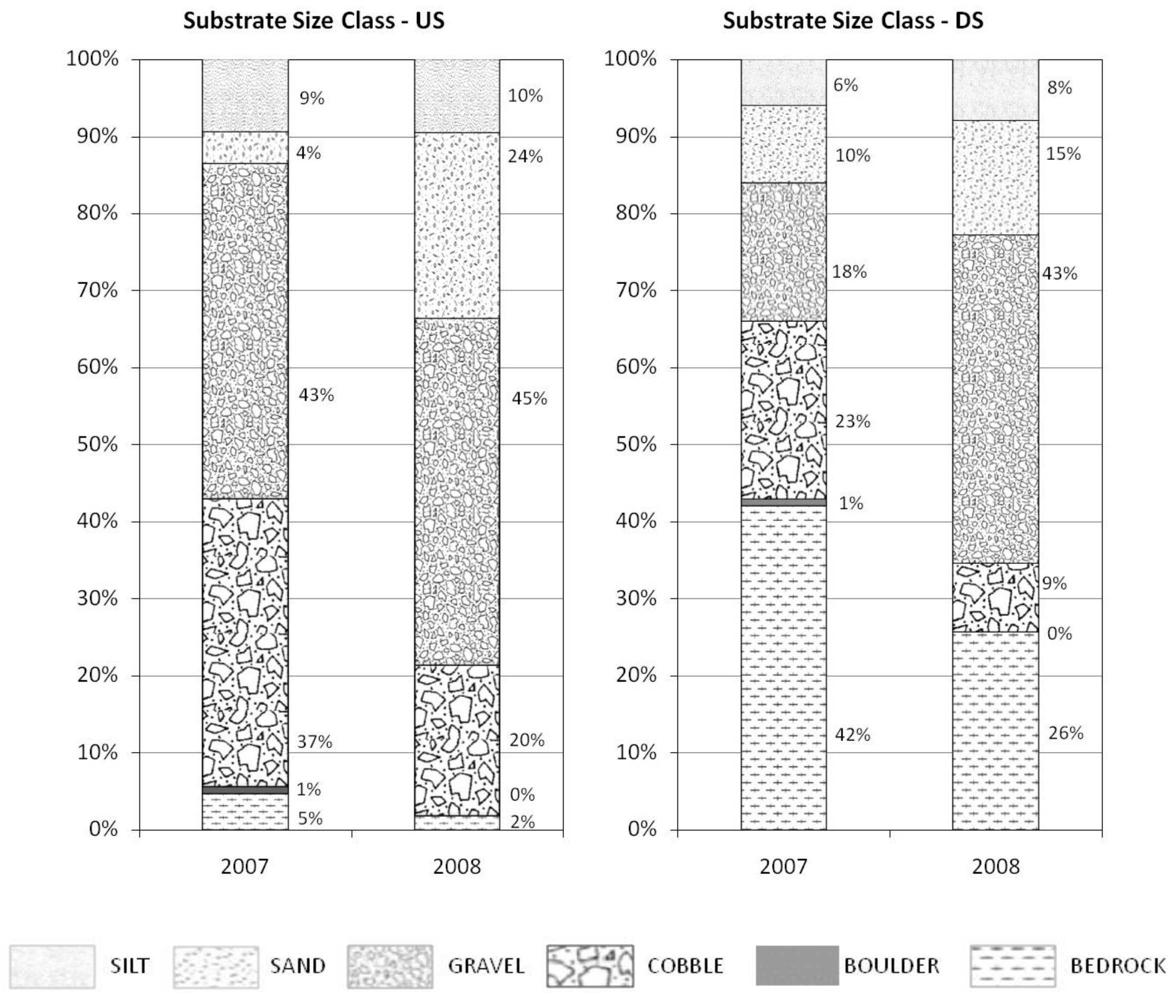

Figure 3. Percent fines in bars and riffles of the response reach (DS) and reference reach (US) before and after dam removal. US data points represent a composite of four samples.

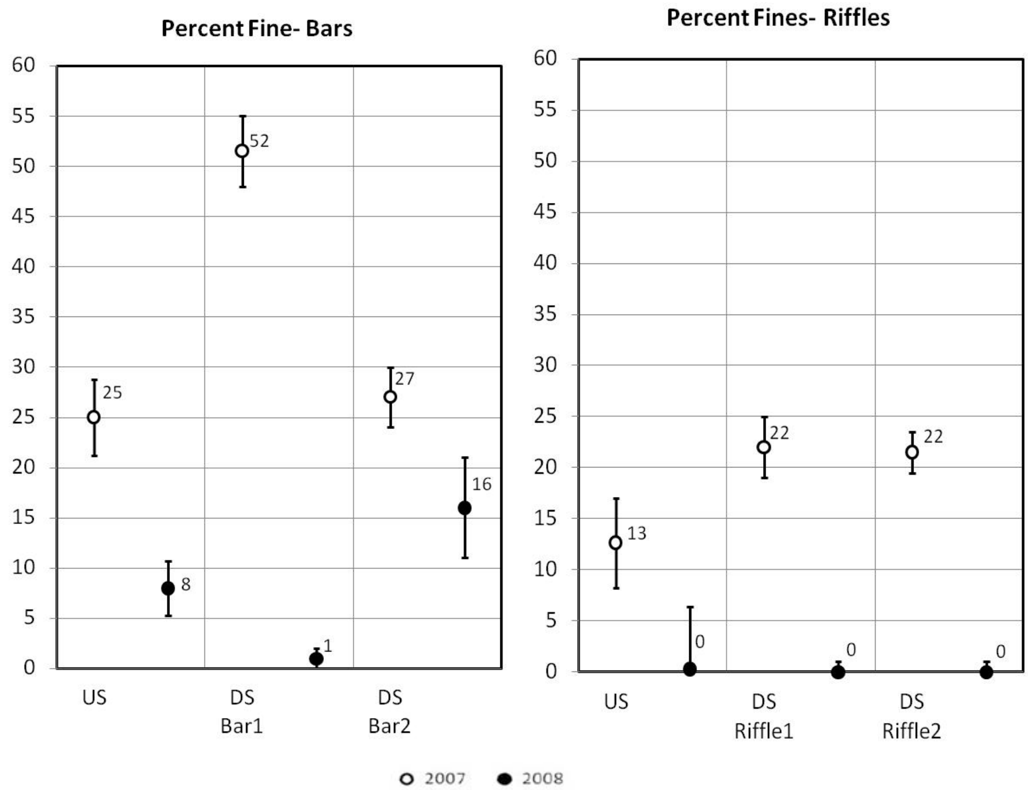

Figure 4. Broad conceptual model of the impounded channel and anticipated responses to the Brownsville dam removal.

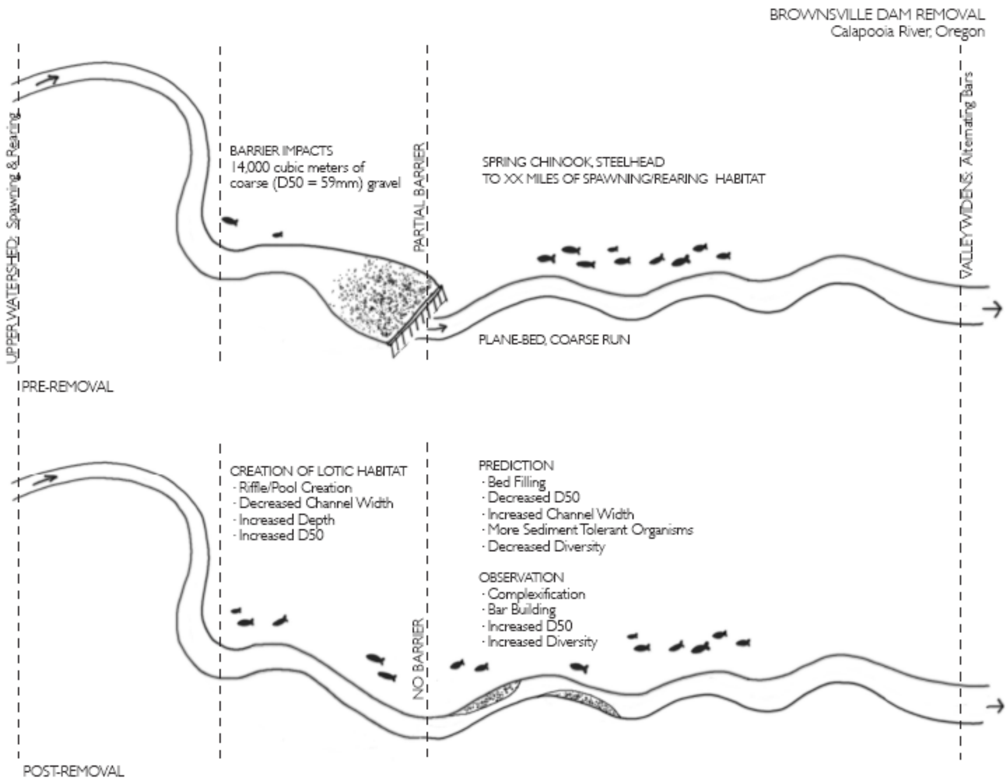

Figure 5: Model of dam removal evaluation process

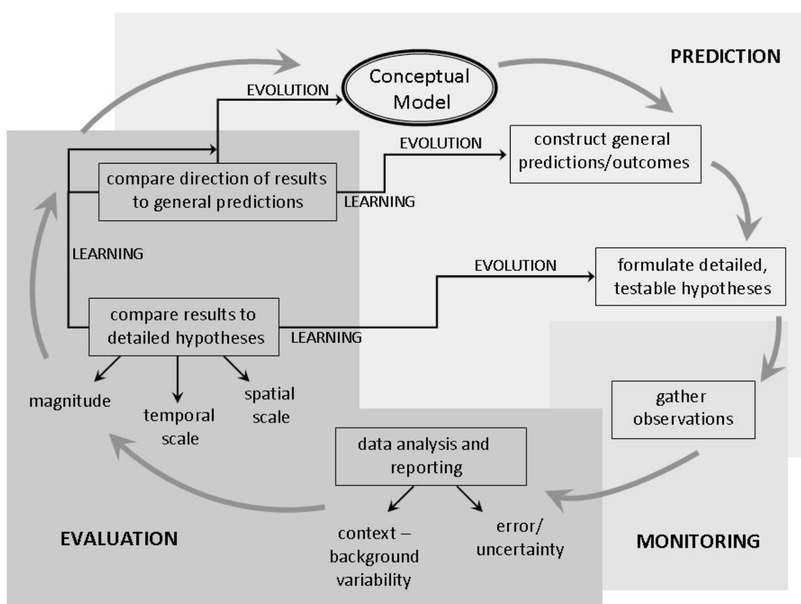

Table 1. Brownsville Social Indicator Matrix: Validated, Emergent and Most Frequently Identified   The SIA matrix, as follows: The black font indicates validated impacts; the red font indicates new impacts that were not represented in the original matrix. The highlighted green boxes represent the **most frequently identified** impacts, which include traditional indicators and emergent, as found by the interviewed stakeholders.

Health and Social Well-Being Impacts	Quality of the Living Environment (Livability) Impacts	Economic Impacts and Material Well-Being Impacts	Cultural Impacts	Family and Community Impacts	Institutional, Legal, Political, and Equity Impacts
Elimination of location for delinquent behavior	Habitat Restoration	Maintenance cost alleviated/eliminated/ Created financial obligation to operate pump station	Cultural integrity-degree to which local culture is respected and likely to persist	Community safety	Conflicting agency agendas
Uncertainty -being unsure of the effects or meaning of dam removal	Leisure and recreational activities and opportunities	Change to tourism industry	Historic structure- Place of interest	Community identification and connection-sense of belonging, attachment to place	Impact equity distribution of social and economic impacts across the community
Dam Removal Created Hazard	Perceived and actual quality of the living environment	Local employment opportunity	Loss of cultural or natural heritage- areas of recreational value	Lack of participatory involvement	Access to and utilization of legal procedures and advice throughout project
Annoyance -experiences due to disruption of life	Fire Control	Standard/Cost of living	Change in cultural traditions	Changes in social networks	Meet agency objectives
Sense of Identity	Perception of personal safety, hazard exposure, and fear of crime	Liability risks eliminated/ Liability Risk created	Experience of being culturally marginalized-e.g., structural exclusion of certain groups	Changes in demographic structure of the community	Formation of special interest groups as a result of institutional priority to certain groups
Dissatisfaction -due to failure of removal to deliver promised benefits	Shared vision for the watershed	Access to public goods & services / change cost recreation shift		Perceived and actual community cohesion	Participation in decision-making/ Lack of participation in decision making
(Location for) delinquent behavior		Replacement costs of environmental services/ Access to public goods/services		Social differentiation and inequality	Fulfilled legal/ regulatory obligation of administrative order
Aesthetic Quality	Aesthetic Quality	Litigation	Aesthetic/spiritual qualities	Changes in social tension-conflict within the community	