Social, Economic, and Environmental impacts of Brownsville Dam Removal

Desiree Tullos, PhD
Denise Lach, PhD
Jack Zunka
Trent Carmichael
Cara Walter

http://home.netcom.com/~horse/digitarium.html
Who we are
Presentation Outline

• Project overview - Desiree
• Biophysical results - Desiree
• Socioeconomic results – Desiree
• Ongoing work
  – Modeling dam removal - Jack
  – Geopolitics of dam removal - Trent
• Project impacts - Desiree
Study objectives

• Document extent, magnitude, and drivers of changes in Calapooia with dam removal

• Provide foundation for long-term projections in Calapooia

• Analyze and propose social, economic, and environmental impact monitoring for dam removal
Brownsville Dam removal

Brownsville Dam
River: Calapooia
Purpose: mill diversion, esthetics
Constructed: 1960’s
Removal: 2007

As a small case study, tests our limits of detection.
Monitoring process

EVALUATION

- model evolution: compare monitoring results to predictions
- data analysis and reporting
  - background variability
  - error/uncertainty
  - ecological thresholds

CONCEPTUAL MODEL

- construct general predictions/outcomes
- formulate detailed, testable hypotheses
  - magnitude
  - temporal scale
  - spatial scale

PREDICTION

MONITORING

gather observations
Monitoring components

- **physical**
  - substrate size distribution – bulk samples, pebble counts
  - discharge – historical record extension and gaging
  - channel geometry, facies/features

- **biological**
  - coarse vegetation
  - benthic macroinverts
  - habitat quality

- **socio-economic**
- **geopolitical**
Socioeconomic results

- How has the Brownsville Dam removal impacted the social and economic status of the community?
- What indicators can be used to characterize and monitor these impacts?
Dam Removal and Societal Considerations

• Born *et al* (1998) suggests dam owners, local communities, interest groups, and regulatory agencies across the country will have to look at the social and economic considerations in more detail.

• 2002 Heinz Report concluded that little research exists on the human dimension of dam removal.
Case Study:
Data gathered directly from individuals or the groups in natural environment to study the interactions, attitudes, and characteristics

Multiple Methods:
Participant Observation
Document Analysis – police reports, newspaper articles, etc.
Semi-Structured Interviews
<table>
<thead>
<tr>
<th>Health and Social Well-Being Impacts</th>
<th>Quality of the Living Environment (Livability) Impacts</th>
<th>Economic Impacts and Material Well-Being Impacts</th>
<th>Cultural Impacts</th>
<th>Family and Community Impacts</th>
<th>Institutional, Legal, Political, and Equity Impacts</th>
</tr>
</thead>
<tbody>
<tr>
<td>Elimination of location for delinquent behavior</td>
<td>Habitat Restoration</td>
<td>Maintenance cost alleviated/eliminated/ Created financial obligation to operate pump station</td>
<td>Cultural integrity-degreeto which local culture is respected and likely to persist</td>
<td>Community safety</td>
<td>Conflicting agency agendas</td>
</tr>
<tr>
<td>Uncertainty -being unsure of the effects or meaning of dam removal</td>
<td>Leisure and recreational activities and opportunities</td>
<td>Change to tourism industry</td>
<td>Historic structure- Place of interest</td>
<td>Community identification and connection-sens eof belonging, attachment to place</td>
<td>Impact equity distribution of social and economic impacts across the community</td>
</tr>
<tr>
<td>Dam Removal Created Hazard</td>
<td>Perceived and actual quality of the living environment</td>
<td>Local employment opportunity</td>
<td>Loss of cultural or natural heritage- areas of recreational value</td>
<td>Lack of participatory involvement</td>
<td>Access to and utilization of legal procedures and advice throughout project</td>
</tr>
<tr>
<td>Annoyance -experiences due to disruption of life</td>
<td>Fire Control</td>
<td>Standard/Cost of living</td>
<td>Change in cultural traditions</td>
<td>Changes in social networks</td>
<td>Meet agency objectives</td>
</tr>
<tr>
<td>Sense of Identity</td>
<td>Perception of personal safety, hazard exposure, and fear of crime</td>
<td>Liability risks eliminated/ Liability Risk created</td>
<td>Changes in demographic structure of the community</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Dissatisfaction -due to failure of removal to deliver promised benefits</td>
<td>Shared vision for the watershed</td>
<td>Access to public goods &amp; services / change cost recreation shift</td>
<td>Experience of being culturally marginalized- e.g., structural exclusion of certain groups</td>
<td></td>
<td></td>
</tr>
<tr>
<td>(Location for) delinquent behavior</td>
<td></td>
<td>Replacement costs of environmental services/ Access to public goods/services</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Aesthetic Quality</td>
<td>Aesthetic Quality</td>
<td>Litigation</td>
<td>Aesthetic/spiritual qualities</td>
<td>Changes in social tension-conflict within the community</td>
<td></td>
</tr>
</tbody>
</table>
Economic Impacts

Indicator: Access to public goods and services

Measurement: Distance and Cost to replace the amenities at the Brownsville dam site

“[A negative impact is] losing the recreation resource. You either went swimming at the dam or you went really far away. We would have to go to Foster Dam in Sweet Home or you could go out toward Crawfordsville to a place called Swiss Cheese.”

- Community member
## Surrounding Recreation: Alternative Use Area Replacement Costs

<table>
<thead>
<tr>
<th>Name</th>
<th>Location</th>
<th>Distance (miles)</th>
<th>Amenities</th>
<th>Cost for Services</th>
<th>Fuel Cost* ($)</th>
</tr>
</thead>
<tbody>
<tr>
<td>McKercher Park</td>
<td>HWY 228</td>
<td>4.5</td>
<td>Swimming, Picnic Area, Fishing</td>
<td>N</td>
<td>0.80</td>
</tr>
<tr>
<td>McClun Wayside</td>
<td>Holley, OR</td>
<td>11.5</td>
<td>Picnic Area, Fishing, some swimming</td>
<td>N</td>
<td>2.01</td>
</tr>
<tr>
<td>Waterloo County Park</td>
<td>Waterloo, OR</td>
<td>16.2</td>
<td>Swimming, Fishing, Picnic area, Hiking</td>
<td>Y</td>
<td>2.84</td>
</tr>
<tr>
<td>Lewis Creek</td>
<td>Foster Reservoir, Sweet Home OR</td>
<td>23.7</td>
<td>Swimming, Fishing, Hiking, Picnic area</td>
<td>N</td>
<td>4.15</td>
</tr>
</tbody>
</table>

*Assumptions: The travel cost for replacement services was based on vehicle that gets at least 25mpg and current gas price of $2.19 per gallon; Fuel price represents round trip approximation.

Data from Linn County Parks and Recreation: [www.co.linn.or.us/parks/2009](http://www.co.linn.or.us/parks/2009)
Institutional, Legal, Political, and Equity Impacts

“I feel that we worked really hard to be transparent. We invited the whole community to come to council meetings not just the Canal Company or Watershed Council members. We made an effort to get to know local shop owners and used the local community to help get the information out.”
- Watershed Council member

“It was out there an appropriate amount…there were public meetings. I feel that people got a chance to voice their opinions, if that is what the people wanted.”
- Community member

“I feel that most people did not know about what happened. They did not have an opportunity to vote on the issue and by the time I found out about this, the decision was already made”
- Canal Company member
Institutional, Legal, Political, and Equity Impacts

Indicator: Participation in Decision Making

Measurement: Published announcements and notices of local meetings

<table>
<thead>
<tr>
<th>Year</th>
<th>2002</th>
<th>2003</th>
<th>2004</th>
<th>2005</th>
<th>2006</th>
<th>2007</th>
<th>2008</th>
</tr>
</thead>
<tbody>
<tr>
<td>Announcement of public meetings: Watershed Council, City Council, Canal Company</td>
<td>15</td>
<td>17</td>
<td>15</td>
<td>22</td>
<td>31</td>
<td>34</td>
<td>28</td>
</tr>
</tbody>
</table>
Socioeconomic: Take home messages

• Results suggest the dam removal had a minimal effect across the community

• Limited data resources make measuring impacts challenging

• Collaborative partnerships of watershed based management may be a critical mechanisms in the successful coordination of small dam removal deliberation in the future
Biophysical results

• What is the extent and significance of impacts to habitat and invertebrates?

• What physical processes explain the observed habitat and invertebrate responses?

• What methods are valid and in the complicated study of dam removals?

Cara Walter
MS – Water Resources Engineering

Kelly Kibler
PhD – Water Resources Engineering
study layout
Biophysical studies

Where did all the sand and gravel go? And what impact will it have on habitat for fish and other organisms?
Historical context
Field surveys

- **Channel survey**
  - Repeat cross-sections
  - Longitudinal profile along thalweg (deepest part of channel) for each reach
  - Sediment bar mapping

- **Sediment sampling**
  - Repeat pebble counts on bars and riffles
  - Bulk samples on bars

- **Habitat Surveys**

- **Macroinvertebrate sampling**
Reservoir sediment erosion

- 2007-2008 – 29%
- 2008-2009 – 10%
- 2007-2009 – 39%
Results: Downstream Channel Changes

Pre-removal | 1 year post-removal | 2 years post-removal
Percent fines in riffles and bars

Percent fines- Riffles

Percent fines- Bars

0% 13% 22% 22% 0%

0% 6% 4% 6% 0%

0% 6% 4% 6% 0%

US DS Riffle 1 DS Riffle 2

0% 8% 1% 16% 35%

0% 25% 24% 27% 27%

0% 52% 35% 30% 40%
Substrate sizes

![Substrate size class - DS](chart)

- **SILT**:
  - 2007: 3%
  - 2008: 12%
  - 2009: 5%

- **SAND**:
  - 2007: 5%
  - 2008: 5%
  - 2009: 19%

- **GRAVEL**:
  - 2007: 48%
  - 2008: 45%
  - 2009: 28%

- **COBBLE**:
  - 2007: 11%
  - 2008: 25%
  - 2009: 28%

- **BOULDER**:
  - 2007: 31%
  - 2008: 4%
  - 2009: 16%

- **HARDPAN**:
  - 2007: 3%
  - 2008: 13%
  - 2009: 13%
Bar areas

**US Bar Area**

- 2007: 2887±1262
- 2008: 2902±400
- 2009: 2959±840

**DS Bar Area**

- 2007: 237±77
- 2008: 1206±613
- 2009: 1320±247
Biophysical: Take home messages

• the upstream and downstream channel changes were limited in extent with no detrimental impacts in terms of bank erosion or flood risk

• Project benefits:
  – Unobstructed fish passage
  – Some increases in habitat diversity

• Substantial learning on methods and physical processes of dam removal
Ongoing work

• Place Brownsville results into broader scientific context for dam removal

• Modeling physical processes of dam removal

• Drivers of dam removal decisionmaking

Jack Zunka
MS – Geosciences

Trent Carmichael
MS – Water Resources Science
Modeling dam removal

Objectives:

• Evaluate need for concern about the environmental impacts of removing small dams.

• Evaluate overall impact of the removal on geomorphic complexity / habitat diversity in the channel.

• Evaluate DREAM-2 as a predictive tool.

• Develop quantitative methods for describing 2-D changes.
1-dimensional analysis

• Using sediment transport model (DREAM-2), generate a 1-D, cross-sectionally averaged prediction of channel change following removal.

• Compare model outputs spatially and temporally with field data.
1-dimensional analysis
2-dimensional analysis

• Evaluate differences between predicted vs collected profiles and address questions relating to styles of deposition downstream of former dam in 2-D
  – Is there noticeable DS deposition? Is it occurring as bar growth or pool fill?
2-dimensional analysis

DS1 XS3

Elevation (m)

Station (m)

2007
2008
2009
2-dimensional analysis

- Analyze 2-D changes quantitatively using geomorphic complexity metrics
  - Coefficient of Variation (CV) of thalweg depth
  - CV of individual cross sections
  - Mean maximum residual pool depth
  - Variation in thalweg sinuosity
  - D84/D16
  - Change in % sediment size class
Drivers of dam removal decisionmaking

Objectives

• Investigate why one community embraces dam removal while another may not
• Examine the major drivers in dam removal decisions
• Explore theories to explain patterns in dam removal rationale

(Environmental Kuznets Curve)
Dam removal: Emerging Policy

- Lowry (2003) suggests a movement away from traditional development practices

- Passage of environmental legislation and support of federal, state, and local agencies

- Decentralized movements of environmental protection

Photo Source OWEB: www.oregon.gov/BrownsvilleRemoval.jpg
Why is dam removal becoming an increasingly viable option?

• Most dams built with ~50 year lifespan. Many of the nations’ dams are at or near that age

• Removal is often the most economic option

• Regulatory changes and recent dam re-licensing make removal a more likely option

• Environmental restoration has become increasingly important to the general public

What drivers influence a community to consider dam removal?

Physical/Environmental
- Aging dams, human safety issues
- Environmental restoration

Social
- Changing land use practices
- Income, education?

Political
- Dam re-licensing, policy changes

Economic
- Funding, cost of alternatives
- Benefit to fisheries?
What drivers affect a community’s decision to choose dam removal?

- **Social**
  - Certainty of outcome, community participation
  - Cultural traditions, historic ties?

- **Political**
  - Money allocation

- **Economic**
  - Funding availability, cost of alternatives
  - Change in property values?

- **Physical/Environmental**
  - Human safety, habitat restoration
Examining drivers

• Research funding sources and availability

• Compile information about dams considered for removal

• Download demographic data

• Compile timeline of important policy changes
Examining drivers

• Discussion with community and agencies involved

• Interest and participation at local to national level

• Analysis of quantitative data (census, land use, etc.) within GIS
Project Impacts

- 3 publications accepted or in review (+3 in prep)
- Dam Removal Monitoring Guide
- Students supported
  - 1 Phd
  - 4 masters
  - 5 undergraduate
Project Impacts

Flow records on Calapooia

Discharge on the Mohawk or South Santiam Rivers (cfs)

Discharge on the Calapooia River at Holley (cfs)

- South Santiam River
- Mohawk River
Project Impacts

“When you have change it helps define the character of the people, it helps establish and formulate community identity. When you are working with people and hearing different view points, people start working together, discussing issues in the community, and try to solve problems based on a greater set of information. Change essentially helps build infrastructure of the community from the bottom-up”

- City Official
Thank you! Questions?

http://rivers.bee.oregonstate.edu/index.html