Improving Implementation and Effectiveness Monitoring at Dam Removal Sites: Integration with project and program planning

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NOAA Restoration Center

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Presentation Map

- Consider why we monitor dam removal sites
- Review NOAA Restoration Center’s (RC) monitoring program design and basic elements
- Present RC dam removal monitoring network in Northeast U.S.
- Present example of monitoring results informing project implementation
- Questions
Why does NOAA RC monitor dam removals?

- NOAA Fisheries aims to improve diadromous fish habitat quality and access
- NOAA RC provides funding and technical assistance for dam removals
- Thus a direct interest in project outcomes:  
  - implementation quality (short-term)  
  - ecological effectiveness (long-term)
NOAA RC monitoring program: three organizing principles

1. Tiered monitoring
   - improves cost-effectiveness
   - evaluates short and long-term outcomes
2. Monitoring integrated with program planning
3. Partnerships to accomplish
Principle 1: tiered monitoring

• Tier I
  • implementation monitoring
  • short-term
  • provides basic project QA/QC
  • ALL PROJECTS

• Tier II
  • effectiveness monitoring: ecological, socioeconomic, and/or technique
  • long-term
  • addresses questions of regional importance
  • provides science base to advance RC programs and restoration practice
  • SELECTED PROJECTS
Principle 2: integrated monitoring

- Systematic project monitoring
- Data capture, storage, and management
- Project implementation
- Influence program priorities, project selection, and/or techniques
- Regional analyses by project type
- Project analyses/disseminate results

Regional analyses by project type influence program priorities, project selection, and/or techniques, which in turn lead to systematic project monitoring and data capture, storage, and management. This integrated cycle supports project implementation.
Tier I dam removal monitoring

- All NOAA RC-funded dam removals (since 2009)
- Primary ecological metrics:
  - site passability (as-built survey)
  - upstream presence/absence of target species
- Socioeconomic metrics too
- Before-After (BA) design
- Evaluated within 1 year post-project
Tier II dam removal monitoring

- Selected sites
- Evaluates ecological, socioeconomic, and/or technique effectiveness
- Standard metrics and methods—some flexibility for site requirements
- Before-After, Control Impact (BACI) design
- Long-term data collection (i.e., > 5 years post-project)
Northeast Region Tier II sites: dam removal

- 5 sites to date
- Evaluating parameters recommended in regional monitoring guidance (Collins et al., 2007)

<table>
<thead>
<tr>
<th>Project</th>
<th>Parameter</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>cross-sections</td>
</tr>
<tr>
<td>Penobscot River, ME</td>
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<tr>
<td>Brewer Dam, ME</td>
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</table>

UMaine-Orono
USGS
U of S. Maine
Penobscot Indian Nation
GMRI
Boyle Associates
Penobscot Trust

UMaine-Orono
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GMRI
Boyle Associates
Penobscot Trust

McCormick-Taylor
USGS
Johns Hopkins U
UMaryland-BC
State of MD
Northeast Region Tier II sites: dam removal

- Chosen to answer ecological or technique effectiveness questions of interest
- Chosen to represent regional fluvial habitat variability

<table>
<thead>
<tr>
<th>Project</th>
<th>Fluvial Habitat Variability</th>
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<tbody>
<tr>
<td>Penobscot River, ME</td>
<td>10^1 10^2 10^3 10^4 mud</td>
</tr>
<tr>
<td>Brewer Dam, ME</td>
<td>10^1 X X X mud/sand sand</td>
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<tr>
<td>Merrimack Village Dam, NH</td>
<td>10^1 X X X sand sand/gravel</td>
</tr>
<tr>
<td>Larkin Mill Dam, MA</td>
<td>10^1 X X X sand gravel</td>
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- basin size (km²)
- dominant impounded sediment
- reach gradient (%)
- physiography
- glaciated
- climate
**Northeast Region**
**Tier II sites: dam removal**

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<tr>
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<tr>
<td>Penobscot River, ME</td>
<td>10³ 10² 10¹ 10⁰</td>
<td>mud  mud/sand  sand  sand/gravel  gravel</td>
<td>&lt;&lt;1 1 1-2 2-5</td>
<td>PU  PL  CP  NU  SL  HV</td>
<td>Y  N</td>
<td>Dfb  Dfa  Cla</td>
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<tr>
<td>Brewer Dam, ME</td>
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**Legend:**
- Dfb: Boreal Forest, Dfa: Atlantic Forest, Cla: Coastal Atlantic

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**Project Fluvial Habitat Variability**

- **Penobscot River, ME**: X
- **Brewer Dam, ME**: X
- **Merrimack Village Dam, NH**: X
- **Larkin Mill Dam, MA**: X
- **Patapsco River, MD**: X

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**Basin Size (km²):**
- 10³
- 10²
- 10¹
- 10⁰

**Dominant Impounded Sediment:**
- Mud
- Mud/sand
- Sand
- Sand/gravel
- Gravel

**Reach Gradient (%):**
- <<1
- 1
- 1-2
- 2-5

**Physiography:**
- PU
- PL
- CP
- NU
- SL
- HV

**Glaciated:**
- Y
- N

**Climate:**
- Dfb
- Dfa
- Cla
Northeast Region
Tier II sites: dam removal

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Northeast Region
Tier II sites:
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<td>$10^4$</td>
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<td>Brewer Dam, ME</td>
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Tier II technique effectiveness example: Merrimack Village Dam (NH)

KEY QUESTION
• At what rates do sediments (sand) deliberately discharged to a downstream reach, and temporarily stored there, remobilize?

IMPACT
• Improved understanding of the potential impacts of sediment accretion on stream biota, infrastructure, flood stages, recreational uses of the river, and adjacent land uses

RESULTS
• Large downstream sand deposits remobilize surprisingly quickly
• Results directly impacted Patapsco dam removal design approach and regulatory process
after Pearson et al. (2011)
• Simkins dam removal site (MD) analogous to Merrimack site
  ➢ Sediment volume, grain size, and quality
  ➢ Watershed size
  ➢ Low gradient downstream reach
• Simkins project team seeking passive sediment management
Further Work

• Improve Tier II network’s representation of regional habitat variability
• Formalize a process for identifying monitoring questions of programmatic importance
• Strengthen many components of the integrated monitoring process