Development of an Ecosystem Restoration Strategy for the lower Columbia River using a Multiple Lines of Evidence Approach

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Presentation Outline

• Overview of need

• Overview of Current Prioritization Framework
  – Tier 1
  – Tier 2

• Tier 3 Concepts
  – Habitat change analysis
  – Habitat Suitability Index
  – Habitat Gap Analysis, Others

• How it all comes together
Habitat Loss

- Significant declines in emergent marsh and tidal swamp habitats
- Off-channel habitats cut off
- Reduction in flow, access to habitats
- Decreases in habitat complexity, changes to food web
- Changes in habitat forming processes
- Resulting in rearing, spawning, and refugia habitat loss for ESA listed species
- Restoration of these habitats should help improve these species’ abundance and sustainability
- To the extent possible, we need to restore historic conditions on the ecosystem scale to achieve recovery goals
Restoration Goals

- **19,000 acres to be restored by 2014**
  - From LCREP Management Plan
  - Included in EPA Strategic Plan
- **Includes 3,000 acres of tidal wetlands along lower 46 miles**

*Culvert Removal, Young Creek*
 Restoration Investment in the Lower Columbia

Habitat Restoration Projects Funded By the Estuary Partnership
1999 to 2009

- > 16,235 acres acquired and/or restored since 2003, including major partners
- Next phase of restoration may be more difficult; require strategic approach
Restoration Projects

- Most projects have occurred in the floodplain and tributaries

Habitat Enhancement

Passage Improvements

Floodplain Reconnections
Funding Partners

• NPCC/BPA:
  – ca. $4,000,000 (2003-2007)
  – ca. $9,000,000 (2008-2010)

• NOAA – Community Based Restoration:
  – ca. $350,000 (2008-2010)

• NOAA – Marine Debris Removal:
  – ca. $100,000 (2008)

• EPA – Targeted Watershed:
  – ca. $700,000 (2003-2005)
  – NEP funds (2003 to date)

• Corps of Engineers - Section 536:
  – ca. ±$2,000,000, approx, since 2002
  – e.g., Crims Island, Julia Butler Hansen Wildlife Refuge, Sandy River Delta, Vancouver Water Resources Center, etc.
Implementation Partners

- Local Governments
- SWCDs
- Conservation Organizations
- Watershed Councils
- Councils of Government
- Federal and State Agencies
- Consulting Firms
~50% of our projects have occurred in the vicinity of Astoria and Portland.

~33% of our projects have occurred in the vicinity of Portland.

~80% of our projects have occurred in the vicinity of Astoria and Portland.
Opportunity-driven restoration

- Bottom-up approach, reactive to RFP
- Favors projects after concept is already developed, usually meeting a local need
- Favors sponsors with capacity to manage projects
- Favors project that can leverage funding from multiple sources (e.g., BPA, LCRFRB, OWEB)
  - has helped promote tributary/floodplain focus
- Project significance often assessed on local level, but less clear on landscape scale
- To date, restoration efforts have been more fragmented than ecosystem-based
  - Connected to upstream restoration projects?
  - Focus on protecting entire life cycle?
  - Tie to water quality and food web?
  - Incorporate toxic contaminant sources and pathways?
Program Improvements

• Developing science and understanding of the complex system

• Experience leads to more informed project designs and decisions

• Improved monitoring efforts resulting in better decisions/designs

• Can lead to more strategic approach focusing on ecosystem scale restoration
  – Requires bi-state, central coordinating entity
Tools to Inform Restoration

- Columbia River Estuary Classification-inc. bathymetry, topography, landcover
- Restoration Prioritization Strategy
- Shoreline Condition Inventory
- Ecosystem Status Monitoring
- Action Effectiveness Monitoring
- Reference Sites
- Cumulative Effects
- Meta-analysis
- Data Management
- Adaptive Management
Current Habitat Restoration Prioritization

- **Two-tiered - Scales from system-wide to project specific**
  - **Tier 1** uses disturbance model (stressors)
    - provides method for comparing site function and structure at larger scales
    - Focuses on existing data
    - refines by updating/adding new data

- **Tier 2** provides scientific method of comparing specific projects using change in function and likelihood of success

*PNNL and Estuary Partnership*
Current Habitat Restoration Prioritization

Existing Components of the Prioritization

1) Tier 1a Analysis of Site and MA disturbance scores.

This section was completed with the available data. May want to update the datasets.

Sites: 18 stressors impact 7 control factors (CF), for a final score.
Final score is an average of the control factors:

Stressor datasets used:

Bonneville Flow Alteration          Pile Dikes
Diked Area                          DMDS
Flow Restrictions                   Population
SEDQUAL                            Industrial Shoreline
Facilities – Land Type              Dredging (Shoal Areas)
Facilities – Water Type             Shoreline Change (not used)
Industrial Development              Shoreline Armoring (not used)
303d Impaired Water bodies          Invasive Species (not used)
Agriculture
Marina Area
Minor OW Structures
Major OW Structures
Protected Marinas
Prioritization Framework — Tier 1

Site and Management Area Rankings (Reach A,B)
Adjacent site quality affects ability of site to recover.
Tier 2 Project Evaluation

Project Priority Score
Specific projects or proposals are given a priority rank using detailed information on potential change, site size, probability of success, and cost:

\[
\text{Site score} = \frac{(\Delta \text{function} \times \text{size} \times \text{success})}{\text{cost}}
\]

Where,

- \( \Delta \text{ Function } \) = change in site ecological functions
- Size = relevant measure of the area encompassed by the project
- Success = an estimate of the probability for the site to meet the goal
- Cost = planning, implementation, monitoring, contingency, and management costs
## Tier 2 Project Evaluation

### Site Score

\[
\text{Site Score} = (\Delta \text{ function} \times \text{size} \times \text{success}) \div \text{cost}
\]

<table>
<thead>
<tr>
<th>Function/process</th>
<th>Preserve</th>
<th>Greater</th>
<th>Lesser</th>
<th>No Change</th>
<th>Unsure</th>
<th>Not applicable</th>
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<tr>
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<tr>
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<td>Nutrient processing</td>
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<td>Flood attenuation</td>
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<td>Food web support</td>
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<td>Natural biodiversity</td>
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### Totals

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<td>2</td>
<td>1</td>
<td>0</td>
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</table>
## Tier 2 Project Evaluation

### Site Score = \( (\Delta \text{ function} \times \text{ size} \times \text{ success}) \div \text{ cost} \)

<table>
<thead>
<tr>
<th>Success Factor</th>
<th>High</th>
<th>Moderate</th>
<th>Low</th>
<th>Unsure</th>
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<td>Case studies indicate success of...</td>
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<td>Restoration strategy is suitable</td>
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<tr>
<td>Habitat forming processes will be...</td>
<td>X</td>
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</tr>
<tr>
<td>Landscape features are...</td>
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<td>X</td>
<td></td>
<td></td>
</tr>
<tr>
<td>The site condition is...</td>
<td></td>
<td></td>
<td>X</td>
<td></td>
</tr>
<tr>
<td>Adjacent habitats are...</td>
<td>X</td>
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<tr>
<td>Self-maintenance</td>
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<td>Resilience</td>
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<td>Time Frame</td>
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<tr>
<td><strong>Total</strong></td>
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</table>
New: Tier 3 Restoration Strategy

- **Ecosystem-based with focus on salmon**
  - **Goals:**
    - restoring natural habitat diversity
    - restoring diversity of salmonid life history strategies
  - **Employ multiple lines of evidence approach**
    - Several analyses w/ each identifying areas of importance for protection and restoration:
      1. historic vs. current habitat coverage change analysis
      2. salmonid habitat suitability index (HSI model)
      3. *Upcoming Salmon Benefits Products* (e.g., nearest neighbor, structural connectivity)
- **Using currently available data**
New: Tier 3 Restoration Strategy

- Goals:
  - restoring natural habitat diversity
  - restoring diversity of salmonid life history strategies

Restoring natural habitat diversity is key to restoring diversity of salmonid life history strategies

- From NOAA Northwest Fisheries Science Center, September 2009:
  - Shallow water, low velocity, and low salinity surface environments with associated wetland vegetation are features that define juvenile salmonid habitat
  - Diverse distribution of habitat a surrogate for diversity and spatial structure of salmon population
  - Preservation and restoration of shallow water, low velocity, and low salinity environments an important strategy for recovery of salmon and to mitigate for anthropogenic modifications
New: Tier 3 Restoration Strategy

Goals:

- restoring natural habitat diversity
- restoring diversity of salmonid life history strategies

Multiple lines of evidence approach:

1. historic vs. current habitat coverage change analysis
   - Historic habitat coverage is proxy for natural habitat diversity
   - Identify losses by reach and habitat type

2. salmonid habitat suitability index (HSI model)
   - Identify locations in mainstem of optimum water velocities, temperature, depth and salinities based on Bottom et al. 2005 (OHSU model results)

3. New indices such as habitat gap analysis (from USACE’s Salmon Benefits)

4. Others such as CRE Classification
Line of Evidence 1:

Historic to Current Habitat Change Analysis (example below)

See K. Marcoe and C. Judd poster for more details
Line of Evidence 2: Habitat Suitability
(example below)

- Adapt criteria based on Salmon at River’s End report for current model (Bottom et al 2005)

- Examine frequency of suitability of area based on:
  - Water temperature
  - Velocity
  - Depth
  - Salinity

- Map spatial and temporal patterns for habitat and limiting factors
  See K. Marcoe and C. Judd poster for more details
Implications of Nearest Neighbor (NN) analysis for Prioritization:

1. Most tidal wetlands (53, located in all eight reaches of the LCRE): NN between 1 & 2 km.
2. For 28 sites, primarily in Reach B, NN <1 km.
3. Since restoration in Reach H, 3 stretches >7 km exist in LCRE, all located in reaches F and G.
4. Reach Scale: E, F, G have mean NN >2km; A is close with 1.91km and B next with 1.81km.
5. Prioritization of “long tail” of NN distance warranted; but must be weighed vs. historical.

Future Lines of Evidence: CRE Ecosystem Classification, Others

- **Applications:**
- Prioritizing habitats for protection and restoration
  - Using landscape metrics
  - Number of patches
  - Types of patches
  - Edge density
    - Fragstats

From Burke et al. 2005 presentation @ ERF
New Tier 3: Results (conceptual only)
New Tier 3: Results (conceptual only)
New Tier 3: Results (conceptual only)
Overlay with Tier 1 (conceptual only)

Site and Management Area Rankings (Reach A, B)
Reference Sites

Ecosystem Monitoring
Project Sites

Reference Sites

Restored Sites Performance (Report Cards)

Lesson Learned (Meta Analysis)

Program Report Card

Science Work Group

Restoration Site
Action Effectiveness Data

New Science
Cumulative Effects Research

Restoration Strategy

Project RFP
Proposed Project Prioritization Analysis

Project Proposals
New Projects

Stakeholders Report
Next Phases

- **Develop and continue to refine restoration strategy**
  - Support recovery plans
  - Use best available data
  - Support multi-species
  - Improve water quality and reduce toxics
- **Coordinated project development**
- **Increase capacity of project sponsors**
- **Improve efficiencies to increase quantity and quality of projects**

**Applications:**
- Prioritizing habitats for protection and restoration
  - Using landscape metrics
  - Number of patches
  - Types of patches
  - Edge density
    - Fragstats

**CRE Ecosystem Classification**

- Include results from AEM and CE into new project designs

From Burke et al. 2005 presentation @ ERF
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