Effectiveness Monitoring of Restoration Projects in the Columbia River Estuary from a Practitioner’s Perspective

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Goals for this Session

• Provide a brief survey of project effectiveness monitoring work throughout the estuary
• Review the project effectiveness planning ‘process’
• Give specific examples and lessons learned from protocol implementation
• Provide fodder for future discussion
Resource Status Monitoring

- Watershed Assessment
- Fish and Wildlife Populations
- Water Quality/Quantity

Implementation Monitoring

- Completion of site-specific project elements

Effectiveness Monitoring

- Achievement of project goals and objectives

Validation Monitoring

- Change in resource quality/abundance
- Intensively Monitoring Watershed, Cumulative Effects

Loss of Intertidal Wetland Habitat and Juvenile Salmonid Rearing Opportunity

Dikes Breached on Disconnected Floodplains?

Natural Intertidal Wetland Habitat Restored?

Increased Health and Abundance of Juvenile Salmonids?
Regional Monitoring Efforts
(Resource and Validation Monitoring)

- Subbasin Assessment and Planning
- Recovery Planning and Monitoring
- Salmon Recovery Funding Board (WA)
- Oregon Watershed Enhancement Board
- COE/PNNL Cumulative Effects
- Intensively Monitored Watershed
- Pacific Northwest Aquatic Monitoring Program (PNAMP)
- Pacific Coastal Salmon Recovery Fund (PCSRLF) monitoring
- University of Washington/NOAA Estuary Research Program
Project Effectiveness Monitoring

“Measures environmental parameters to ascertain whether management actions implemented were effective in creating a desired outcome at either the project (stream reach) or watershed scale. It relies on an experimental design approach utilizing treatments and controls. It is anticipated that monitoring for effectiveness research may often overlap and inform status monitoring of habitat or fish condition. “

PNAMP 2005

Demonstrates what has been done, how the outcome compares to expected results, and what have you learned in the process.

CLT 2006
Partial List of Restoration, Enhancement and Protection Projects within the Columbia River Estuary: 1999-2005
Project Types

• The “Dike Breach” seeks to restore full or nearly full tidal influence into areas that historically contained tidal wetlands. The goal is to restore the natural habitat forming processes (tidal energy) that shape and maintain tidal wetland habitats through full or partial removal of existing tide gate/dike systems.

• The “Tide gate Improvement” project type seeks to improve habitat conditions (typically water quality) and enhance fish access into diked areas by modifying existing flood control structures while maintaining some desired level of flood protection. These projects typically involve removal and replacement of an existing tide gates with ones that provide sufficient operational flexibility to allow fish passage and manipulate levels of desired tidal exchange.

Photo: Columbia Land Trust

Photo: NOAA Fisheries
Ducks Unlimited Fish Monitoring Program

- Began in response to project permits
- Focus was seasonal species presence in wetlands and compatibility of restoration approach and salmon
- 16 sites sampled in OR and WA since 2001

Contact: Cyndi Baker (cbaker2@ducks.org)
DU Fish Monitoring Program

Research Goals

• Fish use of seasonal floodplain habitat OR, WA (movement in/out)
  – Native/introduced fishes
  – Salmon (wild/hatchery)

• Passage capability through water-control structures (in/out)
  – Flow over structure (passage opportunity)
  – Connectivity
  – Species/life-history stage, structure type and hydrology
Two-way trapping
Observations from DU Monitoring

• Juvenile coho and Chinook salmon have been found to use Lower Willamette River and East Fork Lewis River seasonal floodplain wetlands and sloughs in the winter and spring.

• Juvenile coho and Chinook benefit from using floodplain wetlands (as measured by growth) and have spent up to 140 days rearing in this habitat.
Fish catch at Lower Willamette River sites

In descending order of abundance in catch:

- Threespined stickleback
- Crappie
- Common carp
- Bullhead
- Yellow perch
- Sunfish
- Goldfish
- Prickly sculpin
- Chinook salmon
- Banded killifish
- Redside shiner
- Oriental weatherfish
- Largemouth bass
- Mosquitofish
- Coho salmon
- Largescaler sucker
- Peamouth
- Northern pikeminnow
Juvenile salmon caught in 2-way traps

- Catch (by numbers)
- Stage (USGS Vancouver ft.)
Take-Home Message....

• Lower Willamette River is important to the entire system
• Despite 89% off-channel habitat loss we found a life-history type of Upper Willamette River spring Chinook using this habitat as fry
• Chinook fry from the Columbia River have entered the Lower Willamette River to rear
• Restoring floodplain wetlands and other off-channel habitat in the Lower Willamette River is critical to salmon recovery
• Other Lower CR tributaries also contribute to conserving/recovering life-history diversity of salmon
Objective 1: Describe the seasonal use of existing backwater and tidal marsh habitats at Crims Island by juvenile salmon and other fishes.

Objective 2: Describe juvenile salmon feeding preferences and food availability in mainstem, reference, and restored habitats at Crims Island.

Objective 3: Compare the relative productivity of restored and reference habitats at Island.

Objective 4: Create a topographic map of restored habitat at Crims Island for subsequent GIS analyses to document landscape changes.

Contact: Kenneth F Tiffan [ken_tiffan@usgs.gov]
Cathlamet Bay: Blind Slough Restoration
The Project Process: Goal Development

• Grantor Goals
  i.e. Fish Recovery, Wetland Restoration, Water Quality Improvement

• Restoration Goals
  i.e. Floodplain reconnection, Juvenile Rearing Habitat, Spruce Swamp restoration

• Monitoring Goals
  i.e. What is the relative abundance, species composition, and age class of juvenile salmon occupying restoration project areas and references sites?

• Adaptive Management Goals
  i.e. Management Planning and implementation

• Public/Community Interest
  i.e. Flood Control, Mosquito production
Monitoring Plan Goals

• Strike a balance with the multiple needs of CLT
  – Benefits to Salmon Habitat
  – Flood Mitigation
  – Local Concerns

• Ecosystem based linked to the goals of the restoration projects

• Applied Experimental Design
Plan Context and Framework: Estuarine Monitoring Literature

Simenstad, Cordell (2002)
- **Capacity Metrics**: Habitat attributes that promote juvenile salmon production, through conditions that promote foraging, growth, growth efficiency, and/or decreased mortality. (i.e. quantity of selected invertebrate prey)
- **Opportunity Metrics**: Appraises the capability of juvenile salmon to access and benefit from the habitat’s capacity. (i.e. tidal elevation, channel edge)
- **Realized Function Metrics**: Physiological or behavioral responses that can be attributable fish occupation of the habitat and that promote fitness and survival. (i.e. residence time, foraging success, and growth)

Thom, Wellman (1996)
- Linkage between Restoration Goals and Monitoring Objectives
- Conceptual Model Development: Controlling, Structural, and Functional Parameters
Monitoring Design: Testable Hypotheses

- **Control H₀#1**: Tidal channel volume will remain constant due to tidal channel reconnection enhancement
- **Structural H₀#6**: Vegetation community composition will remain unchanged from tidal reconnection enhancement
- **Functional H₀#9**: No difference in salmonid use or benefits among wetland types
CLT Plan Implementation:
Priority Parameters

- Sediment
- Vegetation monitoring
- LWD
- Channel Morphology
- Water Quality
- Fish Sampling
Sediment Dynamics

Sediment-Erosion Transect Monitoring
Devils Elbow Conservation Site
(Preliminary)

Devils Elbow Modified SET #1 – August 2005

Devils Elbow Modified SET#1 – March 2006
Channel Morphology

Channel Cross Section - Upstream of Breach
Deep River

Profile (Feet)

Cross Section Distance

2006 data
2004 data
Fish Sampling Design, Grays River
Fish Use Monitoring Questions

- When (what times of the year) do juvenile salmon occupy restoration project areas and reference sites?
- What is the origin of juvenile salmon occupying restoration project areas and reference sites?
- What is the relative abundance, species composition, and age class of juvenile salmon occupying restoration project areas and references sites?
- For what period of time (length of residence) do juvenile salmon occupy restoration areas and reference sites?
- Do restoring habitats produce adequate prey resources for salmon occupying restoring sites and how does prey abundance and composition compare to reference sites?
- How do juvenile salmon utilize available prey resources in restoration project areas and reference sites?
- What is the relative benefit of each project type and their variations?
Fish Sampling

**Trap Netting**

**Seine Netting**
Fish Sampling: Diet Analysis
Initial Results: Fish Use, Grays Bay-2005

![Graph showing total abundance of salmonids over dates with lines for Chinook, Coho, and Chum.](chart.png)
Vegetation Monitoring: Dike Breech, Youngs River

- Partnership with Upward Bound
- Methods derived from Corps Delineation Manual and Salmon River
- Systematic w/ Random Start
- Track over Time
Water Quality Monitoring: Blind Slough

Blind Slough Temperature 5/23-6/10

Blind Slough DO changes at "Plug" Site 5/23-6/10

2003 mean temp = 21.7°C

2005 mean temp = 19.4°C

2005 mean temp = 16.6°C

Date

Temp (°C)

2003 (before restoration)

2005 (after restoration)
ACOE Project: Cumulative Effects

- Regional effort in partnership with PNNL and NOAA to track overall ecological lift from restoration
- Selected two sites to test and standardize methods for:
  - Hydrology
  - Water Quality
  - Vegetation
  - Fish “Use”
  - Channel Morphology
  - Organic Flux
- Control-Impact Comparison
- Implications future restoration and management in the Estuary

Tidegate Replacement: Vera Slough-Youngs Bay

Dike Breech Project: Kandoll Farm-Grays River
Regional Implications of Monitoring Data

- Data used to link up with shared assumptions regionally about salmon use of the Columbia River estuary and salmon recovery, specific to embayment/deltaic areas

- Continued effort to standardize data can be a tool for tracking success of restoration at a broader scale

- Foundation for informing future restoration design, project priorities, and ongoing management of restored areas
Practical Aspects and Lessons Learned:

- Monitoring methods are not iron-clad, but need to be adaptable to initial results, local conditions and existing capacity
- Statistics v. Data that “tells a story”
- Monitoring Data as a critical tool for ongoing management and maintenance of restored sites, as well as community outreach
- Use existing scientific resources/connections to solicit input through all phase of the monitoring
Conclusions

- Significant amount of baseline data being collected + some preliminary “suggestive” data:
  - Fish are gaining access and using restored wetland habitats
  - Water quality improvements being realized for temperature and DO
  - Native vegetation recolonizes quickly (+ some aquatic weeds)
  - Site serving as sediment sinks
  - Organic material being mobilized
  - Fish utilizing prey resources on restored area

- No substitute for being in the field for collecting both quantitative and observational data

- Leveraging resources is key to monitoring “success”
  - Expansion of effort in Youngs Bay w/ Astoria High School
  - BPA proposal in partnership with NOAA/UW in Grays