Jun 26th, 1:50 PM - 2:10 PM

Concurrent Sessions A: Emerging Engineering Solutions for Downstream Fish Passage at Big Dams - Survival Improvements at Fish Guidance Systems Designed to improve Safe Downstream Passage of Anadromous and Catadromous Fish

Shane Scott
S. Scott & Associates LLC

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A Positive Barrier Guidance System Designed to Improve Safe Downstream Passage of Anadromous Fish

Shane Scott
S. Scott & Associates LLC

(360) 601-2391
sscott06@earthlink.net
Juvenile Fish Passage Behavior

In general, juvenile anadromous salmonids and clupeids (river herring and shad):

- Follow bulk flow in the river thalweg
- Are surface oriented
- Cue on flow and turbulence
- May respond to changes in water quality
Migratory cues are disrupted in reservoirs
Juvenile Fish Bypass

Spillway Passage

Collection and Transport Systems

Screened Turbine Intake and Bypass
Non-Physical Guidance

- Lights
- Acoustic
- Bubble Curtains
Fish Guidance System

- Provides several cues to alter fish migration routes
  - Physical
  - Visual
  - Hydraulic
Forebay Hydraulics and Fish Behavior
Forebay Hydraulics and Fish Behavior

Spillway

Powerhouse

Bulk Flow
Forebay Hydraulics and Fish Behavior

- Spillway
- Powerhouse
- Intermediate Zone
- Bulk Flow
Forebay Hydraulics and Fish Behavior

- Nearfield Zone
- Intermediate Zone
- Bulk Flow

- Spillway
- Spillway Flownet
- Powerhouse
- Spillway Flownet
- Turbine
- Flownet

Image U.S. Geological Survey
Forebay Hydraulics and Fish Behavior

- Nearfield Zone
- Intermediate Zone
- Zone of Separation
- Bulk Flow
- Spillway
- Powerhouse
- Spillway Flownet
- Turbine Flownet

Image: U.S. Geological Survey
Forebay Hydraulics and Fish Behavior

- Nearfield Zone
- Intermediate Zone
- Bulk Flow
- Zone of Separation
- Spillway
- Powerhouse
- Spillway Flownet
- Turbine Flownet
- FGS
- Forebay Hydraulics and Fish Behavior
FGS Results

- 80% Guidance
- Reduced turbine entrainment 16%
Bonneville Dam, Columbia River, WA

PH 1

PH 2

Spillway

PH 1

PH 2
Bonneville Dam, Powerhouse 2
Fish Guidance System

Juvenile Bypass Channel
Fish Guidance System
FGS Results

- 15% guidance improvement for juvenile spring chinook passage
- Guided fish entered the bypass at 2x the rate of unguided fish
Cowlitz Falls Dam, Cowlitz River, WA

Surface Collector

FGS
Cowlitz Falls Dam, Cowlitz River, WA
Frequency Distribution of Juvenile Salmonids

- Successfully guided juveniles to surface collector
Lockwood Station, Kennebec River, ME
Kennebec Dam, Kennebec River, ME

Bypass
Gillman Dam, Connecticut River, NH
Summary

- Permanent Physical Structure
- Significantly Improves Juvenile Fish Guidance and Survival
- Flexible Configuration to Allow Improvements
- Can Reduce Operations Costs
Recommendations

- Know Site Specific Conditions
- Provide Adequate Bypass
- Address Debris
- Work With Manufacturer
- Be Flexible – Modifications Will Further Improve FGS Performance
Thank You

Brookfield

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NEXTera ENERGY RESOURCES

WORTHINGTON
waterway barriers

US Army Corps of Engineers®
Fish Guidance System

QUESTIONS?