Pushing and Pulling II: Survey of Two Behavioral Fish Guidance Systems (FGSs) Designed to Improve Safe Downstream Passage of Anadromous Salmonids

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Survey of Two Behavioral Fish Guidance Systems (FGSs) Designed to Improve Safe Downstream Passage of Anadromous Salmonids

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Juvenile Fish Passage Behavior

In general, juvenile anadromous salmonids and clupeids (herrings and shads):

- 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
Problem

How to get downstream migrants safely past a dam or intake???
Physical Bypass Systems

- Spillway Passage
- Collection and Transport Systems
- Turbine Passage
- Screened Intake and Bypass
Non-Physical Guidance

- Lights
- Acoustic
- Bubble Curtains
Fish Guidance System (FGS)
Fish Guidance System (FGS)

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

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

Nearfield Zone

Intermediate Zone

Bulk Flow

Spillway

Powerhouse

Spillway Flownet

Turbine Flownet
Forebay Hydraulics and Fish Behavior

- Spillway
- Powerhouse
- Nearfield Zone
- Intermediate Zone
- Zone of Separation
- Bulk Flow
Spillway
Powerhouse
Bulk Flow
Nearfield Zone
Intermediate Zone
Zone of Separation
Fish Guidance System
Lower Granite Dam FGS Results

- 80% Guidance
- Reduced turbine entrainment 16%
FGS Results

- 15% guidance improvement for juvenile spring chinook passage
- Guided fish entered the bypass at 2 times the rate of unguided fish
Georgiana Slough
Sacramento River, CA
Georgiana Slough
Sacramento River, CA
Los Padres Reservoir
Carmel River, CA
Los Padres Reservoir
Carmel River, CA
Los Padres Reservoir
Carmel River, CA
Los Padres Reservoir
Carmel River, CA
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
Fish Guidance System

QUESTIONS?