Hydraulic and Biological Evaluations

Hydraulic Evaluations

- Measuring flow distribution for fixed vertical or rotating drums (with adjustments available).
  - Ideally, the screen face should be divided into at least 20 uniform sections.
  - Realistically, divide the screen into sub-sections that each have independent flow adjustment available (baffle location, pump isolation).

Hydraulic Evaluations

- Calculating Average V_a
  - Calculate average V_a by dividing the sum of flow through each sub-section by the total effective screen area.
  - If average V_a exceeds 0.4 ft/s, either flow must be reduced or screen area increased.

Hydraulic Evaluations

- Flow distribution for fixed vertical or rotating drum screens (with adjustments available).
  - Measure velocity at several points depending on the size of sub-section.
  - For each sub-section calculate flow by multiplying V_a for a subsection times the area of the sub-section.

Hydraulic Evaluations

- Forcing V_a closer to the average V_a
  - Once all V_a is compiled for each subsection, choose subsection(s) with highest V_a and close down the baffles by a percentage that represents the percentage V_a over design criteria.
  - Recheck velocities and repeat as necessary.
  - Usually, start an evaluation with baffles wide open. However, if some are not fully open, these can be opened to increase V_a

Tools available for fish passage effectiveness evaluation

- Adult PIT tag readers
- Radio Telemetry
- Acoustic Tags
- Hydroacoustics
- PIT tags
- Hydraulic evaluation to verify design
- Spawning surveys
- Survival studies

Adult PIT tag readers

- These are installed at fish ladders at most mainstem dams, usually with great efficiency rates because of the ability to control the hydraulics.
- There are increasing numbers of PIT arrays installed in tributary rivers, some more efficient than others.
- These read a PIT tag either inserted into an out-migrating smolt, or possibly in other life stages as well.
- Provide great information on run timing, dam passage, dam survival, spawning survival etc.

Radio Telemetry

- A tag that creates a detectable radio signal.
- The radio tag can be detected with a fixed array system, or mobile devices (harder to do).
- Limited tag life, and often lack depth information.
- Provides good 2d tracks of juvenile or adult salmon.

Acoustic Tags

- Surgically Implanted
- Limited study duration
- Battery development
- Good 3-D information
- An AT sends out an unique acoustic signal, detected by strategically placed array of receivers.

Acoustic tags

Combo tag – AT and PIT

Rocky Reach sampling screen

Acoustic Tag Surgery

Hydroacoustic arrays

- “Fish Finders”
- Sends out a sonar signal that reflects off of submerged objects – swim bladders
- Can get multiple detections from same fish – hard to decipher data sometimes
- Non-invasive to fish

PIT tags

- Passive Integrated Transponder (PIT) tags
- Small tag, no battery
- Tag is read when its passed through an energy field which energizes the tag circuit ry.
- Provides a spectrum of data, depending on how the tag is programmed.
- Used for many types of studies

Survival studies

- Usually conducted on a per project basis.
- PIT, Acoustic and Radio tags all work well, if an appropriate study design is developed.
- Provides project survival information based on travel though the forebay, over/through the dam, and into the tailrace.
- Project juvenile survival standards for Upper Columbia River mainstem dams are 93%.
- Small fish – problems with tag studies.

Survival study - some issues to consider

- Multiple surgeons – study design must accommodate the varying level of skill.
- Release locations – verify that the study design releases test and control fish in locations that truly reflect the route of passage.
- Higher control mortality = higher test fish survival

Survival study - some issues to consider

- Fish – do these reflect the run at large, or do they even need to?
- Passage timing is often affected by daylight, predator presence, project operations and route passage efficiency, to name a few.
- One year of data is rarely sufficient for any conclusion regarding passage. In the Upper C, we use a three year average.