



*Independent Scientific Advisory Board
for the Northwest Power and Conservation Council,
Columbia River Basin Indian Tribes,
and National Marine Fisheries Service
851 SW 6th Avenue, Suite 1100
Portland, Oregon 97204
ISAB@nwcouncil.org*

ISAB Report Presentation: Review of the Proposed Spill Experiment

ISAB members Greg Ruggeroni, Vice-chair, and Alec Maule will present findings from the ISAB's Review of the Proposed Spill Experiment: www.nwcouncil.org/fw/isab/isab2014-2

Background

In response to the Northwest Power and Conservation Council's request, the ISAB reviewed the spill experiment proposed by the State of Oregon, the Nez Perce Tribe, and others for inclusion in the Council's Fish and Wildlife Program. This proposal would increase spring spill levels at each mainstem federal Snake and Columbia River hydropower project up to 125% total dissolved gas level in the tailrace of each dam or biological constraints, and then monitor survival effects over ten years compared to the current court-ordered spill program.

The Council asked that the ISAB consider a number of questions. Detailed answers to those questions are provided in the ISAB's full report. [Review materials](#) are also available.

Overview

Potential Biological or Other Benefits

- Prospective modeling of the proposed spill test by the CSS team suggests that increasing spill levels up to 125% total dissolved gas may enable smolt-to-adult-return ratios (SARs) to reach the 4% biological goal for steelhead and approach the 4% goal for Chinook.
- Knowledge gained through experimental spill management could be generalized to inform operations at other dams.

Potential Biological or Other Risks

- The spill test may not result in increased SARs as the justification for the proposed test is based on correlative models that do not establish causality.
- There may be inadequate information gained to justify the cost due to study design limitations and lack of a detailed study and monitoring plan.
- The spill test could result in unintended consequences, including:
 - greater adverse gas bubble disease (GBD) effects on salmonids, native resident fish and/or aquatic life;
 - increased delay and/or predation of juvenile fish in tailraces;
 - increased fallback and/or passage delays of adult salmon at the dams;
 - difficulty in holding spill levels at desired levels, for example in a low water year;
 - increased spillway erosion problems;
 - possible navigation issues for commercial and juvenile fish transportation barges at dams;
 - possible effect on Federal Columbia River Power System (FCRPS) Biological Opinion (BiOp) operations or smolt transportation actions because increasing spill will reduce the number of fish collected for transportation;
 - future engineering changes to juvenile fish passage at dams could confound results from this spill test.

Additional Issues

- A detailed study plan needs to be developed by the proponents. The lack of details and lack of synthesis in the material presented leads the ISAB and others to raise questions (see unintended consequences listed above) that might have otherwise been addressed if a comprehensive study plan was developed.
- The Oregon and Washington water quality standards for total dissolved gas (TDG) would need to be modified with NOAA Fisheries concurring.
- Regional work and agreement would be needed on:
 - the study design including how long the test should run to provide convincing evidence of an increase in SARs that is due to increased spill;
 - an monitoring and evaluation plan for TDG, biological and physical parameters; and
 - changes to dam-specific spill patterns.

ISAB Review of the Proposed Spill Experiment

April 9, 2014



The Independent Scientific Advisory Board (ISAB) for the Columbia River Basin Fish and Wildlife Program serves the Northwest Power and Conservation Council, NOAA Fisheries, and the Columbia River Basin Indian Tribes.

Key Elements of Spill Proposal

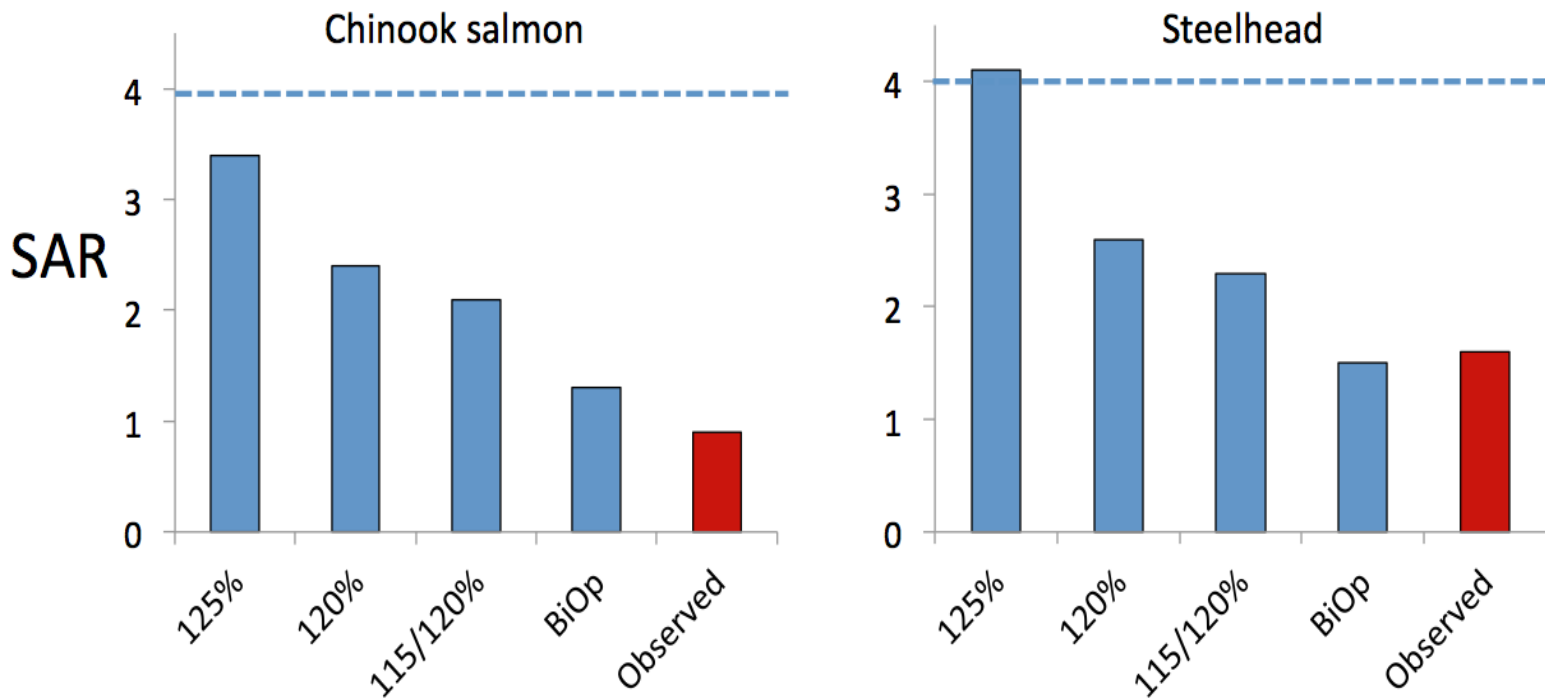
- Increase spill to 125% of total dissolved gas level or biological constraints (voluntary).
- When: 3 April through 20 June; 10 year period; review after 5 years.
- Location: federal Lower Snake and Lower Columbia River Hydroelectric projects

Experiment Approach

- Use the Comparative Survival Studies (CSS) PIT-tag monitoring framework.
- Monitor smolt-to-adult survival rates.
- Compare survival rates with past values and model predictions.
- Include “off-ramps” to ensure hydrosystem viability and “on-ramps” to offset reduced hydropower generation.

CSS Model Predictions

- Applied peer-reviewed models to spill levels



- unpublished analysis by CSS (H. Schaller)

Council Questions

- **Is the spill proposal, and the postulated increases in fish survival, consistent with scientific methods?**
- **If not, what adjustments will ensure that the proposal is scientifically based?**
- **What are the potential biological risks and/or benefits, e.g., increased total dissolved gas effects on other aquatic species?**
- **Is the proposed spill experiment likely to add to our knowledge regarding spill, juvenile dam passage survival, and adult fish returns (SARs)?**

ISAB Review Approach

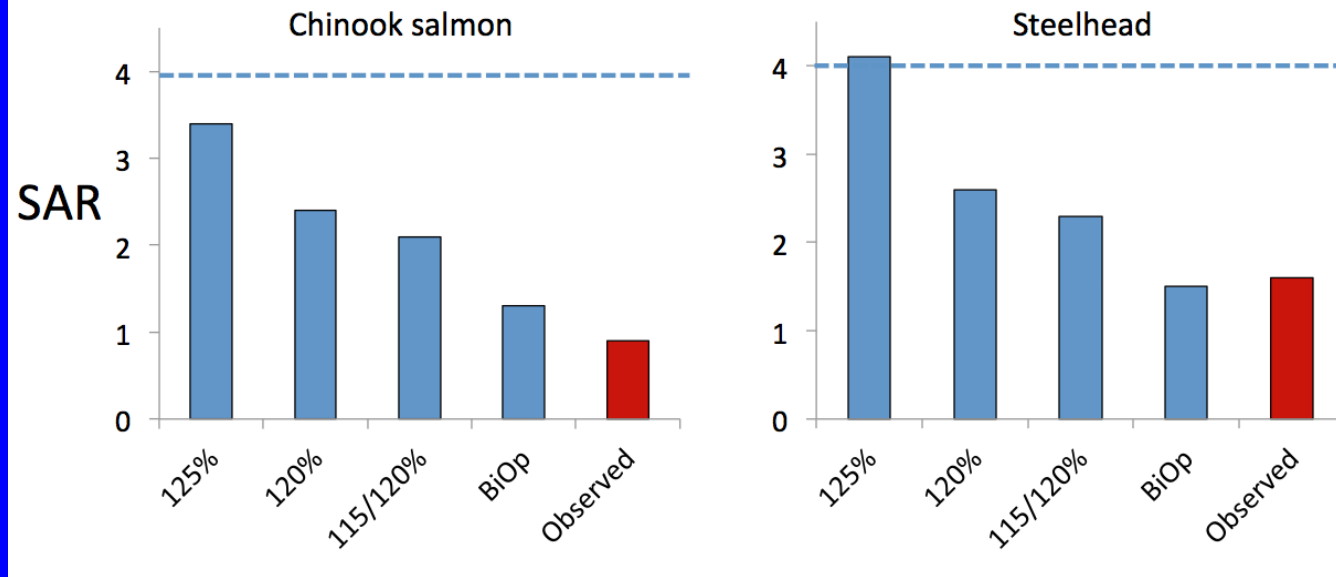
- Briefings
 - CSS, BPA, ACOE, Dr. Skalski
- Comment memos
 - Skalski, agencies, FPC, etc.
- Published manuscripts and reports on gas bubble disease

Q1a-c: Adequate hypothesis, appropriate study design, sufficient duration?

- No. A detailed study plan is needed.
 - quantitative hypotheses
 - synthesis of of existing data
 - describe field methods, monitoring, statistical analysis & alternative approaches
 - discuss controls for dynamic ocean conditions, including PDO, transported fish ratio (TIR), etc.
 - respond to critical comments, peer review
- Still, hypothesis has worthwhile merits.

Update CSS Model & Predictions

- Applied peer-reviewed models to spill levels



- Incorporate new years of data; test new variables
- Is 3.5x benefit reasonable given expected changes in dam passage?
- Address statistical issues raised by stakeholders (C.I.)
- Did predictions account for water transit time?
- Address changes in spillway passage
- Estimate change in spill percentage to achieve 125% TDG

Q1d. Is it possible to isolate spill as a causative factor for changes in fish survival?

- Unlikely to isolate spill as a causative factor for changes in fish survival.
 - correlation not cause and effect.
 - experimental approach might, if feasible.
- But multiple lines of evidence including correlations can be used to evaluate the influence of increased spill.
 - change in turbine v. spill passage; FTT

What are the potential biological risks?

- Gas bubble disease (GBD)?
- Adult migration delay?
- Interfere with BiOp actions?
- Reduce availability of fish for transportation.

Gas Bubble Disease

Gas in tissue forms bubbles

Mortality caused by stopping blood flow



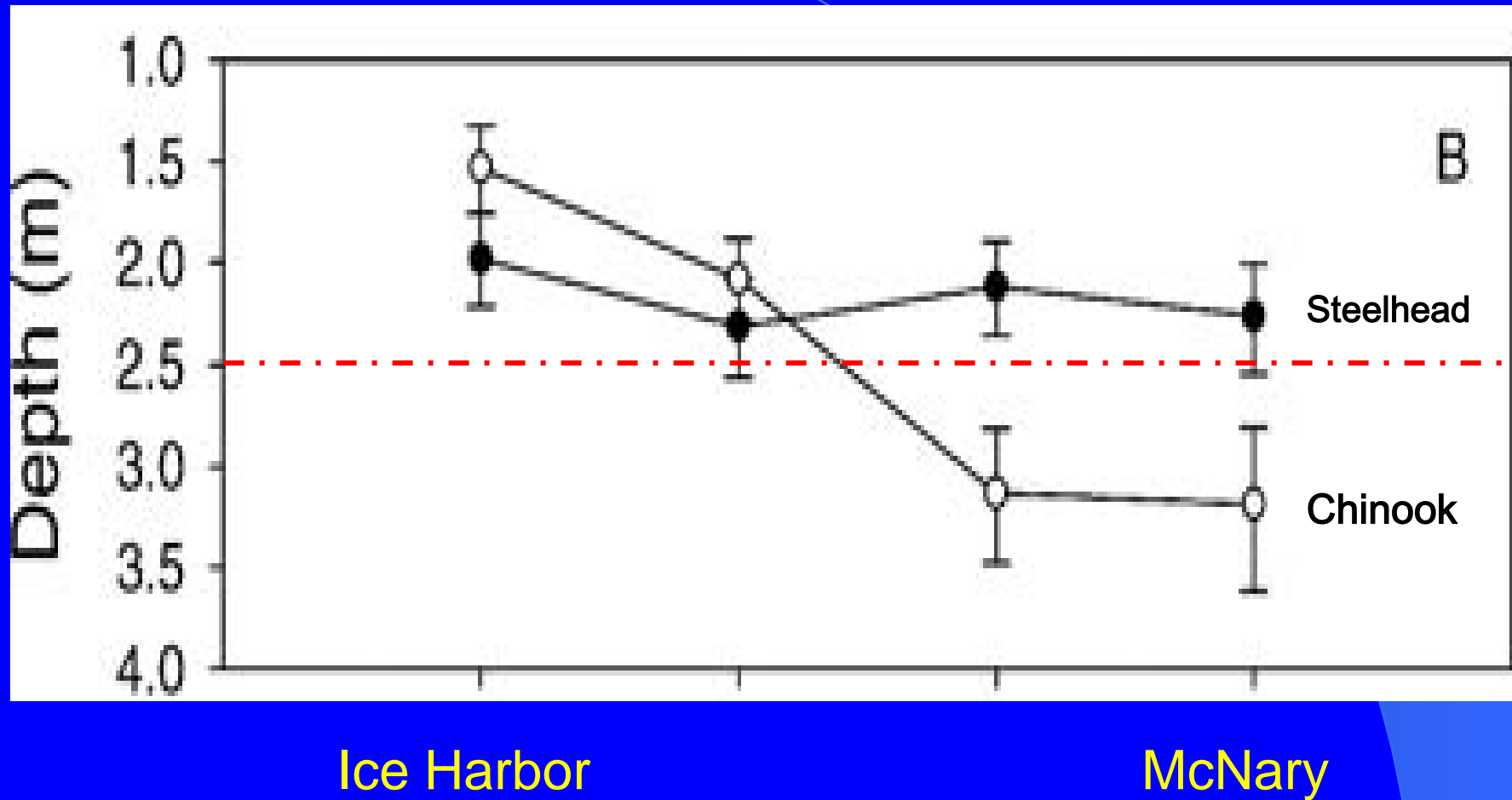


Gas Bubble Disease

Variables:

1. Species (Chinook < Steelhead)
2. Size (small < large)
3. Temperature (cool < hot)
4. Hydrostatic compensation; 1 m depth protects 10% TDGS (e.g., @ 2.5 m 125% = 100%)

Fish Depth (mean \pm 95% CI)

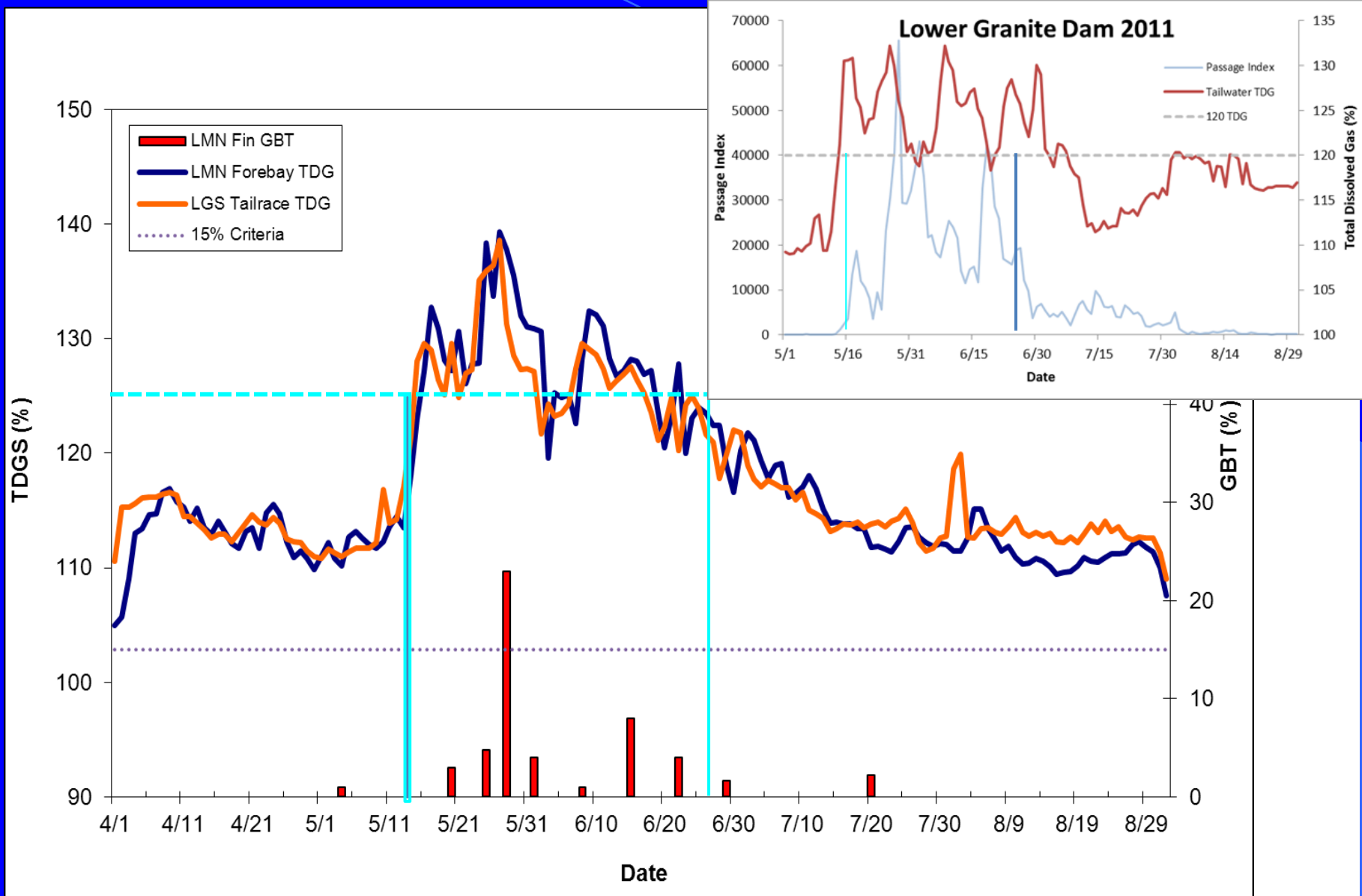


Fish Passage Center GBD Monitoring

- 1 or 2 days/week @ six dams
- Bubbles in eyes or fins
- Ranking (1 to 5) based on % covered
- Action: >15% ranked 1 or 5% ranked > 1



Lower Monumental Dam 2011 TDGS & GBD



Upriver Bright Fall Chinook Adults

- 2013 - record URB Fall Chinook < 748K
 - Many fish from 2011 juvenile migration

Other Aquatic Organisms

- Macro-invertebrates

5400+; 120% - 135% TDG; 0.6 m deep;
0.1% with signs (Ryan et al. 2000)

- Frogs

117% – 122%; 4 days; no mortalities
132%; 1 day; 40% dead (Colt et al. 1984, 1987)

- Sturgeon larva & Sucker fry

Bubbles – buoyancy – predation? (Counihan et al. 1998;
Schrank et al. 1998)

- Lamprey?

A photograph of a large dam with water cascading over its spillway. The dam is made of concrete and has a series of vertical spillway gates. The water is white and turbulent as it falls. The sky is overcast with grey clouds.

GBD Conclusions

Most data = no significant issues

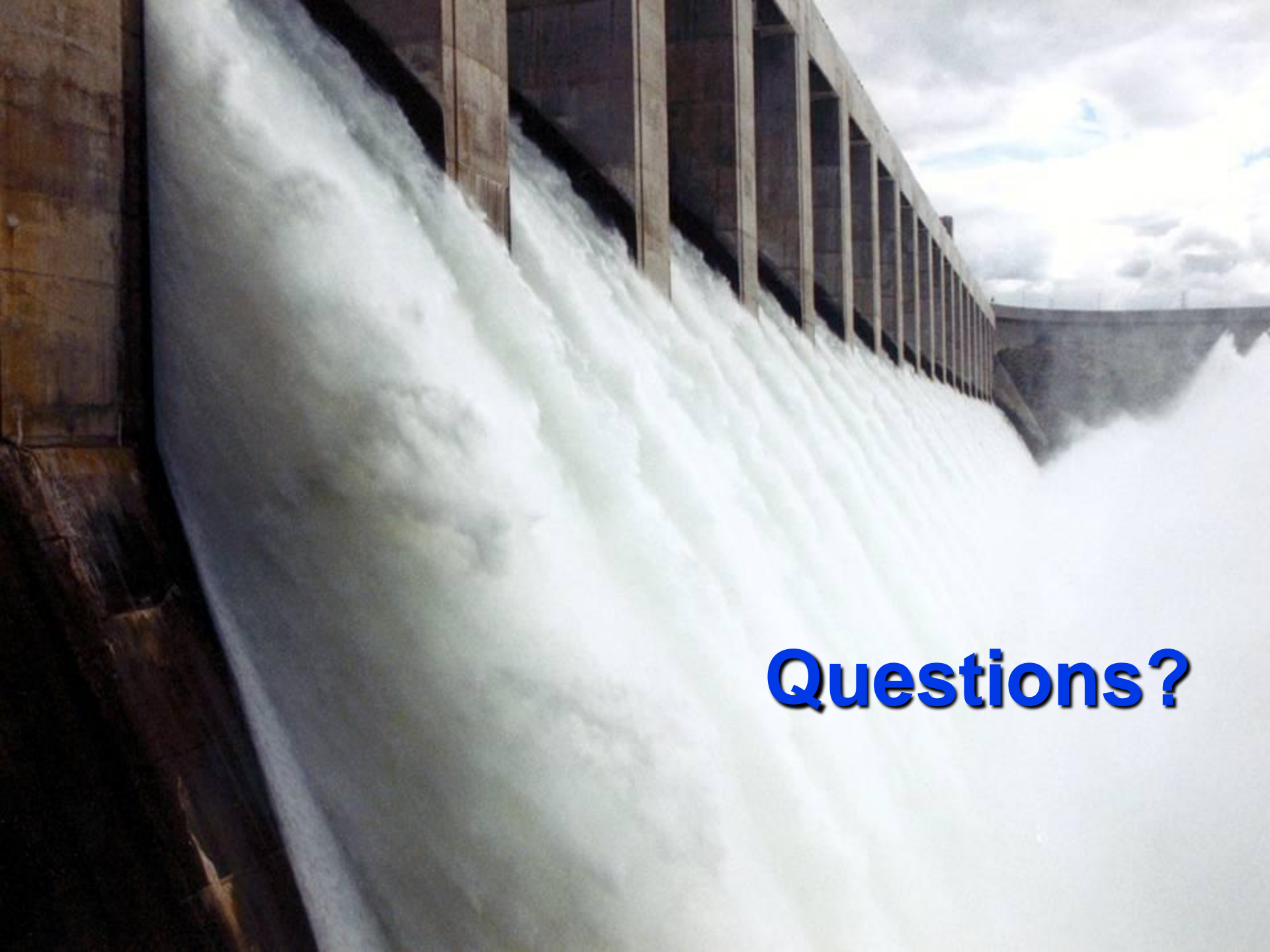
Some unknowns

- No dead fish suggests no direct mortalities, but delayed mortalities?
- 2.5 month duration?
- Sturgeon exposure?
- Lamprey exposure?

Recommend: Increased monitoring

Will the spill experiment enhance knowledge about spill, salmon survival, & adult returns (SARs)?

- Yes, assuming:
 - a detailed study plan is developed
 - Plan addresses all agency and stakeholder issues
 - Study design maximizes learning potential.
- SARs are well below goals, so alternative approaches, including the spill concept, worth exploration and discussion.



Questions?