Analysis of Snake River Spill

Information based on the CRiSP[1] research project

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The impacts of the 1995 Snake River Spill actions were analyzed with the CRiSP smolt passage model. The CRiSP model considers mortality associated with dam passage and gas bubble trauma produced from spill-generated gas supersaturation. In addition, the model considers the effects of fish depth and exposure time on the gas bubble trauma. The model was calibrated with a variety of data sets and model predictions were checked against independent data in a model validation (page 2).

A model sensitivity analysis indicated that spill can have a small benefit on in-river passage if the total dissolved gas level is below 120% supersaturation. Above this level the mortality from gas bubble trauma is significant. Under the current assumptions on transportation of fish, spill at collector dams has no benefit since the survival of transported fish is larger than the survival of fish passing in-river (page 3).

The 1995 spill actions and monitoring studies were analyzed with CRiSP. The model produced levels of mortality similar to those observed in the cage studies below Ice Harbor dam. The model indicated that survival between Ice Harbor Dam tailrace and Bonneville Dam trailrace was between 31 and 34% depending on the depth of fish passing through the river. In comparison, with no spill the predicted in-river survival was 35% (page 4).

Monitoring of fish passing in-river has revealed few signs of gas bubble trauma and the CRiSP modeling has likewise predicted little impact. Furthermore, model analysis indicates that the small increase in dam survival resulting from the spill program was negated by a small increase in mortality from gas bubble trauma. Uncertainty exists as to the precise levels of the factors, but given the available information the result of the spring 1995 spill program was most likely small and negative.

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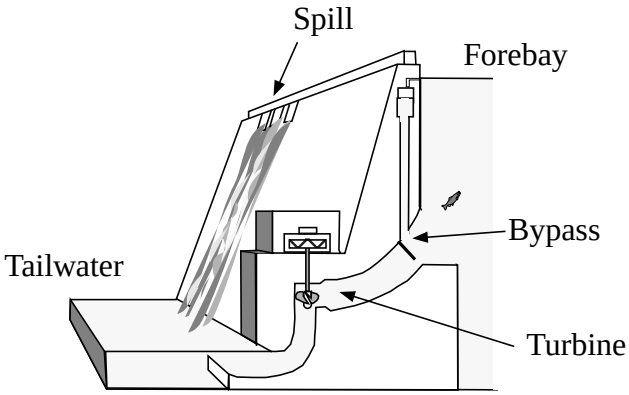
1. The University of Washington has developed the Columbia River Salmon Passage model under funding by Bonneville Power Administration. The project began in 1989.
2. Dr. James J. Anderson is an Associate Professor in the School of Fisheries and Center for Quantitative Science at the University of Washington. His work on salmon issues has been funded by Bonneville Power Administration and the Army Corps of Engineers. The views in this document are a result of that research. This paper was supported by the Direct Service Industries, Inc.

Spill as a recovery action

Spill is used to pass fish over dams. This reduces total mortality in dam passage since mortality resulting in passage by spill is less than passage resulting through turbine passage.



Spill also produces gas supersaturation in the water downstream of dams. Fish exposed to the supersaturation suffer some additional mortality from gas bubble trauma. The amount of mortality depends on:

- level of gas supersaturation
- length of time fish are exposed to supersaturation
- depth of fish in the reservoir

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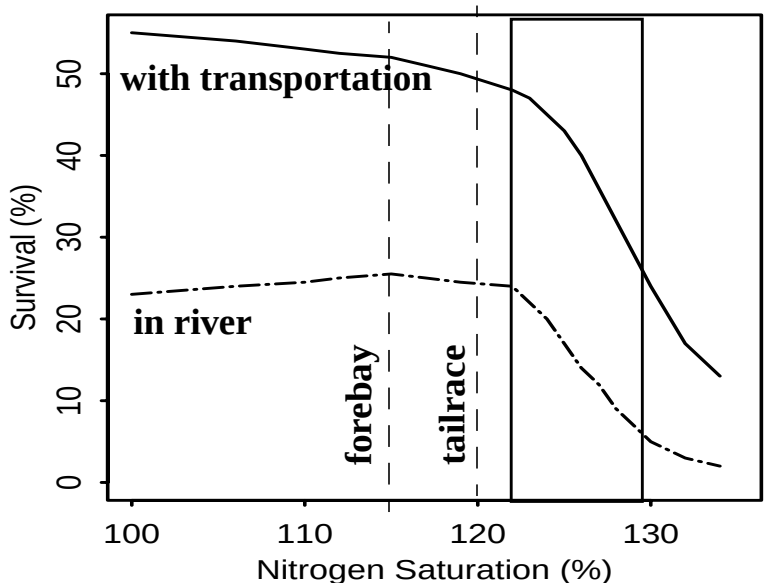
The results of spill

Spill has counteracting effects:

- (+) Fish survival in spill passage is higher than in turbine passage.
- (-) Spill increases gas supersaturation in tailwaters and reservoirs.
- (-) Gas supersaturation in water kills fish downstream of dams.
- (-/+) Spill at transport dams lessens the fraction of fish transported, which, under current assumptions of transportation, lessens total survival.



CRiSP-predicted survivals with spill-produced gas levels

The dashed line indicates forebay and tailrace gas levels allowed in the NMFS spill plan. The solid lines indicate the range of total dissolved gas below Ice Harbor Dam in the 1995 spill program.

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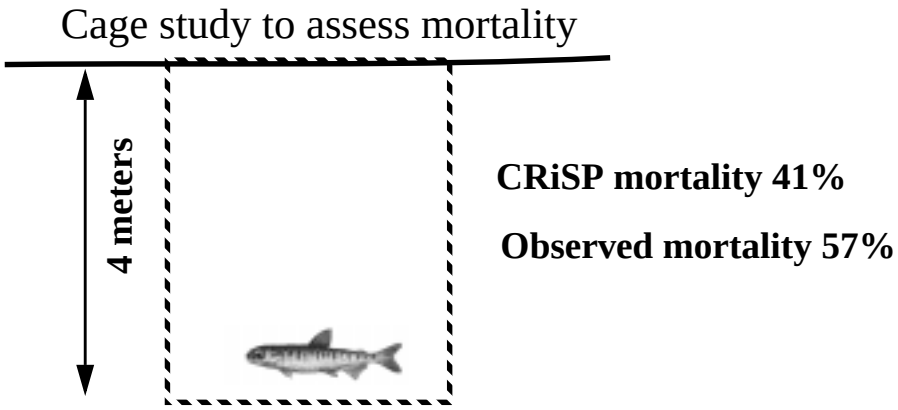
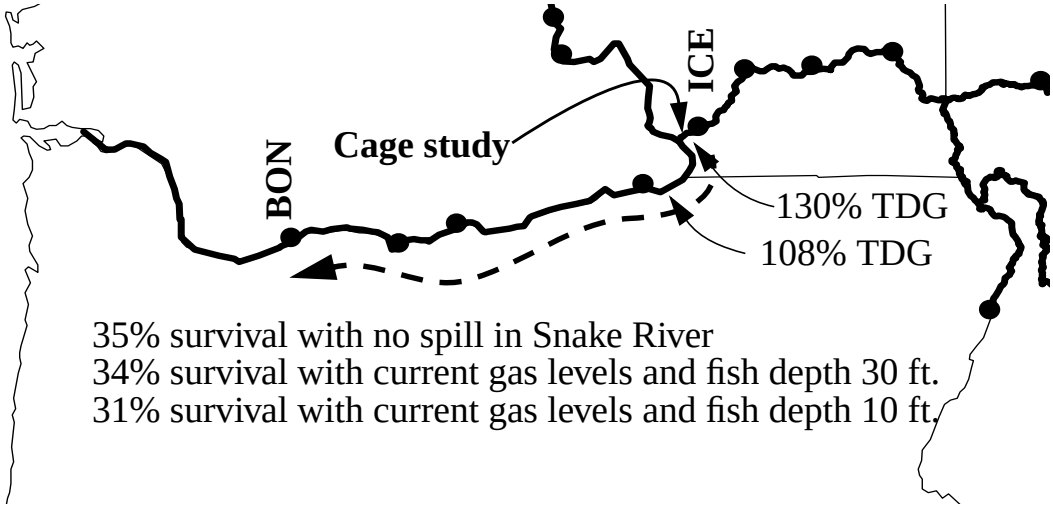
CRiSP predictions and cage studies

For the period June 9 to 13, 1995, the observed mortality in the cages downstream of Ice Harbor Dam were 88% in the 0 to 1 meter cage and 57% in the 0 to 4 meter cage. CRiSP-predicted mortalities were 94% for the 0 to 1 meter cage and 41% for the 0 to 4 meter cage.



CRiSP predicts higher in-river survival with no Snake River spill.



TDG = total dissolved gas under 1995 spring spill program

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