A Personal In-side Review of PATH

presented at the Idaho State House in Boise, Jan 20 1999.
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The Plan to Analyze and Test Hypotheses (PATH) consists of a group of 32 scientists who developed life-cycle and hydrosystem passage models to evaluate causes for the decline of Snake River salmon and the probability of their recovery under improved transportation or dam breaching.

A scientific review panel (SRP) of four scientists evaluated the work and weighted the hypotheses developed in PATH.

All analyses and weightings were put in a complex decision framework which concluded:

- Fish passing in-river and in barges have low survival.
- Dam breaching has a 60% chance of meeting all recovery standards, Fish transportation has a 30% chance of meeting all recovery standards

An alternative scenario not emphasized in PATH concluded:

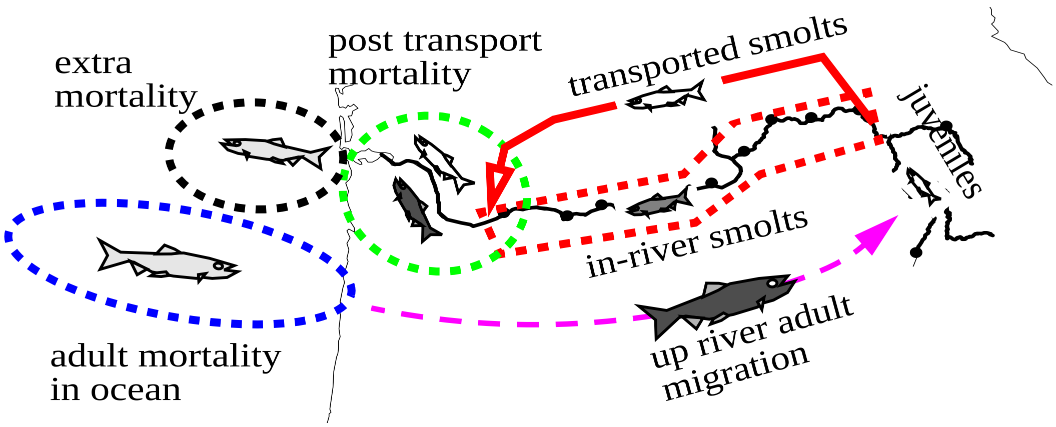
- Fish passing in-river and in barges have medium to high survival.
- Breaching dams will return the hydrosystem to its present day condition. That is breaching does not improve the chance of fish recovery.

Although PATH claimed to be scientific, rigorous and peer reviewed there were problems with the process and there is significant disagreement within PATH as to the validity of the weighting process as well as the PATH analysis itself.

Basic problems in PATH include:

- The work as presented is very complex and difficult to understand, even for the SRP and PATH scientists. Because of the complexity and style of the presentation PATH gives the false impression that consensus was reached.
- Not all relevant information was considered
- The peer review was inadequate
- The PATH/SRP conclusions simply do not comport with the recent data

PATH Estimated Survival at Important Life Stages Using Models and Data



Data were available for:

- river passage survival
- ratio of survival of transported to in-river passing fish
- survival of smolts to adults
- number of spawning adults observed each year

Models were used to estimate:

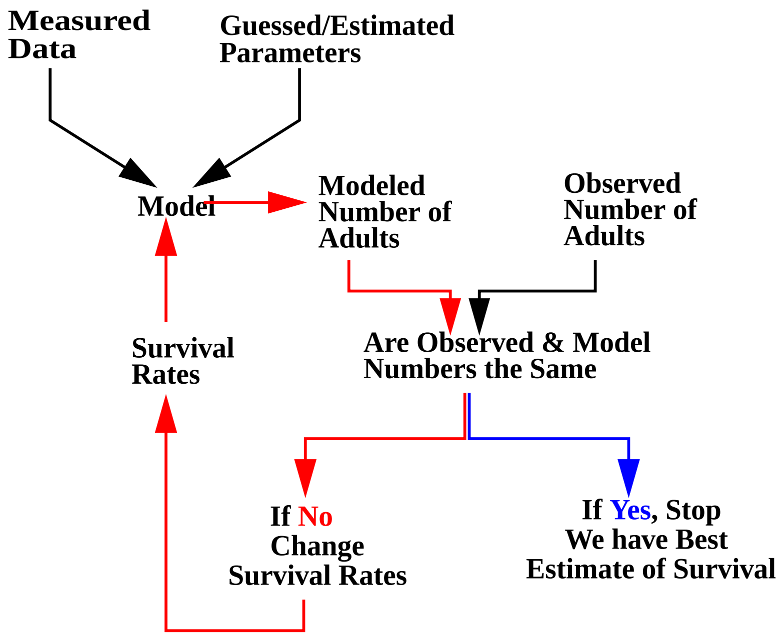
- post transport survival
- extra mortality after the dams
- ocean mortality
- river survival in drawdown

To determine what is best, dam breaching or fish transportation, the estimates of survival noted above are required.

The survival estimates depend on the selection (hypotheses) of: 1) measured data, 2) guessed or estimated parameters, and 3) the choice of models.

Different hypotheses give different answers. Thus, the answer to what is best, depends on which models, data and parameter guesses are used. The process is complex and involves an iterative search for the best survival estimates by adjusting survival rates in the models until observed and predicted adult spawning numbers are similar (See diagram below).

Model Fitting Process



The process of selecting parameters, data and models is at the heart of the ***Bayesian Decision Analysis*** used in PATH. The process is difficult to understand, contains significant uncertainty and is strongly determined by the judgements of the designated reviewers who weight the alternative hypotheses involving the parameter guesses and estimates, and the selection of data and models. The process runs the risk of improperly ascribing scientific validity to the personal opinions of reviewers. By weighting a particular combination of data, parameter, and models nearly any desired result can be obtained. The four SRP scientists weighted the PATH hypotheses and got the result that breaching dams is best. Using other weights transportation is best.

Reason to believe the Decision Analysis Process was inadequate:

- Not all the relevant data was considered by PATH or provided to the SRP.
- Not all Estimated Parameters were identified to the SRP or the full PATH group.
- Not all the models used in the analyses were made available to the PATH group.
- The SRP consisted of four scientists with similar backgrounds and viewpoints. A more diverse group is needed to consider breaching dams.
- The Bayesian Decision process melds conflicting hypotheses and biases. It does not readily provide an intuitive understanding of how models actually work.
- The analysis did not rigorously identify how well the hypotheses fit independent data or if they made biological sense.

Survivals over life stages with transportation (Alternative A2)

In PATH the mixture of hypotheses and analyses can be reduced to two very different life-cycle scenarios which are characterized by the respective smolt passage model used. One scenario is based on the FLUSH passage model. It was favored by the SRP and it supports dam breaching. The other scenario is based on the CRiSP passage model and it supports fish transportation. The figures on the next page illustrate the life-cycle scenarios in the transportation (Alternative A2).

The illustration below shows survival of spring chinook over the critical life-stages for each scenario (FLUSH and CRiSP). Survivals over life-stages are represented by arrows. The steeper the arrow drops the larger the mortality over the life stage. The stages illustrated include transportation, in-river passage, post hydrosystem passage and extra mortality, ocean residence, and up stream adult passage.

Most smolts are transported to below Bonneville Dam and survival in transport barges is high in both CRiSP and FLUSH (solid red lines (1) in the Figures).

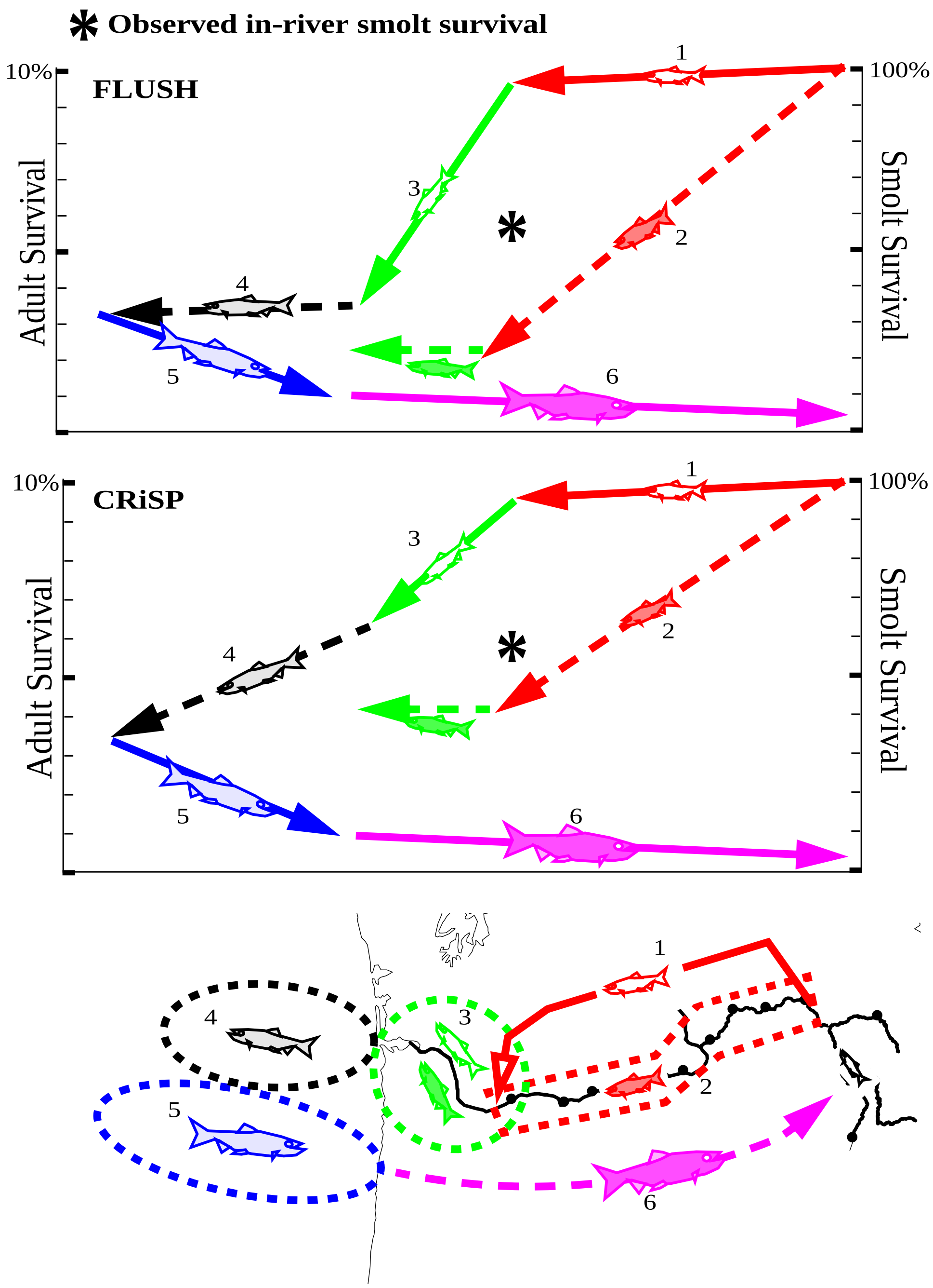
A small number of the smolts pass in-river and here the two models differ. CRiSP survival is twice the FLUSH survival in normal to low water years. In very high water years the two models are closer because FLUSH has a strong flow survival relationship while CRiSP does not (dashed red lines (2) in the Figures). Recent survival studies show no in year flow survival relationship and only a weak flow survival relationship between years.

Both models include a post transport survival (green lines (3)) that is calculated from in-river survival. Errors in the in-river survival estimate causes errors in the post transport survival. CRiSP post transport survival is twice that estimated for FLUSH because the CRiSP in-river survival is twice the FLUSH estimate. Note recent studies show high survival (identified by a * in the Figures). CRiSP predicted survivals are close to the recent observations while FLUSH consistently underestimates the recent observations. Therefor the recent studies suggest post transport survival is higher than is estimated in PATH by either model.

The extra mortality (black lines (4) in the Figures) is a factor needed to explain the difference between high survivals in transportation and the low adult returns of the Snake River stocks since the completion of Snake River dams and the concomitant climate switch from a wet fish favorable regime to a dry fish-unfavorable regime. With CRiSP extra mortality is large and with FLUSH it is small. FLUSH hypothesizes extra mortality was produced by the hydrosystem. CRiSP hypothesizes extra mortality was produced by the climate regime shift.

The ocean survival (arrow 5 in the Figures) is similar in both models and has a cyclic variation with climate.

The upstream mortality (arrow 6 in the Figures) was not considered in the models but was set from observations.



Survival over life stages with dam breaching (Alternative A3)

The FLUSH scenario:

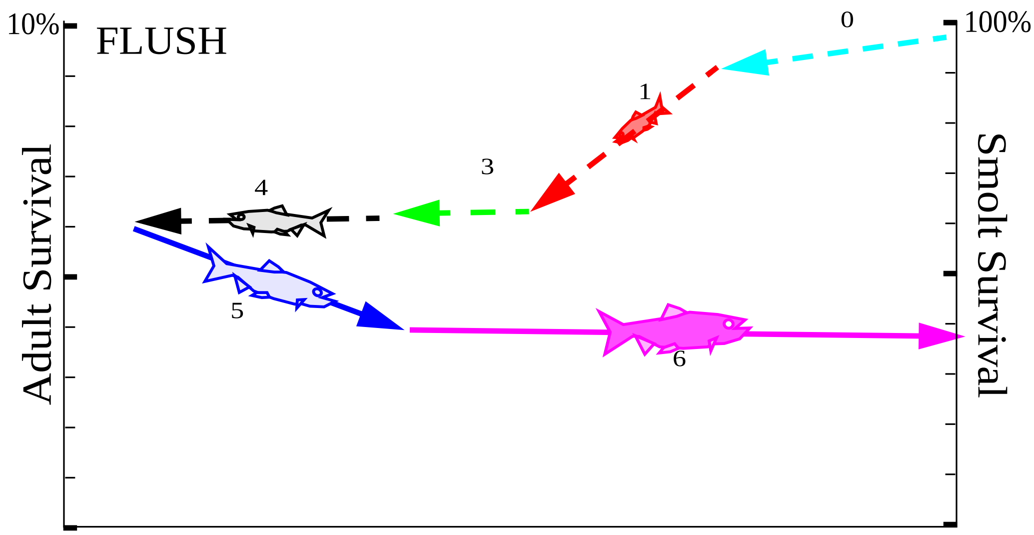
Breaching the Snake River dams is assumed to give high smolt survival down to McNary Dam (arrow 0 in Figures). The survival of fish through the remainder of the hydrosystem is also high because FLUSH has high survival over short travel times. With dam breaching the extra mortality was initially assumed to decrease as the in-river survival increases. This hypothesis was unsupportable from past data. In response it was assumed extra mortality simply disappeared with dam breaching. This alternative hypothesis is untestable. Ocean survival is unchanged with dam breaching. The upstream mortality was not considered in the model nor considered in a full PATH discussion. It was assumed to decrease with dam breaching.

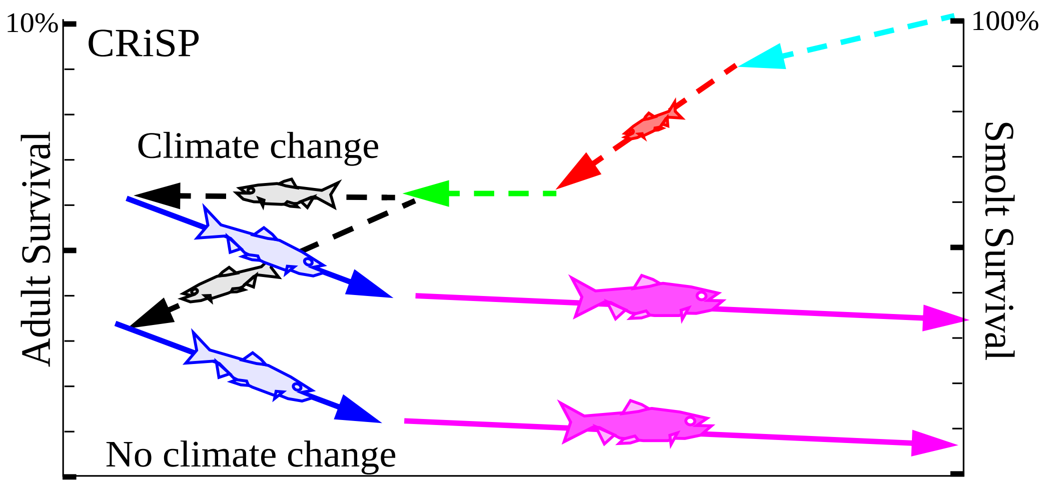
Under the FLUSH scenario fish recovery with dam breaching occurs because the assumed large mortality in transportation and dam passage is removed. Mathematically the FLUSH model gives high survival when travel time is short, as is the case with breaching. Thus a major contribution to fish recovery with dam breaching is the reduction of fish travel time through the hydrosystem from about 24 to 14 days. It is interesting to note that with drawdown the travel time to the ocean is longer than currently exists with transportation.

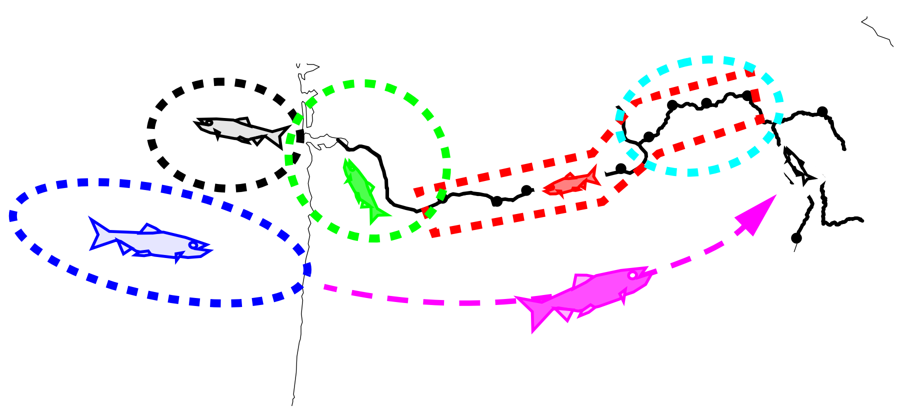
The CRiSP scenario:

Smolt survival in the breached section is assumed high but it could be lower than the current survival. The level depends on whether or not the drawdown concentrates predators into a smaller volume making for a higher encounter rate between smolts and their predators. The survival of fish through the remainder of the hydrosystem is high because CRiSP gives high survival at short travel times. The extra mortality is assumed to depend on the non-hydrosystem factors involved with climate or the condition of the fish. If the extra mortality is related to the climate and it does not change, the extra mortality does not change. Ocean survival is unchanged with dam breaching. The upstream mortality was not considered in the model nor considered in a full PATH discussion. It was assumed to decease with dam breaching.

Under the CRiSP scenario the net effect of dam breaching is to return hydrosystem survival to the level fish now experience with transportation. The scenario assumes that processes that must improve to increase fish to harvestable stocks are largely beyond our control.

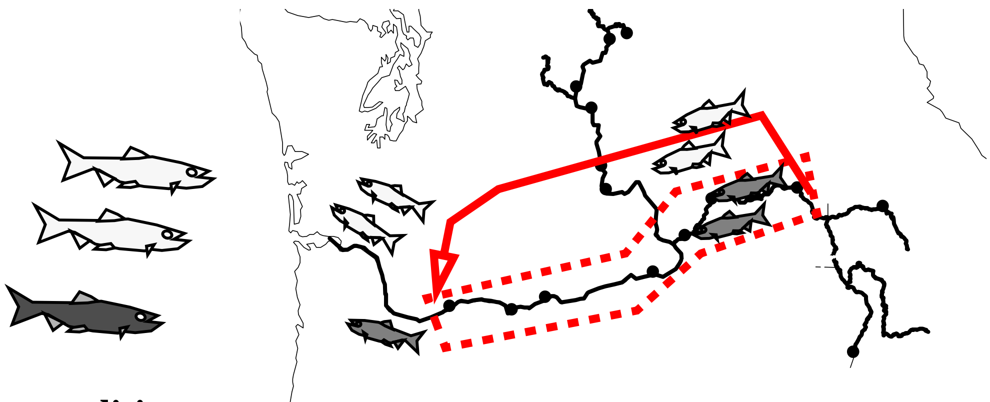

10%
FLUSH
0
100%
1
3
4
5
6
Adult Survival
Smolt Survival


10%
CRiSP
100%
Climate change
No climate change
Adult Survival
Smolt Survival



The PATH conclusions do not fit the new data

Recent National Marine Fisheries Service studies of in-river survival and transportation survival give a picture that does not fit with the FLUSH scenario preferred by the Scientific Review Panel. Basically the measured in-river and transportation survivals are now high and no mechanism has been proposed for how the remove of four Snake River dams will increase smolt to adult returns by the needed factor of ten.



Current conditions

In river smolt survival is 30 to 50% and

Transported fish return about twice the rate of in-river fish so

Transport fish passage survival is 60 to 100%.

But only 0.25% of smolts return as adults.

With dam breaching

In-river smolt survival is 50 to 70% and

Is the same as the existing system survival so

Under existing ocean conditions 0.25% of the smolts return as adults

Recovery requires

2 to 5% of the smolts return as adult, which is ten times above the 0.25%