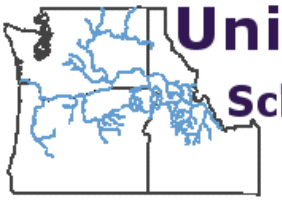
Salmon Insider

Columbia Basin Research Newsletter

Autumn 2004

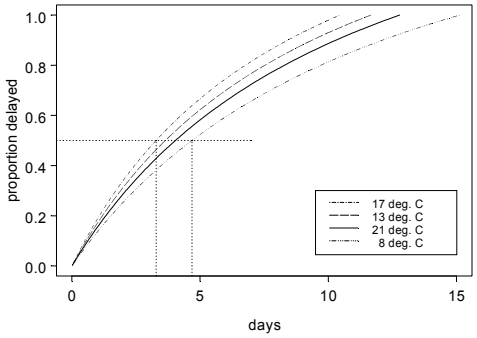


University of Washington
School of Aquatic & Fishery Sciences
Columbia Basin Research

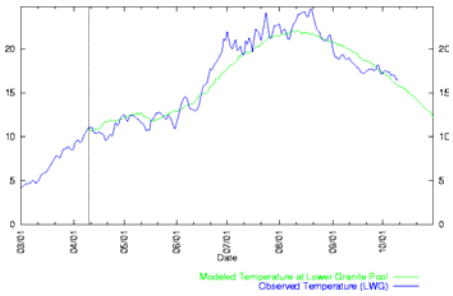
Columbia Basin Research (CBR) is a scientific research group at the University of Washington, School of Aquatic & Fishery Sciences. We investigate salmon biology and survival in the Columbia and Snake river basins. We provide user-friendly data analysis and modeling tools, and maintain DART, an interactive secondary database, for the fisheries community and the general public.

Inside . . .

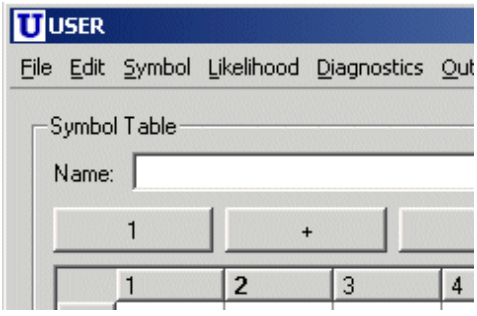
Adult Migration Speed



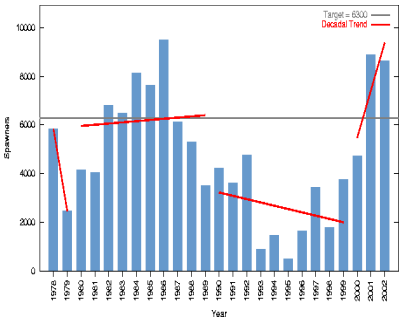
Water Temperature Forecasts



Program USER



Adult Escapement Targets



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Warmer Temperatures Speed Adult Chinook Migration—to a Point

We find that adult chinook migration swim speed increased with temperature to 16.3°C and then diminished at higher temperatures. We examined 5226 adult chinook, PIT-tagged as juveniles, migrating up the Columbia and Snake rivers, from Bonneville through Lower Granite dams in 1998-2002. Because migration duration ranged from 7 to 130 days, we developed a new analysis method based on swim speed-ranked data partitioning, which extracts both delay times (see Figure 1) and swim speeds from migration time data. The resulting broken linear model for the optimal ground speed (V) - temperature (θ) relationship is

$$V = \begin{cases} 27.3 + 2.0\theta - 0.04F, & \text{if } \theta \le 16.3 \\ 100.7 - 2.5\theta - 0.04F, & \text{if } \theta > 16.3 \end{cases}$$

in km/day where F is the flow in kcfs. This provides a better alternative to the currently accepted exponential model, which overestimates speeds at higher temperatures.

The warming effects of dam impoundments and global climate change make modeling of higher temperatures particularly important, since migration time has a bioenergetic impact on spawning success.

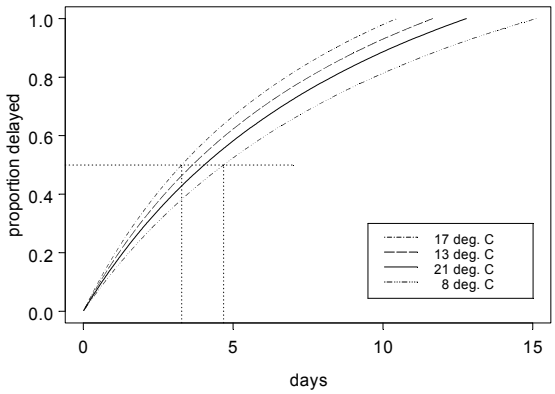


Figure 1. The cumulative distribution of total migration delay for chinook passage of seven dams, given the mean flow F = 137.7 kcfs. At 17°C, 50% of fish have cumulative delay of at most 3.3 days, or about 0.5-day delay at each dam. But at 8°C, 50% of fish have cumulative delay of at least 4.7 days, or about 0.67-day delay at each dam.

Early Season Temperature Predictions

With studies indicating that temperature is a factor in smolt survival and upstream adult migration rate, the CBR inseason temperature forecast has taken on added significance. A prediction algorithm was developed for use with the CRiSP1 model to predict the current year's water temperature based on historical temperature and flow data, year-to-date temperature and flow data, and a forecast of flow (provided by the Bonneville Power Administration). The temperature forecasts concur with the most current data, are consistent with historical seasonal patterns in temperature, and use predicted flows to make moderate adjustments. An early season forecast, calculated April 10, 2004, tracked well with the actual temperature pattern observed over the year (see Figure 2).

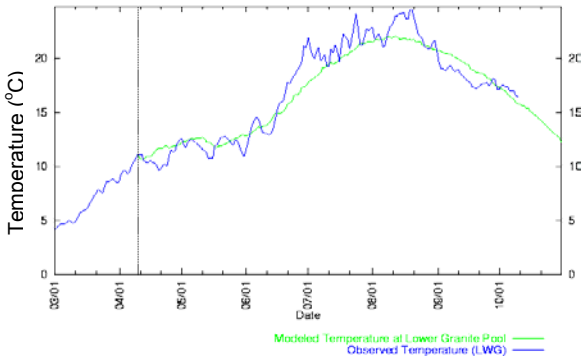
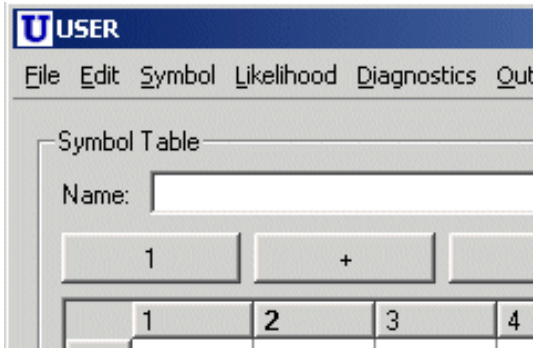


Figure 2. Plot of predicted and actual temperatures (°C) in Lower Granite Pool, 2004.

For Temperature Forecasts, see http://www.cbr.washington.edu/crisprt/index_snake_col_wq.html. For more details on the prediction algorithm, see http://www.cbr.washington.edu/crisprt/realtemp.html.

Introducing Program USER



The **U**ser **S**pecified **E**stimation **R**outine, or **USER**, is a statistical software program for the estimation of parameters of customized multinomial likelihood models.

The widespread use of radio- and acoustic-tags for smolt survival studies has fueled the demand for a flexible and convenient approach to analyzing the complex capture history data from these studies. In the past, this could only be done by someone with statistical programming capabilities who would write the code for each customized likelihood model.

With Program USER, a person creates a likelihood model by entering for each capture category (or cell): (1) A unique category name, (2) the mathematical expression for the probability of occurrence, and (3) the corresponding number of observations. All categories for a likelihood must be mutually exclusive and exhaustive, and Program USER enforces this condition by verifying that the probabilities for a likelihood sum to one. Program USER permits the construction of both multinomial and product-multinomial likelihoods.

Program USER will calculate parameter estimates and their corresponding standard errors. The investigator can also select to see the covariance matrix or the correlation matrix for the parameter estimates.

Program USER also provides the capability of calculating the profile likelihood confidence intervals for any parameter, or any desired function of the parameters. The user can select profile likelihood confidence intervals for alpha levels of 0.05 or 0.10.

Program USER also has the capabilities to display a table of the normalized residuals, and diagnostic plots of the observed vs. expected and observed vs. normalized residuals. Below is an example of an observed vs. expected plot with the observed counts on the X-axis, and the expected values based on the parameter estimates from the model on the Y-axis. Points on the 45-degree line indicate an exact match between the observed counts vs. the expected counts.

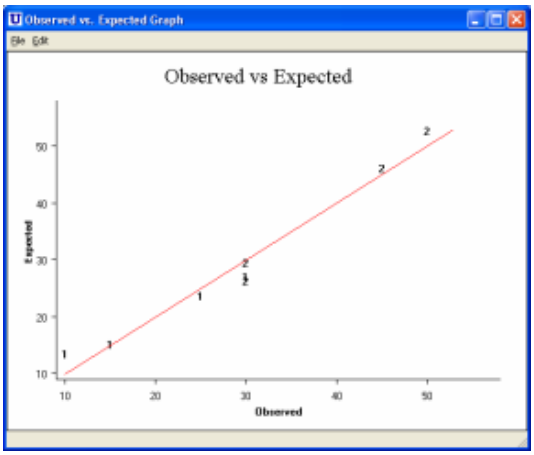


Figure 3. Example of diagnostic plot of observed vs. predicted values following model construction using Program USER.

Program USER and a PDF user's manual can be obtained at: http://www.cbr.washington.edu/paramEst/USER/.

Adult Escapement

In a letter dated 4 April 2002 to the Northwest Power Planning Council, the National Marine Fisheries Service (NMFS), Northwest Regional Office of NOAA Fisheries, set interim target goals for the abundance of adult spawners for about 50 stocks of listed Interior Columbia Basin salmonids (NOAA Interim Abundance and Productivity Targets). Although the target abundance goals were specified, it was difficult to associate these goals with specific escapement data in StreamNet. Columbia Basin Research has been able to associate about half of the interim goals with the data in StreamNet (http://www.streamnet.org/) or the NMFS Biological Review Team Interior Columbia ESU status review worksheets (http://www.nwfsc.noaa.gov/trt/brtrpt.htm). For these stocks and locations, graphical comparisons of spawner trends and interim goals are displayed in DART.

We provide state-of-art graphical comparisons of these data with the associated abundance goals to help evaluate the recovery status of stocks (Figure 4). NOAA Fisheries is continually updating both the definition of interim recovery and the historical trend data as better information and methods of assessment become available.

Other populations identified in the interim target document will be added to the web site as more of the historical trend data are accurately compiled. The DART database also allows examination of decadal terms (Figure 5) using interactive data displays.

For additional information, see: http://www.cbr.washington.edu/adultEscape/.

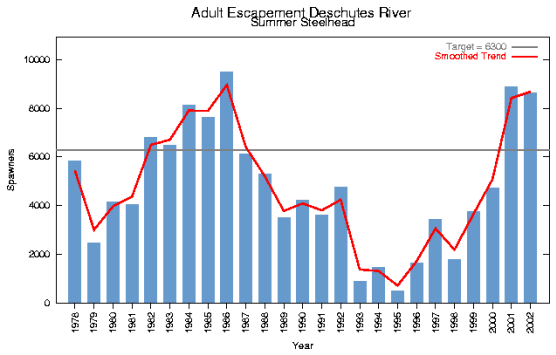
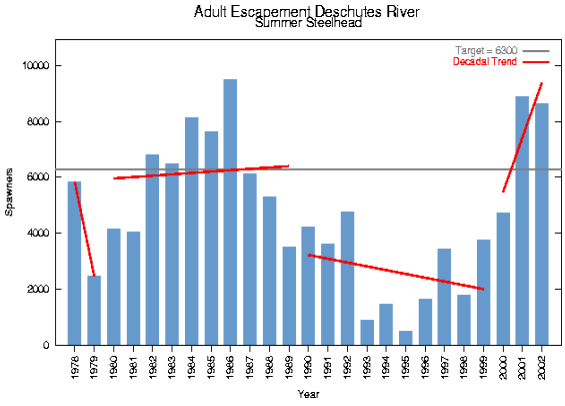


Figure 4. Historical trend of Deschutes River steelhead trout spawners compared with interim target abundance (solid gray line).

a. Linear trends



b. Decadal means

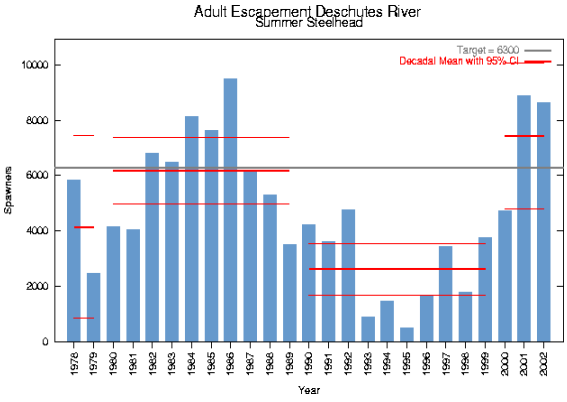


Figure 5. The decadal trends for Deschutes River steelhead trout spawners, 1978-2002.