

University of Washington

School of Aquatic & Fishery Sciences

Columbia Basin Research

Salmon Insider

Autumn 2005

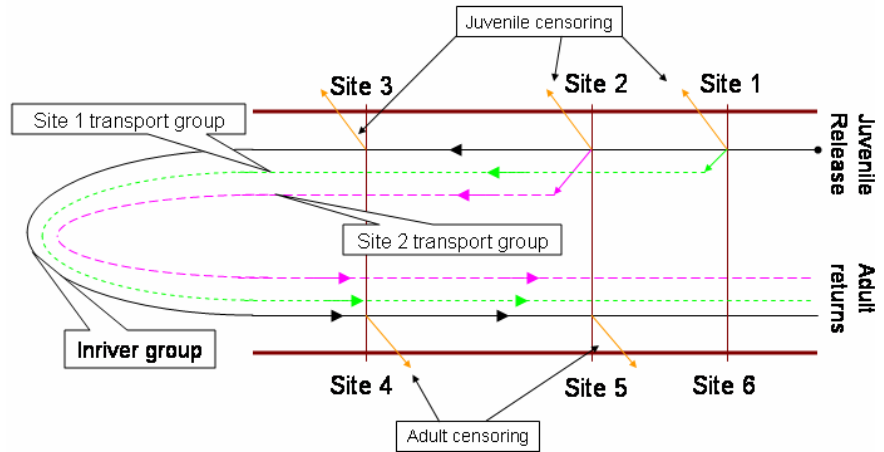
Columbia Basin Research Newsletter

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.

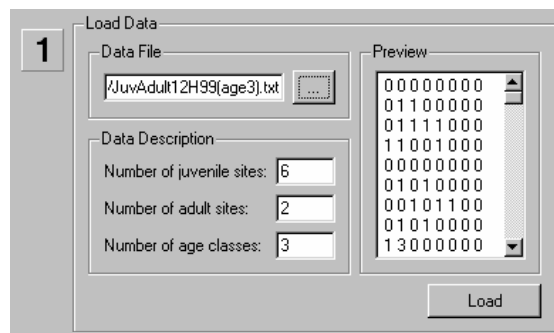
Inside . . .

Introducing Program ROSTER:

The Life-Cycle Model



The Application



University of Washington
 School of Aquatic & Fishery
 Sciences
 Columbia Basin Research
 1325 Fourth Avenue, Suite 1820
 Seattle, Washington 98101-2509

newsletter@cbr.washington.edu
 www.cbr.washington.edu

Program ROSTER: The Life-Cycle PIT-Tag Model

Scheduled for release later this year, Program ROSTER (*River-Ocean Survival and Transportation Effects Routine*) will allow users to analyze expanded detection histories to estimate ocean survival, adult upriver survival, transport-inriver ratios, and delayed mortality.

Historically, juvenile and adult PIT-tag data have been analyzed separately, and records of transported smolts have been removed (censored) from PIT-tag data to estimate smolt survival. The results of these separate analyses can be inefficient and deceptive. A new PIT-tag release-recapture model has been developed that models the life cycle of Pacific salmonids from the initiation of the juvenile migration as smolts to the end of the spawning migration as adults. This model jointly analyzes juvenile and adult PIT-tag data and uses both juvenile and adult data from transported individuals. Multiple performance measures useful in monitoring the juvenile and adult migrations and

assessing recovery effects are produced by the model, including estimates of juvenile inriver survival, ocean survival, adult inriver survival, transportation effects (e.g., T/I, 'D'), smolt-to-adult ratio (SAR), and adult age composition.

This life-cycle model is appropriate for spring and summer Chinook salmon, Sockeye salmon, and Steelhead, and is implemented by ROSTER, new software developed by Columbia Basin Research (see accompanying article).

The life-cycle model primarily uses detections of PIT tags at dams, but can also use detections at hatcheries or spawning sites, if available. The model uses a branching process to describe the age structure of returning adults. Figure 1 shows a schematic of the migration paths used by the life-cycle model. Survival (S) and detection rates (p) can be estimated at each detection site; joint survival and detection (λ) can be estimated

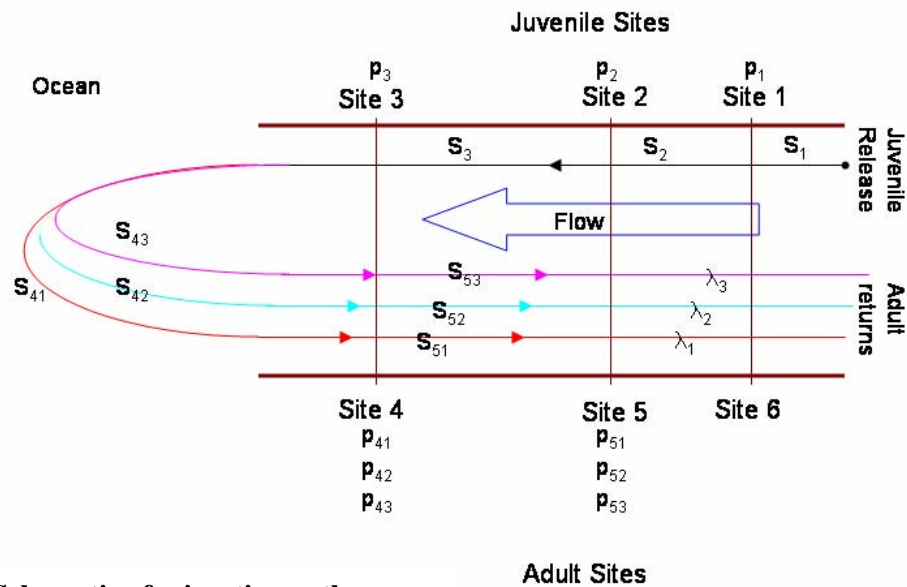


Figure 1 – Schematic of migration paths

Program ROSTER: The Life-Cycle PIT-Tag Model (Continued)

at the last site. Smolts in the release group move downstream along a single path, but branch into one of several paths in the ocean based on maturation rates and transport history. Each branch represents a particular adult age class; these are kept separate throughout the adult spawning migration. While Figure 1 shows only three age classes, ROSTER can accommodate as many age classes as needed.

In addition to multiple adult age classes, the life-cycle model also incorporates transportation and is able to estimate transportation effects directly. Adult detections of transported fish are used to compare the return rates of transported and non-transported fish. Figure 2 shows a schematic of the migration paths of the transported and inriver fish; each ocean and adult path represents multiple return years. The model also accounts for censoring of juveniles and adults due to known removals at dams.

Several types of transportation effect measures are estimated by ROSTER, each appropriate depending on management perspective. The dam-specific measures assess the effects of transportation from a single dam, either isolated from any other downstream transportation or in the context of the rest of the transportation system. The isolated measure characterizes the transportation effects at a particular dam if operated alone, while the contextual measure also incorporates the effects of subsequent transportation of inriver fish below the site of interest. The contextual measure is analogous to the relative recovery measure typically used to measure transportation effects, and reflects the fact that fish not transported at one dam may be transported at a downriver dam (Figure 2). Also available is a system-wide measure that incorporates the proportions of fish transported to assess the effects of the whole transportation system on the return rate of a release group.

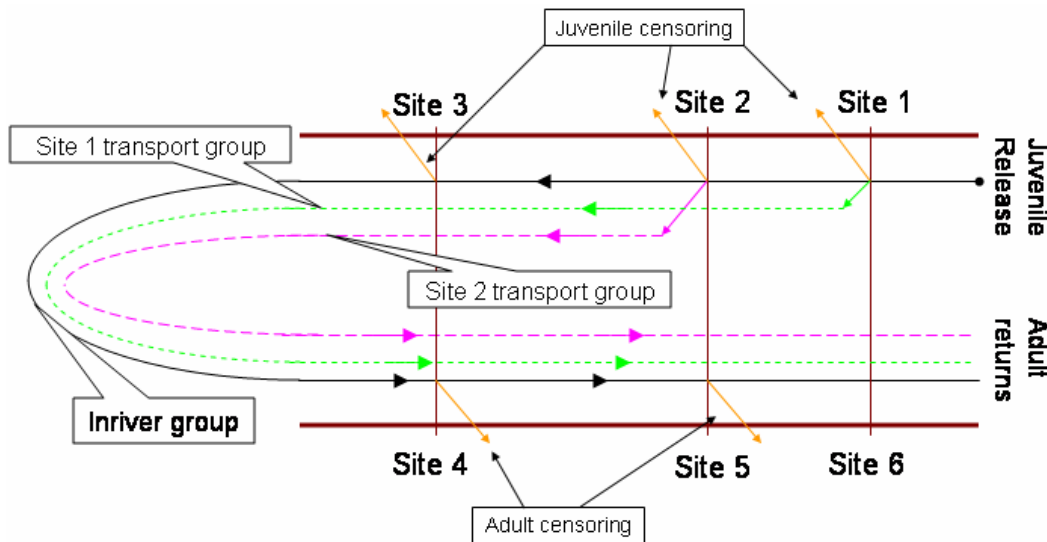


Figure 2 – Schematic of the migration paths of the transported and inriver fish

Program ROSTER: The Application

Program ROSTER (*River-Ocean Survival and Transportation Effects Routine*) 1.0 is designed to be easy to use while providing full computational capabilities for the expert user. The whole process can be broken into three steps: load the data, adjust the model settings, and run the estimation.

The first step is to load the data (Fig. 3). A data file containing capture histories (which may be generated using Program PitPro, <http://www.cbr.washington.edu/paramest/pitpro/>, UW PIT-tag processing software) is selected and the variables describing the capture histories are entered, including the number of juvenile sites in the capture history, the number of adult sites, and the number of age classes for returning adults. A preview of the selected data file is provided to the right in the program interface as a quick reminder of the selected data file composition. When the load button is clicked, the data will be loaded and a basic summary report will be generated.

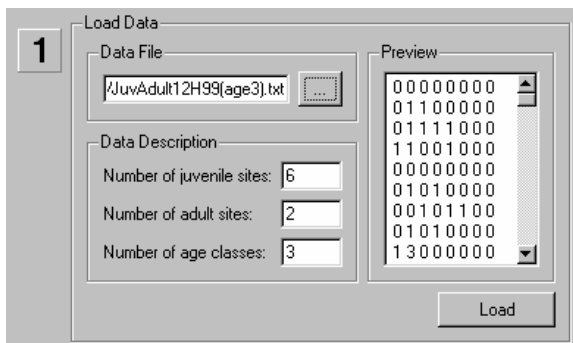


Figure 3 – Loading data

The second step is to configure the model (Fig. 4). Based on the dataset description, Program ROSTER will automatically configure the appropriate model for the data set. The expert user may modify the default model by editing and reloading the model file generated by Program ROSTER. For more

information on the model file, please see the website

<http://www.cbr.washington.edu/paramest/roster/> (the format of the model file is beyond the scope of this article). Additionally, by changing the value of “Extent of transportation effects (adult site),” the user may select the adult site to which transportation effects will be calculated; the default is the first adult site.

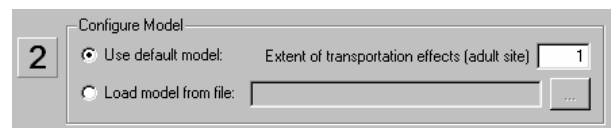


Figure 4 – Configuring the model

The final step is to run the estimation routine (Fig. 5). Program status and any error messages are displayed in the message window at the bottom of the program interface.

Upon successful completion of the estimation process, the program will generate a report including the parameter estimates and selected performance measures.

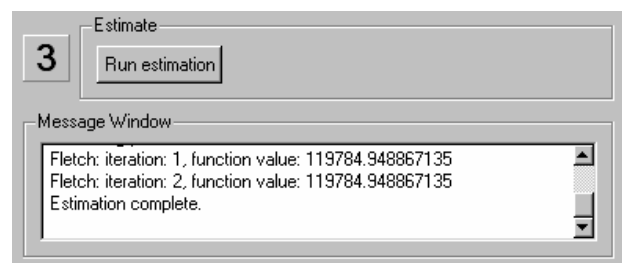


Figure 5 – Parameter estimation

This program is scheduled for release later this year. More information will be available at the website: <http://www.cbr.washington.edu/paramest/roster/>.