

University of Washington

School of Aquatic & Fishery Sciences

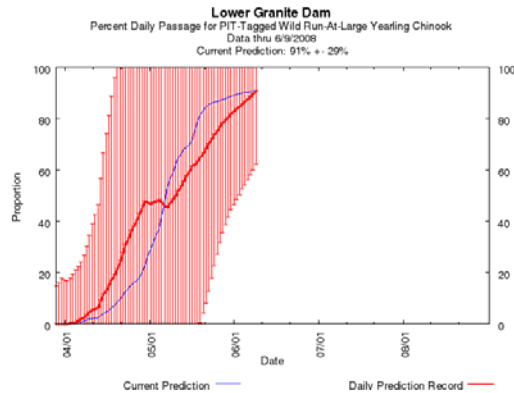
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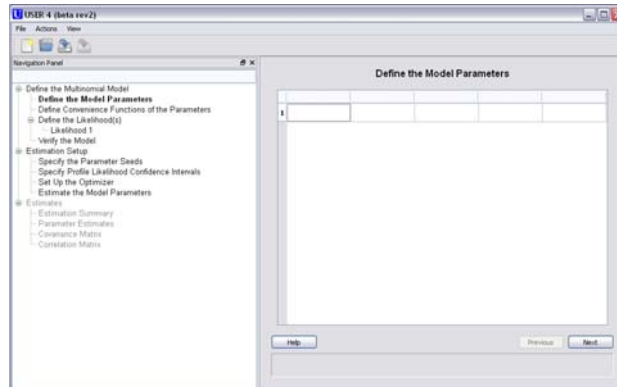
Columbia Basin Research (CBR) is a scientific research group at the University of Washington, School of Aquatic & Fishery Sciences. We investigate salmon biology and survival in the Columbia and Snake river basins. We provide user-friendly data analysis and modeling tools, and maintain DART, an interactive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

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Inseason Forecasts for 2008—It’s that time of year again

The annual outmigration of salmonid smolts in the Columbia and Snake rivers is well underway. In April, we began forecasting the run timing and arrival distributions of 52 salmonid and steelhead stocks from 29 release sites at 10 monitoring sites in the Columbia River Basin.

Forecasts are updated daily from April through October, based, in part, on observed data from the Pacific States Marine Fisheries Commission, Fish Passage Center, US Army Corps of Engineers, and Chelan County Public Utility District.

Smolt forecasts are based on two programs to generate downstream passage and arrival distributions: RealTime and COMPASS (COMprehensive PASSage). RealTime uses statistical

algorithms, updated earlier this year, to smooth patterns of historical PIT-tag data and passage indices to provide forecasts of percent daily passage for salmonid stocks at index locations, e.g., Lower Granite Dam, using weighted generalized least squares for decision criteria (Fig. 1). COMPASS—a juvenile fish passage model developed by NOAA Fisheries in collaboration with other federal, state, and tribal agencies, and the University of Washington—uses the RealTime predicted run timing and arrival distributions at Lower Granite and McNary dams to predict downstream passage and in-river reach survivals (Fig. 2).

All inseason forecasts for 2008, including adult passage and run size and water quality conditions, are available at <http://www.cbr.washington.edu/crisprt/>.

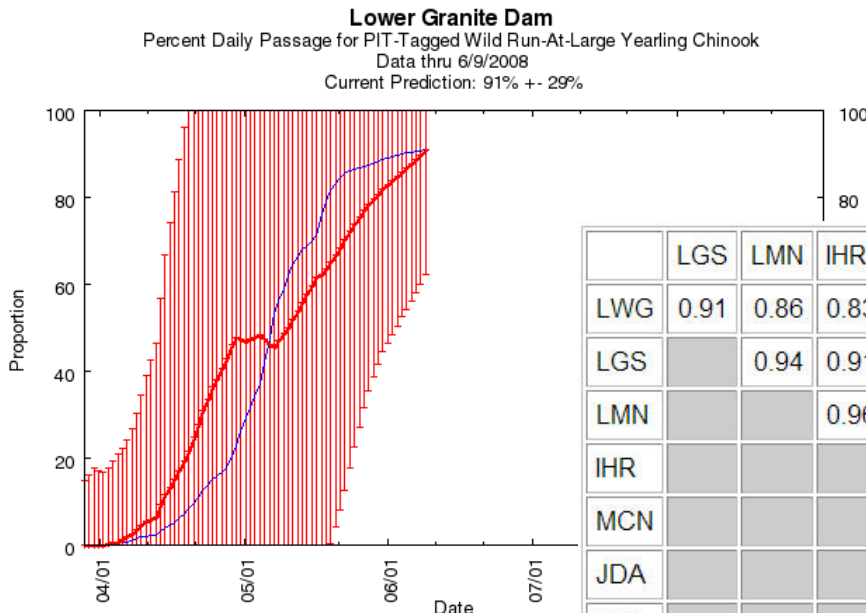


Figure 1. Percent daily passage forecast from Program RealTime for PIT-tagged, wild run-at-large yearling Chinook salmon smolts at Lower Granite Dam.

	LGS	LMN	IHR	MCN	JDA	TDA	BON
LWG	0.91	0.86	0.83	0.76	0.66	0.59	0.56
LGS		0.94	0.91	0.83	0.72	0.65	0.61
LMN			0.96	0.89	0.77	0.69	0.65
IHR				0.92	0.80	0.71	0.68
MCN					0.87	0.77	0.74
JDA						0.89	0.85
TDA							0.95

Figure 2. Predicted in-river survivals of PIT-tagged, wild run-at-large yearling Chinook salmon between dams for 09-Jun-2008 by COMPASS.

Major Update of Program USER (User Specified Estimation Routine)

Program USER (User Specified Estimation Routine) is a software tool available on the CBR website that allows investigators to develop statistical models for analyzing tagging and count data. It provides the capability to estimate the parameters of multinomial and product multinomial likelihood models defined by investigators.

USER 4 provides two major enhancements over previous versions of USER; (1) a more intuitive user interface, and (2) the capability to include total animal abundance as a parameter to be estimated.

Figure 3 shows the new USER interface at startup. At startup, the active page is "Define the Model Parameters" – the first step in defining the model. On the left-hand side is a navigation panel

with the active page identified in bold type. On the right-hand side is the active screen. Every page has "Next" and "Previous" buttons on the active screen, thus allowing the user to move sequentially through the screens and steps of model development and estimation.

The user also has the option of double-clicking on any item on the navigation panel and going directly to the desired page (currently unavailable pages are grayed out). This interface will guide a first-time user through the process of defining a model, estimating the parameters, and viewing the parameter estimates in a sequential manner, but it will also allow a more experienced user with the flexibility to go directly to a desired screen and model step.

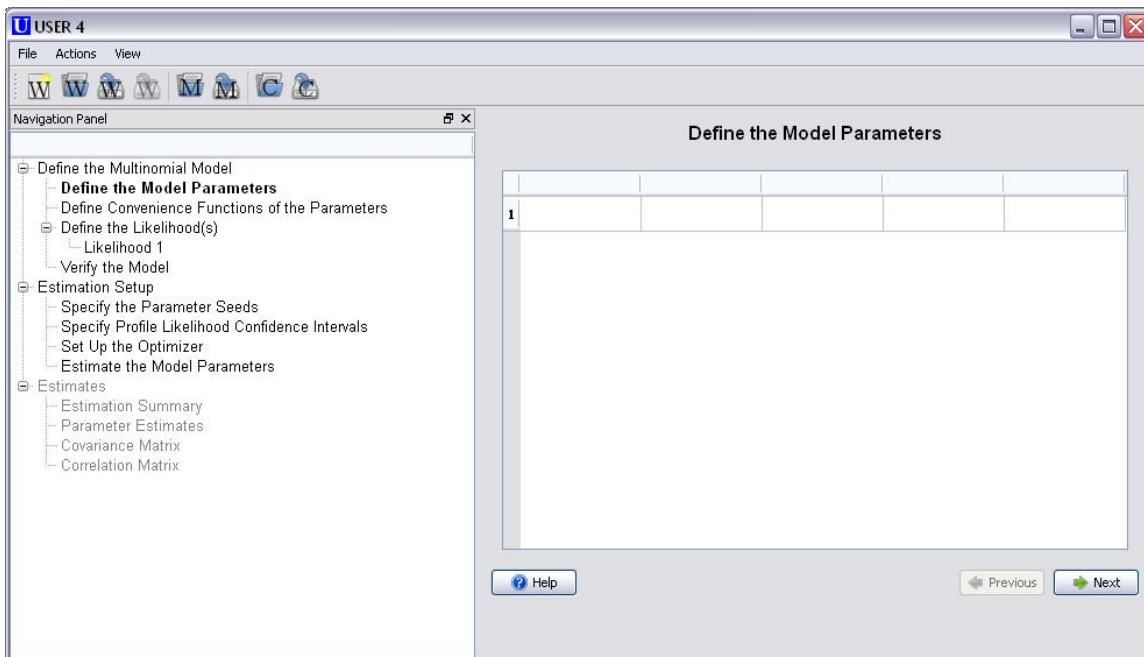


Figure 3. The new startup screen for Program USER 4.

A model in USER consists of parameters and one or more likelihood definitions. Each likelihood consists of a list of categories, with each having (1) a unique label, (2) the probability of the category as a function of the parameters, and (3) the observed count. Figure 4 shows a portion of the parameter definition screen with two parameters defined.

Define the Model Parameters	
1	N
	p

Figure 4. Definition of abundance parameters "N" and "p."

Program USER 4 assesses the validity of model definitions by verifying that the category probabilities for each likelihood in the model sum to 1 (the parameters cannot be estimated if the probabilities do not sum to 1). USER 4 provides the maximum likelihood estimates of the model parameters

along with the standard errors. The resulting covariance matrix and correlation matrices may be viewed and saved to a file for use by other software.

Figure 5 shows a portion of the subsequent likelihood definition page. For each category the user must enter a unique label, the category probability, and the observed count for that category. If the user enters a category label in the form of "(N)" where "N" is any previously defined parameter, USER fills in the Counts column with "N - ..." indicating that "N" is now assumed to be the parameter for the total abundance for the likelihood, and that the counts for this "unobserved" category are N less the sum of the counts for the for the total abundance for the likelihood, and that the counts for this "unobserved" category are N less the sum of the counts for the unobserved categories (i.e., $N - n_1 - n_2 - n_3$).

USER 4 may be obtained at www.cbr.washington.edu/paramest/user. Assistance with Program USER can be obtained by contacting Jim Lady, jlady@u.washington.edu.

	Label	Probability	Counts
1	n1	p	10000
2	n2	$p*(1-p)$	800
3	n3	$p*(1-p)^2$	100
4	(N)	$(1-p)^3$	N - ...

Figure 5. Likelihood definition with a final unobserved category (only allowed if there is an abundance parameter defined).

DART Adult Upstream Conversion Rates: Expanded to Include PTAGIS Recapture and Mortality Datasets

One of the most widely used measures to estimate adult upstream survival is the conversion rate of fish from one project to the next. The conversion rate measures the fraction of adults initially seen at a downstream site that are subsequently detected at a particular upstream site. The use of PIT-tagged fish for estimating conversion rates allows rapid estimation of the current year survivals.

In April 2008, at the request of one of the regional agencies, we expanded and redesigned the [DART PIT Tag Adult Returns Conversion Rate](#) online analysis tool to include additional data from the PTAGIS Recapture and Mortality datasets. This expansion was prompted by occasional detector outages at Wells Dam which resulted in fish being recaptured at Wells Hatchery but not detected at Wells Dam. This detection and recapture data can be added at the discretion of the user to enhance DART conversion rate estimates.

Analyzing and Filtering PTAGIS Datasets

On a daily basis, we filter the PTAGIS observation dataset for detections in adult ladders and identify individuals as adult upstream migrants based on a series of criteria. We label these adult observations at a project as detector observations (PIT) in the database table.

We then compare the PTAGIS Recapture and Mortality datasets to the DART adult observations at each project. Specific recapture and mortality records of adult individuals not found in the observation dataset—based on tag_id and project—are added to the database table. We assume any mortality record at a project after a fish has been assigned adult status indicates the adult successfully migrated to that project. We label these adult observations as project recapture (REC) and project mortality (MRT).

The inclusion of the Recapture and Mortality datasets allows for identifying another group of fish labeled headwater recapture (HDW). PIT-tagged adult recaptures are occasionally recorded above the “final” adult ladder in a particular river system. These individuals have clearly passed the final dam and their successful escapement can be included at that final project. Unique recaptures above the final upstream project are assigned in the database to that project as follows: Wells for the Columbia River, Lower Granite for the Snake River, Three Mile Falls for the Umatilla River, and Prosser for the Yakima River.

Table 1. DART database tag counts for all years for additional detection/recaptures at Columbia and Snake final projects.

Final Project, River System	Observation Type	Tag Count
Wells, Columbia River	Project Recapture (REC)	123
	Project Mortality (MRT)	91
	Headwater Recap (HDW)	9
Lower Granite, Snake River	Project Recapture (REC)	38
	Project Mortality (MRT)	7
	Headwater Recap (HDW)	13

Conversion Rate Online Analysis Tool

The [DART PIT Tag Adult Returns Conversion Rate](#) online analysis tool generates a summary of conversion rates by PIT-tag release site for each detection year possible based on Release Basin, Conversion Reach, Species, Run, Rear Type, and Month Range selections. The results include all adult detections of the population at the lower project of the conversion reach. The detections reported for the upper project include only detections for the PIT-tagged fish which were observed at the lower project.

For the online analysis, inclusion of the expanded recapture and mortality methods is defined by the user. A user can select the default PIT-tag observation dataset, or choose to include any combination of the project recapture, headwater recapture, and mortality datasets. These options are illustrated in the following example and results tables.

In this DART Adult Conversion Rate example, we show the conversion rate from Bonneville to Wells for all Chinook salmon released in the Columbia River and tributaries at or above Wells Dam. The following tables include results from two variations of this analysis for Observation Year 2006. Online results include all years and links to view detection details. Table 2 contains the conversion rates for the default PIT-Tag adult observation dataset. Table 3 contains the results after selecting to include recaptures, which adds 9 fish to the Wells Observations. As a result, the Conversion

Rate for this group of fish increases from 0.69 without recapture data (Table 2) to 0.77 with recapture data (Table 3).

The Additional Detection Type column documents the presence of additional detection and recaptures in the results.

- REC: Results include recaptures. Only fish in the recaptures dataset not observed at an inriver project detector are included.
- MRT: Results include mortalities. Only fish in the mortalities dataset not observed at an inriver project detector are included.
- HDW: Results include recaptures upstream from the final project in a river system but not detected at that project.

Please refer to the DART PIT Tag Adult Returns Conversion Rate web page for detailed methods and information, http://www.cbr.washington.edu/dart/pit_obs_adult_conversion.html.

Table 3. DART PIT Tag Adult Returns Conversion Rates for Bonneville to Wells for PIT-tagged Chinook salmon, released in the Columbia River and tributaries (above WEL) with *no* additional detection or recapture types. The SpRRT column represents the Species, Run, and Rear Type. The Special Conditions column indicates overwintering and multiple migrations (not covered in this article).

Observation Year	Release Site	SpRRT	Bonneville Observations	Wells Observations	Conversion Rate	Additional Detection Types	Special Conditions
2006	BEAV2C	1--	1	1	1.00		
2006	CHEWUP	1--	33	25	0.76		
2006	METH	1--	6	3	0.50		
2006	TWISPP	1--	62	41	0.66		
2006	WINT	1--	18	13	0.72		
2006 Total		1--	120	83	0.69		

Table 3. Results for same group as Table 2, with optional Recapture dataset included.

Observation Year	Release Site	SpRRT	Bonneville Observations	Wells Observations	Conversion Rate	Additional Detection Types	Special Conditions
2006	BEAV2C	1--	1	1	1.00		
2006	CHEWUP	1--	33	26	0.79	REC	
2006	METH	1--	6	4	0.67	REC	
2006	TWISPP	1--	62	47	0.76	REC	
2006	WINT	1--	18	14	0.78	REC	
Total		1--	120	92	0.77	REC	