GUI USER GUIDE FOR THE TRINITY LCM APPLICATION

This is an appendix to the Limiting Factors Analysis for Lower Trinity River Chinook salmon *Oncorhynchus tshawytscha* Using the Hamilton and Murphy Method report prepared for the Trinity River Restoration Program. This appendix provides a user guide for the Graphical User Interface (GUI) for the life cycle model (LCM) that was built for the Trinity River Chinook Salmon Limiting Factors Analysis (Trinity LFA). The appendix provides an overview of the GUI application layout, basic workflows, navigation tabs, sidebar inputs, and important operating notes.

Layout

The Trinity Life Cycle Model app is a Shiny application built around a left-side input sidebar and a top navigation bar with five main tabs: **About**, **Simulation Results**, **Diagnostics**, **Comparison**, and **Resources** (Figure 1). The sidebar is configured to stay open on the left and contains six accordion sections, including the main simulation controls and five sections that organize inputs by life stage or workflow area.

At a high level, the app lets users define assumptions for initialization, adult immigration and spawning, incubation, juvenile rearing, Klamath/estuary survival, and ocean maturation. When the model runs, the app produces plots and tables for Trinity escapement, smolt-to-adult ratio, Trinity emigrant abundance and size, ocean returns, annual abundances, habitat limitation diagnostics, and scenario comparisons.

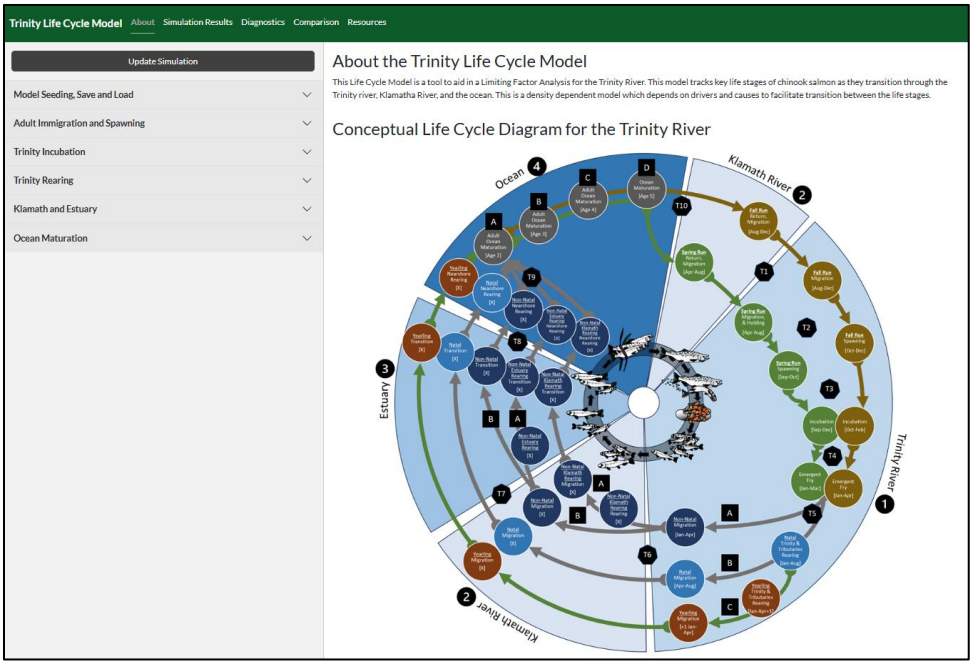


Figure 1. Home page of the Trinity Life Cycle Model Graphical User Interface.

Basic workflow

1. Review the default settings in the sidebar and adjust any values you want to test.
2. Click **Update Simulation** to run the model with the current settings.
3. Review outputs in **Simulation Results** and **Diagnostics**.
4. If you want to compare scenarios, enter a label and click **Bank Current Results for Comparison** before changing inputs again. The app stores the banked results with a label and timestamp for the comparison views.
5. Use **Save Inputs** to export a reusable .RData file, or **Load Model Inputs** to restore a prior configuration.

Many labels include a small information icon that opens a popover help message intended to give quick definitions or context without forcing users to leave the page.

Navigation tabs

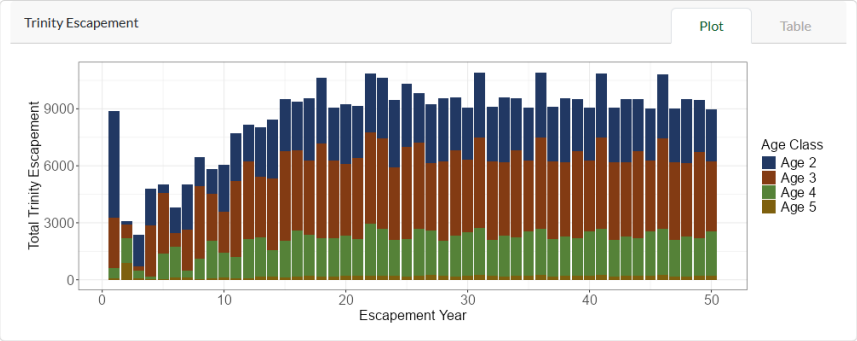
The app is organized across five top-level tabs (Table 1). The **About** and **Resources** tabs are mostly informational, while **Simulation Results**, **Diagnostics**, and **Comparison** hold the working outputs.

Table 1. Navigation tabs for the Trinity River Chinook Life Cycle Model Graphical User Interface.

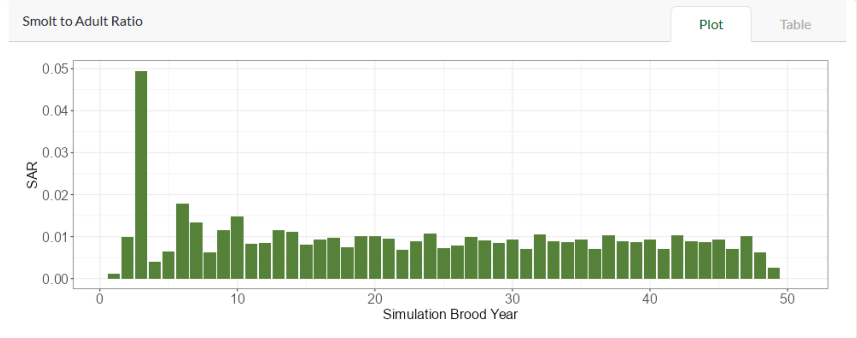
Tab	Description	Notes
About	Short description of the model and a conceptual life cycle diagram image	For orientation and context
Simulation Results	Four result cards: Trinity Escapement, Smolt to Adult Ratio, Trinity Emigrant Abundance, Trinity Emigrant Size Distribution and Ocean Returns	Each card has a **Plot** view and a **Table** view.
Diagnostics	Spawning Capacity Limitations plot, Rearing Capacity Limitations plot, and Annual Abundances table	Use this tab when you want to inspect where habitat is limiting or trace annual abundances by life stage
Comparison	Banked scenario comparison plots plus saved-input-file comparison tools	Use banked results for scenario plots; use uploaded .RData files for input-level differences
Resources	Links to supporting documents for adult immigration and spawning, Trinity incubation, Trinity rearing, Klamath emigration, and ocean maturation	Contains links to this guide

The **Simulation Results** tab contains five plot/table pairs – each is shown below with an example screenshot of the outputs:

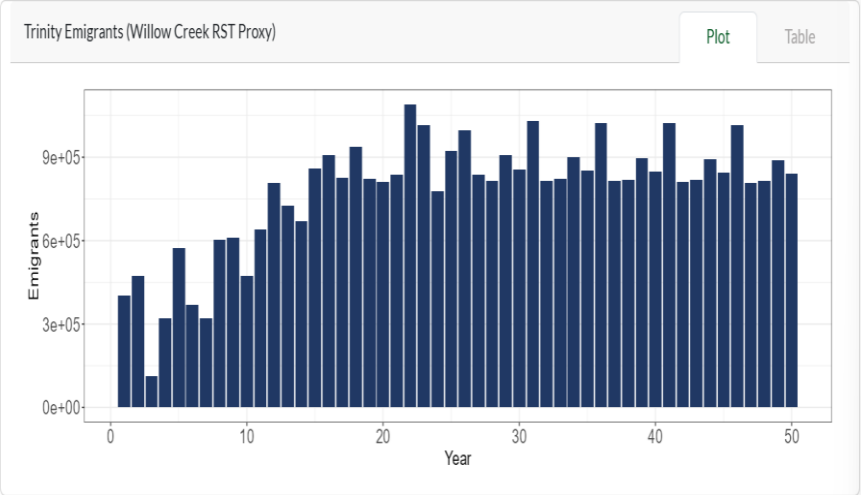
1. **Trinity Escapement** summarizes simulated prespawn adults by age class (natural origin Chinook with spring-run and fall-run Chinook populations pooled). These represent returns by simulated year and are therefore mixed age classes from multiple broodyears.



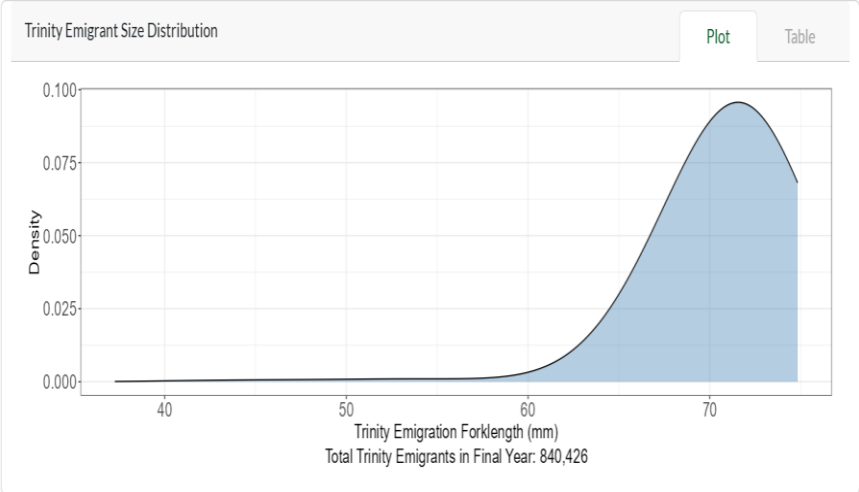
2. **Smolt to Adult Ratio** calculates brood year SAR using total outmigrant counts and associated adult returns from those brood years.



3. **Trinity Emigrants** reports the Trinity emigrant output. These are pooled among life histories (e.g., fry, parr, pre-smolt, smolt, and yearling) and are meant to represent estimated juvenile production at the Willow Creek RST.

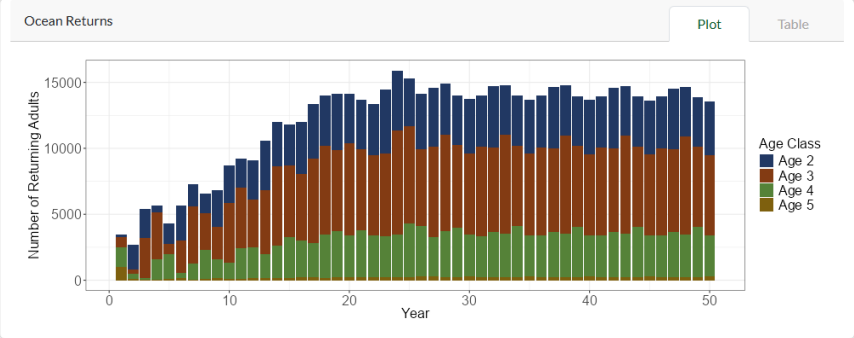


4. **Trinity Emigrant Size Distribution** shows a Kernel Density Estimate (KDE) of the size of fish leaving the Trinity River. This is the size distribution for the fish shown in #3 above, with the total number for the final simulation year shown.



5. **Ocean Returns** displays returning adults by age 2 through age 5 at the point of entry into the Klamath River. This is different than #1 above as it does not account for any

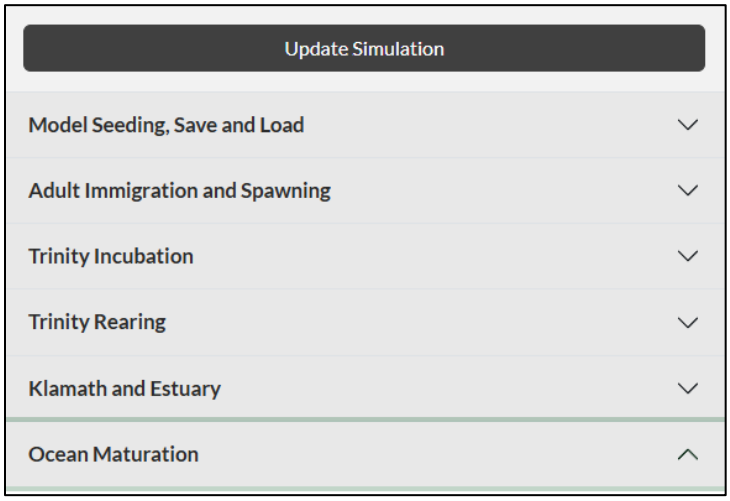
mortality during adult immigration.



The **Diagnostics** tab contains three useful checks. The spawning-capacity plot shows whether spawning habitat was limiting by model year and reach. The rearing-capacity plot shows which reaches were limiting by model year, reach, and relative week. The annual-abundance table shows the selected year's life-stage abundances from the model's main Trinity column, including adult returns, prespawn fish, females, spawners, eggs, fry, Trinity emigrants, yearlings, Klamath emigrants, and ocean age classes.

The **Comparison** tab serves two different purposes. First, it compares the current results with a previously banked scenario using plots for Trinity Escapement, Trinity Emigration, Trinity Emigration (Size), SAR, and Ocean Returns. Second, it allows you to upload two saved input files and compare them cell by cell without changing the current model settings. The file-comparison area includes a preview table of changed values and a **Download Changed Inputs** button that appears only when differences are found.

Sidebar inputs



The left sidebar contains the action button **Update Simulation** followed by six accordion sections. Multiple accordion sections can be open at the same time. These tabs allow the user to access inputs organized by life stages and functions. The tables below summarize the inputs at a practical, user-guide level.

Figure 2. Left sidebar for Trinity LCM GUI used to navigate to inputs.

Table 2. Model seeding, scenario management, save, and load inputs and functions.

Area	Inputs Available	Control Style	What It Is For
Simulation length	Simulation Duration (Years)	Numeric input	Sets the number of annual time steps to simulate
Initial abundance	Starting Number of Adults; Starting Number of Yearlings	Numeric inputs	Seeds the model with initial returners and yearlings
Initial ocean abundance	Ocean Abundance Age 2, Age 3, Age 4, Age 5	Numeric inputs	Seeds starting ocean abundance for older age classes
Banked scenario naming	Banked Scenario Name	Text input	Lets you assign a label to a scenario before banking it
Banked comparison setup	Bank Current Results for Comparison	Action button	Saves the current model results for later comparison in the Comparison tab
Save current inputs	Save Inputs	Download button	Exports current settings to an .RData file
Load prior inputs	Load Model Inputs	File upload	Imports a previously saved .RData input file

Table 3. Adult Immigration and Spawning inputs.

Input Group	Inputs Available	Control Style	User Guidance
Klamath survival entering the system	Klamath Survival for Spring Run; Klamath Survival for Fall Run	Select inputs	Selects condition-based adult survival values using labeled temperature, pathogen, and dissolved oxygen scenarios
Straying survival	Straying Survival for Spring Run; Straying Survival for Fall Run	Select inputs	Sets survival associated with flow strength, holding, and crowding conditions
Straying into Trinity	Straying into Trinity River	Slider	Controls the share of fish straying from the Klamath into the Trinity
In-river impacts by age	In-river Impact Rate for Age 2, Age 3, Age 4, Age 5	Sliders	Sets age-specific in-river impact rates
River harvest thresholds	River Harvest Abundance Threshold Cut Off for Fall; River Harvest Abundance Threshold Cut Off for Spring	Numeric inputs	Defines the abundance thresholds below which low default in-river impact assumptions are used
Spring holding survival	Holding Survival under holding habitat condition and temperature; No Holding Habitat Survival	Select input and slider	Sets spring prespawn survival under good holding conditions and under no-holding-habitat conditions
Holding habitat capacity inputs	Holding Pool Area; Holding Pool Depth; Fish Density in Holding Pools	Numeric inputs	Determines effective spring holding capacity
Trinity immigration survival	Trinity Survival for Spring Run; Trinity Survival for Fall Run	Select inputs	Sets survival after fish enter the Trinity based on environmental conditions
Female proportion by age and run	Proportion Female for Age 2–5, Fall Run; Proportion Female for Age 2–5, Spring Run	Sliders	Sets the female share used in spawning calculations
Spawning habitat capacity	Spawning Capacity Reach 1, Reach 2, Reach 3	Numeric inputs	Sets spawning capacity by reach
Hatchery-origin natural spawner assumptions	Proportion Hatchery Origin Natural Spawners; Hatchery Origin Natural Spawner Limit; Reach 1–3 HOS proportions	Slider and numeric inputs	Controls how many hatchery-origin fish are spawning and how they are allocated across reaches
Redd territory by age	Redd Territory per Female for Age 2, Age 3, Age 4, Age 5	Numeric inputs	Determines territory demand by spawning female age class

Table 4. Trinity Incubation inputs.

Input Group	Inputs Available	Control Style	User Guidance
Fecundity	Fecundity Age 2, Age 3, Age 4, Age 5, and Hatchery	Numeric inputs	Sets egg production assumptions by age and hatchery contribution
Hatchery success	Hatchery Success Multiplier	Numeric input	Scales hatchery-origin spawning success
Gravel size by reach	Gravel Size D84 for Reach 1, Reach 2, Reach 3	Numeric inputs	Affects redd construction survival by age and reach
Thiamine survival	Thiamine Survival for Age 2–5	Sliders	Applies age-specific egg survival modifiers
Egg quality	Egg Quality for Age 2–5	Sliders	Applies age-specific egg quality modifiers
Fine sediment by reach	Percent Fine Sediment Reach 1, Reach 2, Reach 3	Select inputs	Applies reach-specific survival multipliers using condition labels mapped to numeric survival values
Hydrologic conditions by reach	Hydrologic Conditions Reach 1, Reach 2, Reach 3	Select inputs	Applies hydrology-based survival multipliers by reach
Incubation temperature by reach	Incubation Temperature Reach 1, Reach 2, Reach 3	Select inputs	Sets egg-to-fry survival and emergence timing patterns by reach

Table 5. Trinity Rearing, Klamath and Estuary, and Ocean Maturation inputs.

Section	Inputs Available	Control Style	User Guidance
Trinity Rearing core controls	Emergence Size; Baseline Rearing Survival; Portion Yearlings; Overwintering Survival; Yearling Trinity Emigration Survival	Numeric input and sliders	Controls juvenile starting size, survival during rearing, and yearling pathway assumptions
Reach Weekly Conditions	Reach 1, Reach 2, Reach 3 weekly tables with columns for Week, Temperature, Food, Disease	Editable hot tables	Lets you edit weekly rearing conditions by reach; week is read-only and condition fields are dropdowns
Capacity by Flow	Flow versus Reach 1–3 capacity table	Editable hot table	Sets rearing capacity under low, moderate, and high flow conditions
Weekly Flow Conditions	Week and Flow table	Editable hot table	Assigns weekly flow class that links to the capacity-by-flow table
Release Schedule	Week, Reach, Number of Fish, Size	Editable hot table	Defines hatchery release timing, reach, fish count, and size; rows can be added or removed
Klamath and Estuary	Flow Scenario; Klamath Survival for Yearling; Estuary Condition for Fry Growth; Estuary Survival for Yearling	Select inputs and sliders	Controls juvenile survival and growth after leaving the Trinity
Ocean Maturation	Ocean Conditions; Age 3–5 survival; Yearling survival; Ocean impact rates for Age 2–5; Maturation rates for Age 2–5; Straying rates for Age 2–5; Portion Fall Run; Ocean Harvest Abundance Cut Off	Select input, sliders, numeric input	Controls ocean survival, harvest impacts, maturation, straying, and the fall-versus-spring run split

Important operating notes

- The **Comparison** tab itself is always present in the navbar, but the banked-results display inside it is conditional. If no scenario has been banked yet, the tab shows a warning asking you to bank results. Once you bank a scenario, the tab switches to the comparison plot interface and displays the banked scenario label and timestamp.
- Banking results is separate from saving inputs. **Bank Current Results for Comparison** stores a copy of the actual model outputs currently on screen. **Save Inputs**, by contrast, exports the current input settings as an .RData file. Those saved inputs can later be loaded back into the model or compared against a second saved file in the file-comparison tool.
- The rearing hot tables are designed for direct editing. In the weekly reach-condition tables, the **Week** column is read-only, and the condition fields use dropdown-controlled categories. In the capacity-by-flow table, **Flow** is read-only, and the reach capacities must be numeric and nonnegative. In the release schedule, rows can be edited or added through

the context menu, with validation that keeps week, reach, fish count, and size in valid ranges.

- The hatchery-origin natural spawner proportions across Reach 1, Reach 2, and Reach 3 are expected to sum to 1. If they do not, the app shows warning feedback on those inputs.