



TribPIT I USER'S MANUAL

STATISTICAL ANALYSIS OF JUVENILE PIT-TAG DETECTIONS IN TRIBUTARIES

COLUMBIA BASIN RESEARCH

SCHOOL OF AQUATIC AND FISHERY SCIENCES

Program TribPit

Cohort Analysis of Juvenile Salmonid Movement and Survival in Tributaries

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Chapter 1: Overview

1.1 Motivation

Traditional release-recapture models have been used on the Columbia River system to estimate survival with the assumption that from release to a detection point or from one detection point to the next detection point an individual fish either (1) migrates downstream or (2) dies. Studies of Chinook salmon and steelhead, however, show that many juvenile salmon and steelhead stay upstream (residualize) in the tributaries for one or more years before migrating downstream. A traditional release-recapture analysis, which assumes all released fish migrate downstream in the release year, would treat the fish that residualize as mortalities. Program TribPit provides cohort-based survival estimates that account for the possibility of an individual fish overwintering for multiple years during the downstream migration process.

1.2 The TribPit Model

Figure 1 illustrates the TribPit model for a hypothetical study with a release in year 1 and detections at three downstream locations. The parameters of the model are:

ϕ_{ijk} = the joint probability of survival and movement from site $i - 1$ in year j to site i in year k , given that the individual was alive at site $i - 1$ in year j ,

P_{ik} = the probability of detection at site i in year k , given that an individual was alive at site i in year k , and

λ_{jk} = the joint probability of survival, movement, and detection from the penultimate site in year j to the final site in year k , given that the individual was alive at the penultimate site in year j .

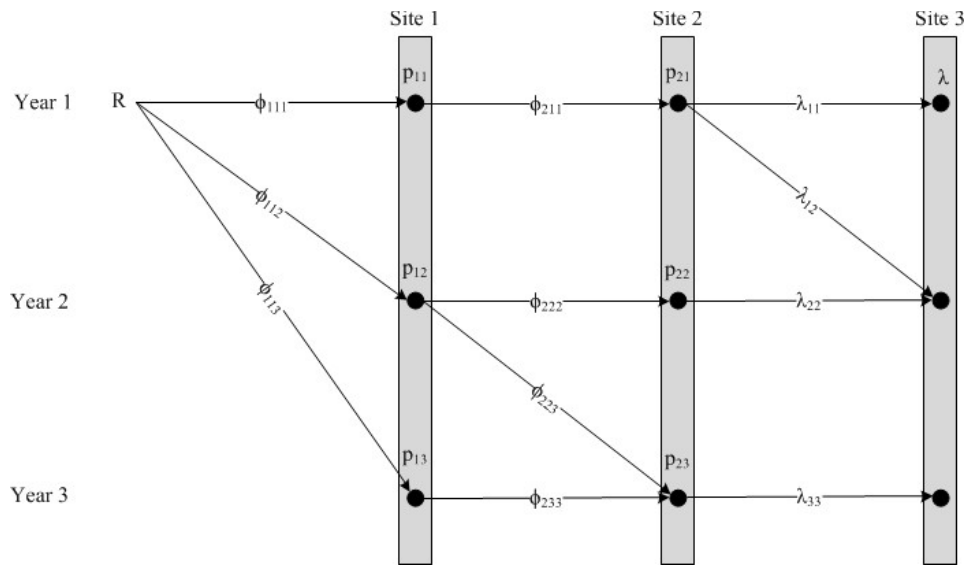


Figure 1. Illustration of the TribPit model for a hypothetical study.

For the sake of clarity, Figure 1 does not show all possible overwintering possibilities of a release (the diagonals on the diagram). For example, if fish detected at site 2 in year 1 were next detected at site 3 in year 3, Program TribPit would include the parameter λ_{13} in the model; TribPit only includes the overwintering-related parameters in the model for which there are observations.

Note that for the final reach, from the penultimate site to the final site, the probability of survival and movement cannot be separately estimated from the probability of detection. For this reason, TribPit models the final λ parameter as the product of the two. A consequence of this is that a study must have an additional downstream detection site beyond the site at which an estimate of survival and movement is desired.

1.3 Auxiliary Releases

Program TribPit allows for multiple releases of a given cohort in other years and/or sites for the purpose of increasing the precision of the resulting parameter estimates. For example, continuing with the hypothetical study of Figure 1, another release from the same cohort and from the same site might be performed one year later, as shown in Figure 2.

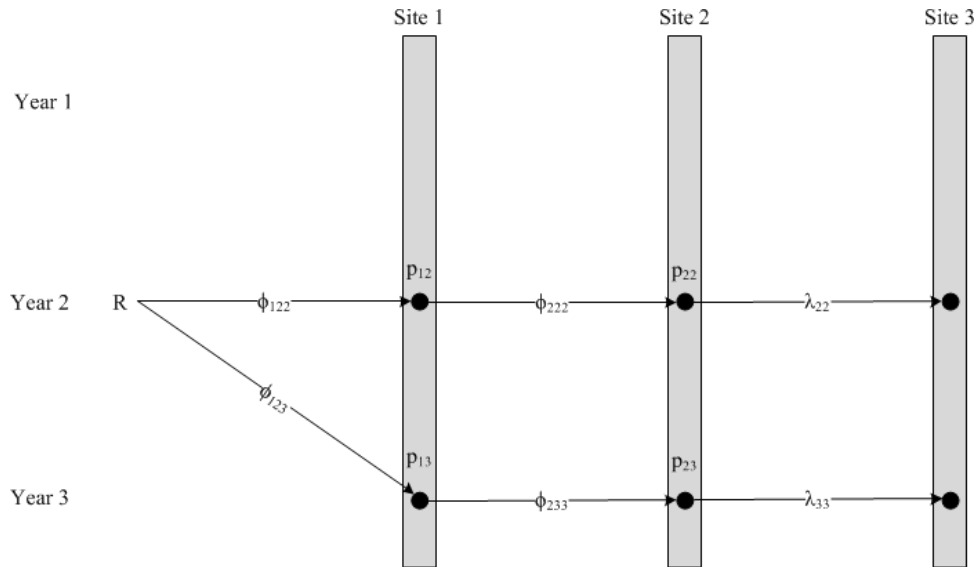


Figure 2. Auxiliary release for a hypothetical study of the same cohort as in Figure 1 in the following year.

There are several parameters that might be in common across the two releases: ϕ_{222} , ϕ_{233} , λ_{22} , λ_{33} , P_{12} , P_{13} , P_{22} , and P_{23} . Program TribPit provides hypotheses testing via the Akaike Information Criterion (AIC) to see if it is possible to equate the equivalent parameters across the releases. The release process depicted in Figures 1 and 2 may be repeated for a number of years.

Program TribPit assumes that the earliest release in time and the most upstream release is the **primary release**; all other releases are assumed to be **auxiliary releases**.

1.4 Model Parameterization

As explained in the previous example, auxiliary releases may be used to increase the precision of parameter estimates by equating equivalent parameters across releases. The possibilities include:

1. keeping all parameters unique across releases, in which case the auxiliary releases do not provide additional precision for the estimates of the primary release,

2. equating only the detection parameters (P_{ik}) across releases, and
3. equating both the detection parameters and the survival and movement parameters (ϕ_{ijk} and λ_{jk}) across releases.

In addition, parameters may be combined:

1. across all releases released from the same release site,
2. across all releases released in the same year, and
3. across all releases regardless of release site and release year.

Although the previous discussion referred to the TribPit model, from here on out the term **model** will be used to refer to the parameterization used in estimating the parameters. The available models are dependent on the number and nature of the releases. The four possible scenarios are:

1. one release only,
2. multiple releases all released from the same site but in different years,
3. multiple releases all released in the same year but from different sites, and
4. multiple releases from different sites and in different years.

The tables in Sections 1.4.1 to 1.4.4 show the models that are available in Program TribPit for each of these four scenarios. Note that in some cases some available models may not be estimable due to the sparseness of the data. The **Model ID** is a unique identifier assigned to each model for ease of reference.

1.4.1 Scenario 1: one release only

Model ID	Capture parameters	Survival and movement parameters
M.n.1A	Unique	Unique

1.4.2 Scenario 2: multiple releases from the same site but in different years

Model ID	Capture parameters	Survival and movement parameters
M.y.1A	Unique	Unique
M.y.2A	Equated across release years	Unique
M.y.2B	Equated across release years	Equated across release years

1.4.3 Scenario 3: multiple releases in the same year but from different sites

Model ID	Capture parameters	Survival and movement parameters
M.s.1A	Unique	Unique
M.s.2A	Equated across release sites	Unique
M.s.2B	Equated across release sites	Equated across release sites

1.4.4 Scenario 4: multiple releases from different sites and in different years

Model ID	Capture parameters	Survival and movement parameters
M.y.s.1A	Unique	Unique
M.y.s.2A	Equated across release years, Unique release sites unique	
M.y.s.2B	Equated across release years, Unique release sites unique	Equated across release years, Unique sites unique
M.y.s.3A	Equated across release sites, Unique release years unique	
M.y.s.3B	Equated across release sites, Unique release years unique	Equated across sites, Unique release years unique
M.y.s.4A	Equated across all releases	Unique
M.y.s.4B	Equated across all releases	Equated across release years, Unique sites unique
M.y.s.4C	Equated across all releases	Equated across release sites, Unique years unique
M.y.s.4D	Equated across all releases	Equated all releases

Chapter 2: Using TribPit

Figure 3 below shows the main user interface of Program TribPit at startup. The main components are:

- the **Navigation Panel** is on the left-hand side. It lists all commands available to the user organized in a hierarchical way, from top to bottom in the order that the user would generally access them,
- the **Releases Summary** is on the right-hand side. It summarizes the releases for all data currently loaded into Program TribPit,
- the **Output** is at the bottom. All status messages and error messages that occur during program execution are displayed here,
- the **Workspace** occupies the center portion of the main user interface. This is where all user dialogs and reports are displayed, and
- **Menus** across the top of the main user interface, described below.

Note in the chapters that follow that items in **bold** (e.g., **Navigation Panel**) occur in every iteration of the program while items in “quotations” (e.g, “FISTRP 2009”) are specific to the given example.

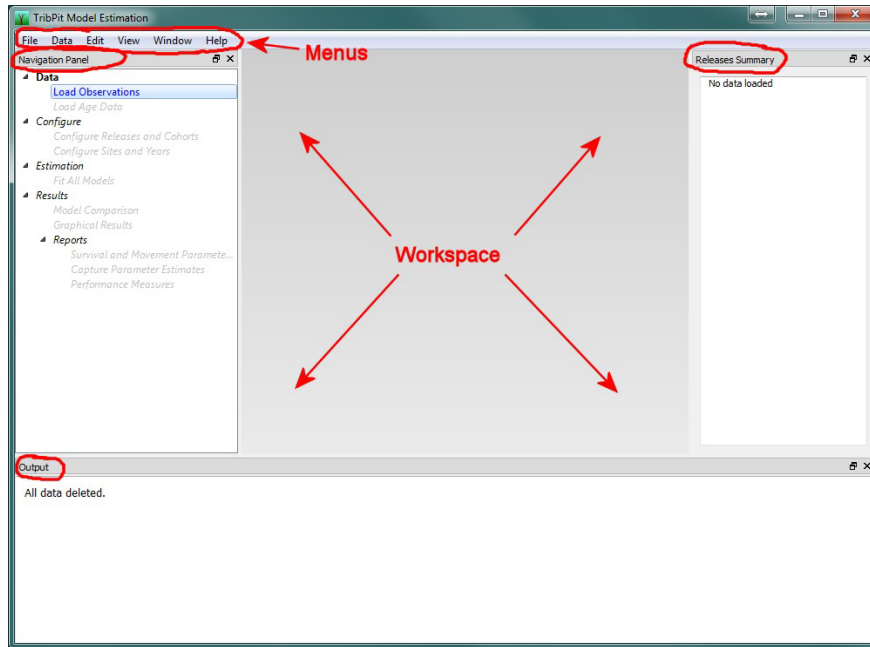


Figure 3. Main user interface of Program TribPit at startup with main components highlighted.

2.1 Menus

The **File** menu commands are shown in Figure 4. The **Exit** command causes Program TribPit to exit. The other commands—**Save As**, **Print**, and **Print Preview**—are available when reports and graphs are active, allowing reports to be saved to a file or sent to a printer.

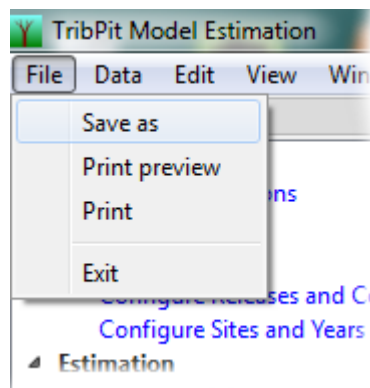


Figure 4. File menu.

The **Data** menu has one command—**Clear All Data**. It clears all data currently loaded and returns Program TribPit to its initial state. The user will be asked to confirm this request before performing this destructive command.

The **View** menu, shown in Figure 5, allows the user to control whether or not the **Navigation Panel**, **Output**, or the **Releases Summary** are visible or not. Figure 5 shows the default state with all three components having a checkmark, indicating they are visible. Clicking on a component will un-check it and hide it from view; clicking on an un-checked item will cause the hidden component to be visible again.

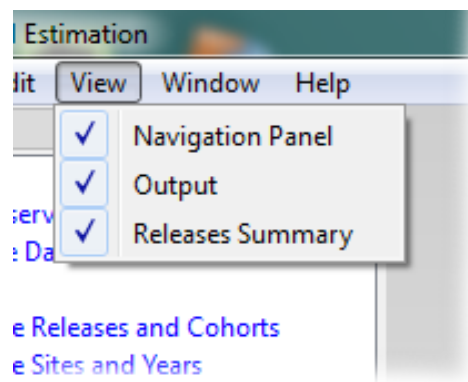


Figure 5. View menu.

The **Window** menu has three actions: **Tile Windows**, **Cascade Windows**, and **Close All**, allowing the user to organize the currently open windows in the workspace.

The **Edit** menu has one item, **Settings** as described below.

2.2 Settings

The **Settings** dialog, shown in Figure 6, has three tabs across the top: **General**, **Sites Configuration**, and **Advanced**. These three tags define the computing environment and are described in detail below.

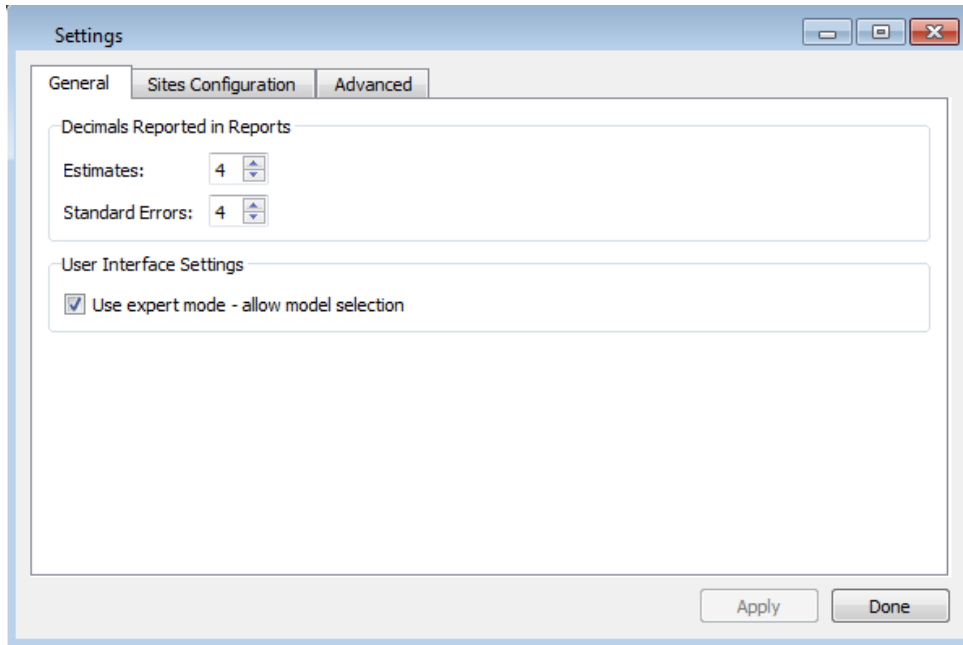


Figure 6. General Settings dialog.

2.2.1 General settings

The **General Settings** dialog is shown in Figure 6. The top part allows the user to control the number of decimal places displayed in reports (**Decimals Reported in Reports**), both for estimates and the standard errors of estimates.

In the **User Interface Settings**, the user may turn on **Use expert mode – allow model selection**. This is described in detail in Section 5.4.

2.2.2 Sites Configuration settings

As will be explained in Chapter 3, a sites configuration file is necessary before loading observations data. The **Sites Configuration** tab, shown in Figure 7, allows the user to select an alternate sites configuration file. If the user changes the sites configuration file, a warning will appear as shown in Figure 8, which the user must acknowledge by pressing the **OK** button. The sites configuration file is used only when data are loaded; if the user wants to apply an alternate sites configuration file to data already loaded, then the **File → Clear All Data** command must be invoked, and the observations must be reloaded after specifying the desired sites configuration file.

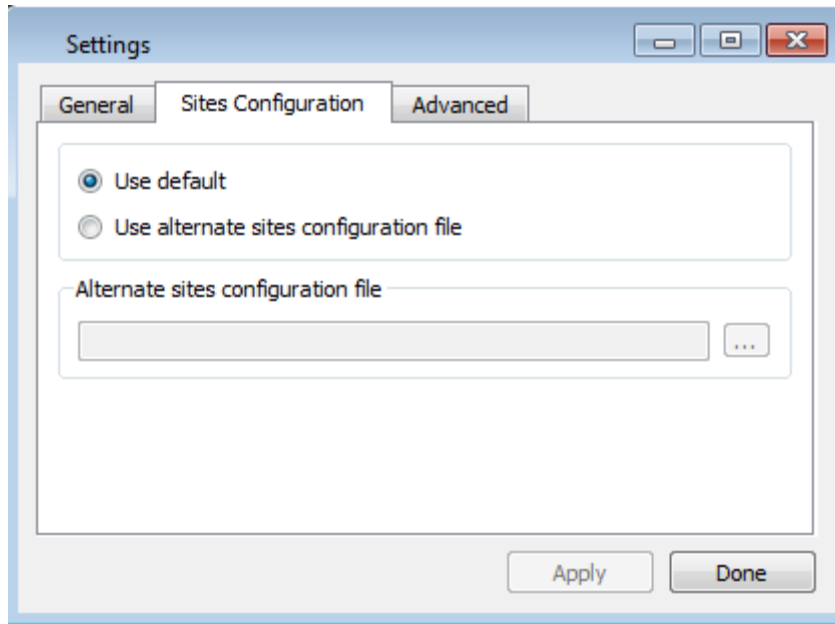


Figure 7. Sites Configuration settings tab.

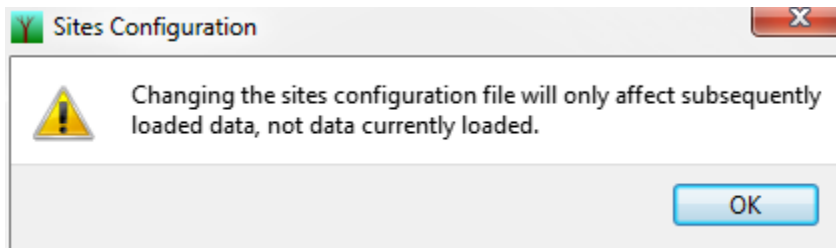


Figure 8. Warning message when the user changes the sites configuration file.

When the user selects **Use alternate sites configuration file**, the dialog appears as shown in Figure 9, with both the **Apply** and **Done** buttons disabled. The user must specify the alternate configuration file before proceeding by pressing the tool button (...) shown in Figure 9.

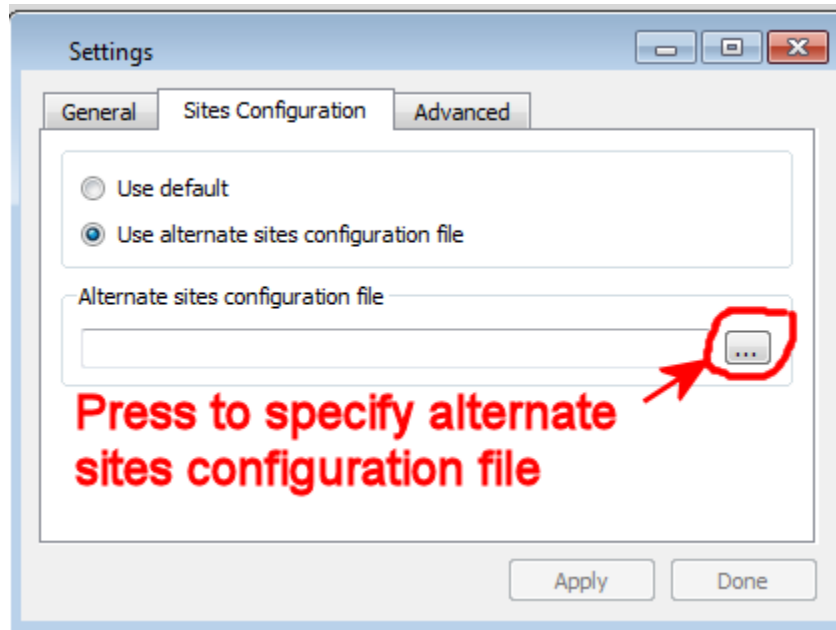


Figure 9. Sites Configuration setting after selecting Use alternate sites configuration file.

Note that when the user exits Program TribPit and then restarts it, it defaults to using the default configuration file; if the user desires an alternate sites configuration file, the user must explicitly select it each time at startup.

2.2.3 Advanced settings

The **Advanced** tab has one item – a checkbox for **Show Diagnostic Tools**. Enabling this will cause a **Diagnostic Tools** section to be added to the **Navigation Panel**, as explained in detail in Chapter 6.

Chapter 3: Data – TribPit

Input Files

3.1 Sites Configuration File

The sites configuration file is maintained on the Columbia Basin Research (CBR) website and is updated as the configuration of PIT-tag arrays on the Columbia River and Snake River systems changes. Program TribPit requires the sites configuration file to be loaded before loading observations in order to be able to convert PIT-tag detections to capture histories.

A version of the sites configuration file is loaded when Program TribPit is installed. The first time an observations file is loaded, Program TribPit accesses the CBR website to see if a newer version of the sites configuration file exists. If so, it is downloaded and loaded into Program TribPit before loading the observations file. Subsequently, whenever the user loads an observations file, if the sites configuration has not already been loaded, and it has been more than a day since the CBR site was queried, Program TribPit queries the CBR website for a newer version and downloads the newer version and loads it. The sites configuration file is always loaded before loading an observations file.

The loading of the sites configuration file described above is all done in the background without the user needing to intervene. The user may, however, load an alternate sites configuration file if desired, as explained in Chapter 2. A new sites configuration file will apply only to subsequently loaded observations; it will not affect observations already loaded into Program TribPit.

3.2 Observations File

The observations file contains all of the actual PIT-tag detections of the tags in the study. It is created via the Columbia Basin Research (CBR) website at the DART Basin TribPit Observations File with Tag File Selection page on [the DART Basin TribPit Observations File with Tag File Selection page](#). Figure 10 shows a portion of the landing page for this data query.

DART Basin TribPit Observations File with Tag File Selection

Data Courtesy of [Pacific States Marine Fisheries Commission](#)

Observation Files Queries

for Basin TribPit for TribPIT 1.1.21 or earlier

Select Release Year, Species, Run Type, Rear Type

2026	1-Chinook	All	All
2025	2-Coho	1-Spring	W-Wild
2024	3-Steelhead	2-Summer	H-Hatchery
2023	4-Sockeye	3-Fall	U-Unknown

Select Release Location

Release Basin Alpha by Water Body Name Release Basin by River KM Release Site

No Selection - Release Basin

Select Tag Capture Method

No Selection - Tag Capture Method

Select Tag Coordinator

No Selection - Tag Coordinator

- AAB-alan byrne, IDFG [2006]
- ACG-Andrew Grassell, CPUD [2006]
- ACP-Ethan Crawford, WDFW [active]

Multiple selections for Tag Coordinator allowed.

Restrict Query by Release Date Range

Select Date Range Type: Calendar Year

Set Date Range: Release Start (mm/dd) 1/1 2026 Release End (mm/dd) 12/31 2026

Displayed year values are determined by selections for: Release Year and Date Range Type.

Options

Not Strict Basin RKM

Check this option to not use strict match for Basin RKM. For example, with option checked, releases with River KM of 754.089 and 754.089.001 would "match" for Nason Creek. With strict match, 754.089.001 designates Nason Creek where as 754.089 designates a release on the Wenatchee River. The default is to use strict matching for Basin RKM.

Submit Query Reset

Figure 10. Portion of the landing page for the DART query to create the observations file.

The user specifies the following items as desired:

1. release year,
2. species,
3. run type,
4. rear type,
5. release location,
6. tag capture method,
7. tag coordinator, and
8. date range for the release date and release end.

After making the selections, press the **Submit Query** button at the bottom of page.

Once the **Submit Query** button has been pressed, it may take several minutes to process the query. Once complete, the query will return a list of tag files that meet the query specifications, as shown in Figure 11.

To Generate TribPit Observations File

1. Review the Tag File List generated by query.
Table includes sortable columns. Click on blue shaded Column Header cell to sort table by that column. Click again to reverse.
2. Select Tag Files to include in observations file generation.
To include all Tag Files:
 - Click the "All" checkbox in the "Select" column. Display is updated showing all Tag Files checked.
 - OR
 - Do not check any Tag Files in the "Select" column.To include a subset of Tag Files (max 145):
 - Click the checkbox in the "Select" column for each individual tag file to include. Use the sortable columns table feature to reorganize the table for grouping by desired column.
 - OR
 - Click the "All" checkbox in the "Select" column. Display is updated showing all Tag Files checked. Click the checkbox in the "Select" column to unselect tag files to exclude.
3. Click the "Generate TribPit Observations File" button at the top or bottom of table.

Generate TribPit Observations File
Clear All

Columbia River DART
Tag File List based on Selection Criteria
Species: Steelhead
Run Type: Summer
Rearing Type: Wild
Release Basin RKM: 163 - 163.999 (Not Strict)
Release Dates: Release 2013
Tag Files: 5

Select	TagFile ▲	Species	Run	RearType	RelSite	Capture Method	Release RiverKM	MigrYear	RelDate (Y-M-D)	TagCoord	RelCount	Tagging Session Message
<input checked="" type="checkbox"/>	All	All Listed Tag Files: 89 Released										
<input type="checkbox"/>	CCC13131.WFT	3	2	W	WILLR1	LADDER	163.043	2013	2013-05-11	CCC	26	WILLAMETTE FALLS ADULT TAGGING UIDAHO
<input type="checkbox"/>	CCC13132.WFT	3	2	W	WILLR1	LADDER	163.043	2013	2013-05-12	CCC	24	WILLAMETTE FALLS ADULT TAGGING UIDAHO
<input type="checkbox"/>	CCC13143.WFT	3	2	W	WILLR1	LADDER	163.043	2013	2013-05-23	CCC	13	WILLAMETTE FALLS ADULT TAGGING UIDAHO
<input type="checkbox"/>	CCC13144.WFT	3	2	W	WILLR1	LADDER	163.043	2013	2013-05-24	CCC	20	WILLAMETTE FALLS ADULT TAGGING UIDAHO
<input type="checkbox"/>	CCC13148.WFT	3	2	W	WILLR1	LADDER	163.043	2013	2013-05-28	CCC	6	WILLAMETTE FALLS ADULT TAGGING UIDAHO

Generate TribPit Observations File
Clear All

Figure 11. Portion of an example of the results of a query to create the observations file.

The user then selects the tag files to be used to create the observations file. The user may select all of them by select the **All** checkbox in the first row of the first column (circled in Figure 11), or by simply not selecting anything. Alternatively, a subset of the tag files may be used by selecting the checkbox next to each desired tag file. When ready, the user then presses the **Generate TribPit Observations File** button to continue.

Figure 12 shows the results of the query. The user then presses **Download TribPit Observations File** to download the observations file, which can be loaded directly into Program TribPit.

The screenshot shows the final page of a DART query. At the top, there are navigation links: '< browser back', 'K query page', 'download csv', 'download csv', and 'download TagIDs list'. Below this is a section of query specifications in a monospaced font, starting with '##### Query Specifications #####'. The specifications include: TribPit Version = 1.1.22 or later, Release Start Year = 2013, Species = 3, Run = 2, Roar Type = M, Rkm Not Strict = yes, Release Area Definition = Release River KM between '843.066' and '843.066.999', Release Group Start Date = 2013-01-01, Release Group End Date = 2013-12-31, Release Tributary/Basin Name = Twisp River, Tag Files = 005-2013-200-LFZ.XML, TagIDs Released = 84, Detection Date Note = Detection Date/Time is last detection at an interrogation site as determined by DART, Exclusions = Fish tagged as adults as determined by DART are excluded from the TribPit Observations File, LastDataDate = Last Possible Data Date 04/21/2026, Generated = 22 Apr 2026 09:24:04 PDT, and Source = Columbia River DART. Data Courtesy of Pacific States Marine Fisheries Commission. Below the specifications is a yellow warning box with the text: 'Warning: If you wish to open and then save the TribPit Observation File/CSV data file before loading into TribPit, it is recommended that you use a text editor rather than Excel in order to preserve the date format required by TribPit. REQUIRED DATE FORMAT for RelVTime, TagDate and ObsDateLast is YYYY-MM-DD hh:mm:ss. REQUIRED DATE FORMAT for RelGrpStartDate and RelGrpEndDate is YYYY-MM-DD.' A red circle highlights the 'Download TribPit Observations File' button. Below the button, it says 'Result set includes rows for 84 unique fish.' At the bottom, there is a 'DART Data Citation' section with the text: 'Columbia River DART, Columbia Basin Research, University of Washington. (2026). TribPit Observations. Available from https://www.cbr.washington.edu/dart/query/pit_basin_branching' and a 'Generated' section with the text: '22 Apr 2026 09:24:04 PDT. Columbia River DART (Data Access in Real Time) www.cbr.washington.edu/dart.'

Figure 12. Final page of the DART query for downloading the observations file.

Figure 13 shows the top portion of an observations file, as displayed in Microsoft Excel. **Warning:** Excel automatically changes the format of date-time objects in .csv files, so it is recommended that the user avoid re-saving a TribPit observations file after opening it in Excel. Instead, use of a text editor is recommended for viewing and then re-saving the observations file in order to preserve the date format required by TribPit. The required date format is YYYY-MM-DD hh:mm:ss for the release time, tag date, and observation date, and YYYY-MM-DD for the release group start date and release group

end date.

```
#####
## Query Specifications
#####
## Release Start Year = 2013
## Species = 3
## Run = 2
## Rear Type = W
## Release Area Definition = Release River KM between '843.066.0' and '843.066.999'
## Release Group Start Date = 2013-01-01
## Release Group End Date = 2013-12-31
## Release Tributary/Basin Name = Twisp River
## TagIDs Released = 477
## Detection Date Note = Detection Date/Time is last detection at an interrogation site as determined by DART.
## Exclusions = Fish tagged as adults as determined by DART are excluded from the model input data.
## This file length at tag and capture method.
## Generated = 24 Mar 2014 13:55:31 PDT
## Source = Data Courtesy of Pacific States Marine Fisheries Commission
#####
```

RelGrpSta	RelGrpEndD	TagID	SpRRT	RelVTime	Lgth	BrdYear	TagFile	MigrYear	TagDate	CoordID	RelSite	RiverKM	CaptureMeth	SessionM	ObsDateLast	ObsSite	ObsMonitor	ObsStage	
1/1/2013	12/31/2013	384.382380889A	32W	4/5/2013 19:00	61		CGS13095	2013	4/5/2013	CSS	TWISPR	843.066.008	SCREW		917				
1/1/2013	12/31/2013	3D9.1C2D10C03A	32W	3/18/2013 15:45	72		CGS13074	2013	3/15/2013	CSS	TWISPR	843.066.003	SCREW		912	3/18/2013 20:42	TWR	Lower In-stream Array	J
1/1/2013	12/31/2013	3D9.1C2D10D851	32W	3/26/2013 15:30	63		CGS13084	2013	3/25/2013	CSS	TWISPR	843.066.008	SCREW		917	4/7/2013 1:01	TWR	Lower In-stream Array	J
1/1/2013	12/31/2013	3D9.1C2D1333CC	32W	3/28/2013 15:30	68		CGS13084	2013	3/25/2013	CSS	TWISPR	843.066.008	SCREW		917	4/4/2013 23:08	TWR	Upper In-stream Array	J
1/1/2013	12/31/2013	3D9.1C2D133994	32W	3/18/2013 15:45	149		CGS13074	2013	3/15/2013	CSS	TWISPR	843.066.003	SCREW		912				
1/1/2013	12/31/2013	3D9.1C2D3DA3AE	32W	4/5/2013 19:00	66		CGS13094	2013	4/4/2013	CSS	TWISPR	843.066.008	SCREW		917				
1/1/2013	12/31/2013	3D9.1C2D445E88	32W	4/5/2013 19:00	56		CGS13092	2013	4/2/2013	CSS	TWISPR	843.066.008	SCREW		917				
1/1/2013	12/31/2013	3D9.1C2D446E00	32W	4/5/2013 19:00	54		CGS13093	2013	4/3/2013	CSS	TWISPR	843.066.008	SCREW		917				
1/1/2013	12/31/2013	3D9.1C2D44903F	32W	4/5/2013 19:00	57		CGS13092	2013	4/2/2013	CSS	TWISPR	843.066.008	SCREW		917				
1/1/2013	12/31/2013	3D9.1C2D449193	32W	4/5/2013 19:00	57		CGS13094	2013	4/4/2013	CSS	TWISPR	843.066.008	SCREW		917				
1/1/2013	12/31/2013	3D9.1C2D448A3D	32W	4/12/2013 18:30	54		CGS13102	2013	4/12/2013	CSS	TWISPR	843.066.008	SCREW		917				
1/1/2013	12/31/2013	3D9.1C2D44E89B	32W	4/5/2013 19:00	56		CGS13093	2013	4/3/2013	CSS	TWISPR	843.066.008	SCREW		917				
1/1/2013	12/31/2013	3D9.1C2D44EDD4	32W	4/5/2013 19:00	61		CGS13095	2013	4/5/2013	CSS	TWISPR	843.066.008	SCREW		917				
1/1/2013	12/31/2013	3D9.1C2D60CA04	32W	4/5/2013 19:00	177		CGS13094	2013	4/4/2013	CSS	TWISPR	843.066.008	SCREW		917	5/17/2013 18:53	BCC	15x15 FULL-FLOW ANTENNA	J

Figure 13. Top portion of an example of a TribPit observations file.

3.3 Age Data

Program TribPit depends on the tagged fish in a study being of a known age. The age data file specifies the age for all aged fish in the study. The age data file is a comma separated value (.csv) text file. All lines beginning with a hash mark (#) are ignored. Otherwise, each line is a record for one fish. Each record may be in one of two formats:

1. A record consisting of two fields: (1) tag ID, followed by (2) brood year. A brood year of NA indicates that the age of the fish is unknown.
2. A record consisting of three fields: (1) tag ID, (2) release year, (3) age at release. The brood year is then calculated by subtracting the age from the release year. A value of NA for the age at release indicates that the age of the fish is unknown.

Analysis can be performed in Program TribPit without loading any age data by assuming that all individuals are of the same brood year. However, pooling the age-class data can seriously bias the survival analysis and is **not** recommended. The user is required to provide the age data file themselves, independent of DART.

3.4 Loading the Data

At initial startup with no observations loaded, the **Navigation Panel** of Program TribPit appears as shown in Figure 14 with only the **Load Observations** command enabled; no analysis can be done until the observations are loaded.

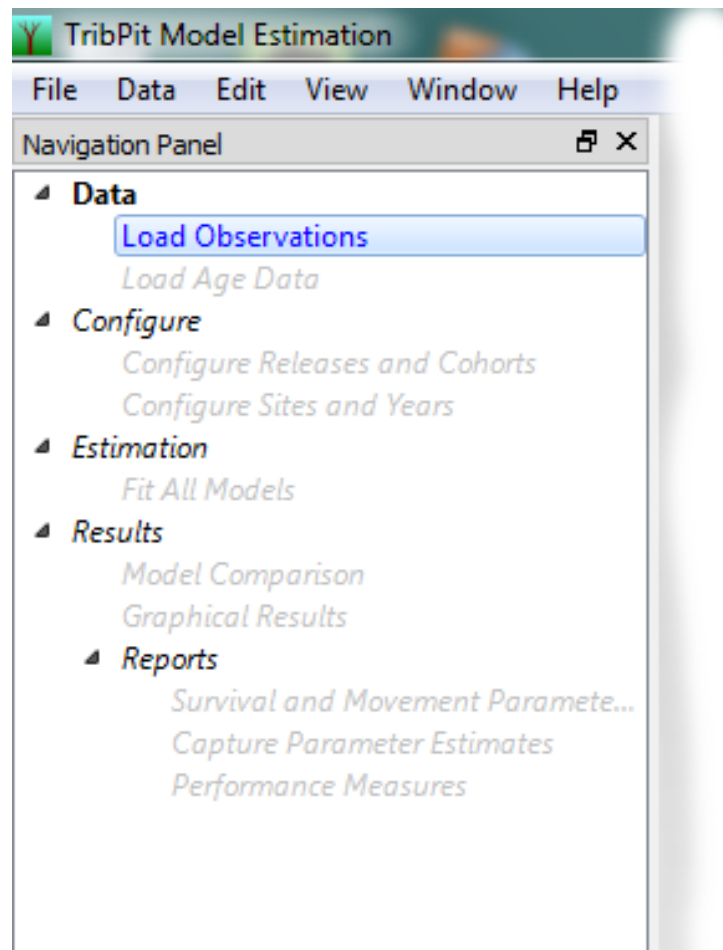
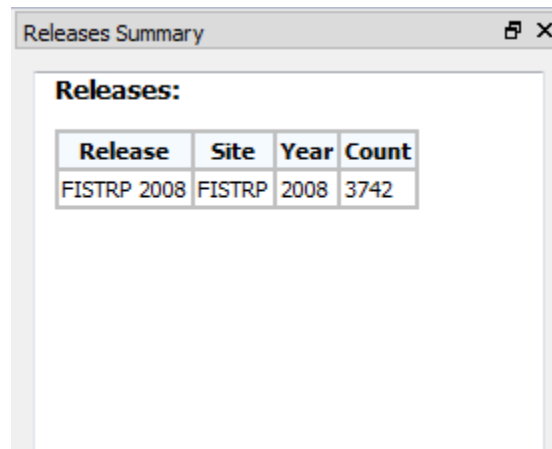


Figure 14. The Navigation Panel at initial startup with no observations loaded.

When the user double-clicks on **Load Observations**, TribPit will prompt the user to select the observations data file to be loaded. While loading the data, all status messages will appear in the **Output** window at the bottom of the user interface. For this example, we load a file with one release: "FISTRP 2008."

Once the data are loaded, the **Releases Summary** will be updated as shown in

Figure 15. A release is defined as all fish released from a given site in a given year. One observation file may contain more than one release.

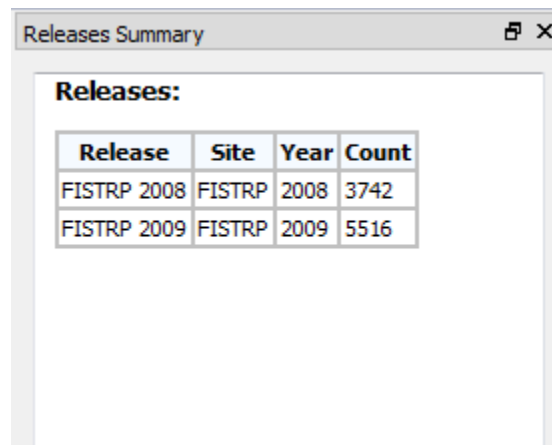


The screenshot shows a window titled "Releases Summary" with a close button. Below the title bar, the word "Releases:" is displayed. A table with four columns is shown: "Release", "Site", "Year", and "Count". The table contains one row of data.

Release	Site	Year	Count
FISTRP 2008	FISTRP	2008	3742

Figure 15. Releases Summary after loading observations file “fistrp2008.csv.”

Multiple observation files may be loaded into TribPit. In this case, we will load another file with a release named “FISTRP 2009”—fish released from the same site in the year 2009. After loading this observations file, the **Releases Summary** appears as shown in Figure 16.



The screenshot shows a window titled "Releases Summary" with a close button. Below the title bar, the word "Releases:" is displayed. A table with four columns is shown: "Release", "Site", "Year", and "Count". The table contains two rows of data.

Release	Site	Year	Count
FISTRP 2008	FISTRP	2008	3742
FISTRP 2009	FISTRP	2009	5516

Figure 16. Releases Summary after loading observations files for 2008 and 2009.

After loading the observation files, the user may continue to **Configuration** on the **Navigation Panel** if all the releases are from the same brood year. If not, an age data file must be loaded, assigning brood years to the tag IDs. This is done by double

clicking on **Load Age Data** on the **Navigation Panel** and selecting the age data file to be loaded. As with the loading of observations data, all status messages appear in the **Output**. The user may see error messages such as shown in Figure 17, indicating the tag IDs that are in the age data file but not in the observations data; in this case, tags that are found in the observations data will still have the brood year assigned to them.

```
Output
Loading C:/Users/jimcuddy/Desktop/Colony Projects/11011910ch2009.csv
Updating
Observation data loaded.
No such tag "3D9.1BF1A7E6EC", line 2
No such tag "3D9.1BF23E6346", line 3
No such tag "3D9.1BF1A33B24", line 4
No such tag "3D9.1BF2325B5B", line 5
No such tag "3D9.1BF23E79B4", line 6
No such tag "3D9.1BF1A23C3D", line 7
No such tag "3D9.1BF1F776FD", line 8
No such tag "3D9.1BF23E83A0", line 9
No such tag "3D9.1BF1F980F8", line 10
No such tag "3D9.1BF231ED65", line 11
```

Figure 17. Output when loading age data.

Chapter 4: Study Configuration

4.1 Configuring Releases and Cohorts

Figure 18 shows the **Configure Releases and Cohorts** dialog.

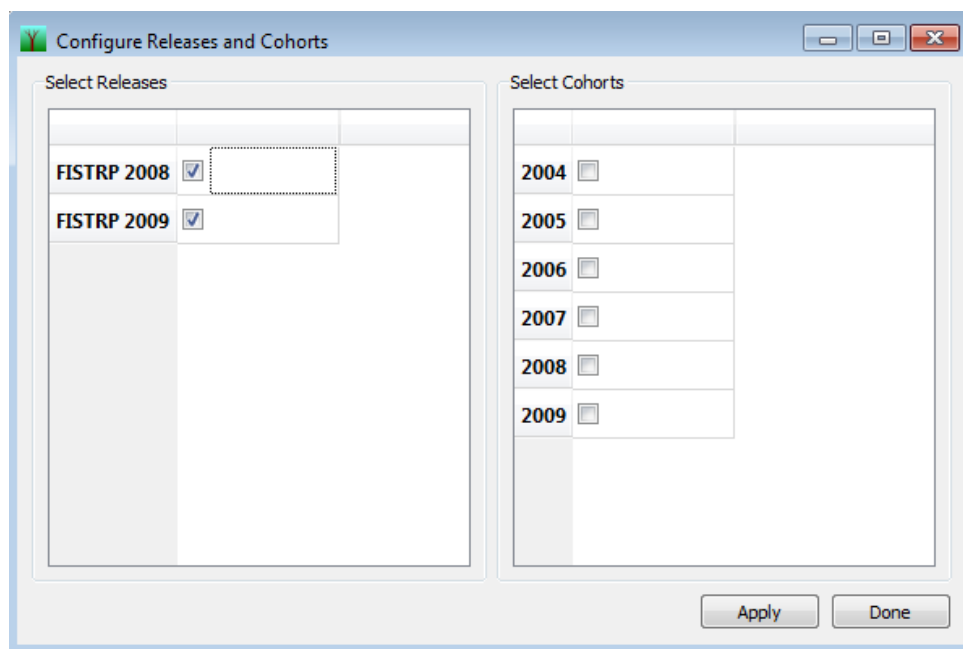


Figure 18. Dialog for configuring releases and cohorts.

On the left in the **Select Releases** column are the releases. By default, they are all selected to be included in the analysis. On the right in the **Select Cohorts** column are the cohorts as determined by the age data. By default, none of the cohorts are selected. The user can select one (and only one) cohort at a time to be included in the analysis. The analysis will assume all fish to be of the same cohort.

When any changes are made to the releases and cohorts to be used, the **Apply** button must be pressed to save those changes. The **Releases Summary** will then be updated to reflect the subset of fish to be used in subsequent analysis. For this example, the 2007 cohort is selected.

4.2 Configure Sites and Years

Section 1.4 describes the models created by Program TribPit for given scenarios of the data loaded in TribPit. Sometimes, even though TribPit creates a model, the data are too sparse to actually estimate the parameters for the model. The **Configure Sites and Years** section of Program TribPit allows the user to change the configuration to allow for parameter estimation. This is done by:

- 1 removing detection sites, causing all detections at the sites to be ignored,
- 2 removing detection years, causing all detections in those years to be ignored, and/or
- 3 setting an upstream site to be the last detection site. This causes all downstream detections to be pooled and treated as detections at the last site set by the user. The parameter estimate for this final reach will lack biological significance, but the reduction in the number of parameters to be estimated may improve the ability of TribPit to estimate upstream parameters of interest to the user.

4.2.1 Interpreting the diagrams

Figure 19 gives an example of the **Configure Sites and Years** dialog. Note that the **Configure Sites and Years** dialog always references a single cohort. Figure 19 references a 2007 cohort with two releases: (1) a release of yearlings in 2008 from location FISTRP labeled “FISTRP 2008” and (2) a release of two-year-olds in 2009 from the same location labeled “FISTRP 2009.”

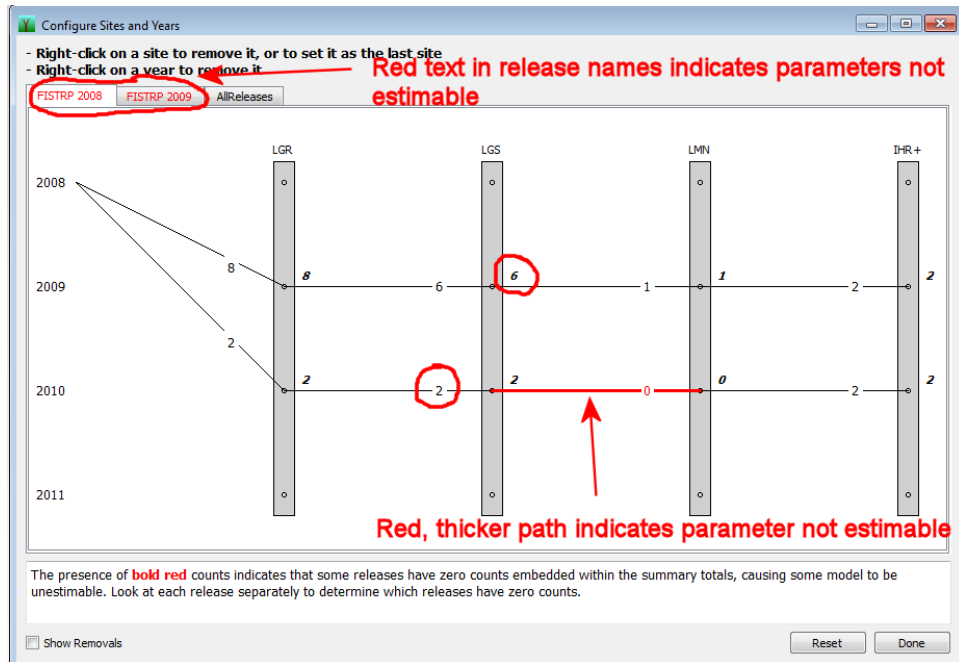


Figure 19. Example of a Configure Sites and Years dialog for a 2007 cohort.

The tabs along the top allow the user to look at each individual release, or the user can look at both releases together by selecting the **AllReleases** tab. In Figure 19, the “FISTRP 2008” tab is selected, illustrating the yearling release in 2008. Because this is the initial release, it is considered the primary release and the “FISTRP 2009” is considered an auxiliary release.

Some things to notice in this example:

- If the release name is red, it indicates that any model that estimates unique parameters for this release will not be estimable. In Figure 19, both the individual release names are in red, but the **AllReleases** tab is not. This means that the only model that may be estimable is the one that combines parameters across both releases (both the capture parameters and the survival and movement parameters).
- The “FISTRP 2008” tab is selected, showing the configuration for that release. Each row represents a year, and each shaded vertical bar represents a detection site. In this example, the years 2008 through 2011 are present in the data as

either release years and/or detection years. The first detection site is labeled “LGR” (Lower Granite Dam), the second “LGS” (Little Goose Dam), and so on. Notice that the fourth and final detection site is labeled “IHR+.” The + indicates that there are downstream detection sites after Ice Harbor Dam that the user has already configured to be pooled with detections at Ice Harbor.

- The narrow diagonal and horizontal lines represent paths that fish were observed to follow. The number in the center of the paths indicates the number of individuals known to have traveled that path and were detected at the end site of the path. For example, two fish were known to survive and migrate from LGR to LGS and were detected at LGS in 2010 (circled in Figure 19).
- The bold, italicized numbers at each detection site show the number detected at that site and year. For example, six fish were detected at the site LGS in the year 2009 (circled in Figure 19).
- The path from LGS to LMN (Lower Monumental Dam) in 2010 has zero counts, making the survival and movement parameter for that path unestimable. Program TribPit thus highlights this path by making it thicker and in red. This is why any model that has unique parameters for this release is unestimable.
- There are no paths for the year 2008. This is because there were no detections for this release in 2008, and Program TribPit thus removes that branch from the model. The same is true for the year 2011. 2011 is included because even though there are no detections in 2011 for this particular release, there were detections in 2011 for other data currently loaded in TribPit.
- The numbers in the paths indicate the number of fish *known* to have traveled that path and were detected at the end site of the path, *known* according to the assumptions of the models. In the example in Figure 19, the diagram indicates that six fish traveled from LGR to LGS in 2009. This does **not** mean that all six fish were necessarily detected at LGR and then at LGS in 2009. It is possible that some of those six fish were released in 2008 and then next detected at LGS. It’s also theoretically possible that they traveled through LGR in 2008 undetected

and then migrated and survived to LGS in 2009. But since we did not observe any fish along that path, we cannot estimate the parameters for that path. Thus, Program TribPit must assume that they traveled along the only observed paths to arrive at LGS in 2009.

Figure 20 shows another example of a study with three releases of a cohort in three consecutive years: 2009, 2010, and 2011.

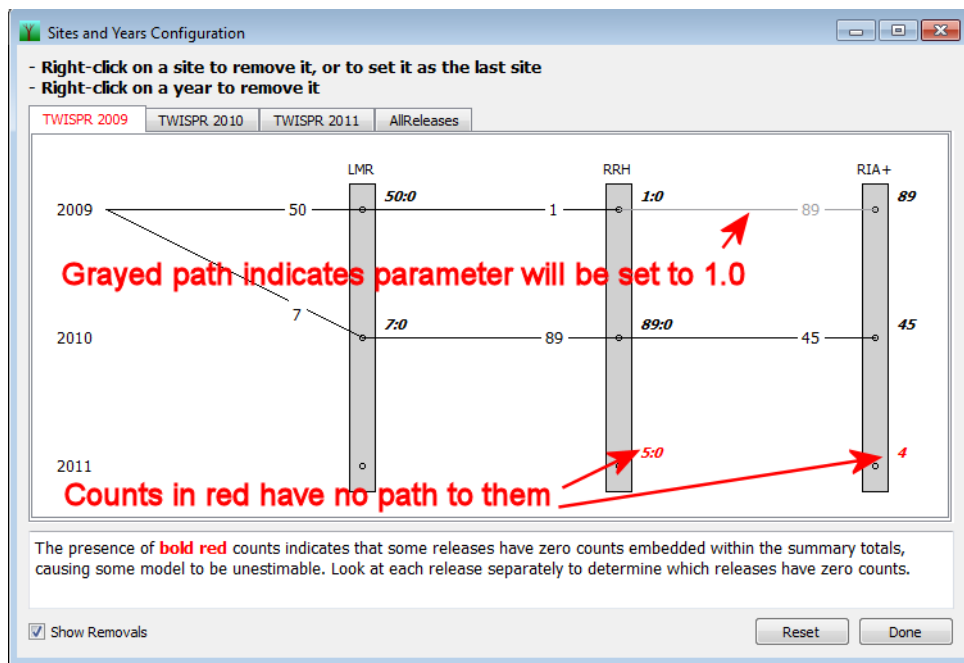


Figure 20. Configure Sites and Years dialog illustrating removals at detection sites.

In the case of Figure 20, the **Show Removals** checkbox is checked, thus showing the number of removals after the colon (:) at each detection site and year. For example, at LMR (Lower Methow River instream PIT-tag array) in 2009, 50 fish were detected, none of which were removed.

- The counts at RRH (Rocky Reach Dam) and RIA+ (Rock Island Dam + further downstream sites) in 2011 are in red, because there is no observed path to these sites and years. No counts were observed from release to LMR in 2011, or from LMR in 2010 to RRH in 2011. Program TribPit cannot estimate parameters for

unobserved paths and, thus, cannot create a model that includes the 2011 counts. The counts are in red because they cause any model that estimates unique parameters for the TWISPR 2009 release to be unestimable.

- The path from RRH to RIA+ in 2009 is grayed out. This is because the single fish detected at RRH in 2009 was also detected at RIA+ in 2009 and trying to estimate the survival and movement parameters along that route would cause numerical problems (i.e., estimating parameters on the boundary of the parameter space results in an error in the optimization routine). Program TribPit thus removes the final survival and movement and detection parameter and uses a fixed value of 1.0 (with standard error of 0.0) to avoid estimation problems. This example also demonstrates challenges that can arise due to sparse detection data.

Figure 21 shows the same cohort and releases with the **AllReleases** tab selected. This shows the counts for all of the releases of the given cohort.

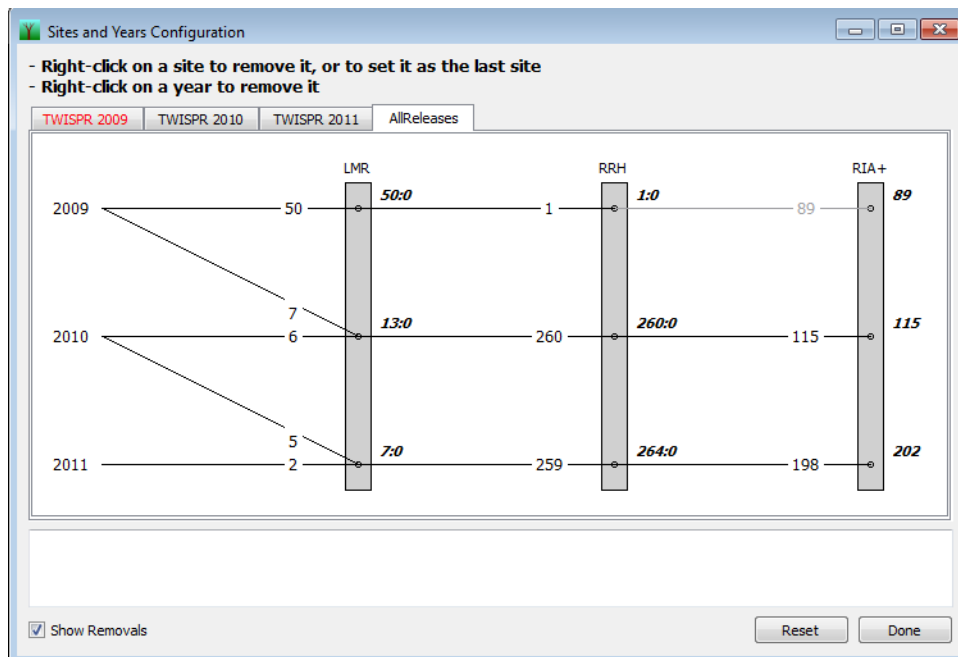


Figure 21. Configure Sites and Years dialog showing the AllReleases tab for combined releases.

Figure 22 shows another example where a path indicates a parameter is fixed to 1.0.

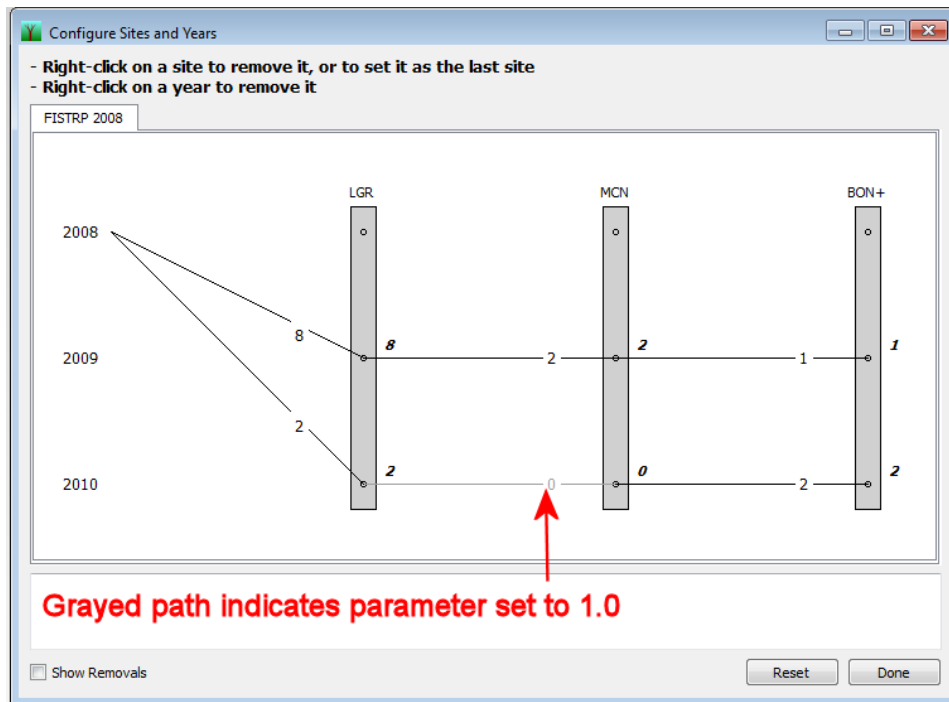


Figure 22. Configure Sites and Years dialog illustrating pathways with parameters fixed at 1.0.

In Figure 22, there are no detections at MCN (McNary Dam) in 2010, but there are detections downstream at BON+ (Bonneville Dam + further sites downstream). Due to the configuration of this model, we know that the two fish detected at BON+ had to travel from LGR to MCN in 2010. Thus, Program TribPit fixed the LGR-MCN survival and movement parameter at 1.0, and the detection parameter at MCN in 2010 at 0.0, and the model is still theoretically estimable (disregarding the sparse data in this case).

In the example in Figure 23, there are 65 detections at TWR (Lower Twisp River detection site) in 2010, but no observations downstream of TWR in 2010. However, this does not make the parameters in the releases unestimable because there is another path observed downstream from TWR in 2010—the path to RRH in 2011. Thus, Program TribPit simply removes the downstream paths for year 2010.

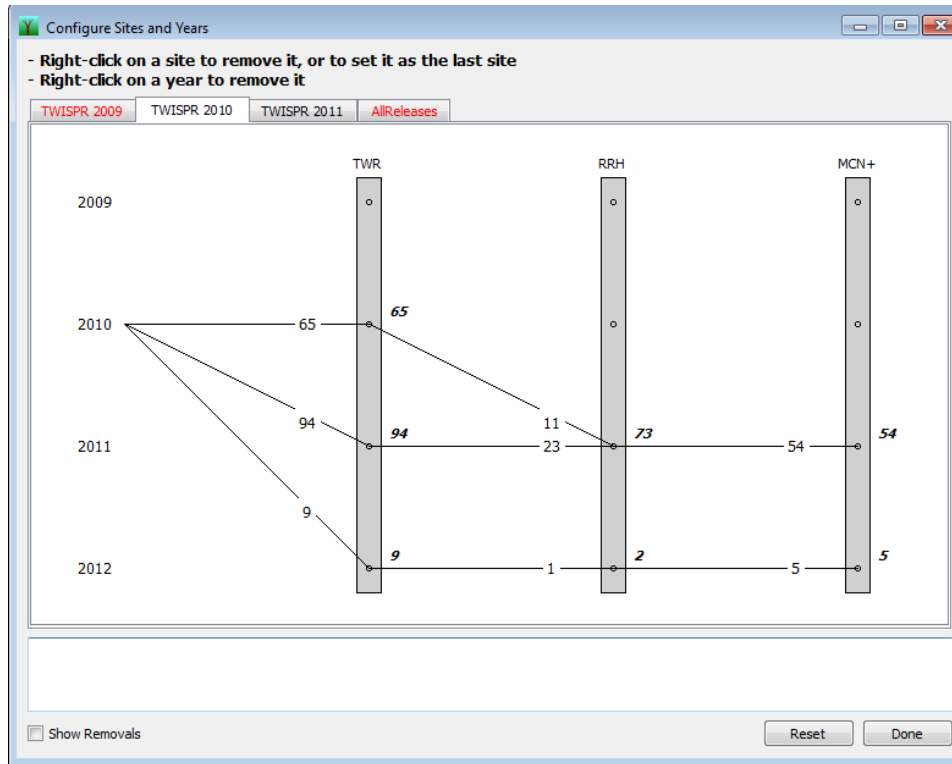


Figure 23. Configure Sites and Years dialog illustrating unnecessary downstream paths removed.

Contrast the last example with Figure 24. In this case, there are 34 fish detected at TWR in 2009, and there are no downstream detections in 2009. But since there are no other observed paths downstream from TWR in 2009, Program TribPit leaves the downstream paths in 2009, and makes them thicker and red to indicate that they render any model that estimates unique parameters for this release unestimable.

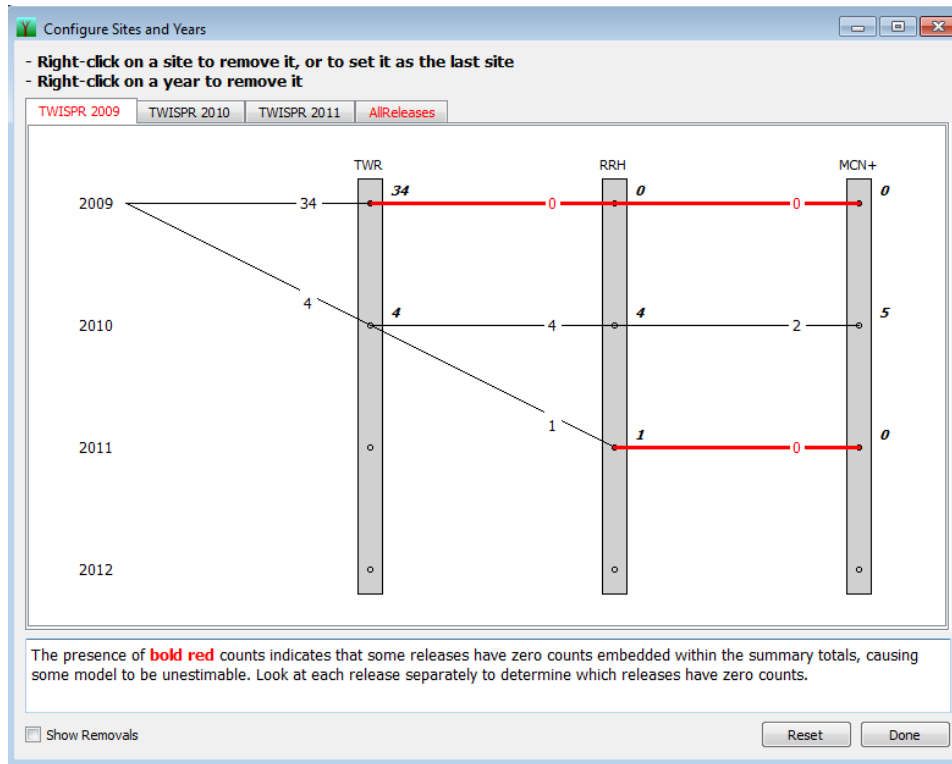


Figure 24. Configure Sites and Years dialog illustrating missing downstream counts.

Finally, we look at a hypothetical example where there are multiple releases of a single cohort, both from different sites and different years. This is a 2007 cohort with two releases of yearlings in 2008—one from FISTRP (“FISTRP 2008”) and another from LGR (“LGR 2008”)—and one release of two-year-olds in 2009 from LGR (“LGR 2009”). Because the “FISTRP 2008” is the earliest and most upstream release, it is considered the primary release, and the others are auxiliary releases. Figure 25 shows the **Configure Sites and Years** dialog for the data.

As with the other examples, there is a tab for each release and an **AllReleases** tab for the combined releases. With multiple release sites and multiple release years, however, there are additional tabs with label beginning with **AllReISites_** and **AllReIYears_**. For example, the tab, “AllReISites_2008” shows the configuration and combined counts for all releases in the year 2008. Similarly, the tab “AllReIYears_LGR” shows the configuration and combined counts for all releases from the LGR site.

This allows the user to see if models that combine parameters across sites and across years are estimable.

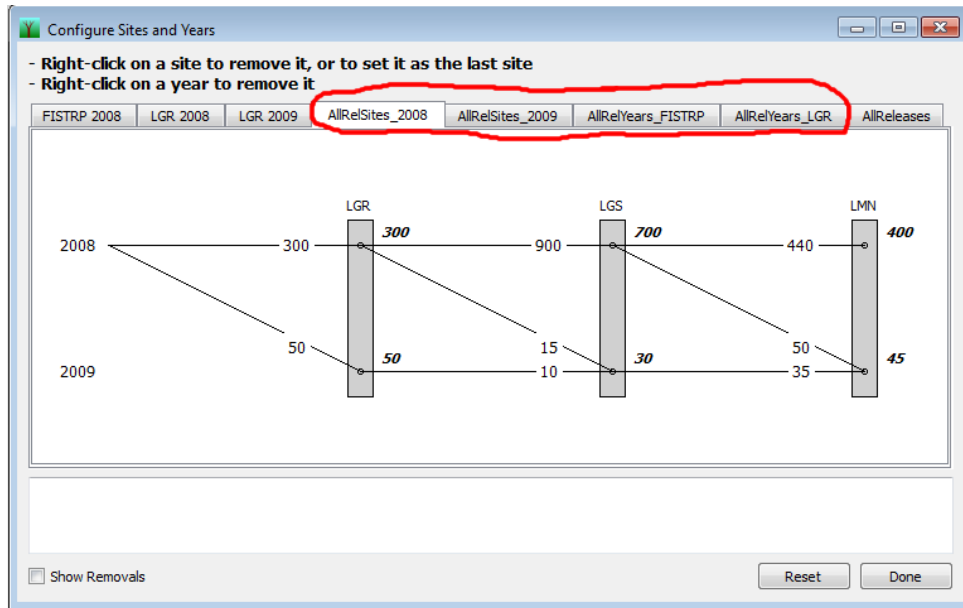


Figure 25. Configure Sites and Years dialog with simulated releases from multiple sites and multiple years.

4.2.2 Changing the sites and years configuration

Figure 26 shows the left portion of the **Configure Sites and Years** dialog after some data are loaded with the **AllReleases** tab selected. Notice that there are no detections at the LTP site, and only four detections at LMR. The ability to estimate parameters will be improved by removing these two sites.

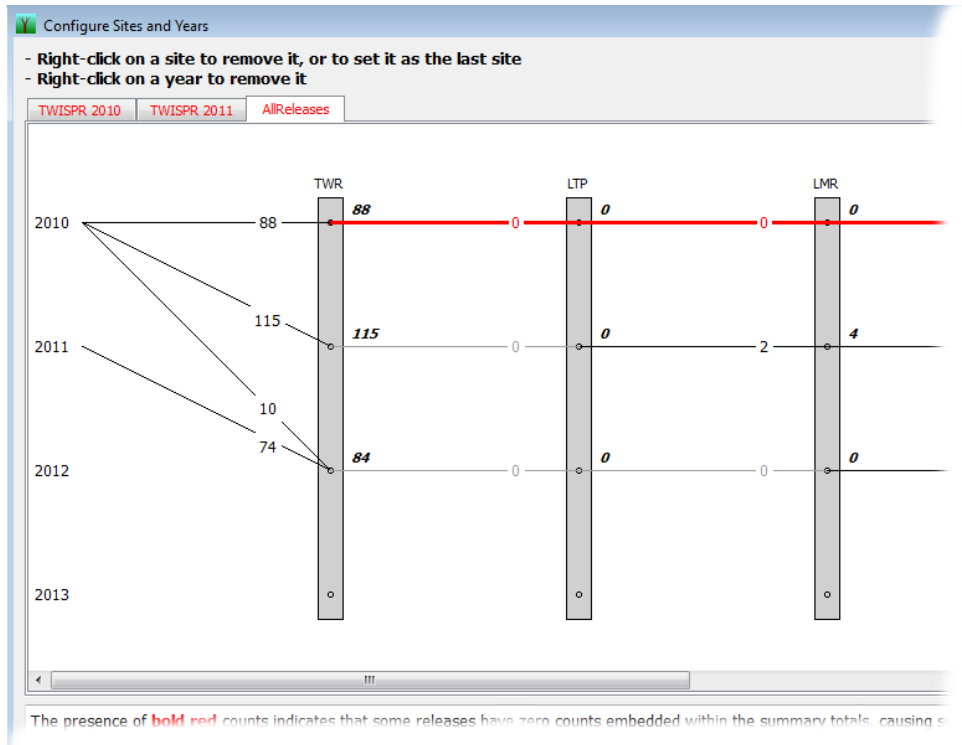


Figure 26. Configure Sites and Years dialog in initial state.

Right click anywhere on the gray column representing LTP and select “Remove site LTP” from the popup menu, as shown in Figure 27. The diagram will then be updated with LTP removed. In the same way, right- click on the LMR site and select “Remove site LMR.”

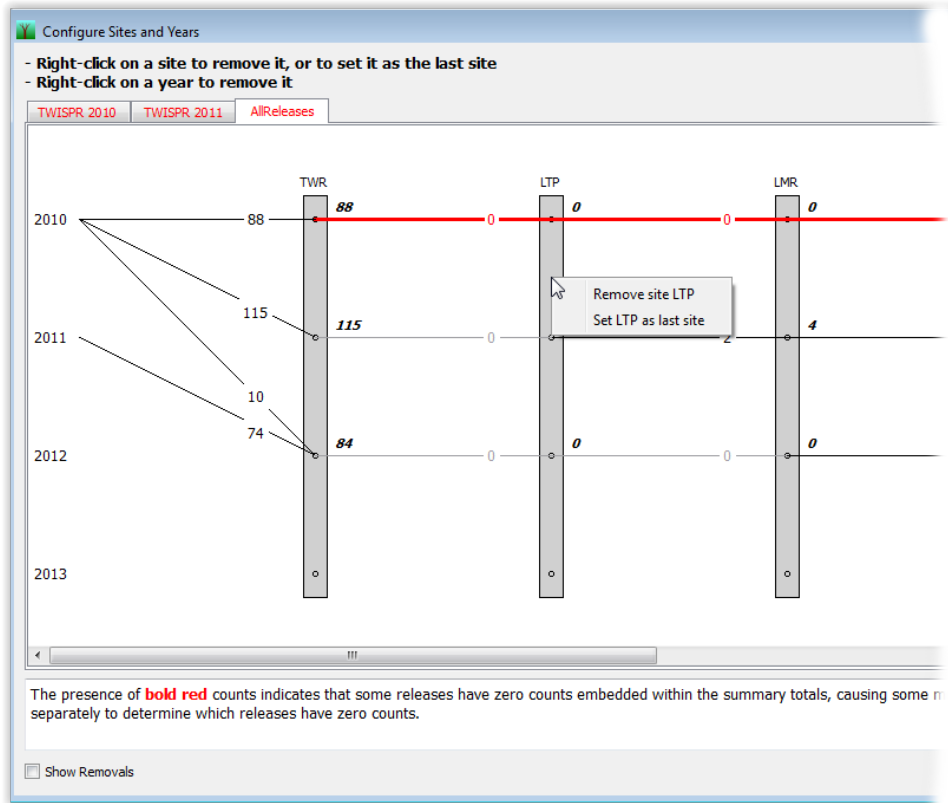


Figure 27. Removing a site in the Configure Sites and Years dialog.

The diagram should now appear as shown in Figure 28.

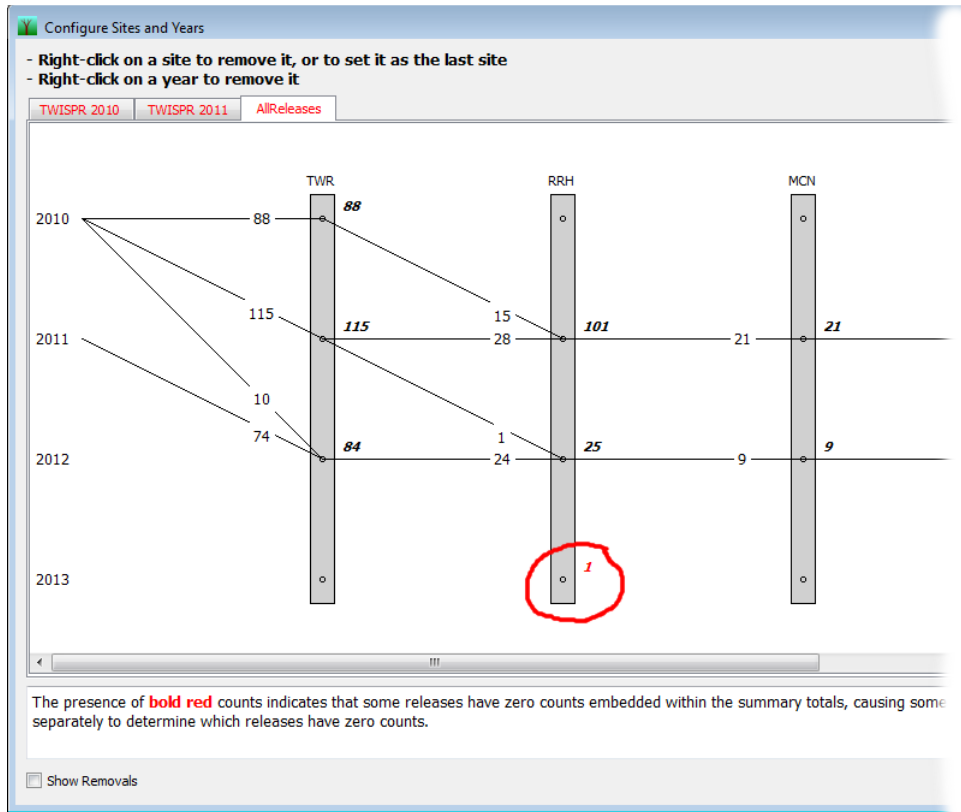


Figure 28. Configure Sites and Years dialog after removing two sites.

All the tabs are still red, showing that there are no estimable models. The problem is the single detection in 2013, circled in Figure 28. There is a detection there, but no observed paths leading to that detection. This can be rectified by removing the year 2013 from the analysis.

Right-click on the “2013” label on the left and select “Remove year 2013” from the popup menu, as shown in Figure 29.

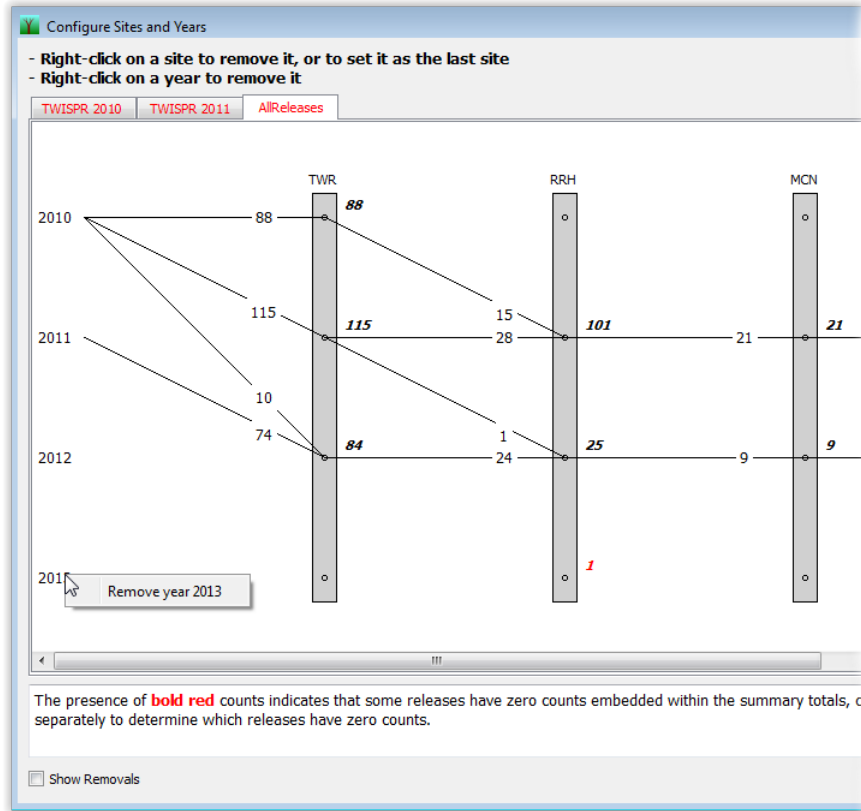


Figure 29. Removing a year in the Configure Sites and Years dialog.

At this point, the **AllReleases** tab should appear as shown in Figure 30. The **AllReleases** tab and the “TWISPR 2011” are no longer red, but the “TWISPR 2010” is red. This indicates that the model combining parameters across releases will be estimable, but the models that use unique parameters for individual releases will not be estimable.

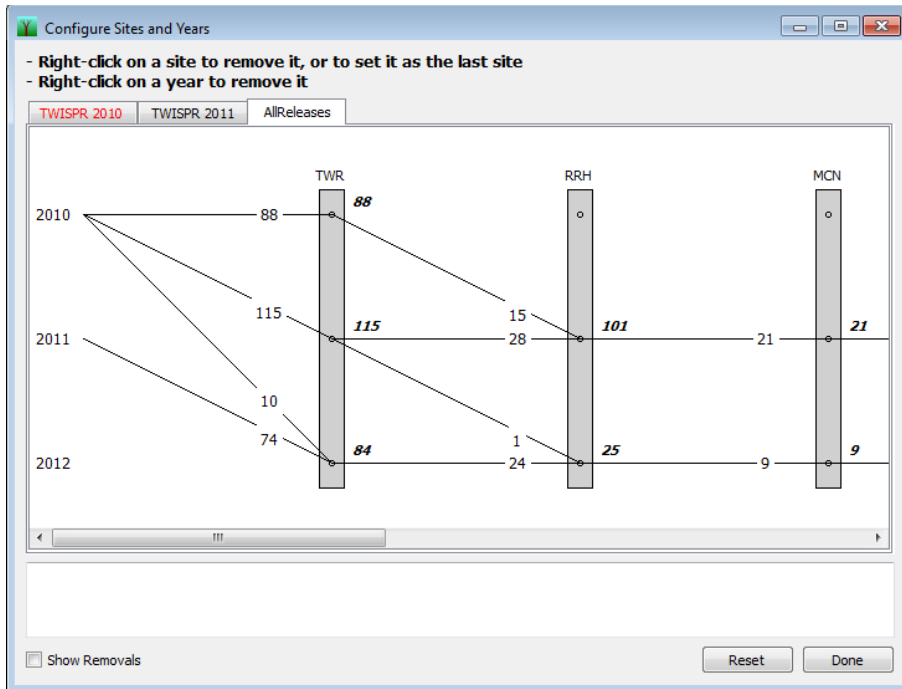


Figure 30. Configure Sites and Years dialog after removing sites and years.

If we select the "TWISPR 2010" tab and scroll all the way to the right, it appears as shown in Figure 31.

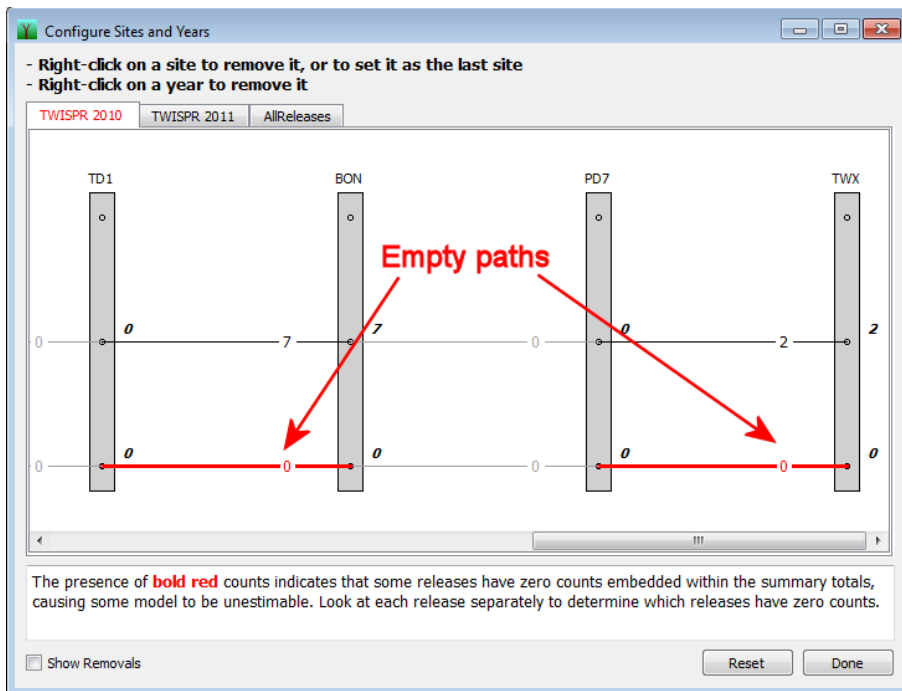


Figure 31. Configure Sites and Years dialog with empty paths downstream.

Notice that the paths for year 2012 between detection sites TD1 and BON, and between detection sites PD7 and TWX, have zero counts and are in red. In this case, the user is not interested in estimates this far downstream—only in survival to the first site, TWR. To get survival and movement estimates to TWR, we need at least one detection site beyond TWR—namely, RRH. So now scroll back to the left portion of the diagram, click on the RRH site and select “Set RRH as the last site” from the popup menu as shown in Figure 32.

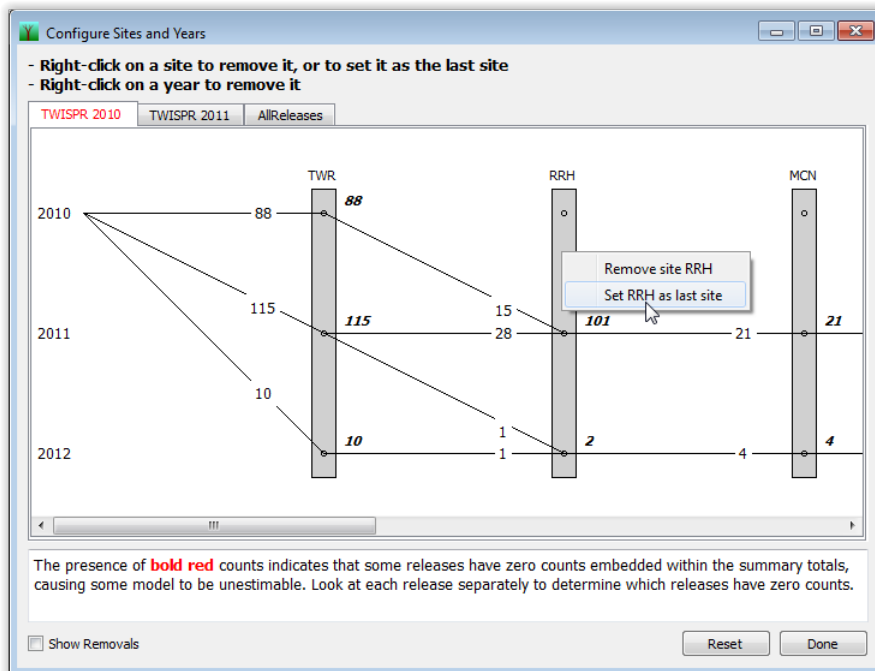


Figure 32. Setting the last detection site in the Configure Sites and Years dialog.

The diagram should now appear as shown in Figure 33 with no red tabs, indicating all available models should now be estimable.

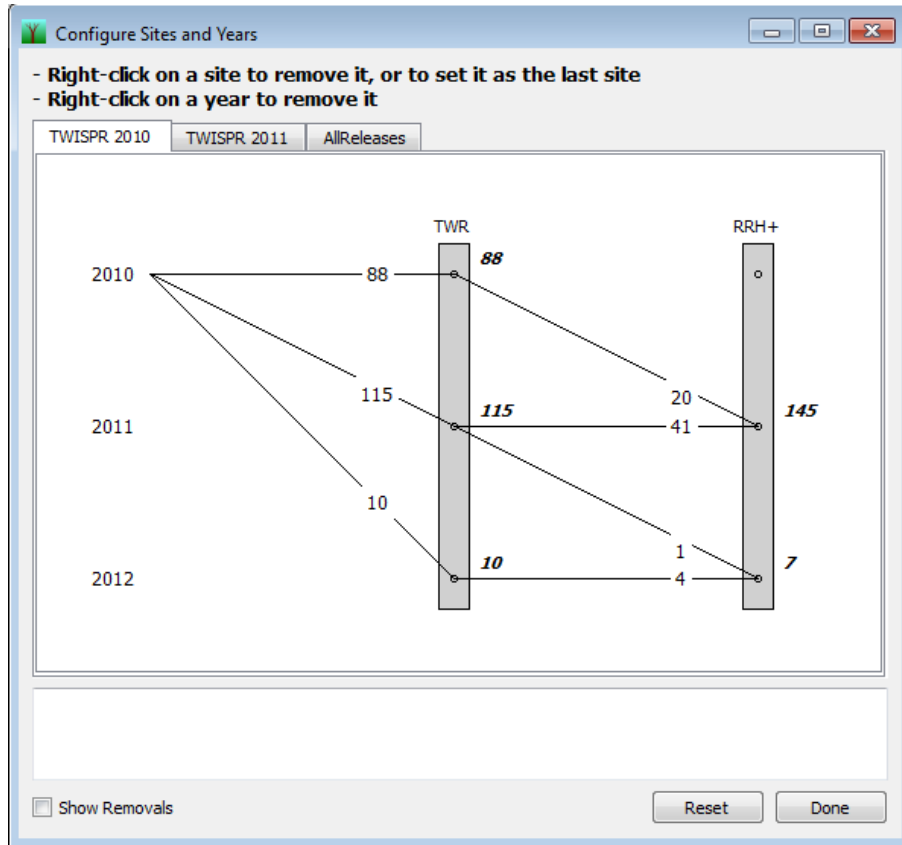


Figure 33. Configure Sites and Years dialog after setting the last site.

The + after “RRH” indicates that this site includes detections from multiple sites downstream of RRH.

Figure 34 shows an example of another situation that may occur. There are no detections at the first detection site CLJ and, thus, no observable paths to any of the downstream detection sites. The CLJ site appears because it is in the data file that has been loaded, but not in the cohort data selected for analysis. This situation can be remedied by simply removing the CLJ site, and the diagram will appear as in Figure 35. The release tab labels are still red, indicating that additional configuration is needed.

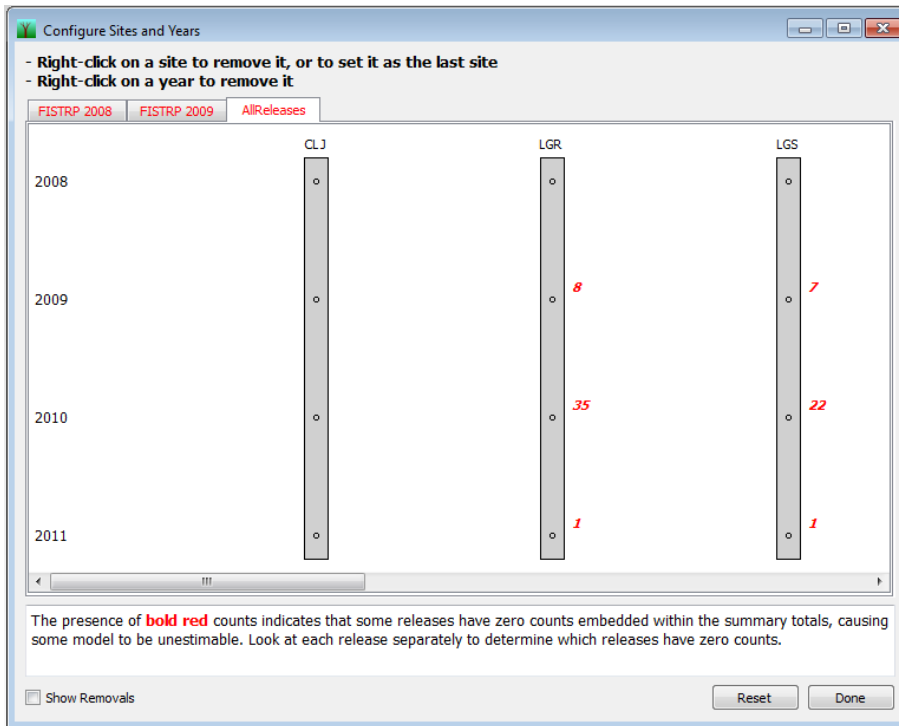


Figure 34. Configure Sites and Years dialog with no detections at the first site.

Note that release sites cannot be removed, nor can release years be removed. Also, the initial detection site cannot be set as the last detection site because Program TribPit requires at least two downstream detection sites.

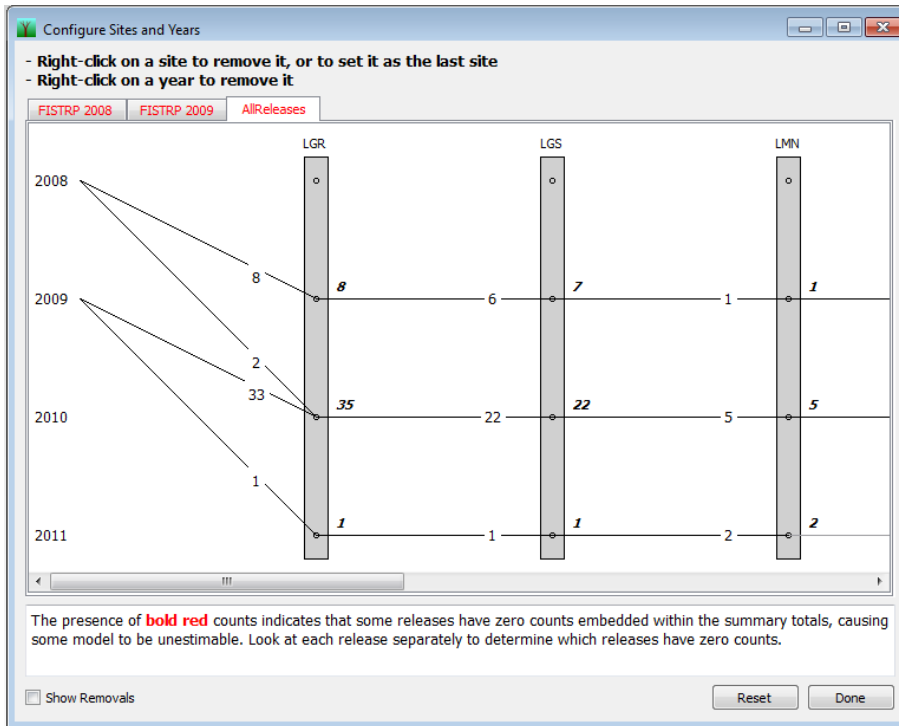


Figure 35. Configure Sites and Years dialog after removing the first site with no detections.

4.2.3 Resetting the sites and years configuration

If the user wants to undo changes made to the configuration, the user simply presses the **Reset** button in the lower right of the **Configure Sites and Years dialog** to restore the configuration to the initial state.

Chapter 5: Estimation and Results

Once the user has finished configuring the sites and years, the user can double-click on **Fit All Models** on the **Navigation Panel** to estimate the parameters. The output from the estimation process is displayed in the **Output** portion of the TribPit dialog (Figure 36). **Fletch** refers to the optimization routine used to maximize the log-likelihood and obtain the parameter estimates.

```
-----  
Estimating ...  
  
Fitting model M.s.1A  
Fletch, beginning function value: 2524.87496936  
Fletch, ending function value: 148.080144677, number of iterations: 171  
Re-estimating using previous estimates as seeds...  
Fletch, beginning function value: 148.080144677  
Fletch, ending function value: 148.080144677, number of iterations: 2  
Error estimating covariance matrix: Singular Hessian in calculating covariance matrix  
  
Fitting model M.s.2A  
Fletch, beginning function value: 2524.87496936  
Fletch, ending function value: 157.356508752, number of iterations: 73  
Re-estimating using previous estimates as seeds...  
Fletch, beginning function value: 157.356508752  
Fletch, ending function value: 157.356508752, number of iterations: 2
```

Figure 36. Example of output during the Fit All Models process

Information displayed in the output includes:

- the model ID currently being fitted,
- the beginning and ending negative log-likelihood function values
- the number of iterations used to converge to a maximum likelihood value. and.
- whether or not the covariance matrix is available.

In Figure 36, the text **Error estimating covariance matrix** indicates that the standard errors will not be available for the estimates for model M.s.1A and thus that results for model M.s.1A should not be trusted. For model M.s.2A, there is no such message, and the standard errors will be available.

Once the estimation process is complete, the **Model Comparison** window will be displayed. It can also be displayed at any time subsequent to fitting the models by double-clicking on **Model Comparison**.

5.1 Model Comparison Window

Figure 37 shows the **Model Comparison** window for multiple releases from different sites. The headings in bold describe the parameterizations of the capture parameters for all models beneath the heading.

Name	Delta AIC	Num Params	Ln Likelihood
Capture: All release sites unique			
M.s.1A: Survival and movement: All release sites unique	88.5426	19	-148.0801
Capture: Equated across all release sites			
M.s.2A: Survival and movement: All release sites unique	65.9899	17	-157.3565
M.s.2B: Survival and movement: Equated across all release sites	0.0000	12	-185.3514

Figure 37. Model Comparison Window for releases from different sites

The columns in the Model Comparison window are:

- 1 the name of the model (the Model ID), followed by a brief description of the model,
- 2 the ΔAIC (delta AIC), which is the deviation of the AIC from the best model. The best model—the one with the lowest AIC — is given the value 0.0, and all other AICs are presented as deviations from that model. In Figure 37, model M.s.2B has the best AIC. Note the actual AIC can be found in the headers of the reports as shown in Section 5.3.1,

- 3 the number of parameters, and
- 4 the log likelihood.

The model with the best AIC is highlighted with a yellow background. All subsequent reports and graphical results will be for the best model.

Figure 38 shows another example of the **Model Comparison** window. In this case, there were multiple releases in different years. However, two of the models were not estimable. The text **Non-Est.** is used when models are not estimable, typically due to sparseness of data.

Name	Delta AIC	Num Params	Ln Likelihood
Capture: All release years unique			
M.y.1A: Survival and movement: All release years unique	<i>Non-Est.</i>	<i>Non-Est.</i>	<i>Non-Est.</i>
Capture: Equated across all release years			
M.y.2A: Survival and movement: All release years unique	<i>Non-Est.</i>	<i>Non-Est.</i>	<i>Non-Est.</i>
M.y.2B: Survival and movement: Equated across all release years	0.0000	12	11.4988

Figure 38. Model Comparison window with some available models not estimable.

5.2 Graphical Results

Once estimation is complete, the user can double-click on **Graphical Results** on the **Navigation Panel** to bring up a graphical display of the survival and movement parameters estimates for the best model (the one with delta AIC of 0.0).

The user may look at the results of the suboptimal models by turning on **Expert Mode**, as explained in Section 5.4.

An example of the **Graphical Results** dialog from simulated data is shown in Figure 39. The tabs at the top allow the user to select the release of interest. The point estimates are given on the path lines on the diagram. On the bottom half are the point estimates with their standard errors in parentheses.

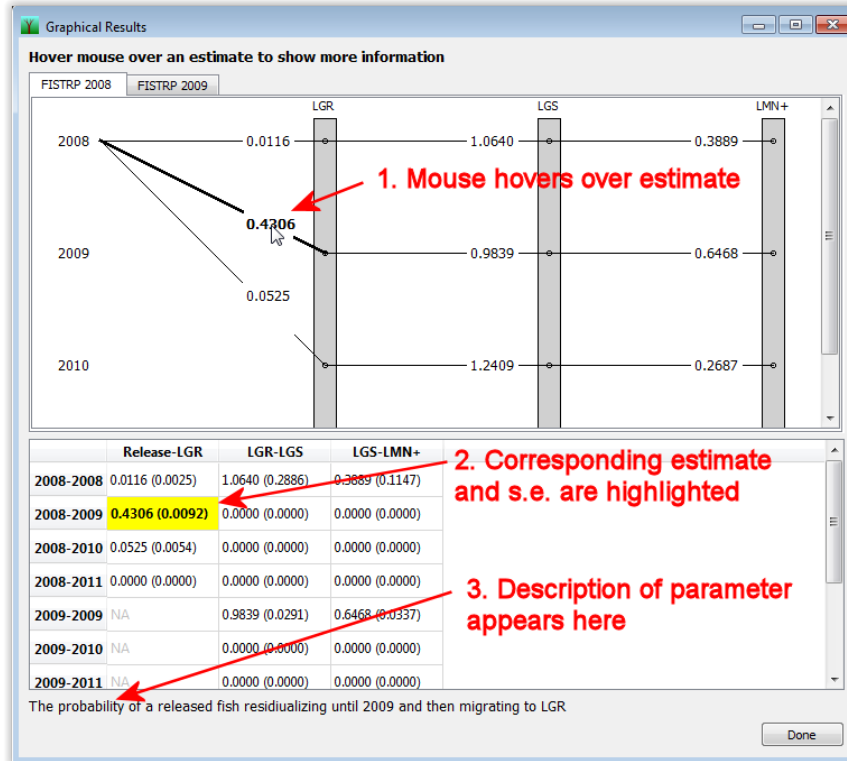


Figure 39. Graphical Results window.

The user may hover the mouse pointer over any result on the diagram, and the corresponding value in the table will be highlighted with bold text and yellow background. In addition, a description of the parameter will appear below the table.

5.3 Reports

Three reports are available after the estimates have been obtained and the model with the best AIC selected (or possibly a suboptimal model if **Expert Mode** is turned on): (1) **Survival and Movement Parameter Estimates**, (2) **Capture Parameter Estimates**, and (3) **Performance Measures**.

5.3.1 Report header

At the top of each of the reports is information about the currently selected model. An example is shown in Figure 40.

Survival and Movement Parameter Estimates

Releases:

FISTRP 2008
FISTRP 2009

Model: M.y.2B

Unique parameters for all reaches and detections sites. Parameters equated across release groups as follows:
Capture: Equated across all release years, Survival and movement: Equated across all release years.

Num releases: 2
Num sites: 4
Num years: 4
Num parameters: 22
Log-likelihood: -89.9557
AIC: -135.911

Figure 40. Header Information at the top of each report.

The information in the report header includes in order:

- 1 the names of the releases used for the estimates,
- 2 the Model ID,
- 3 a description of the model,
- 4 the number of releases,
- 5 the number of sites,
- 6 the number of years,
- 7 the number of parameters,
- 8 the log-likelihood, and
- 9 the actual AIC value, not the Δ AIC value.

5.3.2 Survival and Movement Parameter Estimates report

Figure 41 shows the body of the **Survival and Movement Parameter Estimates** report (excluding the header information at the top).

Estimates

Release: FISTRP 2008

Year		Reach	
Upstream	Downstream	Rel-LGR	LGR-LGS
2008	2008	0.0116 (0.0025)	1.0640 (0.2886)
2008	2009	0.4306 (0.0092)	0.0000 (0.0000)
2008	2010	0.0525 (0.0054)	0.0000 (0.0000)
2008	2011	0.0000 (0.0000)	0.0000 (0.0000)
2009	2009		0.9839 (0.0291)
2009	2010		0.0000 (0.0000)
2009	2011		0.0000 (0.0000)
2010	2010		1.2409 (0.2208)
2010	2011		0.0000 (0.0000)
2011	2011		0.0000 (0.0000)

Release: FISTRP 2009

Year		Reach	
Upstream	Downstream	Rel-LGR	LGR-LGS
2009	2009	0.0006 (0.0003)	0.9839 (0.0291)
2009	2010	0.5392 (0.0299)	0.0000 (0.0000)
2009	2011	0.0477 (0.0033)	0.0000 (0.0000)
2010	2010		1.2409 (0.2208)
2010	2011		0.0000 (0.0000)
2011	2011		1.1315 (0.1484)

Figure 41. Body of Survival and Movement Parameter Estimates report.

There is a table for each of the releases, showing all survival and movement parameter estimates for the selected model with the standard errors in parentheses. For example in Figure 41, the probability of a fish in the FISTRP 2008 release surviving and migrating to LGR in 2010 is 0.0525 with a standard error of 0.0054.

5.3.3 Capture Parameter Estimates report

Figure 42 shows the body of a Capture Parameter Estimates Report.

Estimates

Release: FISTRP 2008

Downstream	LGR	LGS
2008	0.3448 (0.0880)	0.3889 (0.1149)
2009	0.5921 (0.0136)	0.5457 (0.0199)
2010	0.2439 (0.0152)	0.1888 (0.0320)
2011	0.0000 (0.0000)	0.0000 (0.0000)

Release: FISTRP 2009

Downstream	LGR	LGS
2009	0.5921 (0.0136)	0.5457 (0.0199)
2010	0.2439 (0.0152)	0.1888 (0.0320)
2011	0.4380 (0.0341)	0.4348 (0.0634)

Figure 42. Body of Capture Parameter Estimates report.

As with the **Survival and Movement Parameter Estimates** report, there is a table for the detection probabilities for each release with the associated standard errors in parentheses. For example, for a fish of the FISHTRP 2009 release, alive at LGS in 2009, the probability of being detected at LGS in 2009 is 0.5457 with a standard error of 0.0199. Because the model equates capture parameters across release years, the same capture probability is estimated at LGS in 2009 for the FISTRP 2008 release.

5.3.4 Performance Measures report

The **Performance Measures** report gives several different meaningful metrics that are functions of the estimated survival and movement parameters, and capture parameters.

5.3.4.1 Overall Cohort Survival and Cohort survival by site location

Figure 43 shows the section of the **Performance Measures** report that reports the **Overall Cohort Survival** and the **Cohort survival by site location**.

Overall Cohort Survival

The overall cohort survival is the probability of an individual from the 2008 release group reaching the detection site furthest down-river.

Overall cohort survival: 0.5012 (0.0185)

Cohort survival by site location

Downstream survival by age-specific release group.

Release	Site	
	LGR	LGS
FISTRP Sub-Yearlings (2008)	0.4948 (0.0102)	0.5012 (0.0185)
FISTRP Yearlings (2009)	0.5874 (0.0299)	0.7236 (0.1115)

Figure 43. Overall Cohort Survival and Cohort survival by site location sections of the Performance Measures Report.

The **Overall Cohort Survival** is the probability that an individual from the primary release survives and migrates over time to the *furthest downriver* site. The primary release is the earliest and furthest upstream release. We can estimate survival only to the penultimate site—the site upstream from the furthest downstream site. In the example in Figure 43, there is one site downstream from LGS; thus, we can estimate survival only to LGS. Therefore, the *furthest downriver* site is LGS, and survival from release to LGS is reported as the overall cohort survival.

The table under the **Cohort survival by site location** gives the survival probability for each release to each downstream site. The overall cohort survival is emphasized in bold with yellow background (circled in Figure 43).

The calculations for survival to a site are shown in Appendix A.

5.3.4.2 Age Composition of Migrants by Site

Figure 44 shows the age composition of a cohort as they migrate past a detection site (**Age Composition of migrants by Site**). For those migrants that pass by each detection site, this table shows the estimated proportion by age class.

Age Composition of migrants by Site

Age	Site	
	LGR	LGS
Sub-Yearlings (2008)	0.0235 (0.0049)	0.0247 (0.0067)
Yearlings (2009)	0.8703 (0.0110)	0.8452 (0.0220)
2-Year-Olds (2010)	0.1062 (0.0102)	0.1301 (0.0217)
3-Year-Olds (2011)	0.0000 (0.0000)	0.0000 (0.0000)

Figure 44. Age Composition of migrants by Site section of the Performance Measures report.

The calculations for age composition are shown in Appendix A.

5.3.4.3 Down-River Survivals Below Residualization

Figure 45 shows the downriver survival estimates for each age class that passed the site of the last residualizing, or overwintering (**Down-River Survivals Below Residualization**). In the example in Figure 45, there was no residualization beyond LGR. This table will only be displayed if there are at least two detection sites beyond the site of the most downstream residualization.

Down-River Survivals Below Residualization

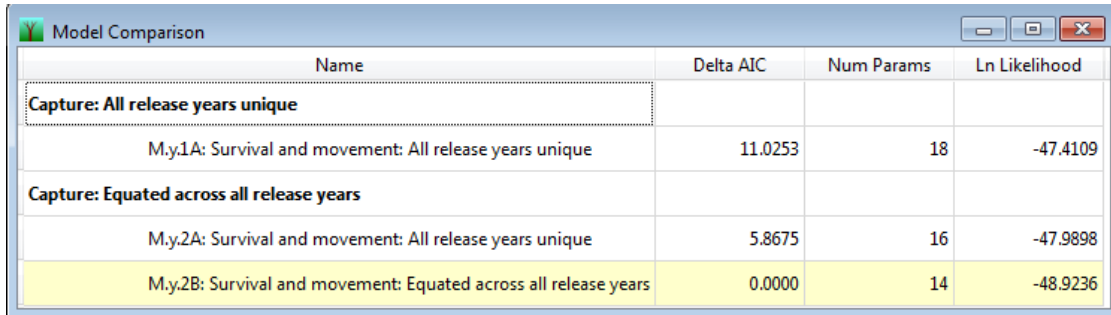
The probability that an individual alive at Lower Granite Dam in a given year survives and migrates to the furthest downstream site in the same year.

Release	Year at LGR	Survival estimate to LMN
FISTRP Sub-Yearlings (2008)	2008	0.6897 (0.2802)
	2009	0.9327 (0.0844)
	2010	0.8241 (0.0655)
FISTRP Yearlings (2009)	2009	0.9327 (0.0844)
	2010	0.8977 (0.0495)
	2011	0.8572 (0.1449)

Figure 45. Downriver Survival Below Residualization section of the Performance Measures report.

5.4 Expert Mode

By default, after fitting the models, the model with the best AIC is selected, indicated by the yellow background in the **Model Comparison** report, as shown in the example in Figure 46, where there are multiple releases in different years. All graphical results and reports are for the model highlighted in yellow.



Name	Delta AIC	Num Params	Ln Likelihood
Capture: All release years unique			
M.y.1A: Survival and movement: All release years unique	11.0253	18	-47.4109
Capture: Equated across all release years			
M.y.2A: Survival and movement: All release years unique	5.8675	16	-47.9898
M.y.2B: Survival and movement: Equated across all release years	0.0000	14	-48.9236

Figure 46. Model Comparison dialog for multiple releases in different years.

If the user would like to look at the results for other models besides the one with the best AIC, the user can do so by turning on expert mode. Go to the **Edit** menu, select **Settings**, and select the **General** tab. Then check the box labeled **Use expert mode – allow model selection** as shown in Figure 47.

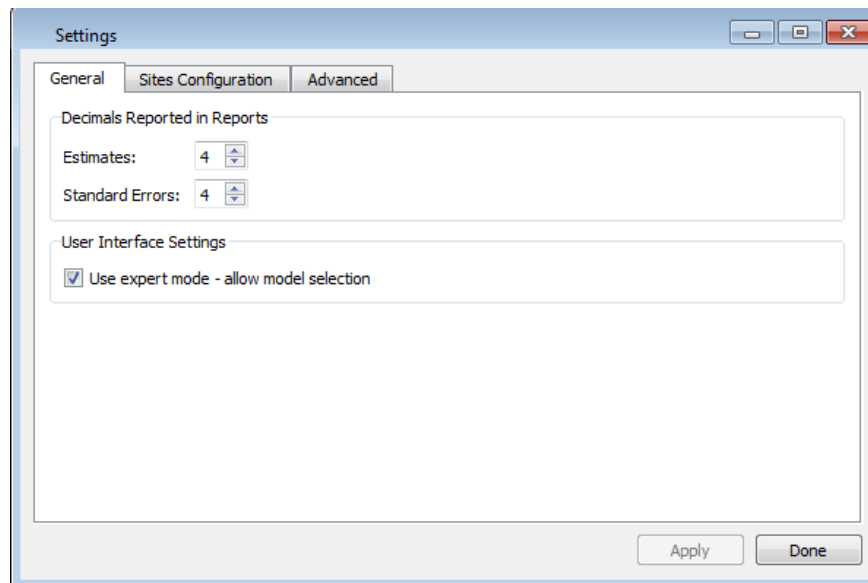


Figure 47. Turning on expert mode in the Settings dialog.

Then click the **Apply** button, and then the **Done** button. A new heading will appear in the **Navigation Panel**, labeled **Model Selection**, as shown in Figure 48.

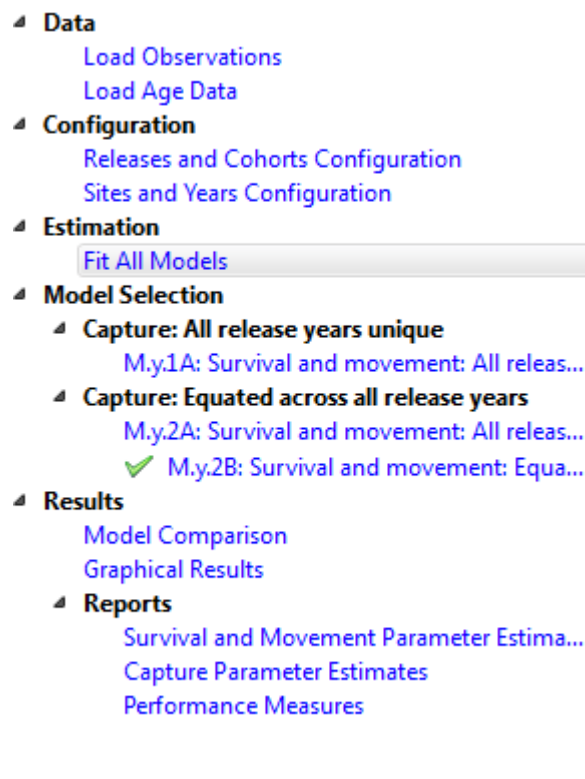


Figure 48. Navigation Panel with expert mode enabled.

A green check mark is next to the M.y.2B model, the one with the best AIC. To look at the estimates for one of the other models, say M.y.1A, simply double-click on it in the Navigation Panel, and green check mark will now be by M.y.1A, indicating that it is the currently selected model, as shown in Figure 49.

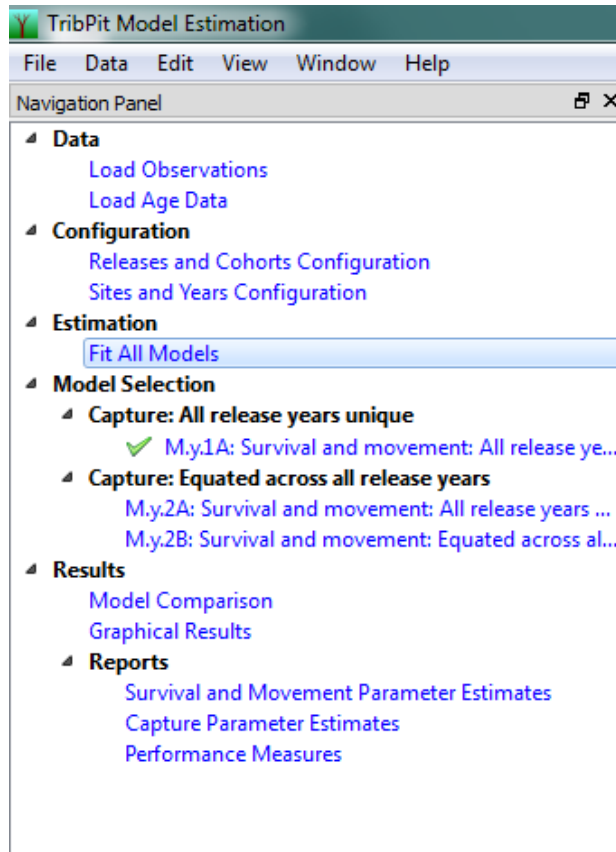


Figure 49. Navigation Panel with expert mode enabled and an alternative model selected.

The **Model Comparison** dialog will now appear as shown in Figure 50. The best model will still be highlighted in yellow, and the currently selected model will be highlighted in green. The graphical results and all the reports will now pertain to model M.y.1A.

Name	Delta AIC	Num Params	Ln Likelihood
Capture: All release years unique			
M.y.1A: Survival and movement: All release years unique	11.0253	18	-47.4109
Capture: Equated across all release years			
M.y.2A: Survival and movement: All release years unique	5.8675	16	-47.9898
M.y.2B: Survival and movement: Equated across all release years	0.0000	14	-48.9236

Figure 50. Model Comparison dialog with an alternative model selected.

Chapter 6: Diagnostic Tools

6.1 Next Detections

Program TribPit provides some diagnostic tools that can be used to better understand the data set. Go to the **Edit** menu, select **Settings**, and select the **Advanced** tab and check the checkbox labeled **Show Diagnostic Tools** as shown in Figure 51.

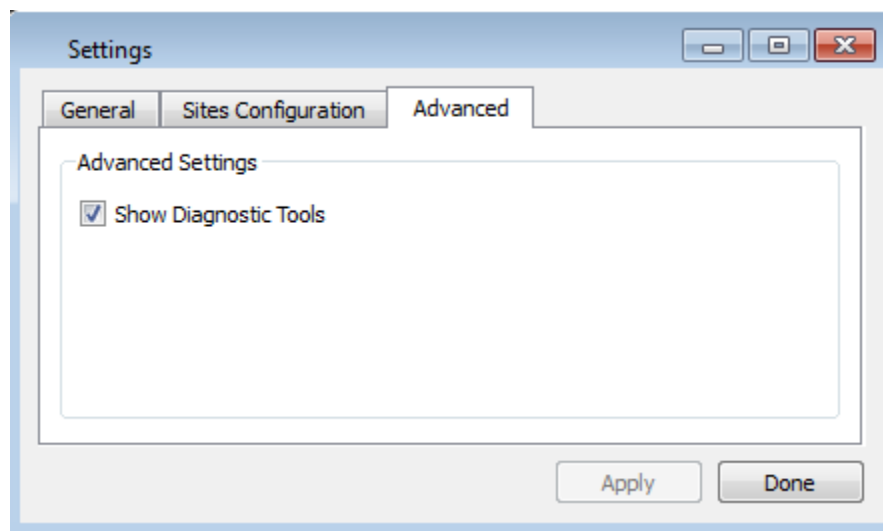


Figure 51. Turning on the Diagnostic Tools.

After clicking **Apply**, a new heading will appear in the **Navigation Panel** labeled **Diagnostic Tools**. as shown in Figure 52.

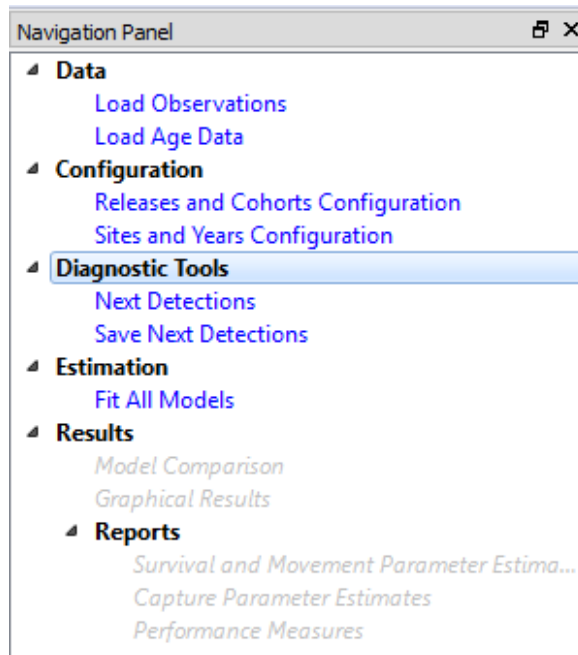


Figure 52. Navigation Panel with Diagnostic Tools enabled.

Double-click on **Next Detections** to bring up the **Next Detections** dialog as shown in Figure 53.

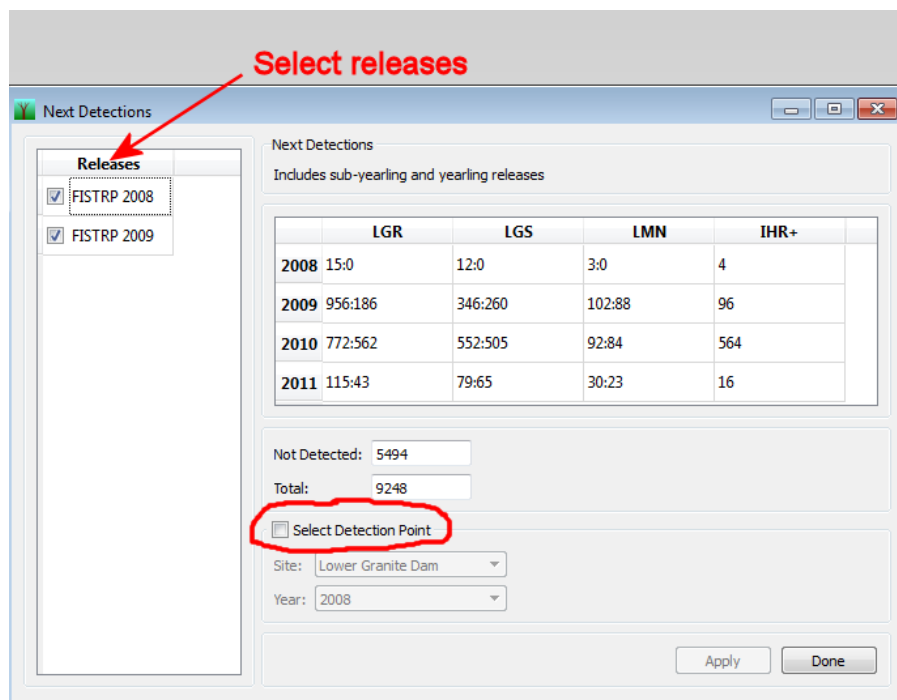


Figure 53. Next Detections dialog.

In the default mode, all releases are selected; the user can look at only one release by deselecting one of them. The **Select Detection Point** is cleared (circled), so we are looking at fish at the initial release. This dialog tells us, for example, that of the 9,248 fish released, 552 of these were next detected at LGS in 2010. Of these 552, 505 were removed (probably due to transportation). Of the 9,248 fish, 5,494 were never detected again.

If the **Select Detection Point** check box is checked, the user can select a **Site** and **Year** of interest. To look at subsequent detections for fish that were detected at Little Goose Dam in 2009, for example, check the **Select Detection Point** check box, choose “Little Goose Dam” for the Site and “2009” for the Year and press the **Apply** button. The result is shown in Figure 54.

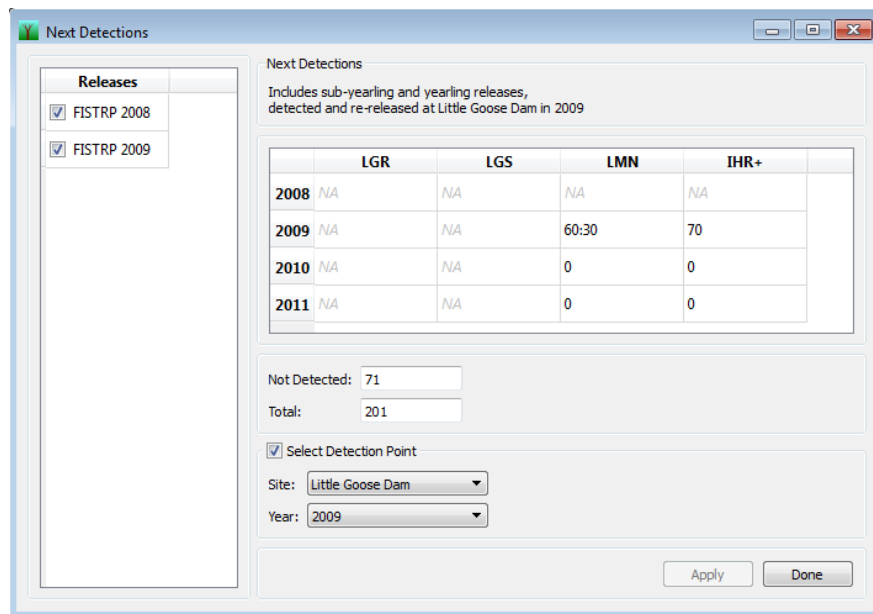


Figure 54. Next Detections dialog with a detection point selected.

This tells us that of the 201 fish detected and re-released (not removed) from Little Goose Dam in 2009, 71 were never detected again, 60 were next detected at LMN, 30 of which were removed, and 70 were next detected at IHR+.

The **Save Next Detections** action on the **Navigation Panel** allows the user to save the next detections data to a text file.

Appendix A: Performance Measures Calculations

This appendix shares the calculations of the performance measures in the Performance Measures Report (Section 5.3.4). The variances of these performance measures are calculated using the delta method.

A.1 Overall Cohort Survival and Cohort Survival by Location

Let S_{jk} be the probability of survival to site k in year j for a given cohort. Let j_0 be the release year, k_0 , the release site, and using the parameter definitions from Section 1.2,

$$S_{jk} = \phi_{k,j_0,j} \text{ for } k = k_0 + 1$$

$$S_{jk} = \sum_{m=j_0}^j \phi_{kmj} \times S_{m,k-1} \text{ for } k > k_0 + 1.$$

Now let S_k be the probability of survival to site k for a given cohort:

$$S_k = \sum_{j=j_0}^J S_{jk},$$

where J is the last observed detection year.

A2. Age Composition of Migrants by Site

Let A_{jk} be the age composition of a cohort at site k in year i :

$$A_{jk} = \frac{S_{jk}}{S_k}.$$

A3. Downriver Survival Below Residualization

Let K_R be the first downriver site beyond all observed residualization, let K be the furthest downriver site for which we can estimate survival (the penultimate detection site), and define S_{jK_R} be the survival from site K_R to site K in year j :

$$S_{jK_R} = \prod_{k=K_R+1}^K \phi_{kjj}.$$

