PitPro 4 USER'S MANUAL

PIT-TAG TO SURPH DATA TRANSLATION UTILITY

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Program PitPro 4: PIT-Tag Processor

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Chapter 1: Introduction

Program PitPro translates raw PTAGIS PIT-tag data into usable capture histories for programs SURPH and ROSTER. PitPro also provides a variety of reports, including an error report, a travel timetable, and program diagnostics for further analysis. The program logic is updated continuously based on the latest PTAGIS site configuration, ensuring accuracy.

PitPro can be obtained on the Columbia Basin Research PitPro webpage. You will also find the latest version of this documentation there, a revision history detailing the differences and upgrades from version to version, links to training videos, and sample data sets used in this manual and the training videos.

Chapter 2 provides an overview of PitPro and describes the user interface. Chapter 3 describes how to configure the program for specific data sets and output formats. Chapter 4 gives more details about the four types of data input files, while Chapter 5 describes the five types of output files. Chapter 6 demonstrates how to run PitPro and Chapter 7 describes the components of the Results Manager. Chapter 8 addresses how to check for program updates, Chapter 9 walks users through the decision logic, Chapter 10 addresses the site configuration file, and Chapter 11 provides information on the PitPro reports in PTAGIS. Acknowledgements are provided in Chapter 12.

Chapter 2: Overview and User Interface

2.1 Overview

PitPro uses four data files: the tagging and interrogation data files are required and the recapture and mortality data files are optional.

The tagging data define the release site and date, species, rearing type, and length for each tag (fish). Using these data, PitPro determines sample size, checks for errors, and can include a length covariate in the capture history files if requested.

The interrogation data provide the time and location of observations of study fish which are translated into capture histories. Based on these data, PitPro determines the "outcome" of a fish at each capture history site: returned to river, sampled, or transported. A capture history for a fish incorporates this information for each site in a sequential record of passage.

The recapture and mortality data are optional. Mortality data provide the time and location of any mortalities. Similarly, the recapture data provide the time and location of recaptures. These data are handled in the same way: a tag that was recaptured or listed as a mortality is flagged as removed and any subsequent observations (in the case of the recaptures) will be ignored. See "Chapter 4: Input Files" for more detail on input data files.

The main output of PitPro is the file of capture histories for each tag. The program provides one capture history for each tag in the tag group defined by the tagging data, excluding those removed for errors but including tags for which there were no detections. Tags with no detections are assigned a capture history of all zeros (not detected). The output file format can be selected to be compatible with SURPH or ROSTER.

PitPro can provide several other useful data files: an error file recording the reason for any removals, a travel time file with the travel time for each fish from release to each detection site (if release data are provided), a detection date file with the date and time of detection measured as Julian date and also including the release date, if provided, and a sequence file with detailed information useful in program diagnostics. The output files are explained further in “Chapter 5: Output Files.” PitPro allows the user to select configuration details via the tabs in the main program window. Many of the settings have defaults that apply to most situations. Two settings that are required are the **Input** and **Output** settings in the **Folders** section on the **Run Setup** tab (“Section 3.1.1 Folder selection”). The program will only be able to “see” data sets that are in this folder. Detection sites on the **Sites** tab will need to be added (see “Section 3.3 Sites”). In many cases this is sufficient preparation to select a data set in the **Run config** box (see “Section 3.1.2 Data and run configuration”), click the **Add Run** button, and run the program (see “Chapter 6: Running PitPro”).

A successful run with all other settings left as defaults will produce capture histories compatible with SURPH (version 2), with fields as defined on the **Sites** tab. PitPro will assume that all observations are of juvenile fish (see “Section 3.5 Adult Settings”). Note, however, that a new session of PitPro remembers some settings from the previous session, so it is recommended to review all settings before clicking the **Add Run** button. For more on configuring PitPro, see “Chapter 3: Program Configuration.”

2.2 User Interface

The PitPro graphical user interface includes a toolbar across the top, two widgets for running the program and getting context-specific help, a series of configuration tabs, and a **Status Messages** window. The toolbar at the top of the user interface includes five drop-down menus: **File**, **Edit**, **Sites**, **Output**, and **Help** (Figure 2.1). The options under the **File** menu allow the user to run the program or cancel a run, save a run configuration file, load a previously saved run configuration file, and exit the program. Under the **Edit** menu, the user can restore the default settings for all configurations.

Under the **Sites** menu, the user can select which sites configuration file to use, show the current sites configuration file, and check for sites configuration updates. The **Output** menu provides easy access to the **Results Manager**. The **Help** menu has options to check for updates to the program and to provide information about the current version of PitPro.

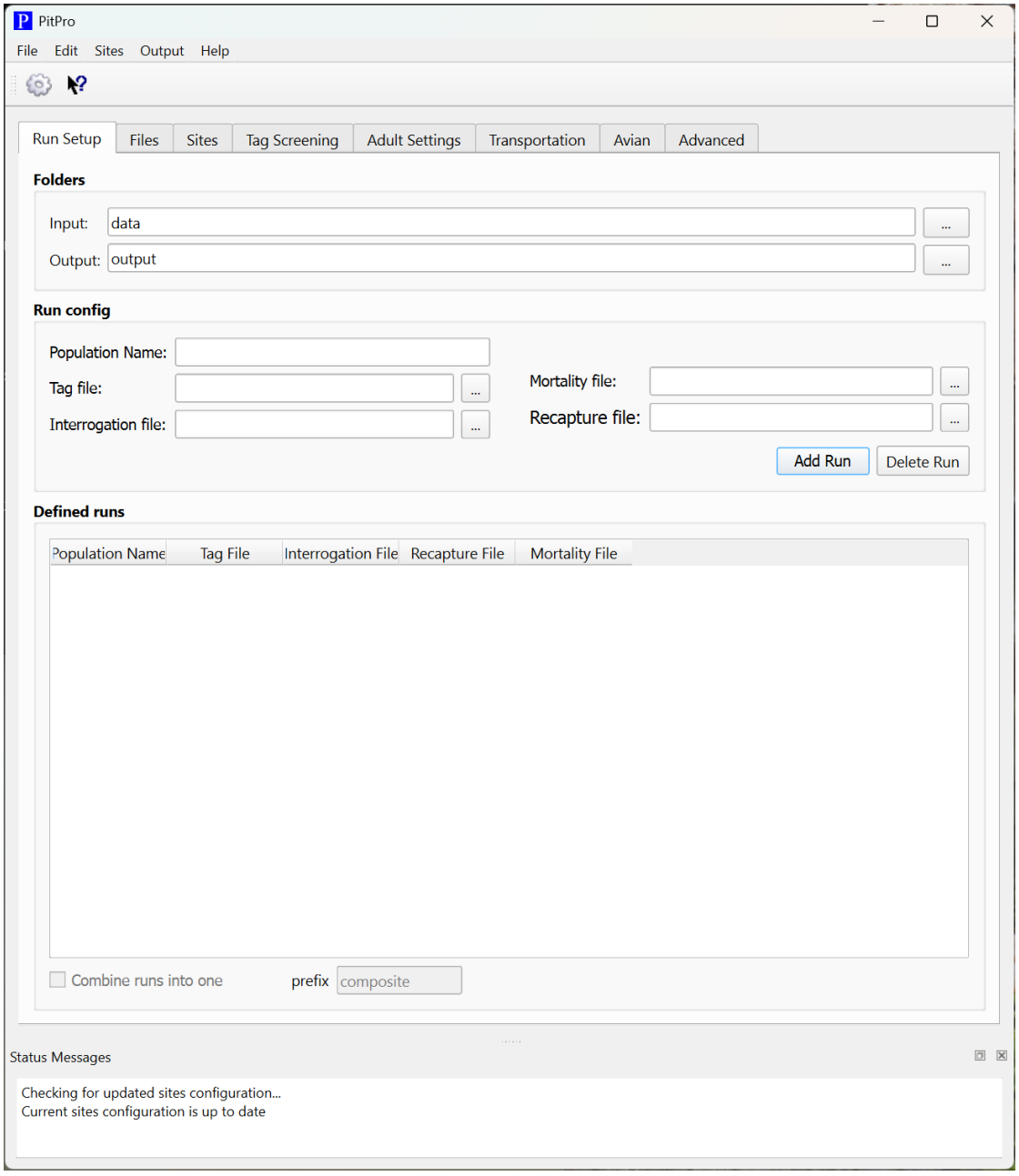


Figure 2.1. The PitPro user interface showing **File**, **Edit**, **Sites**, **Output**, and **Help** on the toolbar.

The configuration tabs in the user interface walk the user through the settings that must be configured for each run. These tabs are: **Run Setup**, **Files**, **Sites**, **Tag Screening**, **Adult Settings**, **Transportation**, **Avian**, and **Advanced**. Each of these settings is addressed in detail in Chapter 3.

PitPro version 4 includes context-specific help. To access this help, click on the **What's this?** icon on the program tool bar and then click on a specific program element. The **What's this?** icon is a mouse pointer with a question mark beside it.

Chapter 3: Program Configuration

The main program window contains a set of configuration tabs: **Run Setup**, **Files**, **Sites**, **Tag Screening**, **Adult Settings**, **Transportation**, **Avian**, and **Advanced**. By selecting the menus and inputs on these tabs, the program can be custom tailored to produce a user-specified analysis.

3.1 Run Setup

The **Run Setup** tab handles the definition of the runs including specifying the data files used. The tag file and interrogation file are required, while the mortality file and recapture file are optional (Figure 3.1). Multiple data sets can be processed either consecutively as individual runs or grouped together to produce a capture histories file with multiple populations. Multiple populations are not supported by ROSTER and should only be used when generating SURPH capture histories.

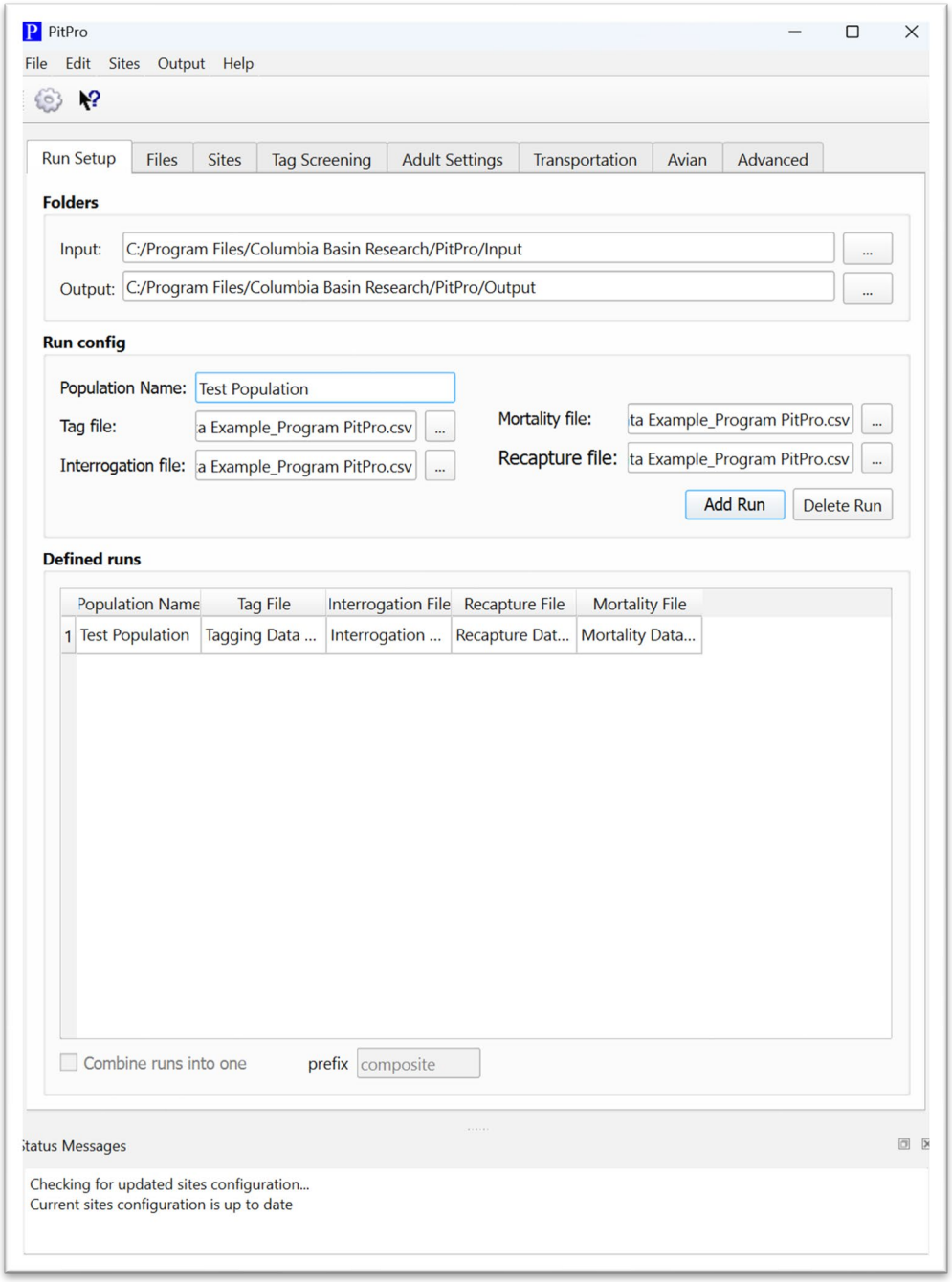


Figure 3.1. **Run Setup** tab.

3.1.1 Folder selection

The **Folders** box on the **Run Setup** tab allows users to select both which file directory PitPro will pull files from (**Input**) and which directory will store the files

generated by PitPro (**Output**). The **Output** folder is the directory searched by the results manager for output.

3.1.2 Data and run configuration

The data input files are selected through a series of menus in the **Run config** box. These menus will display only files that are found in the folder pointed to by the **Input** setting in the **Folders** section. A **Population Name** must be entered; all output files will include the **Population Name** in the file name. The user selects the tag file, interrogation file, mortality file, and recapture file by clicking on the button with the three dots ("**…**") next to each file type, selecting the appropriate .csv file, and clicking **Open**. The run is added to the **Defined runs** table by clicking the **Add Run** button.

3.1.3 Defined runs

The **Defined runs** table contains a list of all of the defined data sets that will be processed when the program executes. A defined run can be removed by selecting the row for the run and clicking on the **Delete Run** button.

3.1.4 Combining runs

Defined runs can be executed either consecutively, with separate output files, or grouped into a single run by checking **Combine runs into one**. When runs are executed consecutively, a separate capture histories file is generated for each run. When runs are grouped, a single capture histories file is generated containing all capture histories for all populations.

When runs are executed separately, the prefix for the output file names is taken from the **Population Name** for the run. When grouping runs together, it is no longer obvious what to use as an output file prefix, so the program uses the prefix "composite" by default. An alternate prefix can be provided by entering a name in the input box labeled "prefix," located adjacent to the **Combine runs into one** check box. The auxiliary output data (error details, travel time, etc.) will be stored in separate files with a file name based on the **Population Name**. Note that including multiple populations in a

single capture histories file is supported only for SURPH and not for ROSTER at this time.

3.2 Files

The **Files** tab (Figure 3.2) provides options for output files. Here is where the type of output files generated can be switched on or off. This is also where the user selects the capture histories format (SURPH or ROSTER) and decides how any added covariates are handled.

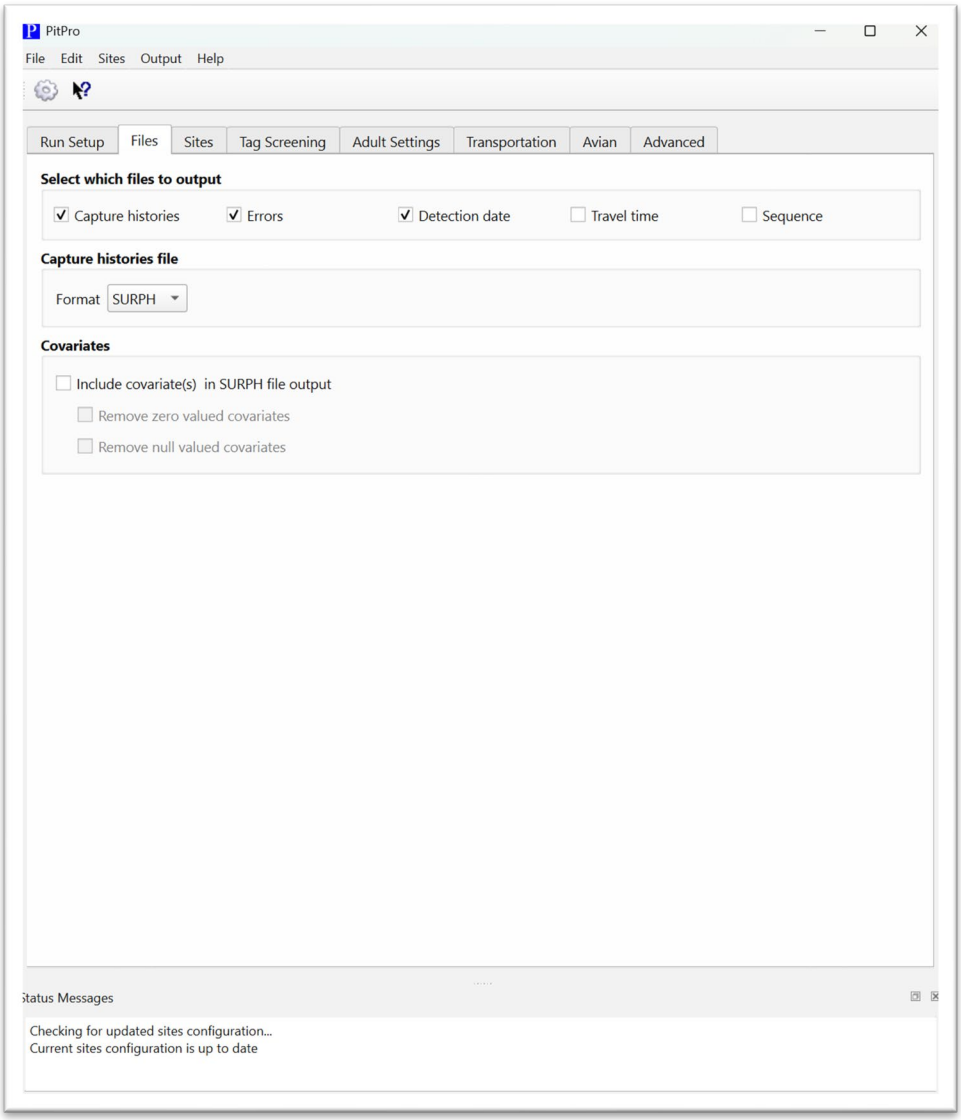


Figure 3.2. **Files** tab.

3.2.1 Selecting output file types

The program results can be customized by checking the boxes for which output files to generate under **Select which file types to output**. The most important files are the capture histories file, the errors file, and the detection date file. The detection date file is used by the **Results Manager** for calculating travel times. The sequence file is an optional file that is used for internal diagnostics and can be very large, with five lines of output for every fish. It is usually advisable to leave the sequence file switch unchecked.

3.2.2 Capture histories file

The format of the capture histories data to be generated can be set in the **Capture histories file** section. The user can select PitPro capture histories to be compatible with either SURPH or ROSTER.

3.2.3 Covariates

Individual covariate data can be included in the SURPH output file format under **Covariates**. The data are input to PitPro via the tagging input file (see “Section 4.2 Tag File”). When including covariate data, it is usually desirable to remove fish that are either missing the covariates (null value) or have a zero for the covariate, depending on the type of data. Either is possible by checking **Remove zero valued covariates** or **Remove null valued covariates**.

3.3 Sites

The **Sites** tab (Figure 3.3) is where the fields that appear in the capture histories are defined.

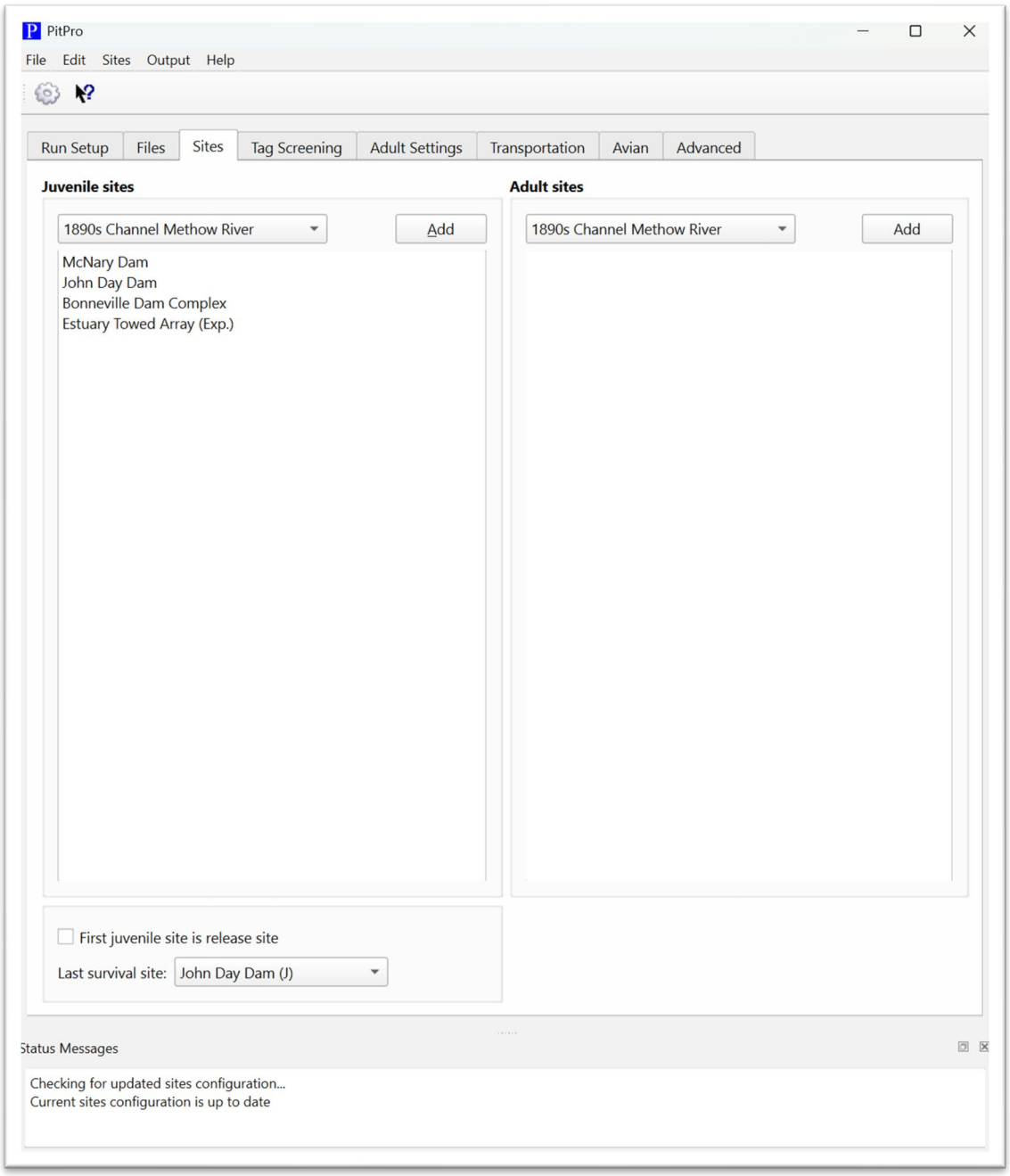


Figure 3.3. **Sites** tab.

3.3.1 Juvenile and Adult sites

Juvenile sites and **Adult sites** are displayed in their respective menus. By selecting a site and clicking **Add**, the detection site is added to the list of capture history sites. The order of the sites in the capture history is defined by the order in which they

appear in these lists, with juvenile sites preceding adult sites. Sites are automatically sorted in upriver-to-downriver order in the case of juvenile sites, or in downriver-to-upriver order for the adult sites.

3.3.2 Release site

The release site is typically assumed to be upriver of the first juvenile site. In some cases, the fish are released directly into the bypass system of a dam, and instead of including all fish released into the bypass as the tag group, only the fish known to have exited the bypass into the river should be included. By checking the box labeled **First juvenile site is release site**, the release site is assumed to be the first defined juvenile site, and any fish not known to be in the river below the site is removed from the tag group and ignored.

3.3.3 Last survival site

The **Last survival site** identifies the final site to which survival will be estimated. It will be represented by the second to last field in the capture history generated by PitPro. The last survival site can be set to any one of the juvenile or adult sites that have been defined in the previous section except for the last defined site (i.e., the most downstream site if only juvenile sites are used, and the most upstream adult site if adult sites are used). If the last survival site is not the next to last defined site, detections at subsequent defined sites will be pooled into the final capture history field. For a site to be pooled into the final capture history field, it must be defined as a selected site, even though it will not be represented individually in the capture history. The interpretation of a pooled last site is that a detected tag survived to at least the first capture site in the pooled group).

If the last survival site is set to the next to last defined site, then there will be a one-to-one correspondence between the defined sites and the capture history fields. The final field will not be pooled in this case; it will represent the final defined site instead.

3.4 Tag Screening

If a tag file contains multiple fish types, the settings on this tab may be used to select a **Species**, **Run**, and **Rearing Type** (Figure 3.4) so that only fish matching the selected fish type will be included in the run. This allows for the download of a single tag file that can be used with multiple interrogation files. Set these settings to **All** to disregard fish type.

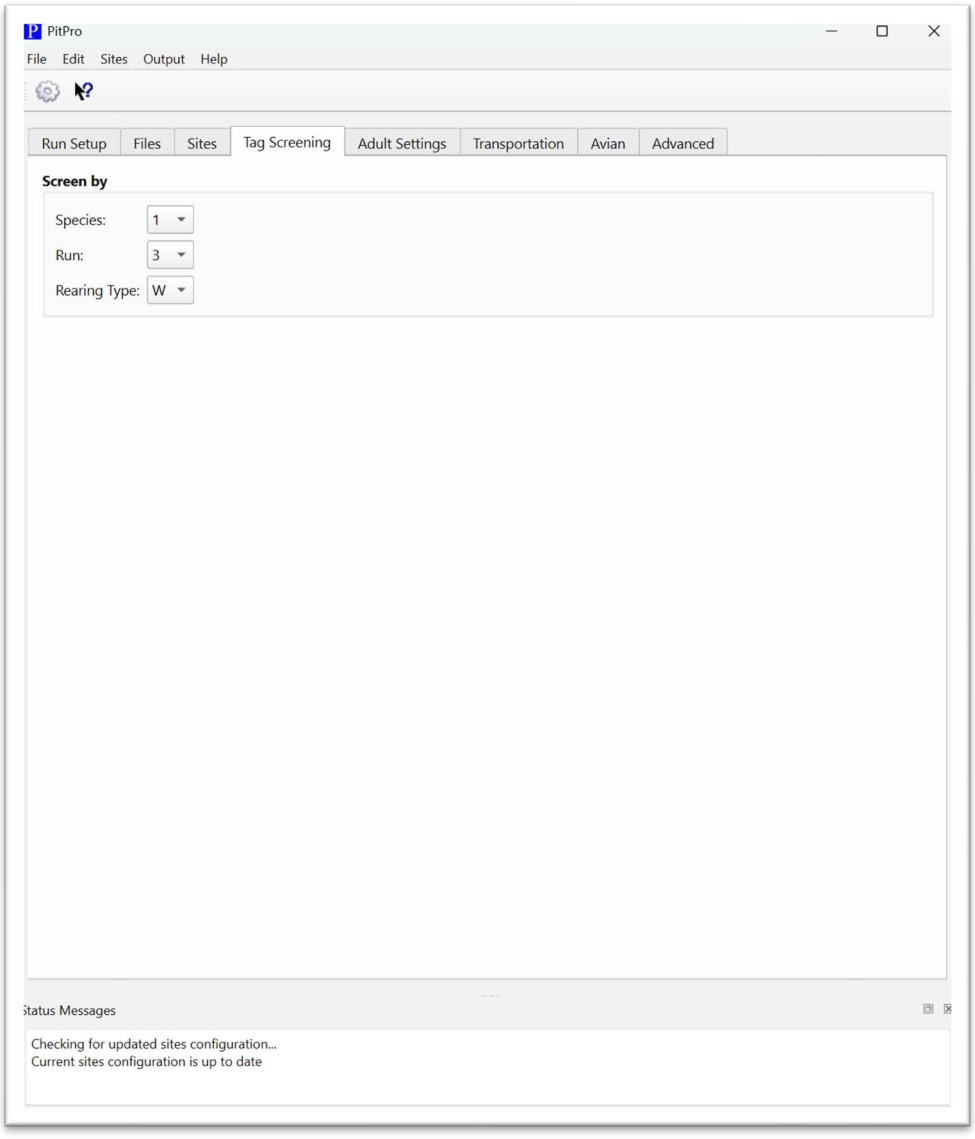


Figure 3.4. **Tag Screening** tab.

3.5 Adult Settings

The **Adult Settings** tab includes configuration settings necessary for interpreting and processing detections of adult fish. If the interrogation data include only juvenile detections, the **Assume all juvenile observations** box may be checked, in which case all other options on this tab are no longer available (Figure 3.5). When this box is selected, all detections are assumed to be juvenile detections. It is the responsibility of the user to ensure that no adult detections, mortalities, or recaptures are included in the data if the **Assume all juvenile observations** box is checked. If the data include adult detections or mortalities and recaptures recorded beyond the juvenile outmigration year, it is recommended to leave this box unchecked.

When the **Assume all juvenile observations** option is unchecked, the user must indicate how to classify detections. Under **Stage Determination**, the user selects the date before which all juvenile detections should occur. The **Return Year** section indicates when adults are expected to be returning and the **Residualization** section determines how to handle detections outside of these boundaries.

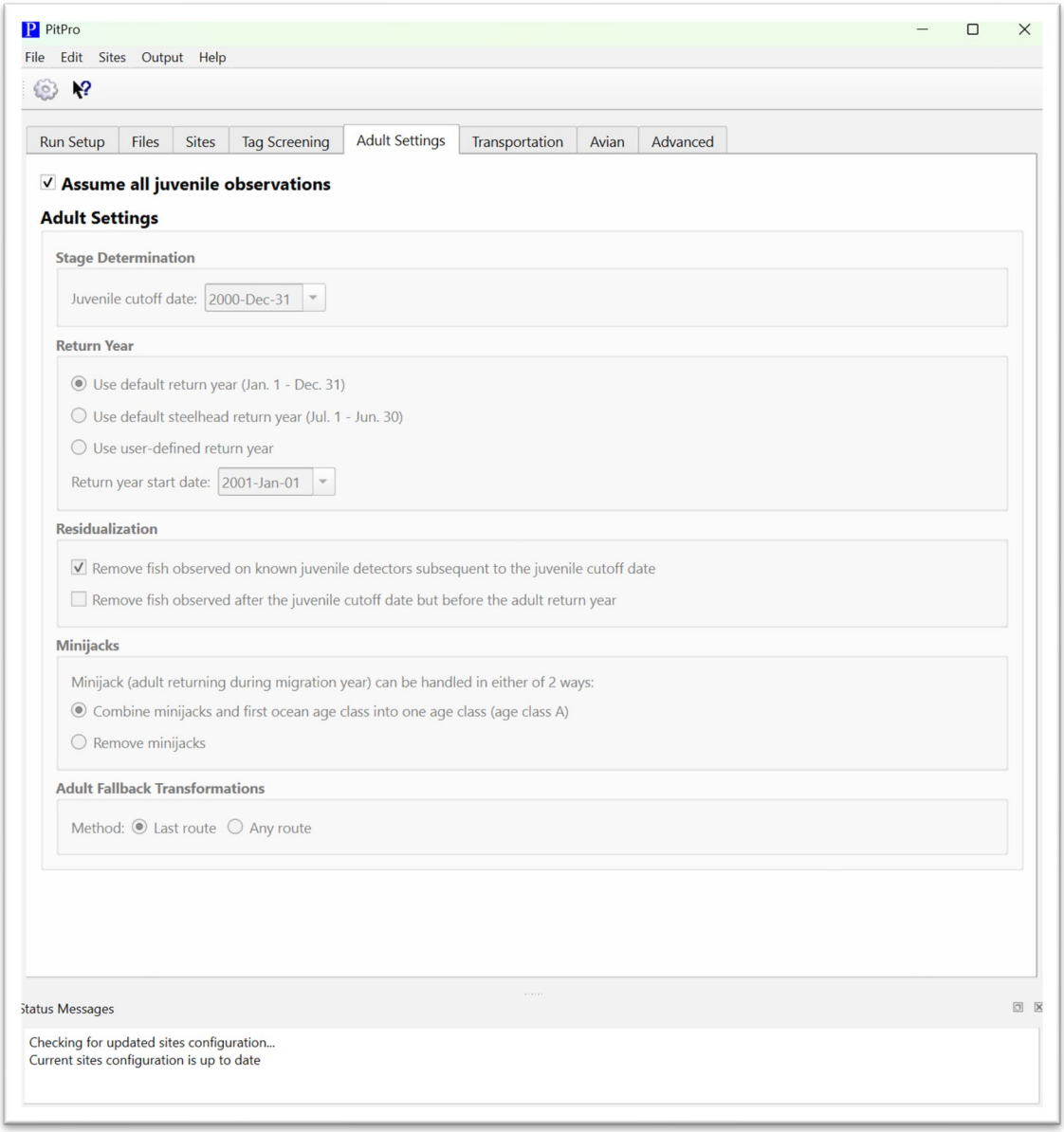


Figure 3.5. **Adult Settings** tab.

3.5.1 Stage determination

When processing mixed stage (juvenile and adult) observations, it is critical to know the age of the fish in determining whether a detection is a juvenile or an adult observation. It is insufficient to use detection location in determining stage because both juveniles and adults may be detected on the same observation monitors.

Under **Stage Determination**, the user indicates the juvenile cutoff date—the date beyond which juvenile detections are not expected. The user can type in the date or use the calendar pop-up (Figure 3.6).

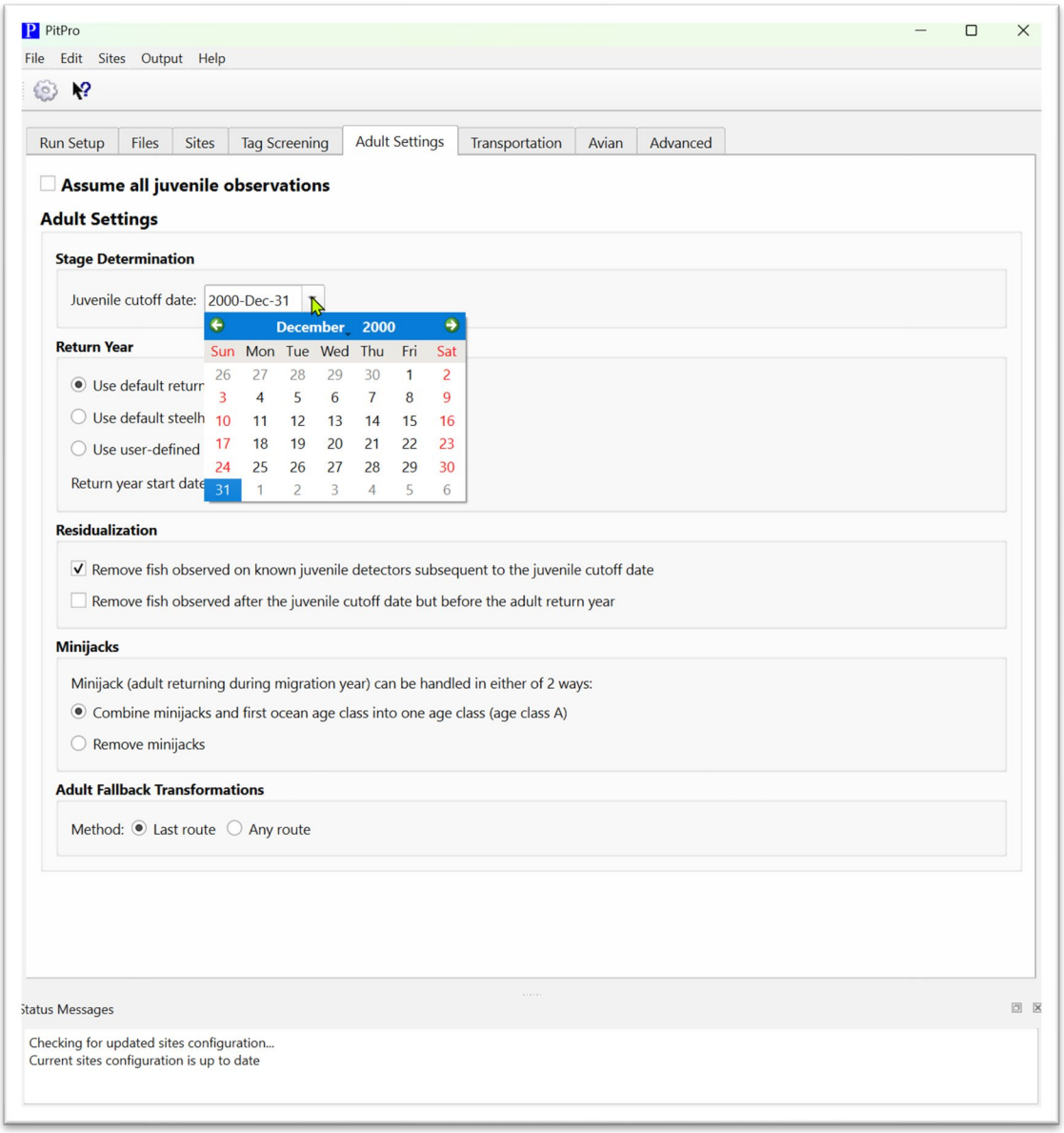


Figure 3.6. Selecting the **Juvenile cutoff date** under **Stage Determination**.

3.5.2 Return year

The adult return year is used to assign ocean ages to returning adults. Three options are provided for defining the adult return year depending on the expected life

history of the tagged population. The start of the adult return year is shown next to **Return year start date** (Figure 3.7). The options for defining the adult return year are as follows:

1. **Use default return year**: The default return year is January 1 through December 31 of the year following the **Juvenile cutoff date**.
2. **Use default steelhead return year**: It is known that some adult steelhead overwinter within the hydrosystem during their upstream migration. This means that they initiate their upstream migration in one calendar year and complete it in the following calendar year. To accommodate this life history trait, the **Use steelhead return year (Jul. 1 – Jun. 30)** is provided**.** If the **Juvenile cutoff date** is between January 1 and June 30, the return year start date is set to July 1 of the same year; if between July 1 and December 31, the return date is set to July 1 of the next year.
3. **Use user-defined return year**: The user may define their own return year start date using this option. When this option is selected, the default **Return year start date** is set to one day after the **Juvenile cutoff date**; the user can edit it via the same interface as used for editing the **Juvenile cutoff date**. The **Return year start date** cannot be set earlier than one day after the **Juvenile cutoff date**.

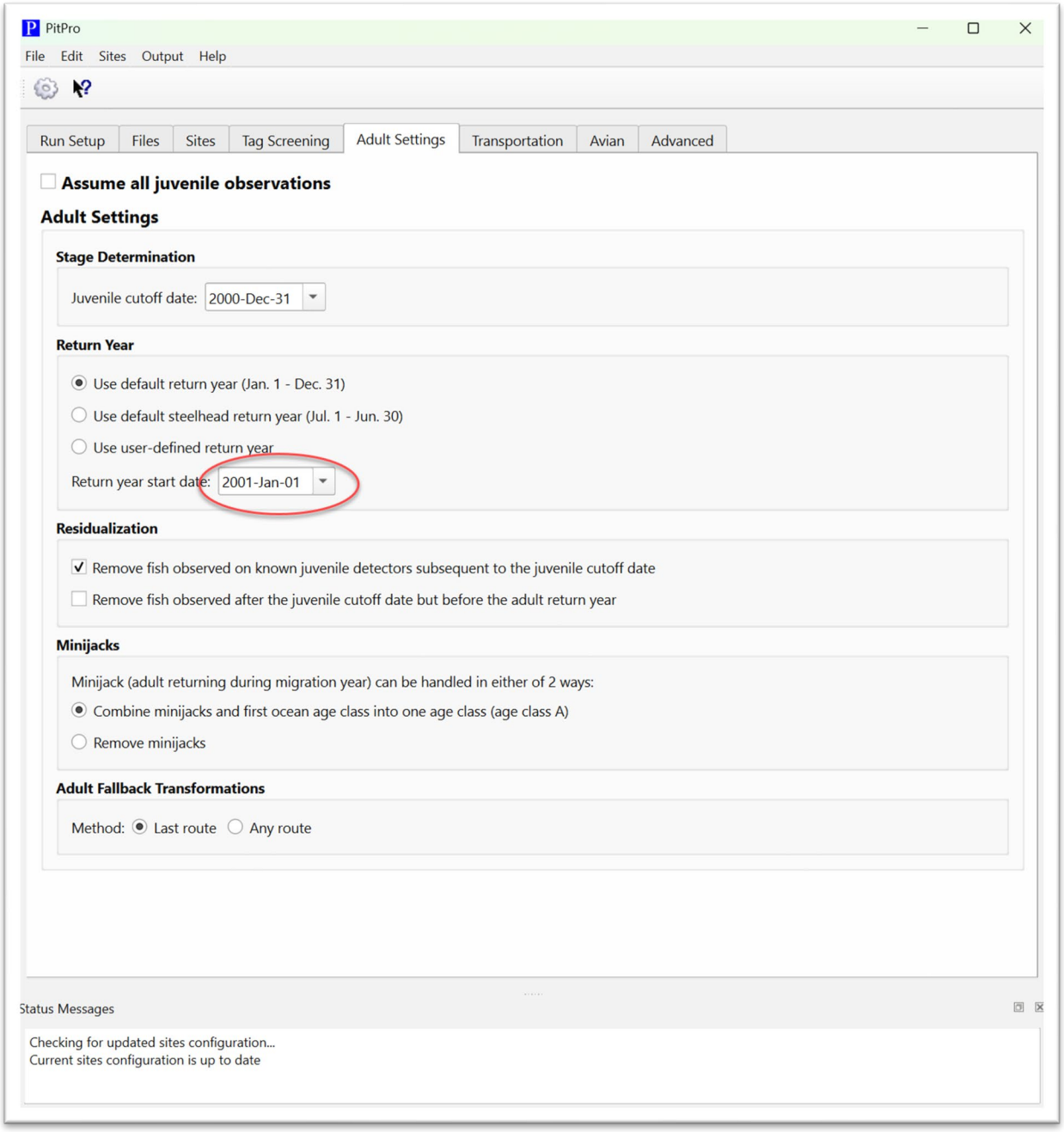


Figure 3.7. The selected **Return year start date** is displayed under **Return Year**. Note: this date is editable only when **Use user-defined return year** is chosen.

3.5.3 Residualization

The models in both programs that use data formatted by PitPro (SURPH and ROSTER) assume that all juvenile migration occurs within a single outmigration season

(i.e., year). Thus, detections indicating residualization must be removed. The program has two non-exclusive methods for removing residualizing fish.

1. **Remove fish observed on known juvenile detectors subsequent to the juvenile cutoff date**.
2. **Remove fish observed after the juvenile cutoff date but before the adult return year**. If selected, all detections after the juvenile cutoff date but before the adult return year will be considered residualized and will be removed from the study; if not selected, such detections will be treated as minijacks.

In each case, fish considered to have residualized will be removed from the dataset.

3.5.4 Minijacks

A minijack is defined, for the purposes of Program ROSTER, as an upstream-migrating fish returning during its outmigration year. Minijacks can be ignored by clicking **Remove minijacks** or else included in ocean age class 1 by clicking **Combine minijacks**. In the latter case, minijack detections would be labeled with an “A” (or “a” if the fish was censored), as would the ocean age 1 fish.

3.5.5 Adult fallback transformation

Because the capture history is designed to be sequential by location rather than by time, fish that fall back will have an observation history that will need to be transformed to fit into the capture history framework. For instance, if an adult fish is detected at Bonneville Dam and then McNary Dam, falls back past both dams, then is detected at Bonneville Dam again but not at McNary, and then is finally detected at Lower Granite Dam, it is not clear whether the fish should have a capture history of 101 or 111 for detections at Bonneville, McNary, and Lower Granite, respectively. If **Last route** is checked under **Adult fallback transformations**, the program will produce the first capture history (101) because it was not detected at McNary Dam on its final passage of that site. If **Any route** is checked, the program will produce the second output (111). Either is valid, but it is recommended to use the **Last route** method when producing data files for use with Program ROSTER.

3.6 Transportation

It is possible to tell the program to censor all transported fish at a particular transportation site. This is sometimes necessary when working with the ROSTER output format in order to simplify the estimation process. Only sites listed in the **Transportation sites** section on the **Transportation** tab (Figure 3.8) will have capture history codes indicating “transported” in the resulting capture history file. Transported fish that are collected and transported from any other site will be flagged as **Unknown**. In most cases, detections flagged as **Unknown** will result in censoring of those fish unless a subsequent return-to-river detection occurs. For non-ROSTER runs, tags that are transported will be censored (“2”) regardless of if the transport dam is listed under **Transportation sites** or not.

It is also possible to treat all sampled fish as transported. This is appropriate in cases where the assumption is that sampled fish are diverted to the raceway. Check the box next to **Treat sampled fish at the above sites as transported fish**. This will apply only to fish that are in the selected **Transportation sites** list.

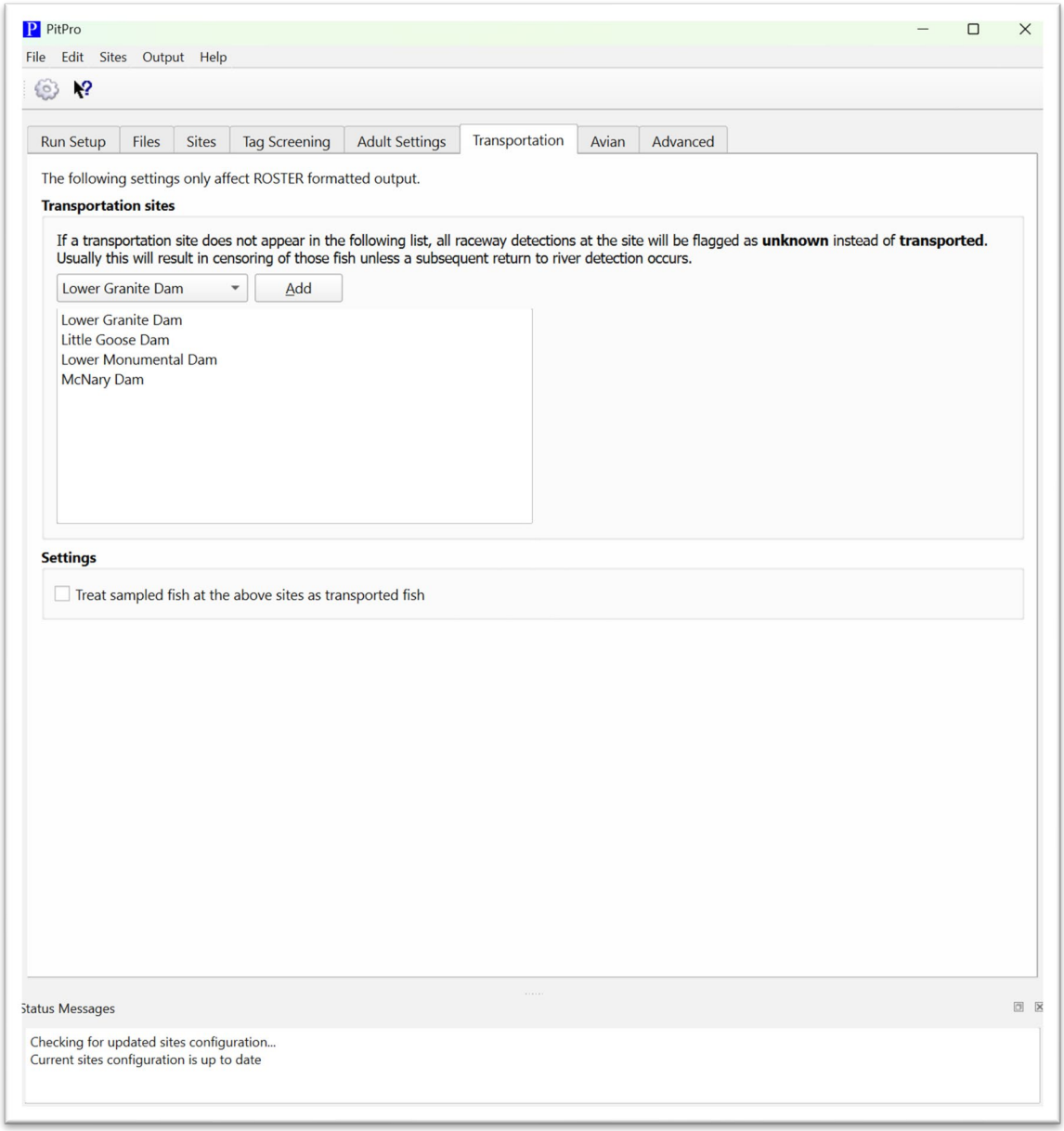


Figure 3.8. **Transportation** tab.

3.7 Avian

The **Avian** tab (Figure 3.9) provides options for how to use tag recoveries from avian colonies. The default option is **Use no avian colony recoveries**. In this case, any such recoveries will be ignored in computing detection histories. The second option is **Use avian colony recoveries** with two options:

- **At the Columbia River Mouth**: Avian colony recoveries will be used only if recovered at the Columbia River Mouth, defined to be river kilometer 40 or less.
- **Downstream of final juvenile detection site**: Avian colony recoveries will be used if they are downstream of the final detection site (i.e., the final site downstream of the **Last survival site** specified on the **Sites** tab). If the final detection site is an adult site, only recoveries at the Columbia River mouth will be used.

The **Use avian colony recoveries** option is not available for the ROSTER file format.

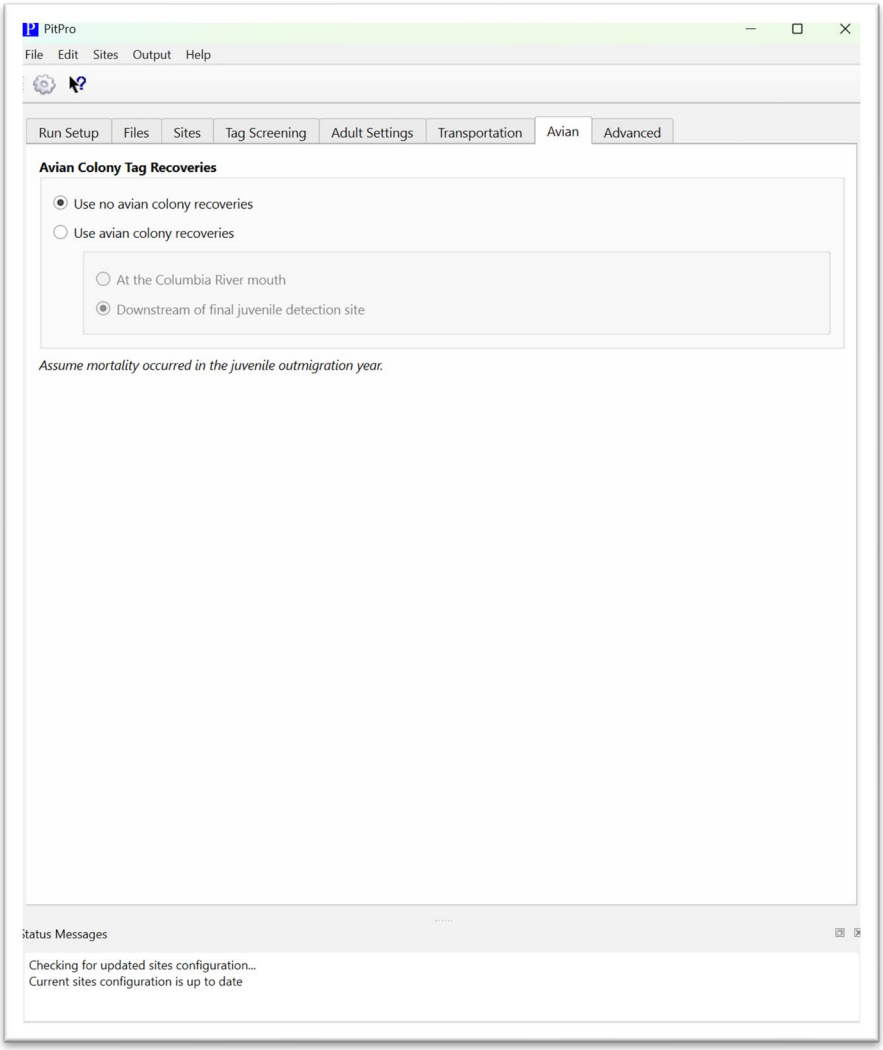


Figure 3.9. **Avian** tab.

3.8 Advanced

The **Advanced** tab (Figure 3.10) contains options that are not usually changed but can be under certain circumstances. For instance, if fish are being recaptured at the point of release and are then removed by PitPro processing, the user can override how release site recaptures are handled. Following is a more detailed discussion of these settings.

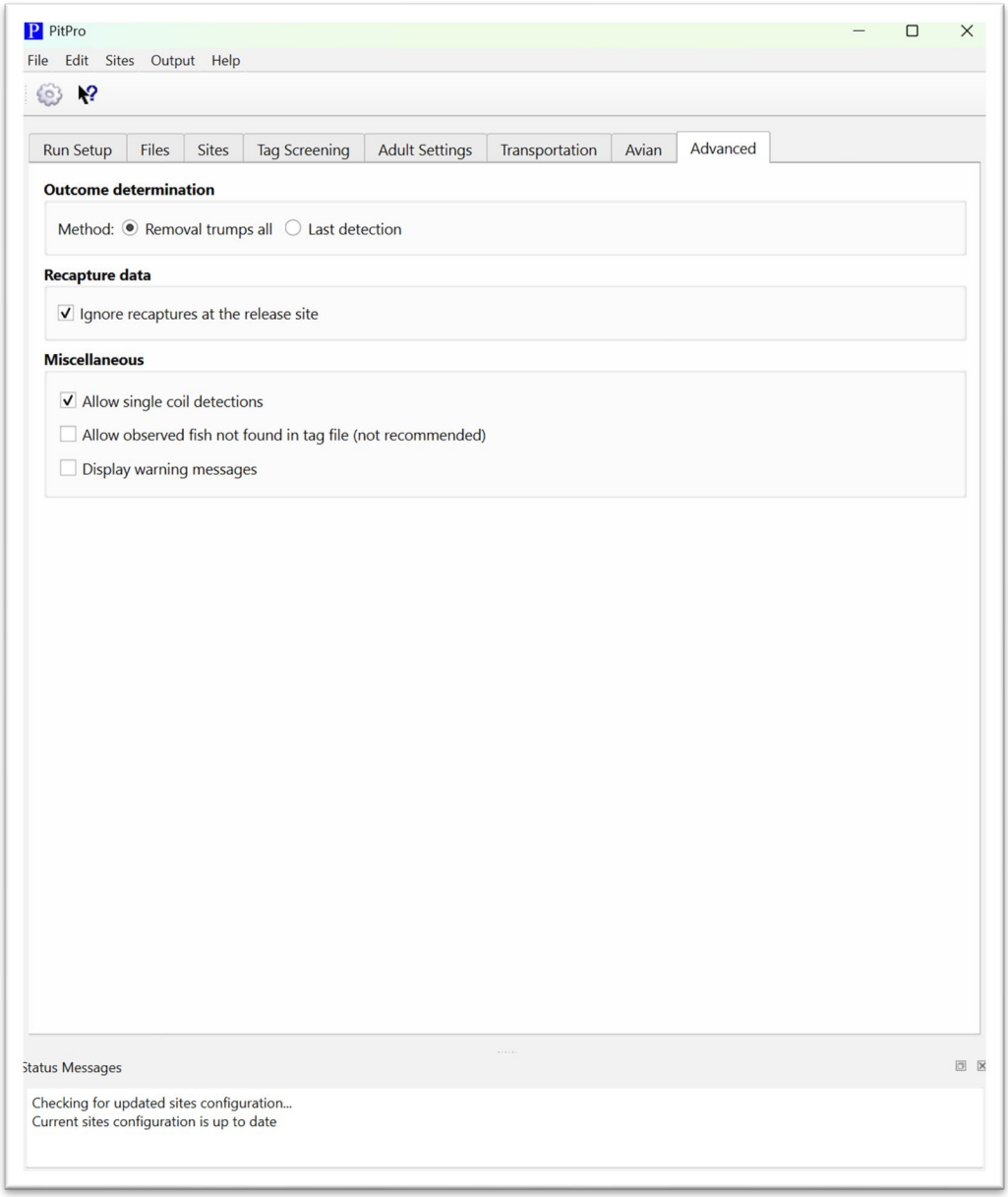


Figure 3.10. **Advanced** tab.

3.8.1 Outcome determination

The outcome, or disposition, of a fish at a particular detection site is determined in one of two ways: **Removal trumps all** or **Last detection**, found under **Outcome determination**. When **Removal trumps all** is checked, any detection on a monitor that indicates removal, either sampled or transported, will supersede any subsequent observations. For example, if a fish is observed on a monitor that indicates transportation, the fish will be flagged as transported, even if it was later observed on a return-to-river monitor. If **Last detection** is checked, only the last observation within that dam will be used.

3.8.2 Recapture data

Typically, a recaptured fish is censored and any subsequent observations will be ignored, including recaptures and mortalities. This may be undesirable in the case of a recapture at the point of release, which is often seen in the data for natural-origin fish. To ignore recaptures at the release site, check **Ignore recaptures at the release site** under **Recapture data**. Any subsequent observations will be treated as if the recapture at the release location had never occurred. It is important that this is checked when using “last detection data” from PTAGIS because one line of data per fish per site is normal.

3.8.3 Miscellaneous

There are three checkboxes found under the **Miscellaneous** section.

3.8.3.1 Allow Single-coil Detections

Typically, a fish is flagged for removal if it is observed on only a single coil at an entire observation site. This option may be changed by checking **Allow single coil detections**. Improvement in detection infrastructure at dams makes this a more reliable assumption.

3.8.3.2 Allow observed fish not found in tag file

Usually, a fish is removed if it is not found in the tag file. Check the **Allow observed fish not found in tag file** check box to allow these fish to be included in the capture histories results. In most cases, we recommend not checking this box.

3.8.3.3 Display warning messages

The program generates warning messages that may provide useful information but are not generally considered errors, so by default these messages are not displayed. Check the **Display warning messages** box to display warnings. Currently the two types of warnings generated are that the program cannot find detector data for a given interrogation record, or when a fish flagged as transported is subsequently detected downstream as a juvenile.

3.9 Site Configuration

The internal logic that allows PitPro to determine fish outcome, interrogation site sorting order, names, etc., is encapsulated by the sites configuration file. The sites configuration file is based on the PTAGIS Site Configuration History and is updated frequently. Nevertheless, there may be circumstances when the user may wish to customize the site configuration. See “Chapter 10: Site Configuration,” for more information on the site configuration file format.

Chapter 4: Input Files

PitPro uses the data input files to create a single capture history file containing release and detection information, with adjustments for mortalities and recaptures if the user specifies a recapture data file and a mortality data file, respectively. PitPro treats a mortality or recapture in almost the same way: a fish is censored at the point of recapture/mortality or at the nearest prior defined capture history site. In other words, if a juvenile fish is recaptured or removed as a mortality at McNary Dam, or between McNary and John Day dams, and McNary is defined as a capture history site, the fish will be flagged as removed at McNary. The only exception to this rule is for fish recaptured at the point of release. If the release site and the recapture site are identical, the recapture may be ignored, as one option, and any subsequent capture history will be unaffected (i.e., processed normally). See “3.8.2 Recapture data,” for more details.

In general, data downloaded from PTAGIS are ready for use in PitPro. PitPro will remove quotes, commas, and any header or footer information before processing the data. In most of the following examples, the data are shown in comma-separated variable (.csv) format but tab delimited will work, too. The next sections offer a detailed look at the input data files. For a short primer on using PTAGIS to download PitPro data, see “Chapter 11: PTAGIS.”

4.1 Interrogation Input File

The example below shows the proper format for the **Interrogation** data file. The file consists of 4 columns (or 5 after commas are removed): tag id, observation site, observation date and time, and observation coil. The allowed date formats are dd-mmm-yyyy format (e.g., 03-feb-1997) or m/d/yyyy format (e.g., 2/3/1997). Generally, dates provided by PTAGIS should work. Any lines that do not match these formats are ignored. Any commas, quotes, and extra white spaces (spaces or tabs) are also ignored.

Tag ID Code	Observation Site Code	Observation Date Value	Antenna ID ID
384.3B23A41BF8	GRJ	5/5/2016 12:08	A1
384.3B23A41BF8	GRJ	5/5/2016 12:08	A2
384.3B23A41BF8	GRJ	5/5/2016 12:09	C1
384.3B23A41BF8	GRJ	5/5/2016 12:09	C2
384.3B23A41BF8	GRJ	5/5/2016 12:09	91
384.3B23A41BF8	GRJ	5/5/2016 12:09	92
384.3B23A41C1F	GRJ	4/28/2016 12:04	A1
384.3B23A41C1F	GRJ	4/28/2016 12:04	A2
384.3B23A41C1F	GRJ	4/28/2016 12:04	C1
384.3B23A41C1F	GRJ	4/28/2016 12:04	C2
384.3B23A41C1F	GRJ	4/28/2016 12:04	91
384.3B23A41C1F	GRJ	4/28/2016 12:04	92
384.3B23A41C1F	JDJ	5/7/2016 0:03	1
384.3B23A41C1F	JDJ	5/7/2016 0:03	2
384.3B23A41C1F	JDJ	5/7/2016 0:03	3
384.3B23A41C1F	JDJ	5/7/2016 0:03	4
384.3B23A425EF	GRJ	5/20/2016 1:27	A1
384.3B23A425EF	GRJ	5/20/2016 1:27	A2
384.3B23A425EF	GRJ	5/20/2016 1:27	C1
384.3B23A425EF	GRJ	5/20/2016 1:27	C2
384.3B23A425EF	GRJ	5/20/2016 1:27	91
384.3B23A425EF	GRJ	5/20/2016 1:27	92

Figure 4.1. **Interrogation** input file.

4.2 Tag File

The **Tag** data file provides PitPro with tagging data, i.e., tag file ID, release information, fish type, and fish length. The sample below (Figure 4.2) shows the proper format for a tag file. The minimum required columns are tag ID, release date and time, release site code, species code, run code, and rearing type code. As with the observation data, commas, quotes, headers, and incorrectly formatted lines will be ignored.

Tag ID Code	Release Date MMDDYYYY	Release Site Code	Species Code	Run Code	Rear Type Code
384.1B79718BEF	11/23/2016 0:00	WIMPYC	3	2	W
384.1B7971A068	10/7/2016 0:00	SECTRP	3	2	W
384.1B7976959E	11/16/2016 0:00	BOHANC	3	2	W
384.1B79769D0C	11/4/2016 0:00	KENYC	3	2	W
384.1B7976A4BF	4/12/2016 0:00	LEMHIR	3	2	W
384.3B239AFA4B	10/7/2016 0:00	FISTRP	3	2	W
384.3B239B5247	10/5/2016 0:00	FISTRP	3	2	W
384.3B239B6484	10/7/2016 0:00	FISTRP	3	2	W
384.3B239B648F	10/7/2016 0:00	FISTRP	3	2	W
384.3B239B653D	10/7/2016 0:00	FISTRP	3	2	W
384.3B239B6556	10/8/2016 0:00	FISTRP	3	2	W
384.3B239B6595	10/4/2016 0:00	FISTRP	3	2	W
384.3B239B6778	10/3/2016 0:00	FISTRP	3	2	W
384.3B239B6792	10/3/2016 0:00	FISTRP	3	2	W
384.3B239B74A0	10/6/2016 0:00	FISTRP	3	2	W
384.3B239B7ADD	10/5/2016 0:00	FISTRP	3	2	W
384.3B239B7F4C	10/6/2016 0:00	FISTRP	3	2	W
384.3B239B8971	10/8/2016 0:00	FISTRP	3	2	W
384.3B239B8B38	10/6/2016 0:00	FISTRP	3	2	W
384.3B239B8B99	10/6/2016 0:00	FISTRP	3	2	W
384.3B239B8C4A	10/4/2016 0:00	FISTRP	3	2	W
384.3B239B8CA8	10/6/2016 0:00	FISTRP	3	2	W
384.3B239B904B	10/6/2016 0:00	FISTRP	3	2	W
384.3B239B9971	10/5/2016 0:00	FISTRP	3	2	W
384.3B239B9AAD	10/7/2016 0:00	FISTRP	3	2	W
384.3B239B9ABE	10/8/2016 0:00	FISTRP	3	2	W
384.3B239B9D67	10/6/2016 0:00	FISTRP	3	2	W
384.3B239BA85D	10/6/2016 0:00	FISTRP	3	2	W
384.3B239BA8AD	10/6/2016 0:00	FISTRP	3	2	W
384.3B239BA904	10/3/2016 0:00	FISTRP	3	2	W

Figure 4.2. **Tag** file.

Optionally, individual covariate data may be input via the **Tag** file. Any columns in addition to the required ones shown above are taken to be covariate data. In the example below (Figure 4.3), length has been added to the end of each row. Any number of additional columns can be added so that there is no limit to the number of individual covariates that can be provided in this way. These covariate data will be available for inclusion in the SURPH data file.

Tag ID Code	Release Date MMDDYYYY	Release Site Code	Species Code	Run Code	Rear Type Code	Length mm
384.1B79718BEF	11/23/2016 0:00	WIMPYC	3	2	W	62
384.1B7971A068	10/7/2016 0:00	SECTRP	3	2	W	164
384.1B7976959E	11/16/2016 0:00	BOHANC	3	2	W	64
384.1B79769D0C	11/4/2016 0:00	KENYC	3	2	W	60
384.1B7976A4BF	4/12/2016 0:00	LEMHIR	3	2	W	61
384.3B239AFA4B	10/7/2016 0:00	FISTRP	3	2	W	126
384.3B239B5247	10/5/2016 0:00	FISTRP	3	2	W	146
384.3B239B6484	10/7/2016 0:00	FISTRP	3	2	W	128
384.3B239B648F	10/7/2016 0:00	FISTRP	3	2	W	130
384.3B239B653D	10/7/2016 0:00	FISTRP	3	2	W	118
384.3B239B6556	10/8/2016 0:00	FISTRP	3	2	W	137
384.3B239B6595	10/4/2016 0:00	FISTRP	3	2	W	125
384.3B239B6778	10/3/2016 0:00	FISTRP	3	2	W	140
384.3B239B6792	10/3/2016 0:00	FISTRP	3	2	W	156
384.3B239B74A0	10/6/2016 0:00	FISTRP	3	2	W	119
384.3B239B7ADD	10/5/2016 0:00	FISTRP	3	2	W	149
384.3B239B7F4C	10/6/2016 0:00	FISTRP	3	2	W	150
384.3B239B8971	10/8/2016 0:00	FISTRP	3	2	W	135
384.3B239B8B38	10/6/2016 0:00	FISTRP	3	2	W	121
384.3B239B8B99	10/6/2016 0:00	FISTRP	3	2	W	141
384.3B239B8C4A	10/4/2016 0:00	FISTRP	3	2	W	138
384.3B239B8CA8	10/6/2016 0:00	FISTRP	3	2	W	137
384.3B239B904B	10/6/2016 0:00	FISTRP	3	2	W	127
384.3B239B9971	10/5/2016 0:00	FISTRP	3	2	W	157
384.3B239B9AAD	10/7/2016 0:00	FISTRP	3	2	W	124
384.3B239B9ABE	10/8/2016 0:00	FISTRP	3	2	W	152
384.3B239B9D67	10/6/2016 0:00	FISTRP	3	2	W	120
384.3B239BA85D	10/6/2016 0:00	FISTRP	3	2	W	114
384.3B239BA8AD	10/6/2016 0:00	FISTRP	3	2	W	115
384.3B239BA904	10/3/2016 0:00	FISTRP	3	2	W	136

Figure 4.3. **Tag** file with an additional column for length.

4.3 Recapture File

A **Recapture** data file is used to augment interrogation data. When a fish is recaptured, PitPro flags the fish as removed at the recapture site, if the recapture site is also a defined capture history site, or the nearest prior-defined capture history site. In other words, a fish recaptured at McNary Dam, assuming that McNary Dam is one of the defined capture history sites, is flagged as removed at McNary. If the fish is recaptured downstream of McNary but upstream of the next capture history site, it also will be flagged as removed at McNary.

In some cases, fish are recaptured soon after release and the recapture site matches the release site. It is possible to configure PitPro to ignore these recaptures, allowing subsequent observations to be recorded in the capture history as if the

recapture never happened. Downstream recaptures will be treated as described above. See “Section 3.8.2 Recapture data,” for more information on the setting for recapture data at the release site.

The required columns in the **Recapture** data file are tag ID, recapture date and time, recapture site, and recapture river kilometer (Figure 4.4).

Tag ID Code	Recapture Date Value	Recapture Site Site Code	Recapture River KM Value
384.3B239B6556	10/9/2016 11:59	FISTRP	522.224.120.037.039.002
384.3B239B6595	10/5/2016 9:46	FISTRP	522.224.120.037.039.002
384.3B239B8B38	10/7/2016 9:20	FISTRP	522.224.120.037.039.002
384.3B239B9AAD	10/8/2016 13:50	FISTRP	522.224.120.037.039.002
384.3B239BB27A	10/6/2016 9:22	FISTRP	522.224.120.037.039.002
384.3B239BC189	10/7/2016 9:20	FISTRP	522.224.120.037.039.002
384.3B239BC90D	10/8/2016 13:50	FISTRP	522.224.120.037.039.002
384.3B239BCFE9	10/6/2016 9:22	FISTRP	522.224.120.037.039.002
384.3B239BD2AF	10/5/2016 9:46	FISTRP	522.224.120.037.039.002
384.3B239BE767	10/7/2016 9:20	FISTRP	522.224.120.037.039.002
384.3B23A42673	3/8/2016 10:15	JOHTRP	522.303.215.060.024.007
384.3B23A4276B	7/10/2016 8:45	JOHTRP	522.303.215.060.024.007
384.3B23A431E4	8/12/2016 8:30	SECTRP	522.303.215.059.007
384.3B23A440BD	7/12/2016 7:15	JOHTRP	522.303.215.060.024.007
384.3B23A45A6C	9/21/2016 11:00	JOHTRP	522.303.215.060.024.007
384.3B23A45B5B	10/16/2016 10:45	JOHTRP	522.303.215.060.024.007
384.3B23A45CDC	6/28/2016 10:30	JOHTRP	522.303.215.060.024.007
384.3B23A46960	7/7/2016 10:31	JOHTRP	522.303.215.060.024.007
384.3B23A49C9A	7/8/2016 10:27	JOHTRP	522.303.215.060.024.007
384.3B23A4D1B4	10/28/2016 7:30	JOHTRP	522.303.215.060.024.007
384.3B23A4DDF7	5/30/2016 7:35	SECTRP	522.303.215.059.007
384.3B23A4E5D5	6/28/2016 10:30	JOHTRP	522.303.215.060.024.007
384.3B23A4E615	9/11/2016 8:47	SECTRP	522.303.215.059.007
384.3B23A4EFB6	4/15/2016 8:15	SECTRP	522.303.215.059.007
384.3B23A4FDCA	10/17/2016 7:45	JOHTRP	522.303.215.060.024.007
384.3B23A52609	9/18/2016 9:45	JOHTRP	522.303.215.060.024.007
384.3B23A5364C	4/5/2016 8:30	SECTRP	522.303.215.059.007

Figure 4.4. **Recapture** file.

4.4 Mortality File

Mortalities are treated the same way as recaptures except that removal of mortalities is optional only for tags recovered from avian colonies. See “Section 3.7

Avian," and "Section 4.3 Recapture File." The required columns in the **Mortality** data file are tag ID, mortality date and time, mortality site, and mortality river kilometer (Figure 4.5). It is important to note that the mortality date and time may represent when the tag was reported as a mortality rather than when the mortality event actually occurred. Also note that the river kilometer in a given mortality record is used rather than the river kilometer in the sites configuration file.

Tag ID Code	Mortality Date MMDDYYYY	Mortality Site Code	Mortality River KM Value
384.3B239B653D	9/20/2017 0:00	CBLAIS	440
384.3B23A44E86	8/10/2016 0:00	LMILIS	331
384.3B23A518F0	9/26/2018 0:00	ESANIS	8
384.3B23A51AA1	9/25/2018 0:00	ESANIS	8
384.3B23A5BFE5	8/10/2016 0:00	LMILIS	331
384.3B23A64F8F	9/19/2016 0:00	ESANIS	8
384.3B23A8890F	10/21/2016 0:00	ESANIS	8
384.3B23A8A988	10/18/2016 0:00	BADGEI	512
384.3B23A8AFE7	10/16/2016 0:00	ESANIS	8
384.3B23A8AFE7	10/19/2016 0:00	ESANIS	8
384.3B23A8BC25	8/3/2016 0:00	RICHIS	545
384.3B23A8D651	9/20/2017 0:00	CBLAIS	440
384.3B23A8FCD8	8/10/2016 0:00	LMILIS	331
384.3B23A95A31	9/12/2017 0:00	ESANIS	8
384.3B23A96EE9	8/8/2016 0:00	CBLAIS	440
384.3B23A9B2B5	10/19/2016 0:00	ESANIS	8
384.3B23A9B9C6	9/19/2016 0:00	ESANIS	8
384.3B23A9F90B	9/11/2017 0:00	ESANIS	8
384.3B23AAAC1D	9/25/2018 0:00	ESANIS	8
3D9.1C2D64C7B1	9/19/2016 0:00	ESANIS	8
3D9.1C2D64D597	9/5/2017 0:00	ESANIS	8
3D9.1C2D64D64D	9/19/2016 0:00	ESANIS	8
3D9.1C2D64DB77	10/18/2016 0:00	BADGEI	512
3D9.1C2D69F486	10/16/2016 0:00	ESANIS	8

Figure 4.5. **Mortality** file.

Chapter 5: Output Files

5.1 Capture Histories File

The **Capture Histori**es file is either a SURPH-compatible file (Version 2) or a ROSTER-compatible file. The file is saved under the name created under **Defined runs** and will end with a ".ch" file extension.

5.2 Errors File

The **Errors** file has one line for each removed fish, followed by a series of fields representing the particular errors that contain either a "1," indicating an error, or a "0," indicating no error (Figure 5.1). The errors are labeled in Table 5.1.

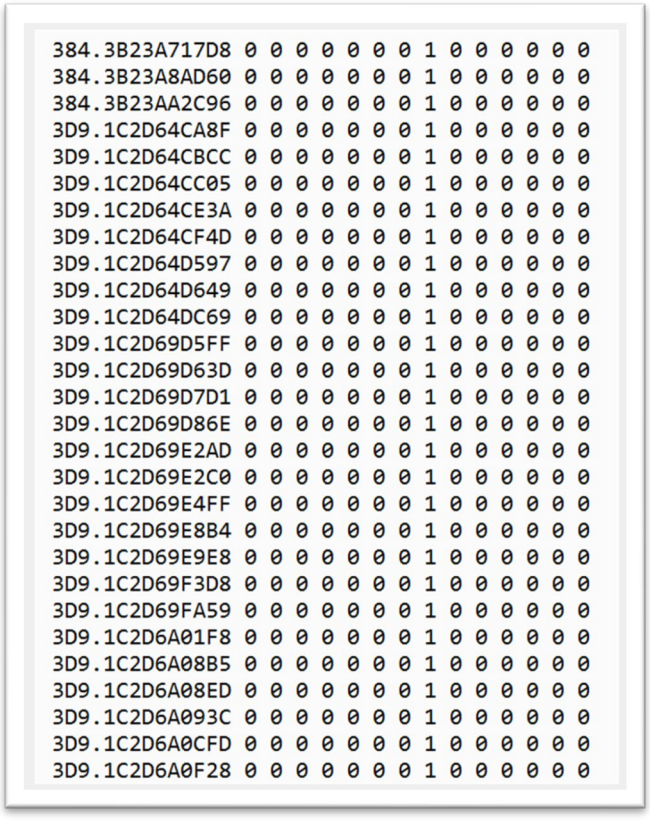


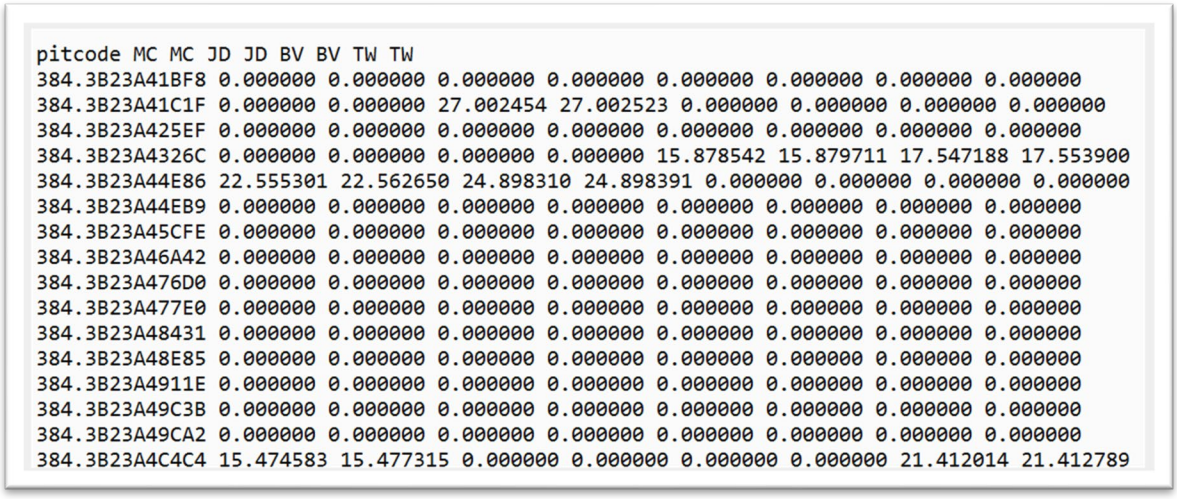
Figure 5.1. A selected portion of an **Errors** file.

Table 5.1. **Errors** file fields.

Column	Description
1	PIT-tag id
2	Observation on known juvenile detector after migration year
3	Fish removed as minijack.
4	No release data found.
5	Fish released at dam (site release) not returned to river.
6	PIT tag not found in list of valid tags or tag not loaded.
7	Observations out of sequence.
8	Fish observed before release date.
9	Fish removed before first capture history site.
10	Fish observed before residualization cutoff date in year following migration year.
11	Stage unknown.
12	Wrong species.
13	Wrong run.
14	Wrong rearing type.
15	Individual covariate has zero or null value.

5.3 Travel Time File

The **Travel Time** file provides the first and last travel times from release to each observation site for each fish (Figure 5.2). To generate this file, the **Travel Time** box must be checked on the **Files** tab. Travel times are calculated only if a release date is provided for the fish in the tag data file. The file has a header indicating the column labels: the first column is the PIT code and the remaining columns are pairs of first and last detections for each defined site as defined on the **Sites** tab (Section 3.3). If a fish was not detected at a site, the travel times will be reported as 0.000. If a fish was detected at a given site but no release data were provided for the fish, the travel times will be reported as -999.999.



```
pitcode MC MC JD JD BV BV TW TW
384.3B23A41BF8 0.000000 0.000000 0.000000 0.000000 0.000000 0.000000 0.000000 0.000000
384.3B23A41C1F 0.000000 0.000000 27.002454 27.002523 0.000000 0.000000 0.000000 0.000000
384.3B23A425EF 0.000000 0.000000 0.000000 0.000000 0.000000 0.000000 0.000000 0.000000
384.3B23A4326C 0.000000 0.000000 0.000000 0.000000 15.878542 15.879711 17.547188 17.553900
384.3B23A44E86 22.555301 22.562650 24.898310 24.898391 0.000000 0.000000 0.000000 0.000000
384.3B23A44EB9 0.000000 0.000000 0.000000 0.000000 0.000000 0.000000 0.000000 0.000000
384.3B23A45CFE 0.000000 0.000000 0.000000 0.000000 0.000000 0.000000 0.000000 0.000000
384.3B23A46A42 0.000000 0.000000 0.000000 0.000000 0.000000 0.000000 0.000000 0.000000
384.3B23A476D0 0.000000 0.000000 0.000000 0.000000 0.000000 0.000000 0.000000 0.000000
384.3B23A477E0 0.000000 0.000000 0.000000 0.000000 0.000000 0.000000 0.000000 0.000000
384.3B23A48431 0.000000 0.000000 0.000000 0.000000 0.000000 0.000000 0.000000 0.000000
384.3B23A48E85 0.000000 0.000000 0.000000 0.000000 0.000000 0.000000 0.000000 0.000000
384.3B23A4911E 0.000000 0.000000 0.000000 0.000000 0.000000 0.000000 0.000000 0.000000
384.3B23A49C3B 0.000000 0.000000 0.000000 0.000000 0.000000 0.000000 0.000000 0.000000
384.3B23A49CA2 0.000000 0.000000 0.000000 0.000000 0.000000 0.000000 0.000000 0.000000
384.3B23A4C4C4 15.474583 15.477315 0.000000 0.000000 0.000000 0.000000 21.412014 21.412789
```

Figure 5.2. A selected portion of a **Travel Time** file.

5.4 Detection Date File

The **Detection Date** file is similar to the travel time file except that it records the first and last date of observation at each detection site (Figure 5.3). It has an additional column for release date, so it is possible to calculate travel times to all sites and between all sites using only this file. This is the file that the **Results Manager** (Chapter 7) uses to create the **Travel Time** table.

The date format is “Julian” dating, which encodes year information, making it possible to calculate travel times across years. This is essential when processing fish with adult observation data.

```
pitcode rel MC MC JD JD BV BV TW TW
384.3B23A41BF8 2457505.500000 0.000000 0.000000 0.000000 0.000000 0.000000 0.000000 0.000000
384.3B23A41C1F 2457488.500000 0.000000 0.000000 2457515.502454 2457515.502523 0.000000 0.000000 0.000000 0.000000
384.3B23A425EF 2457519.500000 0.000000 0.000000 0.000000 0.000000 0.000000 0.000000 0.000000 0.000000
384.3B23A4326C 2457512.500000 0.000000 0.000000 0.000000 0.000000 2457528.378542 2457528.379711 2457530.047188 2457530.053900
384.3B23A44E86 2457478.500000 2457501.055301 2457501.062650 2457503.398310 2457503.398391 0.000000 0.000000 0.000000 0.000000
384.3B23A44EB9 2457477.500000 0.000000 0.000000 0.000000 0.000000 0.000000 0.000000 0.000000 0.000000
384.3B23A45CFE 2457489.500000 0.000000 0.000000 0.000000 0.000000 0.000000 0.000000 0.000000 0.000000
384.3B23A46A42 2457483.500000 0.000000 0.000000 0.000000 0.000000 0.000000 0.000000 0.000000 0.000000
384.3B23A476D0 2457501.500000 0.000000 0.000000 0.000000 0.000000 0.000000 0.000000 0.000000 0.000000
384.3B23A477E0 2457501.500000 0.000000 0.000000 0.000000 0.000000 0.000000 0.000000 0.000000 0.000000
384.3B23A48431 2457494.500000 0.000000 0.000000 0.000000 0.000000 0.000000 0.000000 0.000000 0.000000
384.3B23A48E85 2457483.500000 0.000000 0.000000 0.000000 0.000000 0.000000 0.000000 0.000000 0.000000
384.3B23A4911E 2457480.500000 0.000000 0.000000 0.000000 0.000000 0.000000 0.000000 0.000000 0.000000
384.3B23A49C3B 2457508.500000 0.000000 0.000000 0.000000 0.000000 0.000000 0.000000 0.000000 0.000000
384.3B23A49CA2 2457504.500000 0.000000 0.000000 0.000000 0.000000 0.000000 0.000000 0.000000 0.000000
384.3B23A4C4C4 2457495.500000 2457510.974583 2457510.977315 0.000000 0.000000 0.000000 0.000000 2457516.912014 2457516.912789
```

Figure 5.3. A selected portion of a **Detection date** file.

5.5 Sequence File

The **Sequence** file provides detailed information on observation sequence analysis (Figure 5.4). There are five steps reported in the sequence file: the raw observation sequence, the sequence sorted by time, the sequence compressed, the sequence transformed for fallback, and the sequence fit into the structure defined by the selected capture history sites. To generate this file, the **Sequence** box must be checked on the **Files** tab.

The fields in the sequence each contain a three-part item, separated by periods (“.”): the location, the life stage, and the outcome. For instance, “GR.J.U” indicates an observation at Lower Granite Dam (“GR”) of a juvenile fish (“J”) which had an unknown disposition at that point in the observation sequence (“U”). The life stage can be “U” for unknown, “J” for juvenile, or “A” for adult. The outcome (disposition) can be “R” for returned to river, “T” for transported, “S” for sampled, “B” for bypassed, “H” for held, or “U” for unknown.

In the sample code shown below (Figure 5.4), fish 384.3B23A41C1F is observed at Lower Granite Dam six times and John Day Dam four times as shown in the fifth line, which is prefaced by “r” for “raw.” The number “0” following the “r” indicates that the sequence is in order with respect to location; an out-of-order sequence would have a “1” instead of a “0” here. In the next line, prefaced with “s” for sorted, the sequence is sorted with respect to time; in this case, the sorted sequence is identical to the raw

sequence. In the next line, prefaced with “c” for compressed, the multiple observations at each site are compressed into a single observation, with the life stage and outcome combined to result in an overall stage and outcome determination. If the “Last route” method of accounting for transformation had been selected on the Adult Settings tab, the next line would be prefaced by “t” for transformed and it would show the sequence after transformation for any known fallback; see “Section 3.5.5 Adult fallback transformation.” The last line for this tag, prefaced by “m” for modeled, is the result after fitting the observation sequence to the selected capture history fields, where observations at sites not in the capture history fields are ignored, capture history sites with no valid observations are assigned a no-detection observation record (“N”), and observations at valid sites are shown in the correct position in the capture history. For this example, the sites in the capture history are McNary Dam, John Day Dam, and Bonneville Dam, all juvenile sites; because the tag was detected only at Lower Granite and John Day, the tag’s capture history indicates no juvenile detection at McNary, a juvenile detection in the bypass at John Day, and no juvenile detection at Bonneville: “MC.J.N JD.J.B BV.J.N.”

```
r 0 384.3B23A41BF8 GR.J.U GR.J.U GR.J.U GR.J.U GR.J.R GR.J.R
s 0 384.3B23A41BF8 GR.J.U GR.J.U GR.J.U GR.J.U GR.J.R GR.J.R
c 0 384.3B23A41BF8 GR.J.R
m 0 384.3B23A41BF8 MC.J.N JD.J.N BV.J.N
r 0 384.3B23A41C1F GR.J.U GR.J.U GR.J.U GR.J.U GR.J.R GR.J.R JD.U.B JD.U.B JD.U.B JD.U.B
s 0 384.3B23A41C1F GR.J.U GR.J.U GR.J.U GR.J.U GR.J.R GR.J.R JD.J.B JD.J.B JD.J.B JD.J.B
c 0 384.3B23A41C1F GR.J.R JD.J.B
m 0 384.3B23A41C1F MC.J.N JD.J.B BV.J.N
r 0 384.3B23A425EF GR.J.U GR.J.U GR.J.U GR.J.U GR.J.R GR.J.R
s 0 384.3B23A425EF GR.J.U GR.J.U GR.J.U GR.J.U GR.J.R GR.J.R
c 0 384.3B23A425EF GR.J.R
m 0 384.3B23A425EF MC.J.N JD.J.N BV.J.N
```

Figure 5.4. **Sequence** file example.

Chapter 6: Running PitPro

Once the program is configured (see “Chapter 3: Program Configuration”) the program can be executed either by clicking the gear icon on the program tool bar or by selecting **File** from the toolbar and then **Run PitPro** from the dropdown menu (Figure 6.1). A message window displays program status and any errors encountered during program execution. A progress bar displays run status and percentage complete.

When the program execution is complete, results are available for viewing in the **Results Manager**, which pops up automatically and is always accessible by selecting **Output** on the toolbar and then **Results Manager**.

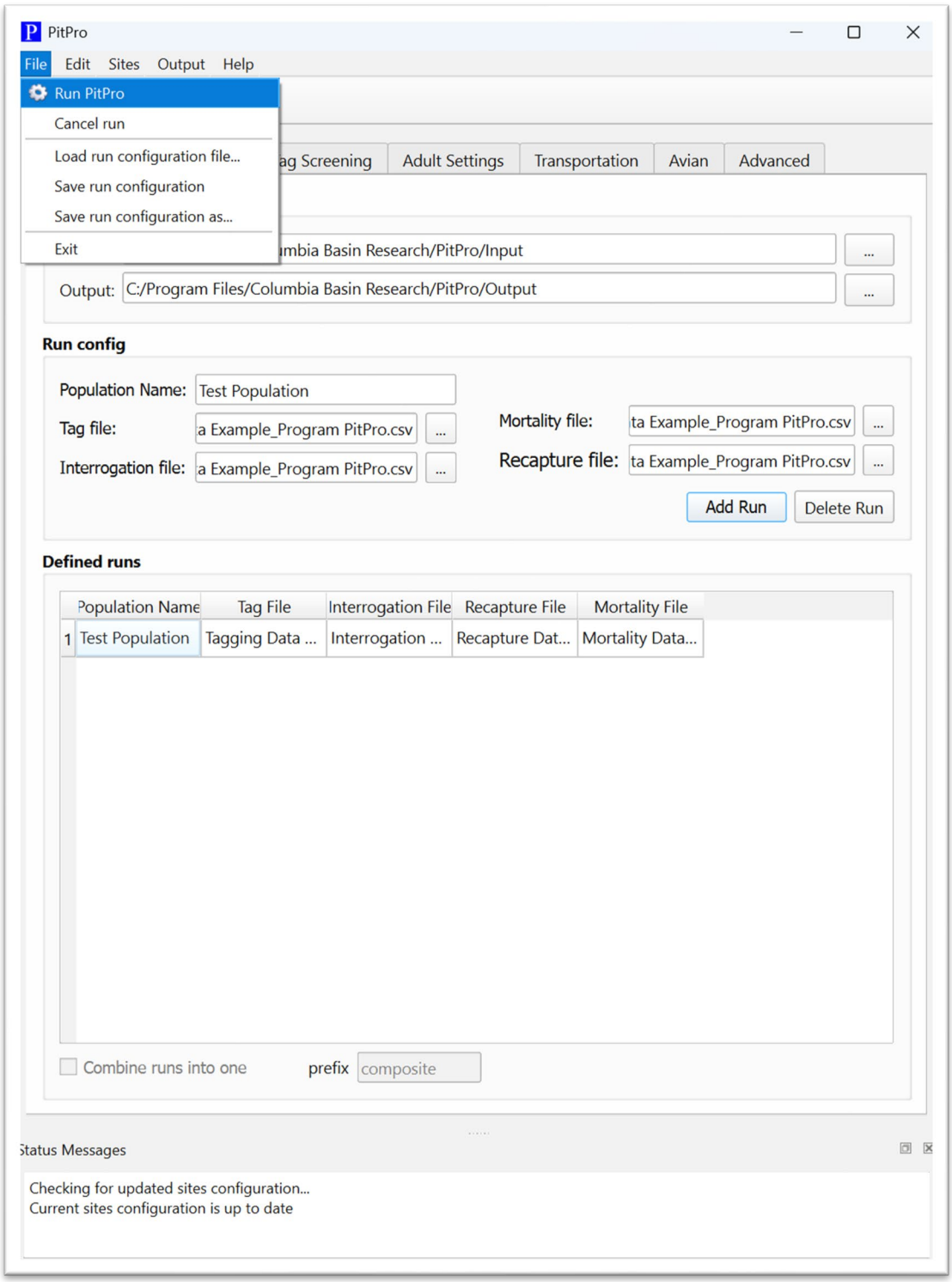


Figure 6.1. Running PitPro.

Chapter 7: Results Manager

The **Results Manager** provides high-level data summaries and tools for analyzing the program output. The **Results Manager** searches for output in the output folder, defined on the **Run Setup** configuration tab (Section 3.2), and presents a menu display with the population names of any results data found there. Selecting a prefix loads the associated data into the **Results Manager**.

7.1 Summary

The **Summary** tab provides an overview of all output files for the selected prefix, giving the names and sizes of each file (Figure 7.1). By clicking on the file name, the user can view the contents of a file. To return to the summary, click the **Back** button.

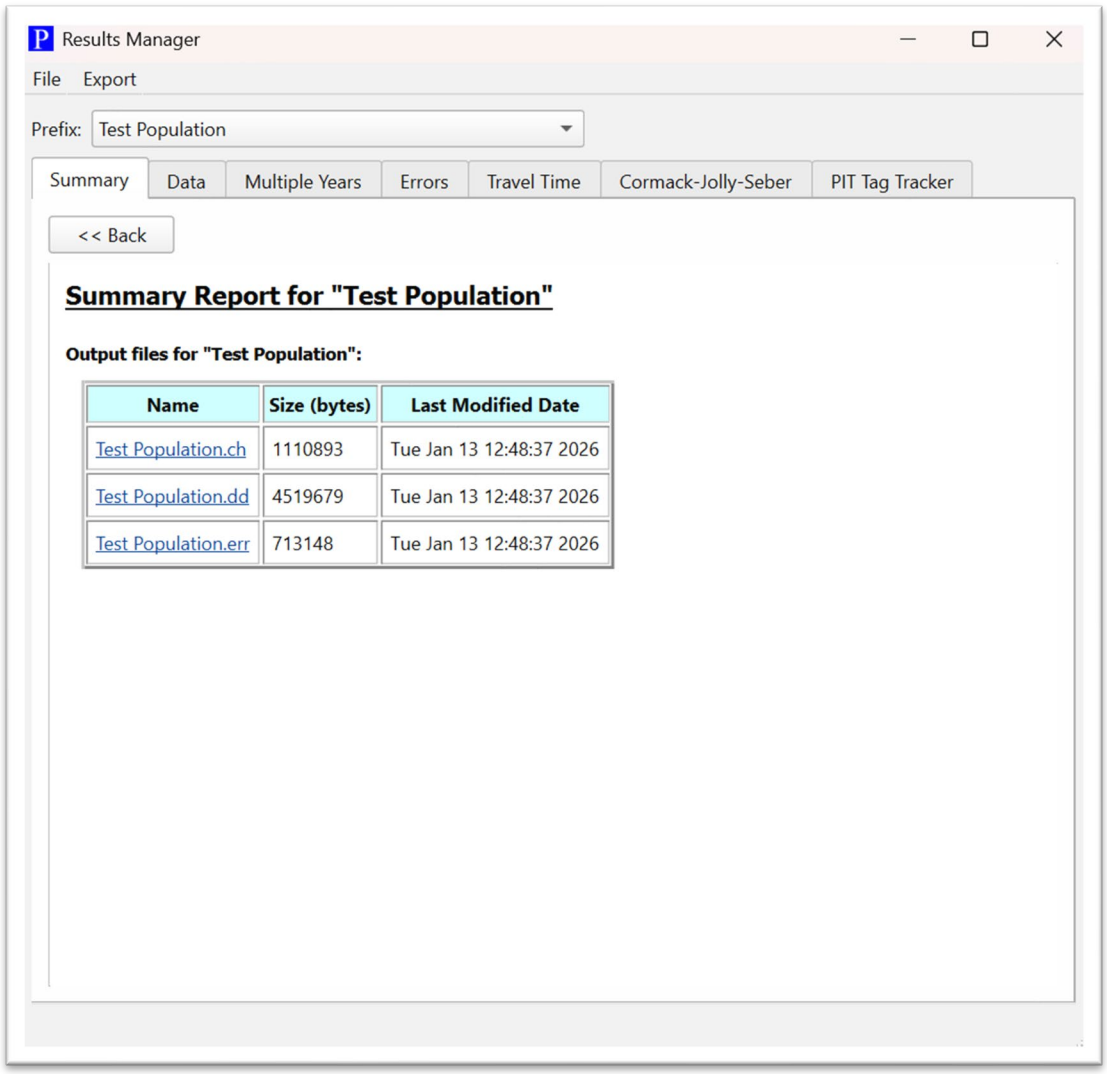


Figure 7.1. **Results Manager** — **Summary** tab.

7.2 Data

The **Data** tab lists and provides access to the data input files that were selected as the data input for the given run (Figure 7.2).

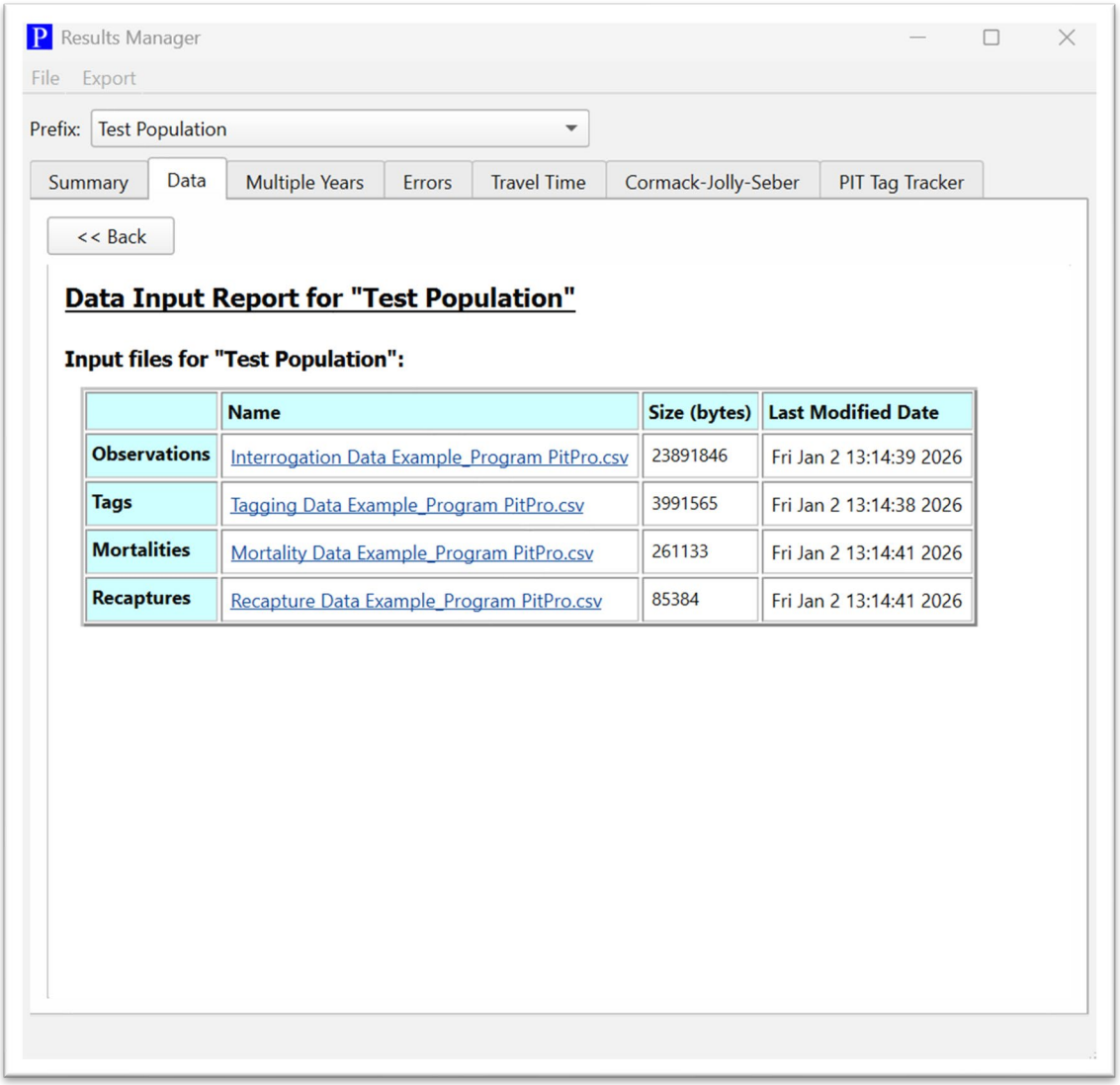


Figure 7.2. **Results Manager** — **Data** tab.

7.3 Multiple Years

The **Multiple Years** tab was a new addition to PitPro starting in version 4.23.1 (Figure 7.3). When processing data with adult detections, tags may be detected in multiple adult return years. Program ROSTER does not currently handle those, so tag IDs are provided here to indicate duplicate tag detections for removal. PitPro only identifies tags with detections in multiple adult years; it is left to the user to handle the multiple adult year detections before uploading the .ch file to Program ROSTER.

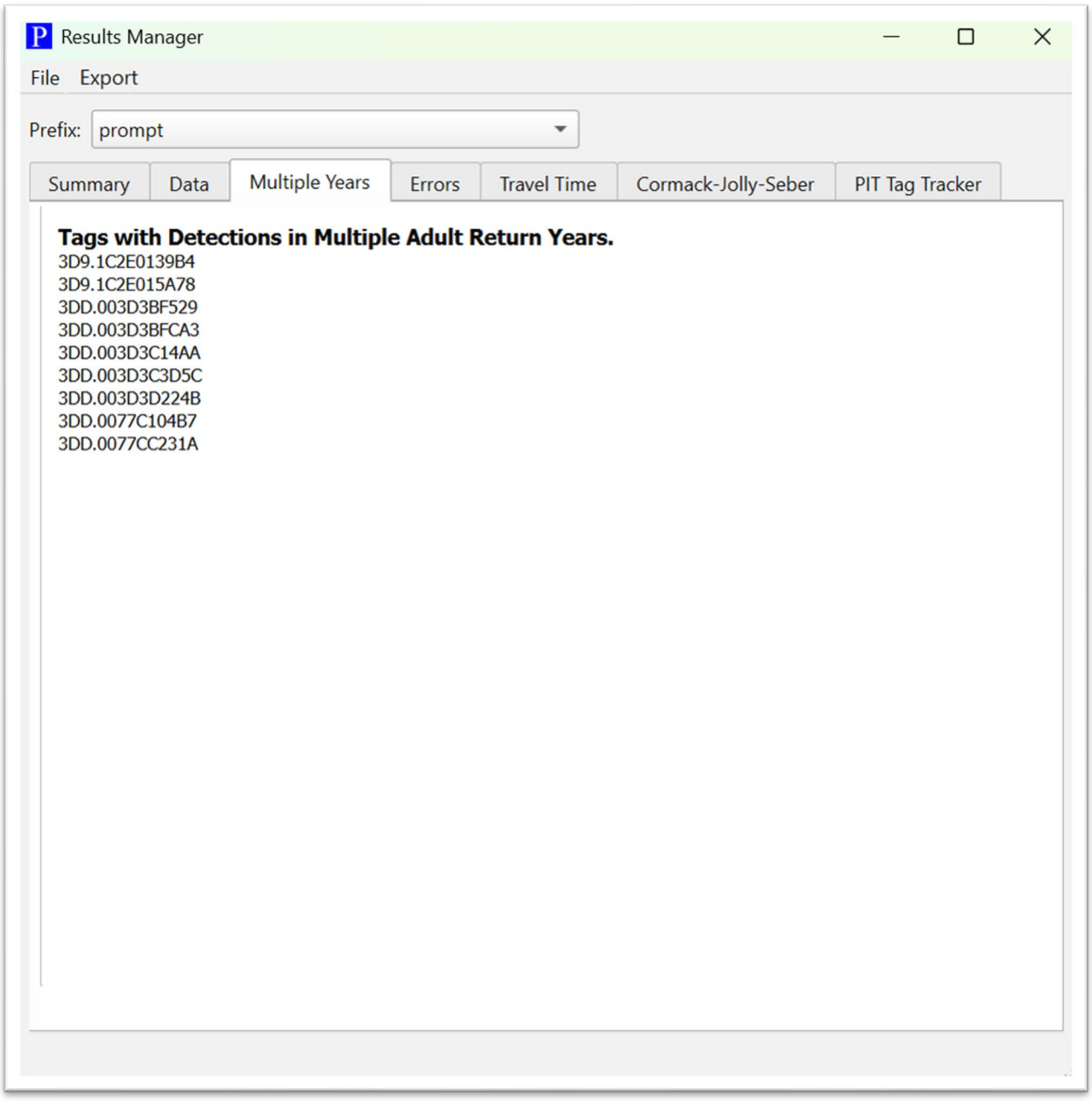


Figure 7.3. **Results Manager** — **Multiple Years** tab.

7.4 Errors

The **Errors** tab provides a summary of any errors encountered for individual fish (Figure 7.4). The table lists each possible error and the number of fish for which the

error occurred. The total number of errors is provided at the bottom of the table. This table lists the errors in the same order as they appear in the error file.

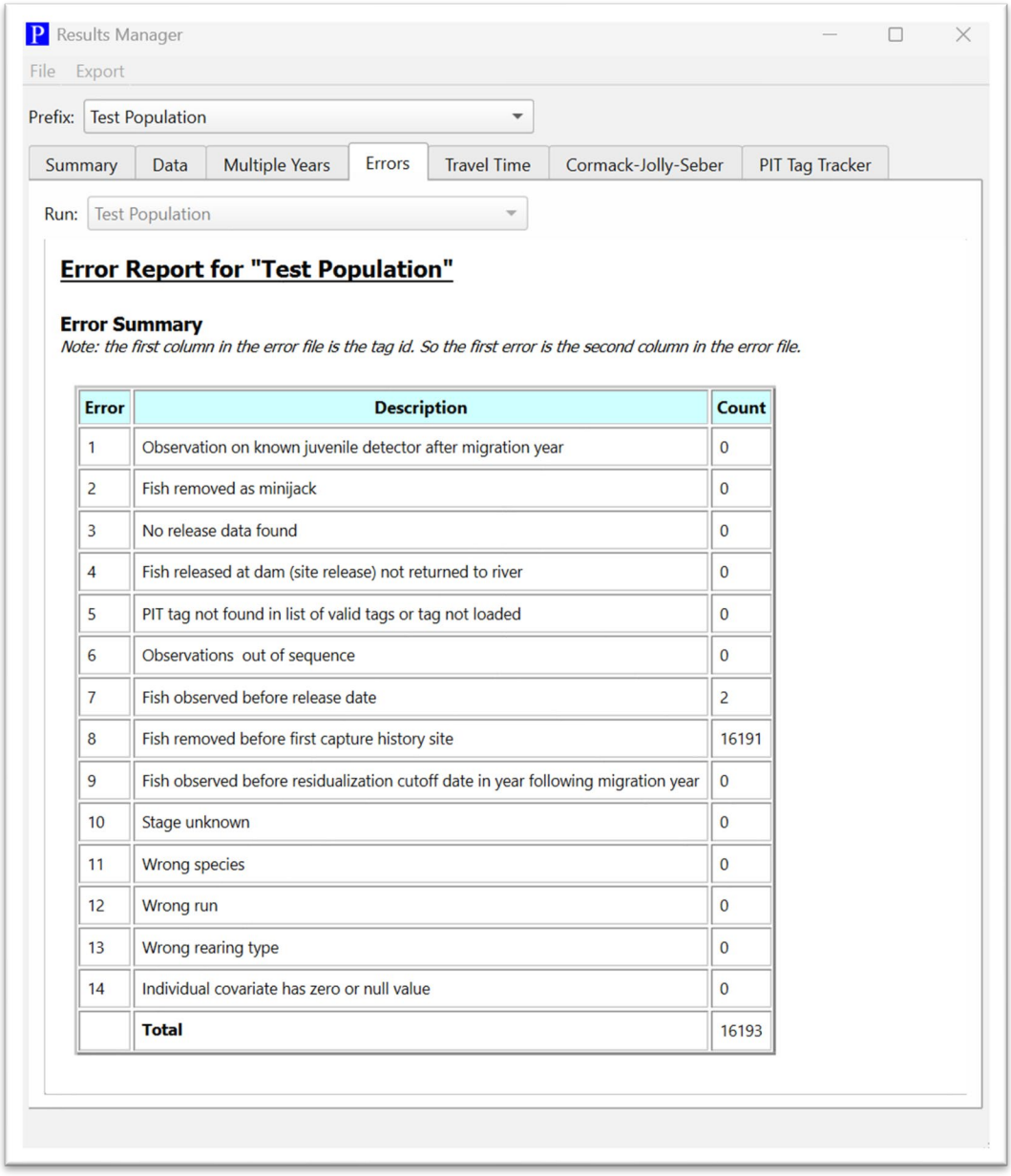
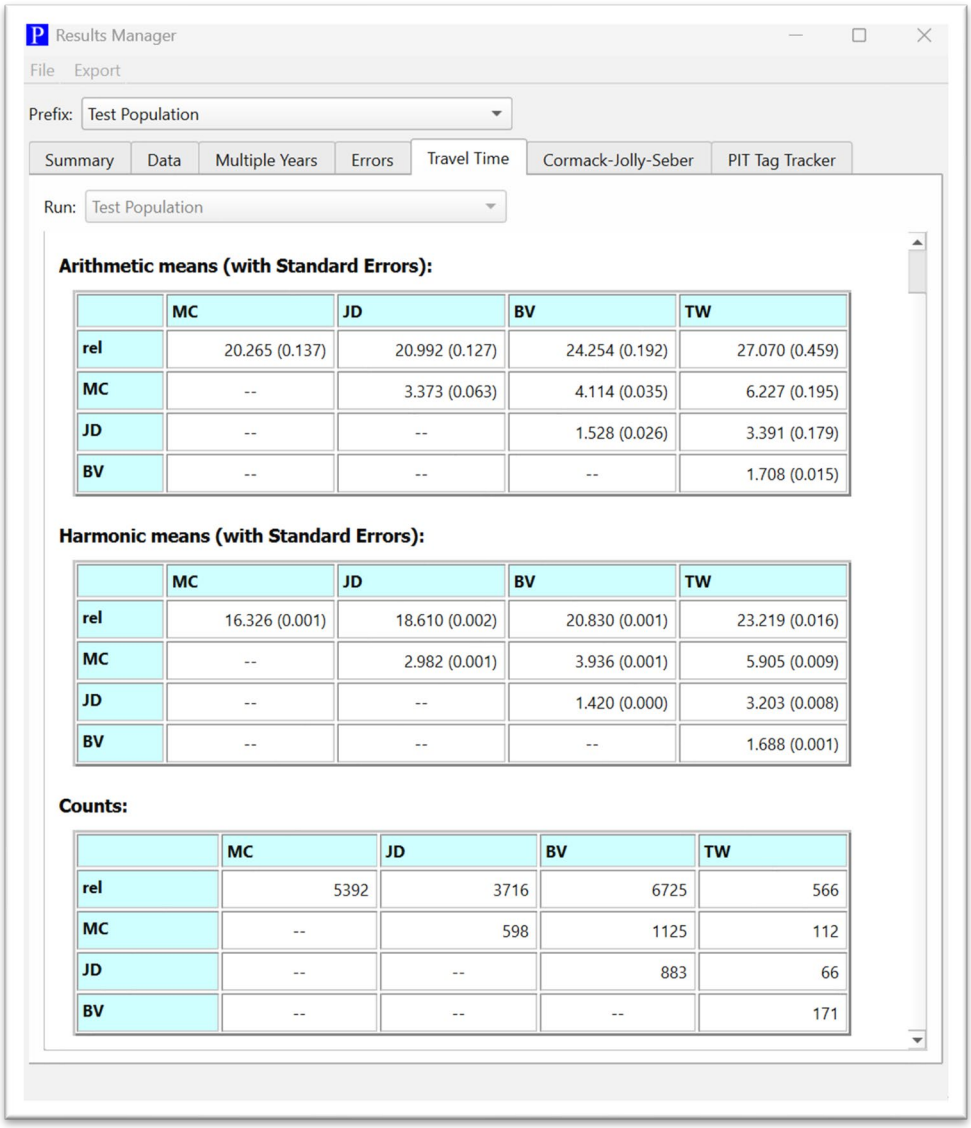


Figure 7.4. **Results Manager** — **Errors** tab.

7.5 Travel Time

The **Travel Time** tab provides arithmetic and harmonic means of travel times, corresponding standard errors, and sample sizes for all possible reaches encountered

by the study fish (Figure 7.5). These calculations are based on the **Detection date** file and will be available only if the **Detection date** file has been generated. If this tab is blank, confirm the check box for **Detection date** under **Select which files to output** in the **File** tab has been checked (see “Section 3.2.1 Selecting output file types”).



Arithmetic means (with Standard Errors):

	MC	JD	BV	TW
rel	20.265 (0.137)	20.992 (0.127)	24.254 (0.192)	27.070 (0.459)
MC	--	3.373 (0.063)	4.114 (0.035)	6.227 (0.195)
JD	--	--	1.528 (0.026)	3.391 (0.179)
BV	--	--	--	1.708 (0.015)

Harmonic means (with Standard Errors):

	MC	JD	BV	TW
rel	16.326 (0.001)	18.610 (0.002)	20.830 (0.001)	23.219 (0.016)
MC	--	2.982 (0.001)	3.936 (0.001)	5.905 (0.009)
JD	--	--	1.420 (0.000)	3.203 (0.008)
BV	--	--	--	1.688 (0.001)

Counts:

	MC	JD	BV	TW
rel	5392	3716	6725	566
MC	--	598	1125	112
JD	--	--	883	66
BV	--	--	--	171

Figure 7.5. **Results Manager** — **Travel Time** tab.

7.6 Cormack-Jolly-Seber

PitPro provides a **Cormack-Jolly-Seber** estimates tab for SURPH data output (Figure 7.6). These estimates are not valid for any results that include adult

observations, except when the adult observations occur in the last field only. There are two settings which influence the format of the output. The first setting allows users to view the parameter estimates in a single table rather than broken out into separate tables for the survival probabilities, capture (i.e., detection) probabilities, and final product (lambda). The second setting gives the users the option of showing the estimate for the final product (lambda). Some users may not want to show that estimate because it is a combined probability of survival to and detection at the last detection site and may be misinterpreted.

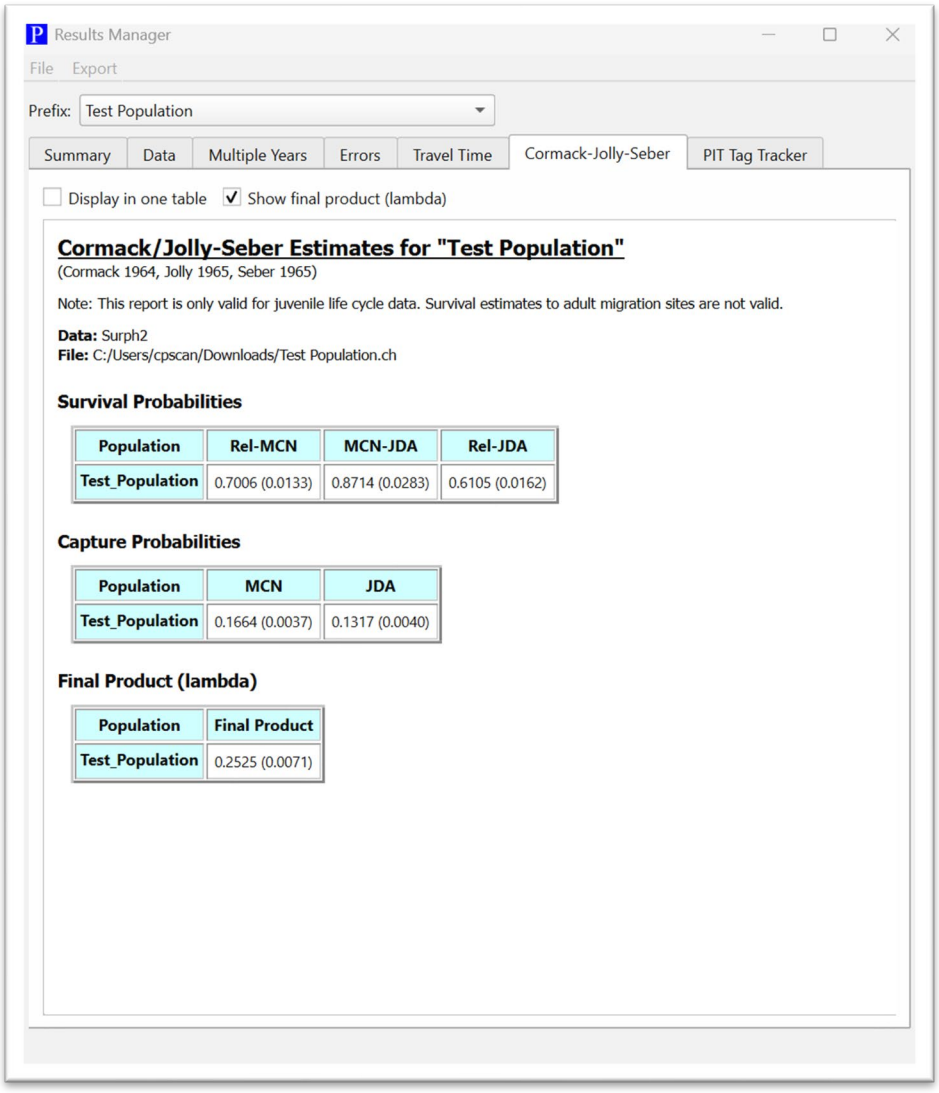


Figure 7.6. **Results Manager** — **Cormack-Jolly-Seber** tab.

7.7 PIT-Tag Tracker

The **PIT-Tag Tracker** tab allows the user to view all input and output data pertaining to an individual fish in one convenient place (Figure 7.7). This can be useful for tracking down issues that may arise in data processing. To view the data, enter a PIT code and click the **Go** button. The default view is a summary table of the capture history output and a table with interrogation input data for the fish. Check **Show details** for a full report displaying data from the observation, tag, recapture, and mortality input files, and the capture history, errors, travel time, detection date, and sequence output files.

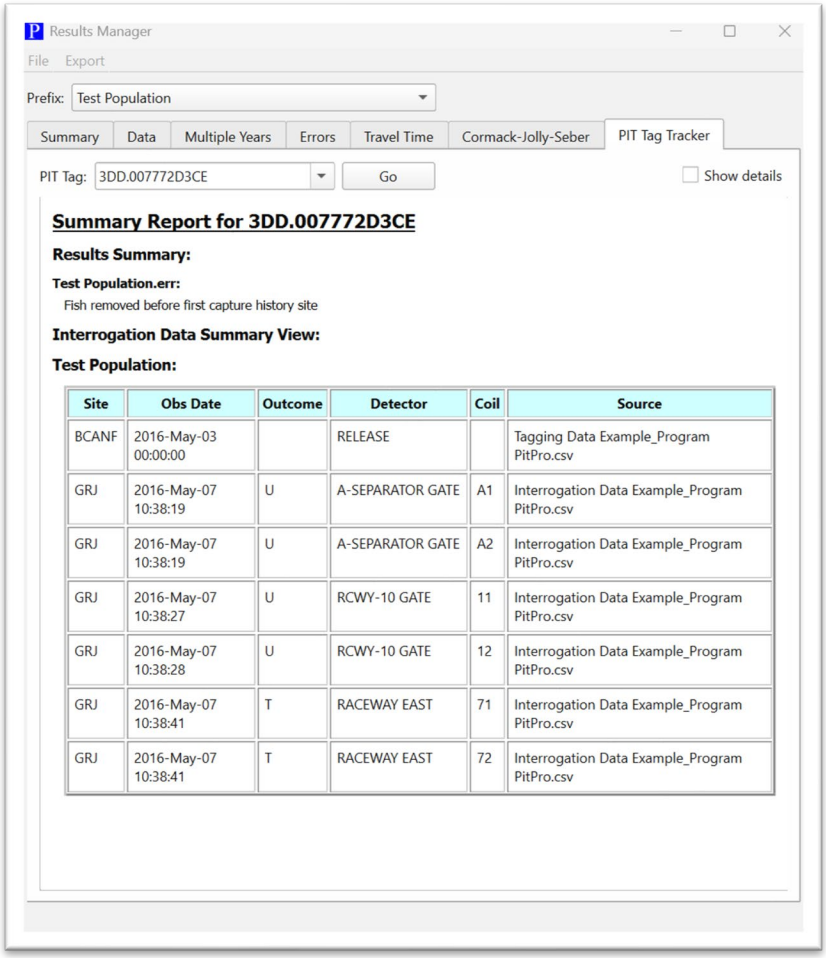


Figure 7.7. **Results Manager** — **PIT-Tag Tracker** tab.

7.8 Export Menu

Several of the results reports are available for export to .csv format. These can be accessed via the **Export** dropdown menu on the **Results Manager's** toolbar. The user can **Export Cormack-Jolly-Seber data** and **Export travel time data**. In addition, one can **Export a covariance matrix** from the CJS calculation from this menu.

Chapter 8: Check for Updates

When installing an older version of PitPro, the program will automatically detect a newer version and ask if users would like to update to that latest program version. Users can also select **Help** on the toolbar and then **Check for updates** to check if there are newer versions of the program available. In either case, the computer must be connected to the Internet. If a newer version is available, a **Found Updates for PitPro** box will appear (Figure 8.1), allowing users to click **Next** and begin installation of the latest version of the program. That screen also lists any changes and fixed bugs in the newer version. The latest version will then be installed on users' systems like any fresh install of the program from that point forward, overwriting the previous version. Please be sure to save any pertinent data loaded into the program before updating to the latest version.

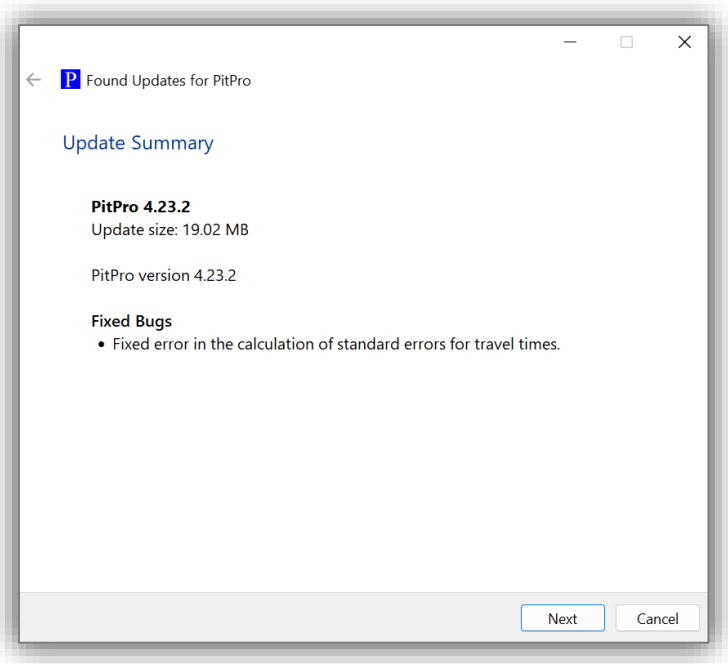


Figure 8.1. **Found Updates for PitPro** — prompts users to install any newly available versions of the program.

Chapter 9: PitPro Decision Logic

PitPro is a tool to convert raw PIT-tag data from the PTAGIS database into a format that is more easily analyzed by software provided by Columbia Basin Research. Multiple PIT-tag observations may occur for a single fish at a single detection site (e.g., a dam), representing one particular route out of many possible routes a fish may take. Although most of these routes result in fixed outcomes (e.g., returned back to the river, bypassed), some are dependent on specific activities occurring during intermittent periods at the detection site, such as transportation or sampling. As such, there are several decisions required in determining an individual's fate and the appropriateness of using the resulting detection or capture history in an analysis. Listed below is the general logic behind the processing of the PIT-tag detections of each fish. These approaches are crucial to the proper interpretation of any analysis results. Researchers using this software are encouraged to be aware of these general assumptions in order to better understand the applicability of their results. Specific logic criteria for each detection site can be viewed and altered using **Show current sites configuration…** under the **Sites** menu on the PitPro toolbar.

- At an observation site, a fish will be assigned one of three outcomes: returned to river, censored, or transported. For a censored fish, observations up to that point are used but subsequent observations are ignored.
- A monitor is a series of PIT-tag coils at an observation site. Monitors have one of five designations: return to river, hold, sample, transport, or unknown.
- All observations at a detection site are used to determine final outcome at that site. Two methods of processing those observations are available as a user option (see "Section 3.8.1 Outcome determination"):
    - use only the last observation in determining outcome (Table 9.1), or
    - give priority to censored outcomes, regardless of subsequent detections (Table 9.2).

Table 9.1: Outcome determination — last detection method

Last Detection Monitor	Outcome
Return to River	Returned to River
Transport	Transported
All others	Censored

Table 9.2. Outcome determination — removal trumps all method

Detection Monitor	Outcome
Sample	Censored
Hold	Censored
Return to river; no sample or hold	Returned to river
Transport; no sample, hold, or return to river	Transported
Unknown; no other monitor to imply specific outcome	Censored

- A transported fish is not observed again as a juvenile, unless the observation is in the estuary downstream of Bonneville Dam. Any fish observed at a dam as a juvenile subsequent to transportation at a previous site is censored at the transport site. A transported fish can be observed as an adult.
- An adult observation is assigned an ocean age class based on the number of winters between the juvenile outmigration and the adult observation. For example, if 3 winters have passed, the ocean age class is 3, which is represented by the letter “C.”
- A minijack is defined as a fish that migrates upstream before its **Juvenile cutoff date** as defined on the **Adult Settings** configuration tab. Minijacks are assigned to ocean age class 1 (“A”) or are removed as errors, at the option of the user (see “Section 3.5.4 Minijacks”).

- A recaptured fish is given an outcome of censored. The location of the outcome is based on the user-selected set of capture history fields. If the recapture site coincides with one of the capture history fields, the censored outcome applies to that site. If the recapture does not coincide with any defined capture history field, but is downstream of at least one capture history field, the censored outcome applies to the nearest prior field in sequence. If the recapture occurs in sequence before any capture history field, the fish is removed from the release group and will not be included in the program output. For instance, if the first defined capture history field is McNary Dam but the recapture occurs at Rock Island Dam, the fish will be removed.

- When a recapture site is not a specific location but instead spans a range of locations, the following policy is used. If the fish is observed at other sites, the sequence of observations is used to locate the recapture. If the recapture is the only observation of the fish, the up-river extent of the range is used for juvenile outmigration, and the down-river extent of the range is used for adult migration.

- A mortality is treated in the same way as a recapture; see above. Certain mortalities are considered to be due to natural causes. Unlike handling mortalities which, if left in, would bias the survival estimates, these mortalities occur during the natural course of events, and so are not removed from the analysis. As with any other natural mortality, the fish will simply not be observed again. Mortalities at a release site with mrr_type “Avian Colony” are ignored unless the user specifically chooses to include them using the Avian configuration tab.

- Adult fallbacks are handled in one of two ways by user option:
    - **Last route**: The final route (i.e., passage) through the system is used for capture history processing and any migration prior to fallback is ignored. For instance, if a returning adult is observed at a site, falls back to downstream of the site, and is not observed on a subsequent ascent of the site, the relevant field in the capture history will be “not detected.”

    - **Any route**: Any observation at a capture history field is included. Whether the observation occurred prior to or subsequent to a fallback is not considered.

- A fish observed anywhere before its release date is removed.
- The river km from the recapture and mortality data files are used in determining the recapture or mortality location, rather than the river km in the sites configuration file. In cases where the river kilometer (km) for a recapture or mortality is unavailable, the program will look up the pre-defined location for the site. When this site represents a range of river kms, the following policy is followed. If the recapture or mortality site is subsequent in sequence to a site with a known river km, the recapture applies to that site. If there are no such preceding sites, the upstream river km is used for juvenile-stage observations; the downstream river km is used for the adult-stage observation. It is best to include river km data in your PTAGIS queries for recapture and mortality data files. These are more precise and avoid this issue.

Chapter 10: Site Configuration

The internal logic that allows PitPro to determine fish outcome, interrogation site sorting order, names, etc., is encapsulated in the site configuration. The internal site configuration is based closely on the PTAGIS Site Configuration History available from the Pacific States Marine Fisheries Commission web server. This file is checked weekly for updates and any new or changed configuration data are automatically added to PitPro. The latest configuration updates can be added to your current version of the program through the **Sites** menu on the toolbar.

It is possible to access this internal configuration and to make changes to it, thereby changing the default program behavior. This can be useful in cases where the user has more specific knowledge about a certain interrogation site or in cases where the user needs to add an interrogation site that does not exist in the PTAGIS configuration. One way to modify the sites configuration is to save a copy of the internal site configuration, modify this file, and reload the modified sites configuration file into the program.

To view the internal sites configuration, select **Sites** on the toolbar and click **Show current sites configuration…** from the program menu to display the current configuration file. The file will be displayed in a text window in plain text format (Figure 10.1). The text window includes a Find function at the bottom to help users navigate the file. To save the internal sites configuration in a file, select **File** from the menu of the text window and then select **Save as**.

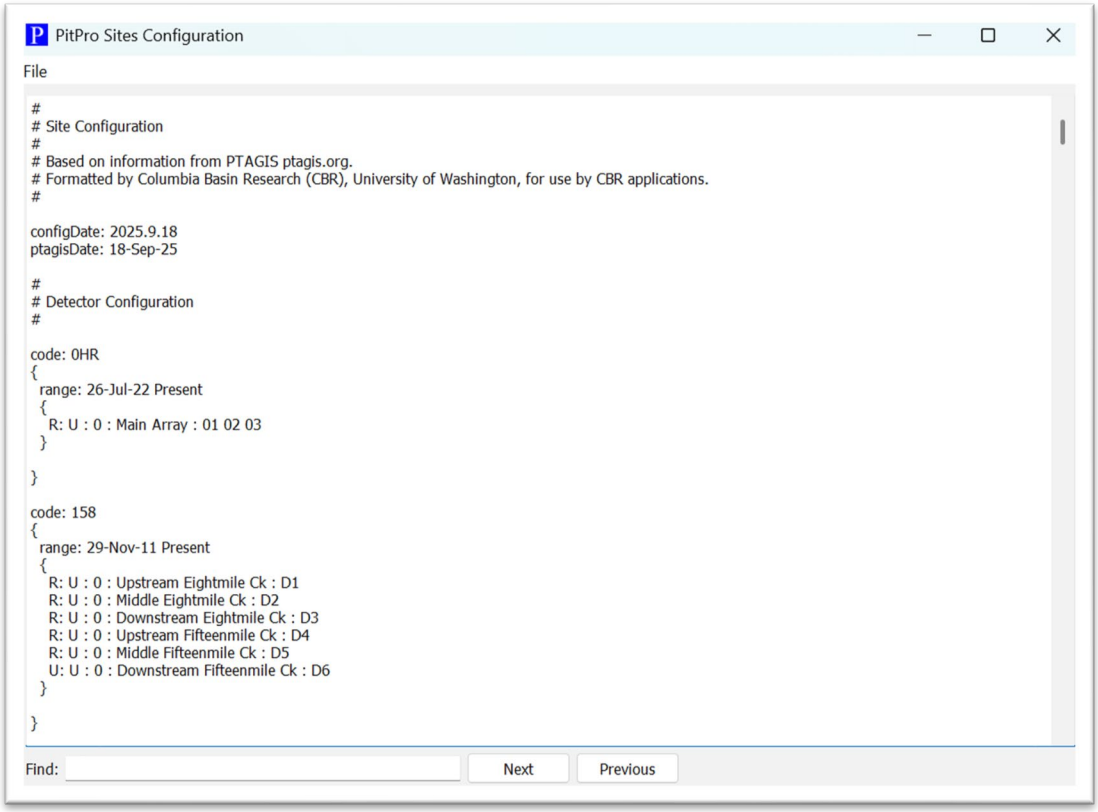


Figure 10.1. **PitPro Sites Configuration** window.

10.1 Modified Sites Configuration

If you wish to modify the sites configuration, first use an external text editor (e.g., Notepad) to make the desired modifications to the file as described below. Load the modified sites configuration file into PitPro by selecting **Sites** on the toolbar and then **Select sites configuration file**. Click **Use alternate sites configuration** and then the button with the three dots (…), and then select the saved configuration file you wish to use. Finally, click the **Apply** button to apply the changes. Now the program will use your customized sites configuration.

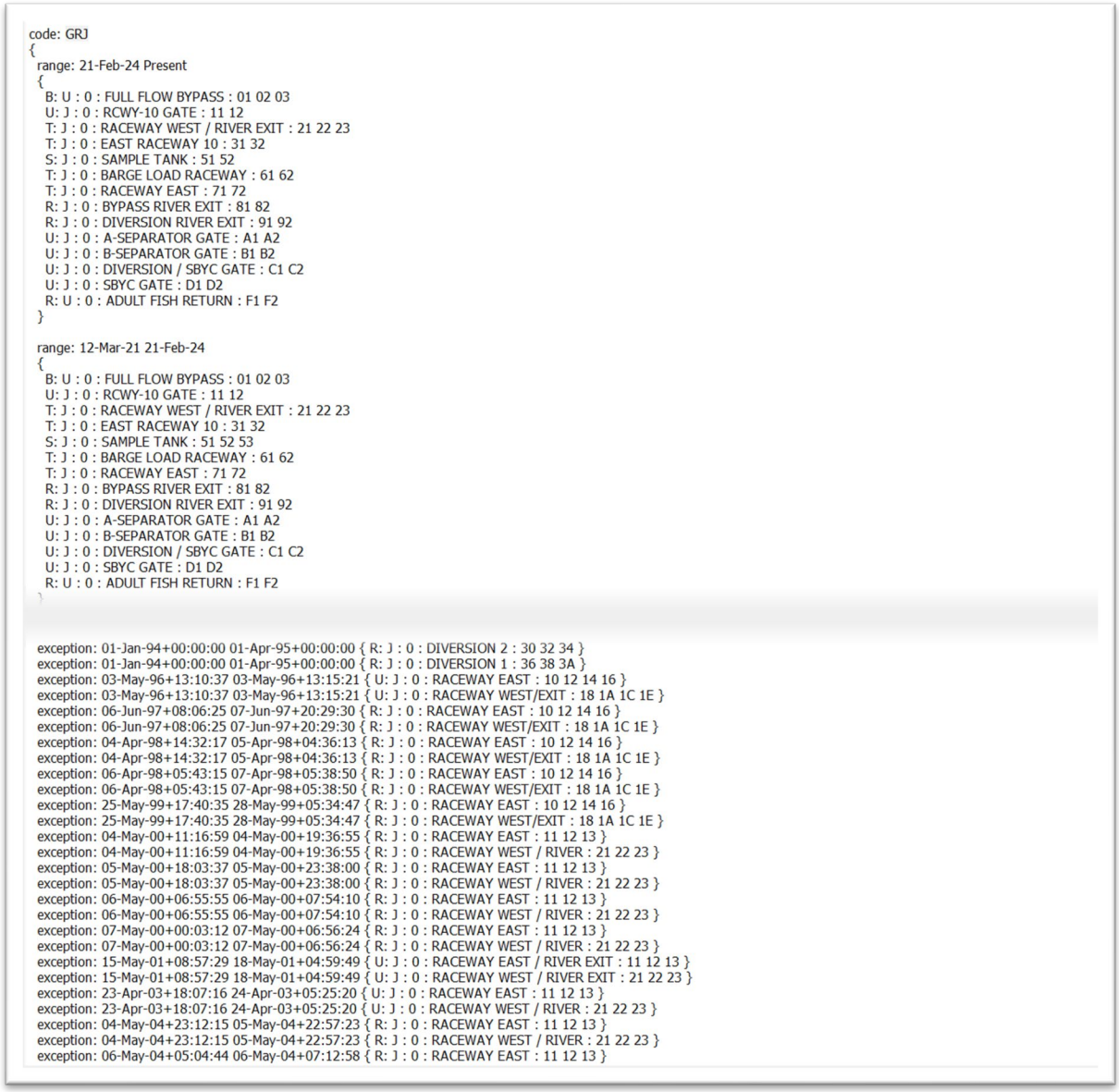
10.2 Understanding the Sites Configuration

The PitPro sites configuration is structured with three basic types of data: (1) site codes, (2) observation sites, and (3) release sites. Site codes correspond to the

PTAGIS site codes and represent particular interrogation sites: GRJ, MCJ, BO4, etc. An observation site is defined as a collection of one or more of these site codes. For instance, the Lower Granite Dam observation site (“site: gr”) encompasses the GRJ, GRX, GRS, and GRA site codes as part of its definition. These site code and observation site definitions provide the data required by PitPro to determine fish outcome. The mortality and recapture data use the release site (“relsite:”) codes for their location codes. The release site data in the site configuration file allow PitPro to determine the river km for each mortality and recapture site; note, however, that PitPro processing uses the river km from the mortality and recapture data files rather than from the sites configuration file. PitPro shares the configuration with other programs and some features of the sites configuration are not used in PitPro.

10.2.1 Site code definition

A site code is the three-letter code that represents a grouping of monitors. In the PTAGIS site configuration data, the monitor groupings and names for a given site code are grouped into time periods; when new systems are added or old system removed, a new section is added in the site configuration for the site code. The PitPro site code configuration is structured in a way similar to the PTAGIS site configuration (Figure 10.2).



```
code: GRJ
{
 range: 21-Feb-24 Present
 {
  B: U : 0 : FULL FLOW BYPASS : 01 02 03
  U: J : 0 : RCWY-10 GATE : 11 12
  T: J : 0 : RACEWAY WEST / RIVER EXIT : 21 22 23
  T: J : 0 : EAST RACEWAY 10 : 31 32
  S: J : 0 : SAMPLE TANK : 51 52
  T: J : 0 : BARGE LOAD RACEWAY : 61 62
  T: J : 0 : RACEWAY EAST : 71 72
  R: J : 0 : BYPASS RIVER EXIT : 81 82
  R: J : 0 : DIVERSION RIVER EXIT : 91 92
  U: J : 0 : A-SEPARATOR GATE : A1 A2
  U: J : 0 : B-SEPARATOR GATE : B1 B2
  U: J : 0 : DIVERSION / SBYC GATE : C1 C2
  U: J : 0 : SBYC GATE : D1 D2
  R: U : 0 : ADULT FISH RETURN : F1 F2
 }

 range: 12-Mar-21 21-Feb-24
 {
  B: U : 0 : FULL FLOW BYPASS : 01 02 03
  U: J : 0 : RCWY-10 GATE : 11 12
  T: J : 0 : RACEWAY WEST / RIVER EXIT : 21 22 23
  T: J : 0 : EAST RACEWAY 10 : 31 32
  S: J : 0 : SAMPLE TANK : 51 52 53
  T: J : 0 : BARGE LOAD RACEWAY : 61 62
  T: J : 0 : RACEWAY EAST : 71 72
  R: J : 0 : BYPASS RIVER EXIT : 81 82
  R: J : 0 : DIVERSION RIVER EXIT : 91 92
  U: J : 0 : A-SEPARATOR GATE : A1 A2
  U: J : 0 : B-SEPARATOR GATE : B1 B2
  U: J : 0 : DIVERSION / SBYC GATE : C1 C2
  U: J : 0 : SBYC GATE : D1 D2
  R: U : 0 : ADULT FISH RETURN : F1 F2
 }

 exception: 01-Jan-94+00:00:00 01-Apr-95+00:00:00 { R: J : 0 : DIVERSION 2 : 30 32 34 }
 exception: 01-Jan-94+00:00:00 01-Apr-95+00:00:00 { R: J : 0 : DIVERSION 1 : 36 38 3A }
 exception: 03-May-96+13:10:37 03-May-96+13:15:21 { U: J : 0 : RACEWAY EAST : 10 12 14 16 }
 exception: 03-May-96+13:10:37 03-May-96+13:15:21 { U: J : 0 : RACEWAY WEST/EXIT : 18 1A 1C 1E }
 exception: 06-Jun-97+08:06:25 07-Jun-97+20:29:30 { R: J : 0 : RACEWAY EAST : 10 12 14 16 }
 exception: 06-Jun-97+08:06:25 07-Jun-97+20:29:30 { R: J : 0 : RACEWAY WEST/EXIT : 18 1A 1C 1E }
 exception: 04-Apr-98+14:32:17 05-Apr-98+04:36:13 { R: J : 0 : RACEWAY EAST : 10 12 14 16 }
 exception: 04-Apr-98+14:32:17 05-Apr-98+04:36:13 { R: J : 0 : RACEWAY WEST/EXIT : 18 1A 1C 1E }
 exception: 06-Apr-98+05:43:15 07-Apr-98+05:38:50 { R: J : 0 : RACEWAY EAST : 10 12 14 16 }
 exception: 06-Apr-98+05:43:15 07-Apr-98+05:38:50 { R: J : 0 : RACEWAY WEST/EXIT : 18 1A 1C 1E }
 exception: 25-May-99+17:40:35 28-May-99+05:34:47 { R: J : 0 : RACEWAY EAST : 10 12 14 16 }
 exception: 25-May-99+17:40:35 28-May-99+05:34:47 { R: J : 0 : RACEWAY WEST/EXIT : 18 1A 1C 1E }
 exception: 04-May-00+11:16:59 04-May-00+19:36:55 { R: J : 0 : RACEWAY EAST : 11 12 13 }
 exception: 04-May-00+11:16:59 04-May-00+19:36:55 { R: J : 0 : RACEWAY WEST / RIVER : 21 22 23 }
 exception: 05-May-00+18:03:37 05-May-00+23:38:00 { R: J : 0 : RACEWAY EAST : 11 12 13 }
 exception: 05-May-00+18:03:37 05-May-00+23:38:00 { R: J : 0 : RACEWAY WEST / RIVER : 21 22 23 }
 exception: 06-May-00+06:55:55 06-May-00+07:54:10 { R: J : 0 : RACEWAY EAST : 11 12 13 }
 exception: 06-May-00+06:55:55 06-May-00+07:54:10 { R: J : 0 : RACEWAY WEST / RIVER : 21 22 23 }
 exception: 07-May-00+00:03:12 07-May-00+06:56:24 { R: J : 0 : RACEWAY EAST : 11 12 13 }
 exception: 07-May-00+00:03:12 07-May-00+06:56:24 { R: J : 0 : RACEWAY WEST / RIVER : 21 22 23 }
 exception: 15-May-01+08:57:29 18-May-01+04:59:49 { U: J : 0 : RACEWAY EAST / RIVER EXIT : 11 12 13 }
 exception: 15-May-01+08:57:29 18-May-01+04:59:49 { U: J : 0 : RACEWAY WEST / RIVER EXIT : 21 22 23 }
 exception: 23-Apr-03+18:07:16 24-Apr-03+05:25:20 { U: J : 0 : RACEWAY EAST : 11 12 13 }
 exception: 23-Apr-03+18:07:16 24-Apr-03+05:25:20 { U: J : 0 : RACEWAY WEST / RIVER : 21 22 23 }
 exception: 04-May-04+23:12:15 05-May-04+22:57:23 { R: J : 0 : RACEWAY EAST : 11 12 13 }
 exception: 04-May-04+23:12:15 05-May-04+22:57:23 { R: J : 0 : RACEWAY WEST / RIVER : 21 22 23 }
 exception: 06-May-04+05:04:44 06-May-04+07:12:58 { R: J : 0 : RACEWAY EAST : 11 12 13 }
```

Figure 10.2. Site configuration — site code. Defines a site code, closely mirroring the PTAGIS site configuration, with augmented configuration for non-standard cases. Note: figure omits full range of date range configurations to show exceptions at end of site code.

Within one site code configuration can be one or more date ranges and any number of exception cases, which override the standard configuration during a given time period. Within a date range is a series of monitor configurations giving the outcome, coils, life stages, and ascent order (for adult ladders) associated with the

monitor. Each exception case gives the same information as well as a date range but takes precedence over the standard site code configuration for the time period. These are configurations that deviate from the PTAGIS site configuration and have been added to the PitPro configuration over the years as these exception cases become known.

When processing data, PitPro looks for a match of the observed site code (e.g., GRJ), then the correct configuration range based on the observation date, finds the coil within the date range configuration, and then returns the relevant information, especially disposition and life stage. When assigning the disposition to a capture history field, the program matches the disposition to the capture history field using the river km, type, and stage fields in the observation site configurations (Figure 10.3).

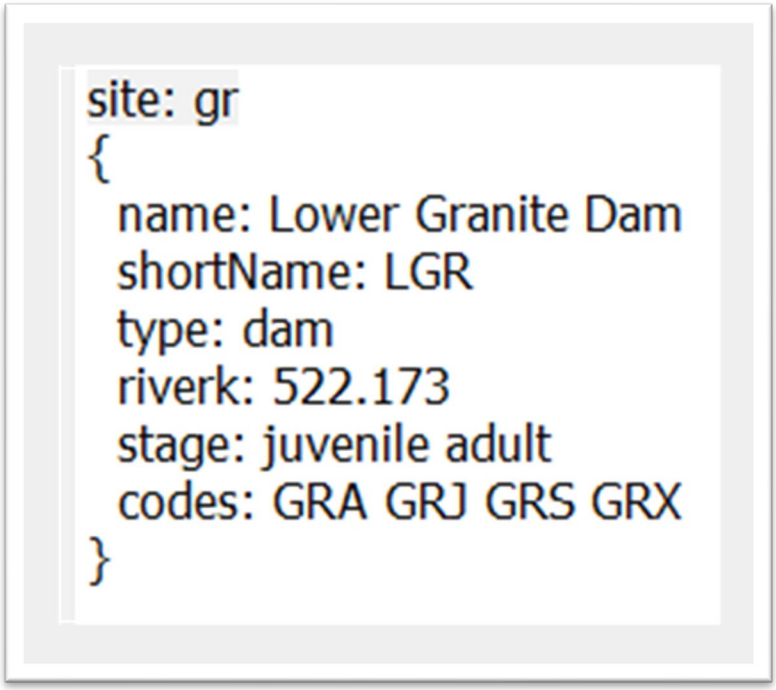


Figure 10.3. Site configuration — observation site. Defines a grouping of site codes, along with site-specific information, useful for sorting and stage determination.

10.2.1.1. Range

A range definition defines a date range for which the enclosed configuration applies. The date range is defined within a site code configuration. The date range

encloses a series of definitions, each consisting of one line pertaining to a particular monitor, with each field separated by a colon (":"). The first field is the indicated disposition: "U," "R," "B," "S," "T," or "H" mean unknown, returned to river, bypasses, sampled, transported, or held, respectively. Depending on how the program is configured, this disposition can stand alone (i.e., be the final determination of disposition) or can be combined with other observations to determine the final disposition for the given site.

The second field indicates the life stage of fish that can be detected on this monitor, where "A" indicates an adult monitor, "J" a juvenile monitor, and "U" unknown. The third field provides an ordering to the monitor, which is used only for adult ladders and fallback calculations and is not used in PitPro. The fourth field is the monitor name. The final field gives a listing of the coils for the monitor. For historical reasons, PitPro has always used the coils instead of the monitor names in the observation data file; coil names and monitor names are basically synonyms, however, when looking at one site code and a specific date range.

10.2.1.2 Exception

An exception case occurs when actual site configuration is found to differ from the standard site configuration as defined by PTAGIS. These exception cases have been discovered over the years and appended to the PitPro configuration. They are listed at the end of the configuration for a given site code but take precedence over the normal configuration.

The format consists of a start date for the exception, an end date, and a monitor definition, enclosed in braces. For instance, based on the definition in Figure 10.2, an observation at GRJ on May 16, 2001, on the RACEWAY EAST monitor (coil 11, 12, or 13) would be flagged with a disposition of "R" (returned to river) instead of "T," as indicated by the standard configuration.

The start date is **inclusive** to the specified actions, while the end date is **not inclusive**. This format ensures that there are no gaps in the defined actions at a site.

10.2.2 Observation site definition

An observation site is a grouping of site codes. For instance, the observation site Lower Granite Dam has used four site codes (what PTAGIS calls sites) over the years: GRA, GRJ, GRS, and GRX. PitPro uses these codes for matching observations by site code to the correct field in the capture history. A field is a one-to-one match with an observation site, as defined here.

The observation site definition also provides the river km of the site for use in ordering the capture history fields. The life stages that can be observed at the site are given. For instance, as indicated in Figure 10.3, both juvenile and adult observations are possible at Lower Granite Dam. The type of site is defined as one of the following: dam, instream, trap, or acclimation. These are used in filtering sites for output but are not used by PitPro. Text labels are also defined here. By changing these labels, the output can be customized to a small degree.

10.2.3 Release site definition

A release site is location or collection of locations where fish are initially released, recaptured, released after recapture, or marked as a mortality. Some release sites represent precise locations denoted by a single river km while others represent a reach, denoted by a range of river kms, and others represent an entire stream, in which case no river km is included. The information included for each release site is the site code name as used in PTAGIS, a long form version of the name, the river km (if relevant), and the hydrologic unit code (i.e., HUC) (Figure 10.4).

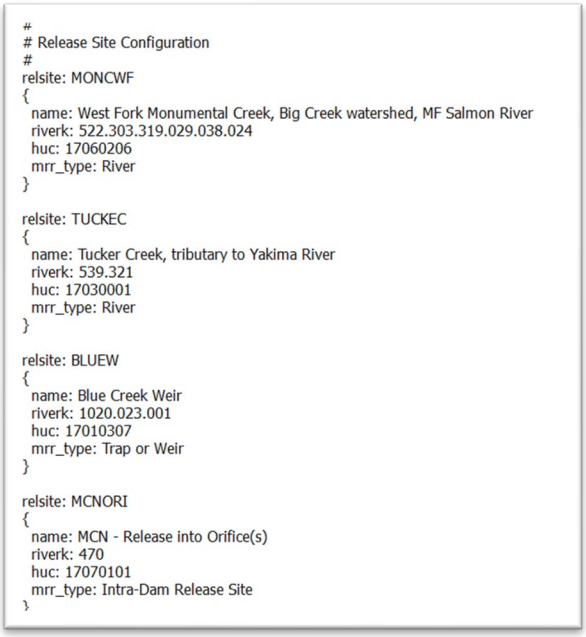


Figure 10.4. Site configuration — release site definition.

Chapter 11: PTAGIS

PIT-tag data are available from the PIT Tag Information System (PTAGIS) of the Pacific States Marine Fisheries Commission. To access the PTAGIS database and download data you will need to create an account. The information about PTAGIS found in this document is valid at the time of publication (November 2025) but is subject to change.

Instructions for creating an account and running queries can be found on the Columbia Basin PIT Tag Information System (PTAGIS) site.

After logging on to PTAGIS, click on the **Advanced Reporting Home Page** under **Advanced Reporting Links** (Figure 11.1), then select **Standard Reports** and then **PitPro**. From there you can choose which input files you wish to create: **PitPro Interrogation Detail**, **PitPro Tagging**, **PitPro Recapture**, or **PitPro Mortality.**

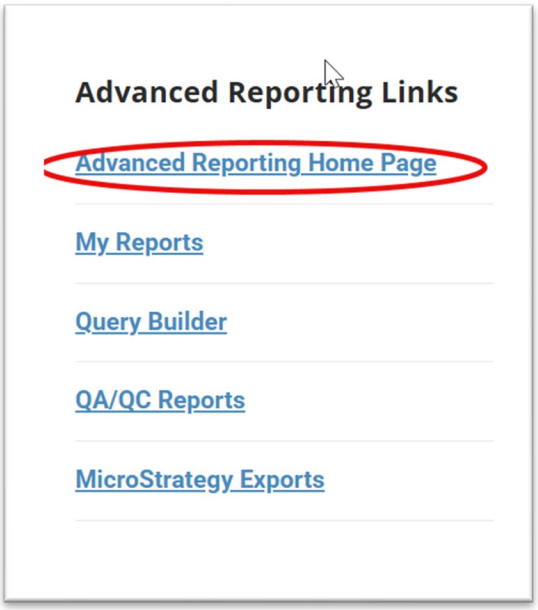


Figure 11.1. Main PTAGIS Dashboard showing the **Advanced Reporting Links** and the **Advanced Reporting Home Page** that leads the user to PitPro input file creation.

From there, the process is as follows: select from an array of filter options that pertain to the input file that you're trying to create (i.e., if you were generating an **Interrogation Detail** file, you would at least want to include **Obs Site** and **Obs Time**), give the query a name, and run the report. Once the query has been run, it can be saved inside the PTAGIS system for future use. Data will be sorted by tag ID when processed by PitPro. No further sorting is required.

After running the query, click on the arrow/triangle icon next to **Report Home** and then click **Export** and then **CSV file format** to export your created data as a file that can be loaded into PitPro. Data downloaded from PTAGIS in .csv file format are compatible with PitPro, and no additional processing should be required. Users may wish to rename the files to make it easier to select the appropriate file in PitPro. If the data are to be processed by a relational database (e.g., Access) or a spreadsheet (e.g., Excel), care must be taken to preserve the correct field order and format, paying special attention to the date format.

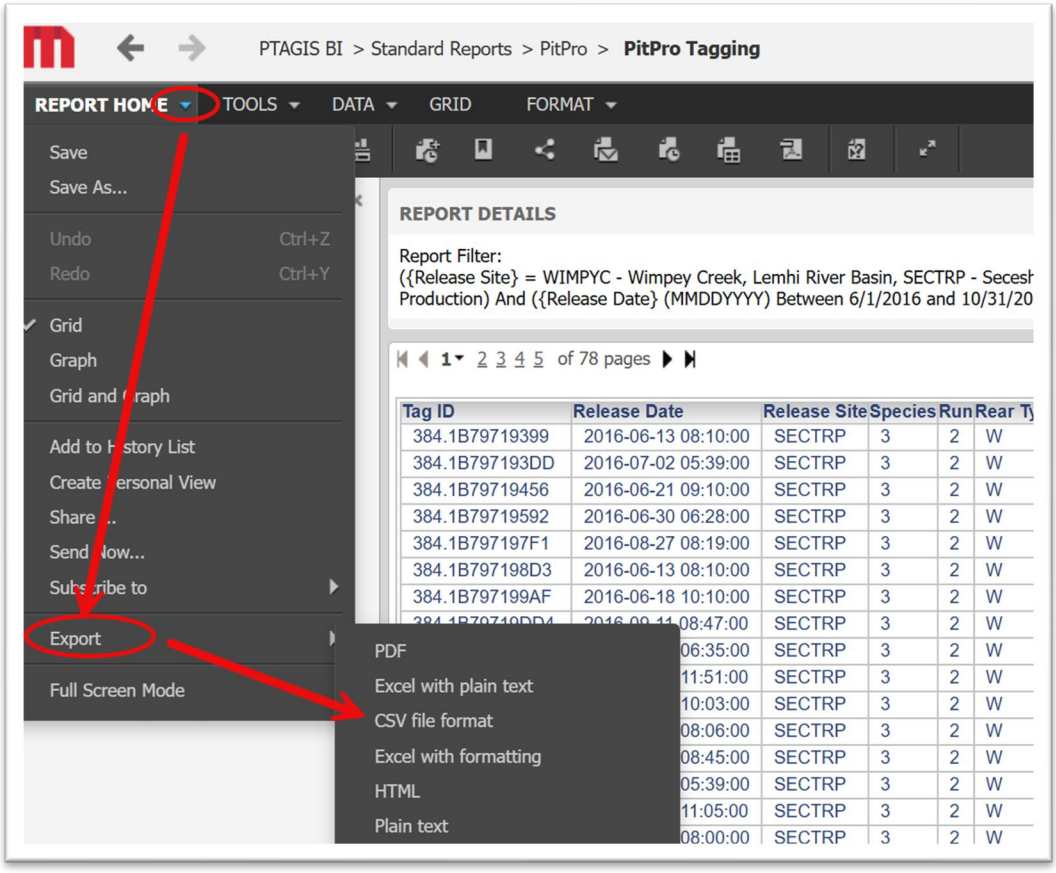


Figure 11.2. Exporting PTAGIS queries as .csv files for use in PitPro.

Screen shots of the PTAGIS selection indexes for each of the data input types, or data sources, are provided in this document. PTAGIS has made default queries for PitPro's four data input sources available: **PitPro Interrogation Detail** (Figure 11.3), **PitPro Tagging** (Figure 11.4), **PitPro Recapture** (Figure 11.5), and **PitPro Mortality** queries (Figure 11.6).

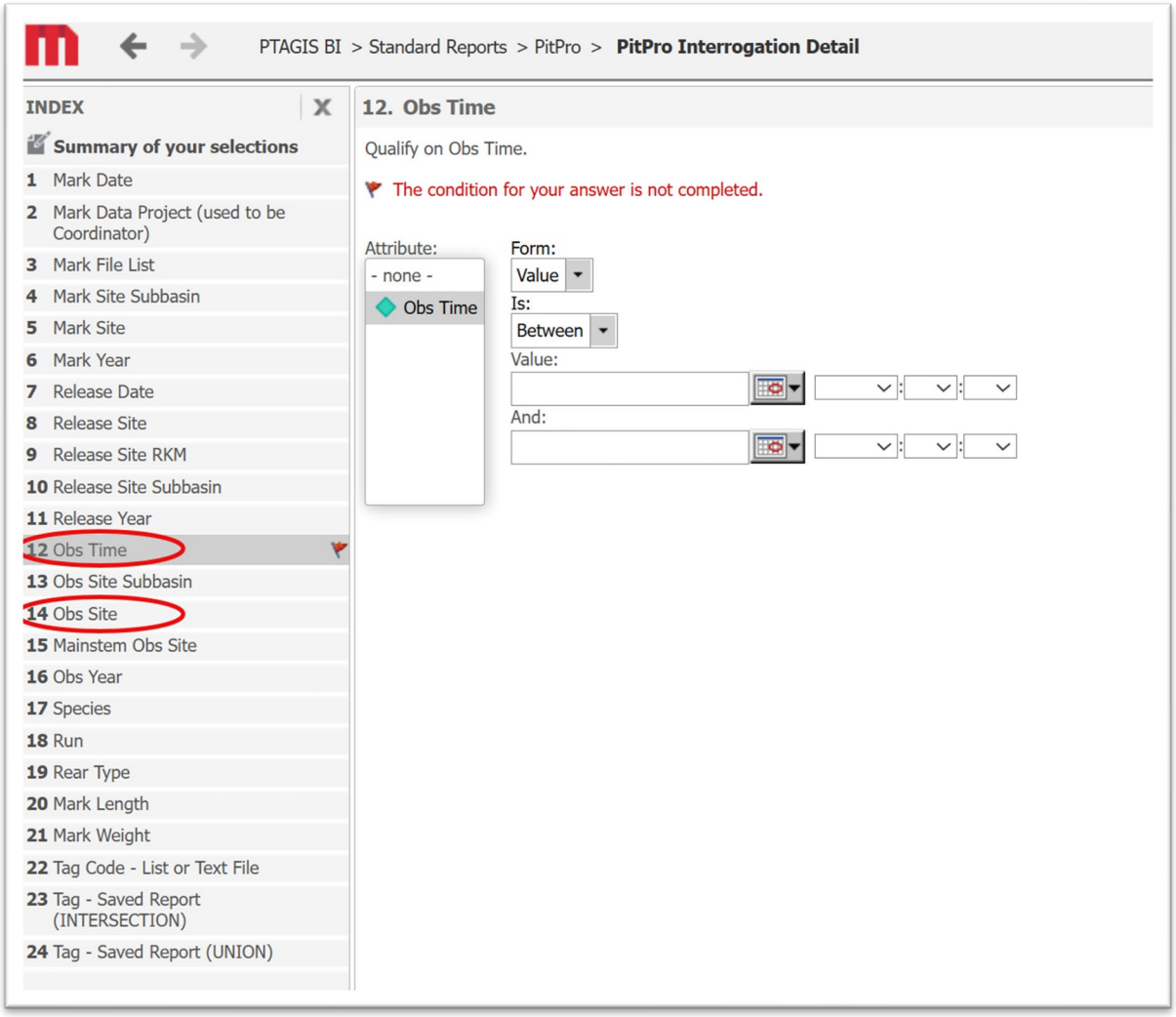


Figure 11.3. PTAGIS — **PitPro Interrogation Detail** query setup screen with **Obs Time** selected. At the least, to produce a PitPro-usable file the user would set the **Obs Time** and **Obs Site** to produce an applicable input file.

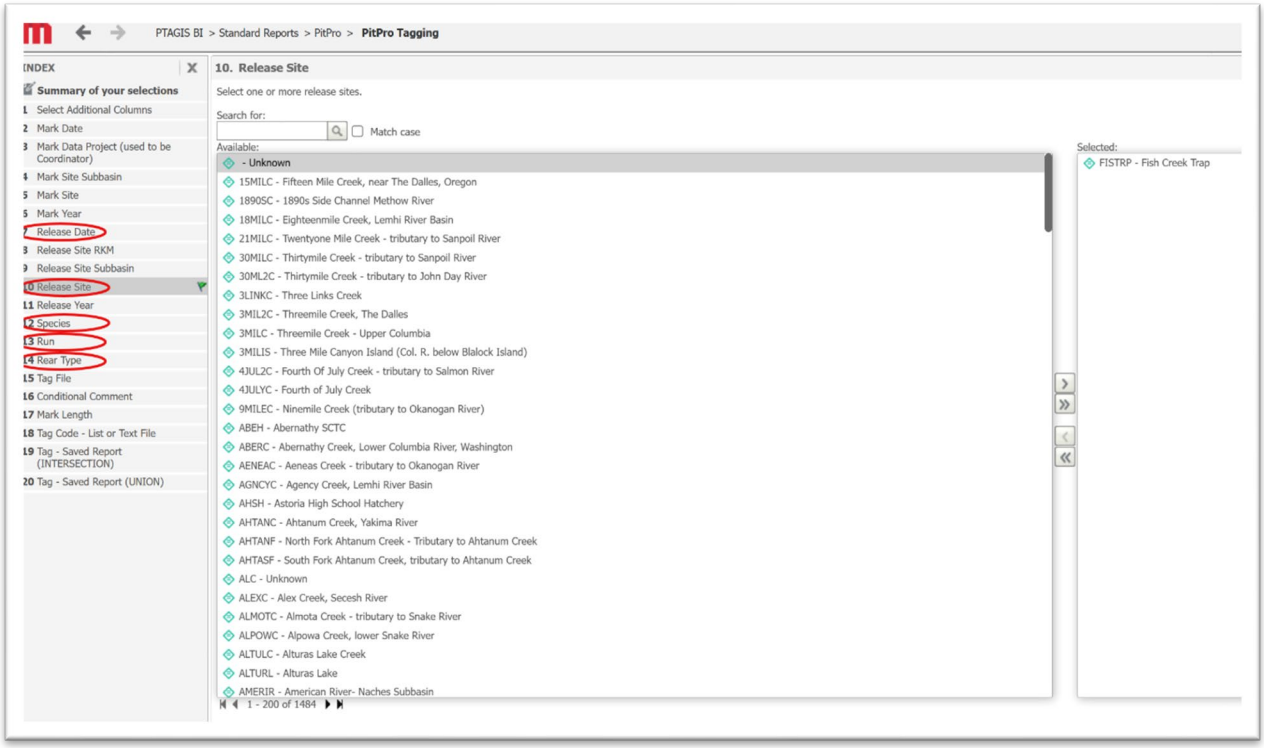


Figure 11.4. PTAGIS — **PitPro Tagging** query setup screen with **Release Site** selected and FISTRP site added. At the least, to produce a PitPro-usable file the user would set the **Release Date**, **Release Site**, **Species**, **Run**, and **Rear Type** to produce an applicable input file.

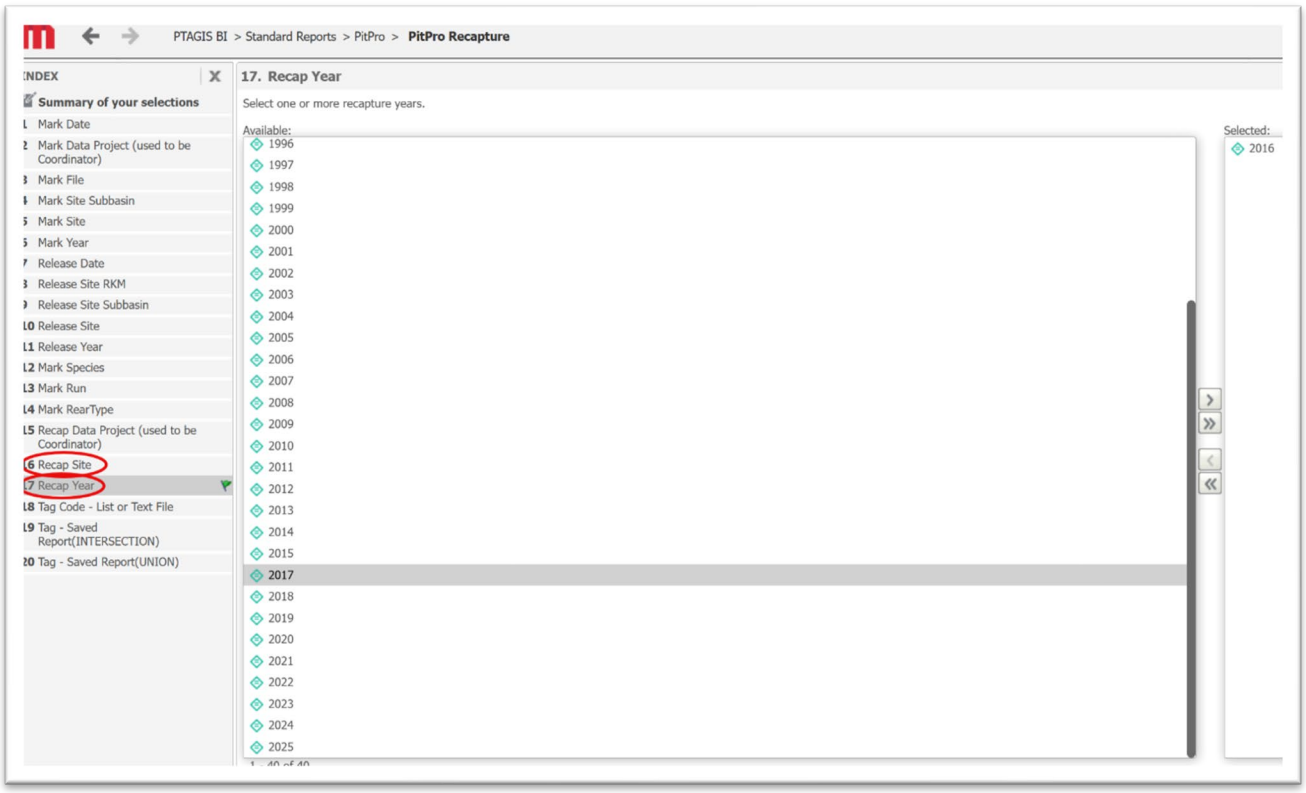


Figure 11.5. PTAGIS — **PitPro Recapture** query setup screen with **Recap Year** selected and 2016 site added. At the least, to produce a PitPro-usable file the user would set the **Recap Year** and **Recap Site** to produce an applicable input file.

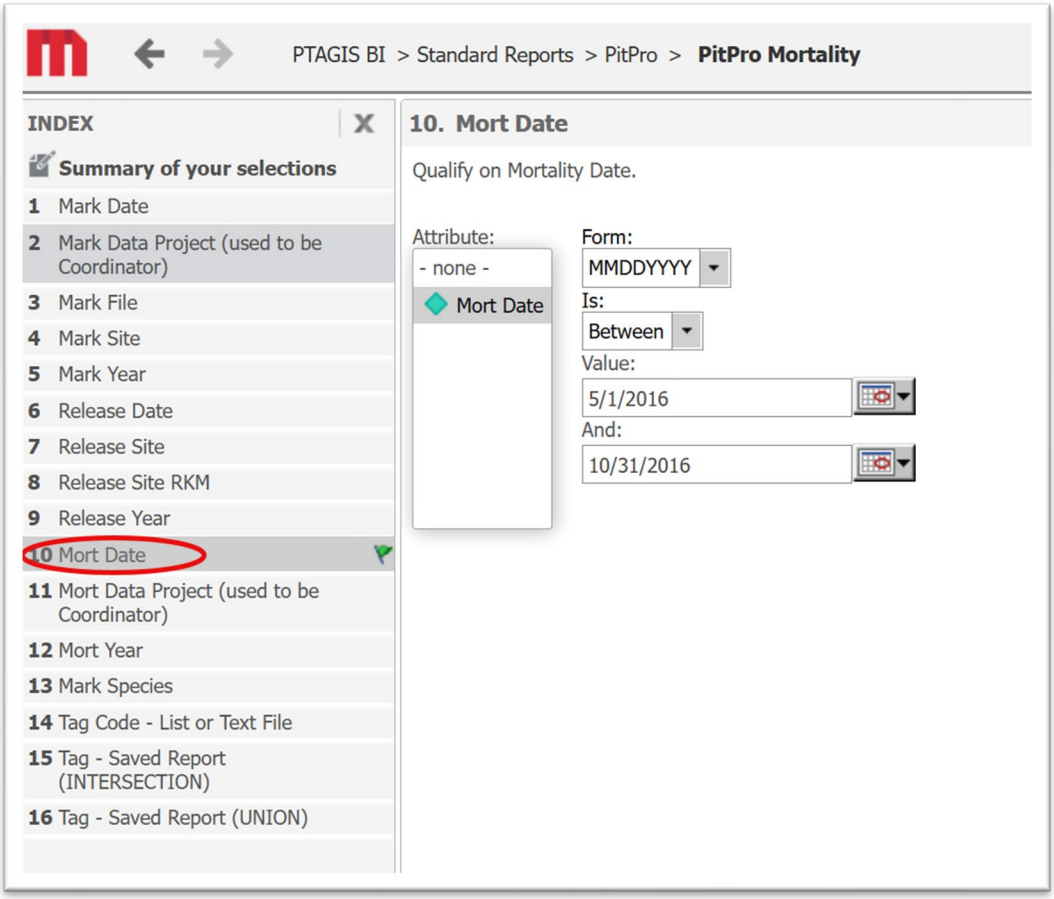
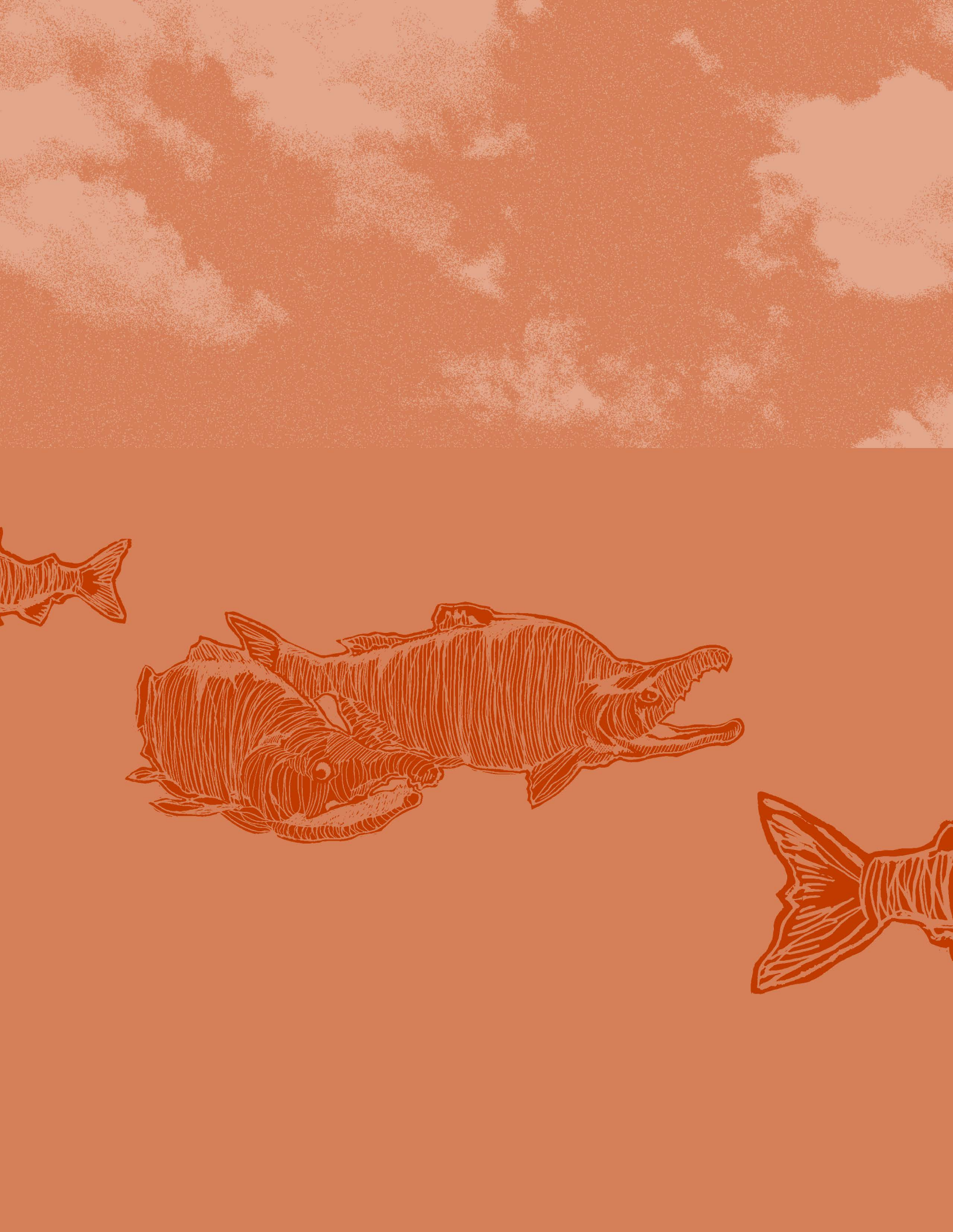


Figure 11.6. PTAGIS — **PitPro Mortality** query setup screen with **Mort Date** selected and range between 5/1/2016 and 10/31/1016 entered. At the least, to produce a PitPro-usable file the user would set the **Mort Date** or **Mort Year** to produce an applicable input file.

Chapter 12 : Acknowledgments

This research is continually supported by the Bonneville Power Administration under project number 1989-107-00. We would also like to thank Pacific States Marine Fisheries Commission and PTAGIS for providing access to PIT-tag data, and the U.S. Army Corps of Engineers for providing access to facility bypass reports.