

TIMELAPSE User Guide

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Abstract. *Camera traps (aka trail / game / remote cameras)* are field-deployable cameras placed at strategic locations, where they automatically take images (and even videos) at either regular intervals (e.g., every 5 minutes, every hour), or when motion is detected (e.g., an animal or person moving through the scene). Scientists use camera traps for many purposes: to track and count entities (such as people and wildlife) and to track conditions that occur in a particular place over time (such as weather and visibility). A technician usually retrieves the camera's card (e.g., after several months), and organizes the captured images into one or more computer folders as an *image set* (the set of images and videos captured by that camera). An analyst then visually examines each image and video for features of interest to their project, and encodes data describing those features.

The two tools described in this manual simplify this last visual examination and encoding step. In brief, the project manager uses the **TIMELAPSETEMPLATEEDITOR** to create a custom template that defines the project-specific data that he or she wants an analyst to encode. An analyst then uses **TIMELAPSE** to open that template and one or more folders containing images and/or videos (the image set). TIMELAPSE automatically goes through all images and extracts information from them (e.g., file name, date and time taken). The TIMELAPSE interface then displays a series of fill-in fields corresponding to the desired data as specified in the template, along with the image or video. The analyst then goes through each image and video, where he or she encodes data by typing into fields, by selecting from menus, or (for counting) simply clicking on entities seen in the image.

Because much data entry is repetitive, TIMELAPSE includes various means to copy encoded data over a group of images and videos. Because the analyst may have to find and identify small details in an image or video, TIMELAPSE includes a magnifying glass, pan and zoom capabilities (where switching images will keep the same pan/zoom levels), and image enhancement methods. The analyst can also examine and encode multiple images at the same time via an overview. Because the project manager may use other software to analyzed the data (Excel, databases, statistical packages, R), data is stored in a standard SQLite database, which can be exported as a CSV file readable by most spreadsheet packages. TIMELAPSE has many other features that are described in this manual.

Finally, TIMELAPSE can incorporate image recognition data produced by a 3rd party (currently Microsoft), where the analyst can use that data for a more efficient workflow. A recognized entity is currently classified as a person or animal (along with a confidence of correctness), and a bounding box is drawn around it. The analyst can select and inspect image subsets by its recognized type and confidence level.

Note. This manual describes version 2.2.4.3 of TIMELAPSE. The software is updated over time, mostly in response to feedback from people like you. Thus some of the information and/or features described in this manual may change. Check for new versions of the software and this manual at <http://saul.cpsc.ucalgary.ca/timelapse>

Users of the much older Timelapse1 system. If you need to migrate your old CodeTemplate.xml and ImageData.xml files to work with Timelapse2, the [Timelapse Download and Installation website page](#) contains a (short) manual that explains how to convert those files to the new format.

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Part 1. TIMELAPSE

Don't Panic!

The length of this tutorial manual may give the impression that using TIMELAPSE is difficult. It isn't. The tutorial is long only because it provides step by step details (and lots of images). It also includes several parts that may not be relevant to all readers.

Part 1 explains and provides a tutorial on how to use TIMELAPSE. This is the tool used by the analyst (the person analyzing images). The analyst is usually provided with one or more folders containing the images and/or videos to analyze (collectively called an **image set**), and a **template** that defines the project-specific data to be encoded. The analyst begins by using TIMELAPSE to open the template and folder(s).

Part 2 explains and provides a tutorial on how to use the TIMELAPSETEMPLATEEDITOR. This tool is used by the project manager to create a custom template that defines the project-specific data that he or she wants the analyst to encode.

The remaining parts are likely relevant to a small number of users.

Part 3 explains how 3rd party image recognition data can be imported and used. This is only of interest if you have a partnership with an agency that produces recognition data, which is currently limited to Microsoft.

Part 4 explains the internal structure of the SQLite database tables created by TIMELAPSE. This is only of interest if you want to access the data directly from the database rather than from the exported CSV spreadsheet.

Note. What you see when you run the TIMELAPSE program may not exactly match the screen images in this manual, due to updates made in the program after the screen images were taken. These are mostly minor visual differences, and / or added features that should not affect your general understanding.

1 Getting Ready

You will need to do several things to get ready for this tutorial.

- have a computer running Microsoft Windows,
- download the TIMELAPSE software,
- download a sample folder containing various images and videos and other necessary files.

Your Computer

Hardware. Timelapse does not require any specialized computer hardware. However, it will perform best on a fast modern computer with a reasonable amount of memory. Because you will be reviewing many images, it's best to have them stored on a (fast) local hard drive rather than a slow network drive.

Mouse with a scroll wheel. Some interactions (such as zooming) are operated by the mouse scroll wheel.

Microsoft Windows. TIMELAPSE runs within most versions of Microsoft Windows. It should run on an Apple computer running a Windows emulator. It does not run on Apple OS/X.

Good quality screen. In our experience, the larger your screen and the better its resolution, the easier it will be for you to examine your images, especially if you are looking for small details in the image.

Software License. Timelapse is licensed under the Creative Commons Attribution-Non-commercial-ShareAlike 4.0 International license. See the Timelapse web site for license details.

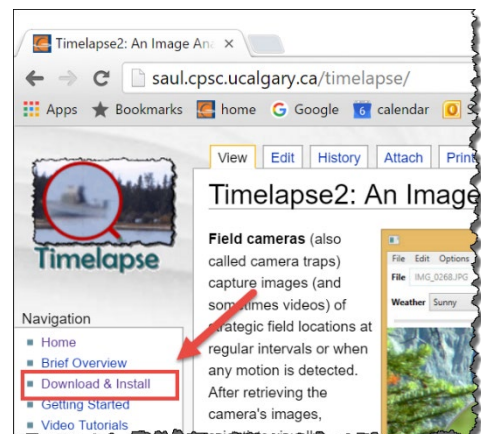
Technical Note. TIMELAPSE requires **Microsoft's .Net framework 4.5**. If you've kept up with Microsoft updates, it is likely already installed on your computer.

However, if you find TIMELAPSE 'crashing' on start-up, it is likely because the correct .Net framework isn't installed. The [TIMELAPSE download page](#) on the TIMELAPSE website provides links that will let you install the .Net framework (this just involves a few button presses – no technical knowledge needed). Alternately, if your machine is managed by an IT person (and likely locked down), you can ask them to install .Net 4.5 if it is missing.

Downloading the TIMELAPSE Software

Downloading the software should be straight-forward.

1. Go to <http://saul.cpsc.ucalgary.ca/timelapse>. You will see a *Download & Install* link on the left side of that page.



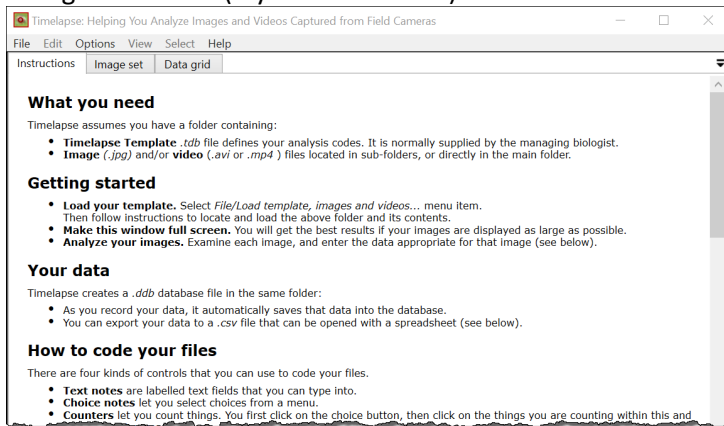
2. Select the **Download & Install** link. You should see something like this section on that page. Follow those instructions closely. Download and uncompress the software and put it in a location of your choosing.

Required Download: The Timelapse Software

- **Select [Timelapse 2 Image Analyser / Template Editor](#) -- as a zip file**

1. Download the zip file
2. Open the zip file (e.g., by double clicking it) and extract the Timelapse2 folder to a place of your choosing (e.g., your Desktop or your My Documents folder).
3. Open the Timelapse2 folder, which contains the two applications below as well as various other files needed by that software.
 - Timelapse2.exe
 - TimelapseTemplateEditor.exe
4. **Important:** Leave the Timelapse executables in that folder! It needs the files in there to work properly. Start either program from that folder.
 - **Recommended:** Alternately, create [shortcuts](#) to those programs and put them in a place of your choosing (e.g., your desktop). You should now be able to run the software by double-clicking its icon or shortcut.

3. Briefly test the software. Start TIMELAPSE by double-clicking its icon within the download folder, or by clicking its shortcut (if you created one). You should see something like this.



4. If you don't see the above screen or if the system crashes, follow the instructions in the 'Potential problems' section on that download page, as illustrated below.

Troubleshooting Potential Problems Running the Timelapse software

If the software crashes immediately on startup, or displays an error message saying the **.Net framework is missing**: Timelapse requires the Windows .Net Framework 4.5. While most up-to-date versions of Windows will already include this, it may be missing from older versions of Windows. If this is the case, install the

- [Microsoft .NET Framework 4.5](#)

Note that if you have a 'locked down' institutional machine, you may have to get your system administrator to do it for you. -)

The screenshot shows a dialog box titled "Timelapse2.exe - .NET Framework Initialization Error". The message reads: "To run this application, you first must install one of the following versions of the .NET Framework: v4.0.30319".

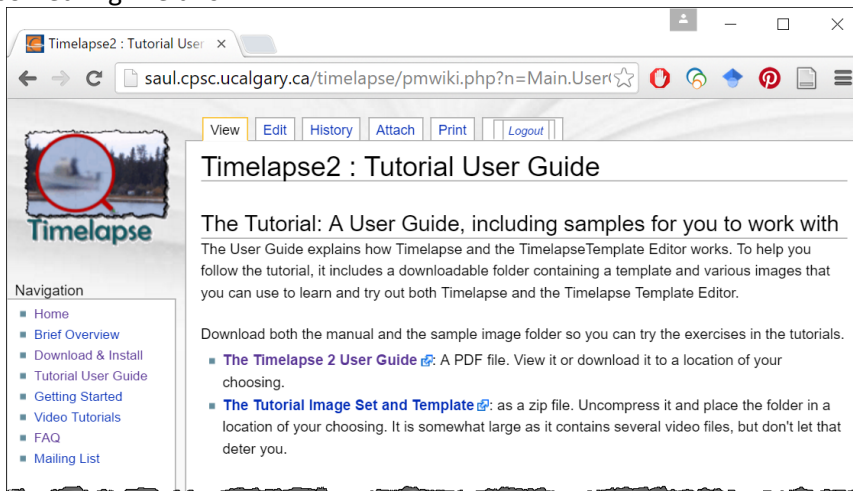
Tip: Updating TIMELAPSE. Whenever you start TIMELAPSE, it checks if an update is available. If so, it tells you and directs you to the TIMELAPSE download page. To update, delete the old Timelapse folder, and repeat the above steps to download and install the new version.

Tip: Join the Timelapse Mailing list (via the Help menu). You will receive email when a new version is available.

Downloading the Sample Image Folder and Template

To help you follow this tutorial, you should download the tutorial image set. This folder contains the set of images, videos and other necessary files as used in this tutorial.

1. Return to the TIMELAPSE download page. Select **Tutorial User Guide** from the sidebar. You will see something like this.



2. Follow the instructions to:

- View or download the **Timelapse User Guide** (this document)
- Download and unzip the **Tutorial Image Set and Template** zip file. That folder will contain:
 - a file called TimelapseTemplate.tdb.
 - three sub-folders, each with a small sequence of jpg image files and avi video files.

How should you name your image files?

By default, TIMELAPSE adds images alphabetically, based on the subfolder path and file name. Your folder and file names can reflect the order that your images were taken, but only if you use a good alphabetic naming scheme. The best practice is to have your naming scheme reflect the time order. Its not strictly necessary, as TIMELAPSE by default sorts your files by subfolder and then by date/time. But see §Menus: Sort menu) for other sort criteria.

Alphabetic ordering works reasonably well, as long as you understand its limitations. In particular, most cameras name images and videos by some common text at the beginning, and then by adding a sequence number (padded with leading 0's) at the end.

- IMG_0001.jpg, IMG_0002.jpg, ...
- image (00912).jpg, image (00913).jpg, ...
- 001.JPG, 002.jpg,

However, alphabetic ordering can be confusing in cases where image numbering does not contain leading 0's. For example, consider the sequence:

- image1.jpg, image2.jpg, image3.jpg, ... image9.jpg, image10.jpg, image11.jpg.

The alphabetic ordering of the above sequence is actually

- image1.jpg, image10.jpg, image11.jpg.image2.jpg, image3.jpg... image9.jpg, which is not what you want

Leading 0s circumvent this problem, i.e., the files should end in 0001, 0002... 0010 rather than 1,2,... 10
Various off-the-shelf photo software include facilities to rename your photos. For example, the TIMELAPSE download page includes a link to 3rd party software called 'Renamer'.

2 Timelapse Files and Folders Explained.

TIMELAPSE requires and/or creates various files and folders, organized in a certain manner, as summarized below. While some of this may be a bit unclear for you right now, it should become clearer as you read this tutorial.

File and Folder Types

Root folder: the folder that contains all your files that you want to analyze collectively. In the tutorial, the root folder is named TutorialImageSet.

Image set are all the images (.jpg) and / or videos (.avi , .mp4 or .asf) files you will be examining. They are normally located in one or more subfolders within the root folder, or directly in the root folder. In the tutorial, the image set comprises three subfolders: Site1-08.14, Site1-08.15, and Site1-09.09.

Template file (.tdb) is the template database file located in your root folder. This template file defines your project-specific data needs (*aka* schema). It is normally created by the project manager (see Part 2), who then provides it to the analyzers. This file is used by TIMELAPSE to specify the fill-in data fields that appear in the TIMELAPSE window, and how your data fields are named and saved. While its default name is **TimelapseTemplate.tdb** (as in this tutorial), you can rename it as long as you keep the **.tdb** suffix.

Data file (.ddb) is the data database file created and updated by TIMELAPSE as you load and analyze your image set. This file stores all the data that you entered. Part 4 describes this file's database format in case you want to access your data directly from its data tables rather than from a **.csv** (spreadsheet) file. While its default name is **TimelapseData.ddb**, you can rename it as long as you keep the **.ddb** suffix. Don't delete this file, unless you want to delete all your work!

Comma separated value file (.csv) are files that can be opened and/or imported by most spreadsheet packages, databases, and statistical analysis tools (e.g., Excel). TIMELAPSE lets you export all your data into a **.csv** file. It normally has the same name as your data file, except it has a **.csv** suffix (e.g., **TimelapseData.csv**). You can also edit your **.csv** file (albeit with restrictions) and import it back into TIMELAPSE: the edits will be applied to update your data and the **.ddb** file.

Note: CSV files separate columns by a ','. If your data includes any commas, the package reading the csv file can misread that as a column separator.

Backups is a folder created in your root folder as you use TIMELAPSE. Every time you start TIMELAPSE, TIMELAPSE creates a time-stamped backup of your **.ddb** file within that folder (e.g., TimelapseData.2017-05-01.18-04-55.ddb was backed up on May 1, 2017 at time 18:04:55). Similarly, it backs up any existing **.csv** file whenever you export a new one. To conserve space, TIMELAPSE deletes older backups as new ones are created (around 8 backups of each file type are maintained).

DeletedFiles is a folder that may be created in your root folder. If you ask TIMELAPSE to delete any of your images or videos, TIMELAPSE will back up those files by moving them into the DeletedFiles folder just in case. Using *Options / Preferences*, you can configure when TIMELAPSE actually deletes those files.

Best Practices for Organizing your Files and Folders

Organizing your project

Many projects contain millions of images, and these need to be carefully organized. For example, projects often use multiple cameras, each located at different areas, where each area can contain different camera sites. Image sequences representing a particular time period are usually retrieved from each camera's SD card over time.

Consider organizing your folders and sub-folders using something similar to the following the structure.

ProjectName (the name of your project)

--- Station Name (a station contains all images contained from a specific camera location)

--- Deployment Name (a set of images collected from the camera at that station)

--- images.jpg (the images)

To illustrate, this path is to an example image, where each subfolders reflects the above naming scheme

WolverineStudy/Site5/2019-01/image0001.jpg

Note. Keep careful records that completely describe your project, each station, and each deployment. Other camera trap researchers are currently developing an open standard for these records, described in <https://www.ncbi.nlm.nih.gov/pmc/articles/PMC5267527/>. We are also developing an extension to Timelapse that lets you record your data according to that standard: Contact saoul@ucalgary.ca if you want to try it out.

Choosing where to use Timelapse

The next question is, how should you use Timelapse on these folders? In our experience, running Timelapse on the primary root project folder – especially if it is extremely large - should be avoided for these and other reasons:

- certain Timelapse operations are slow when run over millions of images,
- if your data gets corrupted, you would lose everything (corrupted files are very unlikely, but...),
- only one person can analyze the images at a time, as otherwise database conflicts could occur.

Instead, we recommend the best practice of running Timelapse on a smaller sub-folders, such as at the CameraSite or even the ImageSequence level because:

- most timelapse operations are fast when done on tens or even a few hundred thousand images,
- different people can analyze images concurrently, as long as they work on different folders

For example, if you want to run Timelapse at the CameraSite level, you would copy your template into each sub-folder representing a camera site, and run Timelapse from there. This will generate a Timelapse .ddb database file in each of those sub-folders.

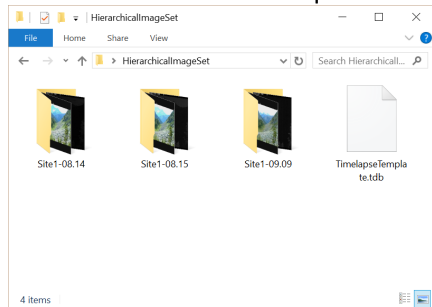
Note. The downside of running Timelapse within different sub-folders is that Timelapse will produce a different database in each of them. However, you can merge that data into a single database (see Merging Databases section) or exported and combine csv files with other software such as Excel.

The Timelapse subfolder organization

When you run Timelapse in a sub-folder, your image files will normally be organized in one of two ways, as illustrated below. Both methods keep your image set and all other necessary files within a single root sub-folder. While you can intermix these two methods if you wish, it could lead to poorer overall file organization.

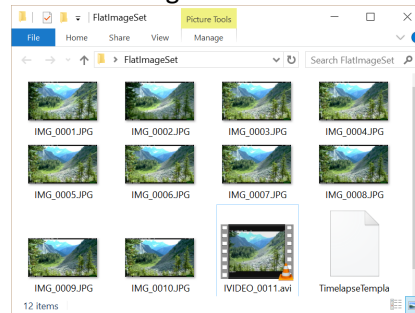
Option 1. The Hierarchical Image Set.

Your root subfolder contains a Timelapse template, and one or more subfolders containing images and videos. This works if you have categorized your images and videos into subsets, or plan to add additional images and videos into your image set over time. The example below illustrates three sub-folders, each based on a retrieved camera card sequence.



Option 2. The Flat Image Set.

Your root folder contains the Timelapse template, and all your images and videos. This works if you have no need to add images and videos at a later time. The example below illustrates Timelapse running on a single retrieved camera card sequence, where all images are in the single folder.



Note: The Tutorial Image Set uses the hierarchical organization.

3 The Beginning and End

Before You Begin

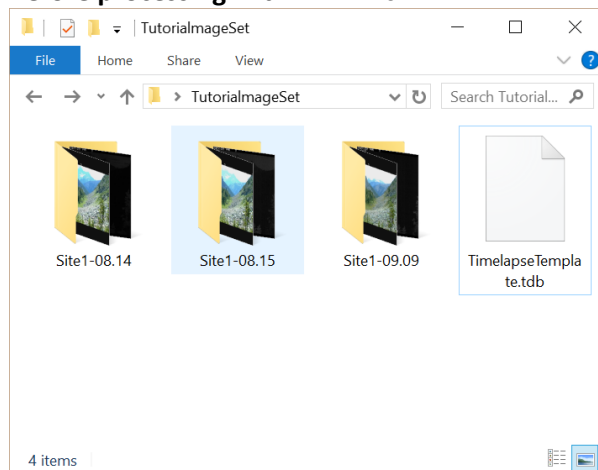
You should have two folders:

1. **TIMELAPSE** software folder containing the downloaded TIMELAPSE software
2. A root folder containing:
 - a. **Your images and/or videos**, located either directly in the root folder or organized in one or more sub-folders,
 - b. A **'template'.tdb file** – by default named **TimelapseTemplate.tdb** – which defines information specific to your project. This file is usually copied into a folder that contains your images or your image folder(s). It will normally be given to you by your project manager. If you don't have a project manager, you can make your own custom template file as described in Part 2.

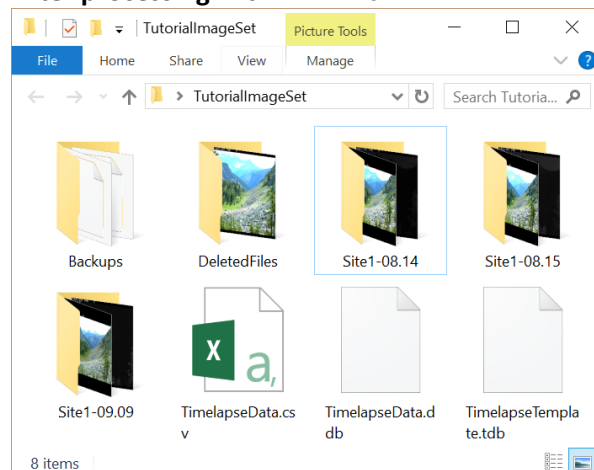
The software and example root folder (including a template) matching those in this tutorial are available on the download page, found at <http://saul.cpsc.ucalgary.ca/timelapse/> (see §Getting Ready). We strongly recommend that the reader walk through the exercises by using that root folder.

The TutorialImageSet folder is organized as shown below, left.

Before processing with TIMELAPSE



After processing with TIMELAPSE



After You are Done

When you are done your analysis, you will see several new files and folders in your image folder (above right).

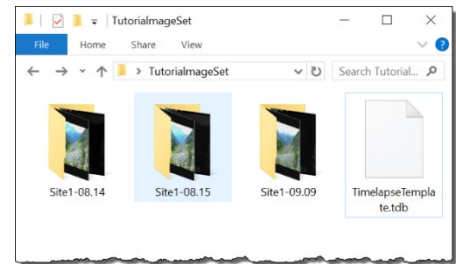
- **The .ddb file** that stores your data, by default named **TimelapseData.ddb**.
- A **.csv file** that can be opened with a spreadsheet, by default named **TimelapseData.csv**. It is created only if you exported your data
- The **Backups folder** containing a backup of various files
- A **DeletedImages folder** containing deleted images. It is created only if you delete an image.

4 The Tutorial Scenario

The Images and Video

The images and videos used in this tutorial were obtained from a project manager who had set up a camera trap to capture human and wildlife usage near a mountain pass. The camera was configured to take an image every 5 minutes, 24 hours a day. Thus images¹ include both day and night time shots, generating tens of thousands of images. The biologist organized images into folders, with each folder containing a day's worth of images. She named the folders to indicate the camera's site number and the date they were taken. For example, Site1-08-14 contains images taken at Site1 on August 14.

For our tutorial purposes we've included three folders reflecting three days (August 14, August 15 and September 9), where each folder only includes a small number of images. Each folder includes a few night-time (dark) shots as well as a video that summarizes the entire day. The Site1-09-15 folder also includes a 'corrupted' (non-readable) image to illustrate how such rare files are displayed.



Tip. The above organization of images and naming of folders is idiosyncratic to the needs of this particular biologist. As mentioned earlier, consider our recommended best practices for organizing and naming your folders and images.

Note: Your images may be quite different from the ones shown here. We deliberately chose images that have wildlife in the distance and that include night-time shots to illustrate particular TIMELAPSE features.

The Data of Interest

TIMELAPSE automatically encodes and makes available the following data for each image.

- **File:** name of the image or video,
- **Folder:** name of the root folder
- **Relative Folder:** name of the subfolder containing the image
- **Date and Time:** the image was taken
- **Image quality:** whether the image is ok or dark.
- **Delete?:** allows the user to mark images for deletion

The biologist is also interested in additional data as follows.

- **Goats:** number of goats present
- **Hikers:** number of hikers present
- **Weather:** one of sunny, cloudy, foggy, raining or snowing
- **Temperature:** in °C, which will be extracted from the metadata found in each image,
- **Analyst:** the name of the person analyzing images
- **Comments:** additional comments made by the analyst after examining the image
- **Publicity?:** images considered interesting enough to be used for publicity purposes

¹ For brevity, the term 'images' as used in this manual includes pictures (.jpg) and video (.avi, .mpg and .asf) files.

Your project manager has provided you with a 'TimelapseTemplate.tdb' template file that specifies the above data fields and how they appear in the use interface (see Part 2). That template is included in the tutorial image folder. Your task is to examine each image and fill in these fields as needed

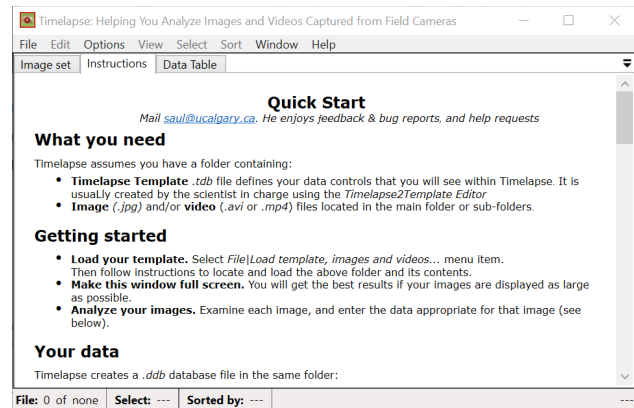
5 Analyzing Images and Videos

Loading your image set for the first time

Begin by loading the template and your images. TIMELAPSE will then examine each image to extract data from it. It shows its progress by briefly displaying the occasional image.

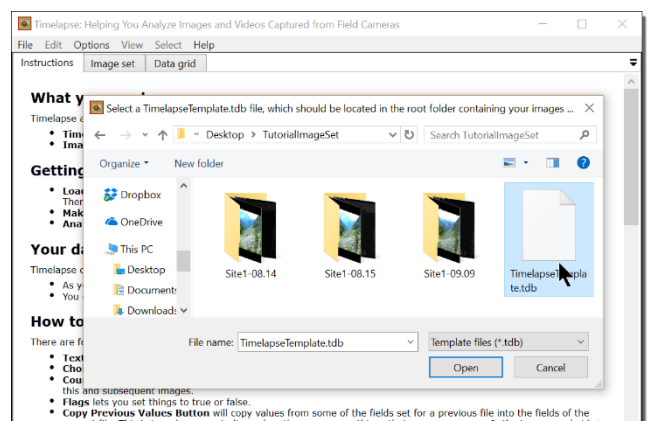
Tip. Pre-processing takes time if there are many images. Be patient: pre-processing only occurs during this initial load. Subsequent openings of this image set will be much faster. Load them over-night if you have a massive number of images (e.g., millions, but see Section 2)

1. **Start the TIMELAPSE software** through its icon or shortcut. You will see an opening screen with brief documentation. Read this, as it is a reminder of how to use the main features of TIMELAPSE. You can revisit this documentation at any time by selecting the *Instructions* tab at the top.



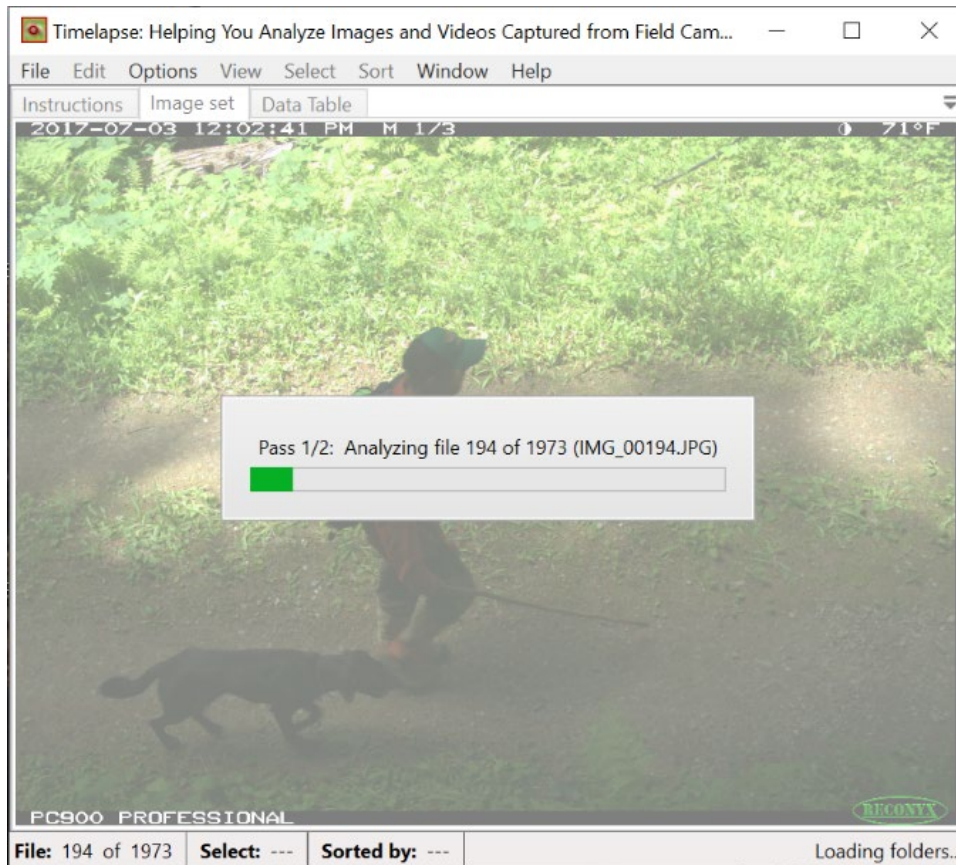
2. (optional) **Expand the window to the full size of your screen.** The larger the window and the bigger and better your monitor, the easier it will be to see details in each image.
3. Load the Template.

- **Select File | Load template, images, and video files...** Navigate to the tutorial image folder (which will be the root folder), and select the **TimelapseTemplate.tdb** file.



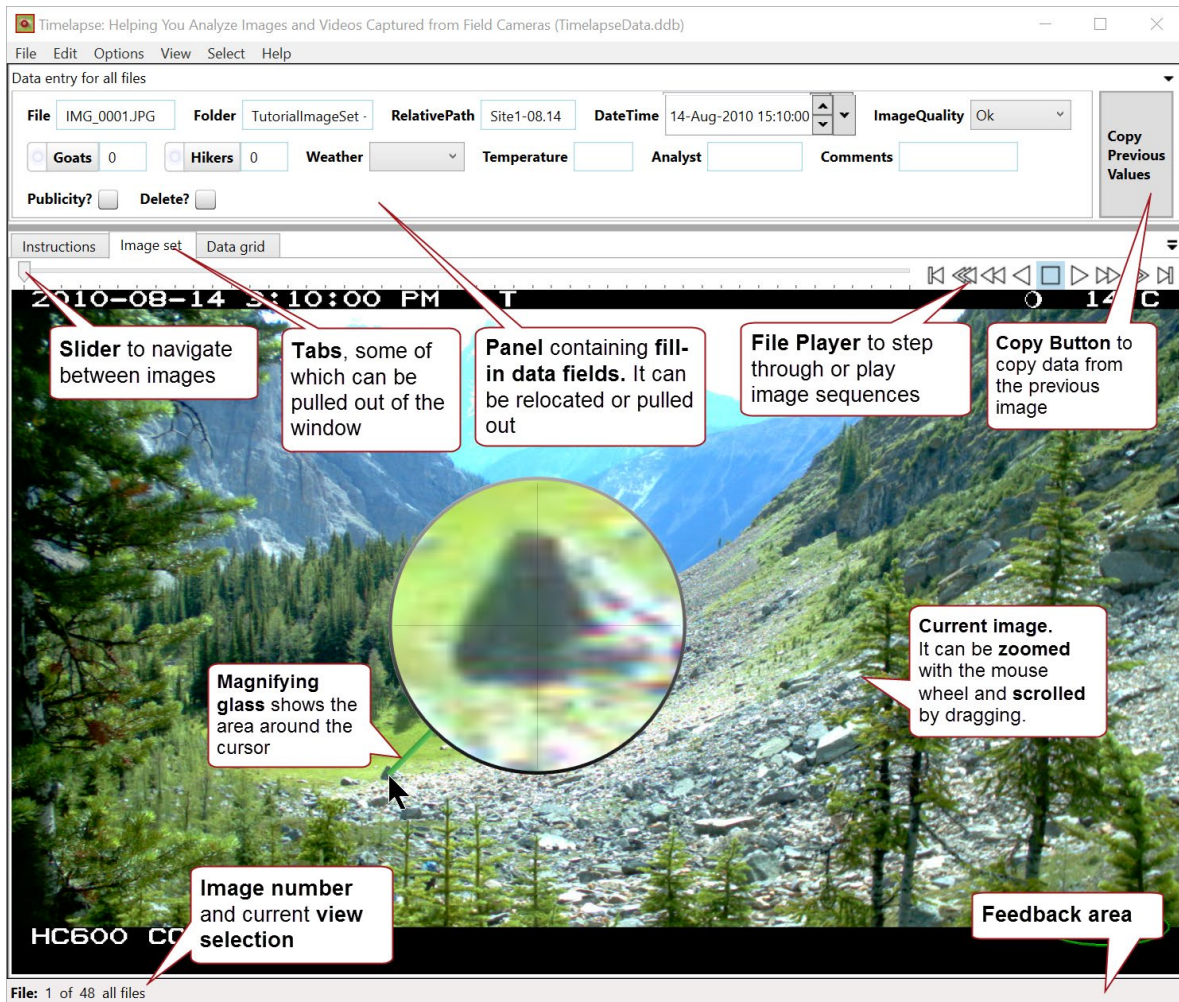
Tip. If you plan to add new image sub-folders later, you will be able to add those by selecting *File | Add image and video files to this image set...*

4. **Watch the software pre-process the images.** Timelapse will search the root folder and each sub-folder for image and video files, and will load all of them. TIMELAPSE will process all images found, where it will show its progress by briefly displaying the occasional image.

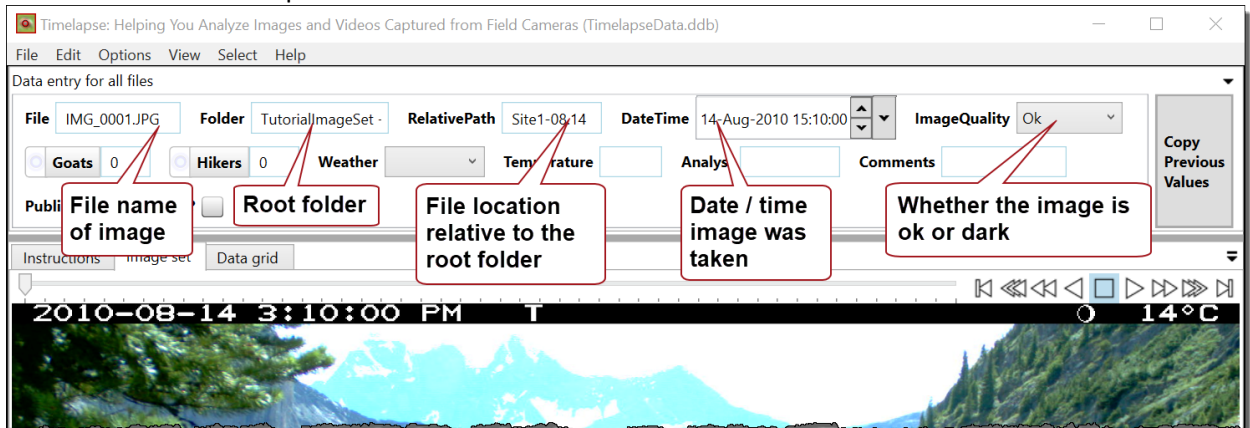


Tip. By default, TIMELAPSE loads and then orders images in sub-folder/filename alphabetic order.

The basic **TIMELAPSE** controls are annotated in the figure below. These will be explained shortly.



5. Examine the control area to see what the software automatically filled in for you. We've annotated each of those fields to explain them.



Note on dates and times. Timelapse tries to retrieve a file's date/time from a metadata field specified in the jpg standard. If its missing, it uses the *file modified* time. If the camera doesn't follow the jpg standard (e.g., when creating videos which don't have to adhere to that standard), the *file modified* time is used instead. Yet that may differ from the date the video was taken (for example, copying a file may change its file modified time). Check the dates/times of a sample of files (especially videos) for correctness.

A second possible problem is that some cameras record date information ambiguously within its image metadata. For example, consider the date recorded as 12/02/10. Is it Feb 12, 2010 (month/day order) or December 2, 2010 (day/month order)? Timelapse tries its best in these cases. If it is unsure about the month/day order of images, it may raise a dialog box informing you, where you can verify if Timelapse's date interpretation is correct.

Tip. You may be able to fix incorrect dates by selectin one of the *Edit | Date Correction | ...* options. For example, the *Edit | Date Correction | Read dates and time from a metadata field...* lets you check for another metadata field you can use instead (this is very useful for fixing video dates). These will be discussed later.

6. Use the slider, or the File Player, or the left/right arrow keys on your keyboard to navigate between your images.

Note on Sorting. By default, Timelapse automatically sorts your images by its *Relative path* (i.e., the folder it is in), and then by *Date/Time* (i.e., the time that the image was taken). The *Sort* menu gives other sorting options.

7. (Optional) Click the *Data Table* tab (circled in red below) to reveal a table that shows, row by row, every image and the current set of values associated with that image. The currently selected image is highlighted in light grey. From this view, you can:

- click the *Image set* tab to return to the view of the image, or
- click on any row to navigate to and view that row's image, or
- use the left/right arrow keys to navigate between images, where that image's data is shown in the *Data entry* pane at the top.

Timelapse: Helping You Analyze Images and Videos Captured from Field Cameras (TimelapseData.ddb)

File Edit Options View Select Sort Window Help

Data entry for All files

File IMG_0001.JPG RelativePath Site1-08.14 Folder TutorialImageSe DateTime 14-Aug-2010 15:10:00 ImageQuality Ok

Delete? Goats 0 Hikers 0 Weather Temperature Analyst

Comments Publicity?

Copy previous values

Image set | Instruction: **Data Table**

Displays the contents of the database, including changes as they occur.
The highlight row indicates the currently viewed file

Id	File	RelativePath	Folder	DateTime	UtcOffset	Date	Time	ImageQuality	DeleteFlag	Goats	Hikers	Weather	Temperature	Analy
1	IMG_0001.JPG	Site1-08.14	TutorialImageSet	8/14/2010 9:10:00 PM	-6	14-Aug-2010	15:10:00	Ok	false	0	0			
2	IMG_0002.JPG	Site1-08.14	TutorialImageSet	8/14/2010 10:40:00 PM	-6	14-Aug-2010	16:40:00	Ok	false	0	0			
3	IMG_0003.JPG	Site1-08.14	TutorialImageSet	8/14/2010 10:45:00 PM	-6	14-Aug-2010	16:45:00	Ok	false	0	0			
4	IMG_0004.JPG	Site1-08.14	TutorialImageSet	8/14/2010 10:50:00 PM	-6	14-Aug-2010	16:50:00	Ok	false	0	0			
5	IMG_0005.JPG	Site1-08.14	TutorialImageSet	8/14/2010 10:55:00 PM	-6	14-Aug-2010	16:55:00	Ok	false	0	0			
6	IMG_0006.JPG	Site1-08.14	TutorialImageSet	8/14/2010 11:00:00 PM	-6	14-Aug-2010	17:00:00	Ok	false	0	0			
7	IMG_0007.JPG	Site1-08.14	TutorialImageSet	8/14/2010 11:05:00 PM	6	14 Aug 2010	17:05:00	Ok	false	0	0			
8	IMG_0008.JPG	Site1-08.14	TutorialImageSet	8/14/2010 11:10:00 PM	-6	14-Aug-2010	17:10:00	Ok	false	0	0			
9	IMG_0009.JPG	Site1-08.14	TutorialImageSet	8/14/2010 11:15:00 PM	-6	14-Aug-2010	17:15:00	Ok	false	0	0			
10	IMG_0010.JPG	Site1-08.14	TutorialImageSet	8/14/2010 11:20:00 PM	-6	14-Aug-2010	17:20:00	Ok	false	0	0			
11	IMG_0011.JPG	Site1-08.14	TutorialImageSet	8/14/2010 11:25:00 PM	6	14 Aug 2010	17:25:00	Ok	false	0	0			
12	IMG_0012.JPG	Site1-08.14	TutorialImageSet	8/14/2010 11:30:00 PM	-6	14-Aug-2010	17:30:00	Ok	false	0	0			
13	IMG_0013.JPG	Site1-08.14	TutorialImageSet	8/14/2010 11:35:00 PM	-6	14-Aug-2010	17:35:00	Ok	false	0	0			
14	IMG_0014.JPG	Site1-08.14	TutorialImageSet	8/15/2010 3:50:00 AM	-6	14-Aug-2010	21:50:00	Dark	false	0	0			
15	VID_0015.avi	Site1-08.14	TutorialImageSet	8/15/2010 2:50:00 AM	6	14 Aug 2010	20:50:00	Ok	false	0	0			
16	IMG_0101.JPG	Site1-08.15	TutorialImageSet	8/15/2010 12:30:00 PM	-6	15-Aug-2010	06:30:00	Ok	false	0	0			
17	IMG_0102.JPG	Site1-08.15	TutorialImageSet	8/15/2010 12:35:00 PM	-6	15-Aug-2010	06:35:00	Ok	false	0	0			

File: 1 of 48 Select: All files Sorted by: Id: (the order files were added to Timelapse)

8. **Export and Preview the Data as a Spreadsheet.** From the *File* menu, select **Export data for this image set as CVS File and Preview in Excel.** If you have Excel installed,

something like the following will appear. Notice that it contains various headers (top row), and that it has populated the cells with the data that the software has already pre-processed. Each column represents one of the fill-in data fields shown at the top of the TIMELAPSE window. As the actual column names and their order are specified in the template .tdb file (§Part 2), the column names and order may not exactly correspond with what you see in the TIMELAPSE interface.

File	Folder	RelativePath	Date	Time	ImageQuality	Goats	Hikers	Weather	Temperature	PublicityShot	Analyst	Comment	DeleteFlag
IMG_0001	Tutorial\m	Site1-08.14	14-Aug-10	15:10:00	Ok	0	0			FALSE			FALSE
IMG_0002	Tutorial\m	Site1-08.14	14-Aug-10	16:40:00	Ok	0	0			FALSE			FALSE
IMG_0003	Tutorial\m	Site1-08.14	14-Aug-10	16:45:00	Ok	0	0			FALSE			FALSE
IMG_0004	Tutorial\m	Site1-08.14	14-Aug-10	16:50:00	Ok	0	0			FALSE			FALSE
IMG_0005	Tutorial\m	Site1-08.14	14-Aug-10	16:55:00	Ok	0	0			FALSE			FALSE
IMG_0006	Tutorial\m	Site1-08.14	14-Aug-10	17:00:00	Ok	0	0			FALSE			FALSE
IMG_0007	Tutorial\m	Site1-08.14	14-Aug-10	17:05:00	Ok	0	0			FALSE			FALSE
IMG_0008	Tutorial\m	Site1-08.14	14-Aug-10	17:10:00	Ok	0	0			FALSE			FALSE
IMG_0009	Tutorial\m	Site1-08.14	14-Aug-10	17:15:00	Ok	0	0			FALSE			FALSE
IMG_0010	Tutorial\m	Site1-08.14	14-Aug-10	17:20:00	Ok	0	0			FALSE			FALSE
IMG_0011	Tutorial\m	Site1-08.14	14-Aug-10	17:25:00	Ok	0	0			FALSE			FALSE
IMG_0012	Tutorial\m	Site1-08.14	14-Aug-10	17:30:00	Ok	0	0			FALSE			FALSE
IMG_0013	Tutorial\m	Site1-08.14	14-Aug-10	17:35:00	Ok	0	0			FALSE			FALSE
IMG_0014	Tutorial\m	Site1-08.14	14-Aug-10	17:35:00	Ok	0	0			FALSE			FALSE
IMG_0015	Tutorial\m	Site1-08.14	14-Aug-10	19:50:00	Ok	0	0			FALSE			FALSE
IMG_0101	Tutorial\m	Site1-08.15	15-Aug-10	21:50:00	Dark	0	0			FALSE			FALSE
IMG_0102	Tutorial\m	Site1-08.15	15-Aug-10	6:30:00	Ok	0	0			FALSE			FALSE
IMG_0103	Tutorial\m	Site1-08.15	15-Aug-10	6:35:00	Ok	0	0			FALSE			FALSE
IMG_0104	Tutorial\m	Site1-08.15	15-Aug-10	6:40:00	Ok	0	0			FALSE			FALSE
IMG_0105	Tutorial\m	Site1-08.15	15-Aug-10	6:45:00	Ok	0	0			FALSE			FALSE
IMG_0105	Tutorial\m	Site1-08.15	15-Aug-10	6:50:00	Ok	0	0			FALSE			FALSE

Notes.

- If you are over-writing an existing csv file, you will find a time-stamped backup of the original file in the Backups folder.
- You can edit the .csv file and import a limited number of changes back into TIMELAPSE. A later section will describe how this is done.

9. If you open the TutorialImageFolder, you will now see two new files and one additional folder.
- TimelapseData.ddb** is the database created and used by TIMELAPSE to store all the information about this image set. If you quit TIMELAPSE and restart, TIMELAPSE will open this file so you can continue where you left off.
 - TimelapseData.csv** is the .csv file generated when you exported your data in the above step.
 - Backups** is a folder that TIMELAPSE uses to create backups of data files that you could manually restore if needed. When you open TIMELAPSE, it copies your .ddb file into this subfolder, where it adds a timestamp to the file names. A similar backup of your old .csv file is created whenever you export your data to a .csv file. If something really screws up during your analysis, you can always rename and copy that file back to your root folder.

Later in this tutorial, you will see another new folder called **DeletedFiles**, which TIMELAPSE creates only when you delete an image or video. Backups of deleted images or videos are located here.

That's it – you are now ready to analyze your images. But read on: TIMELAPSE has many other features that will help you analyze your images efficiently. ...

Note. If you change your folder names and try to reload your images. Timelapse records the folder location (RelativePath) and name of your files, and associates any data you enter with that name. If you change the names of the folder or your files any time after your images have been loaded for the first time, Timelapse will no longer be able to display those renamed file as it will not know where they are. A place-holder image will be displayed instead. However, any previously entered data concerning that file will have been saved.

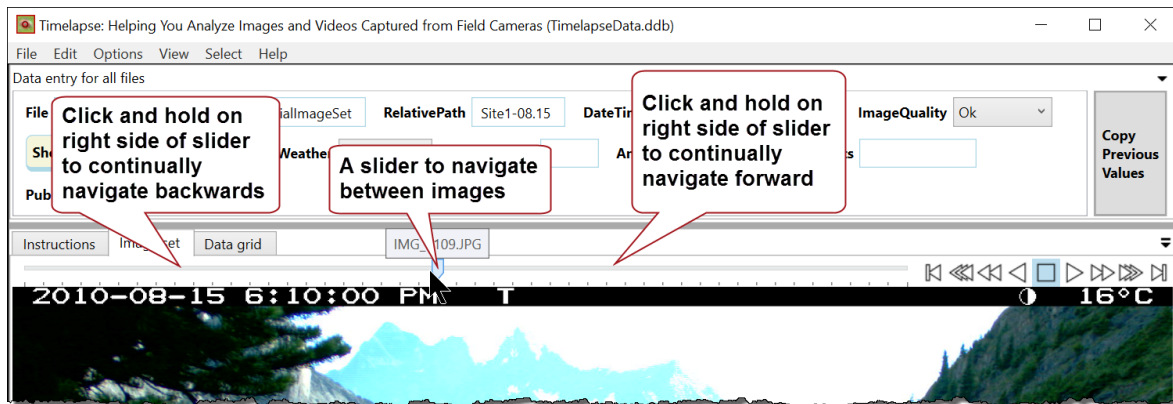
6 TIMELAPSE Interface Basics

Before showing you how to analyze your images, we will explain a few basic things about the TIMELAPSE interface, just so we won't have to explain it later. Have TIMELAPSE running and displaying images so that you can try out some of these features. The subsequent section will show you how to use these features as part of your work flow.

Navigating through files

You will frequently navigate through the files in your image set. You can do this in various ways.

1. **The slider** lets you scroll through your files through various methods.
 - **clicking on the left / right side** of the slider's thumb goes to the previous or next file
 - **sliding the thumb** is good for making large jumps
 - **clicking and holding on the left / right side** of the slider's thumb rapidly moves through all your files one at a time.



2. **Keyboard navigation via left/right arrow keys** lets you move back and forth through the files in a sequence

- Holding the keys down continually moves through multiple images.
- *View / View previous/next file* menu options and the *PageUp/PageDown* keys do the same thing.
- Pressing <control> while using the left/right arrow keys will move to the first image of the previous or next episode

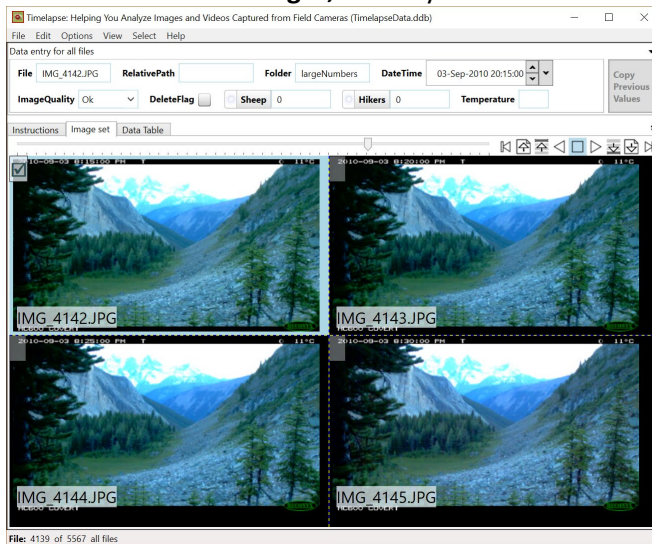


Tip. If a date, note or counter data-entry control has the input focus (because you selected it), that control will use the left/right arrow keys to move through its text rather than to navigate to the previous / next image.

Use **<Shift> left/right arrow** in these cases (or in fact, at any time) to move back and forth through the files instead. ..

3. **The Overview**, explained fully in §Overview, lets you view and navigate through multiple images at a time. To summarize, you can:

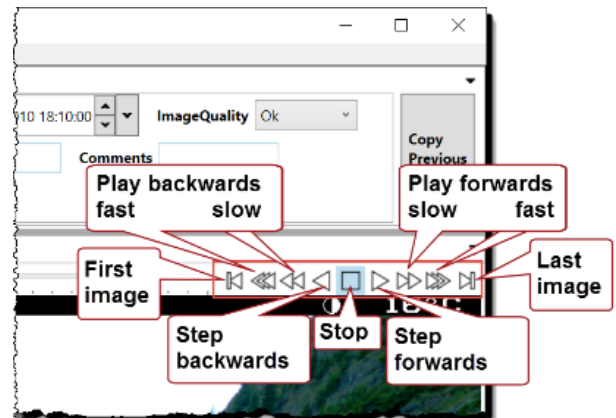
- **switch** between the single file view and the overview by zooming in and out using the scroll wheel, the <> keys, or the zoom menu option,
- **view an image's data** by selecting it,
- **navigate to a particular image** by double clicking it
- **select one or more images**, where you can enter data for them all at once.



4. **File Player**, found at the right of the slider, has multiple controls that let you navigate your files, or review your files by automatically playing them one after the other.

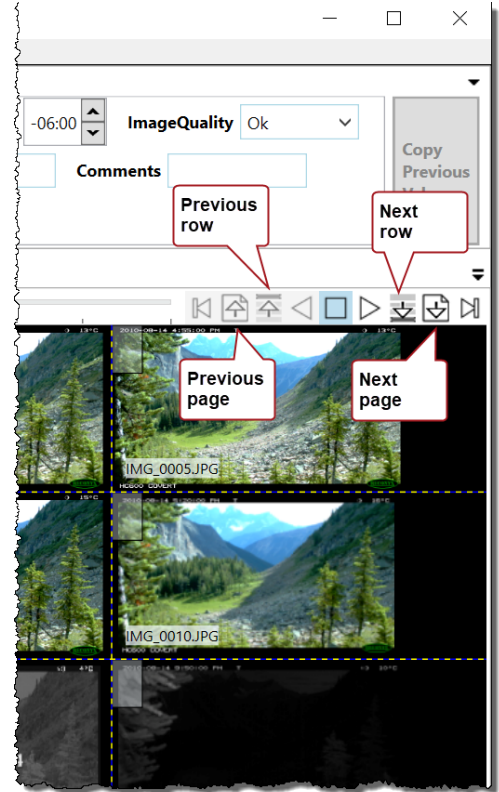
a. If you are in the *single image view* (which displays a single image or video file), the File Player controls let you:

- **step through** your files backwards or forwards,
- **play** files backwards or forwards at different speeds
- **go to** the first or last file.



Note. You can set your preferred playback speed via *Options | Adjust FilePlayer playback speeds...*

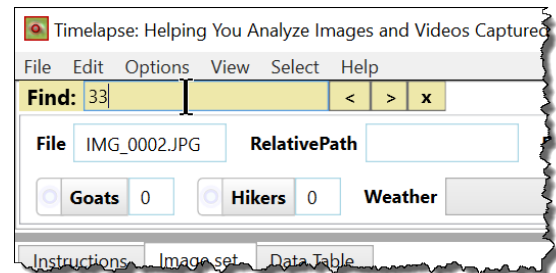
- b. If you are in the **overview** (which displays a page containing rows of multiple images, as illustrated on the right), the four *play* controls are replaced by navigational controls that let you view the:
- **next or previous row** of files (also activated with the ↓↑ keys),
 - **next or previous page** of files (also activated with the page down/up keys).



5. **Find image** is invoked by
- *Edit/Find image* menu, or
 - pressing **<control>-f**

Find image lets you

- enter a search term
- use the | < | > | buttons or *enter* to find the next or previous image whose file name contains that search term.



Note: search terms are case-insensitive. This means you don't have to worry about capitalization.

For example, in the illustration above, the analyst has typed '33' and pressed enter (or '>'), which searches for and displays the next file name in the sequence (if any) that contains the text '33'. In this case, IMG_0033.JPG is found and displayed. If the analyst presses enter two more times, it displays IMG_0133.JPG and then IMG_0233.JPG. On the next enter, no subsequent matches are found, so it restarts from the first image in your selection, where it finds and displays IMG_0033.JPG.

Tip. if the image set had video files scattered in the sequence, doing successive finds on the search term 'avi' will progress through each video that has an .avi or .AVI suffix.

Status Bar Feedback

The **Status bar** displays feedback in several areas.

- **File:** indicates the file number and the total number of file in the current image set. The total number is affected by your selection from the *Select* menu, describe shortly.
- **Select:** indicates your current *selection* i.e., what subset of images you are viewing. See *Select* menu, described shortly.
- **Sorted by:** indicates the current criteria used to sort the order that files are presented to you. This is affected by the sort criteria specified via the *Sort* menu, described shortly.
- **Message area** provides occasional feedback of what you are doing as you are doing it.

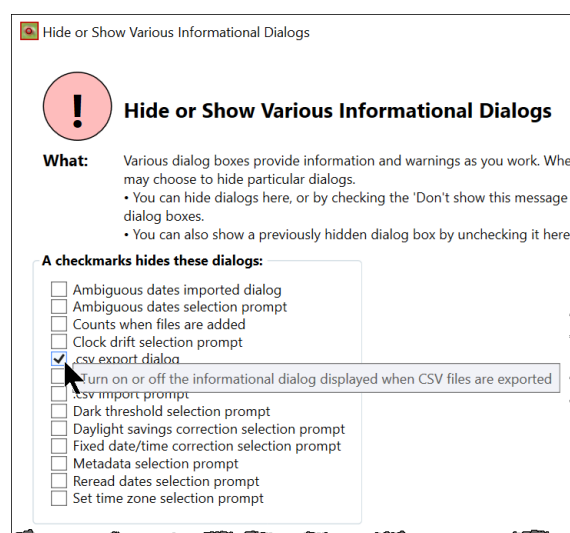
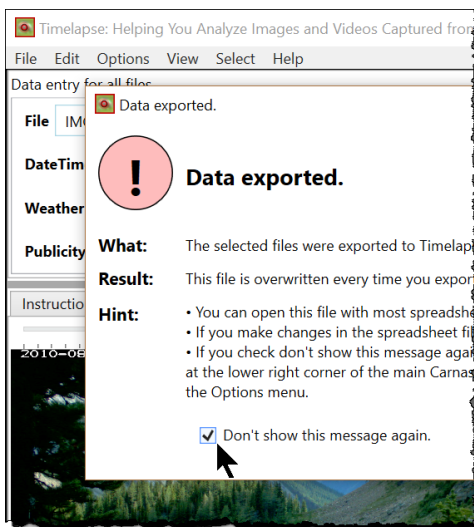


Dialog Boxes

Dialog Boxes will appear as you use the system. Depending on the circumstances, they may display feedback, offer instructions and suggestions about choices you can make, request information from you, or inform you about any issues that arise.

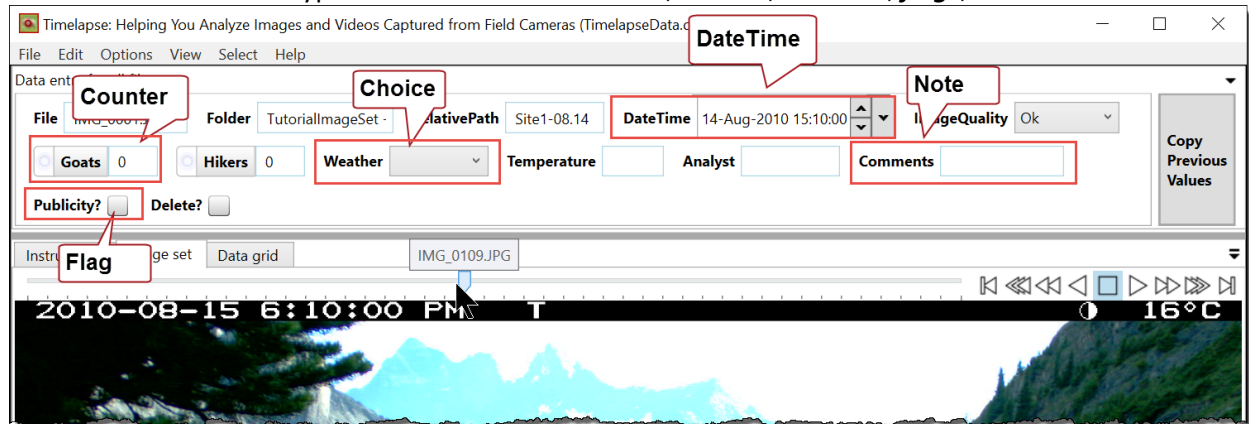
Certain dialog boxes let you control whether or not they will be displayed in the future. This is done in one of two ways.

- Select the *Don't show this message again* that appears at the bottom of the dialog box.
- Select from the menu *Options / Show or hide various informational dialogs*, which lets you select which dialog boxes to show or hide (via another dialog box, as illustrated on the right)



Fill in Fields

There are five different types of fill-in data fields: *notes*, *choices*, *counters*, *flags*, and *date-time*.



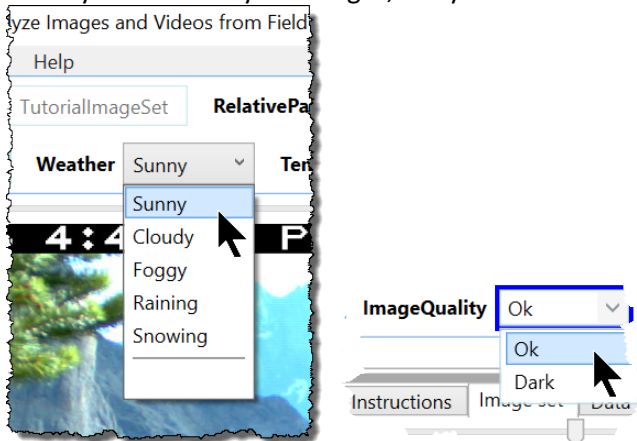
1. **Note field:** enter any text by typing. Tutorial examples are the *Temperature*, *Analyst*, and *Comments* fields above. The top row shows other special Notes filled in by the system during pre-processing. Some cannot be edited and are shown outlined in light blue (e.g., File, Relative Path, and Folder).

Analyst

Tip: Notes use auto-completion, where they predict the rest of the word you are typing based on previous note entries. Predictions appear highlighted. Accept the prediction by hitting return or tab. Ignore it by continuing typing.

Analyst

2. **Choice field:** select from a predefined list of choices. Choices are selected from a pull-down menu raised by clicking the field. Alternately, you can type a choice's first letter to select it, and/or use the down/up arrow keys to navigate through the choices. For example,
 - *Weather's* menu shows six selectable values that you can select from (the last item is an 'empty' choice that lets you clear the field). The selected item will then appear in the text box.
 - *Image Quality* is a system-supplied field. Its initial values are automatically filled in by TIMELAPSE when you first load your images, but you can over-ride those values.



3. **Counter field:** count the things you see in your image by one of three ways:

- **Type in a number** directly into the count field.
- **Click the up/down arrows** to increment or decrement the count
- **Count by clicking and marking.** The left side of the Counter is a toggle button. Select it to activate it (which turns it blue). You can then click on the things you see in the image to increment the count and to leave a *marker* on the image to show what has been counted. This is explain later.
- The *Goats* and *Hikers* fields above are both counters. The Goat radio button is selected and activated.



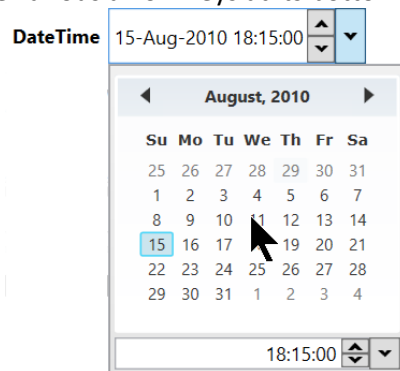
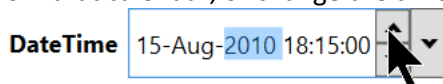
4. **Flag field:** sets a value to *true* or *false* by clicking on a checkbox.

- *Publicity?* is shown below as selected (*true*).
- *Delete?* is a system-supplied flag. When selected, it marks an image for later deletion. This is explain later.

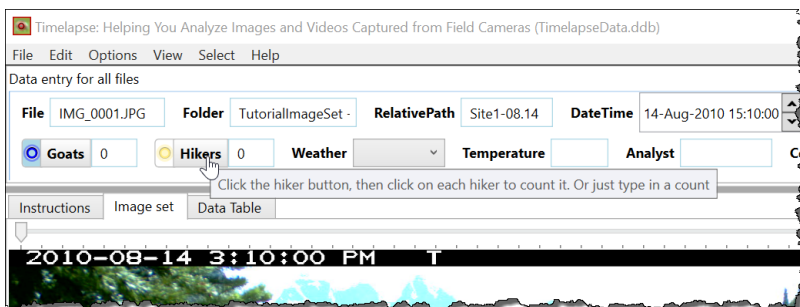


5. **DateTime field:** let you set the current date and/or time. This is a system-supplied field that Timelapse automatically fills in with the date and time the image or video was taken. If it gets it wrong, you can change this by one of two ways.

- *Select a portion of the field* (e.g., the year) and change with the up down arrows (left image).
- *Raise a calendar* (right image) by click the down-arrow on the far right to. Then select a new date from that calendar, or change the time with the various arrow keys at its bottom.



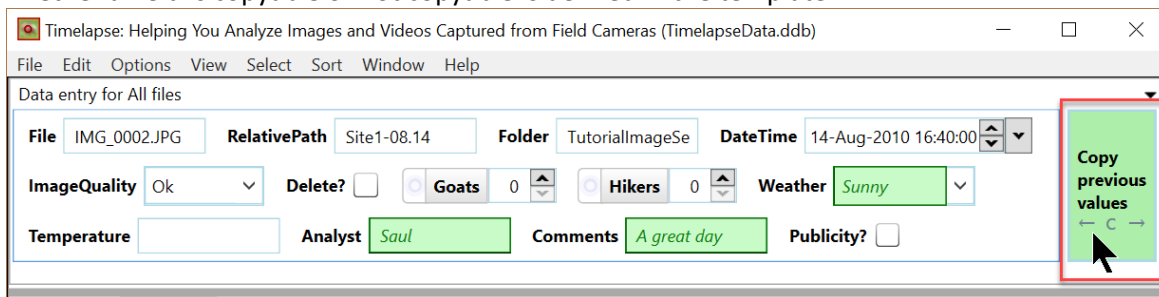
6. **All controls - Tooltips.** Tooltips provide additional detail about each field. They appear when you hover your mouse cursor over a field.



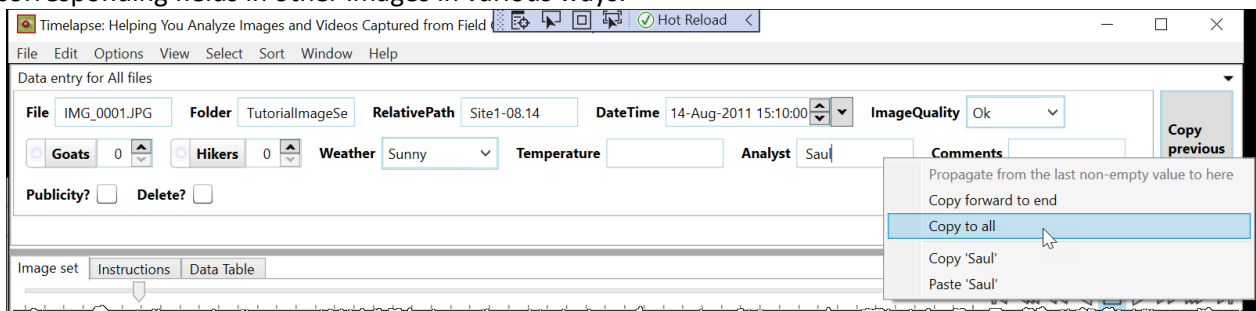
Methods for copying repetitive data

TIMELAPSE includes several methods to simplify repetitive data entry. These are briefly explained here, and illustrated later in this tutorial. *QuickPaste*, described later, is yet another method worth trying.

1. **Copy Previous Values Button**, when selected, copies a subset of data from the previous image to the current image. This is a very handy way to encode repetitive data. As illustrated below, when you hold your cursor over the Copy button, the fields whose values will be copied from the previous image are highlighted in green, where they include a preview of what values will be pasted into those fields (in this case *Weather*, *Analyst*, and *Comments*). Pressing the 'C' shortcut key while the cursor is on the image has the same effect. The fields will flash briefly to indicate that they have been copied. Whether a field is copyable or not copyable is defined in the template.



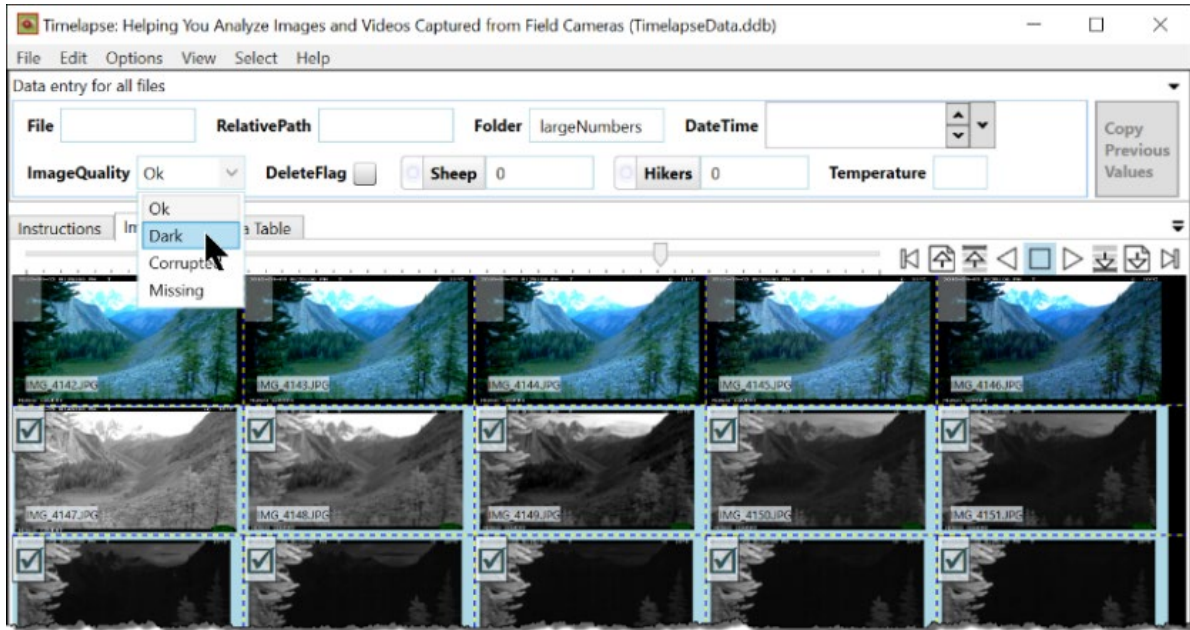
2. **Most fields include a context menu for copying data across images.** This menu appears when you right-click on a field's label. Its menu items let you copy data found in one image field to corresponding fields in other images in various ways.



- *Propagate from the last non-empty value to here* will copy the last non-empty value you entered (e.g., several files back in the sequence) from that file up to the current file.
- *Copy forward to end* will copy the current field's value to all subsequent files in the sequence
- *Copy to all* will copy the current field's value to all files in the sequence.
- *Copy/Paste* copies the complete contents of the currently selected field (what will be copied/pasted will be displayed in the menu item's label). You can then paste that into any field. However, if the field type cannot accept that content, the Paste menu item will be hidden or unselectable.

3. Use the Overview to select and enter data for multiple images at a time. In this example, the user has selected only the dark images, and is setting the ImageQuality for them in one shot.

The Overview section explains this in greater detail.



Magnifying, zooming and panning

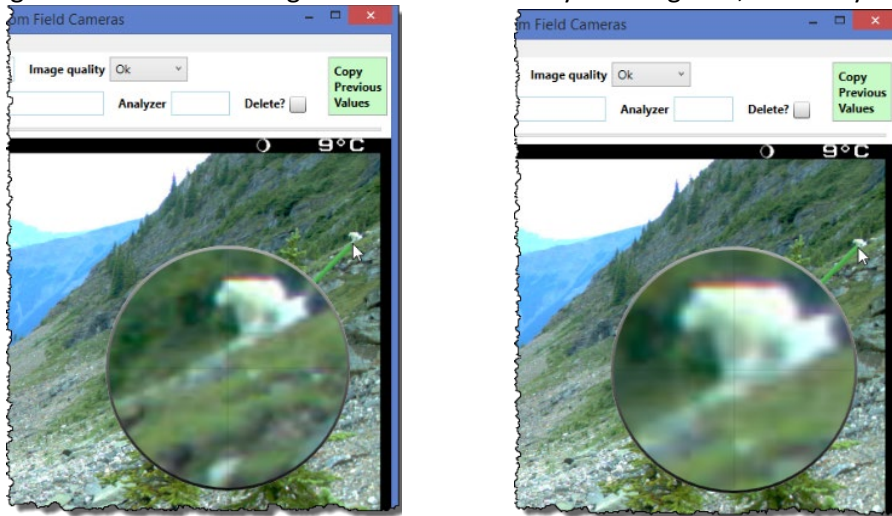
1. The **magnifying glass** magnifies the area under your mouse cursor as you move over the image. You can control its appearance through the *Options | Magnifying Glass* menu or through typing the following keyboard shortcuts:

M – (for Magnifier) while the cursor is on the image toggles its visibility on and off.

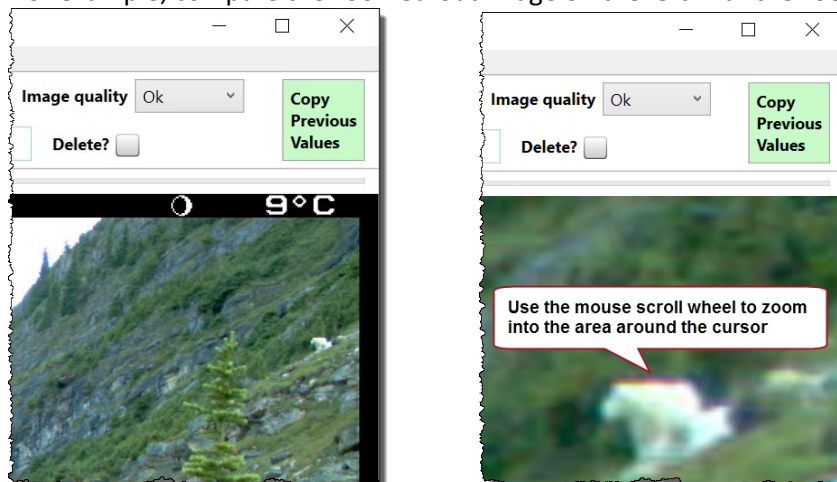
U – increases the magnification Up

D – decreases the magnification Down

The images below show the magnifying glass set at two different magnification levels. Here, the analyst is taking a closer look at a white blob that could be a goat. Normally, you will set the magnification to something that makes sense for your image set, and likely leave it there.



2. **Zoom into the image** by rotating the **scroll wheel** on your mouse or via selecting *View | Zoom in*. You can zoom back out by rotating the scroll wheel in the other direction or via selecting *View | Zoom out*. For example, compare the zoomed-out image on the left with the zoomed in image on the right.



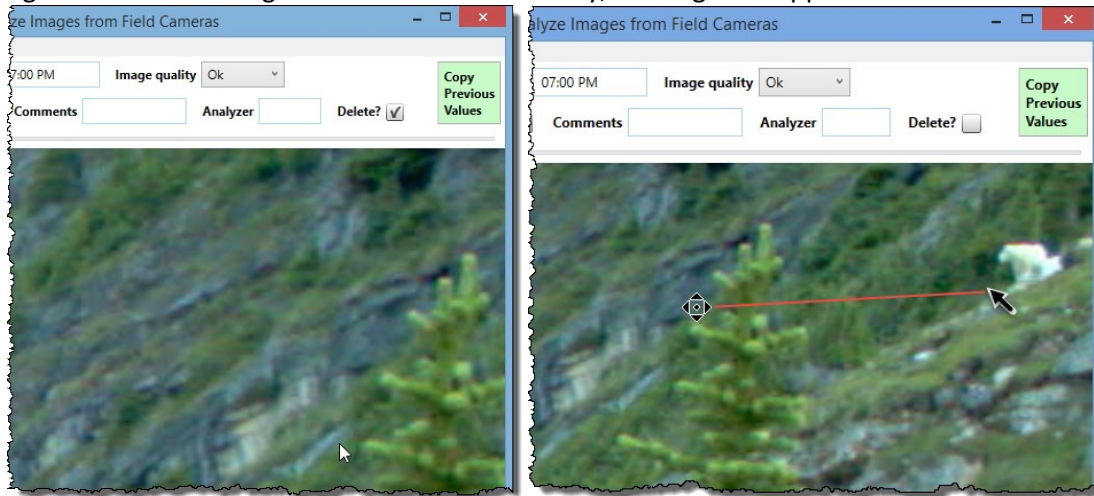
Before zooming

After zooming

Note.

- You can customize the maximum zoom level through the *Options | Preferences* menu. One of the options there will let you increase or decrease the maximum zoom level.

3. **Pan** (scroll) to different regions of a zoomed image by **clicking and dragging** across the image. That is, hold the left mouse button down and move the cursor, as illustrated on the left image. As you do this, the image will scroll to its new position. In the images below, the analyst is panning the image rightwards. If the image is zoomed out all the way, nothing will happen



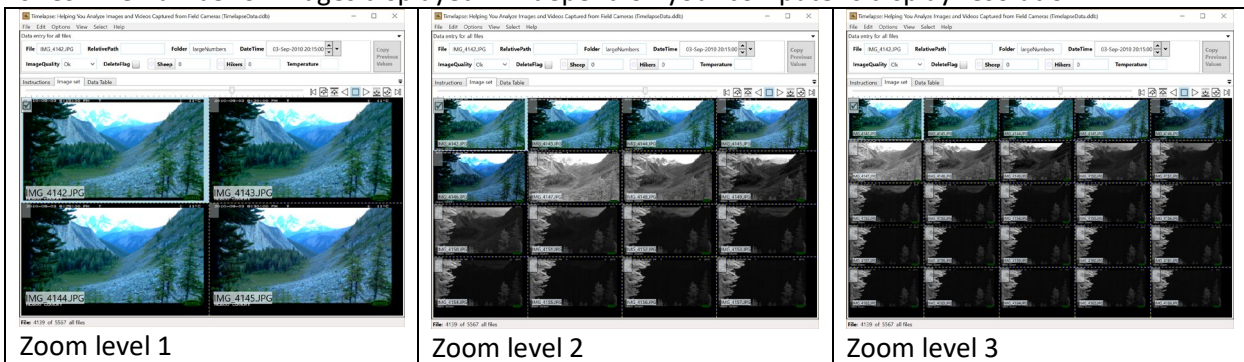
Before panning

After panning

4. **The Zoom Bookmark** remembers your last zoomed-in region, where it can be applied to any image. The keyboard shortcuts do the following actions, with equivalent commands available through the *View* menu.

- B** creates a zoom bookmark of that region
- +** zooms to the region saved by the bookmark
- zooms out all the way to see the entire image

5. **Zoom out to an Overview**, which displays a page containing rows of multiple images. Zoom out by rotating the **scroll wheel** on your mouse or via selecting *View | Zoom out*. You can **zoom back in** again to the single image view by rotating the scroll wheel in the other direction or via selecting *View | Zoom in*. You can zoom out through three overview levels, each showing more images at smaller sizes. The number of images displayed will depend on your computer's display resolution.



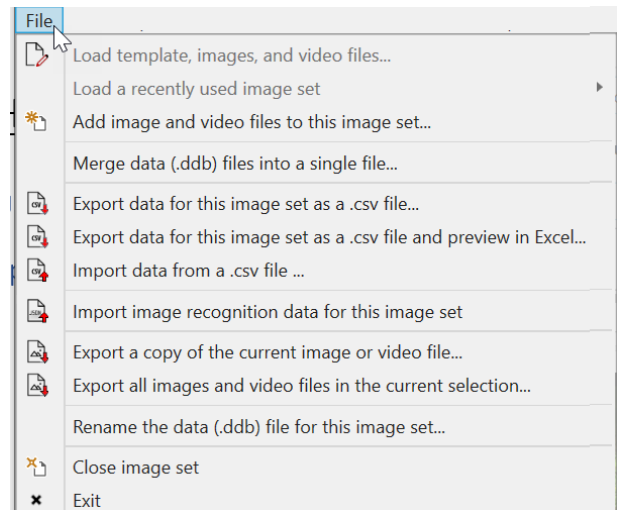
Note.

- **Using the overview**, you can select multiple images. Any data entered is then applied to all those selected images. See §Overview for details.
- **The File Player controls** let you navigate to the next or previous row of images, or the next or previous page of images. See §File Player for details.

The Menus

There are seven pull down menus, whose purpose is summarized below. Every menu item has a tooltip to remind you of its purpose, which appear when you hover the mouse over it.

File menu



1. **Load template, images, and video files...** asks you to select the Timelapse Template **.tdb** file from the root folder. On first use, it loads every image it can find in your root folder and its sub-folders, creating an *image set*. You can then analyze your images. If you load an existing image set, it re-opens your image set from where you previously left off.
2. **Load a recently used image set** displays a submenu listing the last few Template **.tdb** file you had opened, in recency order. Select one to reopen that image set.
3. **Add images and video files to image set...** lets you add images and videos to an existing image set. You specify the location. Files that already exist in the image set are skipped over. This is useful if you add folders or files to an existing image set and want to include them.

4. **Merge data (.ddb) files into a single file...** merges all databases found in sub-folders into a single new database. The found databases are otherwise unaffected. See Section *Merging databases*.

5. **Export data for this image set as a CSV file...** exports the data for the currently selected files as a comma-separated value **.csv** file that can then be opened in a spreadsheet or analytics package such as Excel or R. The format for the Date and Time can be specified in the *Options | Preferences | Exporting CSV files – Adjust Date and Time formats*.
6. **Export data for this image set as a CSV file and preview in Excel** is similar, but it will also try to open the **.csv** file in Excel (assuming you have Excel installed) for you to view and/or edit.

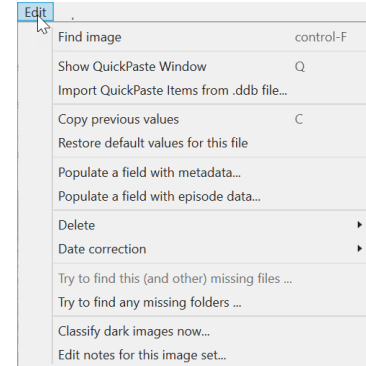
Definition: Currently selected files. Timelapse lets you select a subset of your files to view and work on via the *Select* menu. Many Timelapse operations – such as export data above – restrict their actions to only those currently selected files
7. **Import data from a CSV file...** imports data from a comma-separated value (**.csv**) file. For example, you can export your data to a **.csv** file, and then edit some of the values in that file using Excel. You can then import the edited **.csv** file back into TIMELAPSE, which will update the data accordingly. However, restrictions apply. See Section *Import data from a CSV file* in for specifics.

8. **Import recognition data for this image set...** is only visible if you have turned on Detections. See Part 3: *Automatic Image Recognition*.

9. **Export a copy of the current image or video file...** lets you save a copy of the current image or video to a folder of your choosing. The original is kept intact.
10. **Export all images and video files in the current selection...** lets you save a copy of all images or videos in the current selection to a folder of your choosing. The original is kept intact.
11. **Rename the data file...** lets you rename your **.ddb** file.

12. **Close image set** closes the current image set, where you can then load another image set if desired.
13. **Exit** quits the program.

Note. There is no **Save** menu item: TIMELAPSE automatically saves all data as you perform your actions.



Edit menu

- 1. Find Image** finds the next or previous image that contains the case-insensitive text.

- 2. Show QuickPaste Window...** displays the QuickPaste window, which lets you bulk-paste previously copied data. Use the window to create, select, edit, delete QuickPaste items and past them as desired.
- 3. Import QuickPaste Items from .ddb file...** lets you retrieve and add quick paste items that were created for another image set, and saved in that image set's .ddb file

- 4. Copy Previous Values** performs the same action as the Copy Previous Values button.
- 5. Restore default values for this file** restores the data fields associated with either the current file or (if in the overview) the files selected with a checkmark to the default values specified in the template. However, the file/relative path/ folder fields and the date/time field are left as is. This option is also accessible by right clicking an empty area in the data entry pane, which raises a context menu.
- 6. Populate a field with metadata...** raises a dialog box allowing you to: inspect the metadata included in your images, select a metadata field of interest; select a Note field to hold that metadata; then populate that Note field for all your images with that metadata found in those images.
- 7. Populate a field with episode data...** raises a dialog box allowing you to choose a Note field, and then have Timelapse write Episode information into that field for all the files in your current selection. See Section on *Episodes*.

- 8. Duplicate this record** creates a duplicate of the current record. This is very helpful if you need to use a data field several times in an image. See the section **Duplicate this record** to understand where it can be very useful in your workflow.

- 9. Delete** opens a sub-menu with several options. All delete operations raise a dialog box that displays the images to be deleted and asks for confirmation. Operations are performed on the currently selected files only.
 - **The current image or video file** deletes the currently displayed image or video, but not the data associated with it
 - **The current image or video file and its data** is similar, except it also deletes the data associated with the current image or video
 - **Only the data associated with the current file** deletes the data associated with the current image or video, but leaves the image or video file intact. This is helpful in cases where you made a duplicate record but no longer want it.
 - **All selected images or video files marked for deletion** deletes all images and videos that have the Delete? flag checked
 - **All selected image or video files marked for deletion and their data** is similar, except it also deletes the data associated with the images and videos that have the **Delete?** flag checked
 - **Only the data associated with all selected image or video files marked for deletion** deletes the data associated with all images or videos that have the **Delete?** flag checked, but leaves the image or video files intact. This is helpful in cases where you made several duplicate records but no longer want them.

Note. The Delete operation does not actually delete the images. Rather, it moves those images into a sub-folder titled Backups. You can delete the images within that (or the entire folder) at your leisure. However, any deleted data is permanently deleted.

10. Date Correction opens a sub-menu with several options. Operations are performed on the currently selected files only.

- **Re-read dates and times from files...** displays a dialog box that will let you re-read the original dates and times from your image and video files. This is useful if you altered some dates or times, and want to revert back to the original ones.
- **Correct for standard and daylight savings time changes...** displays a dialog box that lets you adjust the date to account for the extra / lost hour during time changes. This is useful for cameras that do not handle time changes automatically.
- **Correct for cameras not set to the right date and time...** displays a dialog box that will let you adjust all dates and times. This is useful if your camera was not initialized to the correct date/time. All you have to do is supply the correct date/time for the first image, and all others image dates/times will be adjusted accordingly.
- **Correct for cameras whose clock runs fast or slow...** displays a dialog box that will let you correct for clock drift, i.e., cameras whose clocks run slow or fast. All you have to do is to supply the correct date and time for the last image, and all other dates and times will be proportionally adjusted.
- **Check and correct for ambiguous dates...** displays a dialog box that examines the first image of each day to see if its date is ambiguous, i.e., uncertainties about whether certain dates are in day/month or month/day order. You can then selectively swap the day/month order for images taken on those days, or swap all ambiguous dates.
- **Read dates and times from a metadata field...** displays a dialog box that lists all metadata containing what appears to be a date or time value in the currently selected file. If one of them contains the correct date/time, you can ask Timelapse to update the Date/Time field for all selected files to the contents of each file's value for that metadata field. Files that do not have that field are left unchanged. This is particularly valuable for correcting video file date/times, where the correct date/time may be stored in a non-standard metadata field.

11. Try to find this (and other) missing files...

12. Try to find missing folders...

- TIMELAPSE can also help you locate missing files and folders. See Section *Missing Folders and Files*.

13. Classify dark files now... TIMELAPSE uses thresholds for determining whether an image is light or dark, which in turn is used to set image's ImageQuality to Ok or Dark. You can fine-tune how TIMELAPSE does this, and have TIMELAPSE examine your images as Ok or dark. Operations are performed on the currently selected files only.

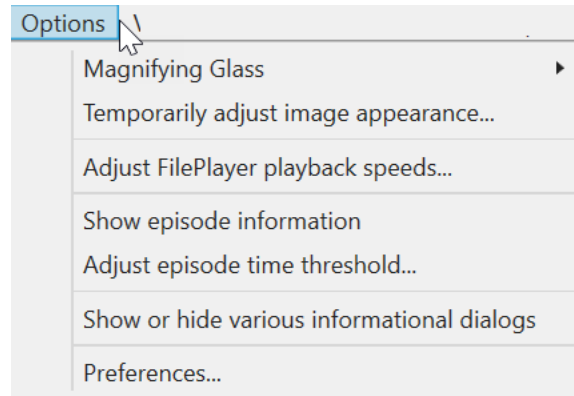
14. Edit notes for this image set allows you to edit and save notes that are associated with this image set, e.g., a description of the project and the particular information regarding this image set (as below), comments as a whole, your own 'to do' list, messages to other analysts who may go through these images, etc.



Options menu

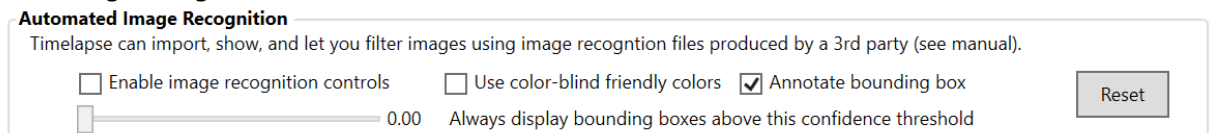
This menu lets you adjust a few settings on the fly.

1. **Magnifying Glass** provides a sub-menu that lets you turn the magnifying glass on off, or increase/decrease the amount of magnification.
2. **Temporarily adjust image appearance** raises a small window that lets you temporarily adjust the image's brightness, contrast and sharpness, as well as showing its edges.



3. **Adjust File Player playback speeds** raises a dialog box that lets you adjust how many images per second you would prefer to see when using the play forward/backwards buttons on the File Player. Note that your computer may not be able to keep up with really fast speeds, especially if you have large images. This feature is really useful for letting you review images rapidly, but you should experiment with the speed to find a setting suitable for you.
4. **Show episode information.** Timelapse identifies images as belonging together in an *episode*, i.e., a sequence of images separated by a short time duration. An episode, for example, can group together the multiple images taken of an animal moving through a scene. Episode information is shown as a text overlay atop the image. See §Episodes later in this manual.
5. **Adjust episode time threshold** raises a dialog box allowing you to adjust the time threshold for determining whether images belong together in an episode.
6. **Show or hide various informational dialogs** raises a dialog box that gives you a list of other dialog boxes that you can optionally show or hide.
7. **Preferences** is a dialog allowing you to set various options that affect how TIMELAPSE behaves, and which are remembered on your computer across your Timelapse sessions. The default settings are restored when you click each preference's *Reset* button.

Automated image recognition.



Timelapse can import image recognition files produced by a third party (see Part III).

- *Turn on detection controls* exposes the menu controls that will let you import and use detections (default is off).
- *Always display detection bounding boxes...* will display a rectangle around the detected entity when it exceeds a particular detection confidence threshold. The rectangle color's transparency will roughly reflect its confidence.
- *Annotate bounding boxes* will add information to each bounding boxes about what is detected

- *Use color-blind friendly colors* will use a bounding box color palette (without transparency) that is somewhat better for color-blind people.

Tabbing between fields.

Tabbing through fields
 Select which system-supplied data fields to include when tabbing through your data. (These are normally skipped over.)

DateTime
 ImageQuality
 Delete

If you tab between fields in the data entry area, you can select which system-supplied data fields to include (or skip) in the tab order.

How deleted files are managed.

How Deleted Files are Managed
 Timelapse deletes files by first moving them to the 'DeletedFiles' sub-folder. Thus you can recover them if needed. The options below direct Timelapse on how to manage your DeletedFiles folder, ordered from safest to riskiest.

Manual: Files moved into DeletedFiles stay there until you manually delete them.

Ask: When an image set is closed or on exit, Timelapse asks if you want to empty DeletedFiles (if it exists).

When an image set is closed or on exit, Timelapse empties DeletedFiles (if it exists).

When you delete files within TIMELAPSE, TIMELAPSE actually moves them into a 'DeletedFiles' sub-folder so you can recover them if needed. The options included direct TIMELAPSE on how to manage your DeletedFiles folder, e.g., to keep them there, to ask you if you want to delete them, or to delete them automatically on exit.

Exporting CSV files – Adjust Date and Time formats.

Exporting CSV File - Date and Time Formats
 Dates and times can be output in one of these formats.

Date column (DD-MMM-YYYY), Time column (HH:MM:SS) e.g., 24-Dec-2021, 16:00:05

DateTime column, local time (YYYY-MM-DDTHH:MM:SS) e.g., 2021-24-12T16:00:05 (includes 'T' separator)

DateTime column, local time (YYYY-MM-DD HH:MM:SS) e.g., 2021-24-12 16:00:05 (excludes 'T' separator)

DateTime column, UTC time+offset (YYYY-MM-DDTHH:MM:SS±HH:MM) e.g., 2021-12-24T22:00:05Z-06:00

Timelapse lets you choose how Dates and Times are exported to CSV files. This includes two separate Date and Time columns, or as a single DateTime column set in either local time, or as UTC (Greenwich time) plus the time zone offset. See the sections *Exporting Date to CSV files* and *Understanding UTC Dates and Time zones* for further information.

Zooming within the Main Image.

Zooming within the Main Image
 The maximum you can zoom into the image. Select the highest zoom that doesn't result in blurry pixels

Minimal zoom Mazimum zoom.

When you zoom into the image, TIMELAPSE will stop zooming when it reaches a particular zoom setting. You can increase or decrease the maximum zoom allowable through this control. Note that really high zooms be of little value for low-resolution images, as you will just see a bunch of blurry pixels.

Adjusting performance when scrolling rapidly.

Adjusting Performance when Scrolling Rapidly

Timelapse displays occasional images when you rapidly scroll through them.

- Some machines can't show images quickly, leading to skipping, stuttering, freezing or even a crash.
- Adjust the slider to change how frequently successive image displays. If there are no issues, try a faster speeding.

Display: fewer images (safer)  more images (riskier)

Reset

Timelapse displays successive images when loading images for the first time, and when you rapidly scroll your images. Yet older machines and older Windows versions may have problems showing image quickly, leading to image skipping, stuttering, freezing and perhaps even a system crash. You can tweak the performance by

- Adjusting whether Timelapse should display fewer images (i.e., how many images it should skip displaying)
- For fast machines, you can tell it to try to display as many images as possible when loading.
- If you don't see stuttering or stalling, try displaying more images. Otherwise try fewer ones.

Image Differencing Threshold.

Image Differencing Threshold

This threshold determines how visual differences between images are calculated and displayed. Low thresholds increases noise, while high thresholds may miss differences.

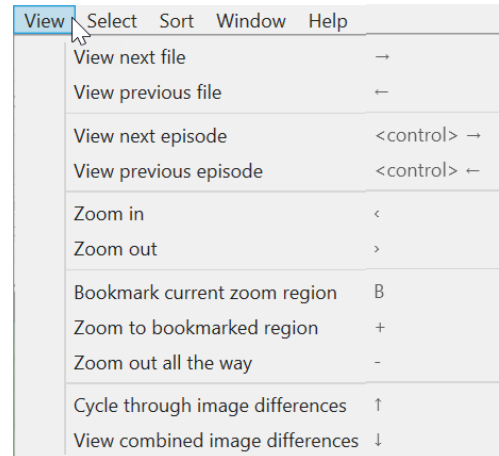
Low threshold  High threshold

Reset

When performing image differencing (discussed later, see the sub-section *Introducing image differencing*), TIMELAPSE uses a particular threshold to determine if the difference spotted between images should be displayed or ignored. You can adjust this threshold if you wish. However, if you set it really low, TIMELAPSE will likely display many unimportant differences. If you set it to high, Timelapse may not display some differences that you would have judged as important. Your best setting will likely depend on the kinds of images you take.

View menu

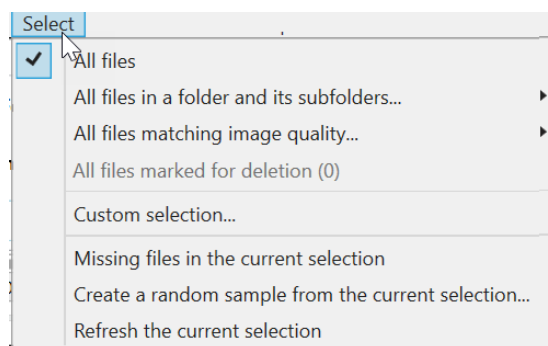
- 1. View Next file / Previous file** navigates to the next and previous image. They perform the same action as using the left/right arrow keys on your keyboard.
- 2. View Next episode / Previous episode** navigates to the first image of the next and previous episodes (see *§Episodes* in this manual). They perform the same action as using the <control> left/right arrow keys on your keyboard.
- 3. Zoom In / Zoom out** zooms into and out of the image and/or the overview. They perform the same action as using the scroll wheel on your mouse.
- 4. Bookmark Current Region / Zoom to Bookmarked Region / Zoom Out All The Way** allows you to 'bookmark' your current zoomed in region, then return to that zoomed-in region, or zoom out all the way. They perform the same action as using the 'B', '+' and '-' keys on your keyboard as previously explained
- 5. Cycle Through Image Differences / View Combined Image Differences** visually displays an image that shows the differences between the current image and / or the previous and next image. It is useful for spotting small visual changes that you could easily miss. It will be explained in detail later.



View	Select	Sort	Window	Help
View next file				→
View previous file				←
View next episode				<control> →
View previous episode				<control> ←
Zoom in				<
Zoom out				>
Bookmark current zoom region				B
Zoom to bookmarked region				+
Zoom out all the way				-
Cycle through image differences				↑
View combined image differences				↓

Select menu

This menu lets you selectively show only a subset of the images from your image set, where selection operations are applied to select (i.e., filter) which images will be displayed. Note that the subset of images you select will be displayed by the sort order as specified in the *Sort menu*. Most will also show how many files match that selection.



Tip. Selections are actually 'database queries'. A selection creates a query which is used to internally to search the Timelapse database. Only those images whose data match the queries are returned.

1. **All files** display every single image and video.
2. **All files in a folder and its subfolders...** displays a submenu listing all the folders in your image set. When you select a folder, it displays every single image and video in that particular folder and its subfolders.

Tip. Selecting by folders is a very convenient way of analyzing on a subset of images. For example, if your image set includes files from multiple cameras, each camera in a different folder, you can select that folder to analyze images only from that camera. Similarly, if images retrieved from a camera card is in its own folder, you can select for that folder and analyze only that card's images.

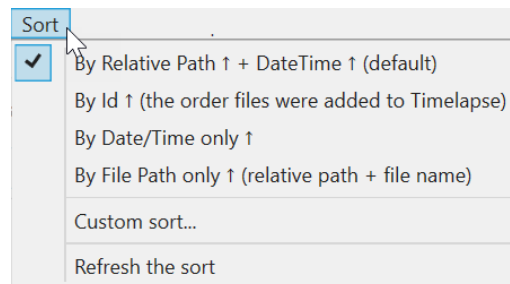
3. **All folders matching image quality...** lets you select the subset of images that marked as
 - i. **Ok files** -all files that are not classified as dark.
 - ii. **Dark files** - only those files whose ImageQuality field is set to Dark. While ImageQuality can be set manually, its best done by having Timelapse automatically dark-classify your images via *Edit | Classify dark files now...*
4. **All files marked for deletion** displays all files that have the Delete? flag checked. This lets you review those files before you actually delete them.
5. **Missing files in the current selection** displays only those files that are no longer present, i.e., where the file is missing. Missing files are usually those that have been deleted or moved, but where the data still exists
6. **Custom selection...** displays a query form that allows you to precisely specify the properties of only those images that should be displayed.

Tip. Custom Selection is an extremely powerful work aid. It can help you speed up your workflow hugely. See Section on *Custom Selection*.

7. **Create a random sample from the current selection...** randomly samples the current selection to produce a subset of files, where you set the number of files you want in it. Sampling is a convenient way to quickly review a particular selection against some criteria. See Section on *Random Sampling*.
8. **Refresh the selection** will re-select the files based on the current values of your selection filters. This may be useful if you entered data on the currently selected files that changes whether it fits within the selection criteria.

Sort menu

This menu lets you set the criteria for how your files should be sorted, i.e., the order of files from first to last. Note that images shown will be of the files you selected in the *Select menu*.



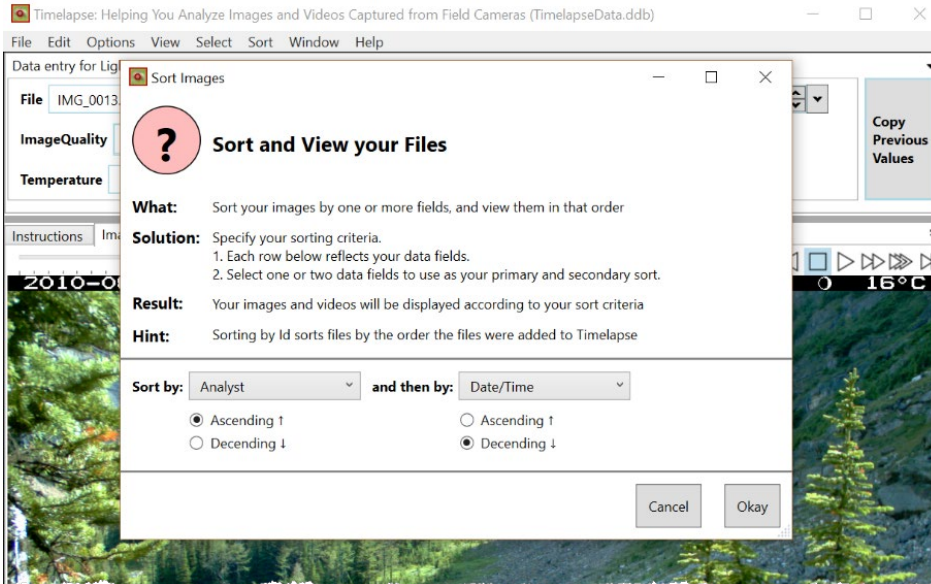
Note. By far the most useful sort setting is by *Relative Path* and then by *Date/Time*, as this is likely how you will want to go through your images. This sort criteria will;

- Sort your images into groups by their *File Path* (that is, the name of the sub-folders your image is in)
- within each group, sort your images by their Date and Time.

This sort order is used by Timelapse as its default sort setting.

1. **By Relative Path↑ then by Date/Time↑.** This is the default and recommended sort setting, as described in the note above.
2. **By Id↑.** As files are first added to Timelapse, they are given a sequential ID number. Thus sorting by Id sorts by the same order you added files to Timelapse. Because images are usually added a folder at a time, where image names are numbered sequentially in a way that reflects its date/time order, this usually – but not always – produce results similar to sorting by *File Path*↑ *then by Date/Time*↑. If you really want to see your files by folder and then by date/time, use that sort option instead.
3. **By Date/Time only↑.** Files are sorted by date and time in ascending ↑ order. That is, the first file in the sequence of images will be the one with the earliest date. This will produce the same results as 1 above if you have a single folder. However, if you have multiple folders where images across folders are taken at similar times, they will be intermixed – so use with caution. This is useful if, for some reason, you want to view images taken at the same time by (say) different cameras whose images are sorted into different folders
4. **By File Path only↑.** Files are sorted alphabetically in ascending order by the file path, that is, a combination of the relative path (if you are storing images in subfolders) and the file name.
 - If you store your images in a sub-folder, the file path would be something like Set1/image001.jpg, Set1/image002.jpg ... Set2/image001.jpg...). it will sort alphabetically on the combined path/filename.
 - If you have no sub-folders, it will just sort by the filename
 - Because image names are often numbered sequentially in a way that reflects its date/time order, this usually – but not always – produce results similar to sorting by *Relative Path*↑ *then by Date/Time*↑. If you really want to ensure that you see your files by folder and then by date/time, use the *Relative Path*↑ + *Date/Time*↑ sort option instead.
5. **Custom sort** raises a dialog box that lets you sort in ascending or descending order on any two terms i.e., the data fields that appear in Timelapse. Using the Tutorial example, lets say you had three analysts working on the image set, where each had put their name in the Analyst box. Sorting by Analyst (ascending) and DateTime (descending) will group each analyst's images together, where the their subset of images with show the one with the latest date first.

6. **Refresh the sort** will re-sort on the current values of your sort criteria – this may be useful if you entered data that changes where particular images appear in the sorted list.



Note: Sort and Select work together. For example, if you had a field named 'Hikers' and wanted to display only your files with hikers sorted by folders, and then by date/time, you would:

- *Select | Custom selection* to select 'Hikers > 0',
- *Sort | Relative Path↑ + Date/Time↑*

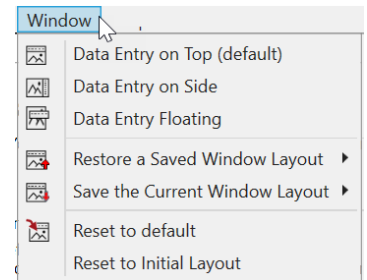
Alternately, if you wanted to display only your hiker images (regardless of where they were stored) with images with the greatest number of hikers in them first, you would:

- *Select | Custom selection* to select 'Hikers > 0',
- *Sort | CustomSort* and then select 'Hikers' 'Descending'.

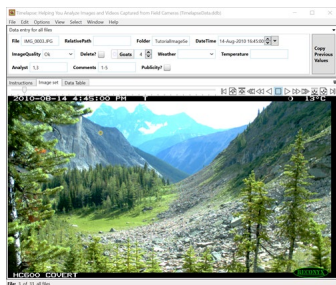
Window menu

This menu lets you selectively rearrange the various panels and windows that comprise Timelapse.

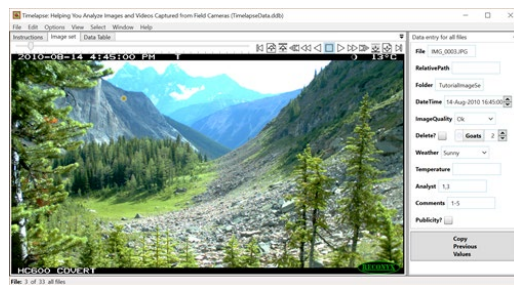
The first three adjust where the Data Entry pane appears relative to the Timelapse Window. You can fine tune the pane size by dragging its grey border.



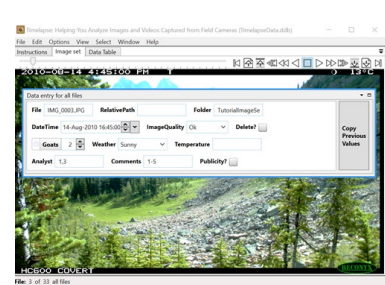
1. **Data Entry On Top.** The data entry pane is tiled at the top of the current Timelapse window.
2. **Data Entry On Side.** The data entry pane is tiled at the right side of the current Timelapse window.
3. **Data Entry Floating.** The data entry pane is configured as a separate 'floating' window atop the current Timelapse window.



Data Entry On Top



Data Entry On Side



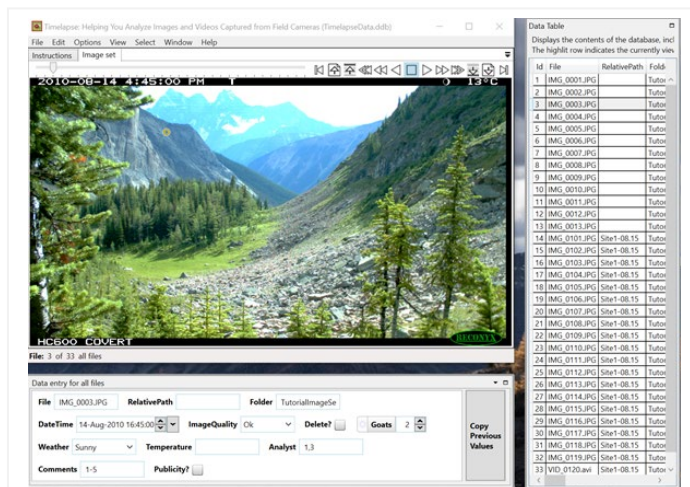
Data Entry Floating

The next two items lets you save the current layout (including position and size), and load them back any time you want.. \$Tabs and the Data Pane describes how you can rearrange your tabs and data panes manually, which you can then save for later reuse.

4. **Restore a Saved Window Layout.** Choose and load one of your previously saved layouts.
5. **Save the Current Window Layout.** Saves the current layout in one of several custom settings.

The last two items lets you quickly restore your layout, which is useful if things get mucked up.

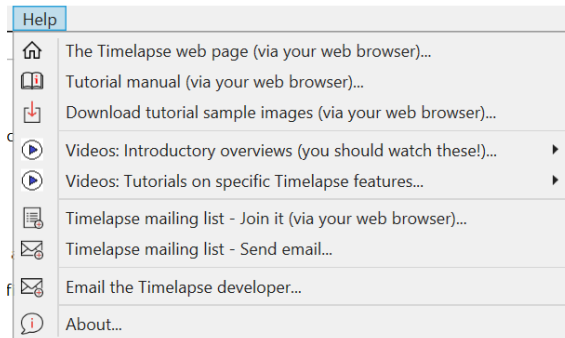
6. **Reset to Default.** Restores the layout to the system default (i.e., Data Entry On Top)
7. **Reset to Initial Layout.** Restores the layout to the initial layout of the current Timelapse session



An example of a manually arranged layout that can be saved and loaded

Help menu

- 1. The Timelapse Web Page** will display the main TIMELAPSE web page in your browser.
- 2. Tutorial Manual** will display the TIMELAPSE Tutorial Manual (a PDF file) in your browser. Note: This is a large file, so it may take some time to load. You need to be connected to the internet.
- 3. Download Sample Tutorial Images** will download the sample images that accompany the TIMELAPSE Tutorial Manual. You can use these images to practice on as you follow the manual's instructions.
- 4. Videos: Introductory overviews...** provides direct links to videos giving overviews of Timelapse and other important topics. Videos are displayed in your web browser. Definitely worth the time, as it may tell you about features and capabilities you didn't know about!
- 5. Videos: Tutorials on specific Timelapse features...** well, the title says it all. Sometimes, watching a video of a feature is clearer than reading text in this manual.
- 6. Timelapse Mailing List – Join it** will let you join the Timelapse mailing list, which will keep you informed of software updates and occasional news. Mailings are fairly infrequent. All emails are moderated, so spam is highly unlikely. We highly recommend you join, as otherwise you can easily miss updates and bug fixes.
- 7. Timelapse Mailing List – Send Email** will let you send email to the mailing list.
- 8. Email the Timelapse developer** will let you send comments, feedback, bug reports, feature requests, experiences, suggestions, questions or whatever else you want to the Timelapse developer.
Feel free to email me at any time. I truly value your feedback, as it helps me improve Timelapse
- 9. About** gives information about the software (such as its version number) as well as how to contact the Timelapse team if you have issues, problems, or questions. It also lets you check to see if a newer version of TIMELAPSE is available.



Feel free to contact the Timelapse team at any time. We truly value your feedback, suggestions, bug reports or experiences.

Markers

In some image sets (such as the one used in this tutorial) counting things can be difficult if:

- there are many entities to count (as it is easy to lose track of what is counted and what wasn't)
- there are different entities to count (as it is easy to mis-categorize counted items)
- the entities you want to count are visually small (as it is easy to miss things)
- you (or another analyst) want to review the image later to verify the correctness of what has been counted and what hasn't been counted.

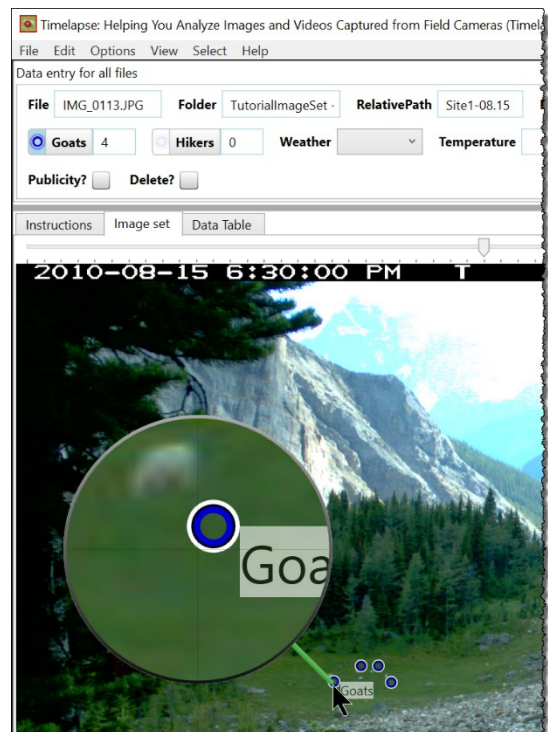
Markers present an alternative to simply entering a number in a Counter. You count by clicking a Counter's radio button, and then clicking over the entities of that type in the image. This also creates a visual marker indicating the location of those entities in the image.

- **Activate a Counter** by clicking its radio, which turns it blue.
- **Create a marker** by left clicking atop the thing you want to count on the image. Note that you must have a Counter selected (selected Counter buttons have blue radio buttons)
- **Highlight markers** by moving your mouse cursor over any Counter
- **Delete a marker** by right clicking on it.

You can de-activated a counter by clicking it again, or by selecting another counter to activate that one instead.

The image to the right illustrates this. The analyst activated the *Goat* counter by clicking its radio button (now in blue). Using the magnifying glass and zoom feature, the analyst scanned the image, identified four goats, and clicked on them. The count automatically increases to 4, and four blue markers now appear atop the goats. Hovering over a marker raises a tooltip describing its type (i.e., that it is a goat marker).

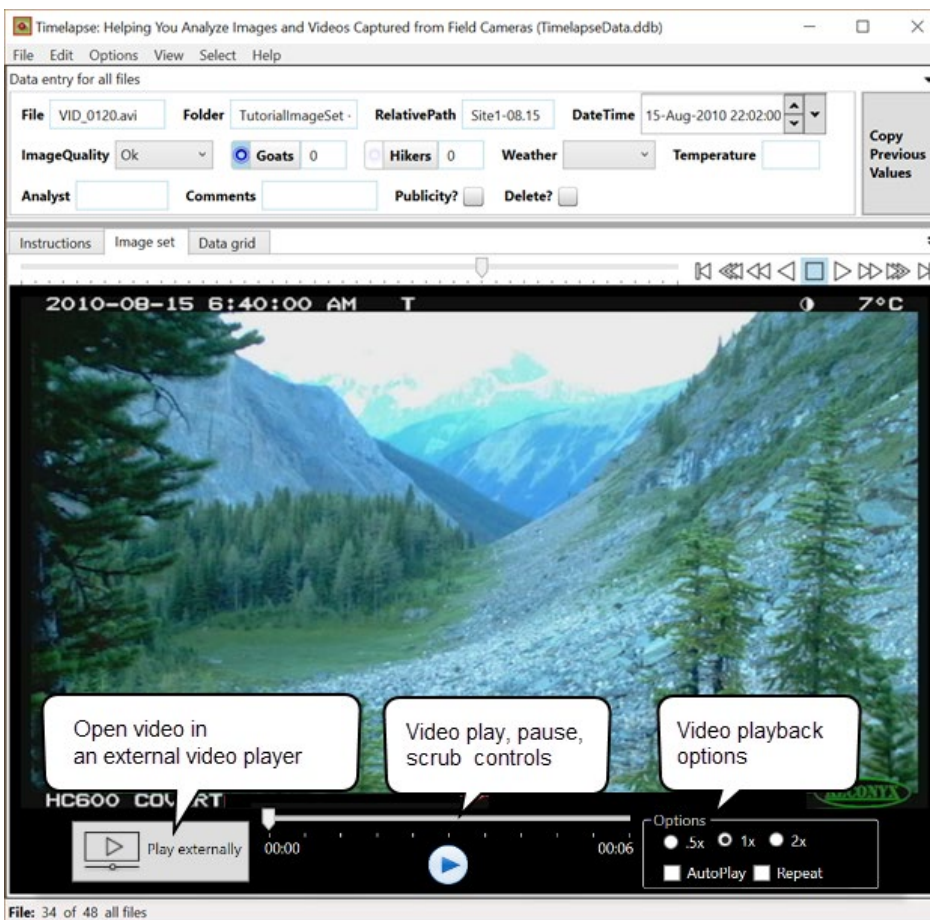
Markers matching an activated (blue) counter appear in blue. Other markers representing other entities are in yellow (matching the yellow color of the other unselected counter buttons).



Videos

TIMELAPSE can display both image (.jpg) and video (.mp4, .avi, and .asf) files. When you navigate to a video file, Timelapse will show the video player and its various control.

- **Video play, pause or scrub controls** similar to most video players
- **Video playback options** adjust playback speed (.5x, 1x, 2x), autoplay to automatically begin playing the video, and whether playback should be repeated.
- **Play externally:** When pressed, the video will be opened in your external – and possibly more sophisticated - default video player
- **Spacebar or Clicking the video** are shortcuts to toggle between play and pause
- **Zoom and Pan controls** are similar to those in the image viewer i.e., mouse wheel to zoom, then click and drag to pan will let you zoom in and out of any video area,
- **Magnifying glass (shortcut 'M')** is also similar, where it will display a magnifying glass (only on unzoomed videos)



Videos have several limitations

- TIMELAPSE may not be able to read the video's correct date. Always check the dates on videos!
- You cannot place a Marker on a video
- Videos are somewhat slower to load, where they may initially display a 'black' frame before showing its content.

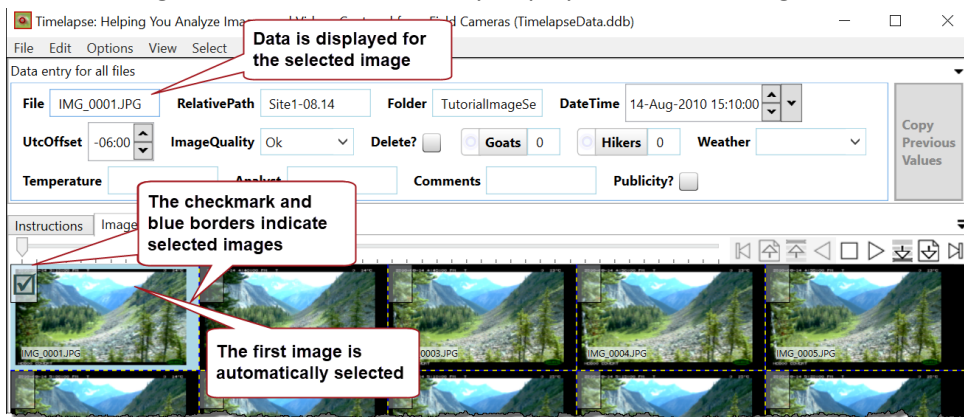
The Overview

As mentioned in §Magnifying, zooming and panning, you can zoom out to an Overview, which displays a page containing rows of multiple images. You can zoom out through various overview levels, each showing successively more images at smaller sizes. Zooming in and out of the overview is done via the scroll wheel, the ‘<’ or ‘>’ shortcut keys, or via the zoom in/out menu.

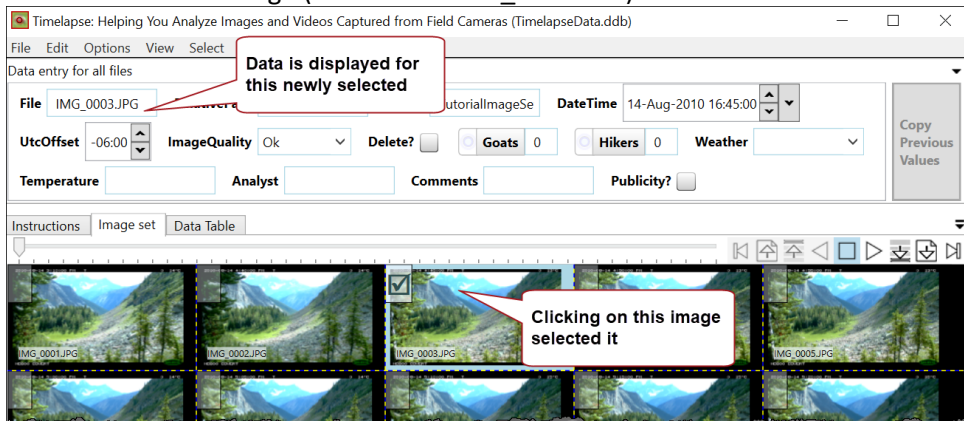
Note. Some functions are disabled in the overview. These include a handful of menu options, the Copy Previous Values button, the magnifying glass, and marking.

1. **Displaying a single image’s data.** When initially zooming into the overview, the top-left image is automatically selected and its data displayed.

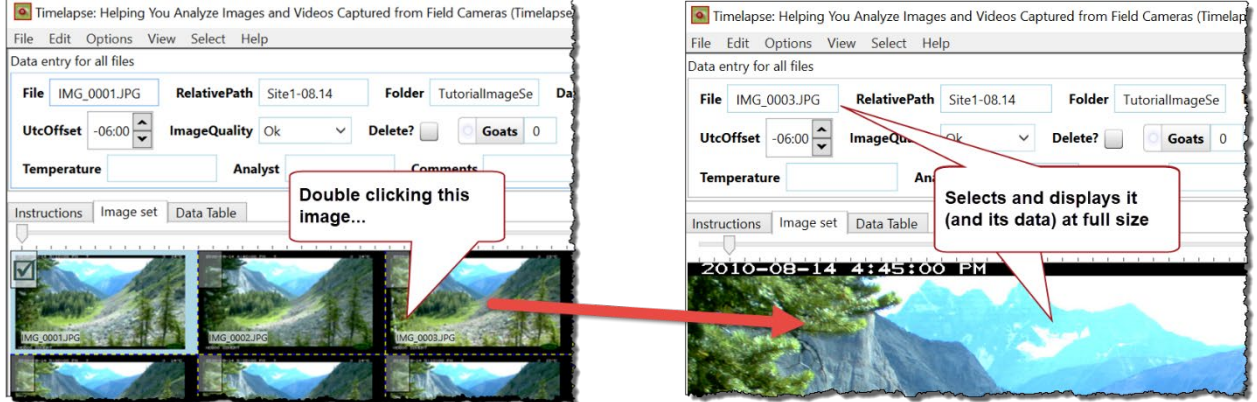
The first image and its data are normally displayed after switching to the overview.



A single click on any other image will display the data for that image. For example, the user has selected the third image (in this case IMG_0003.JPG) and its data is now shown.



2. **Zooming out to a selected image.** If you double click any image, it will return to the single image view, where it will navigate to the selected image and display it.



3. **Navigating to other images.** The file player controls navigation. Alternately, you can use these shortcut keys:
 - →←arrow keys advance to the next/previous image
 - <control> →←arrow keys advance to the 1st image in the next/previous episode,
 - ↓ ↑ display the next/previous row of images,
 - Page Down/Page Up keys display the next/previous page of images. Navigation always resets the selections to the first image on the page.

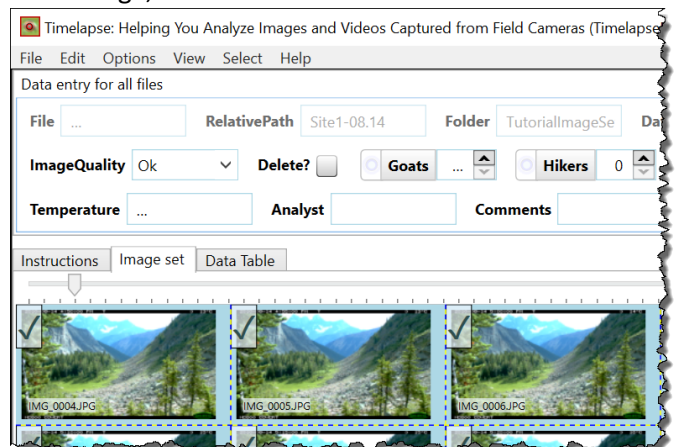
4. **Selecting and entering data for multiple images at a time.** The overview is a convenient way to enter data common to multiple images.

You can select multiple images similar to how Windows lets you select multiple files,

- **Click and drag to select a range of images:** Click and drag from one image to another image will select all images between the two.
- **Control-click an unselected image** to add that image to the set of selected images.
- **Control-click a selected image** to remove that image from the set of selected images.
- **Shift-click an image** will extend the selection from the previous selected image to the current image. If there is no previously selected image, it will extend the selection to the next selected image.

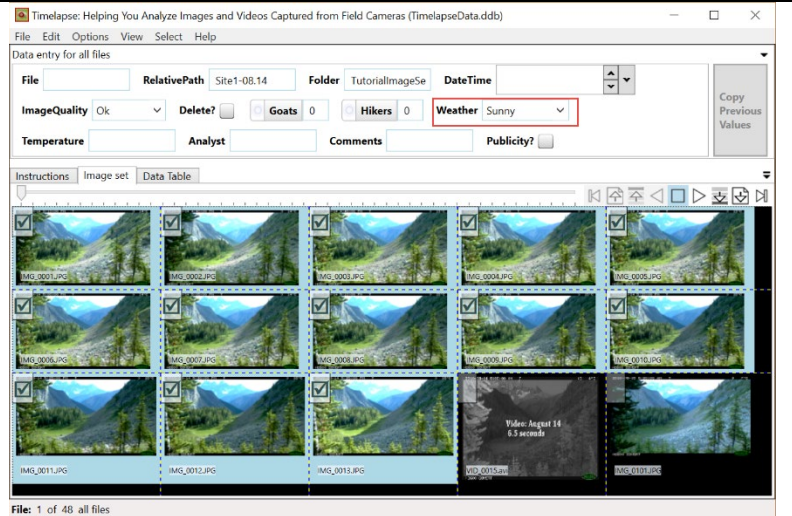
When multiple images are selected, data is displayed **only if** it is common to all selected images. If data differs, an ellipses '...' will be displayed instead.

For the example at the right, the user has selected several images. Those selected images all have a Hikers value of 0. However, the same images don't have a common value for the Goats count, as it displays '...'.

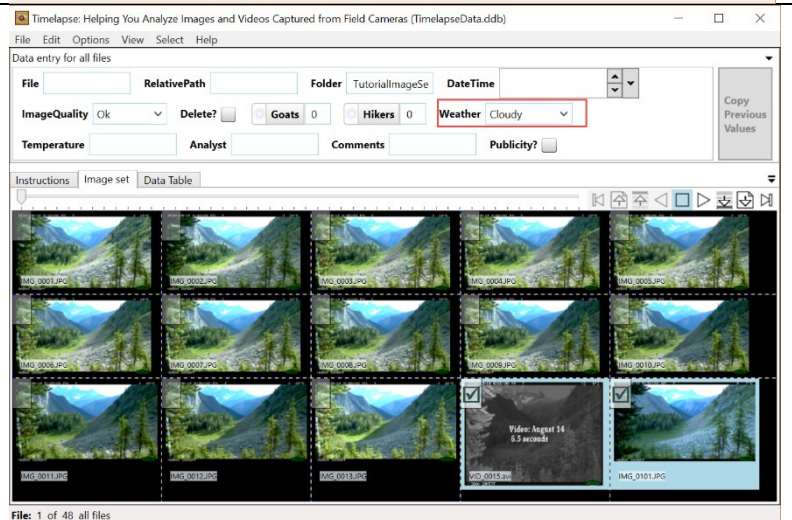


Any data entered will then be applied to all selected images. To illustrate, the example below shows a user setting the weather.

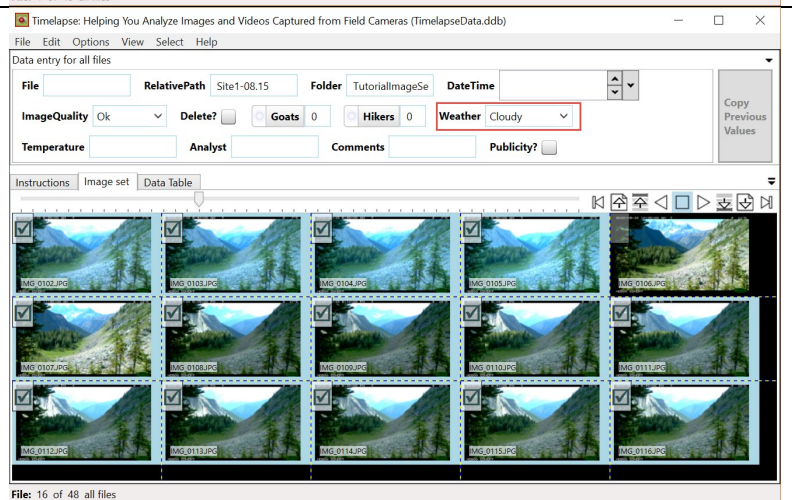
She selects all sunny images on this page (all but the last two, which she leaves unselected) and sets the weather to Sunny.



She then selects the last two images on this page and sets their weather to Cloudy.



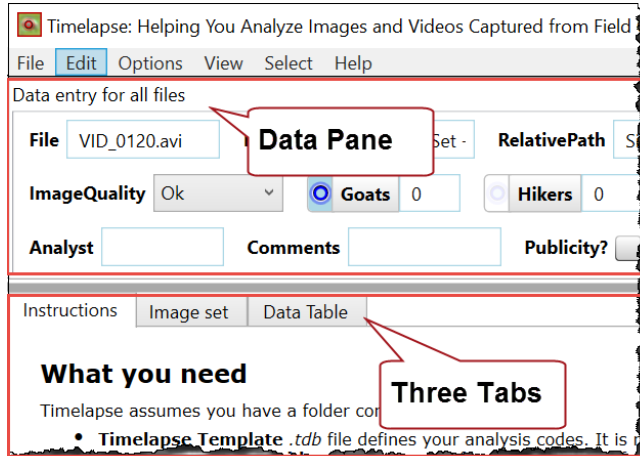
She then clicks the next page button on the File player to show the next page of image files. All but one are cloudy, so she selects those and sets them to Cloudy.



She continues this process to enter the weather for all other images.

Window Tab Panes and the Data Pane

TIMELAPSE provides its major informational components within one **data pane** and three **tabs**.



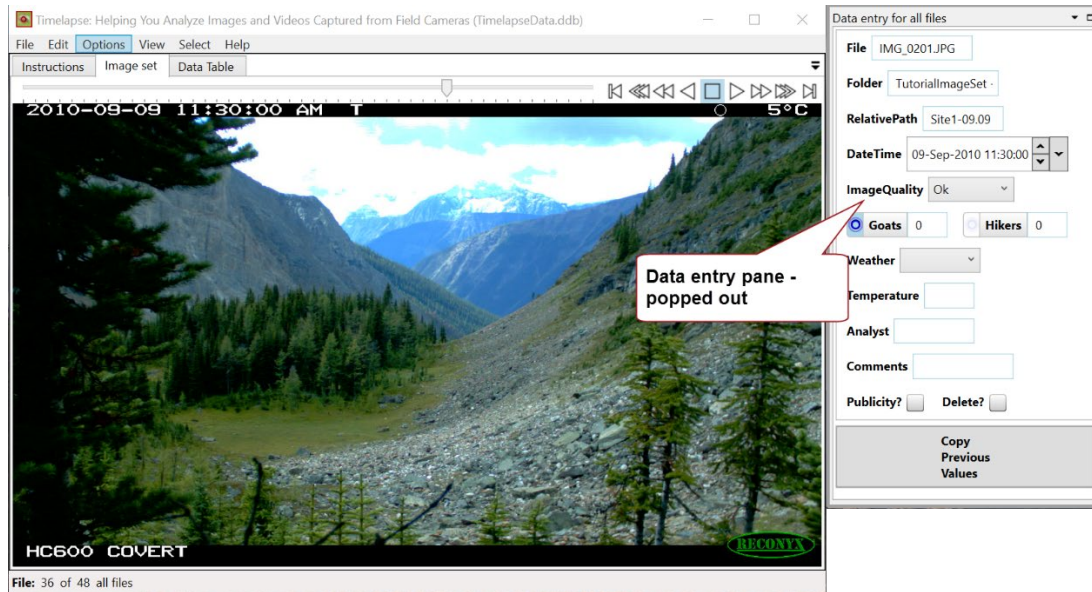
The **three window tab panes** are:

- **Instructions tab** contains a brief summary of how to use TIMELAPSE.
- **Image set tab** displays the current image or video
- **Data grid tab** displays a grid that lists all you files in rows, and all the current data values as columns

The **data pane**

- contains all the fill-in data fields associated with the image being displayed.

You can re-arrange the window tabs and data pane on the display to best fit your working style and screen size. This includes adjusting how they appear within the main window, or popping some of them out as a separate floating window. For example. The image below shows the data pane arranged as a separate movable and resizable window.



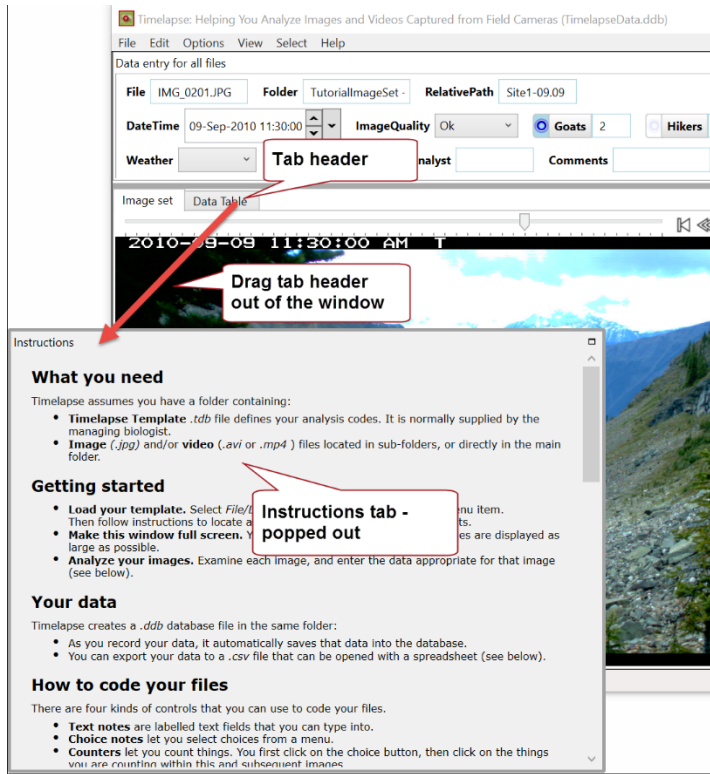
A popped- out data pane appears in its own movable and resizable window.

You can save arrangement at any time via the *Windows->Save a Custom Layout* menu item. You can then restore that arrangement at a later time via the *Windows->Load a Custom Layout* menu item.

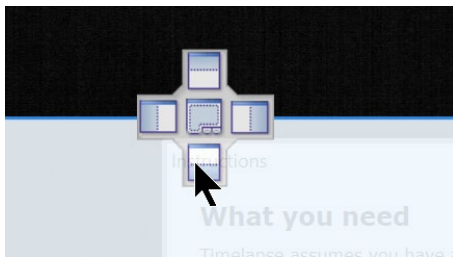
Window Tab Pane rearrangement

Window tabs can be rearranged as follows.

- **Switch between tabs** by clicking the tab header.
- **Pop out the instructions or data grid tab** by selecting and dragging the tab header out of the window



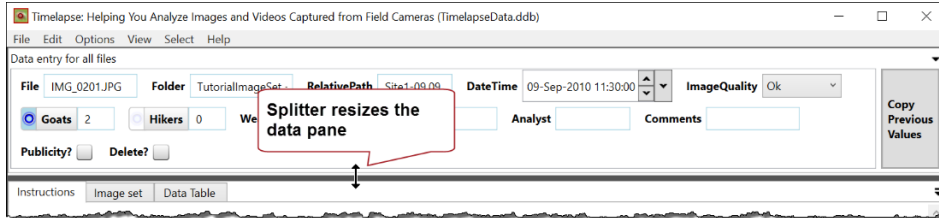
- **Place a popped-out Window tab pane back into the window by:**
 - o *recommended*: reverse the above, by dragging its title bar back into the tab headers
 - o *alternate, not recommended*: drag its title bar over the icon that will appear at the center of the window(see below), which splits the current tab window into two (not advised, as the image set tab will then become quite small)



Data Entry Pane

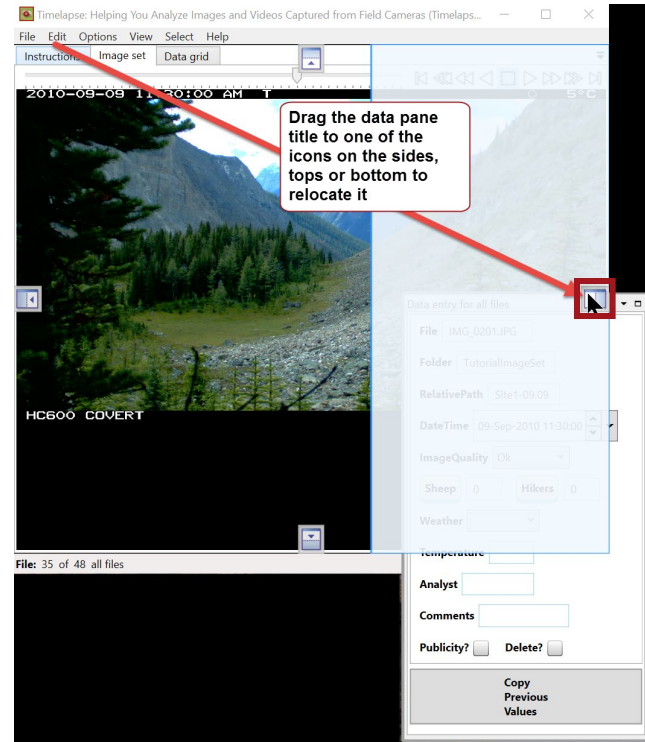
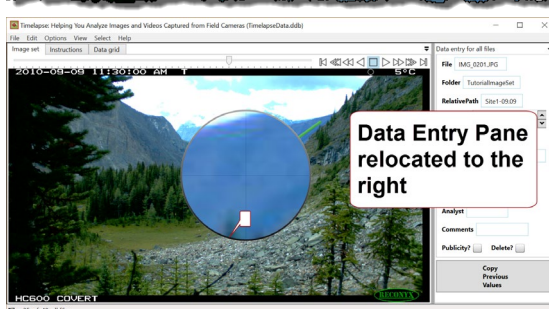
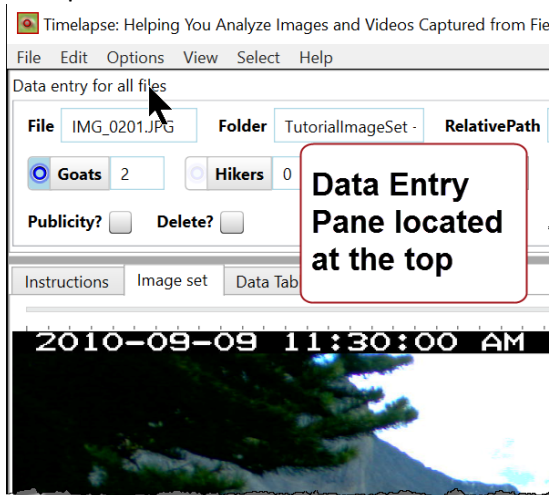
The data entry pane can be re-arranged as follows

- **Resize the data entry pane** by dragging and moving the grey splitter bar that separates it from the Window tab pane, or by selecting one of the window arrangements on the *Windows* menu.



- **Pop out the data entry pane** by selecting and dragging the data pane header out of the window (similar what was illustrated for tabs)
- **Relocate the data entry pane on different sides of the window.** Select and drag the data entry pane's title header out of the main window. Icons will appear at the left/right/top/bottom sides of the main window. Drop the data entry pane onto the icon on your desired side.

Example: The following action moves the data pane from top (upper left image) to the right side (lower left image) of your main window. Select the data entry pane title and drag it over the icon that appears on the right side of the window (see right image). Note that you may have to resize the data pane afterwards.



7 Entering Data via Tabbing

You can select data fields for input by clicking on them with the cursor or by tabbing between fields. With tabbing you can enter your data using the keyboard instead of (or as well as) the mouse. While it takes some getting used to, you may find tabbing a very handy way to enter data quickly.

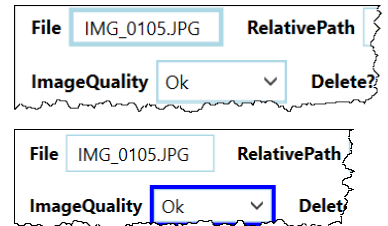
Note. *Focus* is the data field or user interface control currently accepting text input.

To begin, press the tab key or select any data field to give it the focus.

- Read-only data fields (e.g. File) are outlined in thick light blue.
- Editable data fields (e.g. Goats) are outlined in thick dark blue.

Tab goes forward to the next *editable* data field in your Data Entry pane.

Shift-Tab goes backwards to the previous *editable* data field in your Data Entry pane.



Note. Tabbing normally skips over **DateTime**, **ImageQuality**, and **Delete?** data fields, as these fields are rarely edited. However, you can include these fields in the tab order by selecting *Options| Preferences...*

When you reach the end of the data fields,

- Tab to go to the **Copy previous values** button.
- Tab again to go to the first editable data field in your Data Entry pane. *Or*
- Shift-Tab to go back to the last editable data field

Particular keyboard actions / shortcuts work over the particular controls that have the focus.

- **All controls:**
 - **Shift left/right arrow** or **shift page up/down**: navigate to the previous/next image
- **Notes:**
 - Type to enter or edit the data.
 - **Left/right arrow**: character navigation as expected.
- **Counters:**
 - Type to enter or edit the data
 - **Up/down arrow**: increment/decrement the value.
 - **Left/right arrow**: character navigation as expected.
- **Choice menus:**
 - When you type a letter, the first menu entry that matches that letter is selected.
 - **Up/Down arrow**: cycle through the menu items.
 - **Left/right arrow**: navigate to the previous/next image
- **Flag checkboxes:**
 - **Space**: toggle the checkbox.
 - **Left/right arrow**: navigate to the previous/next image
- **DateTime:**
 - **Up/down arrow**: increment/decrement the values.
 - **Left/right arrow**: move between year/month/day fields,
- **Copy Previous Values button**
 - **C** activates the button as if you pressed it
 - **Left/right arrow**: navigate to the previous/next image

8 Entering Data via QuickPaste

Let's face it. Entering data is tedious, especially when you enter the same data into the same data fields repeatedly. Using our tutorial data fields as an example, imagine if you were the analyst where you found yourself re-enter these data patterns over and over again on many images:

- **Goat:1, Weather: Sunny, Analyst: Fred, Publicity?:True, Comment: Nice close-up shot**
- **Weather: Sunny, Analyst: Fred**
- **Weather: Raining, Analyst: Fred, Comment: Poor visibility**
- **Comment: Another species spotted in image**

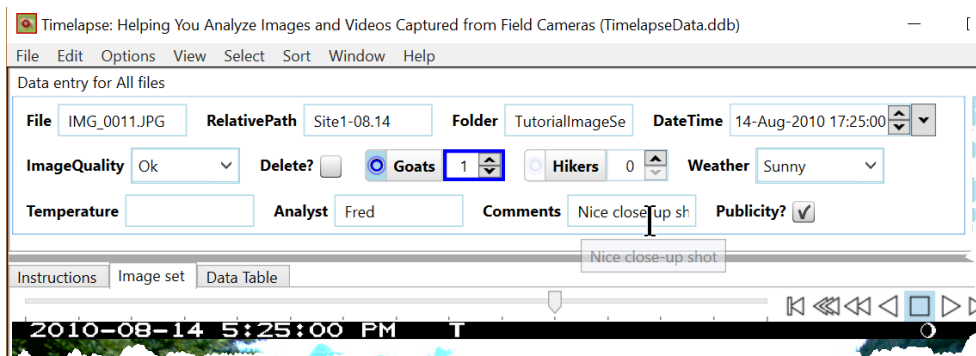
QuickPaste minimizes this pain, where you enter a data pattern with a single button click.

The Quick Paste Editor:

You create a QuickPaste Entry with the QuickPasteEditor, where you indicate

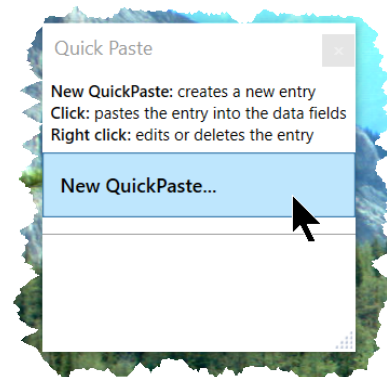
- a name for that entry (optional)
- which data fields you want to *QuickPaste* into, and
- the values to be pasted.

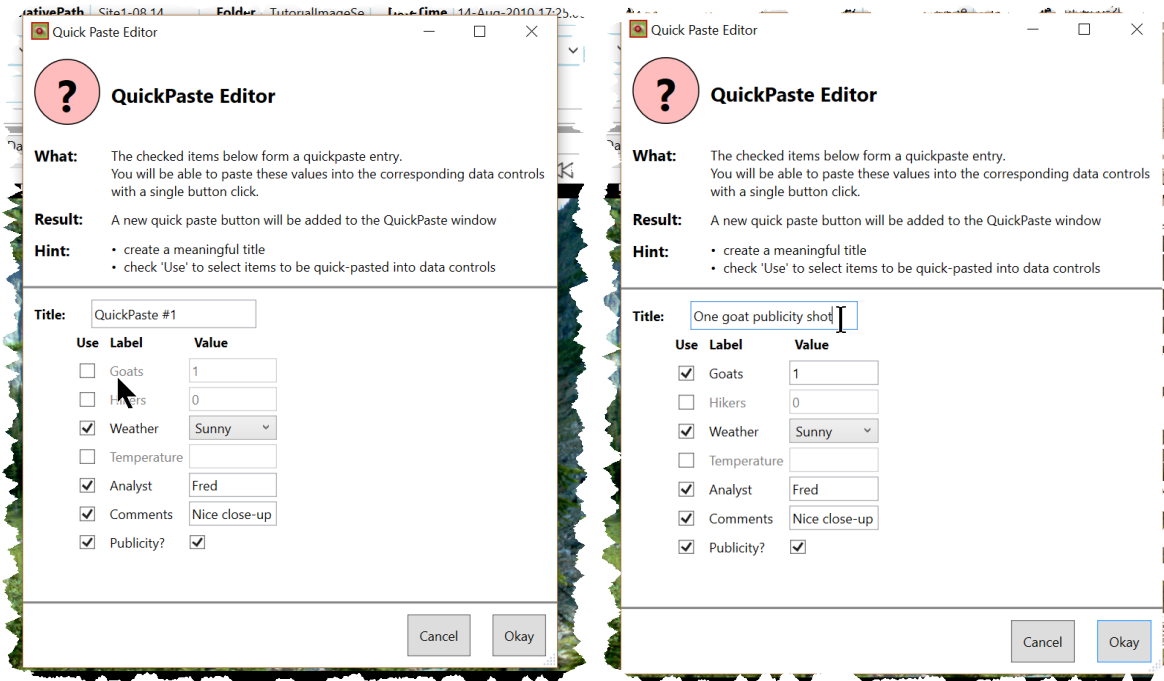
For example, let's say you had just entered the first pattern above into your data fields.



To create a *QuickPaste* entry based on that pattern:

1. **Select** *Edit | Show QuickPaste Window* (or type 'Q') to raise the QuickPaste window (shown at the right).
2. **Click** the *New QuickPaste...* button. The *QuickPaste Editor* window will appear (see next page).
3. **Examine the contents.** The editor pre-fills the fields with the values from your current image. It also pre-selects (via the checkboxes) all the fields marked 'Copyable' in the template, where those fields will be pasted into your data when you use *QuickPaste*.



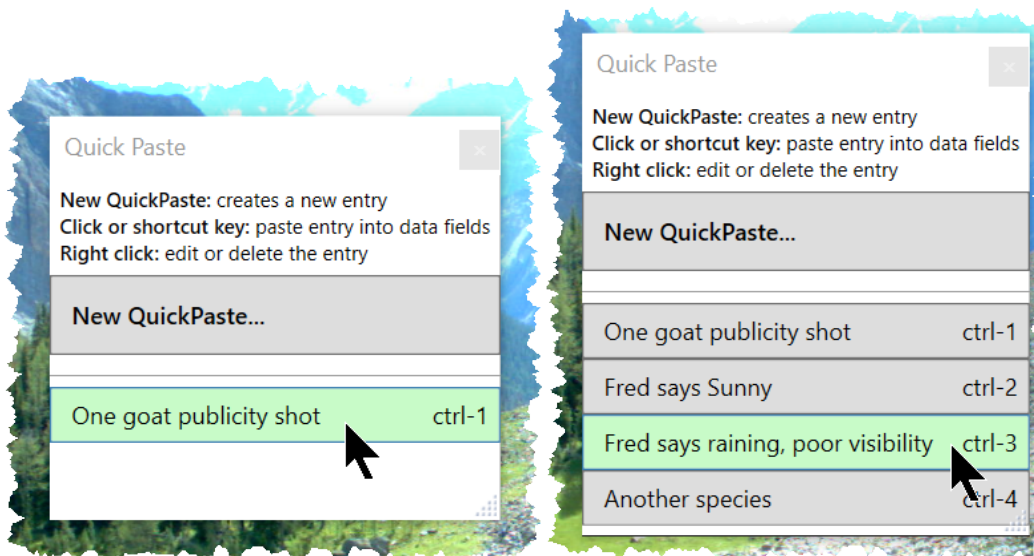


4. **Edit as needed.** Reconfigure the above to what you want. You can easily edit the above by: replacing the default *Title* with one that is meaningful to you; changing the check-marks to indicate which fields you want pasted, and entering new values.

For example, the right image below was edited to change *Title* to 'One goat publicity shot', and to check Goats to make it a pastable item.

When you click Okay, the *QuickPaste* window will appear with a new button on it representing the *QuickPaste* Entry you just created (see left image below).

5. **Create/edit other QuickPaste buttons** at your leisure. For example, the four *QuickPaste* buttons below are based on the example data patterns described earlier (right image below).



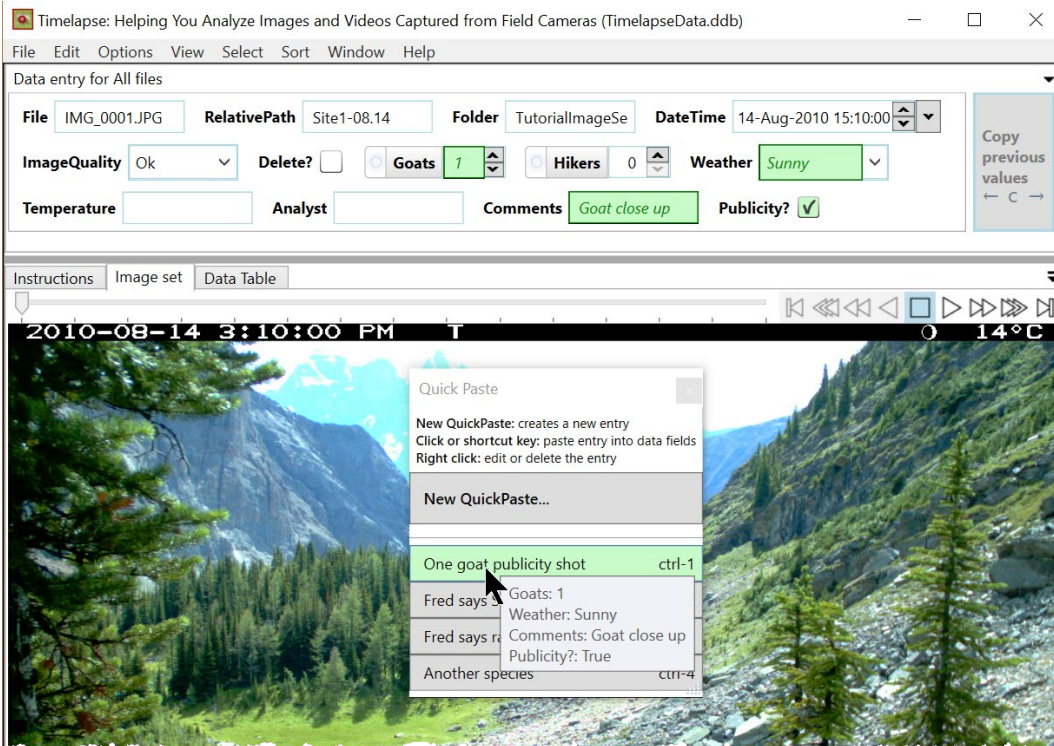
Using the Quick Paste Buttons

Previewing what QuickPaste will do. When you hover your mouse over a button, the data controls that would be affected are highlighted in green, where they show an italicized preview of the data that would be pasted into them.

Doing a QuickPaste.

- **Using the mouse:** Click the *QuickPaste* button to paste the data into the fields.
- **Using shortcut keys:** Each Quickpaste button is automatically assigned a shortcut key, displayed next to its name, e.g., ctrl-1, ctrl-2 as seen below.
Press Control and the desired number key to activate that *QuickPaste* button.

The data fields will flash briefly to indicate that they have been updated.



Other QuickPaste button operations.

<p>The tooltip summarizes values that would be pasted into the corresponding data fields.</p>	<p>Right-click raises the context menu, which lets you re-edit the button's entry or delete it.</p>	<p>QuickPaste also works with multiple images: the selected images get those values</p>

Importing Quick Paste Entries from another Image Set

Timelapse remembers your *QuickPaste Entries* in your image set's database (.ddb) file. This means that when you re-open that image set, your *QuickPaste Entries* will be there for you to use again.

When you open a new image set (or perhaps an old image set with no *QuickPaste Entries*), you can – if you wish - import *QuickPaste Entries* created in another image set and saved to its .ddb file. To do this:

1. Select *Edit/Import QuickPaste Items from .ddb file...*
2. From the file dialog box that appears, navigate to the image set folder that contains the database (.ddb) file holding the desired *QuickPaste Entries*.
3. The *QuickPaste Window* will appear with those entries.

Note 1. Importing over-writes any *QuickPaste* entries you may have already created.

Note 2. Timelapse always checks the imported *QuickPaste* entries against your data fields, where it will adjust the imported entries as needed to make sure they will work against your data.

9 Episodes

An episode is a sequence of images related to each other over time, such as by animal moving through the scene. As described below, Timelapse can try to identify episodes for you.

Why episodes?

Some analysts need to group images together as an ‘episode’ in order to analyze them. For example, consider the analyst has to count the number of hikers using a trail. Yet a single hiker may appear on several images over time, perhaps due to motion triggering (where the camera automatically takes several snapshots after motion is detected), or because the hiker is milling about in front of the camera. To avoid double-counting, the analyst would only count the hiker once in this series.

Yet identifying a series of images as an episodes is tedious and time-consuming. The analyst may examine various cues: distinctive features of the hiker or animal, and the direction of movement of the entity across the scene. The analyst may also check the date/time of the images: if images are separated by a short time interval, it is reasonable to assume that those images are related. The catch is that checking times is both tedious and time-consuming.

How Timelapse determines episodes

Timelapse uses time differences to determine what images belong in an episode. It compares the time difference between successive images against a time threshold: if the time difference is less than the threshold, it adds that image to the episode.

To illustrate, consider these image times, and a time threshold of 2 minutes.

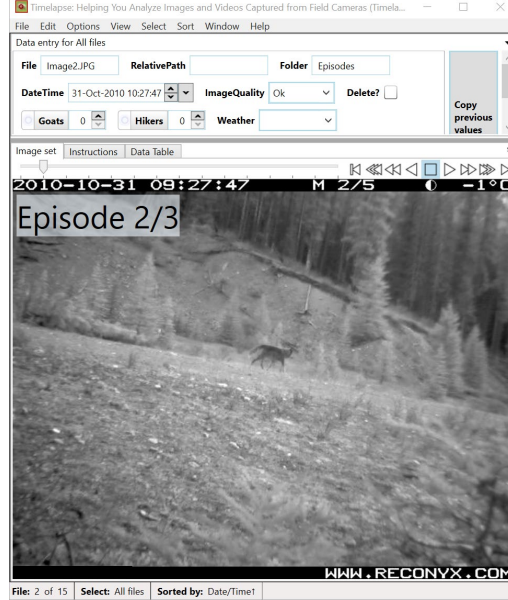
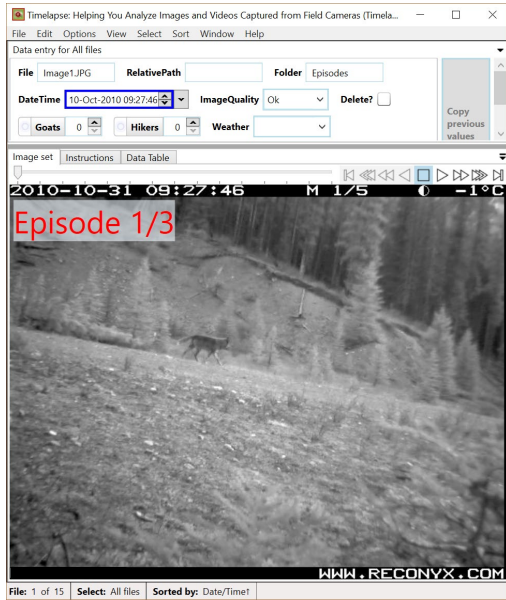
Name	Image1	Image2	Image3	Image4	Image5	Image 6	Image 7
Time (hh:mm)	8:45	8:46	8:48	9:30	9:32	10:00	10:05
Time difference from previous image (minutes)		1	2	42	2	28	5
Episode (image # / total)	1/3	2/3	3/3	1/2	2/2	1/1	...

- The first 3 images form one episode as the time difference between them is 2 minutes or less.
- A new episode begins on Image4, as it was taken 42 minutes after Image3
- Image4 and Image5 are an episode as their time difference 2 minutes
- For the same reasons, Image6 is an episode with only 1 image as the time differences between it and the surrounding images is more than 2 minutes.

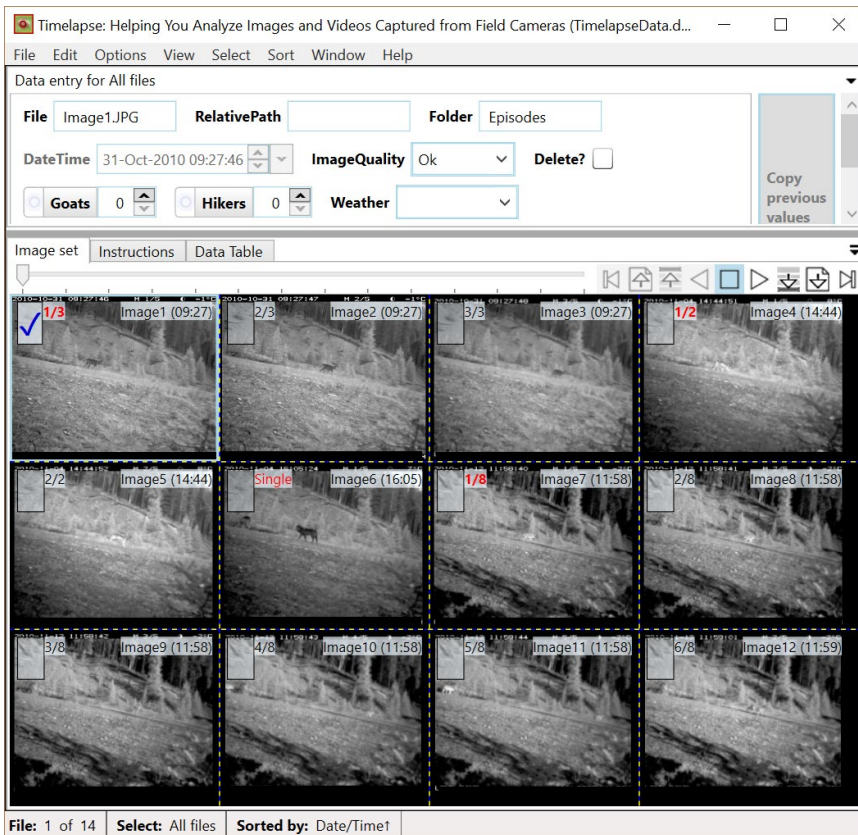
How Timelapse displays episodes

Select *Options | Show episode information*, or press the shortcut key ‘E’ to show episode information. as illustrated below.

Viewing a single image: text is overlaid on the top left corner of the image, identifying the image number in sequence / total number in sequence. The text is colored red if it’s the first image in the sequence, otherwise black. For example, the images below show the 1st and 2nd images in a sequence of 3 images. If there is only one image in an episode, it is labelled as ‘single’.



Viewing multiple images is similar, except the image name and the image time are also overlaid on the right side of the image.

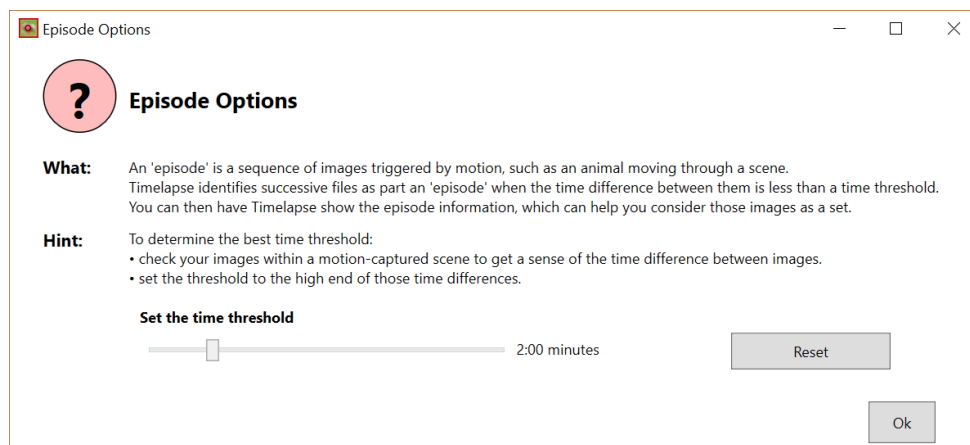


Note. If a relatively large number of images belong to a single episode, Timelapse will just display an ∞ (infinity) symbol.

Setting a time threshold for determining episodes

The time threshold determines whether images belong together in an episode. However, using time to delimit episodes is just a heuristic: it may be reasonably accurate, but it is still just a best guess.

Timelapse allows you to set the time threshold via the *Options / Adjust episode time threshold...* dialog, where it can be set very short (e.g., 15 seconds) or somewhat long (e.g., 10 minutes). We suggest examining a few of your images to determine what time threshold works best for your image set. Alternately, experiment with different threshold values and see how the episode groupings change.



Note. Episodes only make sense when your images are in some kind of date/time order. For example, when you use episodes you may first want to select:

- *Sort | by Date/Time* if all your images are from one camera, *or*
- *Sort | Custom Sort* and then by *File Path* and *Date/Time* if you have images from different cameras and/or different sites organized into sub-folders (as otherwise their times may be intermixed)

Navigating between Episodes

Simultaneously pressing these keys will let you navigate between episodes in either the single image view or the overview:

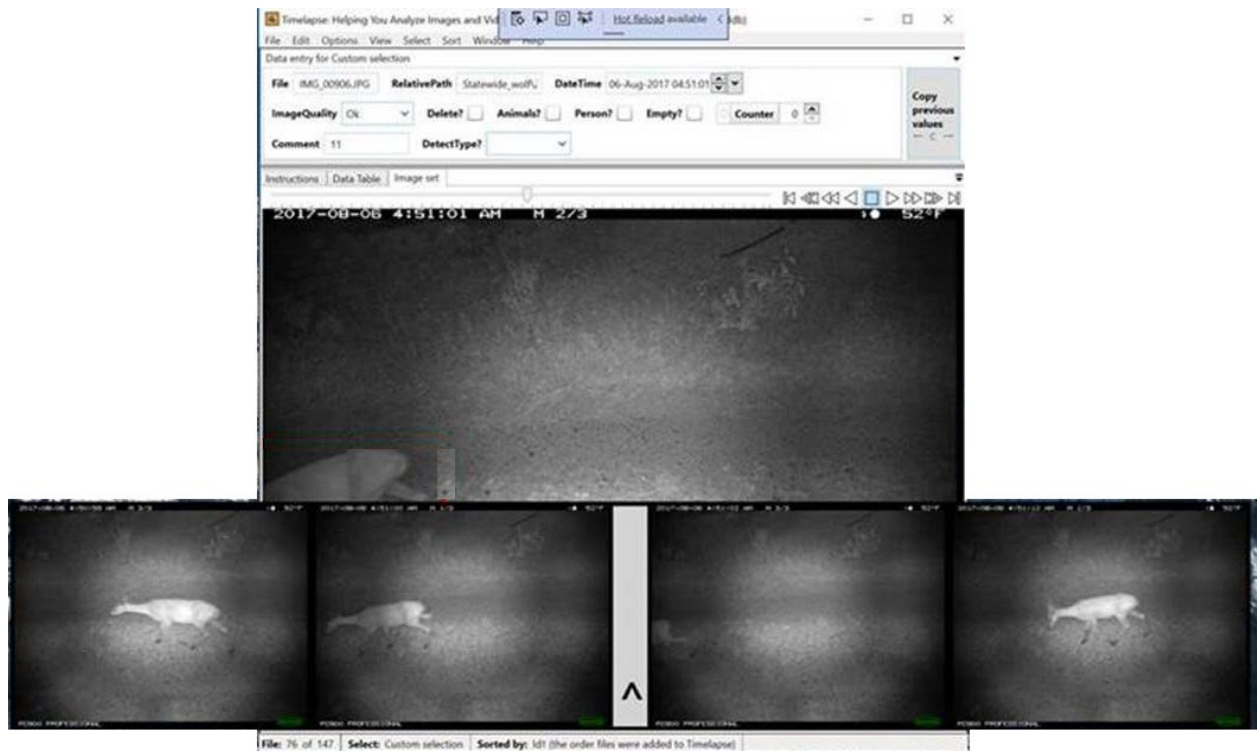
- *<control>* → goes to the 1st image of the next episode
- *<control>* ← goes to the 1st image of the current episode if you aren't on it, or to the 1st image of the previous episode.

In both cases, the Episode information will appear if it isn't already on.

The Episode Popup

If you have a selection activated, some of your images in a sequence may be filtered out. Yet when viewing an image, understanding its surrounding images in the sequence may help you better interpret what is going on. The Episode Popup is a quick way to do this.

Pressing the 'P' key on the keyboard while the cursor is over the image will immediately display the Episode popup. The popup disappears when the P key is released. An example is shown below.



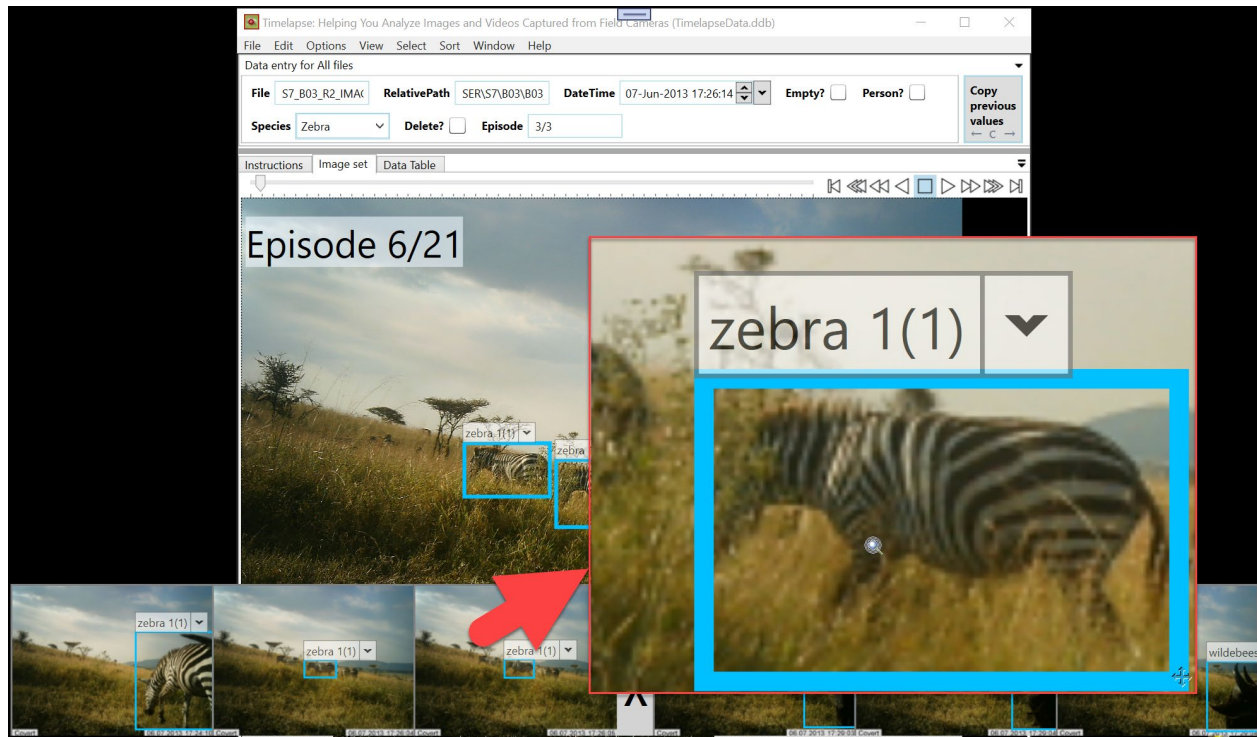
The popup will contain up to six thumbnails of images surrounding the current image that are in the same episode. That is, a surrounding image is displayed only if the time difference between successive images were less than what was set in the Options menu. The '^' indicates where the current image would be in the episode. In this case, because we are in the middle of an episode, we see two images on the left and two on the right. However, if we were (say) at the beginning of an episode, it would show the next 4 images to its right.

Because the popup's thumbnails are relatively small, some of the details you may want to examine may not be clearly visible. To see those details, you can click on any of the popups (while still pressing the 'P' key), which will temporarily raise a newer, larger popup, as illustrated below. Just like the image you normally see in Timelapse, you can use the scroll wheel to zoom into particular image details, and drag the image by panning. During this time, you can also click on any other popup thumbnail will show that image in that larger popup.

For example, in the image below, the analyst

- presses **P** to raise the pop up,
- clicked on the 3rd popup thumbnail to raise the detail popup (as annotated with the red arrow),
- used the scroll wheel to zoom into the detail popup to better identify the zebra within the image.

When the **P** key is released, all popups disappear.

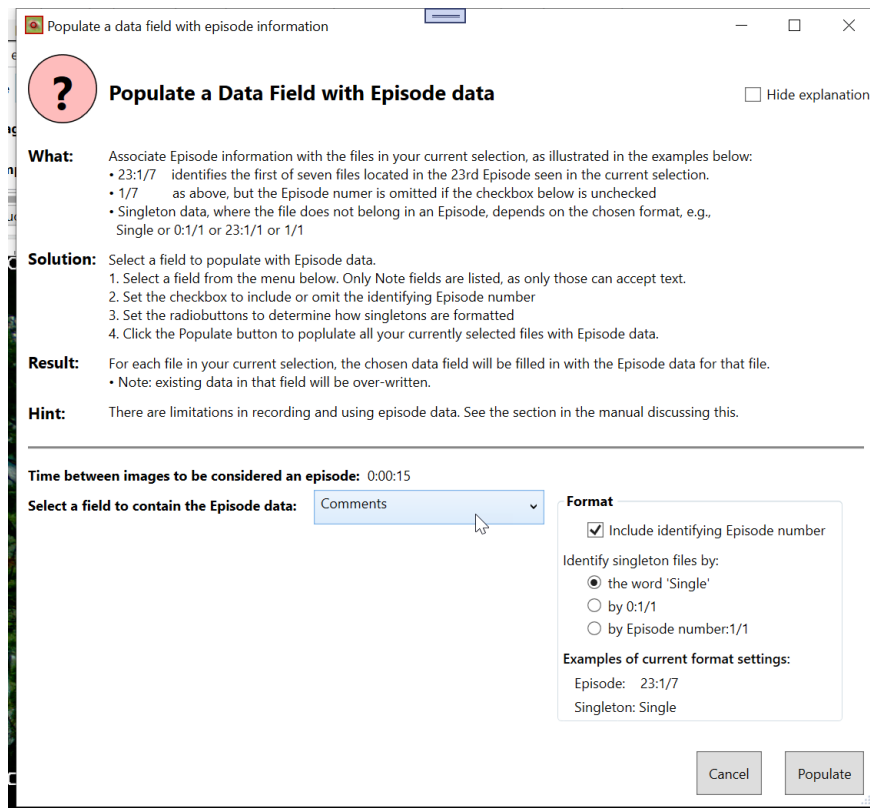


Recording Episode Data

You can record Episode data into a Note field of your choosing by selecting the menu option *Edit / Populate a field with Episode data*. This raises a dialog box that allows you to select a Note field (if you have one available), where episode data is written into that field for all your currently selected files. The time threshold used is the one last set via the *Options / Adjust episode time threshold...* menu item.

The dialog box also lets you set the format of the data written to that Note field. Timelapse numbers each episode, counts the number of files in that episode, and indicates that file's position in the episode. The format is <Episode number>:<file number in episode>|<# files in episode>. Singletons (i.e., files that are not in an episode) are formatted in several different ways.

- Episode full format: 23:1|7 identifies the first of 7 files located in the 23rd Episode.
- Episode without identifier: 1|7 identifies the first of 7 files
- Singleton:
 - Single *identifier never included*
 - 1|1 *without identifier*
 - 0:1|1 *with identifier, always 0 for Singleton*
 - 23:1|1 *with identifier, numbered as with Episodes*



10 Custom Selection

Overview

Selections are a critical feature in Timelapse and can significantly enhance your workflow. Selections allow you to view and work with a subset of your images. That is, they can filter the images you are working with to those that match some criteria. In database speak, each selection creates a query, which returns only the files and data that matches that query.

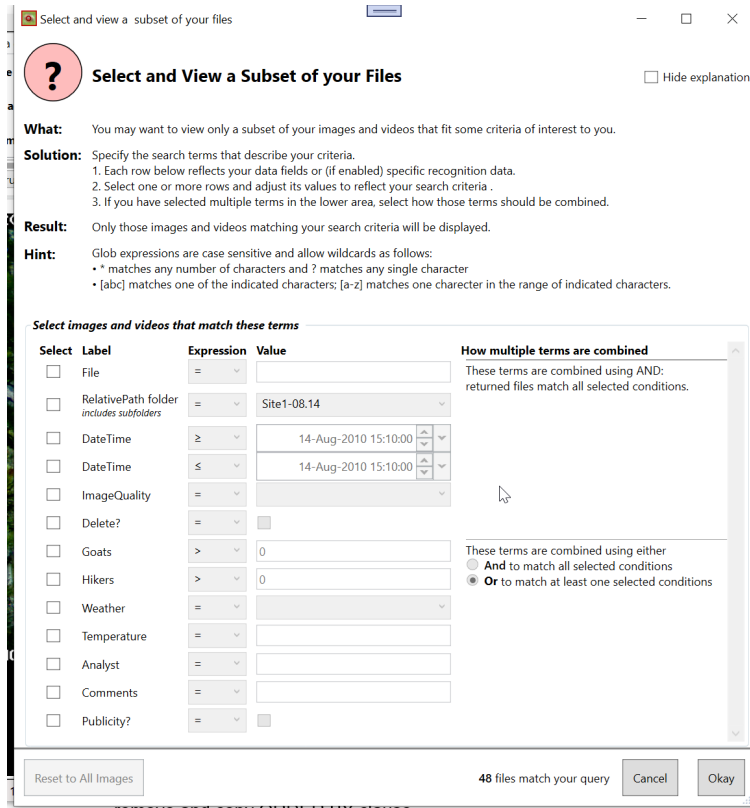
The *Select* menu contains several shortcut selections to common queries. Choosing *Select /*

- *All Files* displays all your image and video files.
- *All files in a folder and its subfolders* displays only those files in the selected folder and its subfolders.
- *All files matching image quality* displays Dark or Ok (not dark) files.
- *All files marked for deletion* display those files whose Delete? field is
- *Missing Files in the current selection* displays, for the current selection, all entries where the actual image or video file appears to be missing.
- *Custom Selection* lets you choose your criteria. See below.
- *Create a random sample from the current selection* randomly samples the current selection to produce a subset of files
- *Refresh the selection* redoes the selection. You would do this if, for example, you updated some file data since the previous selection (e.g., where it may no longer conform to the selection criteria) and want to run the selection again.

Custom Selections

The *Select / Custom selection* menu option raises a dialog box that allows you to create a custom selection by composing a query. As illustrated below, the dialog lists most of your fields. You create a query by selecting one or more field (by clicking the checkbox on its left), selecting an expression from the menu, and entering a value on the right.

If you use image recognition detections and have it turned on, you can also query on detections. See the detections section in this manual.



Most of your selections will likely be simple queries, where you may select (by checking its ‘Use’ box) only a single term to form your query. However, if you select two or more fields, then you need to know how the query combine together using *And* versus *Or*. Our examples below assume that the analyst has already counted the number of goats and hikers in an image.

- **And.** When two terms are combined with *And*, both must be true for it to satisfy the query. For example, selecting ‘Goats > 0’ *AND* ‘Hikers > 0’ will display only those images that contains both a goat and a hiker in it.
- **Or.** When two terms are combined with *Or*, only one of them must be true for it to satisfy the query. For example, selecting ‘Goats > 0’ *OR* ‘Hikers > 0’ will display only those images with a either a Goat in it, or a Hiker in it, or both.

Timelapse automatically combines its standard terms (File, RelativePath, DateTime, ImageQuality, Delete?) using AND. This makes sense, for normally an analyst will be selecting files (for example) in a particular folder and matching a particular data range. However, all other terms give you the option of combining them together using *And* or *Or*. The examples below illustrate how this works.

Selection Examples

Several example selections, starting from simple to more complex ones, are described below. If you have completed analyzing the sample tutorial set, you can use try these examples to your image set to see how they work.

Querying on a single field

1. Show only files that are Publicity? shots.

A screenshot of a query interface. It shows a list of fields: 'Comments', 'Publicity?', and 'Temperature'. The 'Publicity?' field is checked with a checkbox. The operator is set to '=' and the value is 'true'. The resulting query is 'PublicityShot = true'.

Result: Only images with the Publicity? field checked will be displayed.

2. Show only files that have hikers in it.

A screenshot of a query interface. It shows a list of fields: 'Goats', 'Hikers', and 'Temperature'. The 'Hikers' field is checked with a checkbox. The operator is set to '>' and the value is '0'. The resulting query is 'Hikers > 0'.

Result: Only images with at least one Hiker counted will be displayed.

3. Show only files whose Weather field is not Sunny.

A screenshot of a query interface. It shows a list of fields: 'Hikers', 'Weather', and 'Temperature'. The 'Weather' field is checked with a checkbox. The operator is set to '≠' and the value is 'Sunny'. The resulting query is 'Weather ≠ Sunny'.

Result: Only images where the contents of the Weather fields is anything *but* Sunny are displayed.

4. Show only files contained within a RelativePath folder and – if it has subfolders - its sub-folders.

A screenshot of a query interface. It shows a list of fields: 'RelativePath folder', 'Weather', and 'Temperature'. The 'RelativePath folder' field is checked with a checkbox. The operator is set to '=' and the value is 'Site1-08.14'. The resulting query is 'RelativePath = Site1-08.14'.

Result: Only images in the indicated folder – including any images in its subfolders – will be displayed, where the contents of the RelativePath is the desired folder name.

5. **Gotchas.** Only Counters (such as Hikers and Goats) are treated as numbers. For other fields, any comparisons are based on alphabetic ordering. This can lead to confusing results if you are not aware of it. For example, consider Temperature. Even though its contents may look like a number (e.g., 5 C, 12 C), it is treated as an alphabetic string. Thus the > and < expressions may not give you the results you expect.

A screenshot of a query interface. It shows a list of fields: 'Weather', 'Temperature', and 'Analyst'. The 'Temperature' field is checked with a checkbox. The operator is set to '>' and the value is '10 c'. The resulting query is 'Temperature > 10 c'.

The unexpected result: As temperature values whose first character is ≥2 match this query, your results will include temperatures of 2 C to 9 C, which is likely not what you wanted.

Querying on a single field using GLOB pattern matching.

One of the expressions available in the pull-down menu for some of your fields is 'GLOB'. GLOB expressions lets you use 'wildcards' to match various character patterns as follow.

- * matches any number of characters
- ? matches any single character
- [abc] matches one character only if it is present within the brackets
- [a-z] matches one character only if it is within the range of indicated characters

1. Using Glob to partially match a string (e.g., to find particular comments).

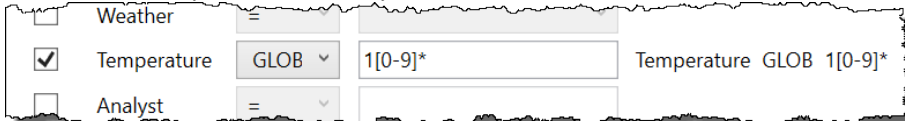
In the tutorial, you had entered a Comment called Sequence #1 for various images. You can use glob to find comments beginning with that sequence as follows.



Result: Only images whose text begins with the characters 'Seq' will be displayed.

2. Finding a set of character matches.

We previously saw that we cannot use '>' or '<' to filter reliably on Temperature, as it is considered an alphabetic rather than a numeric field. However, we can use GLOB to partially give us what we want. For example, to find Temperatures ≥ 10 C, we can construct the following query:



Result: Only Temperatures whose first character is 1 through 9, and whose second character is 0-9 will be displayed. Thus 10 C matches, as does 25 C, as does 100 C. However, 5 C won't match as its second character is not a number.

Querying on DateTime.

The selection dialog box includes two *DateTime* fields.

The image set includes files taken on August 14 and 15th and on September 9.

1. Find the file taken on August 14 at 19:50

To view only the files at an exact date and time, we can construct the following query.

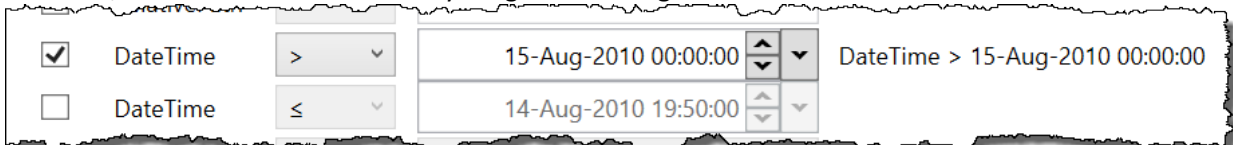


The screenshot shows a query dialog box with two rows. The first row has a checked checkbox, the label 'DateTime', an equals sign in a dropdown menu, the date and time '14-Aug-2010 19:50:00' in a text field with up/down arrows, and the resulting query 'DateTime = 14-Aug-2010 19:50:00'. The second row has an unchecked checkbox, the label 'DateTime', a less-than-or-equal sign in a dropdown menu, the same date and time, and the resulting query 'DateTime ≤ 14-Aug-2010 19:50:00'.

Result: Only images taken on August 14, regardless of the time, will be displayed.

2. Find all files after August 14

The image set includes files taken on August 14 and 15th and on September 9. To view only the files whose date is after August 14, we can construct the following query. Note that the time is set to 00:00:00, as we want to include everything from midnight onwards.



The screenshot shows a query dialog box with two rows. The first row has a checked checkbox, the label 'DateTime', a greater-than sign in a dropdown menu, the date and time '15-Aug-2010 00:00:00' in a text field with up/down arrows, and the resulting query 'DateTime > 15-Aug-2010 00:00:00'. The second row has an unchecked checkbox, the label 'DateTime', a less-than-or-equal sign in a dropdown menu, the date and time '14-Aug-2010 19:50:00', and the resulting query 'DateTime ≤ 14-Aug-2010 19:50:00'.

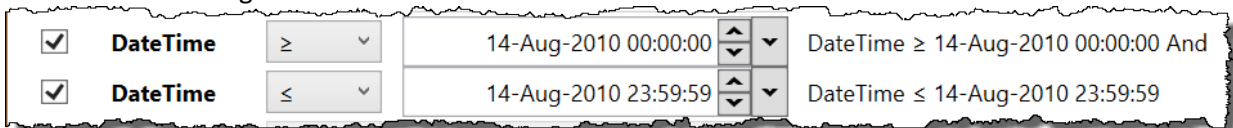
Result: Only images taken after August 14, regardless of the time, will be displayed.

3. Gotchas

Remember that queries use both date and time. Thus '=' has to match both the date and time. Other operations apply not only to the indicated date, but to the indicated time included.

4. Find all files taken on August 14

For this query, we need to use both DateTime controls to specify a range of dates between 00:00:00 and 11:59:59 on August 14.



The screenshot shows a query dialog box with two rows. The first row has a checked checkbox, the label 'DateTime', a greater-than-or-equal sign in a dropdown menu, the date and time '14-Aug-2010 00:00:00' in a text field with up/down arrows, and the resulting query 'DateTime ≥ 14-Aug-2010 00:00:00 And'. The second row has a checked checkbox, the label 'DateTime', a less-than-or-equal sign in a dropdown menu, the date and time '14-Aug-2010 23:59:59' in a text field with up/down arrows, and the resulting query 'DateTime ≤ 14-Aug-2010 23:59:59'.

Result: Only images taken on August 14 will be displayed.

Note. When two DateTime fields are selected, they are always And'ed together.

Multiple Queries using And vs. Or.

As stated previously, the Custom Selection allows you to specify several search terms at the same time. Query results depend on whether those terms are combined using *And* vs. *Or*. While the stock Timelapse terms are always combined using *And*, you can set whether *And* vs *Or* is used to combine the remaining terms. This is illustrated in the examples below.

And: The values in the file's fields have to match each and every search query.

Or: The values in the file's fields have to match at least one search query.

The screenshot shows a search interface with the following elements:

- Search criteria list:
 - Goats > 0
 - Hikers > 0
 - Weather = [dropdown]
 - Temperature = [input]
 - Analyst = [input]
 - Comments = [input]
 - Publicity? = [checkbox]
- Combination options:
 - And to match all selected conditions
 - Or to match at least one selected conditions

A red circle highlights the 'Or' option.

1. Find all files that contain either counted goats, or counted hikers.

The screenshot shows the search interface for query 1:

- Combination options:
 - And to match all selected conditions
 - Or to match at least one selected conditions
- Search criteria list:
 - Goats > 0 Or
 - Hikers > 0

Result: All images that have any non-zero count in it, regardless of whether the count is of a hiker or a goat, will match the query.

2. Find only those files that contain both a goat and a hiker in it.

The screenshot shows the search interface for query 2:

- Combination options:
 - And to match all selected conditions
 - Or to match at least one selected conditions
- Search criteria list:
 - Goats > 0 And
 - Hikers > 0

Result: Only images that have at least one goat and one hiker in it will match the query.

3. Find files with hikers present on rainy days.

These terms are combined using either

And to match all selected conditions

Or to match at least one selected conditions

<input checked="" type="checkbox"/>	Hikers	>	0	Hikers > 0
<input checked="" type="checkbox"/>	Weather	=	Raining	Weather = Raining

Result: Only images where the weather is raining and where a hiker is counted will match the query.

3. Find all Ok files in the folder Site1-08-15 that contain either goats or hikers.

These terms are combined using either

And to match all selected conditions

Or to match at least one selected conditions

<input checked="" type="checkbox"/>	RelativePath folder <i>includes subfolders</i>	=	Site1-08.15
<input type="checkbox"/>	DateTime	≥	14-Aug-2010 15:10:00
<input type="checkbox"/>	DateTime	≤	14-Aug-2010 15:10:00
<input checked="" type="checkbox"/>	ImageQuality	=	Dark
<input type="checkbox"/>	Delete?	=	<input type="checkbox"/>
<input checked="" type="checkbox"/>	Goats	>	0
<input checked="" type="checkbox"/>	Hikers	>	0

Result: All daytime images in the folder Site1-08-15 (and its sub-folders, if any) that have either a hiker or a goat in it will match the query.

11 The TIMELAPSE Workflow

Image analysis can be tedious and error-prone. To maximize efficiency and minimize errors, this section details a basic workflow sequence that affords best practices.

The basic steps are:

- Populate the fields that are common to all images, or to large subsets of images
- Manage dark images (if desired)
- Analyze your remaining images one by one

We will discuss each in turn.

Note. Your particular workflow will vary from what is described below. Particular workflow steps required may depend upon various factors.

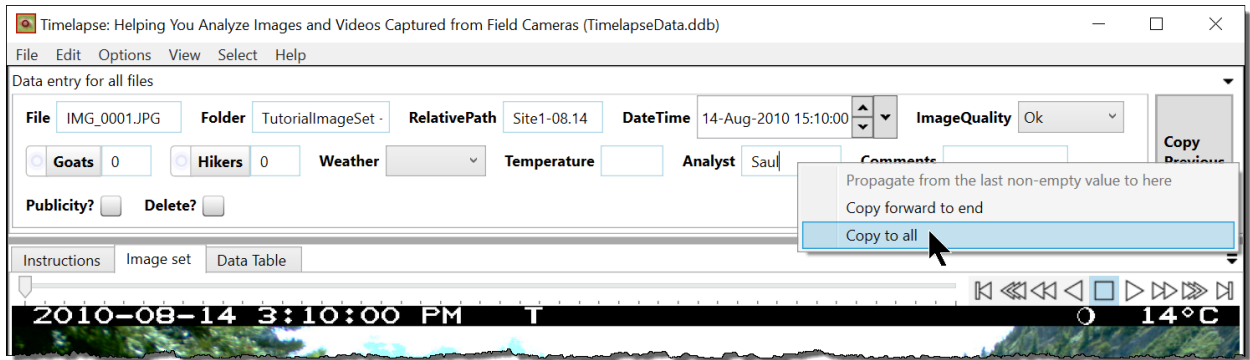
- **How your images were taken.** Cameras set to timelapse mode (images taken at regular time intervals) tend to produce many images. As only a few images contain something of interest, the analyst will tend to run through many images quickly. In contrast, cameras set to motion triggering tend to produce a flurry of images when motion is detected. Here, the analyst needs to examine each image to identify a sequence and to see if that sequence contains something of interest, or if triggering occurred as a result of vegetation motion due to wind.
- **Details of interest.** Some cameras are positioned to capture entities immediately in front of it, such as animals that are a few meters from the camera. These images display large entities of interest visible at a glance. Other cameras are positioned to capture entities far away (e.g., animals or people travelling across a meadow several hundred meters from the camera). These images display very small entities of interest that likely requires careful visual search to find them.
- **Your particular project needs.** Some projects only require you to code a few things in your image, such as the type of animal or person in the scene. Others may require considerable detail for each image, which is much more time-intensive.
- **Accuracy.** Some projects may require highly accurate image analysis, where data entries must be scrutinized carefully and perhaps double-checked by others. Others may just require estimates, where occasional errors due to mis-categorizations, false positives, or false negatives are tolerable.

Populate the Fields Common to All Images

Some of the fields associated with each image may contain a value that is identical across all images. For example, the analyst (you) will be the only one analyzing this image set, so all images would have the **Analyst** field set to your name.

You could, of course, enter your name one by one in the **Analyst** field, but this is tedious indeed. Fortunately, the TIMELAPSE tool lets you copy a value to all images. Let's use the **Analyst** field as an example.

1. Make sure you are looking at All Files (*Select | All files*). This is because copying only works over the particular subset of images you are currently viewing. *Select* will be explained later.
2. Navigate to the first image.
3. Type in your name in the Analyst field.
4. Right click on the Analyzer label to raise the context menu.
5. Select **Copy to all**. A dialog box will detail the changes that will be made, and will ask you to confirm this action. After you accept, all images will have its **Analyst** field set to whatever you typed into it.



6. Test it.
 - a. **Navigate to any other image.** You should see that they all contain the same value for the Sampler.
 - b. **Examine the database.** At any time, you can view your entire data by either selecting *View / Export as CVS and Preview in Excel*, or by switching to the *Data grid* tab. Both the Excel spreadsheet or the *Data Table* tab (both shown below) will show the Analyst column filled in with the same value.

The screenshot shows an Excel spreadsheet titled 'TimelapseData.csv - Excel'. The data is organized in a table with the following columns: File, Folder, RelativePath, Date, Time, ImageQuality, Goats, Hikers, Weather, Temperature, PublicityShot, Analyst, Comment, and DeleteFlag. The data rows show a sequence of images from IMG_0001.JPG to IMG_0009.JPG, all captured at Site1-08.14 on 14-Aug-10, with the Analyst column consistently containing the name 'Saul'.

	A	B	C	D	E	F	G	H	I	J	K	L	M	N
	File	Folder	RelativePath	Date	Time	ImageQuality	Goats	Hikers	Weather	Temperature	PublicityShot	Analyst	Comment	DeleteFlag
1	IMG_0001.JPG	TutorialIm	Site1-08.14	14-Aug-10	15:10:00	Ok	0	0			FALSE	Saul		FALSE
2	IMG_0002.JPG	TutorialIm	Site1-08.14	14-Aug-10	16:40:00	Ok	0	0			FALSE	Saul		FALSE
3	IMG_0003.JPG	TutorialIm	Site1-08.14	14-Aug-10	16:45:00	Ok	0	0			FALSE	Saul		FALSE
4	IMG_0004.JPG	TutorialIm	Site1-08.14	14-Aug-10	16:50:00	Ok	0	0			FALSE	Saul		FALSE
5	IMG_0005.JPG	TutorialIm	Site1-08.14	14-Aug-10	16:55:00	Ok	0	0			FALSE	Saul		FALSE
6	IMG_0006.JPG	TutorialIm	Site1-08.14	14-Aug-10	17:00:00	Ok	0	0			FALSE	Saul		FALSE
7	IMG_0007.JPG	TutorialIm	Site1-08.14	14-Aug-10	17:05:00	Ok	0	0			FALSE	Saul		FALSE
8	IMG_0008.JPG	TutorialIm	Site1-08.14	14-Aug-10	17:10:00	Ok	0	0			FALSE	Saul		FALSE
9	IMG_0009.JPG	TutorialIm	Site1-08.14	14-Aug-10	17:15:00	Ok	0	0			FALSE	Saul		FALSE

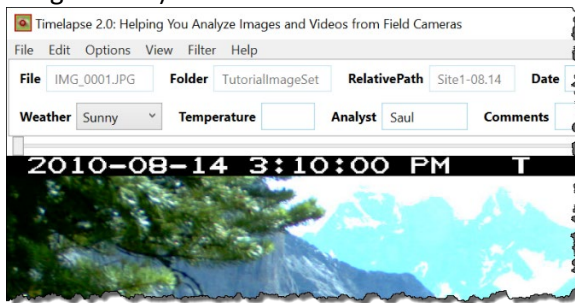
The screenshot shows the 'Timelapse: Helping You Analyze Images and Videos Captured from Field Cameras (TimelapseData.ddb)' window with the 'Data Table' tab selected. The data grid includes an 'Id' column and a 'UtcOffset' column. The Analyst column consistently contains the name 'Saul'.

	Id	File	Folder	RelativePath	DateTime	UtcOffset	Date	Time	ImageQuality	Goats	Hikers	Weather	Temperature	Analyst
1	1	IMG_0001.JPG	TutorialImageSet	Site1-08.14	8/14/2010 9:10:00 PM	-6	14-Aug-2010	15:10:00	Ok	0	0			Saul
2	2	IMG_0002.JPG	TutorialImageSet	Site1-08.14	8/14/2010 10:40:00 PM	-6	14-Aug-2010	16:40:00	Ok	0	0			Saul
3	3	IMG_0003.JPG	TutorialImageSet	Site1-08.14	8/14/2010 10:45:00 PM	-6	14-Aug-2010	16:45:00	Ok	0	0			Saul
4	4	IMG_0004.JPG	TutorialImageSet	Site1-08.14	8/14/2010 10:50:00 PM	-6	14-Aug-2010	16:50:00	Ok	0	0			Saul
5	5	IMG_0005.JPG	TutorialImageSet	Site1-08.14	8/14/2010 10:55:00 PM	-6	14-Aug-2010	16:55:00	Ok	0	0			Saul
6	6	IMG_0006.JPG	TutorialImageSet	Site1-08.14	8/14/2010 11:00:00 PM	-6	14-Aug-2010	17:00:00	Ok	0	0			Saul
7	7	IMG_0007.JPG	TutorialImageSet	Site1-08.14	8/14/2010 11:05:00 PM	-6	14-Aug-2010	17:05:00	Ok	0	0			Saul
8	8	IMG_0008.JPG	TutorialImageSet	Site1-08.14	8/14/2010 11:10:00 PM	-6	14-Aug-2010	17:10:00	Ok	0	0			Saul
9	9	IMG_0009.JPG	TutorialImageSet	Site1-08.14	8/14/2010 11:15:00 PM	-6	14-Aug-2010	17:15:00	Ok	0	0			Saul
10	10	IMG_0010.JPG	TutorialImageSet	Site1-08.14	8/14/2010 11:20:00 PM	-6	14-Aug-2010	17:20:00	Ok	0	0			Saul

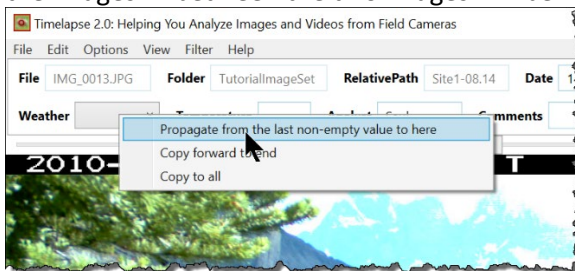
Populate the Fields Common to a Subset of Images

You can also populate a subset of images with a common data value. To illustrate, we will set the weather for images that appear to be daytime shots.

1. **Filter the image set to show only light Images** (i.e., no nighttime shots). You do this by selecting *Select | Image quality | Ok files*.
2. **Start at the first image.** Since it shows a sunny scene, set the **Weather** field to 'Sunny' (see left image below).²



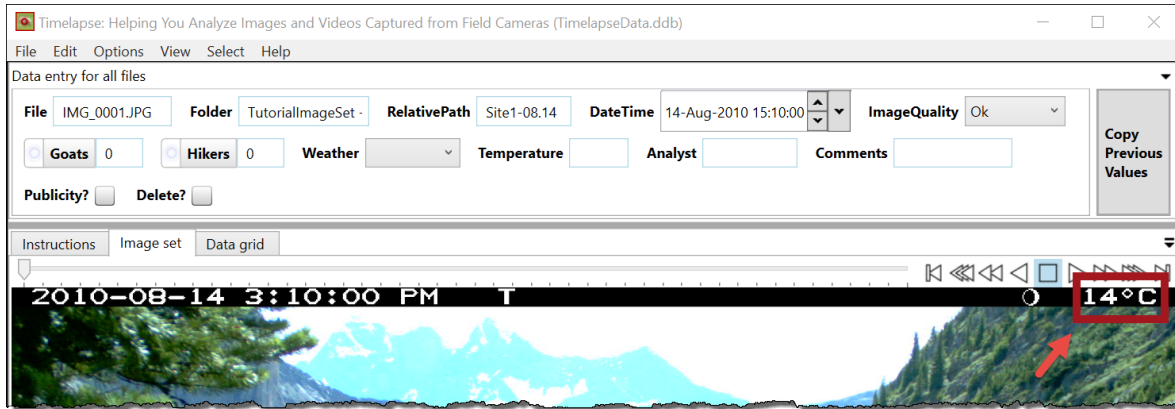
3. **Use the slider, arrow keys, or FilePlayer to scan successive images** until there is a significant change in weather, or until you see a video (which we will analyze later). In this case, all images show sunny weather until the video VID_0015.avi. Back up to the last image IMG_013.JPG.
4. **Right click on the Weather field label to raise the context menu** (see right image below). Select *Propagate from the last non-empty value to here*. Since the last non-empty value was 'Sunny', all the images in-between the two images will be filled in with the value 'Sunny'.



5. **Examine the image after the video** (IMG_0101.JPG). Since it is sunny, set its **Weather** field to 'Sunny'. If you keep on navigating, you will see that subsequent images are sunny until a video taken at dusk (IMG_0118.JPG). As before, back up one image to IMG_0116.JPG and use the *Propagate from the last non-empty value to here* to set the previous images to sunny.
6. **Keep going through subsequent images** and repeat this process. You will likely identify then next set of images as 'Cloudy'.
7. **Test it.** Use the *Select* menu to show 'All images'. Check your data as before. You should see that most images (excluding videos which you skipped) will have their weather field set. Dark images will *not* have their Weather field set, as those were not present since you were working in the 'Ok files' selection.
8. **Alternate approach: use the Overview** to set data for multiple images at a time. This works well for cases when small-sized images suffice for determining its data. See §Overview for details.

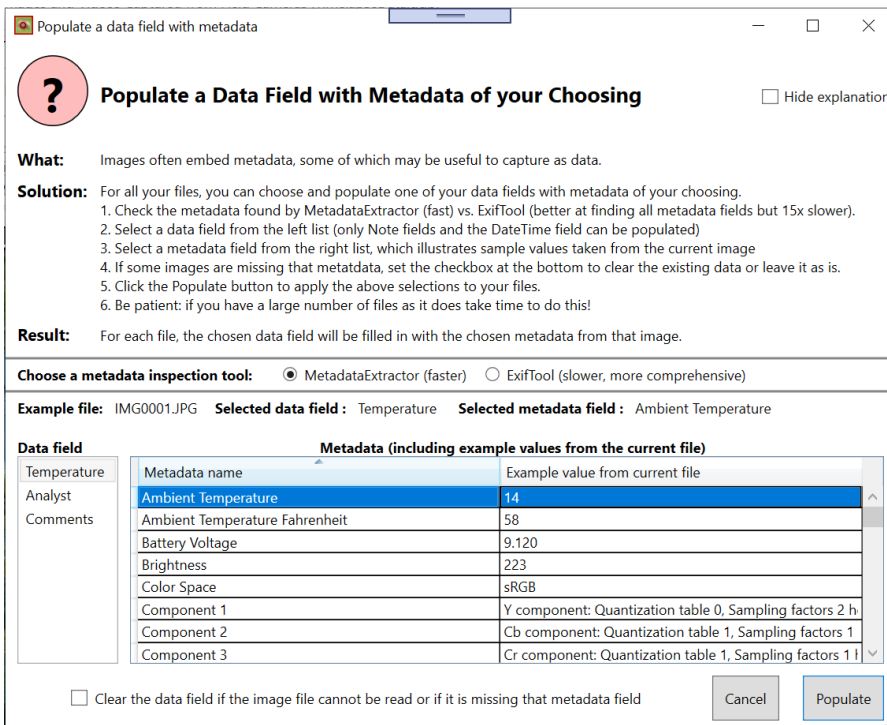
Populating a Field with Metadata

Some cameras store metadata about your image that may be useful to your project. For example, you may have noticed that this particular camera model (an HC600 Convert) includes the temperature in the top right part of the image. It would be nice to have that somehow included in your data.



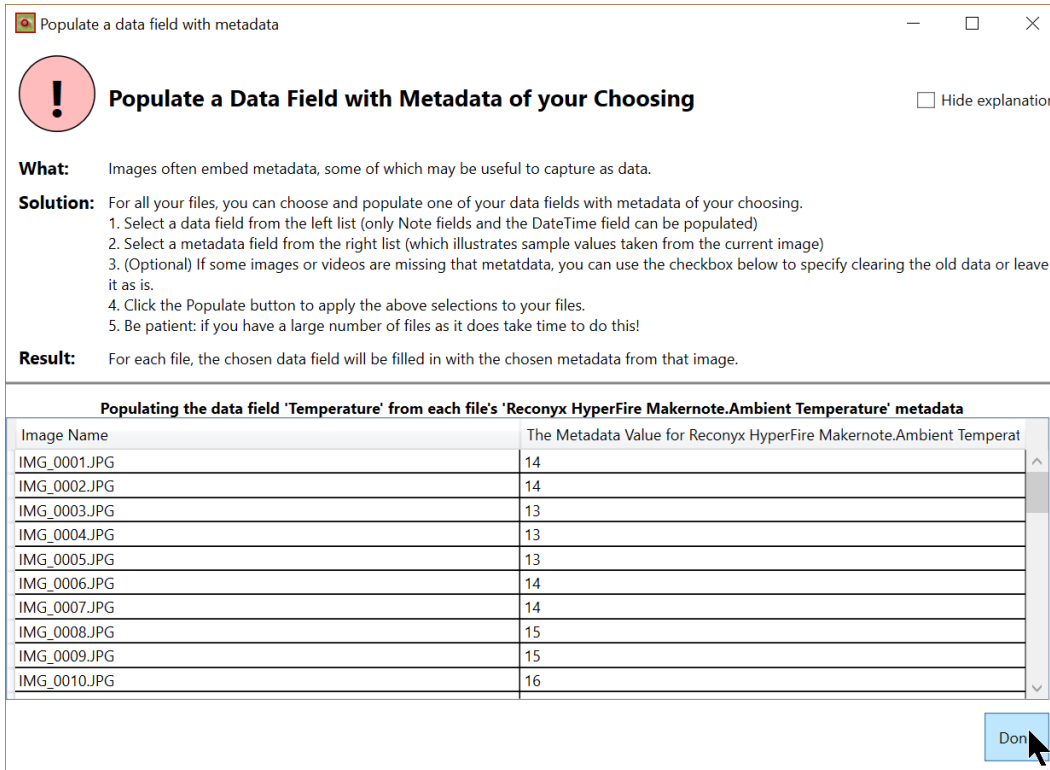
Your project manager included a 'Temperature' Note field, which needs to be filled in to show this temperature. While you could do this by typing in the temperature for each image, this would be quite tedious. Instead, we will check the metadata available for a typical image in your image set to see if there is one that records this temperature.

1. **Navigate to a typical image**, where that image is not missing or corrupt.
2. **Select *Edit | Populated a field with metadata...*** A dialog box will appear that shows you:
 - the metadata available for the current image, including its name and actual value
 - a list of Note data fields



Select the **Ambient Temperature** metadata and the **Temperature Note** field. The listed metadata includes two fields called *Ambient Temperature* and *Ambient Temperature Fahrenheit*. You want to assign the *Ambient Temperature* metadata (the temperature in Celsius) to the *Temperature Note* field.

- a. Select *Ambient Temperature* by clicking on it.
- b. Select the *Temperature Note* field by clicking it.
- c. Click *Populate*. A dialog box similar to the one seen below will display all the changes it made. Note that the feedback also informs you about those images that do not have the *Ambient Temperature* metadata embedded in it (e.g., scroll the list to see that the video files and the missing files do not have any temperature metadata).



3. **Test it.** You should see the temperature has been filled in for all applicable images.

Important note. While there have been attempts by the industry to standardize what metadata is embedded in an image, the actual metadata included by a particular camera can vary considerably. Some information (such as the size of the image) is fairly standard across most cameras. Other information (such as the current temperature) may be recorded only by particular cameras. Videos are even worse. The only way to know what metadata is actually embedded in an image is by examining a particular image. To make matters even more complicated, vendor-specific metadata information is often recorded in 'makernotes', and the software used to extract those makernotes needs to be able to interpret that vendor-specific information. Thus not all software reveals all makernotes.

The '**Choose a metadata inspection tool**' portion of the dialog box allows you to select between two different tools to inspect the metadata. Timelapse currently uses the MetadataExtractor as its default tool, as it is very fast. However, MetadataExtractor is somewhat limited in interpreting makernotes for certain cameras. To get around this, you can also choose Phil Harvey's ExifTool, which is usually more capable of interpreting makernotes, to see if it lists the metadata you want. However, it is considerably slower, which introduces delays if you have tens or hundreds of thousands of images to process.

Bottom line. If your metadata of interest is listed using MetadataExtractor, use that. But if its only available using the ExifTool, use that instead and suffer a bit more waiting.

Manage Dark Images: Selections and Deletion

If your image set has many night-time shots, you may want to deal with them in a uniform way. We will use *Selections* to do this. Typical things you may want to do are to delete the images (to save disk space) or delete them entirely (so they don't clutter your work) or add comments about them.

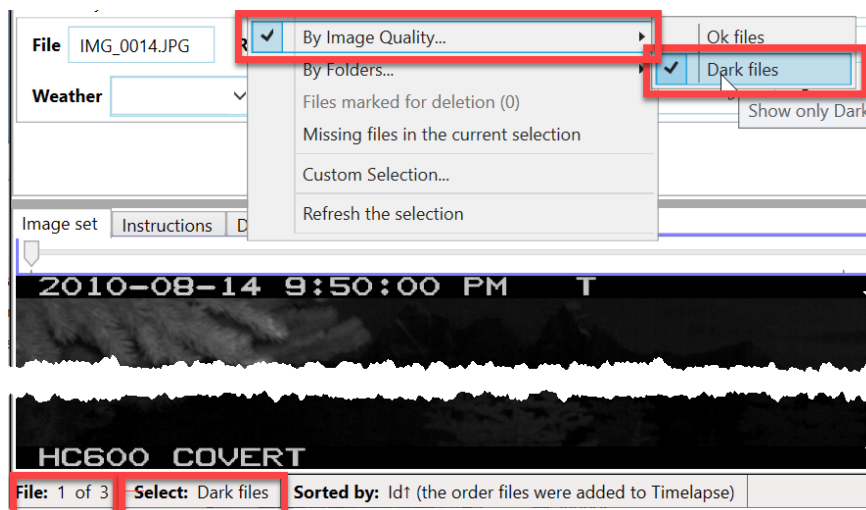
Tip. If you set your camera to take images taken periodically (e.g., every hour in timelapse mode), you will likely collect many night-time shots that you will want to manage collectively. However, if you set your camera on motion detection, you will likely want to examine each image by itself.

A *Selection* lets you look at a subset of all your images. You can choose a selection by selecting one from the *Select* menu. Several stock selection filters are displayed in that menu, as well as a *Custom Select* option where you can create your own selection filter. As previously explained:

- **All files** display every single image.
- **By Image Quality | Ok files / Dark files** display images whose image quality field is set to Ok or Dark respectively (Selecting *Edit | Classify dark files now...* will automatically classify dark images such as night-time shots as Dark).
- **By folder...** will display images in the chosen folder
- **Files marked for deletion** displays all images that have the Delete? flag checked.
- **Missing files in the current selection** display only those images that are no longer present.
- **Custom selection** lets you create your own selection filter using various fields, and will be described separately.

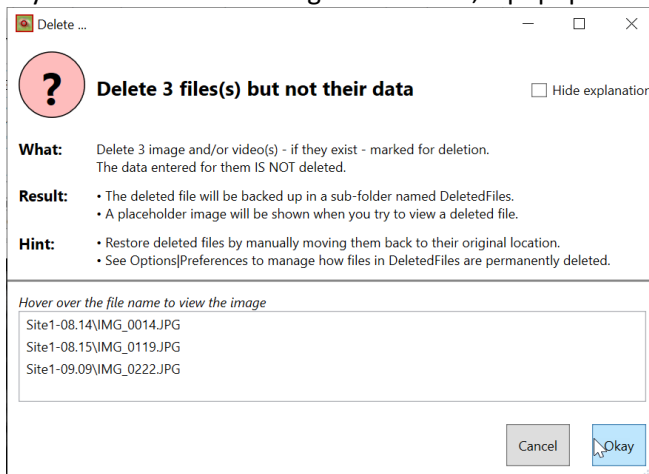
Now let's use these selection filters to manage the dark night-time images.

1. **Select *Image Quality | Dark files*.** The first dark image will be displayed. This assuming you have already classified your images by selecting *Edit | Classify dark files now...*. You will also see that the image number / image count at the bottom left says that this is the 1st image of the 3 dark images found in this image set. (If this were a full image that represents images taken over regular intervals, there could be hundreds of such images). The Date Pane title at the top also shows that dark files are selected.



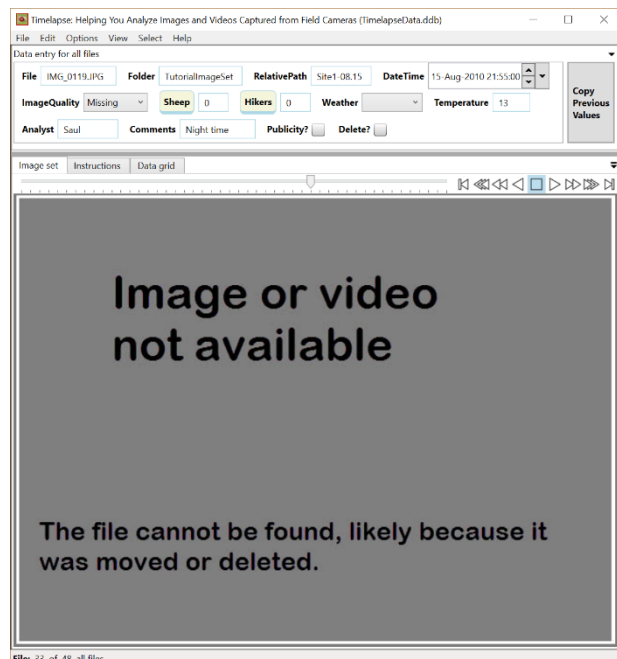
2. **Check that all images are, indeed, dark.** This should be the case, but it never hurts to check. Quickly scroll through them to verify this using the slider or arrow keys.
3. **Change any fields** that are applicable to *only* the dark images.
 - a. Set the **Comment** field text to 'Night time' in the first image,
 - b. Do a *Copy to All* to propagate that comment to the other dark images.
4. **Delete the Dark images, but leave the data intact.** Your project manager has asked you to delete dark images in order to save disk space, but to leave the data associated with those images intact.
 - a. Select the *Delete?* flag for the three images, or use Copy All after flagging one image).
 - b. Select Edit | Delete | All selected image or video files marked for deletion ...

A dialog box appears (see below) that displays thumbnails of the images to delete. If you hover over the image's file name, a popup will appear showing that image.



After you confirm deletion, TIMELAPSE will

- **show a placeholder** for these images as illustrated below.
- **changes the *ImageQuality*** of those images to *Missing*.
- **backup the deleted images** for added safety: TIMELAPSE doesn't really delete these images. Instead, it copies them to the *DeletedImages* sub-folder. Check that folder to see if they are there are there. You can permanently delete those image files if you wish.



5. **Test it.** Preview your data using the spreadsheet or database view. You will see that the nighttime images (IMG_0014.JPG, IMG_0118.JPG, and IMG_0222.JPG) have their *ImageQuality* field set to missing.

Analyze your remaining images

This ‘final’ step is where you do most of your detailed work, as you will be visually scanning and entering data for individual images.

As mentioned previously, different projects will require different levels of visual inspection. For example, projects with motion-activated camera traps usually capture large wildlife, which are easy to detect and count. In contrast, camera traps in our tutorial takes timelapse images over a very large area, where the entities of interest (goats and hikers) are distant and thus quite small. We focus on this later case for now, i.e., how to use TIMELAPSE to help find and count small entities.

The **typical workflow per image** is summarized below, and will be illustrated shortly.

1. **Copy repetitive values** that were entered in the previous image.
2. Fill in all remaining fields excepting the count fields to match what you see in this image.
3. **Scan the image for the entities you want to count.** Sometimes the entities are hard to see, perhaps because the light is bad, or the things you are counting are far away and thus very small. Typical strategies include:
 - a. Look at common places you expect those entities to be.
 - b. Rapidly switch between the current and surrounding images by using the left/right arrow keys. Your eye will be drawn to things that change between them.
 - c. Use the magnifying glass and / or the zoom facilities to see details in high-probability places.
 - d. Magnify or zoom into possible entities to scrutinize them, e.g., if you see something that may be of interest, use the magnifying glass to see details
 - e. Combine steps b and d: if you see something in the magnifying glass but are unsure if it is actually something of interest, try using the left/right arrow keys to see if it’s the same across images (suggesting it is not something that moves), or if it is no longer there (and thus likely something of interest).
 - f. Use the image differencing enhancers via the up / down arrow keys (we will explain this shortly)
4. **Select the counter type, and click on each entity of that type.** A visual marker – a blue circle – appears where you clicked (the currently selected counter is also blue), and the current counter will be incremented.
5. **Create QuickPaste** entries as needed that let you paste in multiple data values in a single click.

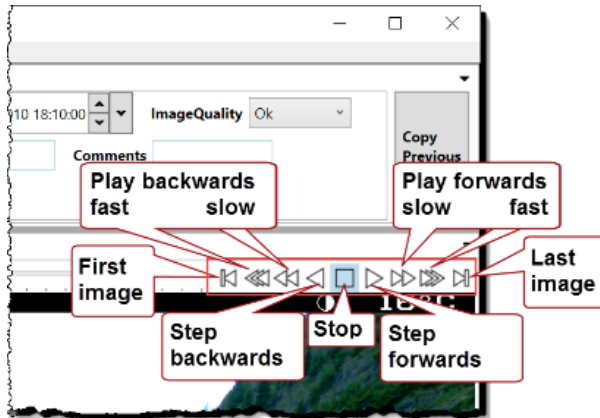
Tip. If you clicked accidentally or in the wrong spot, you can remove the marker and decrement the count by left-clicking that marker.

We will now illustrate this workflow across various images by example.

To begin, set your Selection to *Select | Image quality | Ok files* and go to the first image. There is no point looking at the other images, as you have already dealt with them. We will go through each image in turn, where we will emphasise various ways to analyze these images efficiently with TIMELAPSE. Along the way, we will introduce additional features available in TIMELAPSE.

Get an overview of the images and videos.

Its always helpful to get a sense of the images and videos in your video set. Use the file player controls to go to the first image (if you are not already on it), and then play your images at high speed.



Introducing scanning, zooming, and rapid switching.

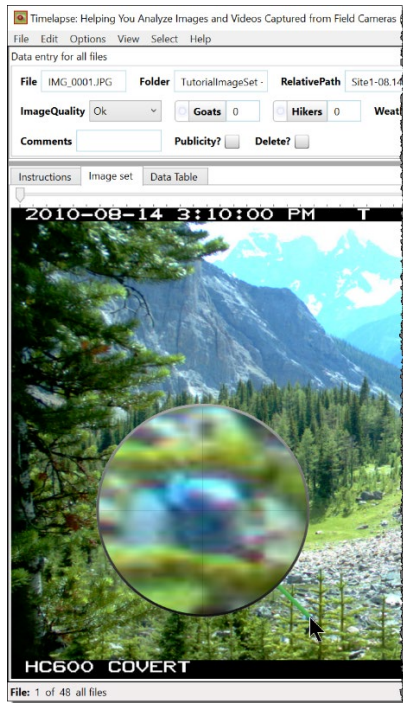
Image 1 (IMG_0001.JPG).

1. Enter any desired data into all but the counter fields. For this image, there seems to be little to add.
2. **Scan the image for goats and hikers.** In this particular image set we would do the following.
 - **Examine common places** you expect them to be. In this scene, goats would likely congregate on the meadow or on the rocky open slopes. You were also told that there is a hiking trail directly in front of the camera, so you would expect hikers to appear there.
 - **Use the magnifying glass and/or Pan and Zoom** to examine details in high-probability places, and/or suspected entities.
 - No goats appear to be present in the meadow or rocky slope. To check, place your cursor over the meadow and quickly zoom into it using the scroll wheel. Since you don't see anything, zoom out again. Repeat this for the rocky slope (or use the magnifying glass).
 - You notice a blue blob at the bottom of the image, which could be a hiker (see left image below). Place your magnifying glass over it to inspect it. It appears to be a hiker wearing a blue hat and black shirt.

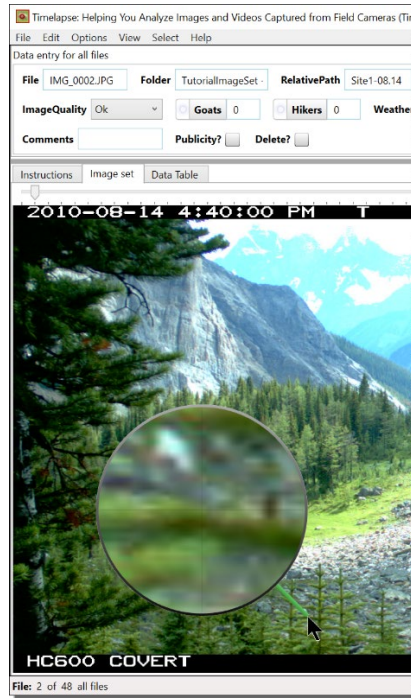
Tip. While you can increase or decrease the magnification (the U key), the actual image resolution and quality – not its magnification – will limit the detail seen. Find a reasonable balance.

- **Rapidly switch between this and surrounding images by using the left/right arrow keys.** You won't be able to go left, as you are on the first image. If you rapidly switch between this and the next image, you'll see that the blue blob is not there (right image below). This confirms your belief that there was a hiker on the first image, who has since moved. Note that

Tip. if you keep the magnifying glass over that spot, you will be able to see the magnified changes between images (if any) within it.

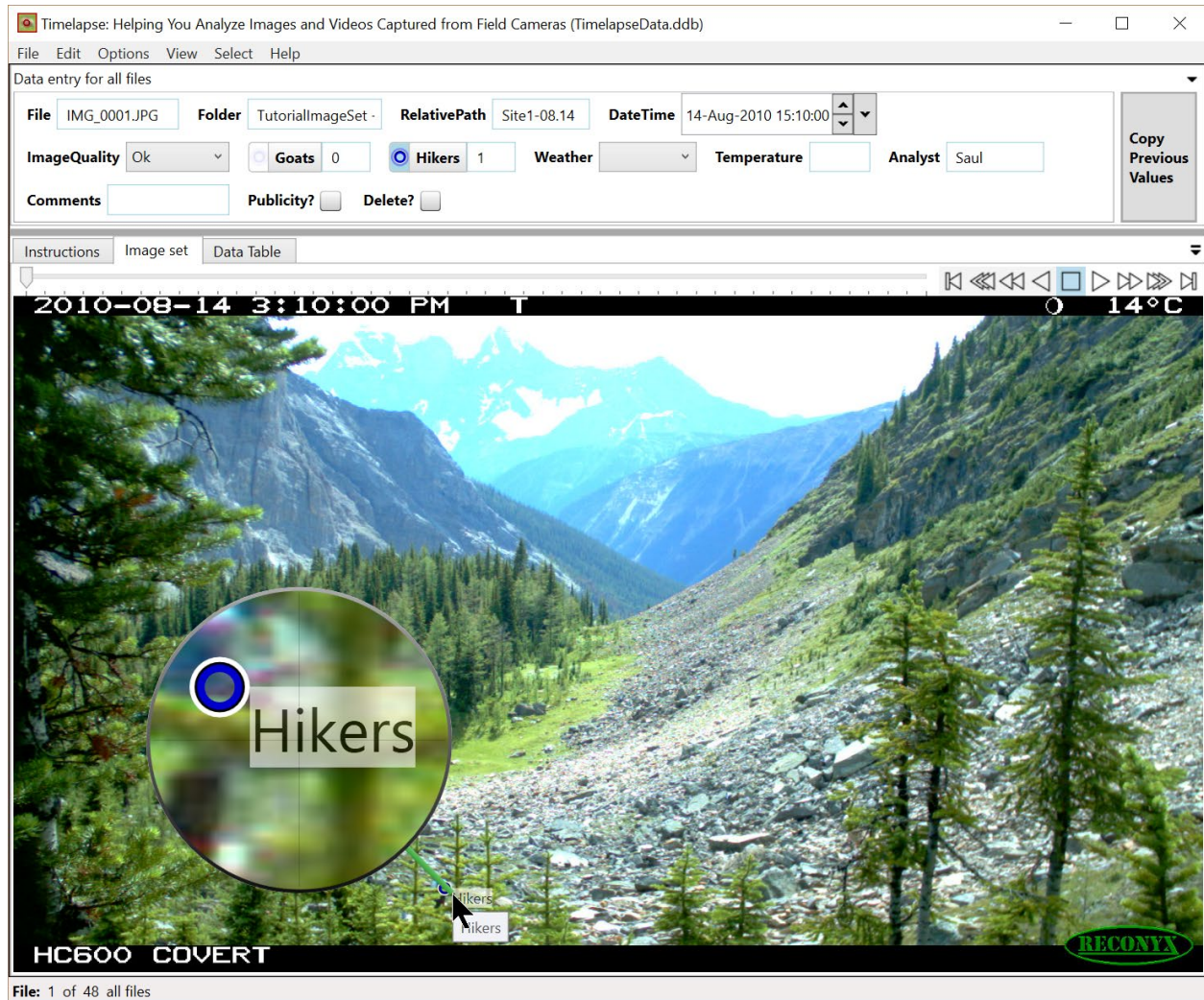


IMAGE_0001.JPG: Hiker present



IMAGE_0002.JPG: Hiker absent

- 3. Count the hiker.** First, click on the *Hikers* counter label to activate it. Then click just next to the hiker in the image. This creates a blue marker next to the hiker, and increments the count.



At this point, we are fairly satisfied that there is nothing else in image 1, so we are ready to move to the next image.

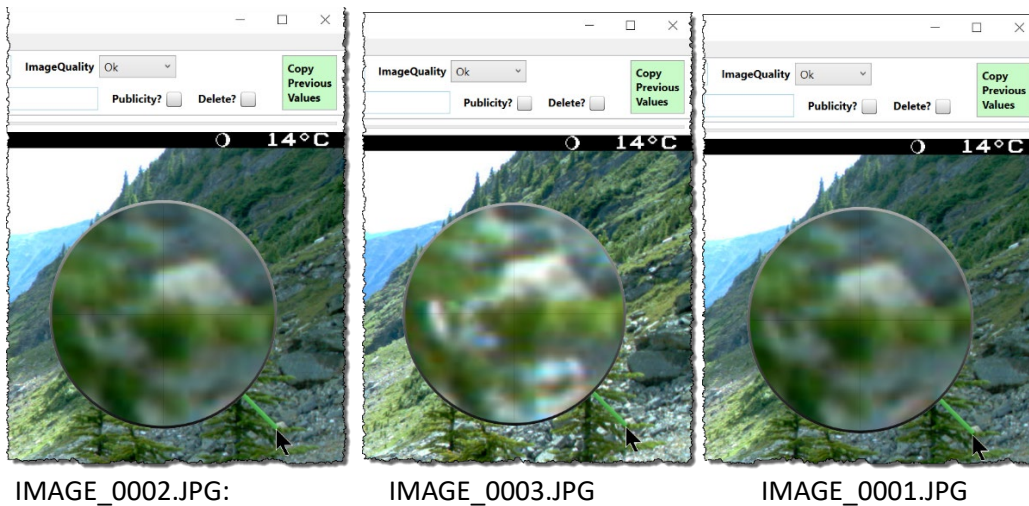
Tip. If the entities you are counting are small, it is better to click just next to that entity (as done with the hiker) so that the marker doesn't occlude it.

Tip. Markers are persistent. If you quit and reopen this image set, or go to another image and then return to this one, the markers will still be there. This means you can check (and change) your counts at any time. It also means that another person can examine what you did and double-check that you correctly identified and counted all entities.

Tip. If you accidentally click on the image and introduce a marker and 'count' when you shouldn't have, simply right-click over that marker in the image. This will remove the marker and decrement the count.

Images 2 and 3 (IMG_0002.JPG and IMG_0003.JPG)

1. Repeat the above process. In these images, the hiker is absent. However, when examining IMG_0002.JPG you see a white blob on the rocky slope which could be a goat (left image below). Using the magnifying glass, you suspect it's a rock. If you use the navigation keys to rapidly cycle to the next and/or previous image (middle and left image below), you see that it hasn't moved i.e., it is indeed a rock. Since there is nothing else of interest, you don't change any of the data fields. Similarly, IMG_0003.JPG doesn't seem to have anything of interest in it.

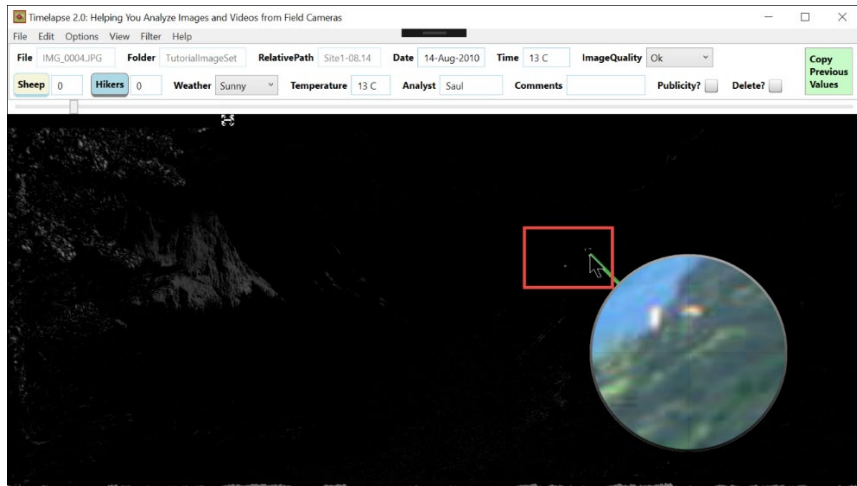


Introducing image differencing

Image 4 (IMG_0004.JPG).

TIMELAPSE includes three image enhancers that may help you spot small, easily missed entities by highlighting visual changes between the current image and the previous/next images. All are activated using the up/down arrow keys. All methods also work at all image zoom levels.

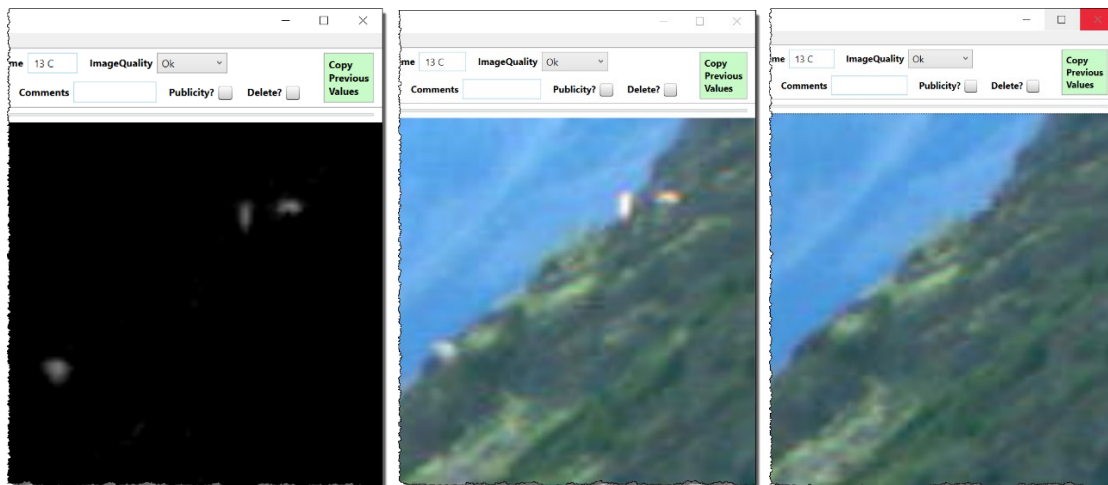
1. While you don't immediately spot anything of interest in IMG_0004.JPG, you decide to double check this via image differencing.
2. **The combined image difference.** If you hit the down arrow key once, you will see something like the image below.



Timelapse creates this combined difference image view by comparing the current image with the next and previous image, and highlighting significant differences between them. Some of these differences may be due to lighting and shadow changes, slight movements of the camera, and wind effects. For example, the dull white shown in the upper left is due to wind effects on the tree. However, people and animals that move in the scene may also become visible, as they appear in different locations (or may leave) across the compared images.

3. **Examine suspect white areas with the magnifying glass.** There appears to be 3 white blobs in an otherwise unchanging portion of the image, which seems uncharacteristic (outlined in red in the above image). When we examine this with the magnifying glass, we see that they could indeed be goats.

Verify by zooming and rapidly switching between images. Zoom into that area (shown below), and use the down-arrow key to examine the combined differences (left) with the original image (middle): three goats do seem to be present. If you then rapidly switch between the current image and surrounding image (right), we see that the white blobs are no longer present, which confirms that they are indeed goats.



IMAGE_0004.JPG:
(differenced and zoomed)

IMAGE_0004.JPG
(zoomed)

IMAGE_0005.JPG
(zoomed)

4. **Count the three goats by clicking on each of them** (make sure the Goats counter is still activated).
5. **Add a comment.** Type in 'Sequence #1' in the comment box, which indicates the beginning of a sequence of images that may contain goats in it (this comment is not really that meaningful, but we include it for illustrative purposes).

Note. Image differencing isn't always effective: if there are large visual changes between images (e.g., due to wind effects), too many differences will be highlighted.

Tip: You can use the up-arrow key to compare the current image with only the previous image. If you press it again, it will compare it to only the next image. A third press will display the original image. Try these to see if you can spot any other things of interest.

Why there are three different image differencing methods. The next and previous differences create a composite of the difference between the current image and the next (or previous) one. This means that if an entity (e.g., a goat) appears in 1 image, and that entity moves to a different position in the next image, you will likely see 2 entities in the differenced image. That is, it's a union of the differences. You would then use the magnifying glass to check which of those actually appears in the current image.

In contrast, the combined differences will only show those things that appears in the current image and that does *not* appear in either of the surrounding images. Thus if you see something there, it is likely only in the current image. You should still check with the magnifying glass.

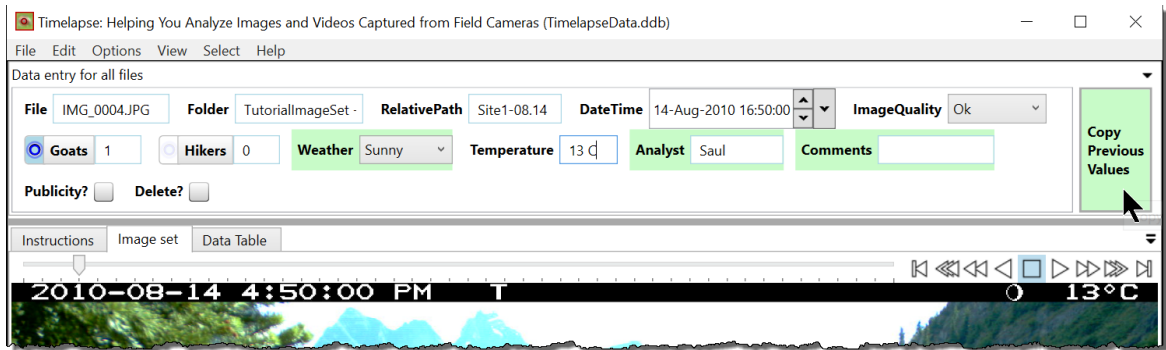
The utility of a particular differenced image depends highly on how the surrounding images differ from the current one. If visual differences are large, then the differenced image would have quite a bit of 'white noise' and thus are of little value. While the surrounding differenced image usually works best, there is no guarantee that any of the differenced images will be useful. Still, it is a quick operation to cycle between all of them.

If you unclear as to what this all means, don't worry. Let the visuals attract your attention, and then use the magnifying glass, zooming, flip backing to the normal image, and comparing what you see to surrounding images to check what is there.

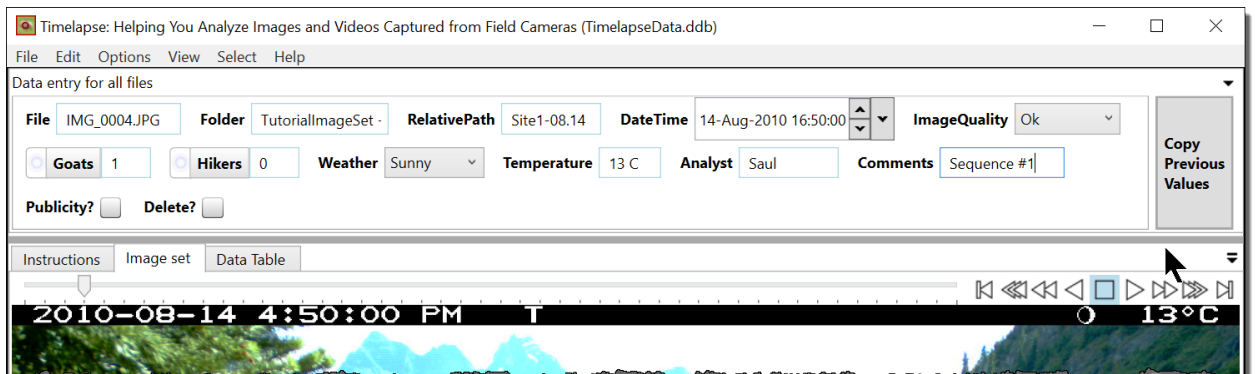
Introducing Copy Previous Values

Image 5 (IMG_0005.JPG). I

2. Repeat the above process. One of the goats is just visible in the same area, so mark that. The earlier comment (Sequence 1) still applies, but that field is not yet filled in on this image. We could fill it in by retyping, but this will become tedious to do.
3. Instead, use the *Copy Previous Values* button on the right.
 - Hover your cursor over the Copy Previous Values button. Various fields change their color to green to match the button's color. These are the fields that are copyable. For example, we see that the 'Weather', 'Analyst', and 'Comments' are in green, but that the other fields (including the counters) are not.



- Press the Copy Previous Values button. This copies the contents of all the green fields in the previous image to the green fields in this image. In this case, only the Comment field will appear to be different (i.e., from empty to 'Sequence #1'), as the other fields in this image were already the same as those in the previous image.



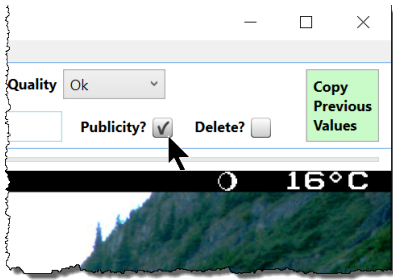
The *Copy Previous Values* button is useful because - most of the time - there is very little difference between one image and the next in a sequence. You may find yourself using this button frequently. If there is something that you want to be different, you can always change that. For example, if everything *but* the 'Weather' field was identical between images, you can press the Copy button, and then change the 'Weather' field to the value you really want.

Keyboard shortcut: The C key will also activate Copy Previous Values.

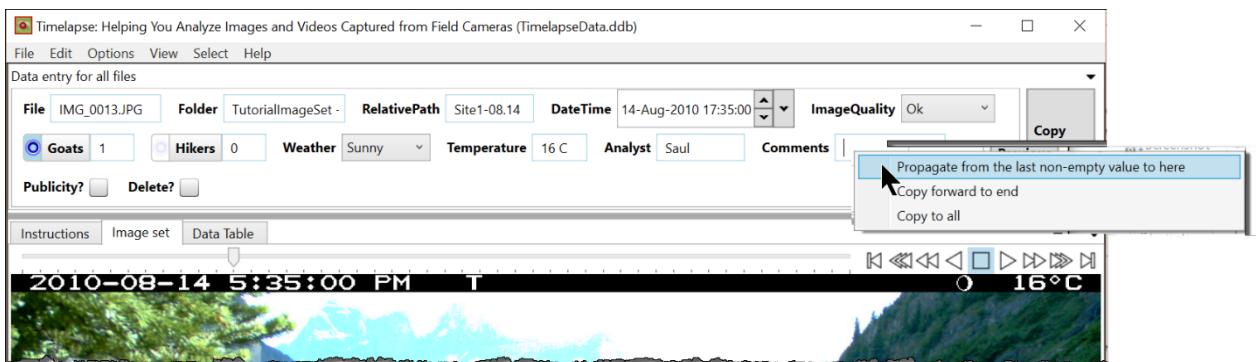
Introducing Propagating Values

Images 6 - 13 (IMG_0006.JPG – IMG_0013.JPG).

1. **Repeat the above process** for the next 8 images. However, don't use the Copy Previous Values as we will show you a different way to copy repetitive fields.
2. **Identify and count the goats.** As before, try rapidly switching back and forth between images, as well as using image enhancement. You should see a herd of goats move down the hillside into the meadow and surrounding trees, and then move up the hillside again near the end.
3. **Mark Image_0010.JPG as a possible publicity shot.** I counted 9 goats in Image_0010.JPG, which makes this a reasonable candidate. Click on *Publicity?*, which will set its data value to true.



4. Use 'Propagate...' to back-fill the Comments field. The final image in this sequence is IMG_0013.JPG. Since we didn't use the Copy Previous Values button, the comment fields from IMG_0007.JPG to IMG_0013.JPG fields are empty. Instead, right click on the Comments field label, and choose 'Propagate from last non-empty value to here'.



Tip. The basic idea of the 'Propagate From...' feature is that you can fill in a field on one image, and then keep going through subsequent images until the last one that should have that field's value. You can then 'backfill' the entries in your selected view. However, this only works if those in-between images have nothing in that field.

Alternately, you can use 'Copy Forward...'. Again, you can fill in a field on one image. In this case, however, doing a Copy Forward will copy the value in that field, and overwrite it for all subsequent images in the selection view. You then navigate the subsequent photos until you find something different. You enter the new value on that image and copy forward again. Repeat until you have gone through all images. Of course, you have to be careful not to over-write existing values (if you didn't fill things in in sequence) and you have to be diligent in this practice, as otherwise you may have filled in fields that you didn't really want to fill in.

In practice, you may use a combination of all these menu items along with the Copy Previous Value button to fill out these fields efficiently.

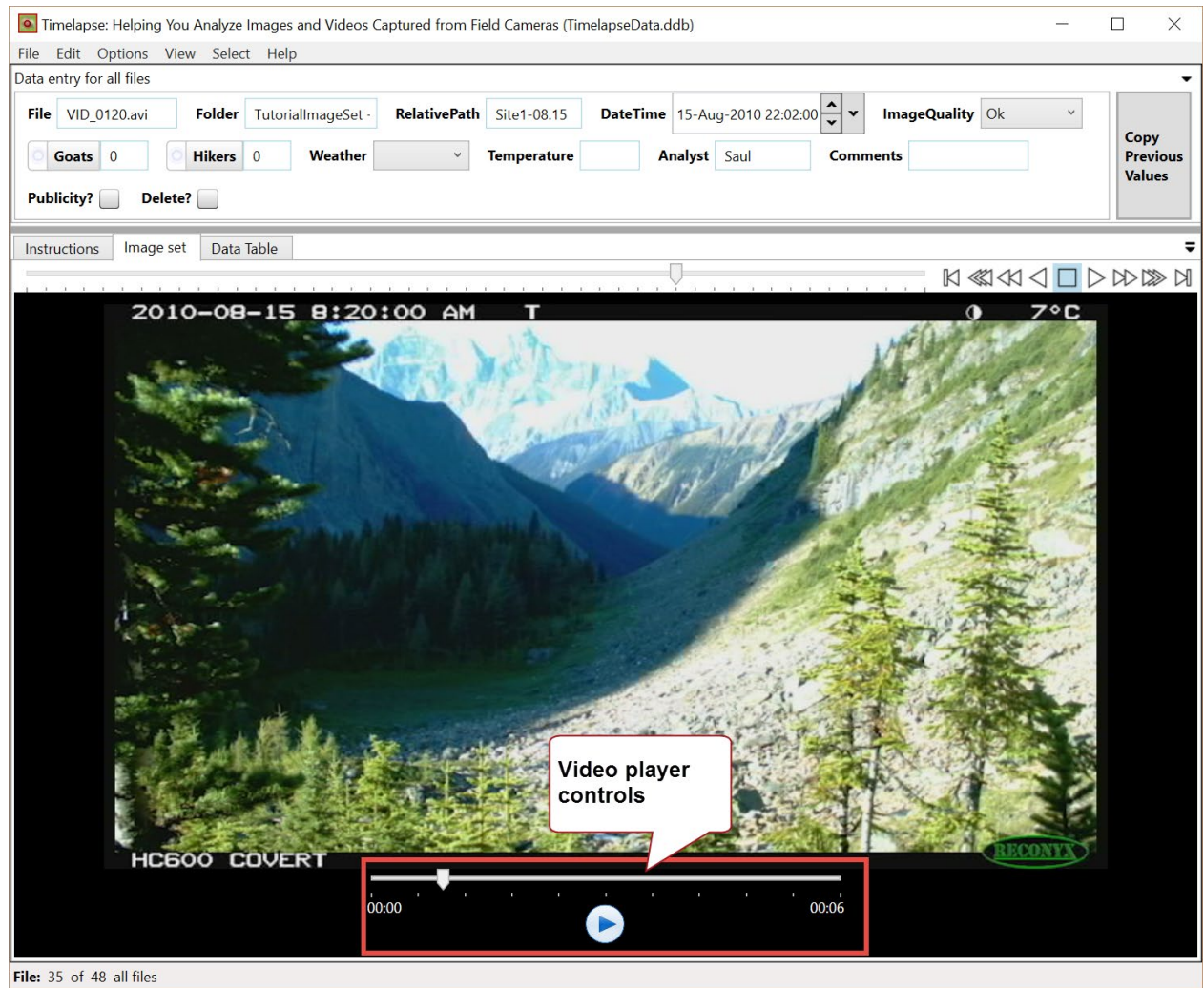
5. Test it. As before, scan through your images, and/or preview your data using the spreadsheet or database view.

Introducing Videos

Video (VID_0015.avi).

Various cameras take short videos (usually 5 – 30 seconds) whenever it detects movement. TIMELAPSE lets you analyze those videos as well as images. The sample set includes three videos that summarize an entire day's activities. While these differ from the typical video produced by cameras, they suffice to illustrate how you can view videos within TIMELAPSE.

1. **Play the video.** Controls appear below the video. Pausing and playing the video is done via the video player buttons, or by hitting the space bar. Scrub through the video using the slider.



2. **Update the Weather field.** You can update any field while using the video player. For example, because the day is predominantly sunny, set the *Weather* field to Sunny.

Notes: Markers cannot be placed atop of videos. Also, check the date carefully – some cameras do not properly record a video's date. Edit it if needed.

Introducing QuickPaste

As you go through your images, you may find that you are entering particular data patterns over and over again (e.g., 1 hiker, sunny). Creating QuickPaste entries for those patterns can significantly speed up the data entry process. See §QuickPaste.

Remaining images and videos.

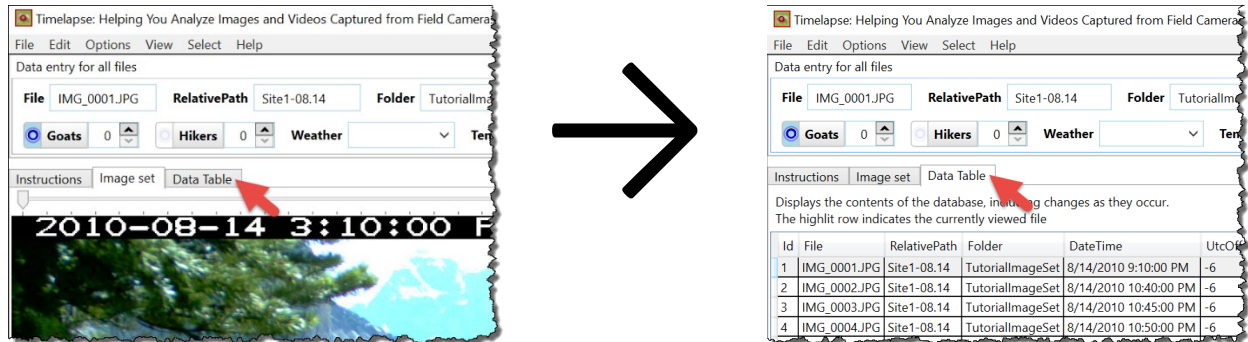
Analyze the remaining images and videos, while at the same time exploring other features available through its menu.

12 Other Helpful Features

There are many other specialized features in TIMELAPSE, not all of which are detailed in this manual. Most of those are well explained in the various dialog boxes that appear as you use TIMELAPSE. However, the following are worth describing in detail, as they can help you considerably in your workflow.

The Data Table

The Data Table view shows the current state of all your image set's data. You can access it by clicking on the Data Table tab as shown below.



The Data Table looks somewhat similar to the spreadsheet that you can export from Timelapse, where each image's data is shown in a row. It differs in that all data fields are displayed, including those not normally exported to the spreadsheet. Date information is also recorded in two formats: a Universal Time format in the DateTime and UtcOffset column, along with a more human-understandable Date and Time columns. Regardless of these differences, you can use the Data Table to inspect the data in your image set and to navigate to images.

Id	File	RelativePath	Folder	DateTime	UtcOffset	Date	Time	ImageQuality	DeleteFlag	Goats	Hikers	Weather	Temperature	Analyst	Comments	PublicityShot
1	IMG_0001.JPG	Site1-08.14	TutorialImageSet	8/14/2010 9:10:00 PM	-6	14-Aug-2010	15:10:00	Ok	false	0	0		14			false
2	IMG_0002.JPG	Site1-08.14	TutorialImageSet	8/14/2010 10:40:00 PM	-6	14-Aug-2010	16:40:00	Ok	false	0	0		14			false
3	IMG_0003.JPG	Site1-08.14	TutorialImageSet	8/14/2010 10:45:00 PM	-6	14-Aug-2010	16:45:00	Ok	false	0	0		13			false
4	IMG_0004.JPG	Site1-08.14	TutorialImageSet	8/14/2010 10:50:00 PM	-6	14-Aug-2010	16:50:00	Ok	false	0	0		13			false
5	IMG_0005.JPG	Site1-08.14	TutorialImageSet	8/14/2010 10:55:00 PM	-6	14-Aug-2010	16:55:00	Ok	false	0	0		13			false
6	IMG_0006.JPG	Site1-08.14	TutorialImageSet	8/14/2010 11:00:00 PM	-6	14-Aug-2010	17:00:00	Ok	false	1	0		14			false
7	IMG_0007.JPG	Site1-08.14	TutorialImageSet	8/14/2010 11:05:00 PM	-6	14-Aug-2010	17:05:00	Ok	false	1	0		14			false
8	IMG_0008.JPG	Site1-08.14	TutorialImageSet	8/14/2010 11:10:00 PM	-6	14-Aug-2010	17:10:00	Ok	false	0	0		15			false
9	IMG_0009.JPG	Site1-08.14	TutorialImageSet	8/14/2010 11:15:00 PM	-6	14-Aug-2010	17:15:00	Ok	false	1	0		15			false
10	IMG_0010.JPG	Site1-08.14	TutorialImageSet	8/14/2010 11:20:00 PM	-6	14-Aug-2010	17:20:00	Ok	false	1	0		16			false
11	IMG_0011.JPG	Site1-08.14	TutorialImageSet	8/14/2010 11:25:00 PM	-6	14-Aug-2010	17:25:00	Ok	false	0	0		16			false
12	IMG_0012.JPG	Site1-08.14	TutorialImageSet	8/14/2010 11:30:00 PM	-6	14-Aug-2010	17:30:00	Ok	false	0	0		16			false
13	IMG_0013.JPG	Site1-08.14	TutorialImageSet	8/14/2010 11:35:00 PM	-6	14-Aug-2010	17:35:00	Ok	false	0	0		16			false
14	IMG_0014.JPG	Site1-08.14	TutorialImageSet	8/15/2010 3:50:00 AM	-6	14-Aug-2010	21:50:00	Dark	false	0	0					false
15	VID_0015.avi	Site1-08.14	TutorialImageSet	8/15/2010 1:50:00 AM	-6	14-Aug-2010	19:50:00	Ok	false	0	0					false
16	IMG_0101.JPG	Site1-08.15	TutorialImageSet	8/15/2010 12:30:00 PM	-6	15-Aug-2010	06:30:00	Ok	false	0	0		7			false
17	IMG_0102.JPG	Site1-08.15	TutorialImageSet	8/15/2010 12:35:00 PM	-6	15-Aug-2010	06:35:00	Ok	false	0	0		7			false
18	IMG_0103.JPG	Site1-08.15	TutorialImageSet	8/15/2010 12:40:00 PM	-6	15-Aug-2010	06:40:00	Ok	false	0	0		7			false
19	IMG_0104.JPG	Site1-08.15	TutorialImageSet	8/15/2010 12:45:00 PM	-6	15-Aug-2010	06:45:00	Ok	false	0	0		7			false
20	IMG_0105.JPG	Site1-08.15	TutorialImageSet	8/15/2010 12:50:00 PM	-6	15-Aug-2010	06:50:00	Ok	false	0	0		6			false

The Data Table includes the following features.

- Pull out the Data Table into a separate window by dragging its title bar (show below)
- Navigate to a particular image by clicking a row
- Row highlighting indicates the currently viewed image, or the set of images currently selected in the overview (see below, where the first three images are selected and the corresponding rows highlight)
- Sort the data by clicking the column title. For example, if you want to see which images have the most goats in it, clicking the 'Goats' column will sort the images by number.

The screenshot shows the 'Timelapse: Helping You Analyze Images and Videos Captured from Field Cameras (TimelapseData.ddb)' application. A 'Data Table' window is open, displaying a list of image files. The table has the following columns: Id, File, RelativePath, Folder, DateTime, UtcOffset, Date, Time, ImageQuality, DeleteFlag, Goats, Hikers, Weather, Temperature, Analyst, and Comments. The first three rows are highlighted in blue, indicating they are the currently viewed images. The 'Goats' column shows values of 0, 0, and 0 for the first three rows, respectively.

Id	File	RelativePath	Folder	DateTime	UtcOffset	Date	Time	ImageQuality	DeleteFlag	Goats	Hikers	Weather	Temperature	Analyst	Comments
1	IMG_0001.JPG	Site1-08.14	TutorialImageSet	8/14/2010 9:10:00 PM	-6	14-Aug-2010	15:10:00	Ok	false	0	0		14		
2	IMG_0002.JPG	Site1-08.14	TutorialImageSet	8/14/2010 10:40:00 PM	-6	14-Aug-2010	16:40:00	Ok	false	0	0		14		
3	IMG_0003.JPG	Site1-08.14	TutorialImageSet	8/14/2010 10:45:00 PM	-6	14-Aug-2010	16:45:00	Ok	false	0	0		13		
4	IMG_0004.JPG	Site1-08.14	TutorialImageSet	8/14/2010 10:50:00 PM	-6	14-Aug-2010	16:50:00	Ok	false	0	0		13		
5	IMG_0005.JPG	Site1-08.14	TutorialImageSet	8/14/2010 10:55:00 PM	-6	14-Aug-2010	16:55:00	Ok	false	0	0		13		
6	IMG_0006.JPG	Site1-08.14	TutorialImageSet	8/14/2010 11:00:00 PM	-6	14-Aug-2010	17:00:00	Ok	false	1	0		14		
7	IMG_0007.JPG	Site1-08.14	TutorialImageSet	8/14/2010 11:05:00 PM	-6	14-Aug-2010	17:05:00	Ok	false	1	0		14		
8	IMG_0008.JPG	Site1-08.14	TutorialImageSet	8/14/2010 11:10:00 PM	-6	14-Aug-2010	17:10:00	Ok	false	0	0		15		
9	IMG_0009.JPG	Site1-08.14	TutorialImageSet	8/14/2010 11:15:00 PM	-6	14-Aug-2010	17:15:00	Ok	false	1	0		15		
10	IMG_0010.JPG	Site1-08.14	TutorialImageSet	8/14/2010 11:20:00 PM	-6	14-Aug-2010	17:20:00	Ok	false	1	0		16		
11	IMG_0011.JPG	Site1-08.14	TutorialImageSet	8/14/2010 11:25:00 PM	-6	14-Aug-2010	17:25:00	Ok	false	0	0		16		
12	IMG_0012.JPG	Site1-08.14	TutorialImageSet	8/14/2010 11:30:00 PM	-6	14-Aug-2010	17:30:00	Ok	false	0	0		16		
13	IMG_0013.JPG	Site1-08.14	TutorialImageSet	8/14/2010 11:35:00 PM	-6	14-Aug-2010	17:35:00	Ok	false	0	0		16		
14	IMG_0014.JPG	Site1-08.14	TutorialImageSet	8/15/2010 3:50:00 AM	-6	14-Aug-2010	21:50:00	Dark	false	0	0				
15	VID_0015.avi	Site1-08.14	TutorialImageSet	8/15/2010 1:50:00 AM	-6	14-Aug-2010	19:50:00	Ok	false	0	0				
16	IMG_0101.JPG	Site1-08.15	TutorialImageSet	8/15/2010 12:30:00 PM	-6	15-Aug-2010	06:30:00	Ok	false	0	0		7		
17	IMG_0102.JPG	Site1-08.15	TutorialImageSet	8/15/2010 12:35:00 PM	-6	15-Aug-2010	06:35:00	Ok	false	0	0		7		
18	IMG_0103.JPG	Site1-08.15	TutorialImageSet	8/15/2010 12:40:00 PM	-6	15-Aug-2010	06:40:00	Ok	false	0	0		7		
19	IMG_0104.JPG	Site1-08.15	TutorialImageSet	8/15/2010 12:45:00 PM	-6	15-Aug-2010	06:45:00	Ok	false	0	0		7		

Duplicate this record

Edit menu | *Duplicate this record...* allows you to duplicate the currently selected record.

Why have duplicates?

To explain why this is useful, consider the following (simplified) scenario.

The analyst is asked to identify an animal in an image by its species and sex by filling in the appropriate data fields. A problem arises when more than one animal is present in the image, as only one set of those fields are available to fill in per image.

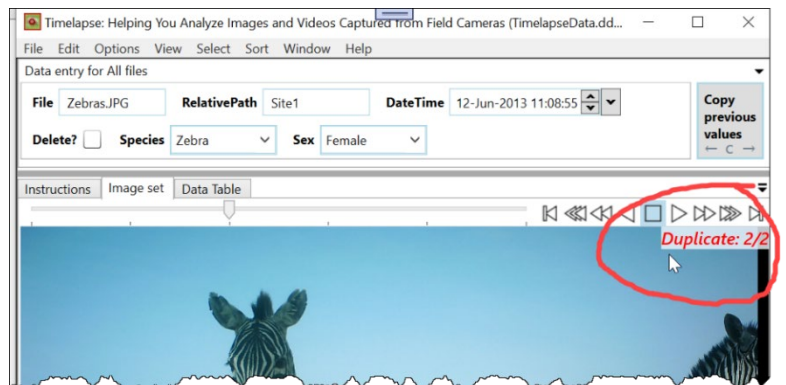
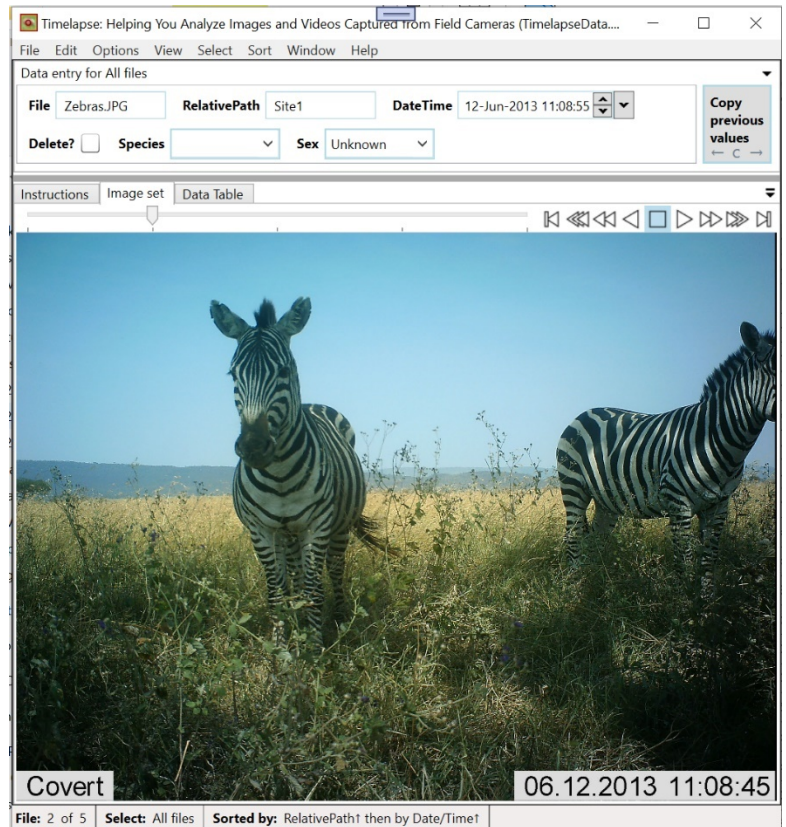
One solution creates a template with multiple versions of each field (e.g., Species1, Sex1, Species2, Sex2...), but this adds considerable clutter. If the number of individual animals exceed the number of fields made, then the problem still remains.

A better solution uses the *Edit/Duplicate this record*, where one or more copies of the current record can be made.

The above scenario requires the original record (for the first zebra, filled in as Zebra, Male) and one duplicate (for the second zebra, filled in as Zebra, Female).

I actually don't know if its male or female 😊.

As you navigate your images, duplicates will be identified by a label, similar to what is shown at the right.



Important note. How your images are sorted affects where the duplicate image is located relative to the original image while you are navigating, and whether the duplicate label appears. Ideally, you are using the *Sort | by Relative Path + DateTime* (the Timelapse default), or perhaps *by DateTime*. These sorting options should order duplicates so they appear one after the other. If they are not sorted, then expect confusion as that duplicate may be located at some random place in your visual stream, and may not be labeled (labelling is done).

These sorting options should order duplicates so they appear one after the other. If they are not sorted, then expect confusion as that duplicate may be located at some random place in your visual stream, and may not be labeled (labelling is done).

Aside. Some agencies use image sequences (where the camera trap takes several successive images in a row) to achieve a similar effect, where different data is entered on each image in the sequence as needed. However, this assumes that enough successive images are available.

Deleting duplicates

Edit | Delete | Only the data ... will delete the duplicate record while leaving the image or video file intact. As the file is still there, the original or other duplicates of that record can still display the image.

Duplicates when exporting a CSV file.

Duplicates appear as separate rows in both the Timelapse DataTable the CSV file: the rows have the same RelativePath and File name, as illustrated below. Whether duplicates appear next to one another depends on the sorting order set in Timelapse (see above note), although you can, of course, resort the CSV file with your favorite spreadsheet application.

Id	File	RelativePath	Folder	DateTime	UtcOffset	Date	Time	ImageQ	DeleteFlag	Species	Sex
1	Field.JPG	Site1	DuplicateExample	4/11/2013 6:08:40 PM	-6	11-Apr-2013	12:08:40	Ok	false		Unknown
5	Zebras.JPG	Site1	DuplicateExample	6/12/2013 5:08:55 PM	-6	12-Jun-2013	11:08:55	Ok	false	Zebra	Male
6	Zebras.JPG	Site1	DuplicateExample	6/12/2013 5:08:55 PM	-6	12-Jun-2013	11:08:55	Ok	false	Zebra	Female
3	Cinffa.JPG	Site1	DuplicateExample	6/18/2013 12:43:10 AM	-6	17-Jun-2013	18:43:10	Ok	false		Unknown
2	VideoBird.MP4	Site1	DuplicateExample	3/8/2021 9:10:48 PM	-7	08-Mar-2021	14:10:48	Ok	false		Unknown

A	B	C	D	E	F	G	H	I
File	RelativePath	Folder	Date	Time	ImageQuality	DeleteFlag	Species	Sex
Field.JPG	Site1	DuplicateExample	11-Apr-13	12:08:40	Ok	FALSE	Unknown	Unknown
Zebras.JPG	Site1	DuplicateExample	12-Jun-13	11:08:55	Ok	FALSE	Zebra	Male
Zebras.JPG	Site1	DuplicateExample	12-Jun-13	11:08:55	Ok	FALSE	Zebra	Female
Cinffa.JPG	Site1	DuplicateExample	17-Jun-13	18:43:10	Ok	FALSE		Unknown
VideoBird.MP4	Site1	DuplicateExample	08-Mar-21	14:10:48	Ok	FALSE		Unknown
VideoRaccoon.MP4	Site1	DuplicateExample	08-Mar-21	14:42:42	Ok	FALSE		Unknown

If you need to identify duplicate rows when processing your images, you can do this by just searching for rows with the same RelativePath/File name. While Timelapse does not add a column identifying duplicates, such a column can be added to the spreadsheet via a formula that compares the RelativePath/File cells in the current row with the cells in the surrounding rows (again, assuming they are in sorted order).

Duplicates when importing a CSV file.

Importing a CSV file with duplicate records works well as long as there are the same number of duplicate records for an image in both the CSV and Timelapse .ddb file. However, if there is a mismatch between the numbers available, Timelapse will fill in what it can, but will generate warnings.

- If the CSV file has more duplicate records than in the Timelapse, the extra duplicate records will be ignored.

Exporting Data to CSV files

File menu | Export data in the current selection as a csv file... lets you save header information and data about the currently selected files as a comma-separated value (.csv) file.

File menu | Export data in the current selection as a csv file and preview in Excel... is the same, but will try to open your exported .csv file in Excel.

What is a CSV file?

A csv file represents a table of rows and columns. The first row is the header identifying column names, each header separated by a comma. Subsequent rows are data fields, each field also separated by a comma.

Many packages, especially spreadsheets, can open .csv files, where they present that information in a table. Because .csv files are readily understood by so many applications, most analysts will tag their data, then save it as a .csv file, then open that .csv file with another package for statistical processing (e.g., via spreadsheets, R, etc.).

For example, exporting a (simple) Timelapse data set may look like this:

```
File,RelativePath,Folder,DateTime,ImageQuality,DeleteFlag,Species,
IMG_0001.JPG,,SameTemplate1,2010-08-15T03:10:00Z-06:00,Ok,false,Elk,
IMG_0002.JPG,,SameTemplate1,2010-08-15T04:40:00Z-06:00,Ok,false,Deer,
```

When opened in excel, data in that csv file may look something like this.

A	B	C	D	E	F	G
File	RelativePath	Folder	DateTime	ImageQuality	DeleteFlag	Species
IMG_0001.JPG		SameTemplate1	2010-08-15T03:10:00Z-06:00	Ok	FALSE	Elk
IMG_0002.JPG		SameTemplate1	2010-08-15T04:40:00Z-06:00	Ok	FALSE	Deer

When Excel opens the csv file, it is displayed in a vanilla format. You may have to adjust the formats to make it look good. You can also apply whatever formulas or statistical analysis you want to it. At that point you may want to save it as an Excel file rather than a csv file if you want to keep that extra information.

Headers, Rows, Columns

The first row of the CSV file is a header, where each column is identified by the field's *DataLabel* as defined in the Timelapse template .tdb file. The order of the columns also follows the order as specified in the template. The data for each image is then written as a row containing the comma-separated data values, as illustrated above.

Selection and Sorting

The presentation of rows in the csv file are based on the current selection and sorting settings. That is, only data for images in the current selection are exported (see the section *Custom Selection*), where they are sorted according to the current sort order (see *Menu/Sort*)

Dates and Times

Dates and times can have many different representations. Timelapse allows you to select one of four different date/time formats when exporting to a csv file through the *Options | Preferences | Exporting CSV Files – Date and Time Formats*. The format will be remembered across future Timelapse invocations on your computer. See *Note 2* below for implications of these formats to csv files opened in Excel.

Exporting CSV File - Date and Time Formats

Dates and times can be output in one of these formats.

- Date column (DD-MMM-YYYY), Time column (HH:MM:SS) e.g., 24-Dec-2021, 16:00:05
- DateTime column, local time (YYYY-MM-DDTHH:MM:SS) e.g., 2021-24-12T16:00:05
- DateTime column, local time (YYYY-MM-DD HH:MM:SS) e.g., 2021-24-12 16:00:05
- DateTime column, UTC time+offset (YYYY-MM-DDTHH:MM:SSZ±HH:MM) e.g., 2021-12-24T22:00:05Z-06:00

Reset

As shown above, there are three different ways for you to specify the Date/Time format in the .csv file. In all cases, time is shown in 24 hour notation.

As an example, let's assume we exported a row where the local time is December 24, 2021 4:00:05 pm and that the recorded time zone is Mountain daylight time (-6:00).

1. Date column (DD-MMM-YYYY), Time column (HH:MM:SS). *The default.*
Example output: File,...,Date,Time...
Img001.jpg,...,24-Dec-2021,16:00:05
Excel will show a Date column and a Time column, will interpret the Date and Time to its own internal representation, and will format them based on the cell's format settings.
2. DateTime column, local time (YYYY-MM-DDTHH:MM:SS). *Recommended*
Example output: File,...,DateTime...
Img001.jpg,...,2021-12-24T16:00:05
Following the ISO 8601 standard, the T in the middle separates the year-month-day portion from the hour-minute-second portion. Excel will not try to interpret this as a Date/Time.
3. DateTime column, local time (YYYY-MM-DD HH:MM:SS).
Example output: File,...,DateTime...
Img001.jpg,...,2021-12-24 16:00:05
Similar to 2, but with no T separator. Excel will interpret this as a Date/Time. You will likely have to choose Excel's Custom Format and set it to something like yyyy-mm-dd h:mm:ss
4. DateTime column, UTC time+offset (YYYY-MM-DDTHH:MM:SSZ±HH:MM). *If timezone needed.*
Example output: File,...,DateTime...
Img001.jpg,...,2021-12-24T:22:00:05Z-06:00
Following the ISO 8601 standard, the Z indicates that the time is in UTC (Greenwich) time. The offset must be added to it to get the local time, which can also change the date.

Note 1. Options 2 and 4 have the added benefit where sorting on the DateTime's text produces the same results as sorting by the Date and Time.

Note 2. When Excel interprets dates and times, it stores it internally as a number: the formatting rule then displays that number in a particular date/time manner. While this has advantages (e.g., you can show it using your cultural settings), it can also lead to unwanted side effects. For example, saving that opened csv file within Excel will save the date/time in the new csv file according to the Excel format rule rather than the prior Timelapse format.

Importing Data from CSV files

File menu | Import data from a csv file... raises dialog boxes that lets you import data from a comma-separated value (.csv) file. When imported, Timelapse will update most – but not all – of its data to match what is found in the CSV file.

If you use the *Edit/Duplicate this record...* facility to create duplicate data, Timelapse will also manage that. Essentially it tries to match and update duplicate entries in the CSV file with corresponding duplicate entries in the database.

Importing data from CSV files is generally useful in several situations, as described shortly.

What Timelapse won't import

- Timelapse checks for possible mismatches when importing data from a CSV file. If it finds any, it aborts the import operation and raises a dialog box listing those errors. This allows you to fix those errors and try again.
- If the File/Relative path in the CSV file doesn't match a file in the Timelapse database, that row's data is ignored.
- Data for files in the Timelapse database that are not listed in the CSV file will not be affected
- Fields relating to the File's location (File, RelativePath, Folder) are not updated.

Reason:

- As Timelapse uses the File/RelativePath values to find the particular image or video file, they would have to be identical to what is already there. Thus there is not need to change them.
- If the Folder doesn't match, timelapse will handle that when you next load the images.
- Fields relating to Date/Time (DateTime, Date, Time, UtcOffset) are not updated.

Reason:

- Excel often modifies the Date and Time data in unpredictable ways.
- This shouldn't be a problem, as Timelapse has many facilities for adjusting dates and times if they are wrong.

What is a CSV file?

A csv file represents a table of rows and columns.

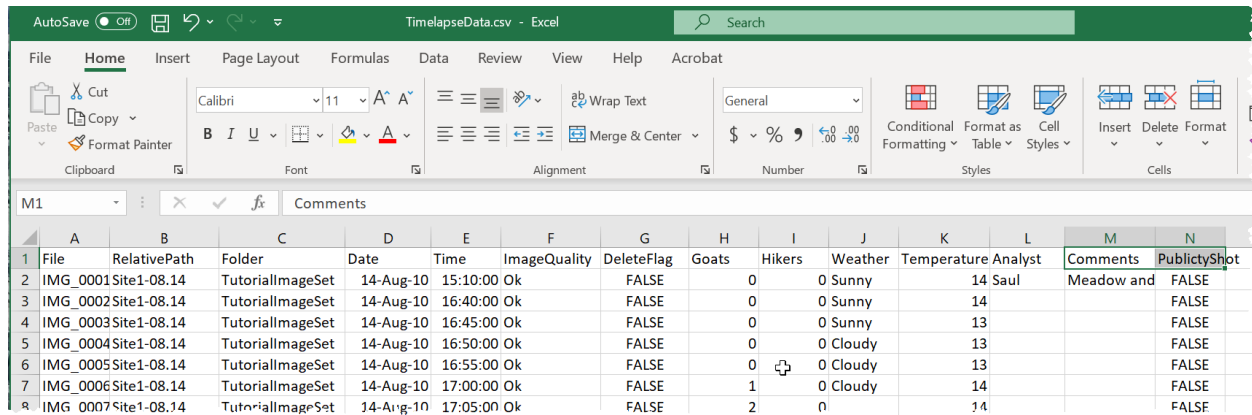
- each row is a line of text, and each column in a row is separated by a comma.
- the first row usually defines column **headers**
- subsequent rows define the data, where each value is under in the matching header.

For example, a CSV file for the tutorial set (populated with some data) for the first few images may look like this. Note how the first line comprises descriptive headers, each corresponding to a field's **DataLabel** as defined in the Timelapse Template.

```
File,RelativePath,Folder,Date,Time,ImageQuality,DeleteFlag,Goats,Hikers,Weather,Temperature,Analyst,Comments,PublictyShot,
IMG_0001.JPG,Site1-08.14,TutorialImageSet,14-Aug-10,15:10:00,Ok,false,0,0,Sunny,14,Saul,Meadow and scree slope,FALSE,
IMG_0002.JPG,Site1-08.14,TutorialImageSet,14-Aug-10,16:40:00,Ok,false,0,0,Sunny,14,,,FALSE,
IMG_0003.JPG,Site1-08.14,TutorialImageSet,14-Aug-10,16:45:00,Ok,false,0,0,Sunny,13,,,FALSE,
IMG_0004.JPG,Site1-08.14,TutorialImageSet,14-Aug-10,16:50:00,Ok,false,0,0,Cloudy,13,,,FALSE,
IMG_0005.JPG,Site1-08.14,TutorialImageSet,14-Aug-10,16:55:00,Ok,false,0,0,Cloudy,13,,,FALSE,
IMG_0006.JPG,Site1-08.14,TutorialImageSet,14-Aug-10,17:00:00,Ok,false,1,0,Cloudy,14,,,FALSE,
```


IMG_0007.JPG,Site1-08.14,TutorialImageSet,14-Aug-10,17:05:00,Ok,false,2,0,,14,,,FALSE,
....

CSV files can be created, viewed and edited by many applications, especially spreadsheet applications. For example, here is what the above CSV file looks like opened (or created) in Excel. Again, notice that the first line comprises the headers identifying each column.



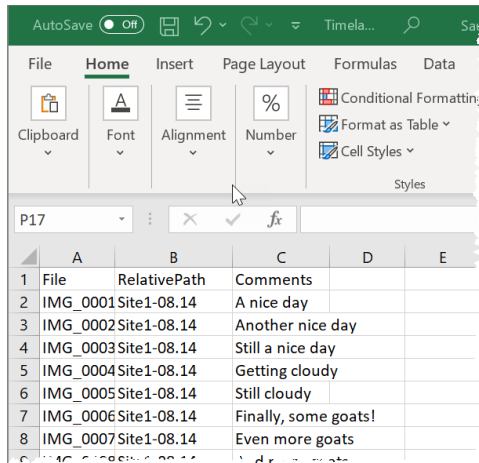
File	RelativePath	Folder	Date	Time	ImageQuality	DeleteFlag	Goats	Hikers	Weather	Temperature	Analyst	Comments	PublicityShot
IMG_0001	Site1-08.14	TutorialImageSet	14-Aug-10	15:10:00	Ok	FALSE	0	0	Sunny	14	Saul	Meadow and	FALSE
IMG_0002	Site1-08.14	TutorialImageSet	14-Aug-10	16:40:00	Ok	FALSE	0	0	Sunny	14			FALSE
IMG_0003	Site1-08.14	TutorialImageSet	14-Aug-10	16:45:00	Ok	FALSE	0	0	Sunny	13			FALSE
IMG_0004	Site1-08.14	TutorialImageSet	14-Aug-10	16:50:00	Ok	FALSE	0	0	Cloudy	13			FALSE
IMG_0005	Site1-08.14	TutorialImageSet	14-Aug-10	16:55:00	Ok	FALSE	0	0	Cloudy	13			FALSE
IMG_0006	Site1-08.14	TutorialImageSet	14-Aug-10	17:00:00	Ok	FALSE	1	0	Cloudy	14			FALSE
IMG_0007	Site1-08.14	TutorialImageSet	14-Aug-10	17:05:00	Ok	FALSE	2	0		14			FALSE

Hint. The *File | Export data for this image set as a csv file...* menu option exports all headers and data to *TimelapseData.csv*, which will be located in the same folder as your template. You can then open that file in Excel.

The CSV file formats readable by Timelapse

Timelapse can import CSV files as long as those files adhere to certain rules.

- Columns must correspond to some or all data fields as defined in the .tdb template file.
- The first row is a list of headers, each matching a DataLabel in the template. If a header doesn't match, an error will be reported.
- Subsequent rows hold each image's data, where each value is under in the matching Header.
- Data values must adhere to the type of items as defined in the .tdb template file:
 - Flags and DeleteFlag can only have true/false values.
 - Choices and ImageQuality can only have values that exactly match the text in the choice menu.
 - Counts can only be positive integers or blanks.
 - Notes can be anything
- the File column is compulsory, where it holds the name of the file.
- the RelativePath column is needed if images are stored in subfolders, where it holds the name of the relative path to the image's subfolder. If all images are at the root level (i.e., RelativePath is empty), then this column is optional.
- All other data columns are optional. For example, the CSV file below only contains columns describing the File, RelativePath and Comments data as defined in the .tdb template file. If that csv file is imported, only the Comments field for the matching relativePath/File will be updated.



Case Study. Export to a CSV file, edit your data, and import it back again.

There may be instances where you may find it easier to bulk-edit your data in a spreadsheet program rather than within Timelapse. For example, you may want to search and replace particular values in a column, or calculate a value based on a spreadsheet formula. This is fairly easy to do with the following workflow.

- Select *File | Export data for this image set as a csv file...* will export all your data as a CSV file (name it *TimelapseData.csv*), found in the same folder as your template.
- Open the file using your favorite spreadsheet program, e.g., Excel.
- Modify the values as needed, being careful to match the data type as described above
- Save the modified file as a CSV file
- Select *File menu | Import data from a csv file...* to import the modified data.
- Timelapse will inform you of any errors it notices, where it will give you the opportunity to correct them.

Tutorial Example.

Let's say an analyst wanted a new field in the tutorial called *TotalEntities* that was the sum of the values in the *Goats* and *Hikers* field. The analyst modifies the Timelapse template accordingly to include a new field called *Total Entities*. However, instead of painfully going through every image to calculate each image's *TotalEntities* value, the analyst:

- exports the data to a CSV file
- opens the CSV file in excel
- uses an Excel formula to set the *TotalEntities* column as the sum of *Goats+Entities*
- imports the CSV file back into Timelapse

Case Study. Importing data from a CSV file created outside of Timelapse

CSV files describing image data may be created outside of Timelapse. For example, we have seen cases where some agencies had the analyst manually inspect each image using a photo viewer, and then enter data describing that photo in a spreadsheet package. Another example includes agencies that used a different tool to analyze images, where its data could be exported as a CSV file.

The primary challenge here is to ensure that the CSV file format matches the format expected by Timelapse. In particular (and as mentioned above):

- the 1st row must be a header including (at the minimum) a File column and – if needed – a RelativePath column
- other header names should match the template DataLabel names
- subsequent data rows should hold data whose type matches the header, and whose File/RelativePath correctly describe the location of the file.

In practice, the list below describes the most common challenges you may have. The ones marked with a * can be quickly fixed using the *UpdateCSVFile.exe* utility (described in the next section). For others, you would have to adjust the CSV file by other means, e.g., editing the CSV file, using formulas or macros to update fields, or by writing a script in your programming language of choice (e.g., R).

1. *** File locations are stored as a full path** (e.g., *C:/Documents/project/site1/day1/foo.jpg*), rather than a separate File name and RelativePath.
2. *** Data Labels do not conform to the matching Timelapse DataLabels.** You may have to change your data labels to match what is found in your Timelapse Template. The UpdateCSVFile can help you fix this.
 - **example:** the CSV file contains a column of file names with the header *Image Name*. This would have to be changed to the matching 'File' header.
 - **example:** the CSV file contains a column with a header that differs from its matching Timelapse DataLabel. Thus you may have a column titled *Analyst Name* that has to be changed to the matching *Analyst* header.
3. **Data values may not conform to the data label type.**
 - **example:** the CSV file contains a column indicating whether something is present or not as Yes/No. If the matching data type is a Flag, Yes/No would have to be updated to true/false.
 - **example:** the CSV file contains a column of text. If the matching data type is a FixedChoice, each text item must match an item in the template's FixedChoice list.
4. **The CSV column describes data that has no match in the template.**
 - **example:** the CSV file contains a column with the header *Bear* whose data counts the number of bears seen in an image. The Timelapse Template has no matching data field. This is easy to remedy by editing the TimelapseTemplate to specify a new data field called *Bears* as a Count. When you create (or re-open) the TimelapseData .ddb file, the *Bear* field will now be included, where you can then import the CSV file.
5. **A Timelapse data file does not yet exist.** Create a template whose DataLabels and types match the contents of the CSV file, and place it in the image set as normal. Load the image set, which will create the Timelapse data file correctly populated with the file locations and date/times. Then load up the matching CSV file. This should work well as long as the CSV file conforms to the template as described previously.

Reminder. Timelapse DataLabels are somewhat restrictive, e.g., they cannot have spaces or some special characters in them. The CSV header name must *exactly* match the Timelapse DataLabel.

The UpdateCSVFile Utility

Timelapse includes a utility program called *UpdateCSVFile.exe* that can help you update your CSV file to match the CSV file expected by Timelapse.

In particular, you can use this program to:

- update the headers of many CSV files to conform to what is expected in Timelapse,
- repair file names that don't conform to the File / RelativePath expectations.

The output is a new CSV file whose name is the same as your old CSV file suffixed with *_updated.csv*.

Note. Utility programs are found on the Timelapse download page in the section titled *Utility Programs – Optional Downloads*. Scroll down that page to find it.

Using this program requires the following steps. To illustrate, let's assume

- your CSV ^{file} contains four columns headed by *Image Name*, *Project ID*, *Genus Species*, *Count*
- *Image Name*, *Project ID*, and *Genus Species* have to be transformed into *File*, *ProjectID* and *Species* respectively to match the DataLabels in the Timelapse template.
- The *Image Name* contains file location in the form of a complete path:
'C:/Documents/Project/site1/image01.jpg'
- The template is located in the project folder, where various subfolders (e.g., site1, site2) contain the images. Thus each value in the Image Name must be transformed e.g., where the File and RelativePath fields contain 'image01.jpg' and 'site1'

1. Use a text editor (e.g., WordPad) to create a text file titled 'headerTranslations.json'. This file should list the headers in your CSV file that you want to change, and what those headers should be changed to. For our example, the text file should look like this (note that Count is not included as it matches the DataLabel in the template).

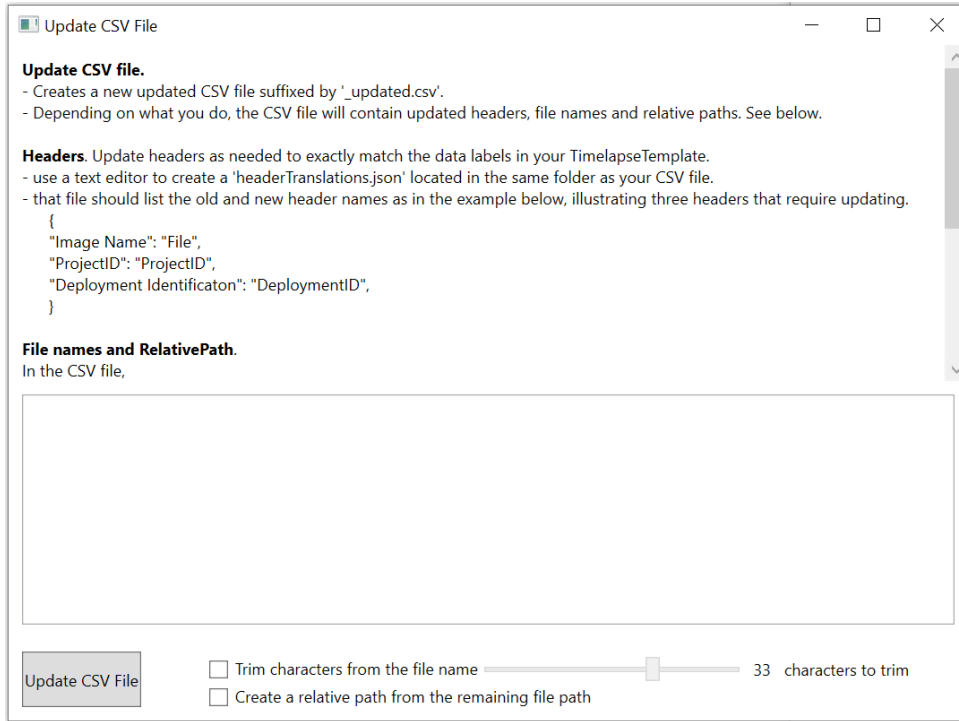
```
{  
  "Image Name": "File",  
  "Project ID": "ProjectID",  
  "Genus Species": "Species"  
}
```

Note. Syntax is important. The file should be structured as:

```
{  
  "old header 1": "new header 1",  
  "old header 2": "new header 2",  
  ...  
  "old header n": "new header n",  
}
```

The braces, quotes, colons and commas are all required. All CSV headers should be listed. Unchanged headers do not have to be included.

2. Copy the headerTranslations.json file into the same folder as your CSV file.
3. Start UpdateCSVFile.Exe. You will see this dialog box:



4. To trim *C:/Documents/Project/* (21 characters) off of the file names,
 - check the 'Trim characters..' checkbox
 - adjust the slider to 21
5. To split the remaining file path into the File / RelativePath columns
 - check the 'Create a relative path...' checkbox

This will place the file name portion (e.g., *image01.jpg*) into the File Column, and the text preceding trimmed file path into the RelativePath column (e.g., *'site1'*). A RelativePath column will be created if none exists in your CSV file.
6. Click *UpdateCSV File* and specify the location of the CSV file to update. Success and error messages (if any) will be reported in the above dialog box.
7. Open up the updated CSV file to ensure that everything was done correctly. You should see the updated header names, and the shortened file names.
8. If anything appears wrong, correct those errors and try again.

Note. If all your files are located in the root directory (e.g., in *Site1*), then you would just trim whatever characters lead up to the file name e.g., to trim off *C:/Documents/Project/site1/* you would set the Trim to 27 characters but you would not check the 'Create a relative path...' checkbox.

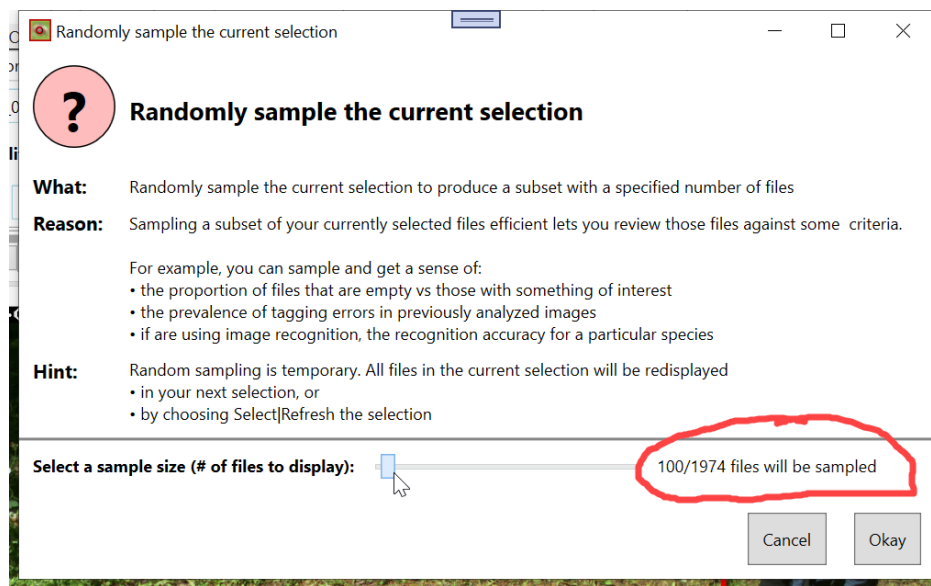
Other variations are, of course, possible.

Random Sampling of Files

One of the options available in the Select menu is *Create a random sample from the current selection*. When you select this option, Timelapse will randomly sample the current selection to produce a subset of those files. You determine the number of files you want using the dialog box that appears.

Sampling a subset of your currently selected files lets you review those files efficiently against some criteria. For example, the dialog box below shows that there are almost 2000 files in the current selection. By requesting a random sample of (say) 100 of those files, you can review just those files to get a sense of:

- the proportion of files that are empty vs those with something of interest;
- the prevalence of tagging errors in previously analyzed images;
- if are using image recognition, the recognition accuracy for a particular species.



Random sampling is a temporary setting. All files in the current selection will be redisplayed in your next selection, or by choosing *Select/Refresh the current selection*"

Missing Folders and Files

When you load your images and videos for the first time, Timelapse stores the file's location by its *name* and *relative path*, rather than its *absolute path*. The advantage is that you can move your entire image set folder to a new location, and Timelapse will still be able to find the files as long as its relative paths remain unchanged.

The *relative path* defines path from the folder containing your template to your image. For example if your template is located in *C:\Users\Documents\Sites*, and you have an image named *Image01.jpg* in a sub-folder called *Site1\Camera1*, the *relative path* is *Site1\Camera1*. The file's *absolute path* is *C:\Users\Documents\Sites\Site1\Camera1\Image01.jpg*.

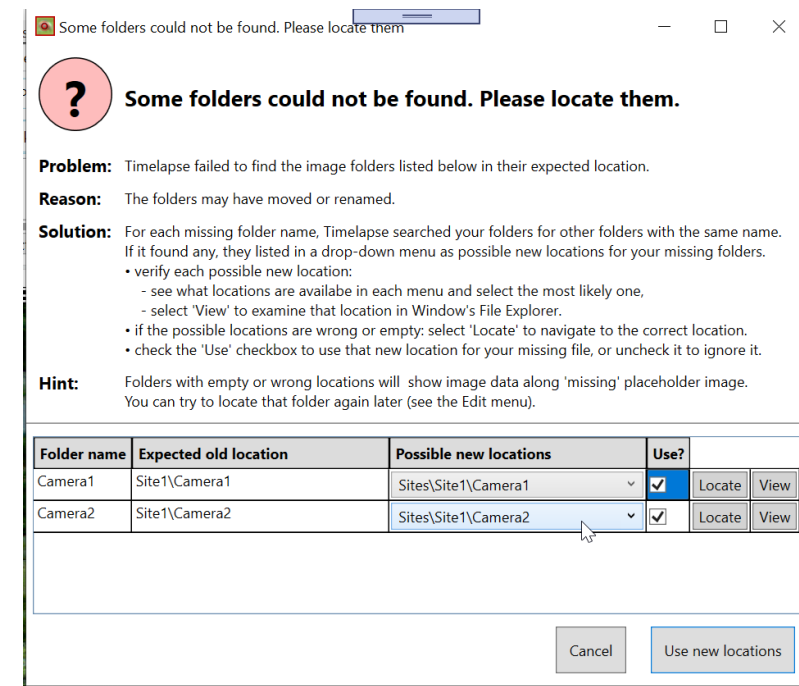
However, people sometimes change file names, folder names, and folder structures for various reasons. When this happens, Timelapse won't be able to find the images. The good news is that everything will all still work. Your data will still be there, and you can do everything you did before. The catch is that Timelapse will display a placeholder image instead of the real image.

Timelapse includes several facilities to help you locate folders and files.

Note. The description below is likely harder to read than to do. If you have any missing files or folders, just try them. But you should always verify that the possible new locations are correct before accepting them.

The Missing Folders dialog

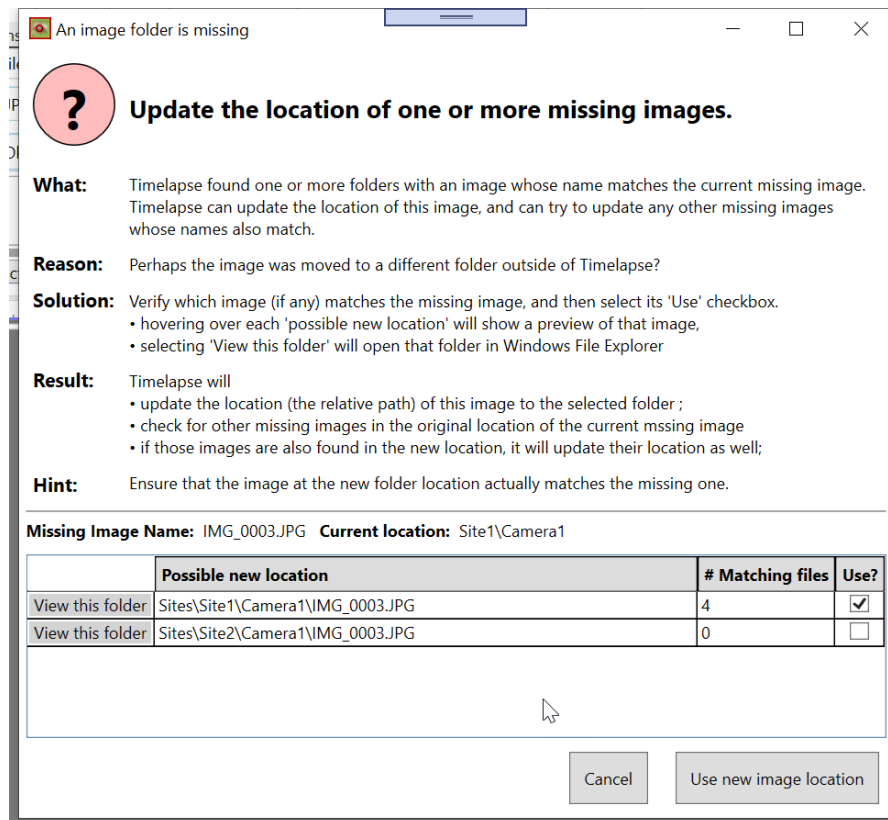
When you select *Edit | Try find any missing folders...* Timelapse will determine if any folders (as defined by all recorded relative paths) are missing. For each missing folder, it also searches your other image set folders for folders with the same name as the missing folder (this works will if a folder was moved but not renamed). A dialog box then displays what is missing, its expected location, and a selectable list of possible new locations, if any. Alternately, you can use the 'Locate' button to manually locate the missing folder (for example, if its been renamed).



The Missing Files dialog

If you are viewing a file that is currently missing (i.e., showing the missing images placeholder), you can select *Edit | Try to find this (and other) missing files...* Timelapse will search all your image set folders for files whose name matches the missing file. It will also check to see if it is an *orphan* file, i.e. that is not currently listed in your image set. Timelapse will present all possible matches as a list. It will also indicate if it found any other missing files in the same folder as your missing file in that new location. Hovering over a row will display a preview of the possible match. The relative paths of all those files will be updated accordingly. This works well if some of your images were moved from one folder to another, or if a folder was renamed.

The example below illustrates how a missing file named IMG_0003.JPG was found in two possible locations. The first row shows 4 other matching (missing) files found at that possible new location. Clicking the 'View this folder' button will show that folder in File Explorer allowing you to examine and verify if these are indeed where the missing images are located.



Which approach to use?

Missing folders dialog: best at finding relocated folders whose names are unchanged e.g.,

- folders moved into or out of other folders, including new containing folders.

Missing files dialog: best at finding relocated files whose names are unchanged e.g.,

- when files were moved from one folder to another, or
- when a folder's name was changed.

Merging Database (.ddb) File into a Single Database

We had previously described the advantages of creating multiple Timelapse databases, each handling subsets of your images as an image set, e.g., images per camera or per site. The primary disadvantage of this is that you may – at some point – want to collect all your data into a single database.

Timelapse includes a facility for merging multiple databases (.ddb files) into a single database. You can invoke it by selecting the *File / Merge database...* menu item. Before you use merge, you need to do the following, where you should also understand what merge does and its limitations.

To do a merge.

- Select (or prepare) a root folder, where the database files (and their images) are located in subfolders to that root file.
- Place a template in it, where that template conforms with the templates for the database files you wish to merge. You can usually do by copying one of the existing sub-folder templates.

Note: Some differences between the templates can be tolerated. What is critical is that the DataLabels in all templates must exactly match each other. If even one differs, Timelapse will not merge that database.

- Start Timelapse.
- Select *File / Merge database...* and select the template in your root folder (an informative dialog box will also be displayed). Timelapse will then do the following:
 - create a new database in your root folder called *TimelapseDatabase_merge.ddb*;
 - search for all the database files in the subfolders;
 - for each database found, it will check to see if the DataLabels in their templates match the DataLabels in your root folder's template;
 - if the DataLabels match, it will add that database's data to the merged database, otherwise that database will be skipped over.
 - it may raise a dialog box list what database files, if any, were skipped.
- You can now load the *TimelapseDatabase_merge.ddb* into Timelapse as normal to inspect its contents.

Important notes.

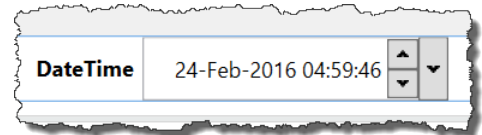
1. **Databases are independent of one another.** The merged database file will be completely independent of the database files that were merged into it. Thus any changes you later make to the merged database will not be reflected in the individual database files. Similarly, changes to individual database files will not be reflected in the merged database. Of course, you can always redo the merge again.
2. **Its all about the templates.** The database files in the sub-folders should all have been built around the same basic template structure (although only the DataLabels really matter). However, you can always try to do a test merge. Timelapse will inform you about which databases could not be merged in due to differences in the template.
3. **If a merged database file *TimelapseDatabase_merge.ddb* already exists it will be over-written.** However, a backup of that file will be made in your Backups folder.
4. **Databases in your sub-folders are not altered.** You can experiment with merging files without worrying that you will be affecting any of your core data.
5. **The merge process skips over .ddb files found in Backup folders.**

Correcting Dates

Dates and times can be problematic for many reasons.

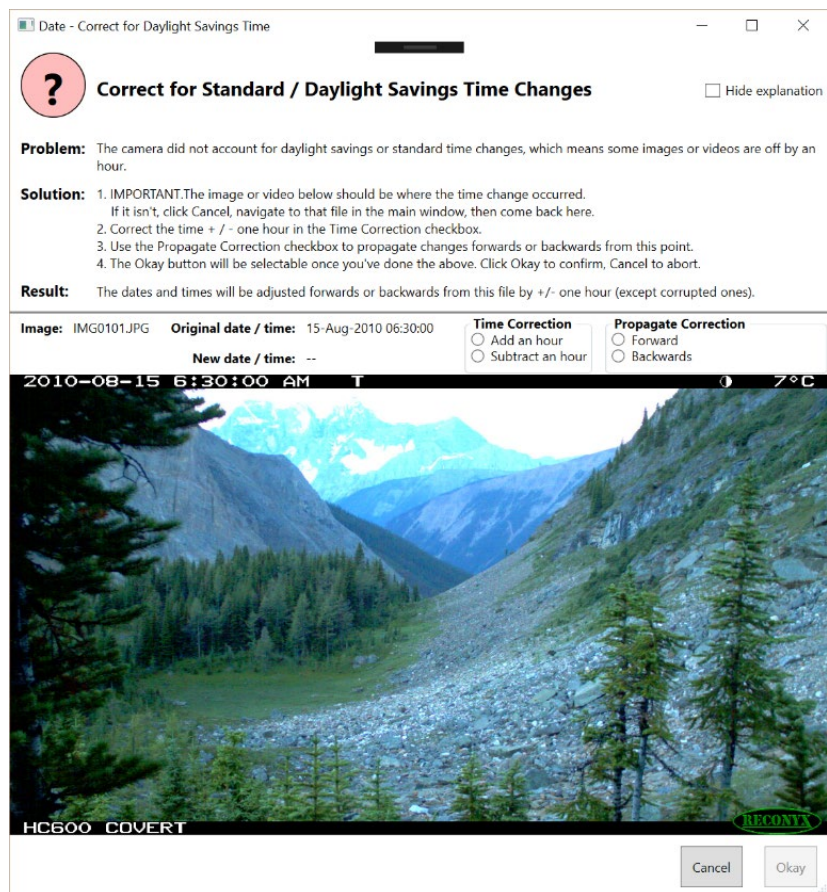
- The camera's date and time setting may be wrong, so all images are 'off' by a given amount.
- Some cameras record dates ambiguously. For example, if your camera records the date as (say) 01/02/2016, this could be interpreted as January 2, 20016 or February 1, 2016.
- A change from daylight savings time to / from standard time may have occurred, which isn't handled by your camera.
- The camera may keep time inaccurately, where times can drift (i.e., similar to a slow or fast watch)
- Even if time change is handled by your camera, your particular project may want all times to be recorded in Standard time vs. Daylight Savings Time.
- Cameras may be sited across different time zones, where – depending upon your particular project – you need to adjust the image times to account for that.

Because of these and other factors, TIMELAPSE provides various facilities to correct the date and time. You can do it individually via the *DateTime* control found in the interface. However, if the problem spans multiple images, you will probably want to correct all *DateTime* fields in bulk. Various date correction facilities are all found in the *Edit / Date correction* menu (a list of the Date correction menu options were described earlier). As they all work somewhat similarly, only one of these is described below: *Edit / Date Correction / Correct for standard / daylight savings time Changes*.

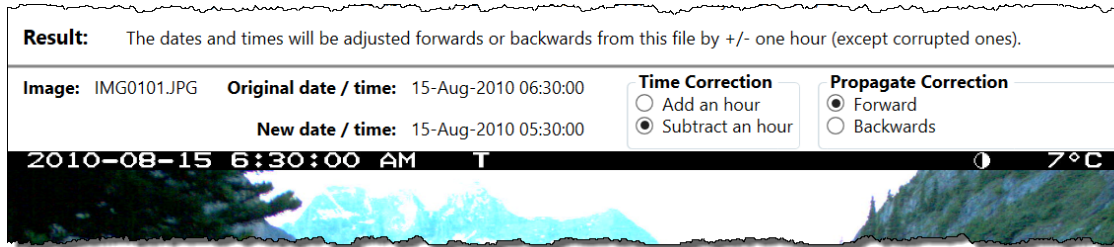


For illustrative purposes, let's pretend that the camera has been set to daylight savings time, and that daylight savings time changes to standard time on August 15 (even though the change time is actually in November). Your camera does not account for this. Your task is to correct the dates for your images from August 15 onwards by subtracting an hour.

1. Navigate to the first image that should have its time corrected. In your tutorial set, this would be IMG0101.JPG, taken on Aug-15 at 6:30 am).
2. Select *Edit | Date Correction | Correct for Standard / Daylight Savings Time Changes*, which will display a dialog box similar to what is shown here.



3. Click *Time Correction: Subtract an hour*, and *Propagate Correction: Forwards*. The adjusted date/time for this image will be shown below.



4. Click Okay. All images from this image onwards will have their time adjusted to decrease it by one hour. This includes changing the date if needed (e.g., if the original date of an image was a few minutes after midnight).
5. Click Okay. All images from this image onwards will have their time adjusted to decrease it by one hour. This includes changing the date if needed (e.g., if the original date of an image was a few minutes after midnight).
6. Check the dates. If something went wrong, you can re-read the original dates back from the image by selecting *Edit | Date Correction | Re-read dates from files...*

Understanding UTC Dates and Time zones

Feel free to skip this section if you are uninterested in time zone information.

Note: You would likely only use UTC time if you really need to know the time zone, or if you want your spreadsheet to show date / time in the UTC format.

In rare cases, you may want to view time zone information in Timelapse, and/or export time zone details about dates/times to a comma separated value (CSV) file. This is possible with Timelapse.

When Timelapse records a date, it assumes that the time zone you want to use is the one on your computer. Dates and Times are then recorded internally following UTC (*aka* Coordinated Universal Time) standard (e.g., see https://en.wikipedia.org/wiki/Coordinated_Universal_Time). This standard separates the time zone information from the date/time, where the time zone (including daylight savings time) is provided as an **UTC offset** (see below).

The Editor lets you configure the template to expose this UTC offset. When exposed, a Timelapse user will be able to view (but not edit) the UTC offset.

To configure the template to show the UTC offset, **select** *View/Show UtcOffset Control Row*. This will expose a new UtcOffset row in the interface, as illustrated below. Then make that control Visible by checking the **Visible** checkbox. The resulting editor window will resemble the following, where it includes a UtcOffset row in the editable grid, and a new control called '**UtcOffset**' in the simulated interface area. To hide the UtcOffset, make sure that the control is not set to Visible, then reselect the menu option.

When using Timelapse to export data to a CSV file, you can optionally set the date/time format to show the UTC+Offset time *vs* the local time. See the *Options/Preferences* Timelapse for the different available date/time formats. Adding the UTCOffset to the UTC DateTime will give the local time.

Timelapse Template Editor | File: TimelapseTemplate.tdb

File View Help

Click the white fields to edit their contents. Gray fields are not editable.
List items: Click 'Define List' to create or edit menu items, one per line.

Type	Default Value	Label	Data Label	Tooltip	Width	Copyable	Visible	List
File		File	File	The file name	100	<input type="checkbox"/>	<input checked="" type="checkbox"/>	
RelativePath		RelativePath	RelativePath	Path from the fo	100	<input type="checkbox"/>	<input checked="" type="checkbox"/>	
Folder		Folder	Folder	Name of the folc	100	<input type="checkbox"/>	<input checked="" type="checkbox"/>	
DateTime	1900-01-01T12:00:00	DateTime	DateTime	Date and time ta	170	<input type="checkbox"/>	<input checked="" type="checkbox"/>	
UtcOffset	0.00	UtcOffset	UtcOffset	Universal Time o	60	<input type="checkbox"/>	<input checked="" type="checkbox"/>	
ImageQuality		ImageQuality	ImageQuality	System-determin	85	<input type="checkbox"/>	<input checked="" type="checkbox"/>	Define L
DeleteFlag	false	Delete?	DeleteFlag	Mark a file as on	20	<input type="checkbox"/>	<input checked="" type="checkbox"/>	

Add:
Count
Choice
Note
Flag
Remove

What the interface will (roughly) look like. Drag and drop these controls (by their labels) to re-arrange their order to your preference

File RelativePath Folder DateTime 01-Jan-1900 12:00:00
UtcOffset 00:00 ImageQuality Ok Delete?

The spreadsheet column order. Drag and drop columns to re-arrange their order to your preference

File RelativePath Folder DateTime UtcOffset Date Time ImageQuality DeleteFlag

Now lets look at how this appears in the Timelapse window.

Timelapse 2: Helping You Analyze Images and Videos Captured from Field Cameras

File Edit Options View Filter Help

File IMG_0001.JPG RelativePath Site1-08.14 Folder TutorialImageSe DateTime 14-Aug-2010 15:10:00 UtcOffset -06:00
ImageQuality Ok Delete? Enter a UTC offset

2010-08-14 3:10:00 PM T 14°C

We see the DateTime recorded as the local time (i.e., it matches the date and time seen in the image). However, we also see that its UtcOffset from the UTC time is -6:00. That is, we would have to add 6 to get the real UTC time. This UtcOffset was calculated as follows.

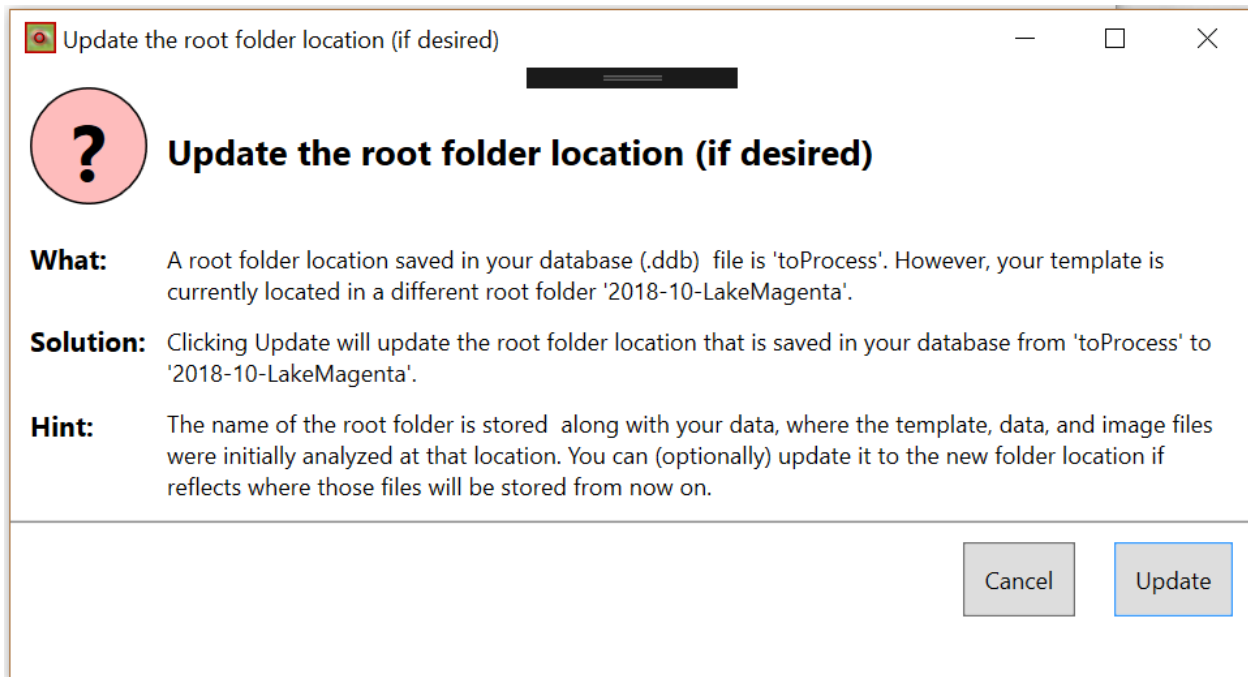
1. Take the time zone from the local machine that created this image set. In this case, it was (UTC-7:00) Mountain Time (US & Canada)
2. Correct for Daylight Savings Time. As August is in daylight saving times, an hour was subtracted, giving a UtcOffset of this image of -6:00

Changing the Name of your Image Folders

As described in the beginning of this manual, TIMELAPSE expects all your images to be located in your root folder (i.e., where your template is located), or in sub-folders of your root folder. The root folder name is stored in the *Folder* data field. If you use sub-folders, it stores the name of an image's subfolder in the *RelativePath* data field along with the file name so it can find and display each image again.

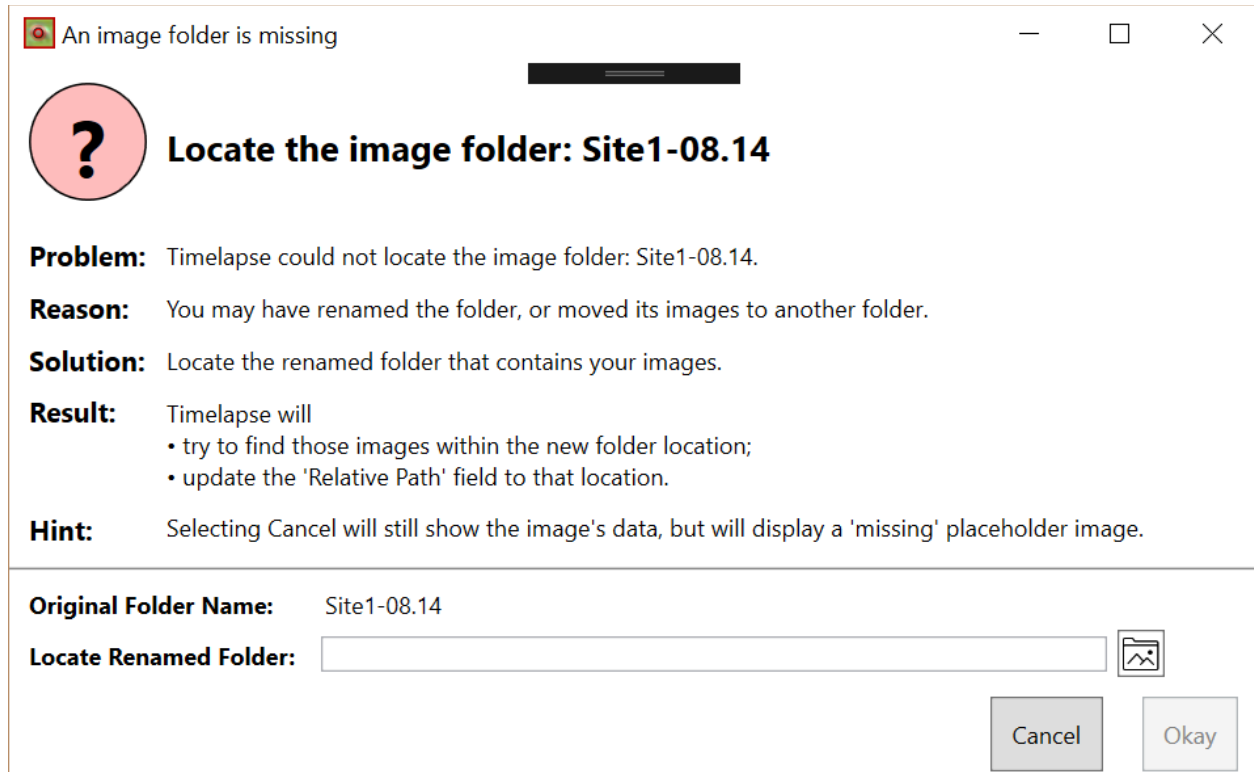
Case one. Changing your root folder name. Let's say you have already used TIMELAPSE on your images, but then decide to change the name of your root folder (or alternately, you may have moved all the files to a new folder location). To illustrate, consider an analyst who initially stored and analyzed images (along with the template) in a root folder named 'toProcess', but then later renames that folder to a more descriptive name, such as '2018-10-LakeMagenta'. When the analyst next loads the images in that folder, TIMELAPSE detects that the stored vs. actual root folder names differ. It will then raise the following dialog to ask the analyst if she wants to update the stored root folder name to match the name of the actual root folder currently containing the files.

Updating the name is optional, as the root folder name is stored only for informational purposes: TIMELAPSE does not need it to locate any of its files. For example, you may not want to update the root folder name if you moved (or copied) your files to a temporarily folder to work on them, and plan to move them back to their original location later.



Case two. Changing your sub-folder name(s). Let's say you have already used TIMELAPSE on your images, but then decide to change the name of a sub-folder (e.g., perhaps to a more descriptive name). When you start TIMELAPSE afterwards, it will still be able to show each image's previously analyzed data, but will be unable to display the image as it can no longer find the folder where that image is located.

TIMELAPSE does give you options in these cases. Whenever TIMELAPSE loads an image set's data, it automatically checks to see that each sub-folder mentioned in that data exists. If it can't find the sub-folder(s), it raises the following dialog to ask you to try to locate it, where you can point to its new name.



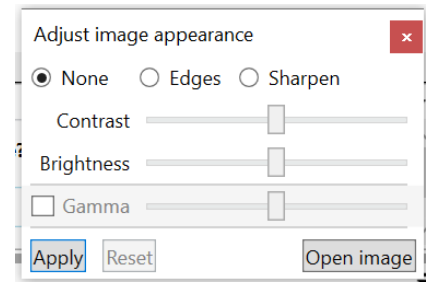
For this to work properly, the original images will still have to be located in the renamed folder under their original names, as otherwise TIMELAPSE will not be able to find those images. If it can't find an image, that image's data is still displayed along with a placeholder 'missing image' instead of the original image.

Note. The renamed folder must still be a sub-folder of the root folder containing your template.

Temporarily Adjusting Image Appearance

Images can be of poor quality, usually because of poor lighting conditions. Timelapse gives you a few rudimentary ways to temporarily adjust the appearance of your image without altering your file.

Choosing *Options | Temporarily Adjusting Image Appearance* raises the following window, which will stay on your display until you close it (or close your image set). Its controls are similar to those found on most image editors.



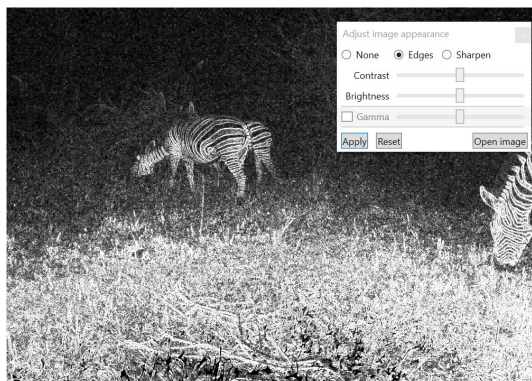
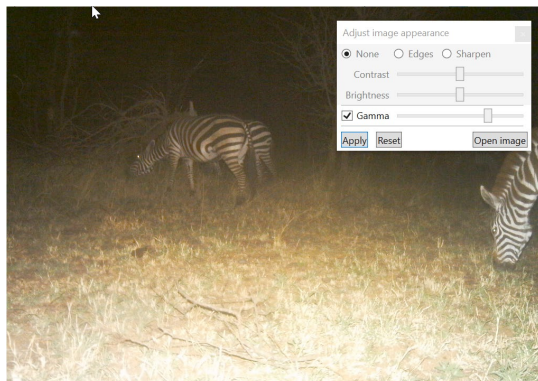
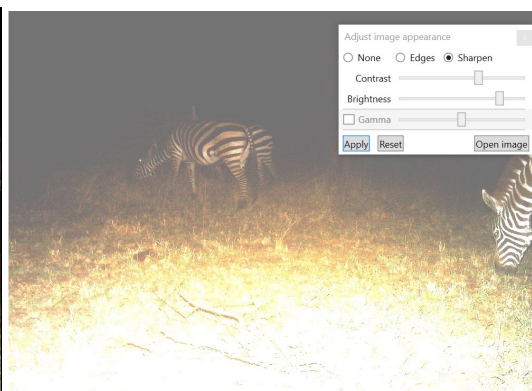
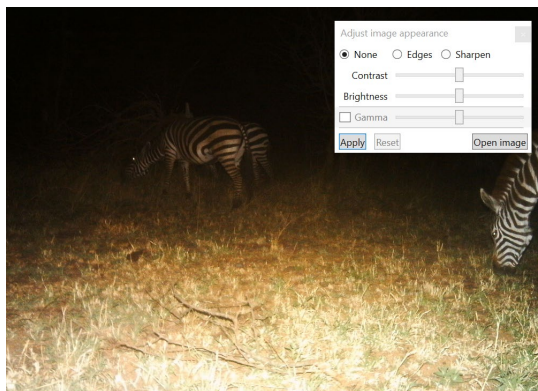
For example, consider the somewhat dark image (top left). To more clearly inspect the individual, the image *brightness*, *contrast* and *sharpness* was adjusted (top right), and its *edges* revealed (bottom right). These settings can be combined with one another.

Gamma is an alternate image enhancement control that tends to do a better job exposing extremely dark or light regions of the image without overly brightening or darkening the rest of the image (bottom left). Use it by selecting the Gamma checkbox and/or by adjusting the slider.

Note: adjusting any of the controls will automatically apply the current settings to the current image.

Other controls are:

- *Apply* applies the settings to the current image (e.g., use it when you navigate to a new image).
- *Reset* resets the controls back to their default neutral values.
- *Open* opens the current image in your default Windows photo viewer, which will likely have more powerful image manipulation features. Be careful: if you save changes, it will be to your image file.

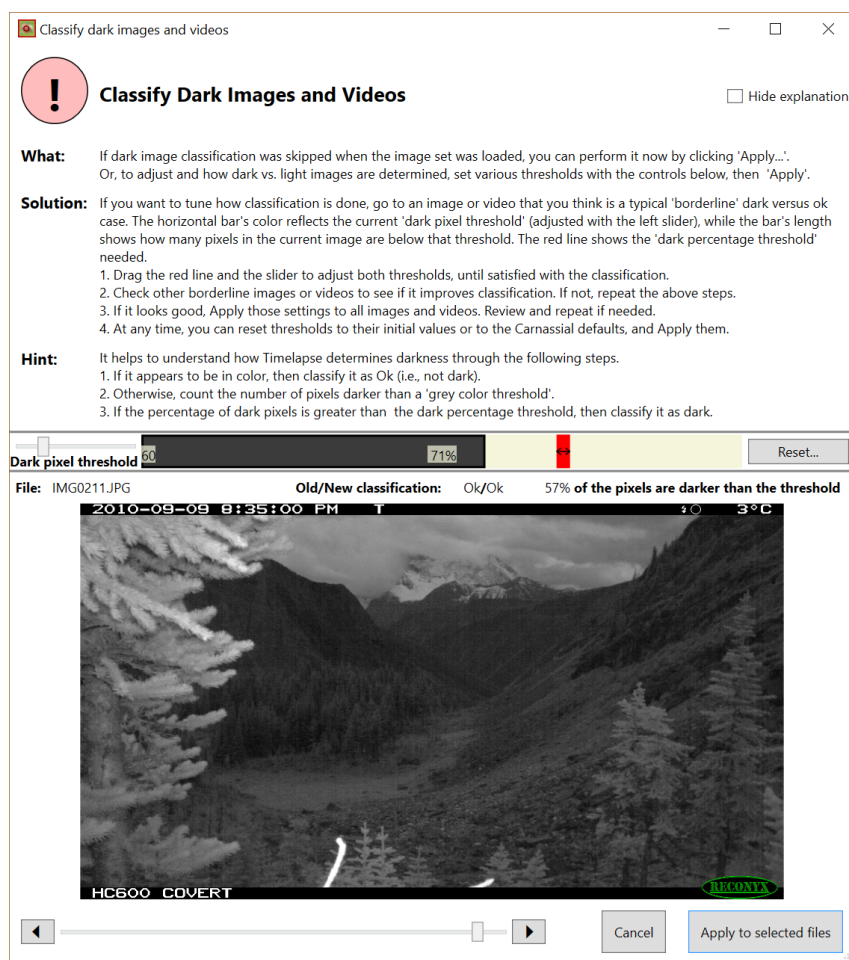


Adjusting Thresholds for Determining Dark Images

When TIMELAPSE first loads your images, it tries to determine and mark those images that are dark (likely night-time) shots. This classification is particularly useful for cameras that are in timelapse mode (images taken at fixed time intervals), as it allows the analyst to later filter out (and possibly delete) many hundreds or thousands of images that are less than useful.

However, classifying dark images on loading is optional: turn this on by selecting the *Options / Classifying dark images when first loading an image set* menu item.

Instead, you can classify your dark images at any time via the *Edit / Identify or reclassify dark files...* menu option. This raises the following dialog. If you then click the *Apply to selected files* button, the files in the current selection will be classified.

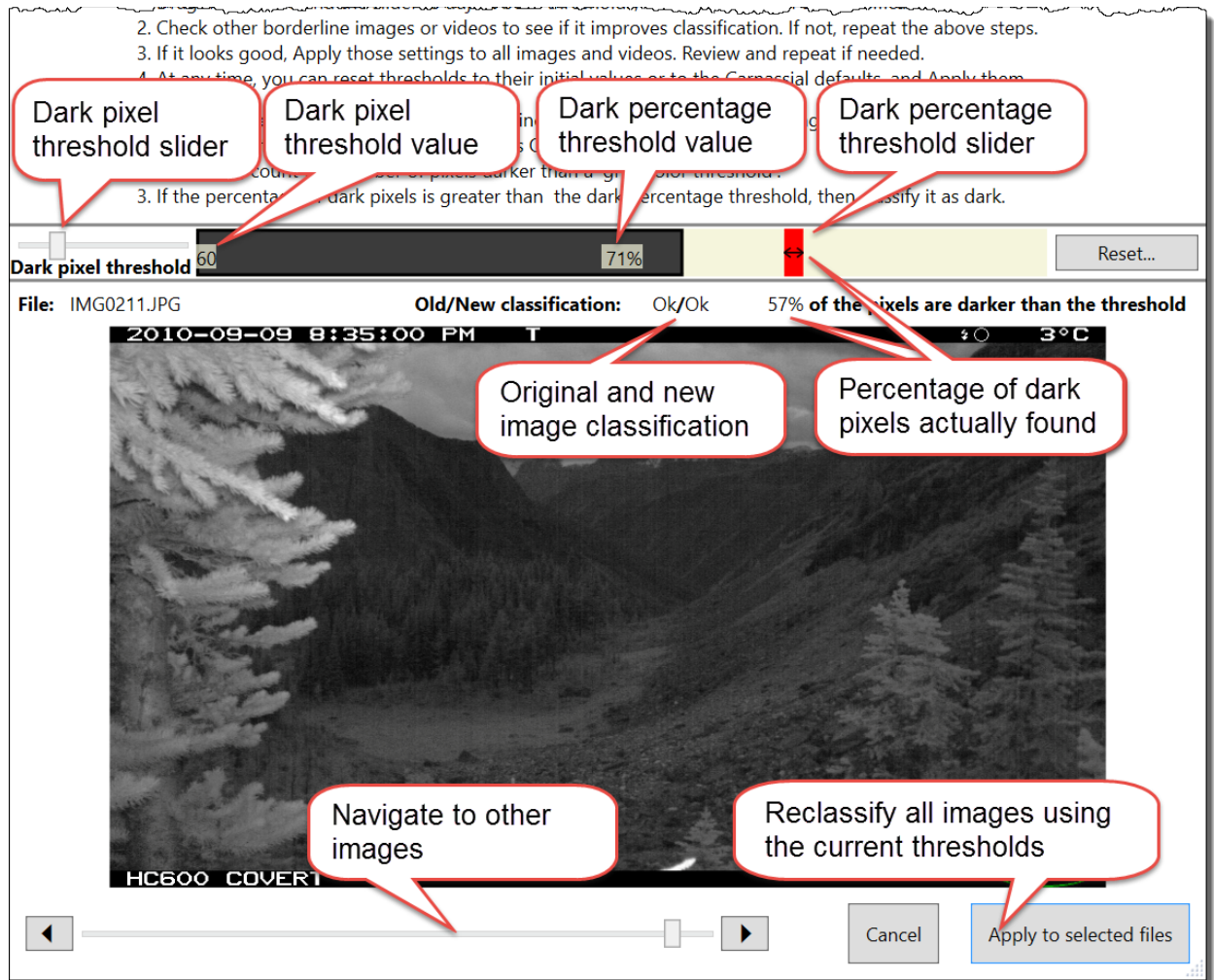


Alternately, you can use the above dialog to tweak how TIMELAPSE does the classification. But first we need to explain how TIMELAPSE does this classification. For each image, TIMELAPSE samples many of its pixels. It then classifies an image as 'dark' by:

- checking to see if the large majority of image pixels are grey-scale vs color;
- counting the number of grey-scale pixels that are darker than a *grey-scale threshold*;
- checking if the total ratio of dark pixels in the image exceeds a *dark percentage threshold*.

You can fine-tune how TIMELAPSE uses these two thresholds to determine which images are dark vs. light, and have Timelapse reclassify your images accordingly.

To illustrate this, the tutorial image set contains an image taken at dusk that TIMELAPSE classified as Ok (see above). However, perhaps you (as the analyst) would prefer to see this image classified as dark. For a single image, you could do this simply by changing the *ImageQuality* field to *dark*. However, this would be tedious indeed if you had other hundreds of similar images taken at dusk and twilight within your image set. To do this, you would use the controls as annotated below.



2. Select the *Edit | Identify or reclassify dark files...* menu option, which will display a dialog box similar to what is shown above.
3. Use the slider at the bottom to navigate to an image that you consider just on the edge of what should have been classified as a dark image (in your tutorial set, this would be IMG0118.JPG).
4. Examine the current threshold settings.
 - The *dark pixel threshold* slider determines how dark the pixel has to be before it is considered a 'dark' pixel. It is currently set to a grey-level of 60 (the actual color is used to color the bar at the right), which is currently a very dark grey.

- The *dark percentage threshold* slider (the red vertical bar) determines how many pixels in the image have to be dark before the image is considered dark. It is currently set to 71%.
5. Examine the classification of the current image against these thresholds
 - The length of the bar indicates the actual percentage of dark pixels in this image, where the actual percentage is textually described below it ('57% of the pixels are darker than the (grey color) threshold').
 - Because the dark percentage threshold is 71%, the image is classified as Ok (also reflected in the text above).
 6. Change the settings as follows. Note that this is somewhat done by trial and error.
 - Relax the dark pixel threshold, where somewhat lighter pixels should be classified as dark. This is useful for this particular image type, as the infrared flash has brightened the surround trees. As you move the grey color threshold slider to the right, you will see the bar getting lighter in color (to indicate the new dark pixel threshold), and longer (as more pixels are now classified as dark).
 - Decrease the dark percentage threshold values by moving the dark percentage threshold slider leftwards. As the slide meets the edge of the grey bar, you will see that your image classification will change from 'Ok' to 'Dark'.
 7. Examine other images to see how this classification works by using the navigation slider at the bottom. In particular, check for:
 - false positives (i.e., images you consider light that have been mis-classified as dark)
 - false negatives (i.e., images you consider dark that have been mis-classified as light)

Readjust the thresholds as needed.

8. If you are happy with what you see, apply these thresholds to reclassify all your images. The image quality field for each image will be reset accordingly.
9. Timelapse saves these threshold settings, and will apply them to future image classifications. At any time, you can use the 'Reset' button to either:
 - revert to the default system settings
 - revert back to your own initial settings (e.g., if you made threshold changes in the dialog box that you did not like).

Dialog Boxes Arising from Changed Templates

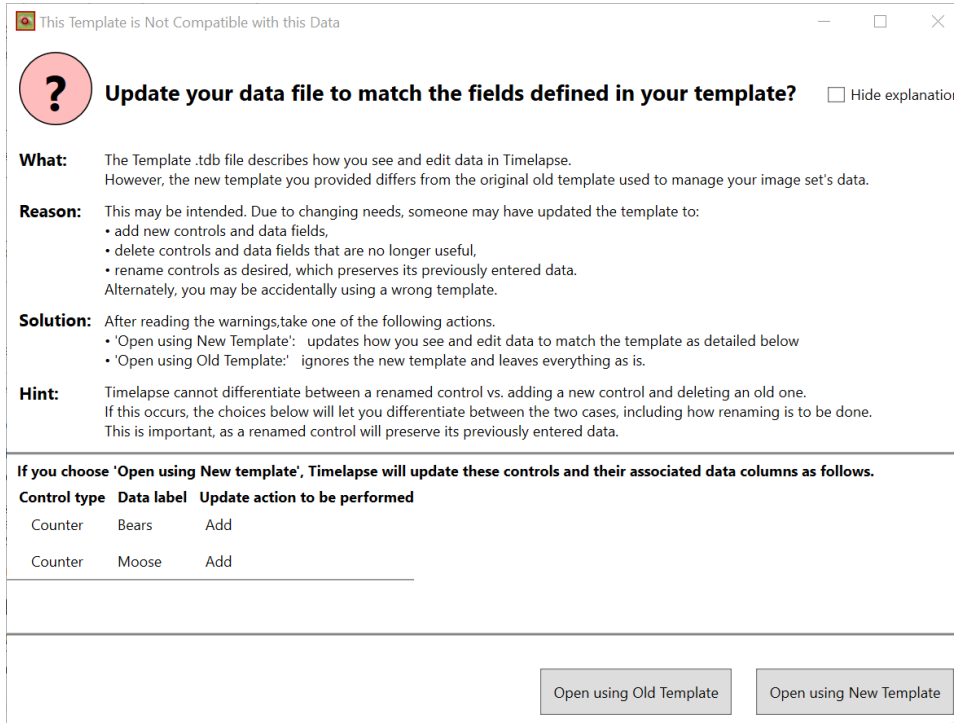
TIMELAPSE uses the **.tdb** template file not only to create the interface, but to structure how it stores its data in an image set's **.ddb** data file. Whenever a previously created image set is loaded with a template, Timelapse will examine the template for possible changes and will raise a dialog box notifying you if any of those changes will affect the data associated with your image set.

Case 1. Adding new control fields and associated data.

After various image sets have already been analyzed, your project manager may decide to add new control fields to the template, which in turn allows you to enter data in that field within TIMELAPSE. To illustrate, the project manager may have added

- a new *Counter* for Bears
- a new *Counter* for Moose

When you open an existing image set, Timelapse detects these changes and will ask for confirmation.



You are given two options:

- *Open using New Template:* Opens your image set with the new template you provided. The Timelapse interface will now include Bears and Moose counter controls, and Bear and Moose data columns are added to the database.
- *Open using Old Template:* Ignores the changes, and opens your image set using an internally stored old copy of the template. Your data is left unchanged, and the Bears and Moose counters will not appear in the Timelapse interface

Case 2. Deleting existing control fields (which deletes any associated data).

In other cases, your project manager may decide that a particular field (and its associated data) are no longer needed. To illustrate, the project manager may delete from the template:

- Analyst field, after realizing that the analyst information isn't particularly useful.

As before, when you open an existing image set, TIMELAPSE detects this deletion and will ask for confirmation.

Important note. Closely examine deletions, as deletions will delete any previously entered data associated with that field. You may want to check with the project manager who changed your template.

As an alternative to deleting a control field, the project manager could have made it invisible in template. This will retain any associated data.

Case 3. Renaming existing control fields (which retains any associated data).

Your project manager may decide to rename a particular field, which retains any associated data. Renaming is done by changing the *data label* associated with the control and your data (the data label is the text that appears atop the data column in your spreadsheet, which may differ from the name of the associated control displayed in the Timelapse interface). To illustrate, the project manager may rename the data labels for the two counters in the template:

- Goats is renamed GoatsCounter
- Hikers is renamed Hikers Counter

As before, when you open an existing image set, TIMELAPSE detects this change and will ask for confirmation. However, TIMELAPSE cannot tell the difference between a renamed control vs a control that has been added and another similar-type of control that has been deleted (e.g., deleting Goats and adding GoatCounter). Consequently, its confirmation dialog box will give you the option to differentiate between these two cases.

Important note. Differentiating between the two cases is important: Adding/Deleting will delete the original data, while Renaming will keep that data.

If you choose 'Open using New template', Timelapse will update these controls and their associated data columns as follows.

Control type	Data label	Update action to be performed
Counter	Goats	<input checked="" type="radio"/> Delete <input type="radio"/> Rename to <input type="text"/>
Counter	Hikers	<input checked="" type="radio"/> Delete <input type="radio"/> Rename to <input type="text"/>
Counter	GoatsCounter	Add
Counter	HikersCounter	Add

To specify that this is a Rename vs. a Delete/Add, click the 'Rename to' on both fields and choose the appropriate new names from the drop-down menu as follows:

If you choose 'Open using New template', Timelapse will update these controls and their associated data columns as follows.

Control type	Data label	Update action to be performed	
Counter	Goats	<input type="radio"/> Delete	<input checked="" type="radio"/> Rename to <input type="text" value="GoatsCounter"/>
Counter	Hikers	<input type="radio"/> Delete	<input checked="" type="radio"/> Rename to <input type="text" value="HikersCounter"/>

That's it! If you spot any problems, or if you think of any ways that Timelapse should be improved, contact Saul Greenberg at saul.greenberg@ucalgary.ca .

Part 2. Creating Templates

Part 1 explained how to use the TIMELAPSE tool. That tool assumes that a template already exists and was included in the image set.

Part 2 explains and provides a tutorial on how to use the TIMELAPSETEMPLATEEDITOR. This is the tool that is usually used by the project manager to create a custom template that defines the project-specific data that he or she wants an analyst to encode.

Part 3 will explain the internal structure of the database tables created by TIMELAPSE. This is only of interest if you want to access the data directly rather than from a spreadsheet.

Part 4 is of interest only to those who used the older TIMELAPSE1 system, and who need to migrate their files to work with TIMELAPSE. It explains how to convert old-style CodeTemplate.xml and ImageData.xml files to the new format.

Note. What you see when you run the TIMELAPSETEMPLATEEDITOR may not exactly match the screen images in this manual, due to updates made in the program after the screen images were taken. These are mostly minor visual differences and /or added features that should not affect your general understanding.

Introduction to Templates

The kinds of information and things that you and/or your organization want to track and count will be specific to the kinds of images you want to analyze and the particular data you want to get out of it. This information will differ between organizations, and possibly between image sets and particular project managers. For example, a fisheries manager may want to count anglers on a shore and boats on a lake, while a wildlife manager may want to count large mammals.

The `TIMELAPSETEMPLATEEDITOR` (included with the Timelapse Software) allows you to create a template (a file) specifying the data you want to track. `TIMELAPSE` will use that template to create the fill-in data fields that appear at the top of the `TIMELAPSE` window. As described next, you create these templates by filling in a table, where each row of the table specifies the custom data you want.

You should give considerable thought to the information you want to capture and how it is structured. Essentially, you are creating a standard on how your images should be analyzed and – by extension – how you want your data named and recorded, perhaps added to a database via your spreadsheet, and (eventually) analyzed via statistics. We recommend you talk with others in your organization to see what their needs are, where you (perhaps) give them samples of the codes you want to use (or a sample image set with the code template file) to see if it matches their needs.

The tutorial assumes that you have read and tried out `TIMELAPSE` as described in Part I of this manual.

Important. Once you analyze an image set, you should not add new data fields or delete data fields in the template file used by that image set (i.e., the template stored in the image set folder). This is because the stored data will no longer match the information specified in the code template file. However, you are allowed to modify all but the `DataLabel` field.

1 Creating a Minimal Template

This tutorial will show you how to create the minimum template required by TIMELAPSE. Try it out by using either one of the sample image sets provided with TIMELAPSE, or by creating a folder with your own modest sample of images.

Creating the template

1. Start the TIMELAPSETEMPLATEEDITOR. It initially displays some brief instructional text.
2. Select the *File* | *New* menu item. It will ask you to select a location to save the template file.
3. Save it by its default name (TimelapseTemplate.tdb) in your test image set folder. The TIMELAPSETEMPLATEEDITOR should then display something like this:³

The screenshot shows the 'Timelapse Template Editor' window. It features a table for defining data fields, a preview of the user interface, and a spreadsheet column order section. Callouts provide detailed explanations of these areas.

Type	Default Value	Label	Data Label	Tooltip	Width	Copyable	Visible	List	Add:
File			File	The file name	100	<input type="checkbox"/>	<input checked="" type="checkbox"/>		Count
RelativePath		RelativePath	RelativePath	Path from the folder containing the template and image data files to	100	<input type="checkbox"/>	<input checked="" type="checkbox"/>		Choice
Folder		Folder	Folder	Name of the folder originally containing the template and image data	100	<input type="checkbox"/>	<input checked="" type="checkbox"/>		Note
DateTime	01-01-01T12:00:00.000Z	DateTime	DateTime	Date and time taken (Year-Month-Day Hours:Minutes:Seconds:Millise	160	<input type="checkbox"/>	<input checked="" type="checkbox"/>		Flag
ImageQuality		ImageQuality	ImageQuality	System-determined image quality: Ok, dark if mostly black, corrupted	85	<input type="checkbox"/>	<input checked="" type="checkbox"/>	Define List	
DeleteFlag	false	Delete?	DeleteFlag	Mark a file as one to be deleted. You can then confirm deletion throu	20	<input type="checkbox"/>	<input checked="" type="checkbox"/>		

What the interface will (roughly) look like. Drag and drop these controls (by their labels) to re-arrange their order to your preference

File RelativePath Folder DateTime 01-Jan-1900 12:00:00 ImageQuality Ok Delete?

The spreadsheet column order. Drag and drop columns to re-arrange their order to your preference

File RelativePath Folder Date Time ImageQuality DeleteFlag

Each column defines an attributed of a data field

Each row defines a data field

How data fields will appear within the Timelapse user interface

Controls for adding a particular data field type

How data fields will appear when exported to a spreadsheet

You will see four main areas in this display.

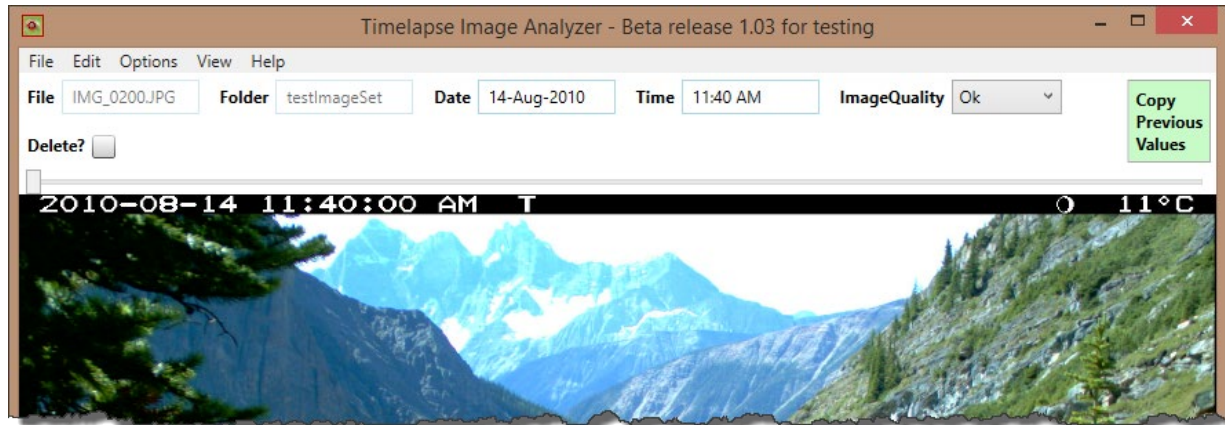
- **Data field specification area** (top). Each row in this area specifies a single data field item and its attributes.
- **Data field appearance within TIMELAPSE** (lower middle) shows how the data will be displayed as fields in the TIMELAPSE user interface. You can drag those fields around to re-arrange their order
- **Data columns in spreadsheet** (lower) roughly shows how the data will be displayed as columns in the spreadsheet generated by TIMELAPSE. You can also drag those columns around to re-arrange their order.
- **Row addition/deletion** (right) are buttons that let you add or remove particular types of rows into the table.

³ There may be differences between the version of the TimelapseTempateEditor portrayed in this manual and the one you are currently using. Even so, the explanation provided should generally apply to all versions.

4. Quit the TimelapseTemplateEditor.

Testing the template within TIMELAPSE

1. Start Timelapse
2. Select *File | Load template, images, and video...* Navigate to the template created above.
3. TIMELAPSE should display something like this if you included any images in that folder.



If you compare the images above, you will see that the fields shown in TIMELAPSE (as well as their contents) directly mirrors each row in the data row area of the TIMELAPSETEMPLATEEDITOR.

2 Explaining the Minimal Template

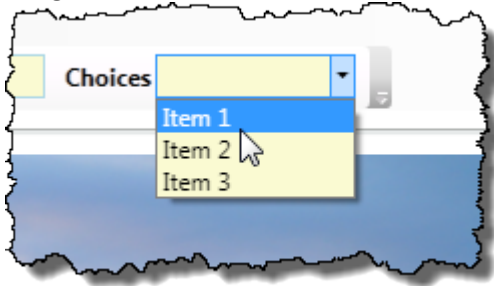
Every `TimelapseTemplate` requires several mandatory data elements, which are automatically added when you create a new `TimelapseTemplate`. `TIMELAPSE` tries to fill in most of these data fields when you first process your images. As seen in the previous figure, these comprise several data *Types*, each present as a row in the data table:

- **File:** the name of the image file
- **Folder:** the name of the root folder containing the template
- **RelativePath:** the path from the root folder to the folder containing the image
- **DateTime:** the date and time the image was taken
- **ImageQuality:** System-determined image quality. One of
 - i. Ok (if the image was ok);
 - ii. Dark (if the image was mostly black, as in poor quality nighttime shots)
- **DeleteFlag:** allows you to 'flag' particular images for later deletion (see `TIMELAPSE` manual)

Each data element has several attributes, presented as columns in the data table, as follows.

- **Type:** the type of data. In addition to the above, types include
 - i. **Counters** for counting specific entities in an image, e.g., number of goats)
 - ii. **FixedChoices aka Choices** for choosing from a set of items presented in a menu
 - iii. **Notes** free-form text
 - iv. **Flags** for boolean true / false values
- **Default Value:** the initial value of that data (which may be left empty) when images are first loaded into `TIMELAPSE`.
- **Label:** how the data field should be labelled in the `TIMELAPSE` user interface
- **DataLabel:** how this field should appear as a column header in the `.csv` spreadsheet file. `DataLabels` must be unique, and its text can only comprise a mix of alphanumeric letters and `'_'`.
- **Tooltip:** defines the text displayed whenever the analyst hovers over a field,. This is handy to remind the analyst as to the meaning of the label.
- **Width:** defines the width of the textbox associated with item. While the units are somewhat arcane, you can see the resulting width in the lower area. Ideally, the width is just wide enough to fit expected values
- **Copyable:** Defines whether that field is affected by the *Copy Previous Values* button in the `TIMELAPSE` tool. When the *Copy Previous Values* button is pressed, only those fields marked as copyable will have its data copied from the previous image to the current image. Copyable field appear in yellow in `TIMELAPSE` when the user hovers over the *Copy Previous Values* button.
- **Visible:** defines whether the field should be displayed in the user interface, and should be set to either true or false. Invisible fields and their default values are still displayed in the spreadsheet. Reasons for having invisible items include:
 - **Reducing clutter** on the `TIMELAPSE` interface by hiding fields not used or not needed by the analyst.
 - **Creating fixed data that should always be present** but that the analyst does not need to see. As an example, each image may be associated with the name of the organization who owns it. To do this, a note could be labelled 'Organization' and its `DefaultValue` set to that organization's name. if it is set to invisible, it won't appear on the interface but it will appear on the spreadsheet.
- **List:** Choice fields have one additional property, called **List**. This contains a series of **Items**. The values of these items define the names of the items in the pull-down menu associated with each Choice. The

image below show how a Choice list is displayed as a pull-down menu when using TIMELAPSE.



Note. The Default Value of a Choice row must be either empty, or must match an item in your Choice list. An warning dialog will appear if they don't match.

- Editable fields are displayed in white, while non-editable fields are in grey.

Note. You cannot delete required data rows (i.e. those whose types are colored grey). However, you can edit some of their properties, as will be shown shortly.

Editable fields are displayed in white, while non-editable fields are in grey.

3 Modifying the Minimal Template

This exercise will show you several basic methods for editing and modifying the template. This exercise uses these methods to modify the minimum template created in Exercise 1.

To begin,

1. Start the TimelapseTemplateEditor.
2. Select the *File / Open* menu item. Select the location where you had previously saved the template file. Alternately, you can just create a new template and over-write the old one.
3. Save it by its default name (TimelapseTemplate.tdb) in your root folder.

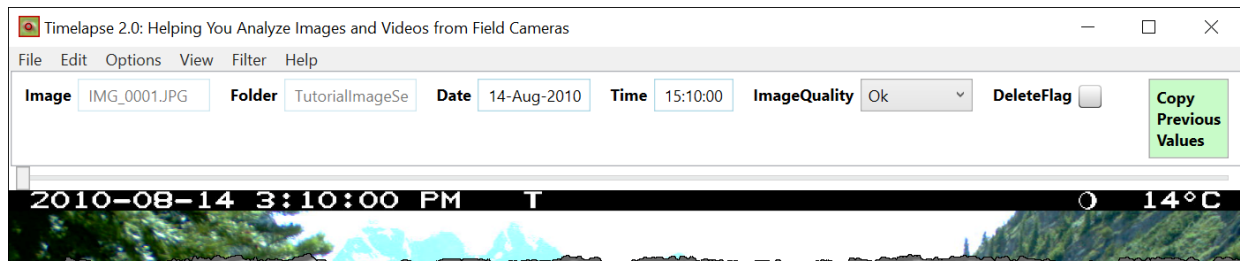
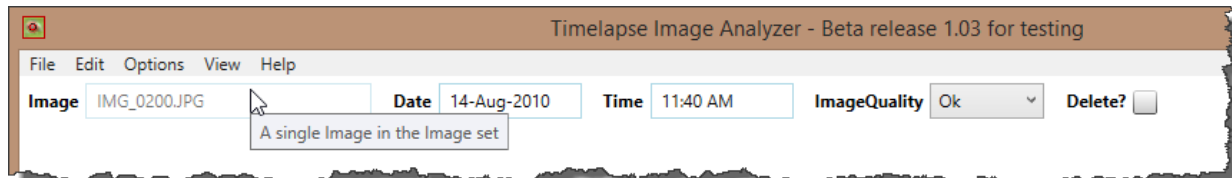
The TIMELAPSETEMPLATEEDITOR should now appear, where it is identical to what you saw t in Exercise 1.

Editing Fields.

We will modify the appearance of the File field, and make the RelativePath field invisible.

1. Modify the text for the File type by changing its Label from 'File' to 'Image', the Tooltip text, and by increasing its Width to 200
2. Also modify the RelativePath Field by deselecting its 'Visible' property.
3. Quit the TIMELAPSETEMPLATEEDITOR, and open TIMELAPSE with the ImageSet to see if the changes worked.

Here is my example below, where we compare it with what is now shown in TIMELAPSE. Note how the image field is now much wider than before.

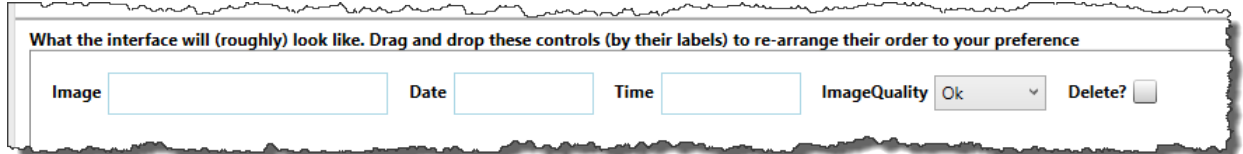


Note. Not all fields are editable. Editable fields are displayed in white, while non-editable fields are in grey.

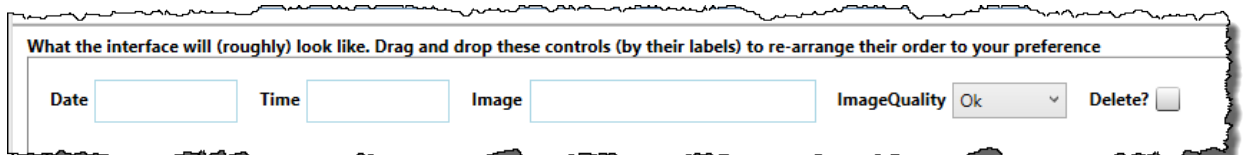
Changing the Order of Fields Displayed in TIMELAPSE.

We will change the sort order so that the Date and Time will appear first.

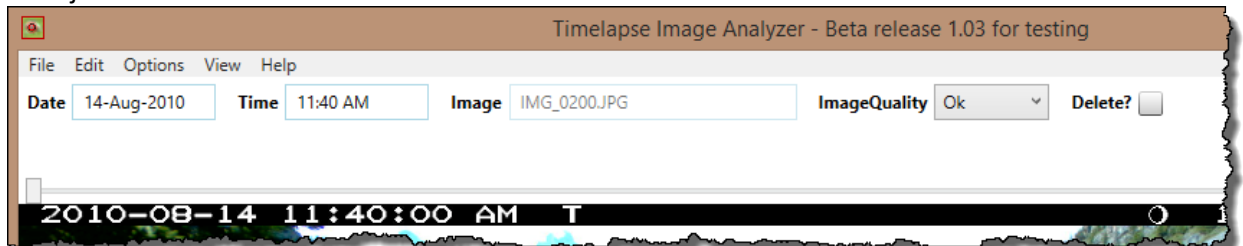
1. Open the TIMELAPSETEMPLATEEDITOR as before, with the same TimelapseTemplate.tdb file.
2. The middle region includes an area that shows how the fields will appear in TIMELAPSE. It should look like:



3. Select the 'Date' label (not its text box), drag it over the 'Image' label, and drop it. The Date field should now be in front of the Image field.
4. Do the same for the 'Time' label. You should now see:



5. Quit the editor and open TIMELAPSE. The order of those fields in TIMELAPSE should reflect what you have just done.

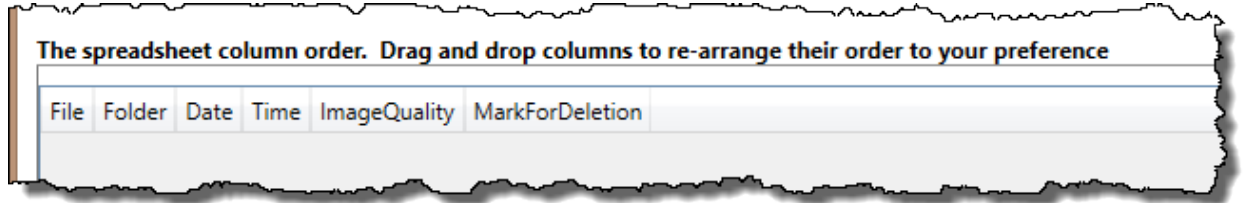


Changing the Column Order Displayed in the Spreadsheet

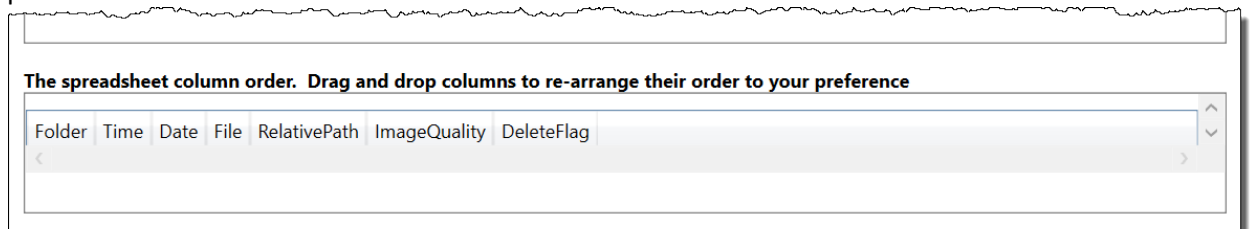
The spreadsheet produced by TIMELAPSE displays the data as columns. We will change the sort order of those columns so that the Folder, Time, Date and File appear in that order.

1. Open the TIMELAPSETEMPLATEEDITOR as before, with the same TimelapseTemplate.tdb file.

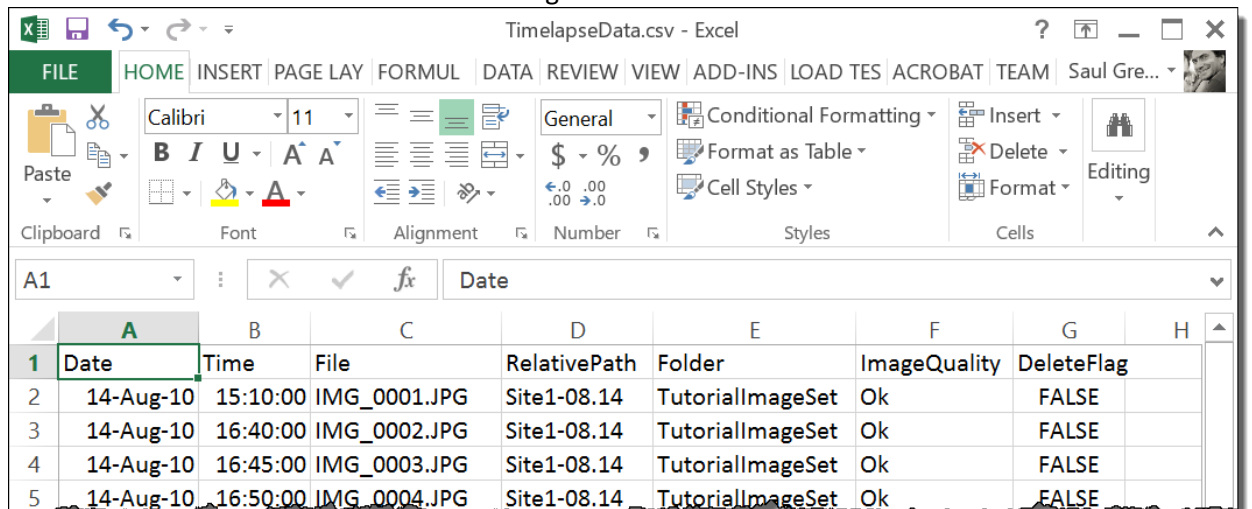
The bottom region includes an area that shows how the columns appear in TIMELAPSE. It should look like:



2. Select the 'Folder' text and drag/drop it to the left side of the 'File' text. The Folder column should now be the first one. Similarly, drag and drop the Time and Date items to their new positions. It should look like:



3. Quit the editor and open TIMELAPSE. Using the File menu, preview the spreadsheet. The columns in Excel should reflect the above new ordering:



	A	B	C	D	E	F	G	H
1	Date	Time	File	RelativePath	Folder	ImageQuality	DeleteFlag	
2	14-Aug-10	15:10:00	IMG_0001.JPG	Site1-08.14	TutorialImageSet	Ok	FALSE	
3	14-Aug-10	16:40:00	IMG_0002.JPG	Site1-08.14	TutorialImageSet	Ok	FALSE	
4	14-Aug-10	16:45:00	IMG_0003.JPG	Site1-08.14	TutorialImageSet	Ok	FALSE	
5	14-Aug-10	16:50:00	IMG_0004.JPG	Site1-08.14	TutorialImageSet	Ok	FALSE	

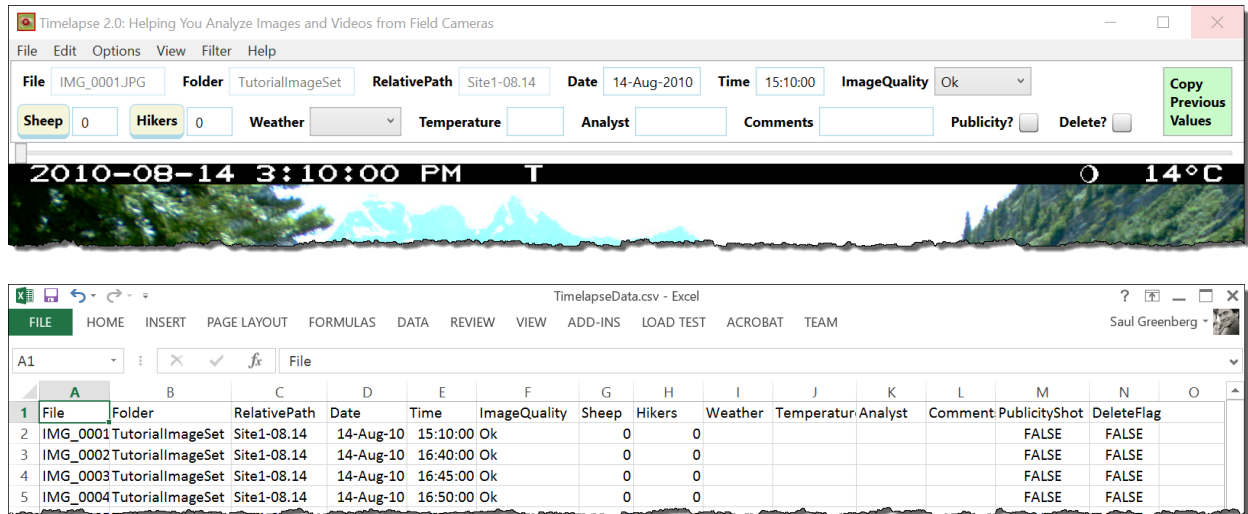
4 Adding New Data Fields as Rows

The power of using templates is that you can add data rows (i.e., new data fields) that are unique to your own projects. As explained earlier, these can be one of four types: count, note, choice, or a flag. This tutorial will show you how to create and modify those four types.

For this exercise, assume you are a biologist described in Part I of this tutorial, who wants to create a template that includes the following custom data fields. The type is most appropriate for that field is shown at the right.

- **Goats:** a count of how many goats appear in an image -> **Counter**
- **Hikers:** a count of how many hikers appear in an image -> **Counter**
- **Weather:** sunny, cloudy, foggy, raining or snowing -> **FixedChoice**
- **Temperature:** the temperature in Celsius, to be extracted from image metadata -> **Note**
- **Analyst:** name of the analyst analyzing the image -> **Note**
- **Comments:** optional comments about the image -> **Note**
- **Publicity?:** whether the image is useful for publicity purposes -> **Flag**

At the end, the biologist want the interface in Timelapse and the spreadsheet to look something like the following.



Adding Data Fields as Rows

We begin afresh. Delete the old TimelapseTemplate.tdb file from your image set. Then start the TIMELAPSETEMPLATEEDITOR, and create a new template (as in Exercise 1). This will create a template with all its default fields present.

We need to create 2 Counters (Goats, Hikers), 1 Choice (Weather), 3 Notes (Temperature, Analyst and Comments), and 1 flag (Publicity?).

1. Click on *Count* twice (right side of display) to add a row. Each row defines a data field of the type Counter.
2. Similarly, click the *Choice* button to add a row defining 1 Choice field, the *Note* button to add 3 Note fields, and the *Flag* button to add a Flag field.

The display should be similar to what is shown below. The image annotates, by using red boxes, the way these new fields now appear in the various parts of the interface.

The screenshot shows the 'Timelapse Template Editor' window. At the top, there's a menu bar (File, View, Help) and a toolbar (Brief Instructions, Template). Below that is a table with columns: Type, Default Value, Label, Data Label, Tooltip, Width, Copyable, Visible, and List. The table lists various data fields like File, RelativePath, Folder, DateTime, ImageQuality, DeleteFlag, Counter, FixedChoice, Note, and Flag. Red boxes highlight the 'Counter' and 'Flag' rows in the table. To the right of the table are buttons for 'Add: Count', 'Choice', 'Note', 'Flag', and 'Remove'. Below the table is a section titled 'What the interface will (roughly) look like. Drag and drop these controls (by their labels) to re-arrange their order to your preference'. This section shows a row of UI controls: File, RelativePath, Folder, DateTime (with a date picker), ImageQuality (with a dropdown), Delete? (checkbox), Counter0 (with a value of 0), Counter1 (checkbox), Choice0 (dropdown), Note0 (text input), Note1 (text input), Note2 (text input), and Flag0 (checkbox). Red boxes highlight the Counter0 and Counter1 controls. Below this is another section titled 'The spreadsheet column order. Drag and drop columns to re-arrange their order to your preference'. This section shows a row of column headers: File, RelativePath, Folder, Date, Time, ImageQuality, DeleteFlag, Counter0, Counter1, Choice0, Note0, Note1, Note2, and Flag0. Red boxes highlight the Counter0 and Counter1 columns.

Type	Default Value	Label	Data Label	Tooltip	Width	Copyable	Visible	List
File		File	File	The file name	100	<input type="checkbox"/>	<input checked="" type="checkbox"/>	
RelativePath		RelativePath	RelativePath	Path from the folder containing the template and image data files to the file	100	<input type="checkbox"/>	<input checked="" type="checkbox"/>	
Folder		Folder	Folder	Name of the folder originally containing the template and image data files	100	<input type="checkbox"/>	<input checked="" type="checkbox"/>	
DateTime	1900-01-01T12:00:00.000Z	DateTime	DateTime	Date and time taken (Year-Month-Day Hours:Minutes:Seconds:Milliseconds)	160	<input type="checkbox"/>	<input checked="" type="checkbox"/>	
ImageQuality		ImageQuality	ImageQuality	System-determined image quality: Ok, dark if mostly black, corrupted if it can not b	85	<input type="checkbox"/>	<input checked="" type="checkbox"/>	Define List
DeleteFlag	false	Delete?	DeleteFlag	Mark a file as one to be deleted. You can then confirm deletion through the Edit M	20	<input type="checkbox"/>	<input checked="" type="checkbox"/>	
Counter		Counter0	Counter0	Click the counter button, then click on the image to count the entity. Or just type ir	30	<input type="checkbox"/>	<input checked="" type="checkbox"/>	
Counter		Counter1	Counter1	Click the counter button, then click on the image to count the entity. Or just type ir	30	<input type="checkbox"/>	<input checked="" type="checkbox"/>	
FixedChoice		Choice0	Choice0	Choose an item from the menu	100	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	Define List
Note		Note0	Note0	Write a textual note	100	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	
Note		Note1	Note1	Write a textual note	100	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	
Note		Note2	Note2	Write a textual note	100	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	
Flag	false	Flag0	Flag0	Toggle between true and false	20	<input type="checkbox"/>	<input checked="" type="checkbox"/>	

What the interface will (roughly) look like. Drag and drop these controls (by their labels) to re-arrange their order to your preference

File RelativePath Folder DateTime 01-Jan-1900 12:00:00 ImageQuality Ok Delete? Counter0 0

Counter1 Choice0 Note0 Note1 Note2 Flag0

The spreadsheet column order. Drag and drop columns to re-arrange their order to your preference

File RelativePath Folder Date Time ImageQuality DeleteFlag Counter0 Counter1 Choice0 Note0 Note1 Note2 Flag0

Editing Rows

Using the editing methods in the previous exercise, change the text in the various rows to make them more meaningful. An example is illustrated below. Note that the lower areas will change to reflect what is in the Data Table.

The screenshot shows the 'Timelapse Template Editor' window. It contains a table with the following columns: Type, Default Value, Label, Data Label, Tooltip, Width, Copyable, Visible, and List. Below the table are two interactive sections: 'What the interface will (roughly) look like' and 'The spreadsheet column order'.

Type	Default Value	Label	Data Label	Tooltip	Width	Copyable	Visible	List
File		File	File	The file name	100	<input type="checkbox"/>	<input checked="" type="checkbox"/>	
RelativePath		RelativePath	RelativePath	Path from the folder containing the template and image data files to the file	100	<input type="checkbox"/>	<input checked="" type="checkbox"/>	
Folder		Folder	Folder	Name of the folder originally containing the template and image data files	100	<input type="checkbox"/>	<input checked="" type="checkbox"/>	
DateTime	1900-01-01T12:00:00.000Z	DateTime	DateTime	Date and time taken (Year-Month-Day Hours:Minutes:Seconds:Milliseconds)	160	<input type="checkbox"/>	<input checked="" type="checkbox"/>	
ImageQuality		ImageQuality	ImageQuality	System-determined image quality: Ok, dark if mostly black, corrupted if it can't	85	<input type="checkbox"/>	<input checked="" type="checkbox"/>	Define List
DeleteFlag	false	Delete?	DeleteFlag	Mark a file as one to be deleted. You can then confirm deletion through the Editor	20	<input type="checkbox"/>	<input checked="" type="checkbox"/>	
Counter		0 Goats	Goats	A count of how many goats appear in this image	30	<input type="checkbox"/>	<input checked="" type="checkbox"/>	
Counter		0 Hikers	Hikers	A count of how many hikers appear in this image	30	<input type="checkbox"/>	<input checked="" type="checkbox"/>	
FixedChoice		Weather	Weather	From sunny, to raining, to snowing	100	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	Define List
Note		Temperature	Temperature	Temperature in Celsius	100	<input type="checkbox"/>	<input checked="" type="checkbox"/>	
Note		Analyst	Analyst	The analyst coding these images	100	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	
Note		Comments	Comments	From sunny, to raining, to snowing	100	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	
Flag	false	Publicity?	PublicityShot	Flags an image as useful for publicity purposes	20	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	

What the interface will (roughly) look like. Drag and drop these controls (by their labels) to re-arrange their order to your preference

File RelativePath Folder DateTime ImageQuality Delete? Goats Hikers Weather Temperature Analyst Comments Publicity?

The spreadsheet column order. Drag and drop columns to re-arrange their order to your preference

File RelativePath Folder Date Time ImageQuality DeleteFlag Goats Hikers Weather Temperature Analyst Comments PublicityShot

If you make a mistake, you can select a row and delete it using the 'Remove' button. Try it by adding a row and then deleting it.

Note that these modifications are important for creating a comprehensive system representing the data you are interested in, as described below.

- Specify an understandable Label and tooltip that will be presented in the interface
- Specify a (possibly different) Data Label used to label a column in the spreadsheet.
- Adjust the Width of some of the fields (e.g., wider for comments, smaller for counts as we don't expect large numbers)
- Counters are usually not Copyable (as we expect counts to change between images)
- Change the Temperature counter to not Copyable (as we expect those values to be read in from image metadata)
- Provide a different Data Label ('PublicityShot') vs Label ('Publicity?'). The label that will be displayed in the TIMELAPSE interface, while the Data Label will be displayed as the column header in the spreadsheet.
- Provide default values if needed.

Very Important Notes on Data Labels.

- The Data Label identifies your field within TIMELAPSE, as well as in the final spreadsheet.
- Data Labels must have unique names, and can only contain alphanumeric and the '_' character. No white space is allowed. TIMELAPSE will warn you if you enter non-unique names and/or problematic characters.

Adding Items to a Choice's List

1. Add the three list items to the Weather row. To do this, click the 'Define List' button in the List Column. A popup window will appear allowing you to create and edit the items, with one item per line. Type in "Sunny", "Raining" and "Snowing", each on a separate line. You can edit these entries at any time, e.g., to add, modify or delete items, and to change their order.
 - If you want your analyst to be able to clear any fields, click the *Include an 'empty' item* checkbox at its bottom.
 - You can also specify a default setting in the *Default Value* column, as long as its identical to one of your entries on the choice menu.

The screenshot shows the 'Timelapse Template Editor' window. A table lists various fields with columns for Type, Default Value, Label, Data Label, Tooltip, Width, Copyable, Visible, and List. The 'Weather' row is selected, and a 'Define List' button is visible. A dialog box titled 'Define choice menu, with 1 item per line' is open, showing a list of items: Sunny, Cloudy, Foggy, Raining, and Snowing. A red arrow points from the 'Define List' button to the dialog box. Below the table, there are sections for 'What the interface will (roughly) look like' and 'The spreadsheet column order'.

Type	Default Value	Label	Data Label	Tooltip	Width	Copyable	Visible	List
File		File	File	The file name	100	<input type="checkbox"/>	<input checked="" type="checkbox"/>	
RelativePath		RelativePath	RelativePath	Path from the folder containing the template and image data files to the file	100	<input type="checkbox"/>	<input checked="" type="checkbox"/>	
Folder		Folder	Folder	Name of the folder originally containing the template and image data files	100	<input type="checkbox"/>	<input checked="" type="checkbox"/>	
DateTime	1900-01-01T12:00:00.000Z	DateTime	DateTime	Date and time taken (Year-Month-Day Hours:Minutes:Seconds:Milliseconds)	160	<input type="checkbox"/>	<input checked="" type="checkbox"/>	
ImageQuality		ImageQuality	ImageQuality	System-determined image quality: Ok, dark if mostly black, corrupted if it can n	85	<input type="checkbox"/>	<input checked="" type="checkbox"/>	
DeleteFlag	false	Delete?	DeleteFlag	Mark a file as one to be deleted. You can then confirm deletion through the Edi	20	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/> Include an 'empty' item
Counter	0	Goats	Goats	A count of how many goats appear in this image	30	<input type="checkbox"/>	<input checked="" type="checkbox"/>	
Counter	0	Hikers	Hikers	A count of how many hikers appear in this image	30	<input type="checkbox"/>	<input checked="" type="checkbox"/>	
FixedChoice		Weather	Weather	From sunny, to raining, to snowing	100	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	Define List
Note		Temperature	Temperature	Temperature in Celsius	100	<input type="checkbox"/>	<input checked="" type="checkbox"/>	
Note		Analyst	Analyst	The analyst coding these images	100	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	
Note		Comments	Comments	From sunny, to raining, to snowing	100	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	
Flag	false	Publicity?	PublicityShot	Flags an image as useful for publicity purposes	20	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	

2. Quit the editor and start TIMELAPSE. The interface should reflect what you specified, as illustrated below. The Weather pull-down menu is raised to illustrate its contents.

The screenshot shows the 'TIMELAPSE' application interface. The 'Weather' pull-down menu is open, displaying the following options: Sunny, Cloudy, Foggy, Raining, and Snowing. The interface includes fields for File, RelativePath, Folder, DateTime, ImageQuality, Delete?, Goats, Hikers, Temperature, Analyst, Comments, and Publicity?. A 'Copy Previous Values' button is also visible.

If you do all the above, then you should have reproduced the .tdb template that was included in the TutorialImageSet. You should have no problems creating your own custom Code Template file.

Other things to try

1. Try reordering a few of the fields to change how they appear in the interface and in the spreadsheet.
2. Try changing the visibility of the fields.
3. Add default values to various fields (e.g., set the Comment default text to 'No comment'. Note that defaults are applied only when you first load images via TIMELAPSE.
4. Inspect the metadata available on the images you expect to use. Note that metadata is camera-specific, so you should inspect metadata for each camera model you have. To do this, choose *View | Inspect Image Metadata* and then click the *Inspect Image* button to navigate to a typical image. You will see something like the image below.
5. If you see metadata that you may want your analysts to include, create a Note field that will eventually hold that data. For example, the AmbientTemperature metadata includes the temperature in Celsius for each image taken with this particular camera model. In our example above, the project manager has done so by creating a field called Temperature.

Note. The 'Choose a metadata inspection tool' portion of the dialog box allows you to select between two different tools to inspect the metadata. Timelapse currently uses the MetadataExtractor as its default tool, as it is very fast. However, MetadataExtractor is somewhat limited in interpreting makernotes for certain cameras. To get around this, you can also choose Phil Harvey's ExifTool, which is usually more capable of interpreting makernotes, to see if it lists the metadata you want. However, it is considerably slower, which introduces delays if you have tens or hundreds of thousands of images to process.

What: Cameras typically embed metadata into image files, some of which may be useful to capture as data. You can inspect an image or video of your choice to see what metadata is typically recorded. You can then create a Note field that will hold that metadata, where you can ask Timelapse populate it with a file's metadata value.

Solution:

1. Click 'Open File' below to navigate to a typical image you will be analyzing.
2. Inspect the metadata to see if there are any fields of interest to you.
3. If so, create a meaningfully-labelled Note for each metadata field you want.
4. Later, use Timelapse to populate that field across your image set by selecting 'Populate a field with metadata...' from the Timelapse 'Edit' menu

Hint: As metadata can be camera-specific, inspect files produced by each camera model you have to see what metadata is available.

Choose a metadata inspection tool: MetadataExtractor (faster) ExifTool (slower, more comprehensive)

Open File **File currently open:** IMG0001.JPG **Metadata name:** Ambient Temperature

Metadata kind	Metadata name	Example value from current file
	Ambient Temperature	14 C
	Ambient Temperature Fahrenheit	58 F
	Battery Voltage	9.12 V
	Bits Per Sample	8
	Brightness	223
	Color Components	3
	Color Space	sRGB
	Component Configuration	Y, Cb, Cr

Okay

Changing the Template after the Fact

See Part 1: Dialog Boxes Arising from Changed Templates

TIMELAPSE uses the **.tdb** template file not only to create the interface, but to structure how it stores its data in an image set's **.ddb** data file. In particular, it uses the Data Label to match the field described in the template **.tdb** to the data stored in the **.ddb data file**. This has implications and limits to how edits to the template are currently managed after a **.ddb** was created.

Consider the case where:

- an analyst has an image set with a TimelapseTemplate.tdb in it and has begun analyzing those images.
- The analyst (or perhaps someone else) then decides to change the template.
- The analyst tries to reopen the image set for further analysis using the modified template

What happens next depends upon the changes that were made in the template.

Changing how controls appear in Timelapse and their order in the spreadsheet

Some changes only alters how controls appear in the Timelapse interface and/or the order that your data is shown in the spreadsheet. They do not affect how your existing and future data is stored and used. Consequently, these changes will be applied automatically when you reload an image set with a template modified as follows.

- edit and alter any field in any row **EXCEPT** the Data Label.
- change a field's Copyable status and Visibility status.
- change the position of those fields in the interface
- change the position of those fields the spreadsheet
- add items to the Choice menu

Adding, Deleting and Renaming controls

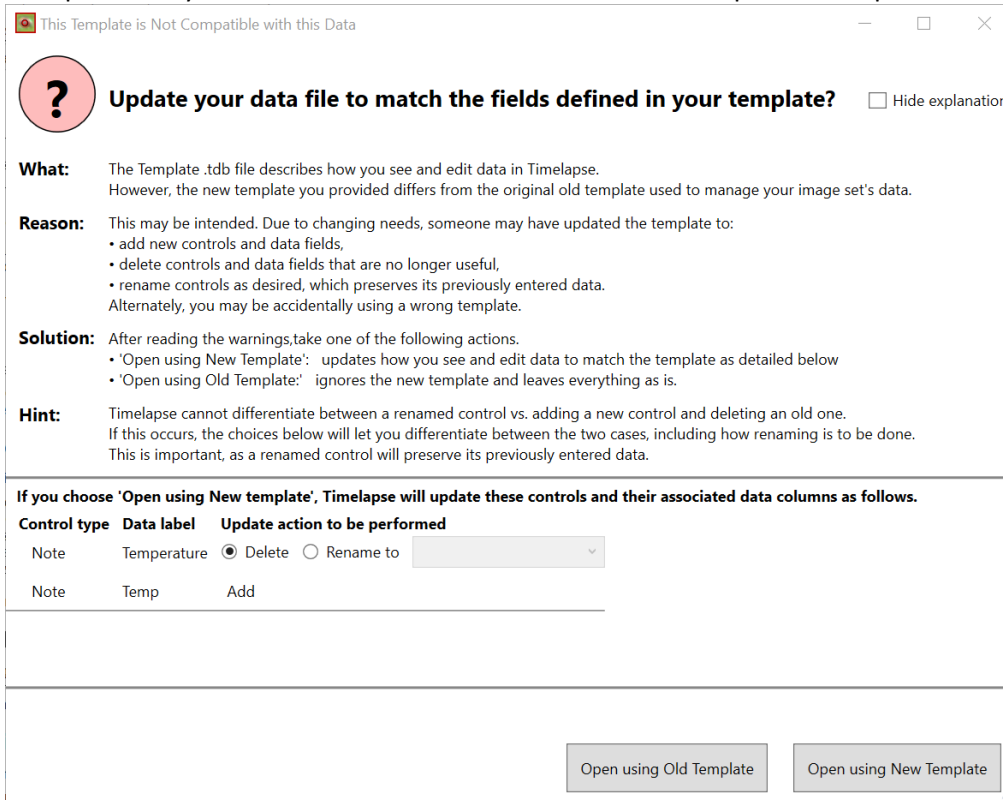
Adding, deleting and renaming controls has implications to the data already stored in a previously created image set. Consequently, Timelapse will check your template against the data, and will notify you (via a dialog box) of the implications that will have on your stored data. At that point, you will be able to open your data using either the new template you provided, or with the template originally used to create your data (which is stored internally by Timelapse).

- *Adding a control:* Adding a row in the template editor defines a new control that will appear in the Timelapse interface, and a new data column in the database and spreadsheet (labeled with the control's Data label).
- *Deleting a control:* Removing a row in the template editor means it will no longer appear in the Timelapse interface. Perhaps more importantly, any previously entered data associated with that control will be deleted as well from the database, and will not appear in the spreadsheet.

Note. If you want to keep the data, then just uncheck the control's visibility field instead of deleting it.

- *Renaming a control:* Changing a row's data label in the template editor has two possibilities, where it can be viewed as:

- deleting that row, and then Adding a new row, which deletes the data associated with the original data label
 - renaming that row, which retains and associates the data with the new data label.
- As Timelapse cannot tell which possibility has occurred, it will raise a dialog box asking you to decide which action to take.
- For example, if you changed the Data label of 'Temperature' to 'Temp', Timelapse will warn you and ask you what it should do. If you wanted to keep the data previously associated with 'Temperature' you would click on *Rename to* and select 'Temp' from the pull-down menu.



Deleting and Renaming Choice Menu Items

Choice fields can only display non-empty text that matches at least one of its menu items. If you use the template to delete or change a Choice menu item's text, Timelapse will detect this and will warn you. While Timelapse cannot display that text if it differs, it still stores the original text.

You try. Alter the template after you've created a .ddb file and then opening up TIMELAPSE again with that image set. You'll see what changes work and where TIMELAPSE gives you an error message.

5 UTC Offsets and Time Zones

See §Understanding UTC Dates and Time Zones in the Timelapse section of this manual.

6 Appendix – Technical details

Internally, the template `.tdb` file is maintained as an SQLite database, where the information you provide is saved as a database table called `TemplateTable`. However, you don't have to know anything about SQL or databases to create these files. The `TIMELAPSETEMPLATEEDITOR` takes care of all the grotty technical details.

To see what the database stores, select `View | Show All Columns`. The window will now display several other non-editable extra columns that are stored in the database table that are not normally made visible.

Making these columns visible is useful for technical debugging purposes, but little else. These extra columns are:

- **ID:** The internal database ID of each row
- **Control order:** represents the sort order for displaying controls (which is used to construct the sample interface in the middle window)
- **Spreadsheet order:** represents the sort order for the spreadsheet columns (which is used to construct the sample interface in the middle window)

Part 3. Automatic Image Recognition

Part 3 explains how image recognition information can be imported from a 3rd party, and how it can be incorporated into the workflow.

Background

Note: There are many subtleties in image recognition and how you can use it in your workflow. While you can experiment (and we do encourage that), you will get better results if you have some understanding of how image recognition works, its possible failures, how Timelapse shows you image recognition results, and possible ways you can incorporate recognition data into an effective workflow.

What we are really saying is that you should read this section, perhaps a few times. As well, you should probably read the article (oriented towards ecologists) available at the following link titled [Automated Image Recognition for Wildlife Camera Traps: Making it Work for You](#)

The two types of image recognition: Detection vs. Classification

A ‘holy grail’ of camera trap analysis is automated image recognition, where a computer automatically inspects your images and identifies what is occurring within them. We will refer to two types of image recognition:

- A *detector* detects whether something is in an image or not, assigns a coarse identifying label to it (e.g., empty, animal, person, vehicle) as well as a confidence value that very roughly indicates the likelihood that the detection is correct. We will refer to the thing the detector found in an image as a **detection**.
- A *classifier* performs a fine-grained classification of what the detector detected as a, chosen from a set of known categories. A classifier will typically produce a list of possible classifications for each detection, where each possibility is assigned a confidence value. For example, for wildlife image classification these categories will typically be different species of wildlife (e.g., elk, wolf, bear, dog). We will refer to the entities the classifier identifies as a **classification**.

Image recognition is not full proof

Image recognition is not a magic bullet. While it works reasonably well at high confidence levels, several types of errors are possible. We will use the following terminology to refer to error types.

- **False positives:** it identifies an entity as being detected in an image when nothing is there.
- **False negatives:** it does not detect an entity present in the image.
- **Incorrect identifications:** it detects an entity, but incorrectly labels it (e.g. an animal instead of a person for a detection, or a particular species for a classification).
- **Ambiguity:** it detects several overlapping – and possibly conflicting – detections.

Image recognition is done by a 3rd party (currently Microsoft’s AI for Earth)

Timelapse does not do image recognition by itself. Rather, you will submit your images to a 3rd party that does the actual image recognition processing, which generates a file describing detections and classifications for each image submitted. It is this file that Timelapse will use, as described shortly.

In particular, we are currently working with Microsoft’s *AI for Earth* program (<https://www.microsoft.com/en-us/ai/ai-for-earth>). They are actively supporting camera trap image processing along with species classification (<https://www.microsoft.com/en-us/ai/ai-for-earth-tech-resources>). Microsoft has developed a really good detector for camera trap images. A classifier is also included, where they are continually trying to improve its results.

Microsoft is also actively working with Timelapse (i.e., with me), where they currently use and recommend Timelapse as the preferred ‘front-end’ for analysts using their recognition data.

If you want to see how well recognition works on your images, contact Microsoft at the email indicated in the note: they will give you instructions. Essentially, you will submit your camera trap images to Microsoft, either through the cloud or by sending a hard drive. Microsoft analyzes those images and produces a data file containing the image recognition data. Microsoft is not charging for this service. Finally, Microsoft says that it is possible, albeit more difficult, to download and use their recognition software on your own computer.

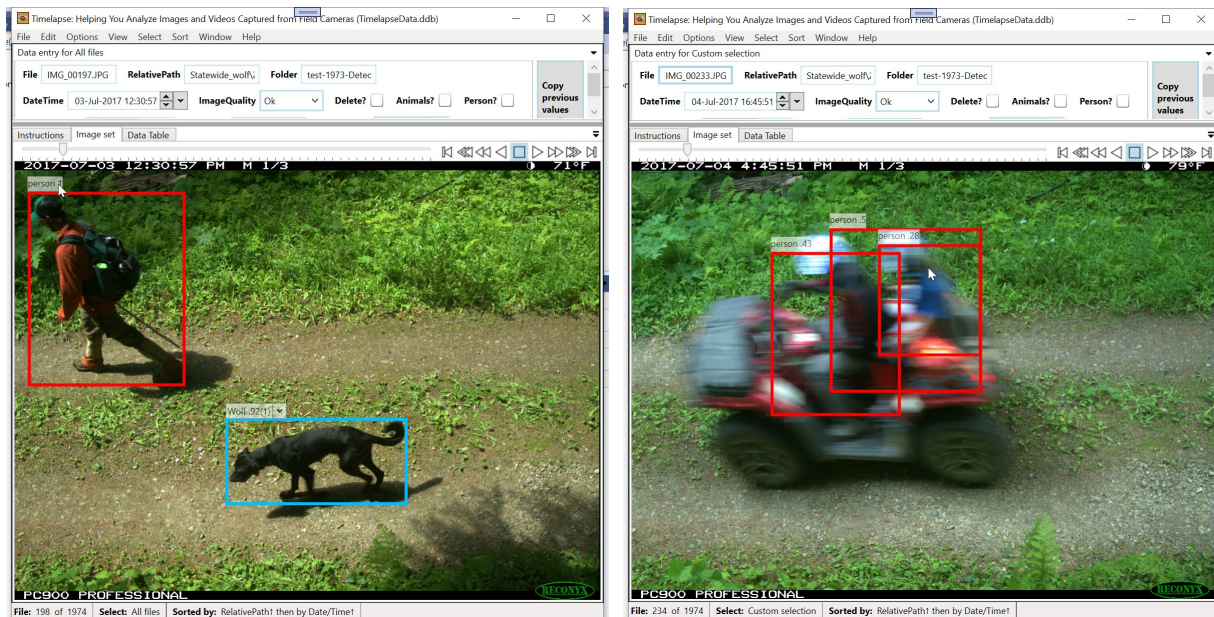
Note. We do expect other companies and agencies will develop their own image classification systems and will produce similar files in the future. For now, you are limited to the Microsoft image recognition system. Contact cameratrap@microsoft.com if you're interested in experimenting with this system. If you are a "DIY type" – visit their GitHub page to try these models directly – but we do suggest talking to the Microsoft folks first as its non-trivial.

Timelapse and the image recognition file

After you have submitted your images, Microsoft will send you an image recognition data file, which you can import it into Timelapse. You can then view and operate on the recognition information to streamline your workflow. Timelapse also lets you use that recognition information in *selecting* subsets of images e.g., all empty images, all images with people in it, all zebras.

Timelapse displays recognized entities as labelled bounding boxes

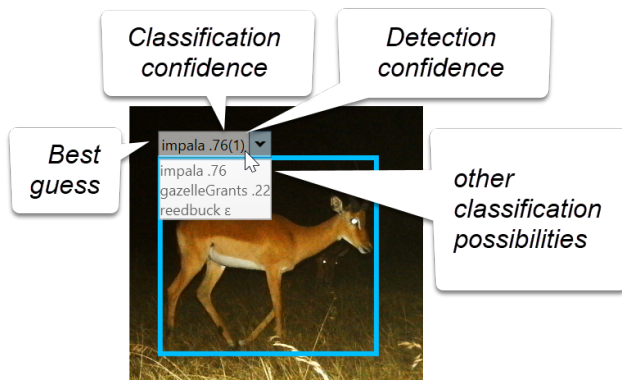
Timelapse uses the data in that file to display each recognized entity as a colored bounding box drawn atop each image. The color depends upon the detection category (e.g., blue for animal, red for person). The left image below, for example, shows two correct high confidence recognitions, one containing a detected person, the other a detected animal. However, it also labels the animal classification as a wolf: while close, it is incorrect. The right image correctly detects several people. However, it is messier as it shows various possibilities of what it thinks is a person.



Each bounding box includes a label showing its best recognition guess, their confidences, and alternate classification possibilities of lesser confidences (if any). The example bounding box below illustrates the following:

- **Impala .76 (1):** its best classification guess is that the recognized entity is as an *Impala*, where its classification confidence is .76.
- Implicitly, that label also indicates that the detected entity would have been an *Animal*, as impalas are animals. The (1) indicates that the detection confidence of Animal is 1.
- The pull-down menu provides other classification possibilities, summing to 1, where:
 - *Impala* .76 is the highest probability classification at .76,
 - *GazelleGrants* .22 is a much lesser probability classification (.22)
 - *Reedback* ϵ is also possible, but at an extremely low probability (indicated by the ϵ).

If no classifications are available, then the label shows the recognized detection category (e.g., *Person*).



You can use recognitions to select a subset of images

As described shortly, you can use the Custom Select Dialog to select and view only those images matching particular detection or classification information categories within a range of confidence values. For example, you can easily select only those images with a detected animal at a high confidence value.

Why use automatic image recognition?

As mentioned earlier, recognition errors are a fact of life: false positives, false negatives, incorrect identifications, ambiguity, and so on. Thus, you can't blindly accept all detection results. Instead, you should consider recognition predictions as information that can augment your workflow and make you more efficient.

In particular, you will be able to ease your image analysis task mostly by eliminating images that do not require further analysis, where it will help you focus on specific images of interest. For example, using the current detection information you can do the following efficiently.

- **Eliminate images that are likely empty from any further analysis**, such as images with no detected people or animals in them or images with only very low confidence. This is especially valuable in cases where your camera generates a large number of empty images, e.g., because

you have your camera on a timelapse mode, or because wind effects frequently trigger your camera in motion-detection mode.

- **Identify images containing people.** This is especially important if your agency has a privacy policy that requires those images to be handled somewhat differently from other images, or when you have a different set of analysis criteria for people vs. animals.
- **Identify images containing animals,** where you will inspect those in detail, for example, to classify or count what animals are present.

Similarly, you can use the classification categories to eliminate images (e.g., to remove species of little interest), or to quickly focus on those images containing a particular classified species.

Getting recognition data for your images

You will have to ask Microsoft to partner with you, where they are currently working with agencies who are collecting large amounts of camera trap data for wildlife studies. If your agency is already using Timelapse, that is considered a bonus to them as it minimizes training. Contact cameratrap@microsoft.com – they will engage you in a discussion to ensure that their recognition system is appropriate for what you are trying to do.

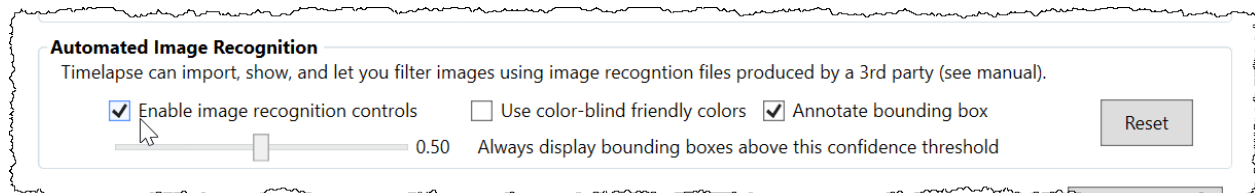
If you are technically savvy, Microsoft makes their recognition models and software publicly available. Visit <https://github.com/Microsoft/CameraTraps> to download models and code samples. However, this is currently not recommended except for those who are very computer savvy, as it will likely require considerable technical work on your part.

Whether you work with Microsoft directly or run their models yourself, the image recognition results will be generated by the Microsoft system as one or more '.json' files.

The remainder of this section will assume that you have a .json file that matches your images.

Turning recognition capabilities on

By default, the user interface allowing you to interact with recognition data is turned off, so it does not add clutter to those who aren't using recognition capabilities. To turn on recognition capabilities, select Option | Preferences and check the checkbox for '*Enable menu items and selections for working with image recognition data*'. Click the '*Annotate bounding box*' checkbox to either include or exclude the recognition labels atop the bounding box.



Importing recognition files

As explained above, once your images are processed (by you or by Microsoft), you will end up with one or more .json files containing recognition data. These files – which can be large – contain recognition information describing every image. This includes the relative path of the image.

Timelapse will look for that image by its relative path. Thus it is important that your image files are placed in folders that correspond to the original folders given to Microsoft, as otherwise Timelapse may be unable to match the detection data with your images.

To make sure recognition data is associated correctly with your images:

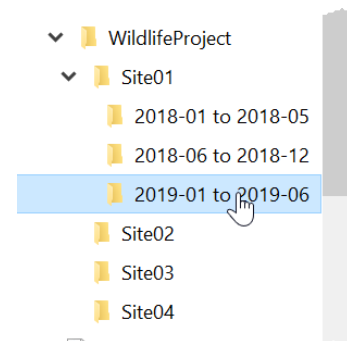
- Place the .json file into the same folder as your .tdb file.
- Make sure recognition controls are turned on (see above).
- Import the .json file by selecting *File | Import image recognition data for this image set*.

Note. Large projects may have many different cameras located at different sites, where camera images may be retrieved periodically. These would then be stored hierarchically in folders and sub-folders. The example illustrated on the right organizes all images within a root folder called 'WildlifeProject', which in turn contains sub-folders identifying camera sites (e.g., Site01). Each site then contains sub-folders identifying particular date ranges from a camera card retrieved from the camera.

Most Timelapse users prefer to process images on a sub-folder level. For example, they may do it on a sub-folder containing images retrieved from a camera card for a certain date interval, where the .tdb file would be placed in that folder.

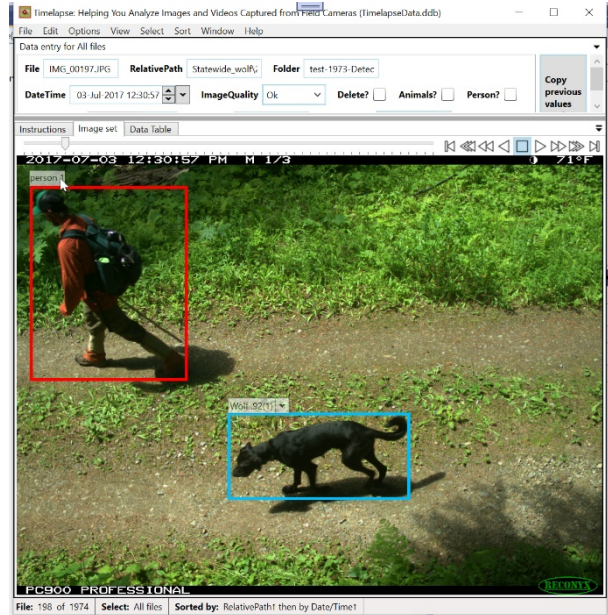
When you give Microsoft the WildlifeProject folder, by default they will create one .json file describing all images in the WildlifeProject. If you copy that into the sub-folder containing your .tdb file, Timelapse will not be able to find the image, as the paths won't match. To avoid this problem, tell Microsoft how you want .json files to be split up, i.e., one json file corresponding to each folder that will eventually contain the Timelapse .tdb file.

Microsoft will soon be releasing software to allow you to split up the file yourself.



Viewing bounding boxes and confidence levels

As previously mentioned, the recognizer associates a 'bounding box' with each recognition, i.e. the region of the image that it thinks may contain an object. It also includes the type of entity detected (e.g., a person or animal, or a particular classification). Each bounding box also includes confidence values that roughly indicates that the certainty that this box really contains a detected entity, and the probability of its classification. Timelapse draws each bounding box atop the image.



Note: Bounding boxes can be temporarily hidden by pressing and holding the 'H' key while your cursor is over the image. This is helpful if you need to inspect a portion of the image directly under the bounding box border.

Detection confidence is best seen as a very rough indicator of how likely it is that a detection (including its identification) is correct. As the reliability of particular confidence values can vary greatly from dataset to dataset, the best way to judge a reasonable confidence level is by reviewing your images. A rough rule of thumb for confidence values is:

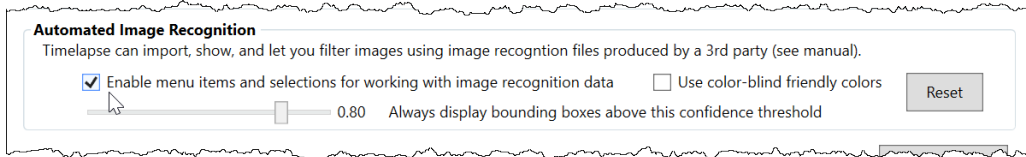
- 0.9 – 1: should be mostly correct with perhaps a few mis-detections.
- 0.8 – 0.9: usually correct, although the possibility of mis-detections is somewhat higher.
- 0.6 - 0.8: detections are more suspect, where you may begin to see many false positives.
- < 0.6: a large mix of detections and mis-detections. The lower the value, the more likely the detection is wrong (i.e., 'noise').

Classification probability, if a recognition is offered, is also a very rough indicator of confidence, i.e., how likely it is that the entity was correctly recognized. In these cases, the classifier produces 1 or more predictions, and assigns each classification with a relative probability of being correct, all summing to 1. As with detections, take the actual number with a grain of salt. Again, the best way to judge a reasonable classification level is by reviewing your images.

Because of the above, you will almost always opt to view bounding boxes above some confidence level. For example, it is rarely helpful to look at bounding boxes where the recognizer has only 10% confidence in its correctness. If you do include low confidence recognition, it will add clutter to the display and unnecessarily attract your attention. Instead, you can direct Timelapse to show only bounding boxes that are above some threshold.

To set the confidence level for viewing bounding boxes, select the *Options/Preferences* menu and look at the detection settings (illustrated below) in the dialog. The slider at the bottom lets you set the threshold for displaying bounding boxes. For example, if you set it to .8, only detections with a confidence of .8 or higher will be displayed. Experiment with what setting is appropriate by reviewing

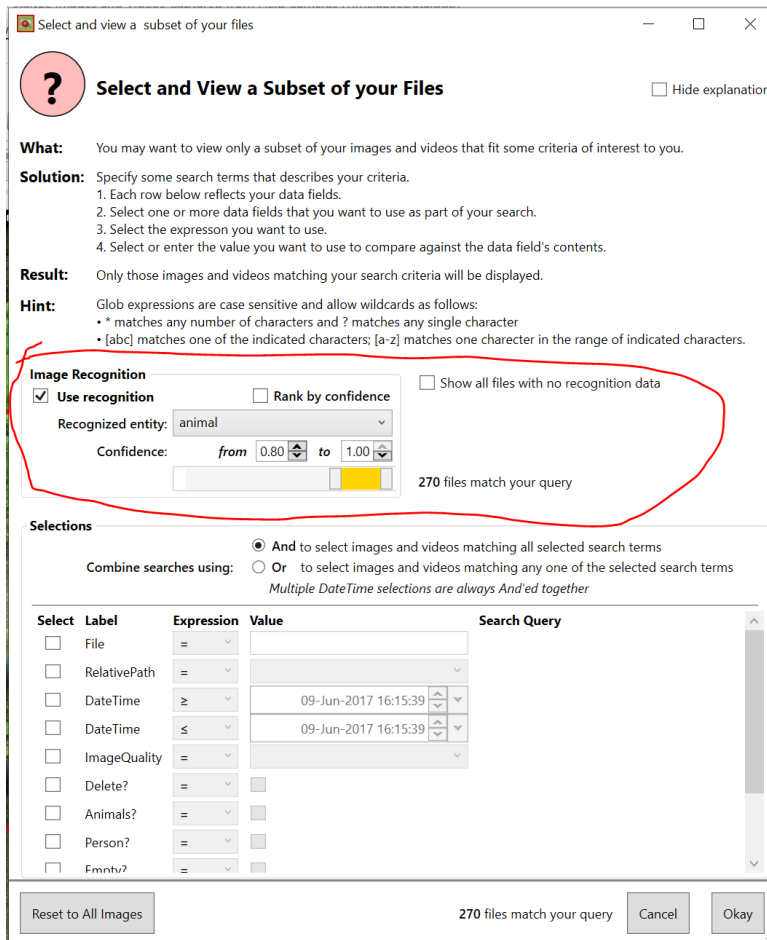
your images. While it is tempting to set the threshold to a low value, it could add a lot of visual clutter by showing incorrect bounding boxes. Alternately, setting it too high will mean that some correctly detected entities will not show their bounding boxes.



Note. As discussed next, you can use Custom Select to selectively view as subset of images that include detections and classifications at a given confidence range. If you have explicitly selected images that covers a lower confidence range, bounding boxes down to that lower confidence range will be displayed (because you are interested in those images). regardless of the confidence threshold set above.

Selecting images that fit some recognition criteria

As discussed elsewhere in this manual, *Select / Custom Selection* displays a dialog box that allows you to select a subset of your images to view according to some criteria. When recognition controls are enabled and a recognition file has been imported, that dialog box will now include an 'Image Recognition' area, as illustrated below.

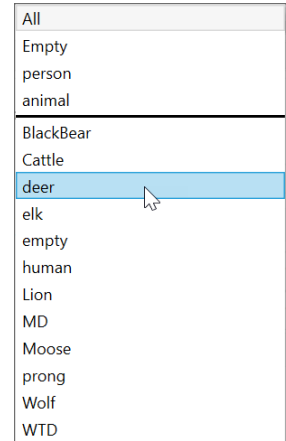


Checking the *Use Recognition* checkbox will select images according to its detections.

- *Recognized entity* drop-down menu: lets you select images according to its detection

Note: As the recognized entities are actually specified in the recognition file, the entities available may differ from what is described below.

- *All* – the image includes a detection of one or more animals or people within the given confidence range. *All* excludes images where the image recognizer has not identified any detections, even if the confidence is set to 0.
- *Empty* – allows you to rapidly select and inspect images where the image recognizer has not identified any detections, or that contain only low-confidence detections.
- *Person*: the image includes a detection of one or more people within the given confidence range
- *Animal*: the image includes a detection of one or more animals within the given confidence range
- *A list of possible classifications* – the remainder of the drop-down menu shows all the available classifications.



- *Confidence Range slider / up-down boxes* allows you to specify a recognition confidence range of interest for each entity type. You can use either the slider or the up-down box to adjust the range.
- *Rank by confidence* will select all images with the recognized entity type, but will sort them by confidence value. That is, the first images will be the ones where the recognizer has the highest confidence of correctness, followed by images with progressively lower confidence of correctness.

In the example figure above, the analyst has asked Timelapse to only display images where the detector has detected an animal with a confidence falling between .8 and 1 (i.e., the detector is pretty confident that it found an animal).

The examples below illustrate working with confidence. Understanding the subtleties – especially for *Empty* – will be helpful to using detections effectively.

- *Entity = animal, confidence range is 0.8 – 1.0* displays images containing at least one detected animal at 0.8 confidence or above (i.e. high confidence animal images that you may want to rapidly inspect for correctness). You may use this to rapidly inspect images to ensure animals are in it, and correct the occasional error.
- *Entity = all, confidence range is 0.1 – 0.5* displays images containing at least one detected entity between 0.1 – 0.5 confidence, (i.e., images containing detections where none of them exceed 0.5 confidence. You may use this to rapidly inspect and eliminate detections that are likely wrong.
- *Entity = Empty, confidence range is 1 - 1* selects all images where the image recognizer has not identified any detections. You may use this to rapidly inspect (and occasionally correct) images with nothing in them.
- *Entity = Empty, confidence range is 0.8 - 1* selects all images where the image recognizer has not identified any detections, and all images with 0.2 or less confidence (i.e., $1.0 - 0.8 = 0.2$). As above, but will include more images that likely don't have anything in them (i.e., erroneous detections)

- *Entity = Empty, confidence range is 0.8 – 0.99* selects all images with 0.2 or less confidence (i.e., $1.0 - 0.8 = 0.2$) but excludes images where the image recognizer has not identified any detections. You would use this a part of a workflow where you first wanted to go through images with no detections ($1 - 1$), and then separately go through images with poor detections.
- *Entity = Black bear, confidence range is 0.8 – 1* selects all images with a high probability that the detected entity was a black bear. You would use this a part of a workflow to perhaps check and quickly label those images as a bear.
- *Rank by confidence* may be useful in your workflow for determining – somewhat qualitatively – the confidence range where that recognizer seems to work well vs. poorly. For example, play images from the beginning, scanning them quickly to check if they have the correct entity. When errors increasingly appear, you can check the confidence value (displayed on the bounding box) to see where the recognizer no longer provides generally useful recognition results. You can then set the confidence sliders to select the mostly correct range.

An Example Timelapse recognition workflow

All workflow strategies depend upon you:

- selecting a subset of your images to display based on the detector’s predictions (via *Select / Custom Selection*),
- rapidly inspecting those images for accuracy (and perhaps correcting mis-detected images), and
- setting data values as needed.

While it may seem like the following steps adds work, you will find that – depending on your images – you can quickly reduce the number of images you need to review for detailed classification.

The workflow described below is based on using detection information (we will defer classifications for now). It is perhaps the most thorough one you can do. You will inspect and tag: all empty images, images with people in it, and then images with animals in it. After this is done, you can then classify just the animal images as desired. While more thorough than other workflows, it is still fast to do. To illustrate, I classified a sample image set of ~2000 images, it took me about 10 minutes to catalog ~1500 images as empty, ~250 as containing people, and ~250 containing animals. This includes correcting the occasional mis-detected images. I could then focus on classifying those 250 animal images.

Tip: This workflow is just one of several possible. The one you choose depends on the nuances of your work. A subsequent section will describe several other workflows that may better fit your situation. We fully expect you to create your own workflow protocol that fits your needs – these descriptions are included just to give you a flavour of the possibilities. Still, go through this one as it described the details that would be useful to consider in other workflows.

A. Getting ready

1. In the Timelapse Template, create three flags called ‘Person’, ‘Animal’, and ‘Empty’. Note that these are not required and have no special meaning to Timelapse. We use these as just part of an example workflow to track and tag what we’ve seen and what we’ve corrected.
2. Load in your image set into TImelapse as normally done (described in Section 1).
3. Move the appropriate .json detection file to the same folder as your template.

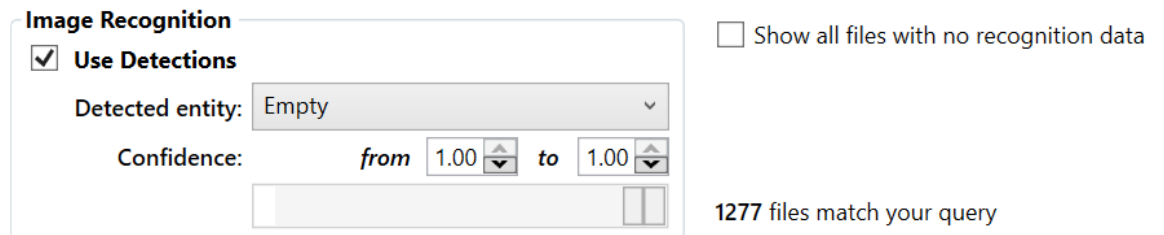
4. Select *File/Import Detection data for this image set* to import the .json file. After this step, you should see blue or red bounding boxes in images, each box indicating where the detector has spotted a person or animal.

Note. You don't really need the 'empty' flag, as an image that does not flag the presence of a person or an animal is, by definition, empty. However, using all three flags are useful for error management and checking. Alternately, you can create a FixedChoice item instead of those flags, containing Empty, People, Animal and a 'blank' item and use that instead of three flags. However, you will not be able to indicate the odd image that (for example) has both a person and an animal in it.

B. Selecting & filtering out images where the detector has not detected anything

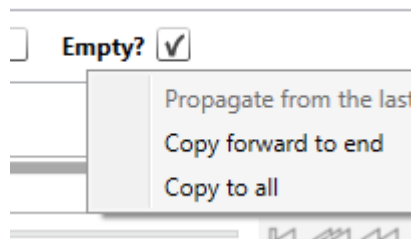
Your goal in this step is to remove empty images from any further consideration.

5. Use the Custom Select to select the images where the detector has not detected any entities.
 - Select Category, with the value 'Empty' and a confidence range from 1 to 1.
 - Click 'Okay'.



Note: The number at the bottom right above indicates how many images match that selection. The same number is repeated at the bottom of the dialog box.

6. Tentatively indicate these images are all empty by setting the all image's 'Empty' flag to true.
 - In your data entry area, check the 'Empty' flag.
 - Right-click that flag to raise the context menu, and select 'Copy to all'.



7. Review those images until you are satisfied that the detector was reasonably accurate at identifying images without animals or people in it. You can do this efficiently by using one or more of these strategies:
 - Use the FilePlayer to automatically play the images at various speeds. See Options|Adjust File Player Speeds to control the playback speed).
 - Use the Overview to display multiple images at a time, where you can use the FilePlayer control to scroll through pages of images.
 - Use the arrow keys to rapidly move through images

Note. A custom selection will show the last image (or as close to it as it could get) that was previously selected. Remember to scroll back to the first image before reviewing them, as otherwise you will miss some of them.

- Correct detections as needed. If the detector is working well, the vast majority of images you see will be empty. If you do see images that contain animals or people (false negatives), you can uncheck the 'Empty' field for those images. At the same time, you can broadly classify those by checking the 'Person' or 'Animal' field.
- Depending on your tolerance for errors, you may want to review all images carefully and correct for false negatives, or just look for glaring errors and correct those. Alternately, you may want to stop reviewing empty images at some point, if you feel the detector's accuracy is good enough for your needs.

(optional) Selecting & filtering out images with low confidence detections

- At this point, you can filter out images with low quality detections by setting the confidence range to other values. For example, the following settings show all images that have a detection whose maximum detection confidence is 0.4 (i.e., from 0.01 – 0.4).

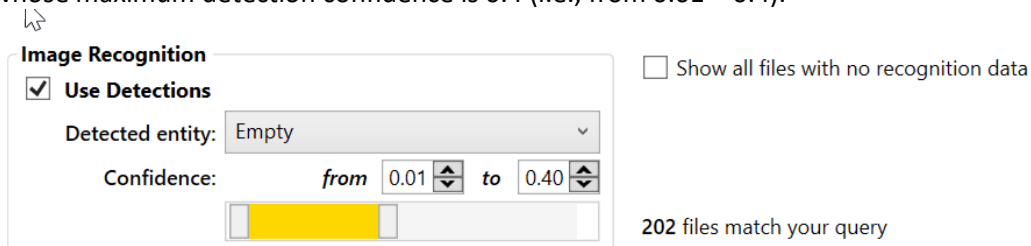


Image Recognition

Use Detections

Detected entity: Empty

Confidence: from 0.01 to 0.40

Show all files with no recognition data

202 files match your query

However, this workflow example will use a different strategy to find those images.

Marking the majority of images with people in them

Your goal in this step is to identify as many images as possible with people in them. Some organizations require, usually due to privacy policies, that images with people in it be identified and even discarded. Alternately, you may be counting people in your images, or you may not be interested in images with people in the context a wildlife survey. In any of these scenarios, it's useful to rapidly identify the subset of images that contain people. The process is somewhat similar to how you deal with empty images.

- Select the images where the detector has a high confidence that a person is in them
 - In the custom selection dialog, select Category as 'person' and Confidence from .9 to 1. Click Okay.

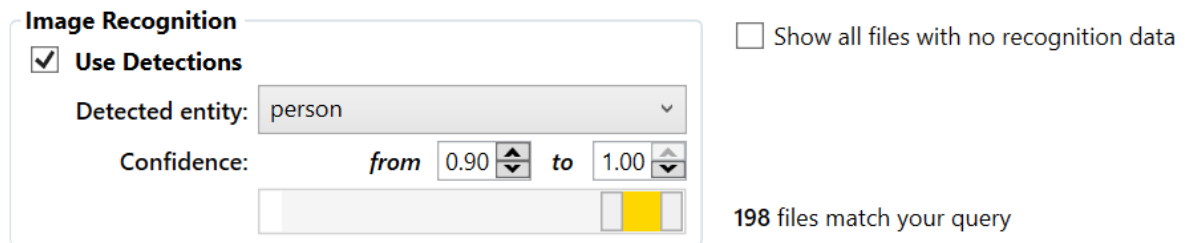


Image Recognition

Use Detections

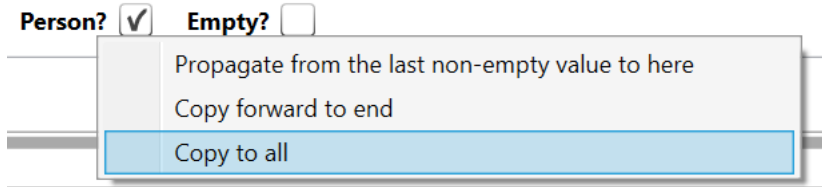
Detected entity: person

Confidence: from 0.90 to 1.00

Show all files with no recognition data

198 files match your query

12. Similar to how you had previously tagged empty images to using 'Copy to all', tentatively indicate a person is present in all these images by setting the 'Person' flag to true for all images in the current selection.



13. Use the FilePlayer and/or Overview and/or arrow keys to review these images.
- If you see an image that does not contain a person (false positives) click on the 'Person' flag to clear it. If the image is empty or has an animal, click the 'Empty' or 'Animal' flag to indicate that.

Tip. Create QuickPaste entries that will let you do the above in a single mouse click.

- As before, depending on your tolerance for errors, you may want to review all images carefully and correct for false positives, or just look for glaring errors and correct those. Or, you may want to stop reviewing the images if you feel the detector's accuracy was good enough. As you've previously set them all to 'person', you don't have to do anything more.

Note. When reviewing images, you may want to use the FilePlayer to rapidly scan images with high detection confidence (as there will be few errors to correct). However, at lower confidence levels you may opt to use the Overview, or even go through every image using the arrow keys to inspect your image. Remember that if you do use the FilePlayer, you can adjust the rate that images are displayed by selecting the *Options | Adjust Fileplayer playback speed...* menu item.

14. Repeat the above, but this time by setting the confidence from .8 to .9, then between .7 and .8, and so on down to 0.
- When you begin to see that the detector is getting things more wrong than right, don't set the person flag via 'Copy to All'. Rather, review the images and click only on the ones with a person in it.
 - At some point, again depending on your tolerance for errors, you may decide to stop reviewing images below a certain confidence threshold.

Hint. Move the 'from' confidence of the range slider slower, and monitor how many files match that confidence range. Use that information to decide how you should set the confidence range. For example, if only a few images match a particular range, you may want to expand the range to generate more images.

Marking the majority of images with animals in them

Your goal in this step is to identify as many images as possible with animals in them for later classification. It is identical to the way you mark images with people in it.

15. Select the images where the detector has a high confidence that an animal is in them
- In the custom selection dialog, select Category as 'animal' and Confidence from .9 to 1. Click Okay.



16. Continue to follow the exact same process as you did for people, but in this instance looking for animals rather than people.

Double-checking

17. If desired, review the final results for errors, again using the custom selection dialog. You should unselect the Detection checkboxes, and select the data checkboxes as needed. To double-check:

- ...whether you missed any images, uncheck the Person, Animals, and Empty checkboxes
- ...your empty images, select and checkmark the Empty checkbox only
- ...your person images, select and checkmark the Person checkbox only
- ...your animal images, select and checkmark the Animals checkbox only

For example, to review only the images you've marked as containing animals:



Detailed classification

18. To classify your animals by species and/or to count them, select and checkmark the Animals checkbox. All other images (which could be a considerable number) will now be filtered from view.

19. Similarly, to classify and/or count people, select and checkmark the Person checkbox. All other images (which could be a considerable number) will now be filtered from view.

20. To discard empty images (if desired)

- Select the Empty checkbox
- In your data entry area, checkmark the 'Delete?' flag (you may have to set it as 'Visible' in the template .tdb file)
- Right-click that flag to raise the context menu, and select 'Copy to all'.
- Use the *Delete* menu to delete all those files (and optionally its data)

21. To discard people images (if desired), repeat the process above except with 'People' selected

Variations of the Timelapse recognition workflow

The above workflow is the most thorough. However, depending on your situation, you may choose one of the simpler workflows below.

An alternate to the prior method

You can skip the step for verifying animal detections, where you instead start classifying animals immediately. The difference is that you will handle mid-detected animals as you do your detailed classification, rather than as a separate step. To do this, follow the workflow above for verifying and correcting detected empty and people images. For animals:

- Set the detected entities to animals and the confidence range from 0 – 1.
- Set the selections area as below, which will exclude all images you have just marked as either empty or having people in it:
 Person? =
 Empty? =
- Start classifying these animal images, skipping over the occasional image that may have a false positive for animal detection.
- As a further variation, you can rapidly inspect and eliminate many of the animal false positives by first selecting images where the detected entity is animal, and the confidence range is (say) between 0 – 0.5. Then continue with the previous step but with the confidence range between 0.5 – 1.0.

A rapid but less accurate method for detecting images with animals

Do a very quick scan with the detector for empty images and people images. If they seem reasonably accurate (with only the occasional false positive), then just set the detector to animals. Slide the confidence downwards until the number of matching images does not increase significantly. Start classifying those images. Note that:

- These images displayed may include some without animals (false positives), but you can just skip over those when you come across them.
- Some of the images detected as ‘empty’ or ‘people’ may have animals in it, which you may or may not have noticed in your quick scan. But if you can tolerate missing some images, this method may still work for you
- Note that this does not require including the animal/people/empty tags in the template.

If you want to ignore images with people in it, treat them as empty

If you simply want to ignore images with people in it vs. tagging them, don’t bother creating a ‘person’ flag in your template. Just use the empty field instead.

The Classification Workflow

The image recognition file read in by Timelapse also includes *classification data*, that further identifies each detection. For example, a detection of Animal can be further classified as a probability-based list of the species of that animal. For example, it may consider an animal as a *deer* with 75% probability, or as an *elk* with 24% probability, and perhaps other species for the remaining 1%.

The best workflow for using classifications is still in progress. If you have found an efficient way to use classification data, let us know – we are highly interested in determining best practices, and will include those in this manual. As a starting point, assume you have already tagged your empty images and perhaps those with people in them (as described above), where you now want to classify the species in each image.

1. Select the species you expect to see most frequently (e.g., deer) at a reasonably high confidence. Review and label those images as deer (excluding any that are incorrect).
2. Select the next most frequent species (e.g., elk), again at a reasonably high confidence and review and label those images as elk.
3. Repeat the above for other species, until the number of returned images per species are small.
4. At this point, you will have already labelled many images with your most frequently seen species. The remaining images should be a much smaller set of infrequently seen species, or which were under the confidence limit you specified.
5. Use custom select to show only that smaller set of remaining images, and label those manually.

Part 4. The Timelapse Database

Part 4 explains the internal structure of the database tables created by TIMELAPSE. This is only of interest if you want to access the data directly from the database rather than from the **.csv** file.

Timelapse saves all your data (as well as other information) in a file called TimelapseData.ddb, which is an SQLite database. If you want to access the database directly (rather than the exported spreadsheet), read on. Otherwise you can ignore this section.

You can directly access the TimelapseData.ddb database using software of your choice. For example:

- **R** is often used to access the data base and perform statistical analysis of that data.
- **SQLite database editors.** There are myriads of free tools available that will let you view SQLite database files, query them, and even modify their entries (e.g., I have used both DB Browser <http://sqlitebrowser.org/> and SQLiteAdmin <http://sqliteadmin.orbmu2k.de/>).

Be aware that altering the database files (e.g., by adding or deleting columns to it) can compromise Timelapse’s ability to read those files. Make sure to back up those files before you do any modifications.

The TimelapseData.ddb file contains various tables, as described below. The other tables, while described here, are used internally by Timelapse and likely of no interest to you – they are included only for completeness.

Tables relating to your data

These tables are likely the only ones with content of interest to you. The DataTable contains all the data entered by the analyzer and will be the most important. A very distance second is the TemplateTable: it mirrors the .tdb file content which describes the relation between the data schema and the Timelapse user interface.

DataTable

The figure below illustrates an example DataTable as held by the database (and as viewed within SQLite Administrator). Each column corresponds to the DataLabel as specified in the TimelapseTemplate file. Each row’s ID should correspond to the original order that the images were read in. If the analyst had deleted an image and its data, that row would no longer appear (i.e., the Id column would appear to skip a number). Note that a UTCOffset and DateTime field is present regardless of how you set the UTC option in your template. See §UTCOffset/DateTime to understand how those values are combined to get the local time.

Id	File	Folder	RelativePath	DateTime	UtcOffset	Date	Time	ImageQuality	Sheep	Hikers	Weather	Temperature	Analyst	Comments	PublicityShot	DeleteFlag
1	IMG_0001.JF	TutorialImag	Site1-08.14	2010-08-14 9:10:00	P	-6	14-Aug-2011 15:10:00	Ok	0	0		14	Saul		false	false
2	IMG_0002.JF	TutorialImag	Site1-08.14	2010-08-14 10:40:00	I	-6	14-Aug-2011 16:40:00	Ok	0	0		14	Saul		false	false
3	IMG_0003.JF	TutorialImag	Site1-08.14	2010-08-14 10:45:00	I	-6	14-Aug-2011 16:45:00	Ok	0	0		13	Saul		false	false
4	IMG_0004.JF	TutorialImag	Site1-08.14	2010-08-14 10:50:00	I	-6	14-Aug-2011 16:50:00	Ok	0	0		13	Saul		false	false
5	IMG_0005.JF	TutorialImag	Site1-08.14	2010-08-14 10:55:00	I	-6	14-Aug-2011 16:55:00	Ok	0	0		13	Saul		false	false
6	IMG_0006.JF	TutorialImag	Site1-08.14	2010-08-14 11:00:00	I	-6	14-Aug-2011 17:00:00	Ok	0	0		14	Saul		false	false
7	IMG_0007.JF	TutorialImag	Site1-08.14	2010-08-14 11:05:00	I	-6	14-Aug-2011 17:05:00	Ok	0	0		14	Saul		false	false
8	IMG_0008.JF	TutorialImag	Site1-08.14	2010-08-14 11:10:00	I	-6	14-Aug-2011 17:10:00	Ok	0	0		15	Saul		false	false

TemplateTable

The TemplateTable is a copy of the template that was originally read from the TimelapseTemplate.tdb file when the image set was first analyzed. It is kept as a fall back if, for some reason, there are inconsistencies in the TimelapseTemplate.tdb file and the way the data is stored. An example is illustrated below. Note that the List (used to create the choice menu) has each entry that defines the menu item separated by a ‘|’.

When Timelapse reads in the TimelapseTemplate.tdb file, it tries to match its data labels with those stored in the DataTable. If it can't (e.g., because you added or deleted columns or changed the DataLabel names), it will use the internal copy instead. If you understand database tables, you may be able to fiddle with both the DataTable and TemplateTable to allow for new template structures (e.g., by adding or deleting columns, by changing DataLabel names), but be careful! Backup the file just in case. Future versions of Timelapse will allow for such modifications.

Although we suspect you will not need to access this table, it may be of interest if you want to retrieve the information associated with each field.

Id	ControlOrder	SpreadsheetOrder	Type	DefaultValue	Label	DataLabel	Tooltip	TXTBOXWIDTH	Copyable	Visible	List
92	1	1	File		File	File	The file nam	100	false	true	
93	2	2	RelativePath		RelativePath	RelativePath	Path from th	100	false	true	
94	3	3	Folder		Folder	Folder	Name of the	100	false	true	
95	4	4	DateTime	1900-01-01T	DateTime	DateTime	Date and tim	160	false	true	
96	5	5	UtcOffset	0.00	UtcOffset	UtcOffset	Universal Tir	60	false	false	
97	6	6	Date	01-Jan-1900	Date	Date	Date taken	85	false	false	
98	7	7	Time	12:00:00	Time	Time	Time taken	60	false	false	
99	8	8	ImageQuality		ImageQuality	ImageQuality	System-dete	85	false	true	Ok Dark Cor
100	9	9	DeleteFlag	false	Delete?	DeleteFlag	Mark a file a	20	false	true	
101	10	10	Counter	0	Goats	Goats	A count of h	30	false	true	
102	11	11	Counter	0	Hikers	Hikers	A count of h	30	false	true	
103	12	12	FixedChoice		Weather	Weather	From sunny,	100	true	true	Sunny Clouc
104	13	13	Note		Temperature	Temperature	Temperature	100	false	true	
105	14	14	Note		Analyst	Analyst	The analyst	100	true	true	
106	15	15	Note		Comments	Comments	From sunny,	100	true	true	
107	16	16	Flag	false	Publicity?	PublicityShot	Flags an ima	20	true	true	

Note: two new rows have been introduced in recent versions of Timelapse as shown above: **DateTime** and **UtcOffset**. See *Understanding UTC Dates and Time Zones* in the Timelapse section of this manual.

Tables used internally by Timelapse

These tables are likely of little to no interest to you. They are primarily used to store internal information as used by Timelapse, mostly to store preferences and to restore state between sessions.

ImageSetTable

The ImageSetTable is likely of no interest to you. It records information about the entire image set, which in turn is used to restore state information when you restart Timelapse.

- **Log** : the contents of the notes Timelapse lets you add through the Edit / 'Edit Notes for this Image Set' menu item.
- **Magnifier**: whether the magnifying glass is visible
- **Row**: The last image the user was viewing
- **Filter**: The last Select item chosen via the select menu
- **WhiteSpaceTrimmed**: used internally by Timelapse to maintain backwards compatibility

- **Timezone:** The global time zone of the user’s computer. Used internally to store date information.
- **VersionCompatability:** The last version of Timelapse used to open this database.
- **SortTerms:** The last used criteria used to sort the images
- **SelectedFolder:** The last folder selected using the Select menu, if any
- **QuickPasteXML:** used internally by Timelapse to save/restore the QuickPaste information.

Log	Magnifier	Row	Filter	WhiteSpaceTrimmed	TimeZone	VersionCompatability	SortTerms	QuickPasteXML
Add text here	false	4	4	true	Mountain Standard	2.2.2.3	DateTime,DateTI	<Entries> <Entr

MarkersTable

The MarkersTable is likely of no interest to you. It records the position of the visual markers that are used to mark counts. Positions are x,y ratios reflecting their relative positions on the image. Multiple markers on an image are recorded as a single entry, where they are separated by a '|', i.e., x1,y1|x2,y2 etc.

Id	Sheep	Hikers
1		0.359,0.882
2		
3		
4	0.674,0.291	
5	0.722,0.223	
6	0.584,0.428	
7		

Tables for Image Recognition

The various image recognition tables are likely of no interest to you. If image recognition is enabled and you have imported recognition data, Timelapse will create several additional tables to hold the recognition data, which in turn is used to select and display recognition data to the analyst. For the most part, the data in those tables mirrors what was read in from the recognition file, albeit in a different format and with a few exceptions as indicated below. Although you could use it to access the recognition data, that data will likely be best exploited within the Timelapse user interface.

DetectionCategories

The image recognition file contains an entry called `detection_categories`, which broadly identifies what the recognizer thinks it has detected and assigns a unique integer to each category. Timelapse reads those values into the table (as illustrated below). Timelapse also adds a new category called 'Empty', which will be used to identify any images analyzed by the detector but which produced no detections.

Table: DetectionCategories

	category	label
	Filter	Filter
1	0	Empty
2	2	person
3	1	animal

Detections

The image recognizer contains, for each image, a list of zero or more possible detections. Each detection identifies a bounding box of 4 coordinates identifying where in the image that detection is located (in relative terms), the detection category, and a confidence value for that detection.

The detections database table holds each detection as a row. The detectionID column is the primary key. The Id is the ID of the image in the DataTable to link each detection to a single image i.e., it is used as a foreign key. That is, there is a many to one relation between Detections and the DataTable. For example,

- DetectionID 1 identifies a detection on image 1406 in the DataTable. Its category is 0 (Empty), which means that although that image was analyzed, no detections were identified for it.
- DetectionID 5,6,7,8 identifies 4 different detections on image 1410 (many to one). Each detection shows the confidence of that detection, and the coordinates of its bounding box.

	detectionID	category	conf	bbox	Id
	Filter	Filter	Filter	Filter	Filter
1	1	0	0.0		1406
2	2	0	0.0		1407
3	3	0	0.0		1408
4	4	0	0.0		1409
5	5	1	0.657	0.9413, 0.384...	1410
6	6	1	0.158	0.9346, 0.301...	1410
7	7	1	0.157	0.9258, 0.389...	1410
8	8	1	0.113	0.2583, 0.926...	1410
9	9	0	0.0		1411
10	10	0	0.0		1412

ClassificationCategories

Tentative – this table, while included, may change.

The image recognition file contains an entry called classification_categories, which produces zero or more possible classifications of what each detection could be. For example, while a detection may broadly identify something as an animal, a classification may further identify that as a deer with high confidence, an elk with lower confidence, and so on. The classification_categories list all possible entities that the recognizer will consider. Each classification_category comprises an identifying integer and label.

Timelapse reads those values into the table (as illustrated below). As with detection_categories, Timelapse adds an 'Empty' classification to identify images that do not contain any classifications.

	classification	label
	Filter	Filter
1	0	empty
2	1	elk
3	2	human
4	3	WTD
5	4	deer
6	5	Cattle
7	6	Moose
8	7	MD
9	8	BlackBear
10	9	Wolf
11	10	Lion
12	11	prong

Classifications

Tentative – this table may change.

The image recognizer contains, for each detection in each image, a list of zero or more possible classifications. Each classification identifies the classification category, and a confidence value for that detection.

The Classifications database table holds each classification as a row. The classificationID column is the primary key. The detectionID is the ID of the detection in the Detections table, and is used to link each classification to a single detection i.e., it is used as a foreign key. That is, there is a many to one relation between Classifications and Detections. For example,

- ClassificationID 1-4 identifies 4 different possible classifications on detection 14 in the DetectionTable. In descending order of confidence (conf) these are 1 – elk, 4-WTD (white tail deer), 5-deer, and 6-cattle.

Table: Classifications

	classificationID	category	conf	detectionID
	Filter	Filter	Filter	Filter
1	1	1	0.6299	14
2	2	4	0.3179	14
3	3	5	0.04718	14
4	4	6	0.002802	14
5	5	11	0.0009018	14
6	6	4	0.9788	36
7	7	1	0.01979	36
8	8	5	0.0006761	36
9	9	6	0.0005328	36
10	10	8	5.36e-05	36
11	11	4	0.9012	37
12	12	1	0.06002	37