



CPW Photo Warehouse User Guide



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The CPW Photo Warehouse was designed by Eric Newkirk for Jacob S. Ivan at Colorado Parks and Wildlife - Mammals Research Section, Fort Collins, CO.

Suggested citation:

Newkirk, E. S. 2014. CPW Photo Warehouse. Colorado Parks and Wildlife, Fort Collins, Colorado, USA. <http://cpw.state.co.us/learn/Pages/ResearchMammalsSoftware.aspx>

Acknowledgements:

Special thanks to Kevin Crooks and Jesse Lewis at Colorado State University (CSU) for help with funding and guidance with earlier versions of the generic photo database and to Mary Schuette for developing critical aspects of the initial Colorado Parks and Wildlife (CPW) Lynx Occupancy database.

Thanks also to Kevin Blecha (CPW/CSU), Stewart Breck (USDA-NWRC), Reesa Conrey (CPW), Joe Halseth (CPW), Rebecca Much (CSU/USDA-NWRC), Lani Stinson (CPW/CSU), Matthew Strauser (CPW), and Colin Wait (CSU) for testing, feedback, and patience.

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General Information

Field Considerations

There are a few things you can do when collecting camera trapping data that will make working with the database much easier. First, make sure you have a system in place to keep track of where and when each camera was deployed. If your cameras have a programmable user label that will appear in each photo, use that as a failsafe. Second, try to avoid viewing your photos on other devices before importing them. Some digital cameras or phones can permanently damage the photos or metadata on your memory cards when you use them to view photos. Others won't be able to view the photos or navigate folder structures, and still others will create hidden thumbnail files that can cause problems later on. If you need to view photos in the field a laptop is the safest option. Finally, it's always a good idea to intentionally trigger the camera when you first set it, whenever you check it, and when you retrieve it. Often in analyzing your data you will need to know exactly when a camera was active and having these photos makes that relatively simple. These photos combined with well-kept records can also help in solving issues later on (e.g. date on the camera was set incorrectly, incorrect user label, etc.).

Enabling VBA Code

The database won't work correctly if the VBA code contained in the forms is blocked. When the database opens the Access window should be a blank blue background, with just the switchboard form showing (

Figure 1). If the ribbon (top menu bar) and navigation pane (left menu bar) are visible when the database opens, that means VBA is being blocked (Figure 2). You should also receive a message noting this just below the ribbon, and a form named "Startup" will display some text addressing the situation. Using the database in this state can cause all sorts of unexpected results, even if you don't intentionally change anything.



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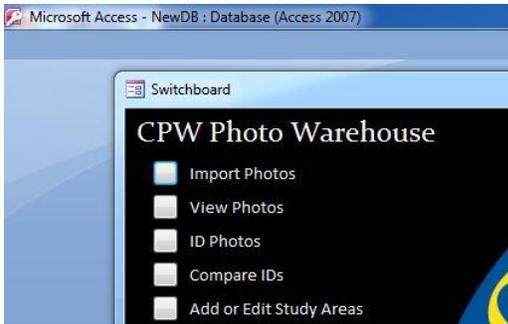


Figure 1 - Access window with code enabled

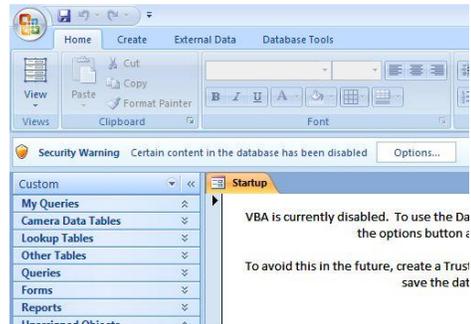


Figure 2 - Access window with code disabled

You can click the “Options...” button below the ribbon and enable VBA in the dialog box that follows, but you’ll have to do this each time you open the database, and you may receive confusing security messages while using the database.

A better way to ensure that code in the database isn’t blocked is to save it in a “Trusted Location.” First, open Access from the start menu. You should see a welcome screen with options to build a new database, open an existing one, get content from Microsoft Online, etc. Click the “Office Button.” Now click “Access Options” --> “Trust Center” --> “Trust Center Settings” --> “Trusted Locations.” Check to see if the folder where you want to save the database is included in the list. If not, you can add it by clicking the “Add New Location...” button. Note that subfolders are not necessarily included, so a database saved in a folder within “My Documents” may not work even if “My Documents” is a trusted location. If you want subfolders of a particular location to be trusted make sure to check the box for that option.

Now you can save the database to your chosen folder (if you haven’t already) and when double-clicked it should open as in

Figure 1.



Understanding the Database

It's important to know a little about the purpose and limitations of the database before you get started. You don't have to be an expert in Access to use the database - in fact you don't need any experience with Access at all.

Think of the database as a catalog of all your photos. It doesn't actually contain any of the images themselves. Instead, it stores the metadata associated with them, such as the date taken and the species present. Using forms and VBA code, it's possible to automate much of the cataloging process, and to make the processes that require user input (such as identifying the species in the photos) work much more smoothly. In addition, the forms link and display the photos represented in the data, eliminating the need to move back and forth between photo viewing and data entry programs.

To use an analogy, think of the database like a card catalog in a library. You can take a book off the shelf and toss it in the trash, but the card in the catalog would remain. Conversely, you can pull a card from the catalog and leave the book on the shelf. In either case, your catalog will become out of sync with the objects it's meant to represent. This database is no different - deleting a record from the database is like pulling a card from the catalog, and deleting a jpeg file is like throwing out the book. Either way, the database will end up out of sync with the photos you've collected.

To keep the database synced with your photos, be as organized when working with the jpeg files as you possibly can be. It's highly recommended that you import all of your photos directly from memory cards, store them in a simple, logical folder hierarchy, and rename them consistently. I also recommend using the import function in the database to copy and rename images from memory cards, as this ensures uniformity in that process. There is a form in the database for updating the location of a folder when it has moved, but if you store your photos in a maze of subfolders or scattered locations it will be difficult to keep track of what you have and where. You can use the database itself to view or work with your photos in subsets based on their metadata, so it shouldn't be necessary to store them in subfolders based on species or similar attributes.

On the other hand, a storage scheme that is too simple can also cause problems. Windows can only support a certain number of files within a given folder, and the limit has nothing to do with available storage space. Our tests put this limit around 15,000 files, but if you use very long filenames the limit could be significantly lower. For most cases storing one memory card worth of photos per folder seems to work well, but if you use very large memory cards it may be necessary to divide the files into smaller batches before importing them.

Of course it's always a good idea to maintain backup copies of the photos as well - organize these however you want, but save them on a different hard drive. The recommended work flow would be something like this: collect the memory card -> copy the photos to a backup folder -> import from the card to the database with the copy option selected (details later) -> format the memory card so it is ready to be cycled back into use.



The Switchboard Form

The form displayed when you first open the database (Figure 3) is designed to allow users to perform most database functions without having to master the inner workings of Access. Click on any of the buttons on the left to perform the action listed. Most of these buttons open new forms, which allow entering or viewing data, importing photos, viewing photos, etc. You can also exit Access by clicking the button next to “Quit.”

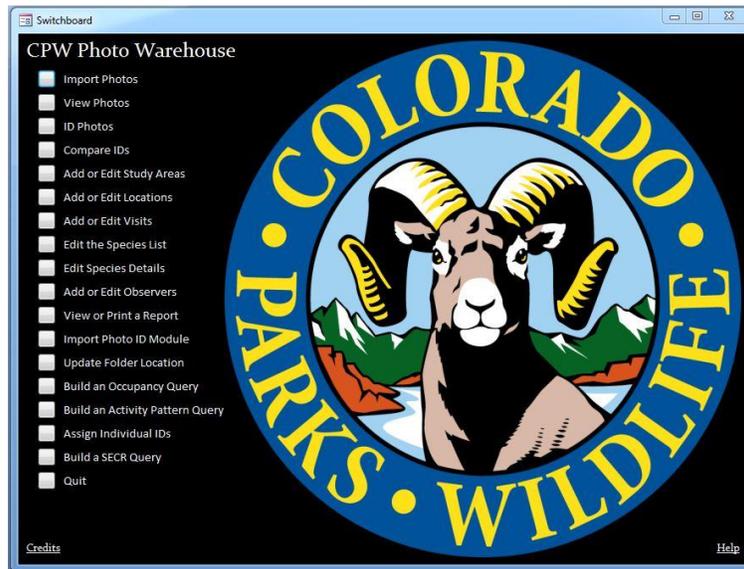


Figure 3 - Switchboard form

This form contains the code that hides the ribbon and navigation pane on startup. If you close the form by clicking the red “X” at the top of the form window (not the one at the top of the screen, which closes Access completely), the ribbon and navigation pane will appear. This allows you to make design changes to the database, create new queries, etc. If you’ve closed the form and you want to get back to it, all you have to do is open it by locating the form named **Switchboard** in the navigation pane and double-clicking it.

More detailed information about each of the commands can be found in the relevant sections below.

The Navigation Pane

When the Switchboard form is closed, the navigation pane appears with the view set to “Custom” (Figure 4), in which objects are grouped in simplified categories. Many of the lesser objects (subforms, subreports, etc.) are filed in hidden groups. To change the navigation pane view, click the drop down arrow at the right of the title bar. In the menu that appears, you can select from a variety of viewing options (“Object Type” can be useful, “Developer” is a more advanced custom option). Most of the objects that are hidden from the custom view are hidden for a reason - you can seriously impair the functionality of the database by modifying these objects. If you’re an expert in Access and VBA go for it. If not it’s better to create your own queries, forms, etc. from scratch so that the original objects remain intact. If you want to make a scrap copy of a form or report, you must copy any subforms or subreports as well and update the form design to make sure you aren’t affecting the original.

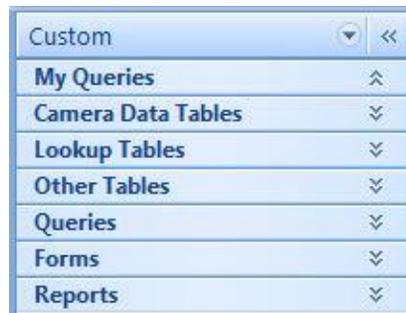


Figure 4 - Custom navigation pane view

Help Messages

Help text is available to guide you through most of the forms you’ll be using in the database. To see the help text for a particular form, click the blue question mark button in the top right of the form itself (not the one at the top right of the Access window). You can also view all of the help messages for the database by clicking the “Help” link on the Switchboard form, then clicking “View All Help Entries...”



Maintenance and Troubleshooting

The most important thing to remember when working with this database is to back it up. There is a backup option listed in the Office Button menu (available if you close the startup form) or you can simply make a copy of the .accdb file in Windows. Back up the database as often as you can remember to do it.

Another important step that will keep the database running smoothly is to compact and repair it. Close the **Switchboard** form, click the Office Button, select manage, and click compact and repair. This gets rid of bloat in the tables and indices within the database file, so it will usually shrink the file size quite a bit as well as boost performance. If you don't compact and repair once in a while the database will get very sluggish over time.

If you're experiencing problems or error messages when using the database, there are a few things you can try. First, double-check that you're running the database from a trusted location. If not, check out the "General Information" section above. The next step is to compact and repair the database following the instructions in the last paragraph. If you're having trouble even opening the file, try holding down the shift key while opening it, then try to compact and repair.

You may experience error messages or the database may fail to open if you move it to a computer running a different version of Access. If that's the case open the database (you may need to hold down the shift key) then open the code window by clicking "Database Tools - Visual Basic." Within the code window, click "Tools" then "References." Look for any reference marked "Missing" and find the closest replacement (usually the name will be the same but the number at the end will be slightly different) in the list. Check the box for the correct reference, and uncheck the box for the missing one. Once all missing references have been resolved, click the save button, then "Compile" from the Debug menu.

If none of these fixes the problem, your database is probably corrupted. It may be fixable but will probably require expert attention.

Limitations

Access databases can only handle 2 million rows in a single table, which can be problematic when working with camera data. Because the CPW database maintains records for multiple detections per photo you will most likely approach this limit when you have around 1 million photos. There are some potential workarounds to this issue, including permanently deleting duplicate detections, but if you anticipate collecting more than a million photos you may want to look into more powerful database options such as Microsoft SQL Server.

Access databases are also limited to 2 gigabytes in size, but in practice your database should never come close to this limit. If you notice the file getting inexplicably large follow the steps above to compact and repair it.



Using the Database

Access databases are designed so that users interact with the data through forms, rather than working directly in the tables. All of the basic tasks required to catalog and identify your photos can be accomplished through forms, which can be accessed using the options on the **Switchboard** form. If you've already closed it you can access most of the forms listed below by double-clicking on the form's name in the navigation pane.

Initial Setup

To set up a blank copy of the database for use with a new project, there are 4 steps to get everything ready to go. The forms for completing these steps can all be accessed from the **Switchboard** form, which is displayed when you first open the database. Before you start this process, make sure you have a list of camera locations (including UTM coordinates if available) ready. It can also help to compile a list of the species you expect to appear in your photos (including Latin names) and a list of any additional details you might want to add when assigning the species to photos (e.g., sex, age, collared or not). It's also a good idea to create a blank copy of the database before you set it up in case something goes wrong and you want to start the process over from scratch.

First, you must add at least one study area to the **StudyAreas** table (Figure 5- **Switchboard** -> Add or Edit Study Areas). If your project doesn't include multiple distinct study areas, a single all-encompassing study area name will do, but you cannot enter information for camera deployments until this step is complete. Study areas should represent distinct groups of camera locations (geographic regions, control vs. treatment, habitat strata, etc.) that you may want to summarize separately or compare later on.

Study Area Name	Abbreviation	Description
Telluride	T	Highway 145 corridor between Telluride and Lizard Head P
Molas Pass	MP	Highway 550 corridor near Molas Pass

Figure 5 - Adding study areas



The next step is to add camera location information (Figure 6- Switchboard -> Add or Edit Locations). You can enter information for all of the camera locations at once when first setting up the database, or you can add some now and continue the process later, but you can't import photos until you have records in the locations table. Enter each camera location on a separate line. Every location must be associated with a study area and must be given a name, but the other fields are optional.

Study Area	Location Name	UTM Easting	UTM Northing	UTM Zone	Access Notes
Telluride	Alta1	*****	*****	13	*****
Telluride	Alta2	*****	*****	13	*****
Telluride	Alta3	*****	*****	13	*****
Telluride	Alta4	*****	*****	13	*****
Telluride	Barlow1	*****	*****	13	*****
Telluride	Dunton1	*****	*****	12	*****
Telluride	Home1	*****	*****	13	*****
Telluride	Home2	*****	*****	13	*****
Telluride	Home3	*****	*****	13	*****
Telluride	Home4	*****	*****	13	*****
Telluride	Home5	*****	*****	13	*****
Telluride	Hope3	*****	*****	13	*****
Telluride	Lizard1	*****	*****	13	*****
Telluride	Lizard1B	*****	*****	13	*****
Telluride	Lizard2	*****	*****	13	*****

Figure 6 - Adding camera locations

Another option is to paste location records from a spreadsheet, but be careful with this process since it can be easy to make a mess of things. With the camera locations form open, open the spreadsheet that contains your location data. For the copy to be successful, the fields in your spreadsheet must be in exactly the same order that they appear in the form, and you can't skip any columns. With your spreadsheet rearranged to match the form, select all the rows you want to paste. If your spreadsheet has a header row, don't select it. Press ctrl+C to copy the selected cells, then move back to the form in Access. Click the blue box to the left of a new record so that it turns black, then press ctrl+V to paste your records. You will probably get an error message about control names not matching - it's okay to dismiss this message and continue the paste operation. If you get any other error message you should cancel the process and enter your locations manually.

The third and fourth steps are not required for importing photos, but it makes sense to spend a little time on them now to make things work more smoothly later on. Step 3 is to add a list of species you expect to detect to the **Species** table (Figure 7 - **Switchboard** -> Edit the Species List). An entry for “None” (meaning no species is present in the photo) has already been entered for you, but it won’t show up in the form. As you enter additional species you can assign keyboard shortcuts for use when ID’ing photos, and a shorter name that will be used in drop-down menus where space may be limited (e.g. “Lynx” for “Canada Lynx”).

Step 4 is to do the same with detection details (Figure 8 - **Switchboard** -> Edit Species Details), which requires some explanation. Detection details provide a little more specificity to detection records. Examples would be “on leash” for a dog or “collared” for wildlife species. When adding a new detail item to the list, you must specify the species to which that item applies. Details and their shortcuts can be repeated for different species. To use one of the examples above, you could add “collared” as a detail that would apply to bobcats with a shortcut of “C”, and then add it again with the same shortcut for mountain lions.

If you decide to skip steps 3 and 4 for now, you can add species and details one at a time through the **PhotoID** form, or you can edit the lists by selecting the appropriate option on the startup form.

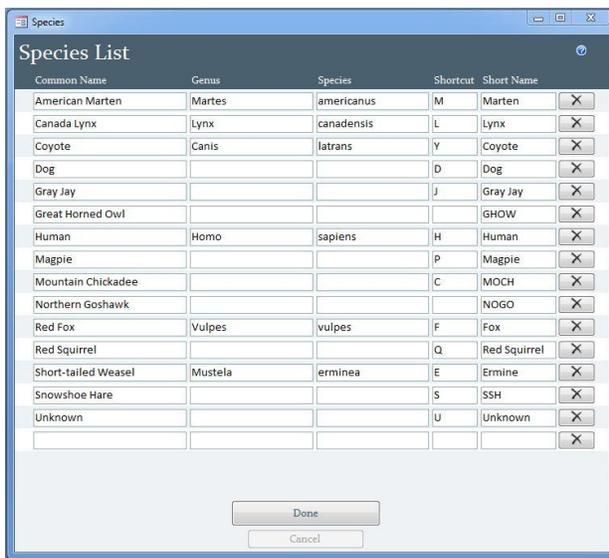


Figure 7 - Adding species

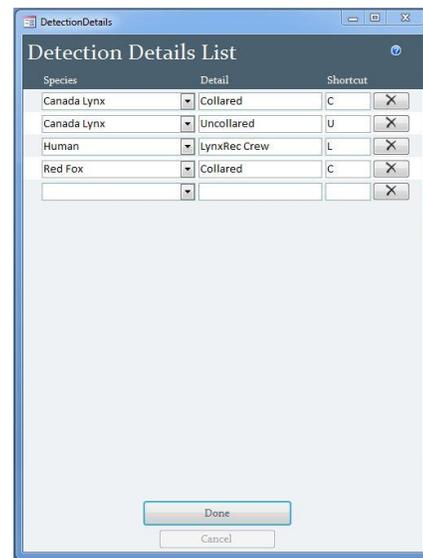


Figure 8 - Adding details

Adding Visits

Once your camera locations have been entered, the next step in getting your photos into the database is adding visits. You can do this ahead of time or when you’re ready to load the photos. Visits fall into 3 categories: Set, Check, and Pull. A set visit identifies the date when a given camera began sampling (i.e. no photos were being taken before that date). A check means the camera was sampling both before and after the visit took place, and a pull means



the camera was not operating after that date. The period of time from a set visit at a particular location to the following pull visit may be referred to as a “deployment.”

Start by clicking “Add or Edit Visits” on the Switchboard to open the **Visits** form (Figure 9). Select a location in the drop-down box at the top of the form, select “Set” for the visit type, and fill in the date when the camera was set at that location. You can also add comments (specific to the visit) or access notes for that location (also available in the **CameraLocations** form). Click the button to move to the next visit, and enter the data for when the camera was checked or pulled. You don’t have to enter visits in any particular order - they will be sorted chronologically next time you use the form, so whenever you want to add a new visit just click the “Next” button until you are past the last visit that’s been entered.

Once you’ve entered data for a check or pull visit, a button will appear in the lower part of the form that allows you to import photos for that visit (Figure 10).

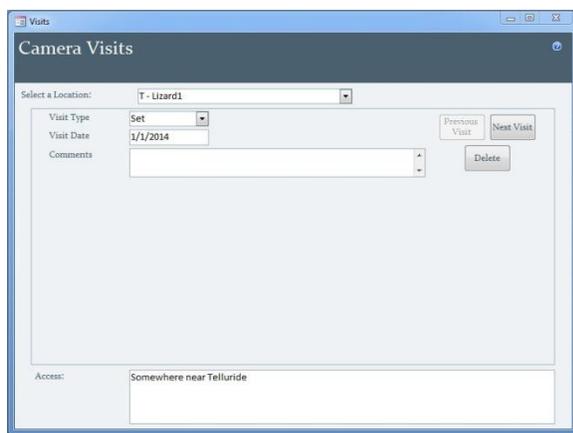


Figure 9 - Visits form (Set)

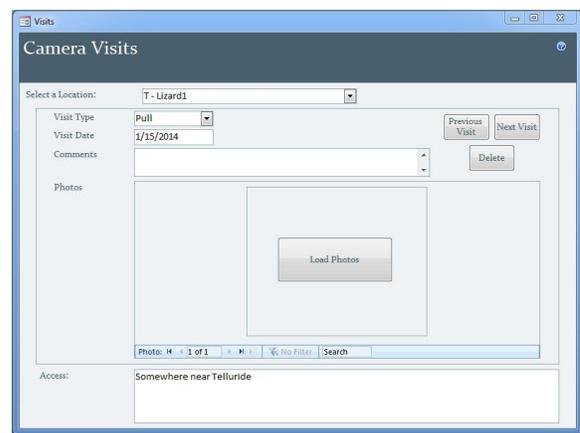


Figure 10 - Visits form (Pull)

Visits are relatively straightforward, but there are a few things to keep in mind when entering this data. Don’t try to represent problems with the cameras by altering your visit information. There is a better way to indicate issues such as battery failure or camera disturbance (more on that later). If you retrieved a camera on June 1 and realized it hadn’t been working properly as of May 15, your pull visit should still be entered as June 1. There is no limit on the number of visits of any type for a given location. If you set up a camera at the same location in two different years, that should be entered as a single location with 2 sets (one in each year), 2 pulls, and unlimited checks in between. Photos are always associated with the visit when they were collected (check or pull visits).

If you need to delete a visit you can do so by clicking the “Delete” button. If there are already photos associated with the visit you wish to delete, you’ll have to decide what to do with them. A popup form (Figure 11) allows you to choose one of three options: you can delete the records for those photos from the database, you can delete both the records in the database and the associated jpg files, or you can switch the photos over to a different visit.



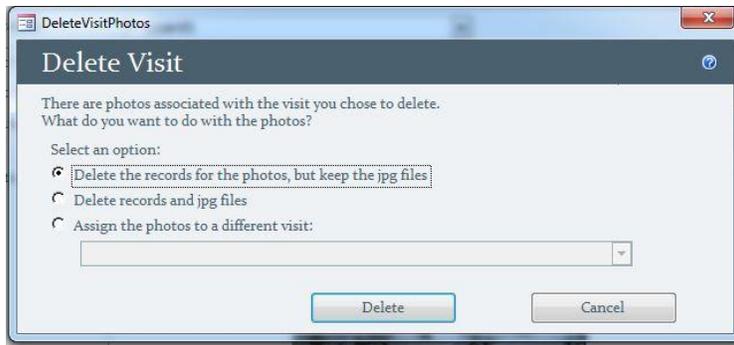


Figure 11 - Deleting a visit with photos

A few examples should make the options more clear. If you associated a set of photos with the wrong visit but don't need to change the filenames, the easiest fix is to delete the incorrect visit and assign the photos to the correct one. If you haven't entered data for the correct visit yet, you can delete the visit and the photo records but keep the jpg files. That way once the correct visit is entered you can import those jpg files without copying them again. If you're in a similar situation but you also renamed the photos while importing them and the names are incorrect, you could delete both the records and the jpg files then redo the import using backup copies of the photos. Likewise if you've imported photos for a visit but then decide that all of them need to be excluded for some reason (e.g. the camera was mounted upside down) you can delete the visit along with all the records and jpg files and pretend it never happened.



Importing Photos

Pressing the “Load Photos” button opens the **ImportOptions** form (Figure 12), which is also available from the **Switchboard** form by pressing the button next to “Import Photos.” In general it’s better to import through the Visits form because the likelihood of assigning photos to the wrong visit is much lower, especially if you have lots of locations or visits. The **ImportOptions** form allows you to browse to a folder that contains jpeg images, select the appropriate visit, and import all of the photos in that folder into the database. If you open it from the **Visits** form the visit will already be selected for you. “Importing” doesn’t necessarily entail moving the image files themselves - at a minimum the data from the files is added to the **Photos** table in the database. If you want, however, you can copy the photos to a new location in the same step - this is particularly useful for importing photos directly from memory cards. Make sure not to confuse the destination folder with the source folder. There is a checkbox to include all subfolders within the source folder you selected (especially helpful for importing from memory cards - you can browse to the drive letter for the card and check the box to import everything on the card), and there are a variety of options for renaming the files if you choose to copy them.

After you’ve imported photos for a visit the “Load Photos” button will be replaced with the images themselves. If you need to import more photos for the same visit, for example if you have paired cameras at each location, you can move past the last photo in the subform and the button will reappear. You can also add additional photos by clicking the “Import Photos” option on the **Switchboard** form, then clicking the link to show visits with photos.

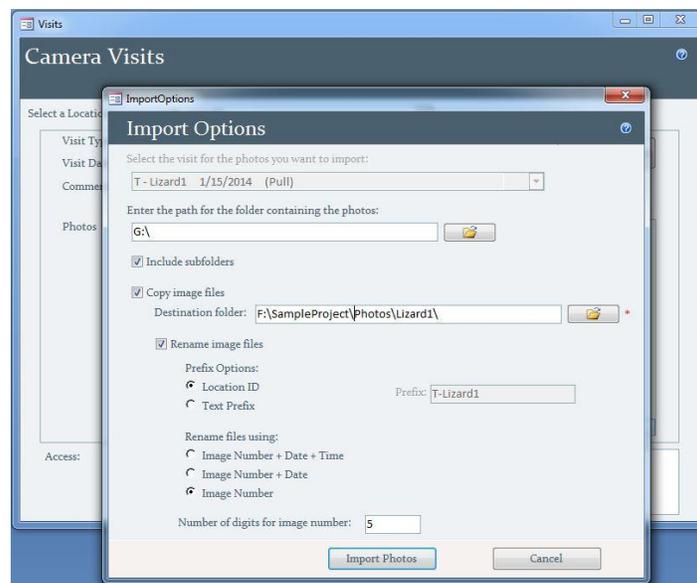


Figure 12 - Importing photos



Identifying Species

Use the “ID Photos” command from the Switchboard form to open the PhotoID form (Figure 13). Before the form opens you’ll be prompted to log in. If your name isn’t already in the list just type it in and hit ‘Enter,’ then you’ll be prompted to add some additional contact info (optional). Never log in as someone else to ID photos.

The PhotoID form displays the photos you’ve imported one at a time, along with a subform for identifying the species present in each photo. Double-clicking on the image will open it in your default photo viewing application, where you will be able to zoom, pan, etc... There are some simple filter options in the form’s header section that allow you to restrict which images the form displays (the “season” filter uses the year from the set date, not the date the photo was taken).

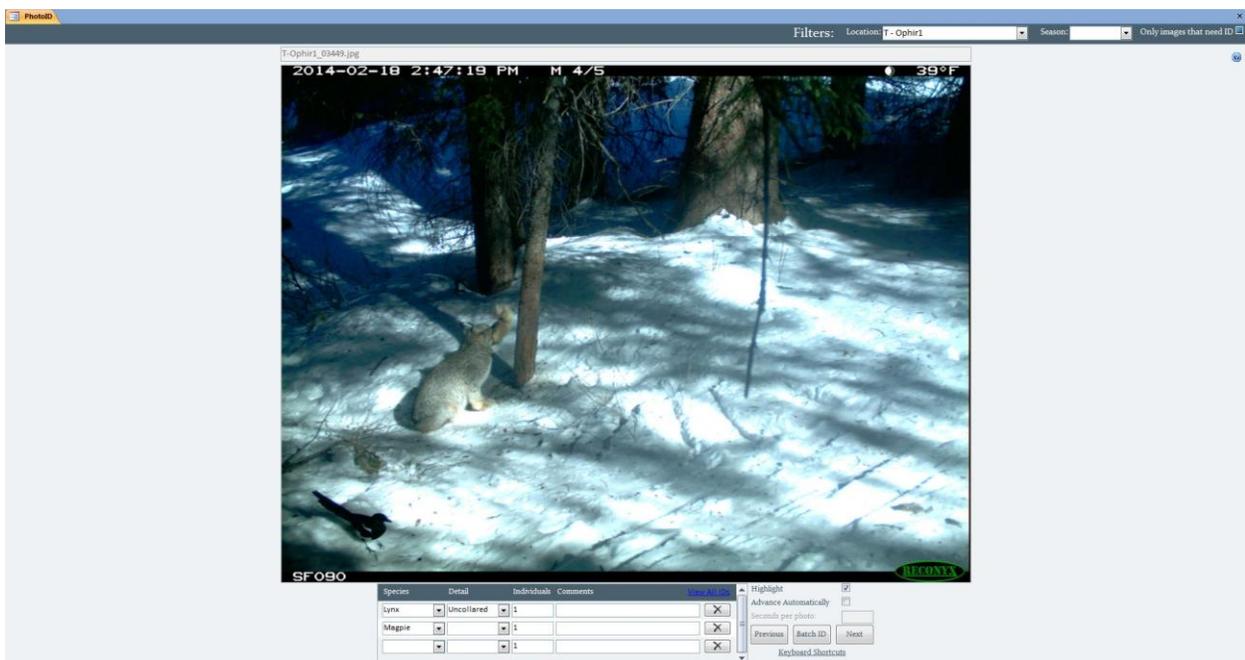


Figure 13 - PhotoID form

To assign species to a photo, select the appropriate species in the drop-down box at the bottom left. You can assign multiple species to the same photo by adding additional rows in the subform. If you want, you can also assign a specific “detail” related to the species you’ve selected. There is also a field for the number of individuals of this species present in the image (default is 1) and a field for comments. Also note the “Highlight” checkbox on the right side - tick this box to flag particularly interesting photos. Highlights can be easily retrieved later on for use in reports or presentations, for example. Once you’ve created a row in the subform for each species present in an image, use the “Next” button to move on.

Don’t just skip photos with nothing in them - specify “None” as the ID. Otherwise you won’t be able to differentiate between photos that haven’t been looked at yet and those that have been reviewed but don’t contain any animals.

If you try to enter something in the species field that doesn’t exist in the **Species** table, Access will prompt you to add a new record to the table. If what you entered was just a typo, click “Cancel” to go back and correct it. If on the other hand it’s a legitimate species that simply hasn’t appeared before, you can click “OK” to add the new species to the table. A message will appear with simple instructions for adding the species and then the form will pop up. Scroll up to make sure that you’re not just adding a synonym for a species that’s already represented (e.g. cougar versus mountain lion), then fill in the Latin name if possible and click “Done” to add the species to the list. You can add a new detail item to the details list the same way.

Check the “Advance Automatically” box to have the form move through the records based on the time period you specify (like a slideshow). To remove a species from a photo, click the “X” button to the right of the comments field.

If all you care about is the species present in your photos, feel free to ignore the Detail and Individuals fields. They make ID’ing the photos take much longer, and aren’t necessary for occupancy or activity pattern analysis.



Using Keyboard Shortcuts

Using the mouse to identify species can be unwieldy and time-consuming, so there are keyboard shortcuts available when using the **PhotoID** form. These are based on the **ShortcutKey** field in the **Species** and **DetectionDetails** tables. To see a list of keyboard shortcuts available, click the link below the “Next” and “Previous” buttons. These shortcuts will only work when the “focus” is on the main form, not within the subform where species are listed. This can be tricky to figure out, but if the keyboard shortcuts aren’t working try clicking the “Next” button, then click “Previous” to return to the record you were on - this ensures that the main form has the focus. In addition to the shortcuts specific to a species or detail, you can use the “Z” key to repeat all of the data from the last photo, and you can use the digit keys 1 through 9 to set the number in the **Individuals** field. You can also use the up, down, left, and right arrows to move between records. Getting this system down can take some practice, but once you learn how to use it you will be able to work through hundreds of photos in no time.

There are a couple of situations to note when using the shortcut keys - first, detail shortcuts will only work if the appropriate species has already been assigned. Otherwise, the species shortcut will take precedence if it exists. For example, imagine “D” is the shortcut for dog, “L” is the shortcut for lynx (both in the **Species** table), and “L” is also assigned for the detail “On Leash” associated with the species dog (in the **DetectionDetails** table). Pressing “D” then “L” will set the species to dog and the detail to “On Leash,” but pressing “L” first will set the species to lynx.

The second important point: while technically it is possible to add multiple species to a photo using the keyboard shortcuts, it’s not practical or intuitive. By default the shortcuts act on the first record listed in the subform. So if the photo in the example above actually had both a dog and a lynx in it, pressing “L” then “D” wouldn’t create the multiple records you need to represent the two different species. Instead, it would set the species for the first record to lynx, then change the species for that record to dog. To assign multiple species to a single image as in Figure 13, use keyboard shortcuts to create the first record, then use the mouse to add a second record and fill in all the fields.

To add or customize the shortcuts available for the **PhotoID** form, click the link to display the list, and then click the button to edit them. This button opens a simple form in which you can edit the **ShortcutKey** fields in both the **Species** and **DetectionDetails** tables. Only letters A through Y are allowed for these fields.



Using the Batch ID Feature

You can assign the same ID to multiple photos at once by pressing the “Batch ID” button on the PhotoID form. This will bring up a new form (Figure 14). Use the drop-down on the left to select the first photo in the series, and the drop-down on the right to select the last. Enter the data you want to add for this range of photos in the bottom of the form, and click “Apply.” If you ID the photo first in the PhotoID form and then click the “Batch ID” button, the ID info will be filled in for you.

Be judicious when using the batch ID feature - it can be a lifesaver when you come across a thousand photos with nothing in them, but it also makes it easier to miss something important. It’s generally most useful for those who like to flip through their photos in Windows Photo Viewer (or another photo viewing program) while ID’ing them. If you prefer this method enter an ID for a photo, and double-click the photo to open it in Windows. Flip through until you find the last photo with the same content, return to the database, and click the “Batch ID” button. Finally, select that final photo on the right side of the BatchID form and click apply.

The screenshot shows the 'BatchPhotoID' application window. The title bar reads 'BatchPhotoID'. The main heading is 'Batch Photo ID'. The interface is divided into several sections:

- Image Selection:** Two side-by-side dropdown menus labeled 'First Image:' and 'Last Image:'. The first dropdown is set to 'T-Ophir1_03400.jpg' and the second to 'T-Ophir1_03447.jpg'. Below each dropdown is a thumbnail of a photograph showing a lynx in a wooded area.
- ID to apply:** A section with four input fields:
 - Species:** A dropdown menu currently showing 'Lynx'.
 - Detail:** A dropdown menu currently showing 'Uncollared'.
 - Individuals:** A text input field containing the number '1'.
 - Comments:** An empty text input field.
- Buttons:** Two buttons at the bottom: 'Apply ID' and 'Cancel'.

Figure 14 - BatchPhotoID form

Distributing Photos for Others to ID

One of the biggest advantages of this database is that you can create a standalone database package and send it off to someone else to ID a subset of photos. We refer to these packages as “modules,” and they include both a stripped down copy of your database and the photo files to go along with it. Start by opening the **PhotoViewer** form and filtering to the photos you want to distribute (more details below). Generally it’s best to include a maximum of 5,000 to 8,000 photos per module for performance and stability reasons, and there’s no advantage to creating a large module with lots of photos lumped together versus a few smaller modules.

Once you have your filters set click the “Copy Photos” button in **PhotoViewer**. When the **CopyPhotos** popup appears, use the browse dialog to **create a new folder** for this module. Name the folder based on the filters you used in the **PhotoViewer** form. Check the box to include a runtime database with your photos and click “Copy.” When the procedure is done, you should have a new file called “PhotoID.accdr” and a folder called “Photos” within the folder you created. The extension “accdr” means the design of the database can’t be edited, and the user doesn’t need the full version of Access to use it. If the person who will be using this module doesn’t have MS Access they will need to download the Microsoft Access Runtime installer from the Microsoft website (free). Your module is now ready for distribution - send it to the person who will be looking through the photos via a thumb drive, ftp site, etc.

The person who uses the module can store it wherever they want - it’s perfectly fine to run it from a thumb drive, or they can copy and paste the folder to any location on their computer. The only caveat is that the folder must be copied in its entirety, meaning the folder with the photos in it and the runtime database must be kept in the same location. All of the information about trusted locations above applies to modules as well.

There is no built-in way of keeping track of which photos you’ve distributed and to whom; creating a simple spreadsheet is recommended.



Photo ID Observers

An appropriate standard for analyzing camera trapping data is to have at least 2 independent observers review each photo, and the database is designed with this in mind. There are really only 2 steps that need to be completed in this process - first, the photos must be reviewed by 2 observers and each observer must independently assign species to the photos. Second, a “referee” must compare any IDs that don’t match between the 2 observers. The referee can be one of the 2 observers who assigned species IDs or a third independent observer.

When you assign a species to a photo through the **PhotoID** form, you’re actually adding a new record to a table called **Detections**. The ID associated with whichever observer is logged in at the time is included with each detection record added to the table, and the record is flagged as “pending.” When you close the **PhotoID** form or import detections from a Photo ID module the records are compared and those that match are flagged as “verified” - meaning the Species, Detail, and Individuals fields all match.

Say you have 100 photos in your database and you ID them all logged in as Observer A. You now have 100 records in your detections table (or more if some photos have more than one species) linked to Observer A. Your coworker (Observer B) then works through all the photos independently assigning IDs. What you end up with in the **Detections** table is a mix of records where Observers A and B agree and those where they don’t. In the first case the records will be marked “verified” and no further action is needed. In the second case both records remain “pending” in the database and need to be reconciled by a referee.

You can have more than 2 observers review your photos if you like. Imagine a second coworker (Observer C) looks through the photos from the example above. There are now several possibilities - A, B, and C can all agree, none can agree, or any combination of 2 observers can agree. In the cases where all observers agree your **Detections** table will simply contain three verified detections with the same information. In any case where the observers disagree, however, there will be pending detection records in the table and the IDs need to be reviewed.

Be careful if you have more than three observers review the same photos - you can inadvertently end up with strange results. Imagine four observers look at a photo of an ungulate and two observers assign “deer” as the species while the other two enter “elk.” If you add all of these IDs to the database at once, all of the detections will be verified because they match another record, and your data will look as if both species are present in the photo. To prevent this make sure to compare the IDs (see below) from the first three observers before adding any more.



Importing IDs from a PhotoID Module

When someone has worked through all of the photos in a module, they can return the “PhotoID.accdr” file via email and delete the jpgs. I like to rename the file once it’s returned with the initials of the person who identified the photos and any other relevant information. Wherever you choose to save the module database, it’s a good idea to make that folder a trusted location.

To retrieve the ID records from the module, open your database (not the .accdr from the module) and click “Import Photo ID Module” on the [Switchboard](#). Browse to the .accdr file and click “Import.” If you see security warnings during the import operation it’s ABSOLUTELY CRITICAL that you press “Open” for each warning. The default button for these warnings is “Cancel,” so don’t just hit the Enter key! Saving the module file in a trusted location will avoid the security warnings altogether. It may take a while for the import operation to run, depending on the number of photos in the module, but when it finishes you will be notified of the number of detections that were added and how they were flagged.

In some situations you may get more detections than you expect from a module. This indicates that some of the photos in the module have more than one associated detection, either because they contain more than one species or more than one observer used the same module database to ID photos.



Managing the Species and Detail Lists

When multiple users ID photos using modules the species and detail lists inevitably get a little sloppy. Imagine Observer A and Observer B both complete a module that includes a few photos of a black bear, but that hasn't been added to the species list yet. Observer A reaches those photos and adds a new record to the **Species** table with a common name of "Black Bear," but when Observer B adds the new record they simply put "Bear" in the common name field. When the IDs from Observer B are imported "Bear" will be added separately to your species list because it doesn't match the existing record, and the IDs for those photos will be considered unmatched.

To fix this, click the button labeled "Edit the Species List" on the **Switchboard**. In the form that appears click the delete button to the right of the record you want to discard ("Bear" in our example). A prompt will appear asking if you're sure, and the database will then check to see if any photos have been assigned that species - in our example we know this is true, since User B applied the "Bear" ID to a few photos. Because there are IDs for the species we're deleting, a second prompt will appear asking whether those IDs should be switched to something else before "Bear" is deleted from the list. Clicking "Yes" brings up a simple pop-up form (Figure 15). On the left in the "Species to Delete" field you see the common name ("Bear") for the record you chose to delete; on the right is a drop down with the other species in your list. Selecting "Black Bear" on the right and clicking the "Merge" button will switch all "Bear" IDs to "Black Bear" and delete "Bear" from the **Species** table, then reevaluate the detections table to see if records flagged "pending" can now be verified.



Figure 15 - Merging species entries

If you choose not to switch the IDs for a particular species when you delete it the IDs will be discarded when the species is removed from the table. If you click yes to switch IDs to a different species but then change your mind and cancel the merge (by pressing "Cancel" on the merge form) you will have another chance to cancel the species deletion.

Managing the details list works exactly the same way - click "Edit Species Details" on the **Switchboard** to get started.



Reconciling IDs

As mentioned above, detections that don't match must be reconciled by a referee - to do so click "Compare IDs" from the **Switchboard** form. This will open the **PhotoID** form in a special mode (Figure 16), and only those photos with pending IDs and two or more observers will be loaded into the form. Verified detections appear in black and pending detections appear in red. For each photo, simply click the "X" next to all incorrect IDs to mark them "deleted" in the table. The information will be kept but the ID will disappear from the form, and any remaining detections will be changed to "verified" in the detections table, and changed from red to black in the form (Figure 17). The same location and season filters are available when comparing IDs that are available when using the **PhotoID** form in its normal mode, but for obvious reasons the "Only Images That Need ID" checkbox is disabled.



Figure 16 - Comparing IDs



Figure 17 - Reconciled ID

If several observers have reviewed a photo and some but not all of the IDs are correct, just delete the incorrect ones. Having duplicate correct IDs is totally fine (those photos won't appear next time you compare IDs). Your goal is to remove any IDs that are incorrect, not necessarily to narrow the list to a single record.

You may however run into situations where a single photo has multiple non-matching IDs and all the IDs are correct (meaning there is no record that needs to be deleted). This can arise when more than one species is present in a photo, for example. In this case, click the button labeled "Verify All Species." This will mark all of the records in the subform verified so that they won't reappear when comparing IDs later on.

If you accidentally delete the wrong record when comparing IDs you can press the "Reset" button, which will set all of the detections for that photo back to "pending." If both initial observers were incorrect, it is best from a bookkeeping perspective to add a 3rd record for the correct species, then proceed to delete the previous 2 records.



Using the PhotoViewer form

Once you've identified the species in your photos through the **PhotoID** form, you can use the **PhotoViewer** form (Figure 18) to view your photos and perform several additional actions. This form contains more sophisticated filtering options for reviewing your photos in more meaningful groupings. It also allows you to move through the photos more easily than **PhotoID**. The location, season, and species filters for this form are dependent, so you can't select a particular season and then select a location that doesn't have any images for that season, for example. Other filters are not dependent, so you may filter down to zero photos when you use those. If you want to include photos for some species but not others, use the "Multiple Species" button to open a form in which you can select the species you want to include. Like **PhotoID**, **PhotoViewer** can advance through photos automatically.

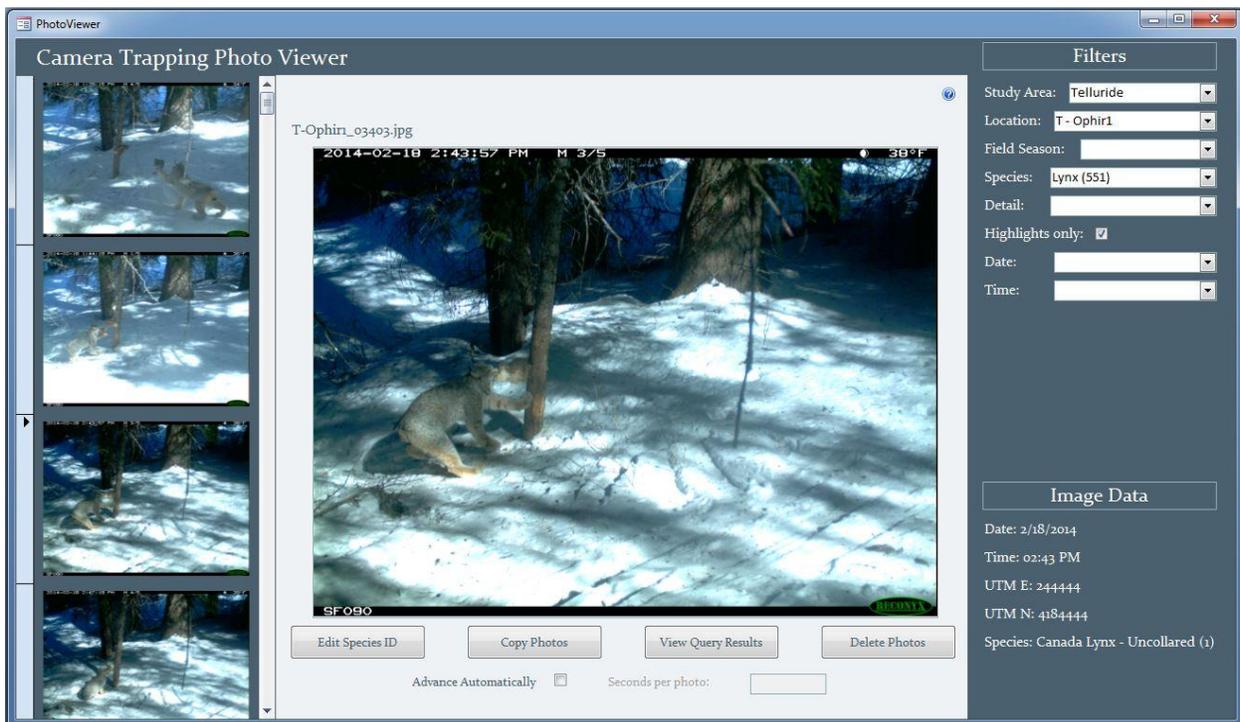


Figure 18 - PhotoViewer form

PhotoViewer also contains a section that displays all of the additional data for each image in the lower right corner. If you need to edit the species for a photo from **PhotoViewer**, press the "Edit Species ID" button. This simply loads the current image into the **PhotoID** form in a pop-up window. This is not an effective way to assign species IDs for batches of photos, since only one photo is loaded at a time. Additional actions you can take from this form are detailed in separate sections below.



Creating a Query with Photo Data

From the **PhotoViewer** form you can create a query that will return the metadata for all of the photos that match your current filters. You can then write additional queries on these results, or paste the results into Excel for further analysis. To do this, specify the filters you want in the **PhotoViewer** form, and then click the “View Query Results” button. This will overwrite the query in the database called **PhotoViewerQuery**, and the results will appear on screen. This query returns location and date/time data, but it doesn’t include species or details assigned. For example, if you wanted to examine changes in ungulate activity over time you could filter **PhotoViewer** to include only ungulate species, click the button, and export your results into Excel to create a graph.

Copying Photos

Another button at the bottom of the **PhotoViewer** form allows you to copy photos based on your current filter settings. Clicking this button opens a simple form where you can specify a destination folder for the copied photos and set renaming options similar to those on the **ImportOptions** form. Before this form opens the **PhotoViewerQuery** is overwritten to reflect the current filters, just as if you had pressed the “View Query Results” button, and this query is then used to identify which files to copy.

A couple examples will make the purpose of this button clearer. Say you deployed a camera on private land, and the landowner requested copies of all the photos in exchange for their permission. You could filter the **PhotoViewer** form to that particular location then use the “Copy Photos” button to create a folder with all the applicable photos. In another case, you might be collaborating with someone who is interested in all of your photos of a particular species. You can filter **PhotoViewer** to display only photos of that species then use the “Copy Photos” button to create a folder of images to send off.

For an explanation of the “include runtime database” option, see “Distributing photos for others to ID” above.

Deleting Photos

Click the “Delete Photos” button on the **PhotoViewer** form to delete all of the photos that match your current filters (similar to the process for copying photos). There are 3 options available when you want to delete photos. You can delete just the jpg files but maintain the records in the database, delete the records but maintain the files, or delete both. Here are a few examples: if you have a ton of photos with nothing in them and you’re tired of looking at them, you may want to delete the records for those files but maintain the jpgs for the sake of keeping a complete archive. On the other hand you may want to clear some space on your hard drive by deleting the jpg files with nothing in them, but maintain the records in the database so you know those photos existed. If you made a mistake importing some files and want to start from scratch, you can delete both the records and the images.



Updating the Path for Photos

If you move any of the folders containing photos you've imported, the database won't be able to display them. To fix this, use the "Update Folder Location" command from the startup form. This opens a form in which you can select a folder location from the **Photos** table then browse to the new location for those photos. When you click the "Update" button, every photo that referenced the location you selected will be updated to the new location. This means you can't update a location for a single photo at a time through this form. If you move a single photo from one folder to another while leaving others untouched, you'll have to update the location manually in the **Photos** table (so don't do it).

If you use an external hard drive to store your photos, the drive letter can change when you switch computers or plug in other drives. If that happens click the "Update drive letter" link on the Update Folder form, select the old drive letter, and enter the new letter for the drive.

If you've moved or renamed a few photos but not an entire folder, you can restore the link to those few photos by double-clicking the empty image frame on the **PhotoID** or **PhotoViewer** form while viewing the appropriate record, then browsing to the correct photo.

Identifying Individuals

If your photos include species with identifiable markings and you want to run Mark/Recapture analysis on your results, you need to assign individual IDs to your photos first. The first step is to identify sequences of photos that represent independent detections. Start by clicking the "Assign Individual IDs" button on the **Switchboard** form. If you haven't already done so you'll be prompted to automatically assign independent detections, and a pop up form will appear (Figure 18 - you can access this form later on from the link on the **IndividualID** form).

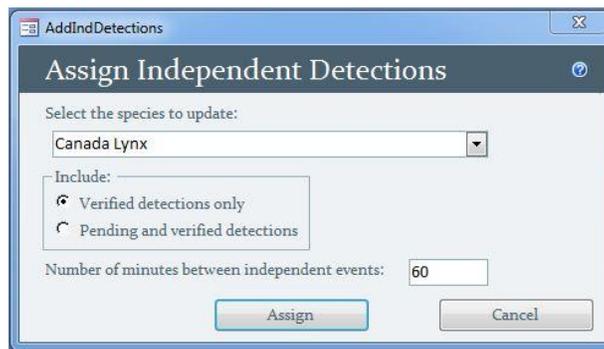


Figure 19 - Assigning Independent Detections

Select the species in which you're interested identifying individuals and specify a time interval for creating independent detection events (hereafter, "events"). The time interval represents the minimum time elapsed between consecutive events of a particular species at a given location that should be considered independent. In other words, if you select cougar in the drop down and enter 90 in the time interval field, an independent event will be added for a photo of a cougar at Location X if at least 90 minutes have passed since the last photo of a cougar at Location X. Independent events can be modified through the **IndividualID** form if

they don't turn out exactly right, so don't stress too much about what you decide to use. For most species 60 minutes will work fine.

Note that this structure is a departure from how identification of species was handled in the database. For *species ID*, an observer reviewed every photo and assigned one or more species to that *photo*. Here, an observer assigns an *individual ID* to each *event*, which is often a *collection of photos*. This structure improves the efficiency with which individual ID data can be stored and manipulated behind the scenes. Furthermore, it improves the efficiency with which individual IDs can be assigned as a single ID will be associated with a (potentially large) collection of photos from the same event, rather than with each individual photo. Thus, the observer is relieved from unnecessary, repetitive ID work.

In general it's best to have all of your species assigned and reviewed before you assign independent events, in which case you can leave the option to include "verified detections only" set. On the other hand if you have still have pending IDs in your **Detections** table you may get better results if you select the option to include them.

Once independent events have been assigned you can move on to identifying individuals using the **IndividualID** form (Figure 19). This form displays a series of photos film-strip style on the left, the currently selected photo and a subform for adding individual IDs in the center, and a few options for modifying events and viewing reference photos on the right. The filters across the top of the form work similarly to those in the **PhotoID** form.

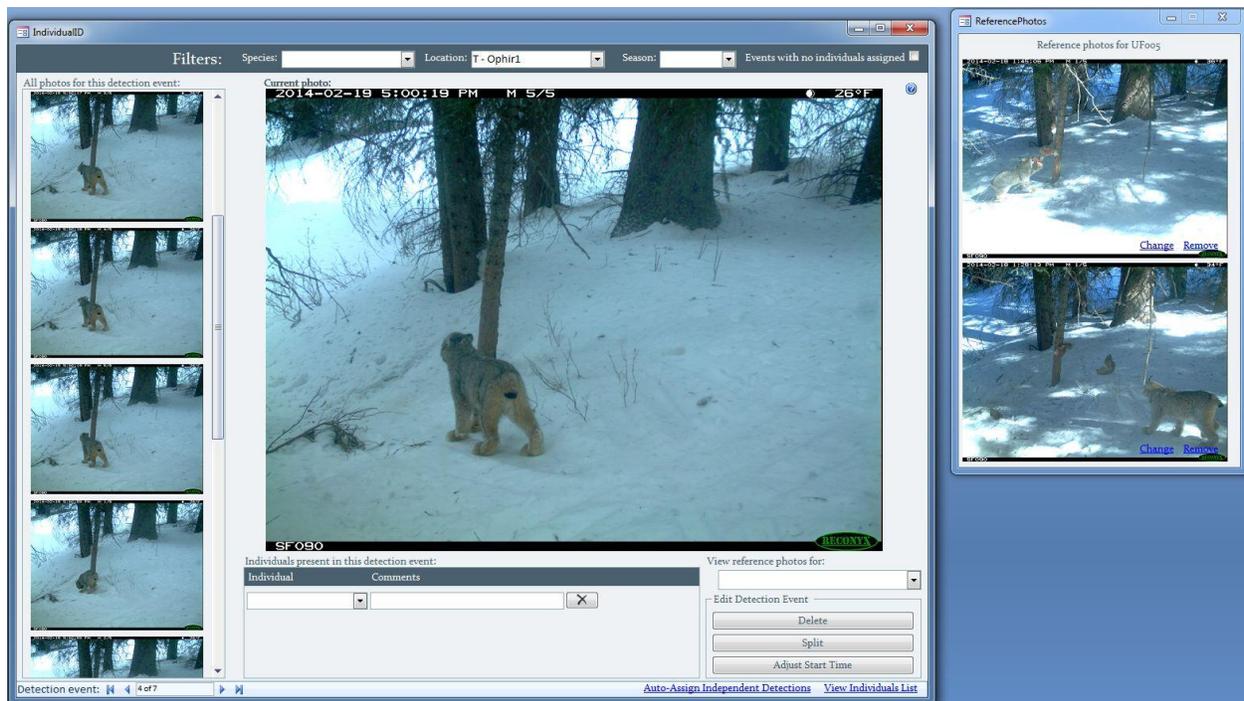


Figure 20 - IndividualID Form

Note that while this form appears superficially similar to the PhotoID form, it is different in some important aspects. Each "page" in this form represents a single, independent event,



consisting of a sequence of photos (filmstrip on left) of one or more individuals of a given species at a given location. To move between events use the navigation bar at the bottom left. Add individual IDs for the current event using the subform at the bottom, which works just like the one on the **PhotoID** form. Once you've added an individual ID a link will appear that you can use to set a reference photo for the individual in question. Unlike the **PhotoID** form it's not important which individuals are in which photos; the individual ID applies to the collection of photos. Just enter all of the individuals present in the sequence in the subform.

When assigning individual IDs you should always check through all the photos on the left side of the form to ensure that no additional individuals are present and that they were grouped correctly. If not use one of the buttons on the right to adjust the detection event as follows:

Delete: This button will delete the current event. Photos currently loaded in the film strip will be considered part of the previous event for this location. This button is unavailable if there are no previous events for the current species at the current location.

Split: This button will create a new event starting with the currently selected photo. Use it if you feel that the photos on the left represent two independent events instead of one. Unavailable if the current photo is already the start of a detection event.

Adjust Start Time: This button opens a pop up that allows you to select the first photo for the current event. Use it if the first few photos loaded on the left should actually be part of the previous event, or if the last few photos for the previous event actually belong with this one. Unavailable if the current photo is already the start of an event.

Pay special attention to events with more than one individual - it can be tough to decide when they should be grouped as a single event or split into two. In general if it seems like the animals are moving together they should be grouped together, but if one individual leaves as soon as another arrives the events should probably be considered independent.

You can view reference photos for a particular individual by selecting the individual's name in the drop down above the buttons for editing detection events. The photos will appear in a pop up form which you can leave open while you work. You can select different photos through the form, and they don't necessarily have to be photos from your camera data, but keep in mind that if you move the database without moving the reference photos the links will break just like the ones in your camera data.

If you can't determine which individual is present in a given event, you can select "Unknown" from the drop down in the subform to indicate that the event has been reviewed.

The individuals list, accessible via the link in the lower right corner, is very straightforward and works similarly to the species list described above.



Analyzing Data

Occupancy Analysis

The OccupancyQueryBuilder form (Figure 21 - Switchboard -> Build an Occupancy Query) allows you to export data from your database for use in single species, single season analysis in MARK or RMARK. It contains a results preview pane on the right and a set of filters and options on the left. No results will display until you've selected a species at the top of the form.

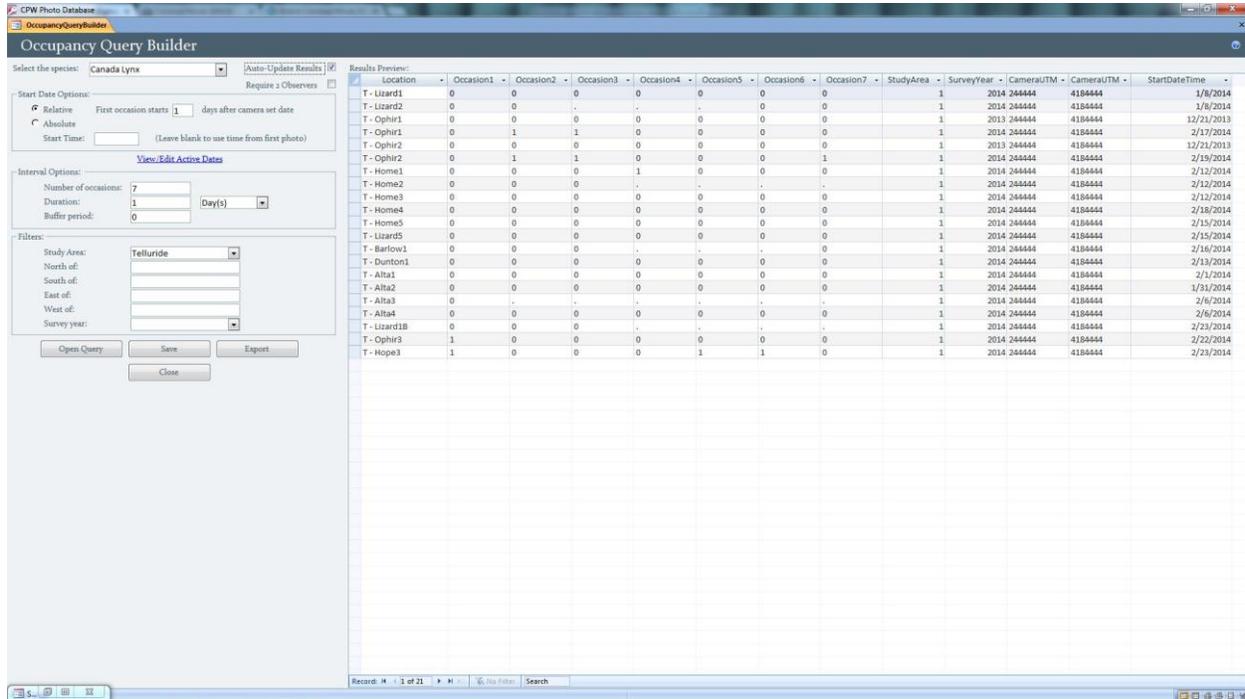


Figure 21 - Occupancy Query Builder

Occupancy input files follow typical capture history format, but each row represents a camera deployment rather than a particular individual. If the species of interest was detected during a particular occasion, the column corresponding to that occasion contains a 1. If the species of interest was not detected during a particular occasion, the corresponding column contains a zero. If the camera was not functional for any part of an occasion it is represented with a “.”.

Uncheck the box labeled “Require 2 Observers” if you want to count detections that have only been entered by one observer. This makes sense if you don’t have two independent observers ID’ing all your photos. Note that if the box is checked and some of your photos have only been reviewed once (or not at all), those rows will have 0’s in the occasion columns (not “.”). For this reason, you should only generate occupancy queries with the 2 observer box checked for deployments that have been reviewed by 2 observers and for which all mismatched IDs have been reviewed and corrected. If you have some data that’s ready to go



and some that isn't you can use the filters to weed out data that hasn't been fully reviewed yet, or you can uncheck the box to accept single observer IDs.

The fields under the "Start Date Options" heading control when the first occasion begins for each deployment. A relative start uses the date of the first photo for a particular deployment and optionally waits a specified number of days afterward before starting the first occasion. Leave the "days after set date" field set to 0 to start the first occasion when the first photo was taken. You can also specify a time to start the first occasion, or you can use the time from the first photo taken by that camera. For an absolute start date you specify a particular date and time, and the first occasion for all deployments begins then.

Under the "Interval Options" heading you can specify the number of occasions for each deployment, the length of the occasions in days or weeks, and the buffer period. A buffer period is an amount of time between when one occasion ends and the next begins during which detections will not appear in the results. This can be helpful if you have relatively few detections of the species in question and you want to ensure that your occasions are independent. For example, imagine you have your query set up for 4 one week occasions starting at midnight on June 1st and you're interested in mountain lions. You can use a one day buffer period to make sure that a mountain lion that showed up on camera at 11:59 PM on June 6th and stayed until after midnight won't be counted as a 1 for both occasion 1 and occasion 2. Another option for obtaining independent occasions is to specify a start time when you don't expect the species of interest to be active, such as noon for mountain lions.

You can limit the data included in your query by using the filter fields. You can select a particular study area or year, or you can enter UTM coordinates to limit the data geographically. If you choose to filter by year, note that the year of the date the camera was set will be used. If you choose to filter using UTM coordinates your locations must all be converted to the same UTM zone for the filters to work properly.

If you experience performance issues while using the occupancy form, try un-checking the "Auto-update results" box near the top. When the box is checked and you change a parameter in one of the fields on the left, the form waits about 2 seconds for further changes then updates the results. This can be clunky, and the form may work more smoothly if you uncheck the box while making changes, then check it only when you want the results to update.

When you're happy with the query you've created you can save the results by clicking the "Export" button. Choose a format (spreadsheet or MARK input file) and specify a name and location for the new file. Check the "view output" box if you want to open the file in Windows once it's created. If you choose to export to a spreadsheet your settings and filters will be detailed on a separate sheet within the workbook. If you export to a text input file the settings will be listed in the header of the text file.

At any time while using the occupancy form you can close it and view your results in a new tab by pressing the "Open Query" button below the settings and filter fields. You can also save the query you've built by pressing the "Save" button and specifying a name for the new



query. When you want to return to it later on you'll find it in the navigation pane category "My Queries."

Adjusting Active Dates for Occupancy Analysis

For the occupancy form to function properly you need an accurate record of when cameras were functioning correctly and when they were not. By default, the first and last photo associated with a particular visit are assumed to represent the period that the camera was active - thus the recommendation that cameras be triggered in the field when set, checked, or pulled. In most cases these should be accurate, but before performing any serious occupancy analysis you should double-check to make sure none of the dates need to be modified. Instructions on changing the active dates will follow after a few examples.

One case where you should modify the active dates is when the camera did not take photos of the crew who set, checked, or pulled it. For example, if a camera was set on June 1st at noon but didn't take a picture until the next day, you can be reasonably certain it was working from the time it was set. In this case you would change the start date for that visit to June 1st at noon. Similarly if the camera was checked June 10th at noon but no photos of the field crew were taken, the end date would be the date of the last photo. As long as you're reasonably sure the camera was still operational when checked you should change that end date to June 10th at noon.

On the other hand a camera may continue to take photos even though it doesn't meet your standards of functionality. If you use bait for your sets and the bait is removed by scavengers, you may want to consider changing the end date for that visit to reflect when the bait disappeared. If a camera is disturbed by a bear and ends up pointing at the ground it may still take a few pictures, but obviously it isn't as likely to detect wildlife as it should be, so you would set the end date to whenever the disturbance occurred.

In some situations involving camera failure you don't need to worry about changing the active dates. This is the case when the camera fails in a way that prevents it from taking photos after the fact, such as battery failure or running out of storage space on a memory card. In these situations the date of the last photo is an accurate representation of when the camera stopped functioning.

One other important point: a camera is considered continuously active across a check visit if less than 12 hours elapse between the active end of the earlier visit and the active start of the second visit. Assuming the crew checking the camera triggered it as they arrived and left, only a few minutes should have elapsed, but if the camera didn't take photos before or after the check you may want to modify one of the active dates to make sure the camera is considered active the entire time.

To modify the active dates when necessary you have two options: you can use the link on the [Visits](#) form or the link on the [OccupancyQueryBuilder](#) form. Working through the [Visits](#) form (Figure 22) is a little more error-proof, since you can only edit the dates for one visit at a time. Simply navigate to the visit in question and click the link to open a popup form with the active dates. The dates of the first and last photo are also listed for reference. Any date



that has been changed will show up in red, dates in black are set to the default first/last photo value. If you modify a date and change your mind you can just copy and paste the date from the first or last photo field.

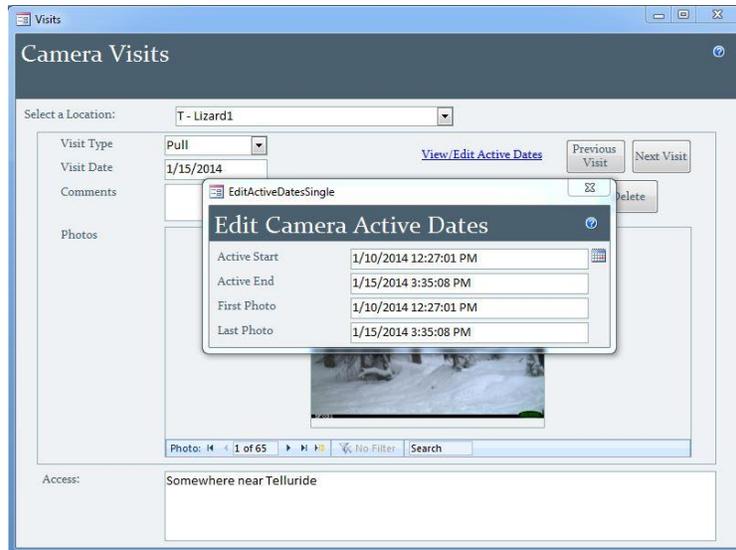


Figure 22 - Editing active dates from Visits form



To modify active dates for several visits open the **OccupancyQueryBuilder** form and click the “View/Edit Active Dates” link (Figure 23). As before the dates appear in red if they have been modified, black if they still match the first and last photo. Dates in red can be reset to the default by clicking the “Default” link to the right of the record.

Study Area	Location	Visit Type	Visit Date	Active Start	Active End	Comments
Molas Pass	Cam1	Set	12/14/2013			
Molas Pass	Cam1	Check	1/14/2014	12/14/13 13:22:26	1/14/14 15:36:28	
Molas Pass	Cam1	Pull	2/8/2014	1/16/14 20:21:38	2/8/14 13:04:22	
Molas Pass	Cam10	Set	12/19/2013			
Molas Pass	Cam10	Check	1/14/2014	12/19/13 16:48:13	1/14/14 14:24:10	
Molas Pass	Cam10	Pull	2/9/2014	1/14/14 14:28:08	2/9/14 16:37:26	
Molas Pass	Cam11	Set	12/19/2013			
Molas Pass	Cam11	Check	1/14/2014	12/19/13 17:26:34	1/14/14 15:00:52	
Molas Pass	Cam11	Pull	2/9/2014	1/14/14 15:07:26	2/9/14 16:12:46	
Molas Pass	Cam2	Set	12/17/2013			
Molas Pass	Cam2	Check	1/14/2014	12/15/13 14:03:44	1/14/14 16:08:26	Default
Molas Pass	Cam2	Pull	2/8/2014	1/14/14 16:13:10	2/2/14 1:19:01	
Molas Pass	Cam3	Set	12/14/2013			
Molas Pass	Cam3	Check	1/14/2014	12/14/13 14:22:14	1/14/14 16:28:14	
Molas Pass	Cam3	Pull	2/8/2014	1/15/14 20:36:40	2/8/14 15:37:12	
Molas Pass	Cam4	Set	12/14/2013			
Molas Pass	Cam4	Check	1/14/2014	12/14/13 16:12:30	1/14/14 16:53:00	
Molas Pass	Cam4	Pull	2/8/2014	1/17/14 5:20:46	2/8/14 15:50:58	
Molas Pass	Cam5	Set	12/17/2013			
Molas Pass	Cam5	Check	1/14/2014	12/17/13 16:05:42	1/14/14 15:31:26	

Figure 23 - Editing active dates from Occupancy form



Activity Pattern Analysis

Creating an activity pattern query is very similar to the process described above, but there are a few key differences. Activity pattern results are formatted for the R package OVERLAP. Click “Build an Activity Pattern Query” on the Switchboard to open the ActivityQueryBuilder form (Figure 24). Activity pattern results consist of a zone column, a species column, and a time column. Each row represents a single photo in which a particular species was detected. The ActivityQueryBuilder form looks very similar to the occupancy form but behind the scenes it works quite differently. It requires a temporary copy of your database to function, so if you notice an extra copy of your .acddb file in the same folder with “AP” added to the name don’t delete it. It will be deleted when the activity form is closed.

Zone	Species	Time
1	Canada Lynx	0.022
1	Canada Lynx	0.024
1	Canada Lynx	0.044
1	Canada Lynx	0.055
1	Canada Lynx	0.117
1	Canada Lynx	0.149
1	Canada Lynx	0.152
1	Canada Lynx	0.167
1	Canada Lynx	0.169
1	Canada Lynx	0.170
1	Canada Lynx	0.208
1	Canada Lynx	0.219
1	Canada Lynx	0.230
1	Canada Lynx	0.251
1	Canada Lynx	0.254
1	Canada Lynx	0.279
1	Canada Lynx	0.257
1	Canada Lynx	0.339
1	Canada Lynx	0.440
1	Canada Lynx	0.562
1	Canada Lynx	0.588
1	Canada Lynx	0.608
1	Canada Lynx	0.615
1	Canada Lynx	0.674
1	Canada Lynx	0.678
1	Canada Lynx	0.708
1	Canada Lynx	0.715
1	Canada Lynx	0.743
1	Canada Lynx	0.779
1	Canada Lynx	0.791
1	Canada Lynx	0.809
1	Canada Lynx	0.829
1	Canada Lynx	0.839
1	Canada Lynx	0.876
1	Canada Lynx	0.881
1	Canada Lynx	0.882
1	Canada Lynx	0.885
1	Canada Lynx	0.916
1	Canada Lynx	0.918
1	Canada Lynx	0.920
1	Canada Lynx	0.931
1	Canada Lynx	0.965
1	Canada Lynx	0.968
1	Canada Lynx	0.988
2	Canada Lynx	0.051
2	Canada Lynx	0.138
2	Canada Lynx	0.148
2	Canada Lynx	0.151
2	Canada Lynx	0.156

Figure 24 - Activity Pattern Query Builder

The “Require 2 Observers” box and location filter fields work exactly like they do on the occupancy form. The species selection box works the same as well, but you also have the option to include multiple species. To do so, click the “Select Multiple Species” button and check the box next to each species you want to include.

Below the species selection section you can specify a quiet period in minutes. The quiet period is the minimum interval between subsequent detections at the same location. The preferred quiet period in the literature seems to be 30 minutes, but you can enter whatever you like. A quiet period of 0 means that all photos will be included in the results. If you set your quiet period and get results that don’t seem to make sense, remember that the quiet period only applies to photos from a single location for a single species. For example, if you set your quiet period to 30 minutes and your first detection is at midnight, no results from

that location will be included until at least 12:30 AM. However you could still have an included detection at 12:01 AM if it's from a different location.

There are two options for grouping your locations into zones. You can use study areas as zones, or you can assign custom zones yourself. If you decide to assign your own be aware that any location which isn't assigned a zone will be omitted from the results, which can be useful if you want to exclude a few locations. Press the button labeled "Edit Custom Zones" to change which locations are assigned to each zone. Once you have your zones figured out you can choose whether you want your results in decimal days ($\frac{hours*60+minutes}{1440}$) or radians (decimal days*2 π). The first step in analyzing your results in R is to convert to radians, so if you plan on using OVERLAP you might as well export your data in radians and save a step.

In addition to the location filters you have the option to filter your results by date, based on a hard cutoff (absolute) or date limits relative to the date each camera was set. All of the date filters are independent, so you can specify an absolute start date with no end date or filter by both absolute and relative dates. If you specify an absolute end date one day is added so that photos are excluded starting at midnight the following day (meaning the end date is inclusive). If you need to specify a date *and time* for the absolute end date field you should subtract one day to achieve the correct cutoff. You can also include additional fields if you like by checking any or all of the boxes in the "Additional Fields" section.

Exporting an activity query is similar to the process for occupancy queries, but the input file option will create a comma-separated values file (.csv) with the settings in the header. To import the data from this file into R use the read.csv command and make sure to specify that the pound sign should be treated as a comment character, otherwise the settings will cause an error. Your R code should look something like this:

```
library(overlap)
myData <- read.csv("C:/Users/DoeJ/MyQueryResults.csv",
                  comment.char = "#")
summary(myData)
spA <- subset(myData, Species == "Red Squirrel")
spB <- subset(myData, Species == "Snowshoe Hare")
spC <- subset(myData, Species == "American Marten")
overlapPlot(spA$Time, spB$Time)
overlapPlot(spA$Time, spC$Time)
overlapPlot(spB$Time, spC$Time)
```

If you export to a spreadsheet your settings and filters will be added to a separate sheet within the workbook. You can also open your query results in a new tab but you can't save queries built with this form. Instead, you can preview your results in a snappy chart (Figure 25 - only available when the output format is set to decimal days).



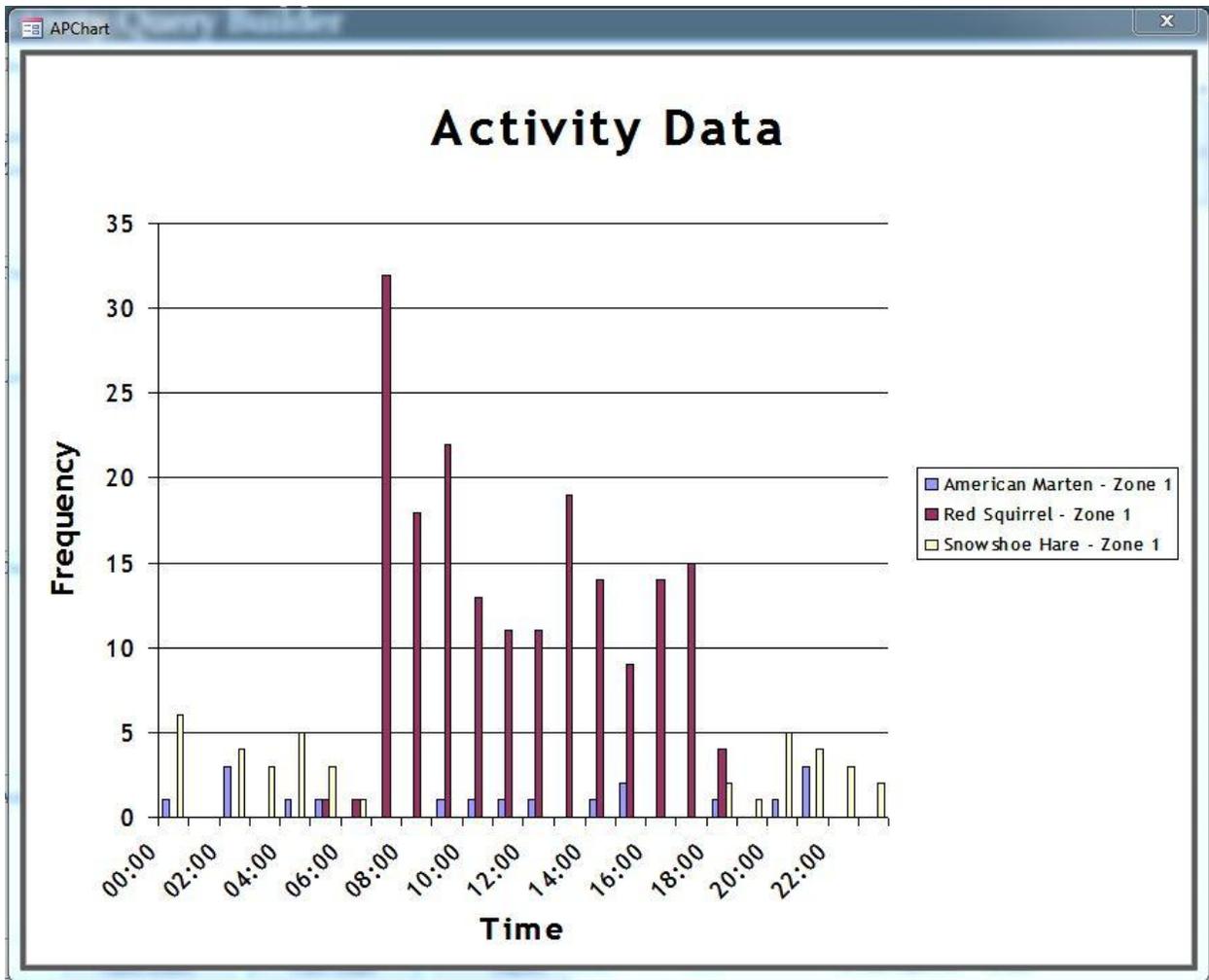


Figure 25 - Activity Data Chart



Mark-Recapture Analysis

A third query builder form is available for creating mark-recapture input files for program MARK or the R package secr - to open it click “Build a Mark-Recapture Query” on the Switchboard form. In order to run either analysis on your data you need to first identify individuals in your photos - see the “Identifying Individuals” section above. The start date options, filters and buttons all work exactly as they do on the occupancy form. Interval options are similar, but no buffer period is available because results are based on independent detections rather than individual photos. There is no option to require two observers because observers are not recorded when assigning individual IDs.

The “Session” field in secr queries combines study areas and deployment periods into a single grouping variable. The first deployment period at a given location is represented by the study area name followed by a 1, and subsequent deployments will be numbered sequentially. For MARK input files the session is identified using group variables after the capture history.

There may be times when you need to change the session field manually after exporting your data to achieve the correct grouping. For example, imagine our study area is Telluride and it contains camera locations numbered from 1 to 20. In 2013 cameras were set at locations 1 to 10, and in 2014 cameras were set at all 20 locations. If you don’t filter by year when creating files for R or MARK, the first session will contain 20 deployments, because it’s based on when a camera was first set at a particular location. The 10 cameras set in 2013 and the 10 cameras set at new locations in 2014 will be grouped together in the session Telluride1. The session Telluride2 will contain the 2014 data for locations 1 to 10, since 2014 is the second deployment at those locations. To group your data more logically you would need to update the session to Telluride2 for locations 11 to 20 and adjust the detector files accordingly. Another option would be to filter by year when creating your mark-recapture queries to ensure the deployments are grouped correctly, but this approach will fail if you have more than one deployment per year.

SECR analysis requires separate input files for detections and detectors - if you export to a spreadsheet these will be included as separate sheets within the same excel file, but if you export directly to “.txt” there will be two separate files created. Trap effort based on the active dates in the visits table is included in the detector file for each location - each number represents the proportion of that occasion for which the camera was operating (from 0 to 1). If you don’t want to include the effort covariates in your analysis you can add “#” before them on each line. If you do choose to include them make sure you set binary.usage = FALSE when you import the files into R, like this:

```
library(secr)
setwd("C:/Users/DoeJ/Documents")
myData <- read.capthist("secrdata.txt",
                       "secrdataTrapsTelluride1.txt",
                       detector = "proximity", binary.usage = FALSE)

plot(myData)
results <- secr.fit(myData)
results
```



If your data includes multiple sessions there will be a separate detector file for each session. Be careful when importing these files using the `read.caphist` function - you must specify the files in the correct order for the data to import correctly (the order is based on alphanumeric sorting of sessions). Keep in mind that if you change the sessions as described in the paragraph above you will need to rearrange the detector files to match your new sessions.

When “`secr`” is selected as the output format you can choose between two types of detectors: proximity and count. Count detectors allow for multiple detections of the same individual at the same location within an occasion, proximity detectors do not. See the documentation for the `secr` package for more details. Make sure to specify the correct detector type when importing your data.

You may get an error in R if you have detections for occasions when the effort is 0. This can happen when the boundary between occasions is almost but not exactly the `ActiveStart` or `ActiveEnd` for a particular location, so that the effort is tiny enough to round to 0. You can either delete the detections for that occasion at that location, or you can set the effort to 0.01 instead of 0. Another error will appear if you have occasions where the effort is 0 for all locations. To fix it you can change the options on the form to ensure that you have at least some camera activity in each occasion, or you can delete the empty occasions from the detector files before you import your data.

If you change the output format to “`MARK`” your results will be pivoted to provide one row per individual, and capture histories will follow traditional “0,1” formatting. Binary group variables after the capture history identify the session associated with each capture history. Additionally, effort (number of cameras operating) by group and occasion is provided in the header of the input file so that you can manually include the effort through the design matrix in `MARK` if you wish.

Keep in mind regardless of which mark-recapture analysis you choose that some detections of individuals may be dependent on others, which can cause unwanted results. For example, if you repeatedly get pictures of a female mountain lion with her offspring, those individuals will appear as separate lines in the input file but their detections were not truly independent. In this case you should delete the rows associated with the kitten to avoid misrepresenting the individuals as independent and overstating the precision of your estimates.

Database Objects

Queries

There are a few utility and summary queries saved in the database in the Queries category of the navigation pane. Summary queries group your camera data by year, study area, or deployment and provide some basic statistics about how long the cameras were deployed and how many photos were collected. [Missing Photos](#) and [Missing Photo Folders](#) find records for which the jpeg file cannot be found. [Occupancy Query](#) is the query that's overwritten each time you create a query through the [OccupancyQueryBuilder](#) form, and the same goes for [SECR Query](#) and [SECR Detector Query](#). [Activity Pattern Query](#) is similar, but it can only be opened while the [ActivityQueryBuilder](#) form is open. [Photo Viewer Query](#) is the query that's overwritten each time you press "View Query Results," "Copy Photos," or "Delete Photos" from the [PhotoViewer](#) form. [Observer Comparison](#) and [Photo ID Summary](#) provide the raw data behind the associated reports.

Reports

Several reports are included to help you manage and summarize your data. To access them, click "View/Print a Report" on the [Switchboard](#) form, then select a report and press the button to generate it. The [Camera Data Summary](#) report combines the summary queries mentioned above to provide summary statistics about your camera deployments. Statistics are calculated first by year, then (within each year) by study area, then finally for each individual deployment. [Camera Pull Checklist](#) provides a list of all the cameras for which you've entered a set visit, but have not entered a pull visit. [Access Notes](#) is exactly what it sounds like - a list of the access instructions that have been entered for each of your camera locations, and the [Contact List](#) report retrieves the data from the [Observers](#) table.

The [Photo ID Summary](#) report is designed to help you keep track of which photos have been processed and which haven't. It's formatted as a list of all your camera deployments with the total photos collected for each, how many of those photos have had at least one species assigned, how many have verified species IDs, and a list of the initials of the observers who have worked on the photos for that deployment. When some work has been done on a group of photos, the location name will appear light green, and when all of the photos in a group have verified IDs the location name will appear darker green. The [Observer Comparison](#) report is provided to give you an idea of how different observers are doing with regard to identifying species in photos.

If you've assigned individual IDs in addition to species, you can open the [Individual Detections](#) report to view a list of detection events and the individuals assigned.



Tables

The tables are described here mainly to provide insight into the functioning of the database. Working with the data in the tables directly is never a good practice - whenever possible use forms to access the data.

The **CameraLocations** table lists each of your camera locations with UTM coordinates and optional access information. Each location is associated with a study area via the **StudyAreaID** field, which corresponds to the field of the same name in the table **StudyAreas** (where the study area names are stored). You can't enter a **StudyAreaID** that doesn't match an existing record in the **StudyAreas** table, so you have to add at least one study area to that table before you can enter location records.

The **Visits** table contains a record for each time a camera was set, checked, or pulled. The **LocationID** field relates **Visits** to the **CameraLocations** table. The type of visit (set, check, or pull) is represented by an integer in the **VisitTypeID** column, and the date of the visit is recorded in **VisitDate**. The start and end times used in occupancy queries are recorded in the **ActiveStart** and **ActiveEnd** fields.

Photos is related to **Visits** on the **VisitID** field. It contains a record for every photo imported into the database. The date/time, folder location, and file name are automatically added to the table when the photos are imported. There is also a **Highlight** field used to flag particularly interesting photos. It's not a good idea to enter photo records manually - always use the "Import Photos" option from the startup form to add photo records.

Detections is related to **Photos** using the **ImageID** field, and is used to store the species (**SpeciesID**, related to the **Species** table) present for each photo. Because these are stored in a separate table, there can be more than one species recorded for each photo. **Detections** also contains a **DetailID** field (related to the **DetectionDetails** table) for adding specific details about the species present, for example "On Leash" if the species is dog. The field **Individuals** stores the number of individuals present in the photo for each species, and the **Comments** field can be used to add additional information. There are also fields that record the observer(s) associated with each detection record.

IndependentDetections, **IndividualDetections**, and **Individuals** contain the data regarding individuals present in your photos. If you never identify your photos to the individual level they will remain empty.

The **SwitchboardItems** table contains the data required for the startup form to function, and **Help** stores the text displayed in custom help messages. Observers' names and contact information are stored in the **Observers** and **ObsPhone** tables.



There are several lookup tables that contain text values for the various ID's stored in the database. Storing an integer (ID) in the data tables and the corresponding text value in a lookup table saves space and improves performance. **DetectionDetails**, **Species**, and **StudyAreas** all function as lookups in this database. Lookup tables can also contain other information about the items in the list that may come in handy at some point, such as the **LatinName** field in the **Species** table.

The following diagram (Figure 266) provides a graphical representation of the relationships between the major tables in the database. To simplify the diagram lookup tables have been omitted. All lookup tables utilize one-to-many relationships with referential integrity enforced.

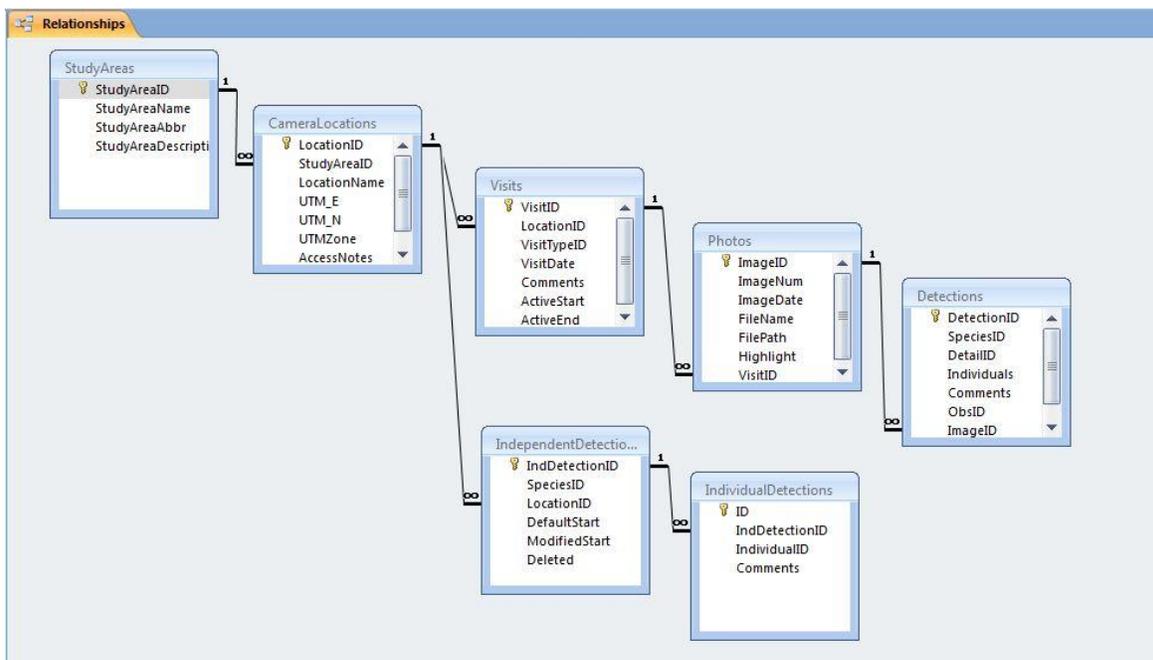


Figure 26 - Relationship schema