

Capture Base

Version 1.3

User Guide

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Table of contents

1	Introduction.....	3
2	Overview.....	4
2.1	Data Management	4
2.2	Analysis and outputs	4
3	Installation.....	5
3.1	System requirements	5
3.2	Installation.....	5
3.3	Settings.....	6
3.4	Update to a new version of the database.....	7
3.5	Know Problems.....	7
4	Entering Data	8
4.1	Overview.....	8
4.2	Entering information for a survey.....	9
4.3	Entering data for each camera station.....	10
4.4	Entering images	11
4.5	Editing species names	12
5	Reports and Queries.....	13
5.1	Reports	13
5.2	Queries	14
5.3	Additional queries.....	16
5.4	Exporting data for analysis in other programs.....	17
6	Capture-Recapture Analysis	20
6.1	Identify individuals	20
6.2	Run the analysis in CAPTURE.....	21
6.3	Calculate the Mean Maximum Distance Moved (MMDM)	22
7	Version History	23
8	Acknowledgements.....	25

1 Introduction

Camera trap surveys produce hundreds if not thousands of photos during each survey. Managing all those photos and the corresponding information can be a difficult task. Camera Base is a tool that should help biologists manage the complete data for multiple camera trap surveys and provide tools for different types of data analysis. The tool was written and used to manage two surveys we carried out in Peru and has saved us a lot of time.

Cameras Base is based on Microsoft Access and requires an installation of Access to run properly. All of the code was written in Visual Basic for Applications and can be accessed through the database. Feel free to make modifications to the database to meet your requirements. I am a biologist and not a computer programmer, so some of the code might be a little messy. Should you add a new module or make an improvement you think might be useful to other users please let me know and I can include it in the official release. We tested the software with several different datasets and I hope I have eliminated most bugs. If you are having problems feel free to contact me. I am also interested in feedback that could help me improve the software.

2 Overview

2.1 *Data Management*

- Manage multiple surveys in one database
- Manage all photos of all species
- Link photos to the data for browsing within the database
- Identify individuals for capture-recapture analysis interactively

2.2 *Analysis and outputs*

- Show a summary of number of photos and capture frequencies (N captures / 1000 camera days) for each species
- Show a photo report for each species
- Run capture-recapture analysis in CAPTURE directly out of Camera Base
- Calculate Mean Maximum Distance Moved (MMDM)
- Show activity pattern graphs
- Automatically assign to each photo if it was taken during the day, night or dusk or dawn based on sunrise and sunset calculated for the survey location for each specific date.
- Mark each photo as independent or dependent event based on a user defined minimum time interval.
- Export data to Mark, Presence, EstimateS and other statistical or GIS software

3 Installation

3.1 System requirements

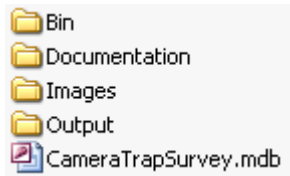
Camera Base was written in Microsoft Access 2003 and was tested with MS Office XP 2002 and 2003. It should work in future Office version but might need some testing. It will probably not work properly in Office 2000 or earlier version. If you are using Office 2000 and don't have access to Office XP please contact the author.

Hard drive space: The installation uses about 10 MB of space. The space required for your photos largely depends on the resolution but can be 100s of MB for a whole survey.

RAM: 512 MB are generally recommended if you are running Windows XP. However, the database should work fine with less RAM. The photo report requires a lot of memory and you might run into problems when creating a report with a large number of images.

3.2 Installation

Unzip the files to a new folder. You should see the following directories and files:

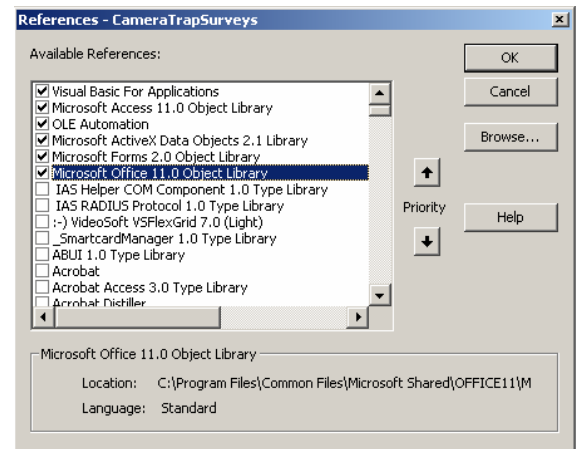


The folder **Bin** contains files needed for image processing. The folder **Capture** contains all the files necessary to run the program CAPTURE. The folder **Images** is where all the image files will be stored after they are imported to the database. Make sure there is enough room for the images on the drive you install the database. The folder **Output** will be used by the database and by CAPTURE to store input and output files for capture-recapture analysis.

Open the database **CameraBase.mdb**. You might get a message telling you that the file might contain harmful code. This is because much of the functionality of the Camera Base was written in Visual Basic for Applications (VBA). Tell Access to open the file. If you get an error message telling you that Access can not open the file for security reasons you need to change your security settings. Select Tools – Macro – Security... from the menu and set the security level to Medium.

Before you can start using Camera Base you need to activate some references in Visual Basic. This needs to be once on each computer running Camera Base. Open The Visual Basic editor form the menu Tools.. Macro.. Visual Basic Editor. In the Visual Basic editor choose Tools... References and make sure the following references are selected:

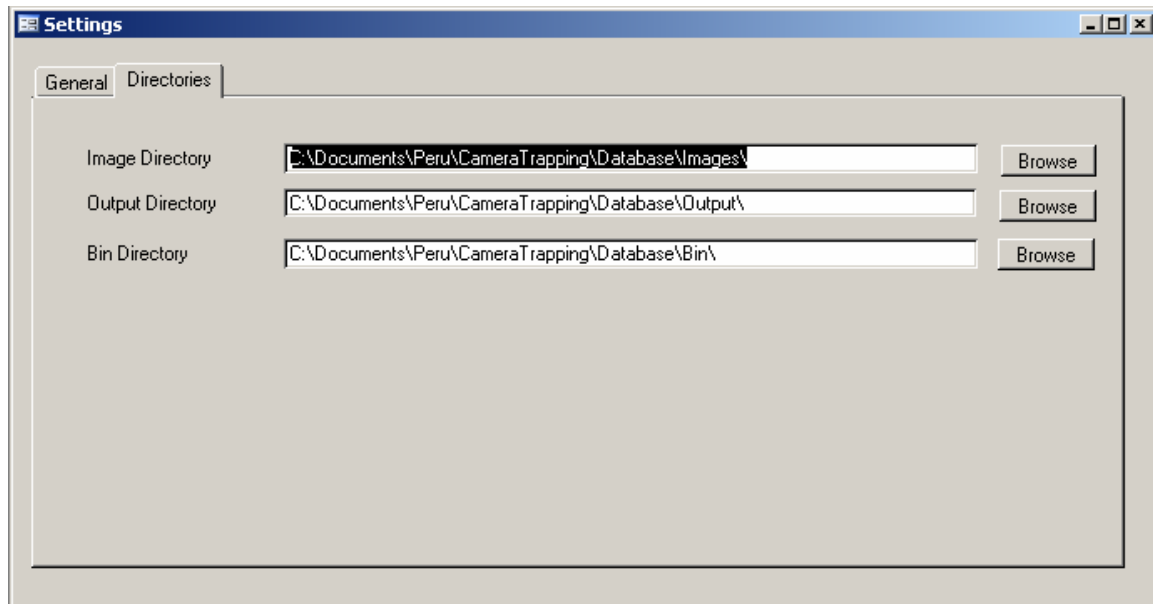
- Visual Basic For Applications
- Microsoft Access 11.0 Object Library
- OLE Automation
- Microsoft ActiveX Data Objects 2.1 Library
- Microsoft Forms 2.0 Object Library
- Microsoft Office 11.0 Object Library



The version number can vary depending on the version of Office you have installed.

3.3 Settings

Before you can start working with the database you need to make sure all the settings are right. In the main menu that is shown when you open the database click on Settings. In the dialog that opens make sure that all the paths point to the correct directories.



3.4 Update to a new version of the database

Unfortunately in Access the data and program code are stored in a single file. So in order to update to a newer program version you will have to transfer your old data to the new version. This can be done in the following steps:

1. Download the new version from the web.
2. Export the data using the Export XML command.
3. Open the new, empty database and import your data using the Import XML command. If there is already existing data in your database you will most likely get an error message.
4. If you have custom queries, reports or forms you can import them using the Get External Data... Import... command in Access.

3.5 Know Problems

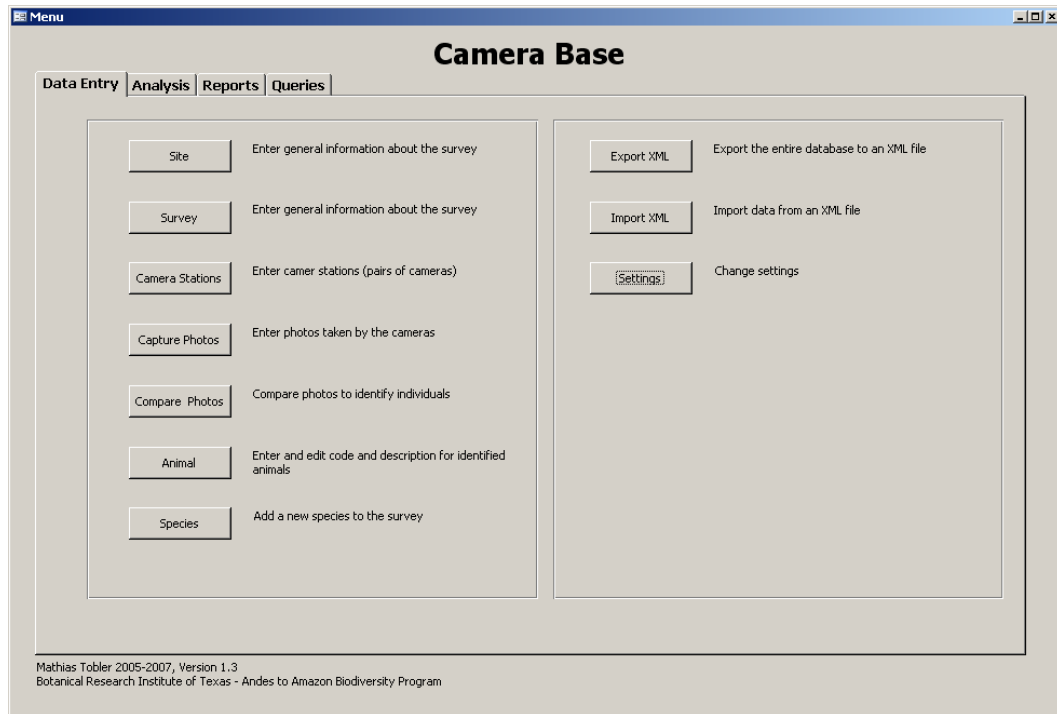
There are a few known bugs that are related to limitations of Access.

- Moving rapidly from one image to another can cause Access to crash or show an error message. This is a problem related to the poor management of images by Access. The best way to avoid this problem is by slowly moving from one record to the next one.
- Creating an image report can take a long time or even freeze your computer. Again this is related to the limitations of Access for image handling. Creating reports with hundreds of images uses a lot of memory. Unless you have a large amount of free memory it is recommended to limit reports to species with up to 30-50 photos.

Please report additional problems with a description of the error message and what you were doing.

4 Entering Data

4.1 Overview



All the functions of Camera Base can be accessed through the main menu. There are different tabs for data entry, analysis, reports and queries.

The following order of entering data is recommended:

1. Enter a Site name
2. Enter the survey information
3. Enter the information for each camera station
4. Enter all the photographs
5. Compare photographs to identify individuals
6. Analyze your data

The following chapters describe each of these steps in details.

4.2 Entering information for a survey

The screenshot shows a 'Survey' dialog box with the following fields and values:

- Site: Los Amigos (dropdown menu)
- Survey Name: Los Amigos 2005
- Organization: BRIT-AABP, WWF-AREAS
- Location: trail system CICRA and CM1
- Latitude: -12.54
- Longitude: -70.06
- Time Zone: -5
- Start Date: 14.09.2005
- End Date: 13.11.2005
- Camera Days: 1440
- Camera Spacing: 2 km
- Responsibility: Mathias Tobler, Renata Leit-Pitman, Rafael Mares, George Powell
- Comments: First survey in this area. Camaras were placed in a regular grid on the CICRA and CM1 trails
- Habitat: Terra Firme

At the bottom, there are record navigation controls showing 'Record: 1 of 4' and 'Record: 1 of 3'.

This dialog lets you enter general information on the survey.

Survey Name	A reference name for the survey. This name will be used throughout the database to refer to the survey.
Project	Name of the Organization conducting the survey.
Location	A general description of the survey location.
Latitude	Latitude in decimal degrees for the survey site. Sites south of the equator have a negative number. This value is needed to calculate sunrise and sunset for the activity patterns.
Longitude	Longitude in decimal degrees for the survey site. Sites west have a negative number. This value is needed to calculate sunrise and sunset for the activity patterns.
Time Zone	Time zone of the survey site with respect to GMT. This value is needed to calculate sunrise and sunset for the activity patterns.
Start Date	The first day of the survey.
End Date	The last day of the survey.
Camera Days	The total number of camera days for the survey. This number is used to calculate capture frequencies.

Camera Days	The number of camera days (number of station multiplied by the number of days they were active).
Camera Spacing	Average distance between cameras.
Responsibility	The people in charge of the survey.
Comments	Genera Comments
Habitat	A list of habitat types that occur in the study area.

Make sure you correctly enter the start and end date. These values will be used for the capture-recapture analysis to define the study period.

4.3 *Entering data for each camera station*

This dialog lets you enter data on each camera station. A station is defined as a location where one or two cameras are set up.

Survey	The name of the survey this station belongs to.
X	X coordinate of the station location in projected or geographic coordinates.
Y	Y coordinate of the station location in projected or geographic coordinates.
Habitat	Habitat type at the station location.
Group	A code for camera groups which allows you to organize cameras and later filter by group. This information is not required.
Code	Code for each camera.

Model	Model of each camera.
Comments	Comments for the station.

4.4 *Entering images*

This dialog lets you enter all the photographs and the associated information. To move from one record to the next use the navigation bar at the bottom left.

Survey	The name of the survey you want to enter photos for. You need to select a survey before you can enter photos.
Station	The station you want to enter photos for. The drop-down list shows you all the stations you entered for the chosen survey. Stations are show with the code of the two cameras.
Date	The date the photo was taken. This information is mandatory.
Time	The time the photo was taken. This information is mandatory too.
Species	The species shown on the photo. You can enter a new species using the New Species... button.
Sex	The sex of the animal shown.
Left side of Animal	Select which image shows the left side of the animal. This information will be used in the identification module and to format the image report.
Browse	Browse for an imge file




Delete Delete an image file. This will also delete the file from your image directory.

The program automatically makes a copy of the photos in the folder specified under Settings for storing images. The photo will automatically be renamed using the following convention: CameraName_Date_Time.jpg. A photo taken by camera Cam1 on the 15. of August 2005 at 15:34 will be named Cam1_20050815_1534.jpg. All photos from the same survey are stored in a subfolder. In order for the program to rename the file correctly it is required that you fill in the station name, date and time.

Important: Images entered with a time of "0:00" are not used in the activity pattern analysis. This allows you to enter images with a missing time stamp without affecting your activity analysis. Should you have a image that was taken exactly at midnight, enter it with a time "0:01".

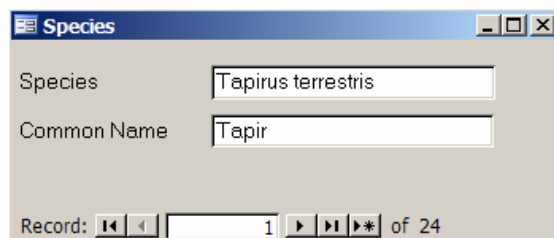
Filter images

You can filter the images shown by different criterias. This is very useful if you want to see only images by a specific station or from a single species.

1. To filter images click on the Filter by Form button: 
2. Select a station, species and/or sex from the drop-dow lists
3. If you want to filter by a specific date enter the date in the date field
4. Apply the filter using the Apply Filter button 
5. To remove the filter click on the Remove Filter button 

With the filter applied you can edit records but you can not add new records.

4.5 Editing species names



This dialog lets you enter species names and add new species to the database.

5 Reports and Queries

5.1 Reports

There are a number of predefined reports. You can create additional reports using the tools provided by Access.

Surveys

This report shows information on all the surveys present in the database.

Species

This report shows a summary of all the species recorded in a survey, the number of photos for each species and the number of stations where the species occurred and the capture frequency as photos/1000 camera days. All values are based on independent events. The time between to events for them to be independent is defined under Settings.

Captures

This reports sows a list of photos taken for each species. For each photo it shows the date, time and station where the photo was taken. If individuals were identified it reports the information by individual.

Animals

Shows the different individuals identified for each species.

Photos

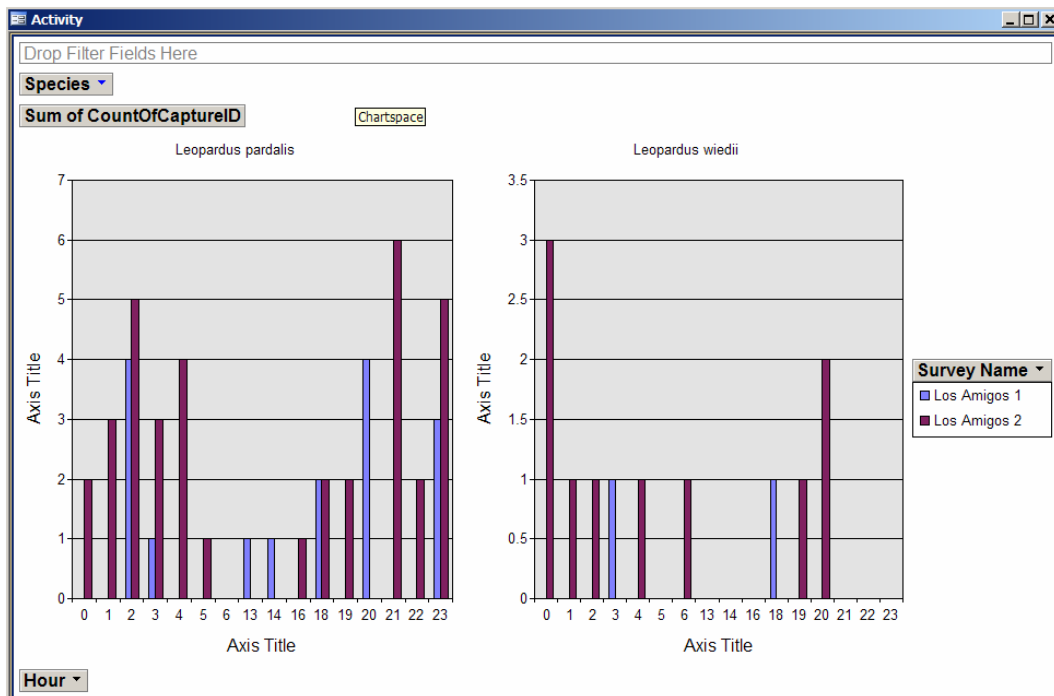
This option creates a report of all the images for a chosen species in a chosen survey. For each image the station information, date and time are given. If individuals are identified images are grouped by individual. Access is limited in its capability of handling images. If there are many images for a species Access will use a lot of memory or the report might crash. Reports work well up to 50 images, depending on your systems resources.

Activity 1

This report shows a summary for each species of how many photos were taken during the day, night or dusk and dawn. Values are calculated based on sunrise and sunset for each day based on the coordinates entered in the Survey form

Activity 2

This report shows you dynamic activity pattern graphs. You can select different species and different Surveys. You can modify different properties of the pivot chart.




5.2 Queries


Export


This option opens all the data in a tabular format for exporting to Excel or a statistical package. To export the data select all records and copy paste them over to Excel. If you would like to export the data in a different format or adding additional fields you can build your own query in Access. There are more predefined queries available in the query list of Access. Please do not delete any of those queries since some of them are needed to create the reports.

If you would like to export only a subset of the data (e.g. only one survey or only one species) you can easily create a filter.

1. Click on the Filter by Form button: 
2. Select the desired options from the drop-down menus

Survey Name	Common	Species	Date
		"Puma concolor"	
		Agouti paca	
		Atelocynus microtis	
		Crypturellus undulau:	
		Dasyprocta variegat	
		Dasyprocta novemcinc	
		Didelphis marsupiali	
		Eira barbara	
		Herpailurus yagouar	

3. Apply the filter using the Apply Filter button 

To remove the filter click on the Remove Filter button 

Species

Shows the species list with the number of images and capture frequency.

Habitat Use

This shows the number of photos in each habitat type for each species and survey.

SexRatio 1

Sex ratio based on identified individuals.

Sex Ratio 2

Sex ratio based on information provided when entering data in the Capture Photos form.

Activity

Shows activity patterns for all species organized by number of photos by hour.

Activity 2

This query shows a summary for each species of how many photos were taken during the day, night or dusk and dawn. Values are calculated based on sunrise and sunset for each day based on the coordinates entered in the Survey form.

Animals

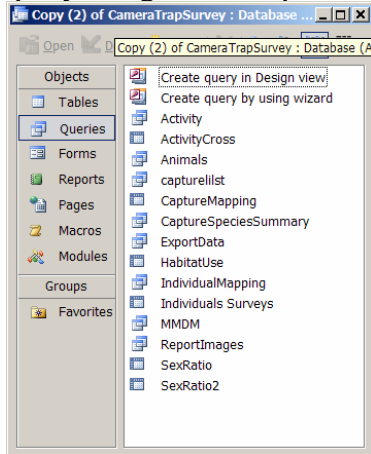
Gives as summary of the number of captures for each identified individual for each survey.

Mapping

This query was made for mapping the number of photos of each species taken by each station. This data can easily be imported to a GIS software to map the distribution of photos.

5.3 Additional queries

Additional queries can be found in Access's query list. Some of these queries are needed for the reports so please don't delete or make changes to them. You can build your own query using the tools provided by access.



Useful additional queries are:

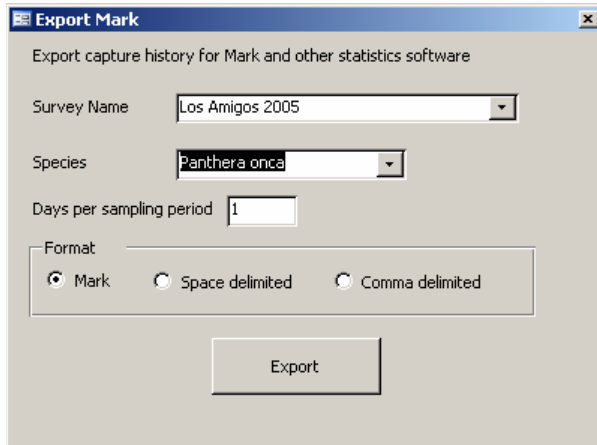
IndividualMapping: Returns a list of capture events with coordinates for each identified individual. You can use filter to reduce your list to a specific species or individual. This list can then be imported into a GIS for mapping.

Individuals Surveys: This query shows the number of photos taken for each individual for each survey. This is especially useful if you want to look at the occurrence of individuals in different surveys at the same place.

5.4 Exporting data for analysis in other programs

Camera base has a variety of options for exporting the data in the correct format for analysis in a variety of software packages such as Mark, Presence and EstimateS. To export the data select the format from the Analysis tab.

Capture History Export



This option lets you export capture histories for analysis in Mark and other software packages.

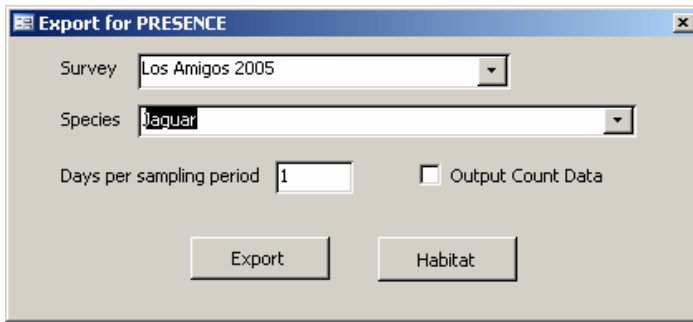
Survey Name The survey you want to export data for

Species The species you want to export data for

Days per sampling period The number of days that are treated as one sampling period. Multiple captures of the same individuals during one sampling period will be treated as one capture. Note that leftover days will not be considered. For example if your survey time was 62 days and you choose 6 days per sampling period you will get 10 sampling periods of 6 days and the last two day won't be used.

Format The export format; Mark, space delimited text file or comma delimited text file.

Export for Presence



The screenshot shows a software dialog box titled "Export for PRESENCE". It contains the following fields and controls:

- Survey:** A dropdown menu with "Los Amigos 2005" selected.
- Species:** A dropdown menu with "Jaquar" selected.
- Days per sampling period:** A text input field containing the number "1".
- Output Count Data:** An unchecked checkbox.
- Buttons:** Two buttons at the bottom, "Export" and "Habitat".

This option lets you export the data to Presence for occupancy analysis. This can be done for all species and does not require individuals to be identified.

Survey Name The survey you want to export data for

Species The species you want to export data for

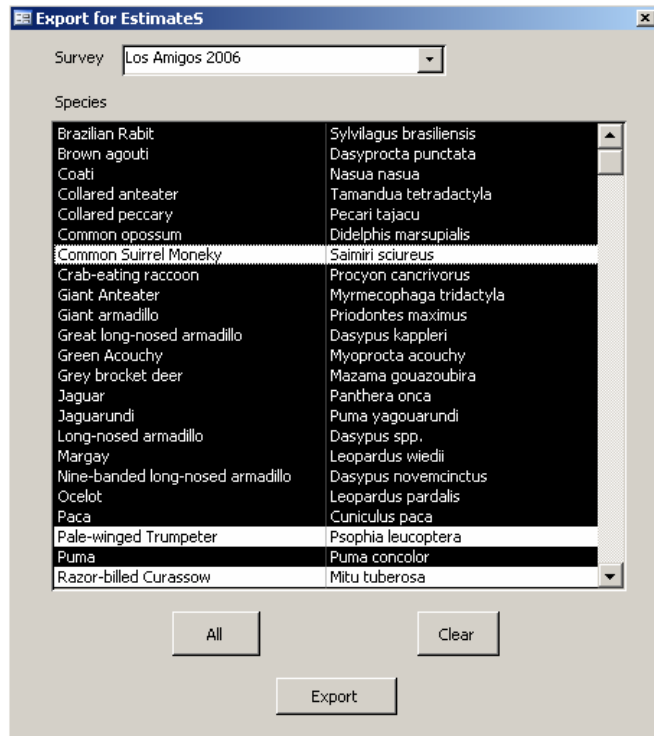
Days per sampling period The number of days that are treated as one sampling period. Multiple captures of the same individuals during one sampling period will be treated as one capture. Note that leftover days will not be considered. For example if your survey time was 62 days and you choose 6 days per sampling period you will get 10 sampling periods of 6 days and the last two day won't be used.

Output Count Writes the number of events instead of 0 and 1 for each survey occasion.

Habitat Writes a file with the habitat for each station that can be used as covariate.

Export to EstimateS

This option lets you export your data for analysis in EstimateS. EstimateS lets you calculate rarefied species accumulation curves and a variety of diversity estimators. To import the data into EstimateS use the Format 4 (Sample, Species, Abundance triplets).



Survey

The survey you want to export data for

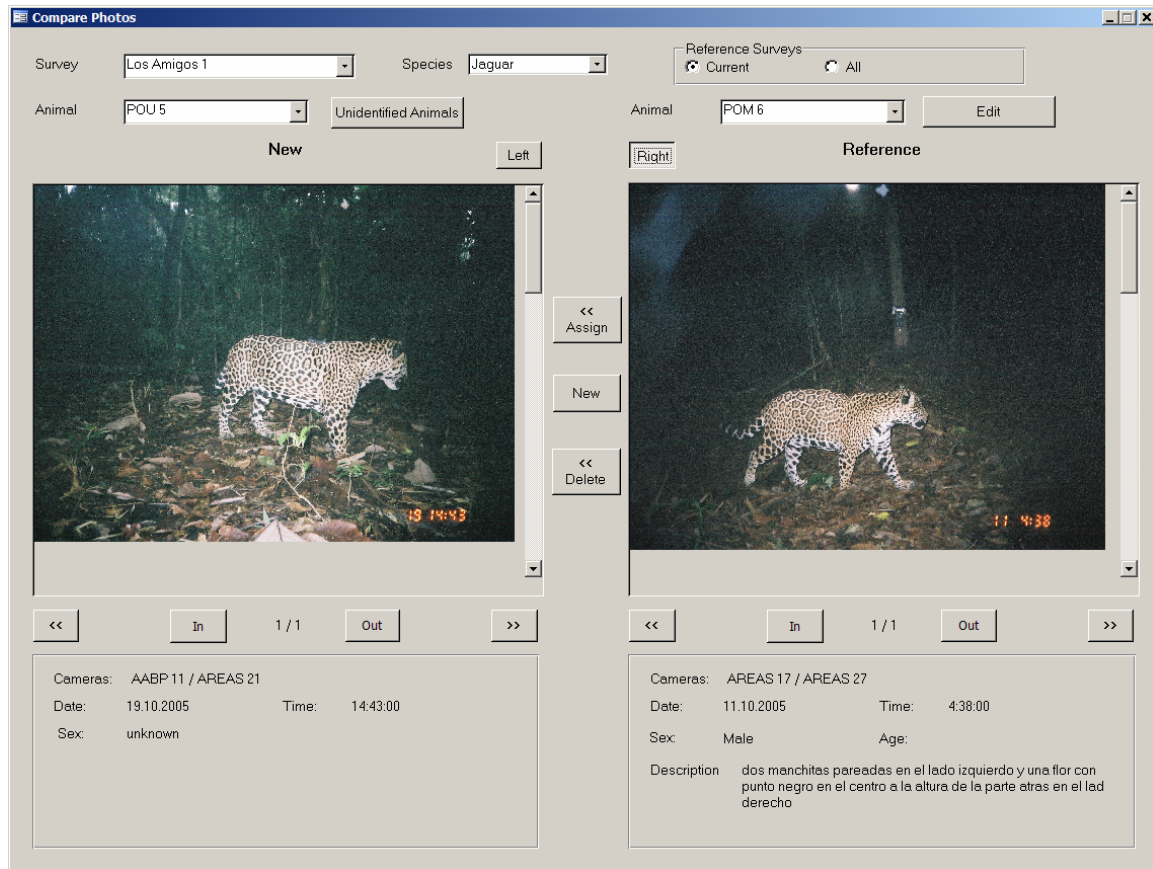
Species

The list of species you want to include. All selected (black) species will be included. You can exclude some species by clicking on them. You can also quickly select All species or Clear the selection.

6 Capture-Recapture Analysis

Capture Base comes with a complete module for identifying individuals and running capture-recapture analysis.

6.1 Identify individuals



The window is divided into a left and a right side. The right side shows the reference image of individuals that have already been identified; the left side shows the photo to be identified. The number below the image shows you the current photo and the total number of photos for an individual (e.g. 3/5, showing photo 3 out of 5).

Survey The name of the survey you want to work on. This information has to be defined before you can start.

Species The species you want to work on. This is the second information you have to enter.

Reference Survey You can either compare individuals from only one survey or from all surveys in the database. The second option is especially useful if you conduct repeated surveys in the same site and would like to see which individuals were photographed in multiple surveys.

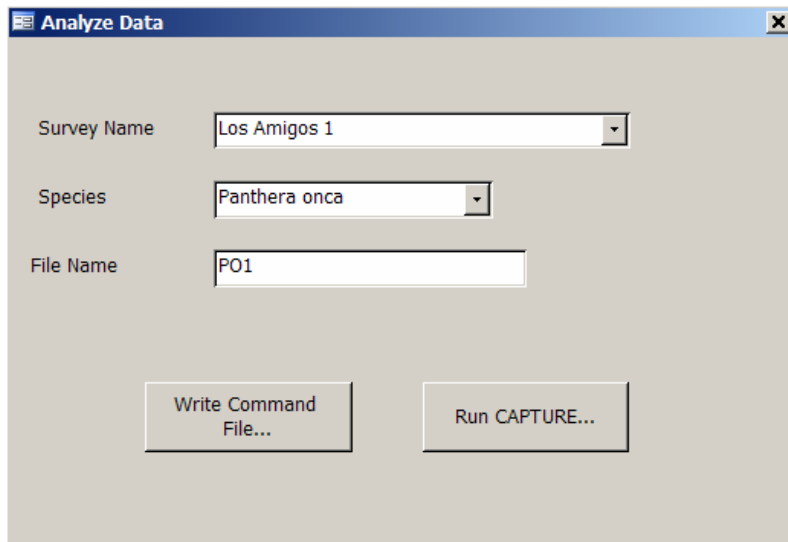
Animal	This drop-down list lets you select an individual. On the left side you can either choose all unidentified individuals or an identified individual you want to check against others to verify your identification.
Left / Right	Switches between the left and right side of the animal.
<< Assign	Assigns the name of the reference photo to the left photo.
New	Creates a new individual.
<<Delete	Deletes the identification for a photo on the left side and marks it as unidentified.
<< and >>	Move to the previous and next photo.
In / Out	Zoom in and out of the photo.

6.2 *Run the analysis in CAPTURE*

Camera Base give you the option to create an input file for CAPTURE or directly run an analysis in CAPTURE with the click of a few buttons.

Before you choose this option make sure the following information is present:

1. The Start and end date for the survey are defined in the Survey dialog
2. All individuals for the species of interest are identified
3. The directories for the CAPTURE program and the Output directory are set correctly



The screenshot shows a window titled "Analyze Data". Inside, there are three input fields: "Survey Name" (a dropdown menu with "Los Amigos 1" selected), "Species" (a dropdown menu with "Panthera onca" selected), and "File Name" (a text box with "PO1" entered). Below these fields are two buttons: "Write Command File..." and "Run CAPTURE...".

In the dialog select a survey, species and define a filename (without extension). Please limit the file name to 8 characters. CAPTURE is a DOS program and only handles filenames up to 8 characters.

You can either write an input file for CAPTURE which you can run later or you can directly run CAPTURE. If you choose the first option the input file will be written and will open in Notepad. If you choose the second option CAPTURE will open in a black window. Please wait until that window disappears until you click OK on the message box. After you click OK your output file will open in Notepad. All files (input and output) are stored in the Output directory you defined under Settings.

6.3 Calculate the Mean Maximum Distance Moved (MMDM)

You can calculate the MMDM for species where you have individuals identified. All individuals with photos from two or more stations will be considered. The results will be shown on the form and can be exported as a text file.

Los Amigos 2005

Survey Name: Los Amigos 2005 Save As...

Species: Panthera onca

Mean Maximum Distance Moved (MMDM) for Jaguar (Panthera onca)

Individual	Camera 1	Camera 2	X	Y
POF 1 Sue	Areas 20	Areas 28	385517	8613050
POF 1 Sue	RL 8	RL 11	381533	8612894
POM 2 Sontqoy	RL 5	RL 10	378327	8614096
POU 3	RL 6	RL 7	379585	8612920
POF 4	RL 1	RL 2	381809	8609217
POU 5	AABP 11	Areas 21	385570	8611222
POM 6	Areas 17	Areas 27	387487	8609288
POM 7	AABP 12	AABP 13	385626	8616998
POU 8	AABP 7	AABP 14	383483	8617008
POM 9	AABP 9	AABP 17	381384	8615016
POF 12 Ciega	AABP 11	Areas 21	385570	8611222

Individual	N Stations	Max Distance
POF 1 Sue	2	3987
POM 2 Sontqoy	1	0
POU 3	1	0
POF 4	1	0
POU 5	1	0
POM 6	1	0
POM 7	1	0
POU 8	1	0
POM 9	1	0
POF 12 Ciega	1	0

MMDM: 3987
1/2 MMDM: 1994

To create the MMDM report select a survey and a species and enter a filename (without extension). The file will be written to the output directory. Files with the same file name will be automatically overwritten.

In the first part the report lists for each individual all the stations where it had been photographed and gives the X and Y coordinates for each station. It then gives a summary for each individual listing the number of stations the animal has been photographed by and the maximum distance moved. At the end it lists the MMDM considering all individuals photographed by at least two stations.

Important: In order for the program to be able to calculate distances the coordinates for each station need to be in a projected coordinate system (e.g. UTM). Geographic coordinates (Lat/Long in decimal degrees) will return invalid results. The output units are in the units of the coordinate system (e.g. meters for UTM).

7 Version History

Version 1.3

- Added a new table "Site" that lets you combine surveys from the same site
- MMDM now shows results in the window
- MMDM can use geographic or projected coordinates
- New option to export capture histories in different formats (e.g. Mark)
- New option to select the number of days that are treated as one survey event for capture-recapture analysis
- New option to export data for occupancy analysis in Presence
- New option to export data to EstimateS for species diversity analysis
- In the "Compare Photos" window you can no filter individuals by site
- Activity queries now ignore events with time "0:00", that time can therefore be used for photos with missing time
- Moved CAPTURE.exe to the Bin directory
- Moved the small images into the survey image folder
- Fixed various small bugs and usability issues

Version 1.2

- Updated the activity pattern pivot table so that all hours are shown even if there are no data for some hours.
- Added new field "Independent" to table Capture, type Yes/No
- Added new field "CameraDays" to table Survey, type Long Integer
- Added new field "TimeEvent" to table Settings, type Long Integer
- Added a macro that automatically marks a record as an independent or dependent event. The macro is run when the Capture Form is closed.
- Added filters to use only independent events to all queries.
- Added capture frequency to the species summary report.
- Added new field "Lat" to table Survey, type Number Single
- Added new field "Long" to table Survey, type Number Single
- Added new field "TimeZone" to table Survey, type Number Integer
- Added new field "DayNight" to table Capture, Type Text 15
- Added a macro that defines for each photo if it was taken during the day, night or at dusk or dawn. The macro is run when the Capture Form is closed.
- Made small changes to the capture history routine.
- Added XML export and import functions
- Made small changes on the Compare Photo form
- Added an option to rename the original image file after importing to the settings
- Updated the main menu
- Added automatic extraction of date and time from EXIF data for digital cameras

Version 1.1

- Improved support for multiple surveys throughout the database

- Added support to compare animals between multiple surveys to the animal identification module
- Added a module to calculate the Mean Maximum Distance Moved (MMDM)
- Added new queries
- Added activity pattern graphs
- Added automatic resizing to create small images for the reports
- Moved over to Access 2003
- Created this User Guide

Version 1

This was the first working version of the database. This version was written in Access 2000 and served as a test platform.

8 Acknowledgements

Funding for this work comes from the Gordon and Betty Moore Foundation through a grant to the Botanical Research Institute of Texas. Camera trap work that led to the creation of this database was carried out in collaboration with the WWF AREAS project. I would like to thank Samia Carrillo-Perceste for continues input and testing during the development of this database.

The code used to calculate sunset and sunrise was translated from a NOAA Javascript to VBA by Greg Pelletier (gpel461@ecy.wa.gov).

Parsing EXIF data is done with the EXIF Reader Class:

<http://sourceforge.net/projects/exifclass/>

Image processing is done with the help of the software Irfan View 3.98, written by Irfan Skiljan.