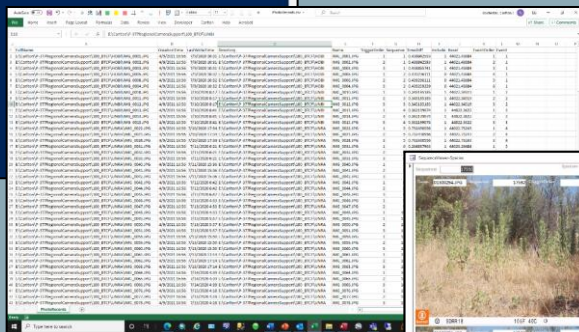


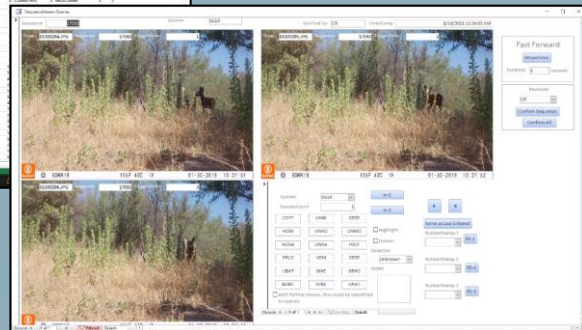
Wildlife Camera Photo Processing Protocol

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```
Windows PowerShell
PS C:\Cap\tonP-37\RegionalCameraSupport\100_BICP> Get-Childitem -Recurse | Select-object FullName, CreationTime, LastWriteTime, Directory, Name | Export-Csv -Path .\PhotoRecords.csv -NoTypeInformation
```



A screenshot of a spreadsheet application displaying a large table of photo processing data. The table has multiple columns, including file names, creation times, and directory paths. The data is organized in a grid format, with rows representing individual photo records.



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U. S. Geological Survey, San Diego, CA, U.S.A.

February 10, 2022

cmd window

MS Excel

MS Access

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What it is not

- Not automatic photo processing
- Not artificial intelligence (AI)
- Not machine learning
- Not the final database
- Not the answer for everyone

What it is

- Multi-step, multi-program process:
 - cmd->MS Excel->MS Access
- Tools to group, subsample, and review
- How we have processed 6.6M photos
 - 91/71 Chino Hills wildlife movement (5.5M)
 - San Dieguito River/San Pasqual (0.7M)
 - Army Corps Dam sites (0.4M)



Wildlife Camera Photo Processing Protocol

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Preprocessing

- cmd window used to generate list of photos

 - Photo name, file path, capture date/time

- MS Excel used to group photos into sequences, events, and subsample class

 - Sequences based on camera setting in the field (3 photos per trigger)

 - Event based on 15 minute moving window to group potentially related photos

 - Subsampling was used to remove potentially related photos, simulating a 5-minute quiet period on the camera settings

 - MS Excel macro used to standardize and automate this step. The macro sorts the records, enter the equations, and filters out non-photo files.

- Records imported into MS Access database and tested

 - Confirm camera names

 - Confirm file path is linking to photos

typically done once per site per sample session

Wildlife Camera Photo Processing Protocol

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Preprocessing

frmSiteSelectorSwitchboard

Database Setup

Step 1: Import SwitchBorad

Step 2: Site List

Step 3: Run Site Name Update Query

Step 4: Review PhotoRecords (Optional)

Photo Sorting

Camera Name: SAR-12

Sequence Switchboard

frmSiteSummary

Site	Total Photos	Processed Photos	%Complete	Start	End	Viewer
91-17N	645	19	2.95%	10/15/2021 9:31:48 AM	1/1/2098	All-Sequence
CHSP-04	555	9	1.62%	10/14/2021 8:55:06 AM	1/5/2022 8:48:04 AM	All-Sequence
CHSP-05	1065	15	1.41%	10/14/2021 8:39:54 AM	1/5/2022 9:06:04 AM	All-Sequence
CHSP-07	636	9	1.42%	10/15/2021 10:31:44 AM	1/5/2022 9:46:48 AM	All-Sequence
CHSP-08	5061	12	0.24%	10/15/2021 10:40:54 AM	1/5/2022 9:20:08 AM	All-Sequence
SAM-05	396	9	2.27%	10/15/2021 9:25:34 AM	1/7/2022 10:27:12 AM	All-Sequence
SAR-05	5166	2	0.04%	10/15/2021 11:48:04 AM	11/16/2021 12:02:28 PM	All-Sequence
SAR-06	1593	9	0.56%	10/14/2021 8:44:42 AM	1/5/2022 8:42:28 AM	All-Sequence
SAR-08	364	9	2.47%	10/15/2021 9:35:58 AM	11/27/2021 6:25:24 AM	All-Sequence
SAR-12	468	9	1.92%	10/15/2021 9:43:30 AM	1/7/2022 10:49:56 AM	All-Sequence

Record: 1 of 10

No Filter

Search

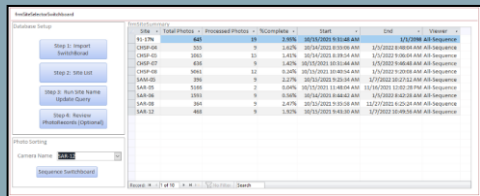
Includes camera name, total photo count, processed photo count, and effective sample range

Wildlife Camera Photo Processing Protocol

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Processing

- The primary reviewer
- Review and tag sequences
- All cameras within a site for the sample session
- Species buttons customization



SequenceSwitchBoard

Site SAR-12

Sequence SwitchBoard

All Sequences All-QP All-QP0

UnTagged Sequences Species Button Setup

None Sequences Events

Single Viewer

All-Single Viewer

UnTagged-Single Viewer

Open Sequence

Sequence

Open Sequence

Species Lookup

Species

Species Lookup

Update Drive Letter

From: To:

Update Drive Letter

ReviewStats

Speci	#	ExPh	HL	QP	QP0	V	FR
	459						
HOB1	9			6	3		

Record: 1 of 2

The highest record number with a species reported

Last Record 156

!!!Only jump to this record if you have been working straight through and not jumping around!!!

Last QP Sequence 2

Last QP0 Sequence 1

Start 10/15/2021 9:43:30 AM End 1/7/2022 10:49:56 AM

Wildlife Camera Photo Processing Protocol

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SequenceViewer

Sequence: Species: Event: Length:

Name: Sequence: TriggerOrder:

Name: Sequence: TriggerOrder:

Name: Sequence: TriggerOrder:

Fast Forward

Duration: seconds

frmExamplePhoto

TriggerOrder:

Step back:

Species:

SpeciesCount:

☐ Highlight

☐ Delete

Direction:

Notes:

☐ With further review, this could be identified to species

RubberStamp-1:

RubberStamp-2:

RubberStamp-3:

frmBatchTagging-Batch

StartSequence: EndSequence:

Record: of

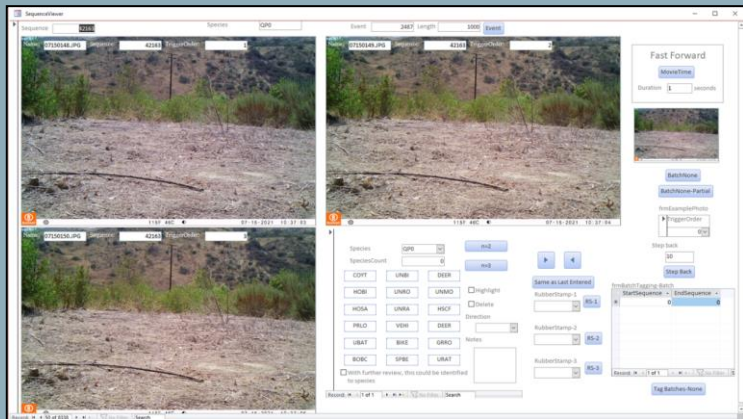
Tag Batches-None

Wildlife Camera Photo Processing Protocol

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Processing by Sequence

- Photos grouped by sequence
- Sequences tagged with species, not individual photos
- Potential to enter species multiple ways
 - Lookup list
 - 18 predefined buttons
 - Same as last
 - “Rubber stamp”
- Blank sequences do not need to be tagged individually

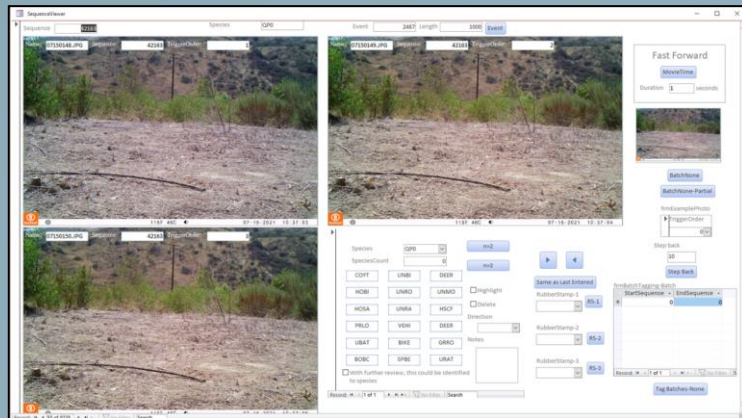


Wildlife Camera Photo Processing Protocol

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Processing by Sequence

- Fast forward by selected interval
- Preview of next sequence
- Record direction of animal movement
- Tag a sequence as a highlight
- Tag a photo as an example of the species identified
- Tag a sequence for deletion due to inappropriate behavior



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Event-000EventList

Event: 5
Name: IMG_0091.JPG
Sequence: 31
TriggerOrder: 1
Open Single Sequence

Event: 5
Name: IMG_0092.JPG
Sequence: 31
TriggerOrder: 2
Open Single Sequence

Event: 5
Name: IMG_0093.JPG
Sequence: 31
TriggerOrder: 3
Open Single Sequence

Event: 5 Length: 24
Species: SpeciesCount: Open Form

Same as Last Entered
RubberStamp-1 RS-1
RubberStamp-2 RS-2
RubberStamp-3 RS-3

EventDurationS: 206.
EventDurationM: 3.43
EventDurationH: .06
EventDurationD: -

P330-Detection
Species: n=2
SpeciesCount: 1 n=3
COYT UNBI DEER
HOBI UNRO UNMO Highlight
HOSA UNRA HSCF Delete
PRLO VEHI DEER Direction: Unknown
UBAT BIKE GRRO Notes
BOBC SPBE URAT
With further review, this could be identified to species

Record: 1 of 1 No Filter Search
Event-BatchNon-Partial

Record: 1 of 24 No Filter Search
Record: 5 of 220 No Filter Search

Wildlife Camera Photo Processing Protocol

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Processing by Event

- All Sequences that are part of the same Event can all be tagged at the same time
- Same species entry tools as Sequence viewer
- Summary of Event
 - Number of photos
 - Duration of Event in seconds, minutes, hours, and days

The screenshot displays two windows from the Wildlife Camera Photo Processing Protocol software. The 'Event-000EventList' window on the left shows a list of three photo sequences, each with a thumbnail image of a road leading into a culvert. The sequences are labeled IMG_0091.JPG, IMG_0092.JPG, and IMG_0093.JPG. To the right of the thumbnails are input fields for Event (5), Name, Sequence (31), and TriggerOrder (1, 2, 3 respectively), along with an 'Open Single Sequence' button. The 'P330-Detection' window on the right provides a summary for Event 5, showing a SpeciesCount of 1 and various duration fields (RubberStamp-1 to -3, EventDurationS, M, H, D). It includes a species selection grid with buttons for COYT, UNBI, DEER, HOBI, UNRO, UNMO, HSCF, UNRA, PRLO, VEHI, DEER, UNB, BIKE, GRRO, BOBC, SPBE, and URAT. There are also checkboxes for 'Highlight', 'Delete', and 'Direction', and a 'Notes' field. At the bottom, there are search and filter controls.

Wildlife Camera Photo Processing Protocol

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Processing by Species Folder

- If the photos have already been sorted into species folders, the folder name can be used to make species records
- Why?
 - Legacy datasets
 - Preference
 - Can still make database records

SequenceSwitchBoard

Site: SAM-06

Sequence SwitchBoard

All Sequences All-QP All-QP0

UnTagged Sequences Species Button Setup

None Sequences Events

Single Viewer

All-Single Viewer

UnTagged-Single Viewer

Open Sequence

Sequence: []

Open Sequence

Species Lookup

Species: []

Species Lookup

Update Drive Letter

From: [] To: []

Update Drive Letter

ReviewStats

Spec	#	ExPh	HL	QP	QP0	V	FR
HOB1	13819	2				2	

Records: 1 of 2

The highest record number with a species reported

Last Record: 1

!!!Only jump to this record if you have been working straight through and not jumping around!!!

Last QP Sequence: 0

Last QP0 Sequence: []

Start: 3/18/2021 10:41:38 AM End: 4/17/2021 1:41:00 PM

Step 1 - Assign QP0 Records

QP0 Insert (Camera Specific)

Step 2 - Assign Observer

Observer: [] (Camera Specific)

Step 3 - Proofs

NonProofs Proofs

Step 4 - File Sorting Code

cmd Code to Sort Files Update File Path (Camera Specific)

If Photos are already sorted into folders

Batch Tag Species By Folder

Delete Photo cmd

Wildlife Camera Photo Processing Protocol

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Processing by Species Folder

- Summary of folders
- Identify the folder name and the species code to assign to all the photos in a folder with that name

This tool does not currently include a means to include the count of individuals that may be included in the folder name



frmBatchTagSpecies

Batch Tag Species Based on Folder Name

List of Folders

Directory
F:\91West\013\91-08S-1\100_BTCF\UNMA
F:\91West\013\91-08S-2\100_BTCF\BOBC
F:\91West\013\91-08S-2\100_BTCF\COYT
F:\91West\013\91-08S-2\100_BTCF\HOBI
F:\91West\013\91-08S-2\100_BTCF\SPBE
F:\91West\013\91-08S-2\100_BTCF\SPBE2
F:\91West\013\91-08S-2\100_BTCF\UNBI
F:\91West\013\91-08S-2\100_BTCF\UNMA
F:\91West\013\91-09-M2\100_BTCF
F:\91West\013\91-09-MID\DCIM\100EK113

Record: 1 of 54 No Filter Search

Species Codes to Assign to Folders

FolderName	SpeciesTag
coyt	COYT
grro	GRRO
hobi	HOBI
hosa	HOSA
none	None
prlo	PRLO
spbe	SPBE
unbi	UNBI
uncr	UNCR
unkn	UNKN

Record: 1 of 11 No Filter Search

Generate Species Observation Records

Wildlife Camera Photo Processing Protocol

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Post-processing

- Secondary reviewer
- Spot-check species identification
- Confirm rare and target species
- Assign primary reviewer initials
- Run proofs
- Sort into folders by species



SequenceSwitchBoard

Site SAR-12

Sequence SwitchBoard

All Sequences All-QP All-QP0

UnTagged Sequences Species Button Setup

None Sequences Events

Single Viewer

All-Single Viewer

UnTagged-Single Viewer

Open Sequence

Sequence

Open Sequence

Species Lookup

Species

Species Lookup

Update Drive Letter

From: To:

Update Drive Letter

ReviewStats

Spec	#	ExPh	HL	QP	QP0	V	FR
BOBC	12	3	3	12	12		
COYT	48	3		42	6	6	
GFOX	54	3		54		54	
GRRO	12	6		9	3	12	
HOBI	45			9	36		
HOSA	3	3		3			
HSCF	12	3		12			
MEME	27	3		27		27	
NONE	4194			1944	2250		
NONF	3			3			
NONL	3			3			
PRLO	3	3		3		3	
SCNI	108	3		87	21	108	
SPBE	21			21		21	
UNBI	27	3	6	27		27	
UNKN	3	3			3		
UNRA	24			24		24	

Record: 1 of 18

The highest record number with a species reported

Last Record 1561

!!!Only jump to this record if you have been working straight through and not jumping around!!!

Delete Photo cmd

Last QP Sequence 774

Last QP0 Sequence 787

Start 8/11/2021 10:23:50 AM

End 10/15/2021 8:38:36 AM

Step 1 - Assign QP0 Records

QP0 Insert (Camera Specific)

Step 2 - Assign Observer

Observer

Observer (Camera Specific)

Step 3 - Proofs

(Camera Specific)

NonNonnes Proofs

Step 4 - File Sorting Code

cmd Code to Sort Files Update File Path

(Camera Specific)

If Photos are already sorted into folders

Batch Tag Species By Folder

Wildlife Camera Photo Processing Protocol

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Post-processing

- Proofs

- Sequences with two records for the same species
- Sequences without a species record
- ... without direction reported for a camera that requires a direction
- ... with a direction reported for a camera that does not require a direction
- ... without a species count
- ... with a species but a count of 0
- ... with a species record and a none record
- ... with an undefined species code
- ... with a record but no species listed
- ... has been tagged for further review

- Why? Because all these things happen and the computer is pretty good at finding them

[illegible]

Wildlife Camera Photo Processing Protocol

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Post-processing

- Sort photos into species folders – cmd code
- Copy out example photos – cmd code
- Copy out highlight photos – cmd code
- Delete inappropriate photos – cmd code
- Export results for migration into final database



ExportSwitchBoard

Export Switch Board
(after all other review has
been done across all cameras)

Step A - Export Detections-
USGS

Enter the path for the folder to
export detection records:

Export Detections-USGS

Step B - Copy Out Example
Photos

Enter the path for the folder to copy
example photos:

cmd Code

Step C - Copy Out Highlight
Photos

Enter the path for the folder to copy
highlight photos:

cmd Code

Wildlife Camera Photo Processing Protocol

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Why have separate databases for sorting photos and the final results?

- Final database is on government server
- Stand alone MS Access database runs faster than processing photos directly from server
- Stand alone MS Access database can be used off-line
- Can be distributed to volunteers



Wildlife Camera Photo Processing Protocol

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Processing time – how long is it taking to review photos using these tools?

- Depends on the site and whether the photos were subsampled (primary photo review)
 - Cameras that require a direction of movement = **1,300 photos/hour**
 - Range: 1,000 to 1,900 depending on primary reviewer
 - Cameras without direction and less than 6,000 photos = **1,800 photos/hour**
 - Range: 1,127 to 2,235 depending on primary reviewer
 - Cameras without direction and more than 6,000 photos = **5,080 photos/hour** (subsampled)
 - Range: 4,355 to 6,000 depending on primary reviewer
 - Overall rate = **2,000 photos/hour**



Wildlife Camera Photo Processing Protocol

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Subsampling – how we're doing it

- Depends on the site and number of photos
- Not subsampled
 - Cameras at culverts and bridges
 - Cameras in habitat with less than 6,000 photos
- Subsampled
 - Cameras in habitat with more than 6,000 photos
 - All photos between 4 PM and 8 AM
 - Artificial 5-minute quiet period



Wildlife Camera Photo Processing Protocol

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Development Process

- Colorado Parks and Wildlife – Colorado Photo Warehouse
 - Starting point
 - Much of the viewer for primary review
 - Much of the database for the final database
- Input from project leads / field leads / primary reviewers / secondary reviewers
 - Project leads: C. Brehme, C. Hitchcock, C. Rochester
 - Field leads: D. Adsit-Morris, D. Williams
 - Primary reviewers: M. Wong, L. Marsten, T. May, S. O'Dell, M. Newton, C. Stafford, A. Sumarli, J. Levy, A. Louros, J. Heath
 - Secondary reviewers: T. Edgarian, J. Kingston

Wildlife Camera Photo Processing Protocol

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Questions?

