

Standard Operating Procedures: Camera Trap Processing Protocol *(ABMI-IC-SOP-014)*

Document Version: 2018-10-11



Acknowledgements

This document was developed by Ola Pierossi, Barry Robinson, Corrina Copp, Julia Vlasenko and Jim Schieck.

Disclaimer

These standards and protocols were developed and released by the ABMI. The material in this publication does not imply the expression of any opinion whatsoever on the part of any individual or organization other than the ABMI. Moreover, the methods described in this publication do not necessarily reflect the views or opinions of the individual scientists participating in methodological development or review. Errors, omissions, or inconsistencies in this publication are the sole responsibility of ABMI.

The ABMI assumes no liability in connection with the information products or services made available by the Institute. While every effort is made to ensure the information contained in these products and services is correct, the ABMI disclaims any liability in negligence or otherwise for any loss or damage which may occur as a result of reliance on any of this material. All information products and services are subject to change by the ABMI without notice.

Suggested Citation: Alberta Biodiversity Monitoring Institute. 2016. Remote Camera Image Processing User Guide, Version 2018-10-11. Alberta Biodiversity Monitoring Institute, Alberta, Canada. Internal Report.

Use of this Material: This publication may be reproduced in whole or in part and in any form for educational, data collection or non-profit purposes without special permission from the ABMI, provided acknowledgement of the source is made. No use of this publication may be made for resale without prior permission in writing from the ABMI.

Contact Information

If you have questions or concerns about this publication, you can contact:

ABMI Information Centre
CW-405 Biological Sciences Centre
University of Alberta
Edmonton, Alberta, Canada, T6G 2E9
Phone: (780) 492-5766
E-mail: abmiinfo@ualberta.ca

Approvals

Version Number 3.4

Approved by: _____ Date: _____
 (Information Director)

Approved by: _____ Date: _____
 (Information Coordinator)

Approved by: _____ Date: _____
 (Domain Expert)

Revision History Log

Version #	Revision Date	Author	Changes
1.0	20/07/2014	Ola Pierossi	Drafted
2.0	12/06/2015	Barry Robinson	Added new QAQC procedures
3.0	06/07/2015	Barry Robinson	Major modifications to uploading/tagging procedure
3.1	18/11/2016	Corrina Copp	Minor modifications to tagging procedures. Updated appendix files to include step-by-step instructions
3.2	30/10/2017	Corrina Copp	Minor modification to auto- and manual-tagging procedures.
3.3	11/09/2018	Corrina Copp	Minor modifications to context-based tagging procedures.
3.4	11/10/2018	Kat Villeneuve	Minor updates to QA/QC procedures

Table of Contents

Approvals.....	3
Revision History Log.....	3
Table of Contents.....	4
1.0 Introduction	5
2.0 Summary of Procedure.....	6
3.0 Work Breakdown Structure.....	7
4.0 Software Requirements.....	8
5.0 Procedures.....	9
Task 1. Pre-deployment Activities	9
Task 2. Camera Deployment.....	9
Task 2. Collecting Cameras and Datasheets	9
Task 3. Post Field Data Upload and verification	9
Task 4. Uploading Images to Camera Trap website.....	10
Task 5. Auto- and Context-Tagging of Images	11
Task 6. Manual-Tagging of Images.....	13
Task 7. Data Validation	17
Task 8. QA/QC of Manual Tagging	Error! Bookmark not defined.
Task 9. Data Export	18
6.0 Appendices 20	
Appendix 1.0 – Checklists	20
Appendix 2.0 – Species List.....	22

1.0 Introduction

ABMI has implemented a new field protocol to monitor the presence of vertebrates (mainly mammals) using Reconyx PC900 camera traps. The aim of this protocol is to compile a comprehensive dataset on species occurrence at ABMI sites while minimizing the time and effort associated with collecting these data.

Once this protocol is implemented, ABMI expects to receive large amounts of data needing to be processed. This SOP aims to facilitate storing, managing and processing these data.

DRAFT

2.0 Summary of Procedure

This SOP concentrates on uploading images from the camera traps’ memory cards and tagging images with all species captured. Processing and interpreting the images acquired by the camera will involve a collaboration between the Monitoring and Information Centres (Figure 1.0). Large amounts of data are expected to be collected through this system; this SOP provides guidelines on how to process it efficiently.

This SOP will NOT cover any information regarding the deployment of camera traps; specific field protocols exist for that. This SOP will cover the steps required for uploading and processing images collected by camera traps, after the units have been retrieved. The camera traps deployment protocol (Monitoring Centre) should be reviewed together with this SOP, in order to gain a comprehensive understanding of the entire process.



Figure 1.0 – Workflow diagram of Camera data collection and processing with responsible centers identified by colour. Abbreviations: MC = Monitoring Centre; IC = Information Centre.

3.0 Work Breakdown Structure

This standard operating procedure involves the Monitoring, Information, and Science Centres. Different levels of responsibility and accountability will be required from each centre and responsible personnel. The aim of this section of the SOP is to provide clear instructions for all parties involved in the processing of the images from the camera traps, what they are responsible and/or accountable for, who they should inform once tasks are completed (Table 1.0).

Detailed list of personnel involved:

1. Field crews and supervisors
2. Information Coordinator
3. Database Manager
4. Image uploaders
5. Science Centre researchers

Table 1.0 – The work breakdown structure including all major tasks and subtasks involved in this SOP. Centres and personal responsible for each task and the predecessor task which needs to be completed before the current task can start are also shown. Abbreviations: R = Responsible; A = Accountable; I = Involved.

ID	Task Name	Centre Responsible	Predecessor task	Field crews and supervisors	Information Coordinator	Database Manager	Image Uploaders	SC researchers
1	Pre-deployment of cameras							
1.1	Record SD card and camera number	MC	-	R,A	I			
2	Collecting cameras and datasheets							
2.1	Pick-up cameras	MC	-	R,A	I			
2.2	Fill out 'Camera Retrieval' table on tablet	MC	2.1	R				
3	Post-field data upload and verification							
3.1	Transfer SD cards to Information Centre	MC	2.1	R,A	A			
3.2	Check-out SD cards	IC	3.1		I		R,A	
3.3	Upload images to external hard drives	IC	3.2		I		R,A	
3.4	Verify # of images uploaded matches	IC	3.3		I		R,A	
3.5	Verify the site and station match	IC	3.3		I		R,A	
3.6	Store SD cards and Check-in SD cards	IC	3.3,3.5		I,A		R	
4	Uploading Images to Camera Trap website							
4.1	Set up an account	IC	-		I	R,A	I	
4.2	Deployment information	IC	4.1				R,A	
4.3	Upload images	IC	3.3, 4.2				R,A	
4.4	Data verification	IC	4.3		I		R,A	
5	Auto-Tagging of Images							
5.1	Tag images that have false-fires using the computer program	IC	4.4					R,A

ID	Task Name	Centre Responsible	Predecessor task	Field crews and supervisors	Information Coordinator	Database Manager	Image Uploaders	SC researchers
5.2	Default tag for other images	IC	4.3			R,A		
6	Manual-Tagging of Images							
6.1	Data verification	IC	4.3	R,A	I			
6.2	First pass – for images tagged as None	IC	6.1	R,A	I			
6.3	First pass – 5000 images tagged as Auto-None and Auto-Cow	IC	5.1	R	A			
6.4	Second pass	IC	6.3		I			R,A
7	Data Validation							
7.1	Review difficult to identify species	IC	6.3		R,A			
7.2	Review uncommon species	IC	6.3		R,A			
8	Quality Assessment							
8.1	Assessment of each interpreter	IC	7.3		R,A			
9	Data Export							
9.1	Export CSV file	IC	8.1		R,A			I

4.0 Software Requirements

- Access to ABMI Cameras Website (<http://cameras.abmi.ca/>). Website sign-up will be required and this can be accomplished by emailing the Database Manager.
- Access to Trello® (www.trello.com). This website is used to track progress on tasks and monitor collaborations. It is used for tracking QAQC procedures for ABMI.
- Access to Google Drive. The Information Coordinator will add individuals to the spreadsheet file. This tool is used to allow users to simultaneously update, monitor and track the completion of tagging by deployment. Ensures individuals are not working on the same deployment.

5.0 Procedures

There are 9 main tasks involved in uploading and processing camera trap images, each with several subtasks (Table 1.0). Below are specific instructions associated with each. Appendices at the end of this document will provide more detail when required.

Task	Instructions
Task 1. Pre-deployment Activities	
Record SD card and camera number	<ul style="list-style-type: none"> → SD cards and cameras are uniquely labelled. Ensure the SD card and camera numbers are recorded on the camera deployment sheet. → This is very important as it will be the main way to link SD cards with specific site numbers
Task 2. Camera Deployment	
Setup camera	→ Specific instructions provided in ABMI Autonomous Recording Unit (ARU) and Remote Camera Trap Protocols.
Fill out 'Camera deployment datasheet' on tablet	<ul style="list-style-type: none"> → This datasheet connects cameras and SD card numbers with the correct ABMI site and station. → This datasheet provides critical metadata information including date of deployment, height of camera, snow depth, attachment, lured or unlured, and other comments → These data are entered into the tablet and uploaded to the secure FTP for amalgamation and upload to Trello.
Task 3. Collecting Cameras and Datasheets	
Pick-up cameras	→ Specific instructions provided in ABMI Autonomous Recording Unit (ARU) and Remote Camera Trap Protocols.
Fill out 'Camera Retrieval' datasheet on tablet	<ul style="list-style-type: none"> → This datasheet connects camera and SD card numbers with the correct ABMI site and station. → It records basic information on the status of the SD cards and cameras at the time of collection, in addition to site information such as the presence of human or natural disturbance, water, and other natural attractants → These data are entered into the tablet and uploaded to the secure FTP for amalgamation and upload to Trello.
Task 4. Post Field Data Upload and verification	
Transfer SD cards to IC	<ul style="list-style-type: none"> → The SD cards are removed from the cameras at the end of the field season by the field technicians. → Each station will have one blue 2.25" x 3.5" coin envelope for ARU SD cards, and one yellow coin envelope of the same size for the camera SD card. On the front of each envelope a label will be affixed with the Site Number, Station, Date and SD card number. → A total of 4 coin envelopes will be collected for each site and placed in a larger envelope which will be marked with the site number. → Sites within the same block will be placed in an even larger envelop together. → An Image Uploading Checklist (Appendix 1.0) is populated with a complete list of cameras (along with the associated SD card, ABMI site and station) that were deployed by the Monitoring Centre.

	<ul style="list-style-type: none"> → Information on the SD cards is uploaded to the provided HD in the designated folder, nested by block, site and station.
Upload images to external hard drives	<ul style="list-style-type: none"> → Insert the SD card into the SD card reader hub. → Prior to uploading to the HD or server, right click on the SD card and select properties to view file size. Record this number on the Image Upload Checklist. Ensure that the correct SD card is selected within the hub reader. → Use the Image Upload Checklist to verify and determine the site and station number associated with each camera and SD card being handled → On the provided external hard drive create a separate folder for each block, a separate sub folder for each site, and then a separate subfolder for each station within a site → Label site folders as SITE (e.g. 921) and sub-folders as 921_NW. → Images are uploaded from the SD cards using Windows Explorer and an SD card reader hub that uploads 4 cards simultaneously. → Upload images from each SD card to the appropriate folder and subfolders
Verify # of images uploaded matches	<ul style="list-style-type: none"> → Check the number of images uploaded to each subfolder on the external hard drive and record this on the Image Upload Checklist → If the number of images uploaded does not match the original number on the SD card, investigate potential causes and record a comment on the Image Upload Checklist
Verify station and site match	<ul style="list-style-type: none"> → The initial images on the camera should be of the field crews holding a sign indicating the site and station; ensure the site and station indicated by the folder and subfolder names matches. → If site and station numbers match, check the appropriate box on the Image Uploading Checklist → If there is a discrepancy, continue to upload images, and double check the site and station on the Image Uploading Checklist. → If there is a discrepancy between the site and station on the Image Upload Checklist and the initial set-up images, create a folder on the external hard drive called 'Discrepancies to investigate' and transfer the folder and images with the discrepancy → Make a comment of the problem in the Image Upload Checklist → Add the site to the master list called Site Discrepancies (Appendix 1.0), including the site and station number listed on the deployment data sheets and those shown in the initial images. Provide the list of sites to the Information Coordinator. → The Information Coordinator will inspect all discrepancies and determine the appropriate site and station number for each.
Store SD cards and Check-in cameras	<ul style="list-style-type: none"> → Once the images are uploaded, do not delete the images from the SD card → Place each SD card back into its original coin envelope labeled with the appropriate site and station (e.g. ABMI_921_NW). Place labelled envelope in the Tupperware container within the locked cabinets. → On the Image Uploading Checklist, check that the SD has be stored.
Task 5. Uploading Images to Camera Trap website	
	<ul style="list-style-type: none"> → Detailed instruction on how to upload images are found in the ABMI Camera Trap User Guide (2018)

Set up an account	<ul style="list-style-type: none"> → Contact ABMI database administrator to set up a unique account. → Login to access the camera website.
Deployment information	<ul style="list-style-type: none"> → The website allows users to add cameras (called deployments). → The following variables are required when creating a new deployment: <ul style="list-style-type: none"> ○ Name, site, station, deployment year → Site and station numbers are obtained from the folders containing the images on the external hard drive. → The deployment names are based on the site and station numbers (e.g. Site 921 and Station NW should be named ABMI_921_NW); note that this name is also used as the label for each photo. → Deployment information can be changed/updated at any time.
Upload images	<ul style="list-style-type: none"> → Click 'Choose files' at the bottom of the Edit/Add Deployment page and select the appropriate images to upload → After image uploading is complete, change the status of the deployment to 'all uploaded'.
Data verification	<ul style="list-style-type: none"> → Record the number of images uploaded to the website on the Image Uploading Checklist and verify it matches the number of images on the SD card and external hard drive. → Double check that the site and station number on the first series of images matches the site a station number entered when creating the deployment; if they match check the appropriate box on the Image Uploading Checklist. → If there is a discrepancy, back track to determine at which stage the site and station numbers were recorded incorrectly and correct the error. → If a solution cannot be found, add the site and station to the Site Discrepancies list. → Once data are verified, change the status of the deployment to 'Auto-ready'
Task 6. Auto- and Context-Tagging of Images	
Tag images that have false-fires using the computer program	<ul style="list-style-type: none"> → Many camera images result from false-fires that do not have an animal present. → Some of these false-fires can be identified based on characteristics of the image in relation to other images from the same camera. → A computer program has been developed to review the images from each camera, and tag those that are determined to be false-fires. → The tag Auto-None is assigned to images that have been filter-out using the computer program.
Tag images that have domestic cows using the computer program	<ul style="list-style-type: none"> → Many camera images results from domestic cows → A computer program has been developed to review the images from each camera, and tag those that are determined to have domestic cows. → The Auto-Cow tag is assigned to images that have been filtered out using the computer program.
Tag images that have Staff/Setup using the computer program	<ul style="list-style-type: none"> → Initial: Images that are within 30 minutes of the first image at the deployment are labelled as STAFF/SETUP, unless there are <=10 images in that first series. → Final: Images that are within 30 minutes of the final image at the deployment are labelled as STAFF/SETUP, unless the final image was taken before Julian day 170 (June 19) or there are more than 1000 images at that deployment. → All of these Auto-STAFF/SETUP images are excluded from further steps

<p>Number series and calculate summary variables using the computer program</p>	<ul style="list-style-type: none"> → A series is a set of images at a deployment where there is ≤ 120 seconds between consecutive images. Auto-tagged images are included when determining whether images are ≤ 120 seconds from the previous or next one, but time lapse images are not. → For each series, determine the total number of images and the number of auto-tagged images (NONE-AUTO or COW-AUTO). → If total number of images in the series = number of auto-tagged images, then the series and all the associated images are excluded from further steps. → Any series that has ≥ 50 auto-tagged images OR has a ratio of number of auto-tagged images / total number of images ≥ 0.7 can be assumed to contain no native mammal images (with a very low error rate). → For any series that qualifies by either of those two criteria, all images not already auto-tagged are tagged in that series as either NONE-AUTO or COW-AUTO depending on prevalence in that series. These series are excluded from further tagging. → Series that don't meet either criteria – including the majority of series which have no auto-tagged images at all – go on to the next tagging step.
<p>Series using two-stage subsampling</p>	<ul style="list-style-type: none"> → All auto-tagged images are excluded. → Human taggers are presented with all images in a series if there are 5 or fewer images (having excluded the auto-tagged images), while a two-stage subsample will be used for series with 6 or more images. → Series of 5 or fewer images. <ul style="list-style-type: none"> ○ All images are presented to taggers, who tag each one in the normal way. → Series of 6 or more images: <ul style="list-style-type: none"> ○ A random sample of 5 images are chosen from the series, not including the final image in the series in that random sample. The random sample is without replacement. These 5 images are shown to the tagger. ○ If all 5 images are tagged with the same native mammal tag, including age, sex, number of individuals then the remaining images in the series are tagged as such. ○ If one or more of those 5 images is tagged as UNKNOWN, then all images in that series are shown to the tagger. The tag for these images is auto-filled to whatever species occurred in the initial 5 images. The tagger then scans all the images in the series and changes the tag to NONE (or possibly some other species, COW, etc.) as appropriate. ○ If the 5 images do not contain a native animal or UNKNOWN, all images in the series are tagged as NONE or whatever domestic species is in the sample of five. If there is both a domestic animal and NONE images in the set of five, we will tag all the images as the domestic animal.
<p>Out-of-acceptance orientation range</p>	<ul style="list-style-type: none"> → Images that don't meet the orientation criteria are uniquely tagged as out-of-range. Taggers do not have to tag animals in series when the camera is clearly out of alignment. These records during those out-of-alignment times will not be used in analysis.

<p>Default tag for other images</p>	<ul style="list-style-type: none"> → Even after the computer program has tagged false-fires, many of remaining images do not have an animal present; false-fires are still expected to be the most common type of these remaining images. → To save time during manual tagging, all images are tagged as ?/?/? by default when they are uploaded. → All images with the temporary tag of ?/?/? are reviewed manually (see Task 6), and the tag changed to the species name if an animal is present.
<p>Task 7. Manual-Tagging of Images</p>	
<p>Data verification</p>	<ul style="list-style-type: none"> → The initial series of images on each camera should be of the field technicians holding a sign listing the site, station and date. → Verify site and station in the image match the name of the deployment → To do this the user must turn on the auto-tagged filter, given these images are hidden via the context-based tagger.
<p>First pass – for subsampled images tagged as ?/?/?</p>	<ul style="list-style-type: none"> → Detailed instructions on how to tag images are found in the ABMI Camera Trap User Guide (2018) → All images with the temporary tag of ?/?/? are reviewed and the tag changed to the species name if an animal is present. → All images from a camera are interpreted by a single interpreter. → To facilitate identification and tagging, images with the tag ?/?/? are sorted based on date/time. → The appropriate Species Code must be entered to replace ?/?/? if an animal is present. → A complete list of species is shown in Appendix 2.0 → Starting at the first image in the camera file, images are displayed on the computer screen in a matrix of 3 x 20 → Images with animals are selected on the screen, and the tag changed from ?/?/? to the Species Code. <ul style="list-style-type: none"> ○ If the animal is not distinct in an image, review multiple images from the series to make the determination. ○ To save time, multiple images can be selected and tagged at the same time. → The number of individuals within an image is added if >1. This is done for all species with the exception of Domestic animals, Humans, and Birds. → When changing the species code, images can simultaneously be tagged for Sex and Age using the drop-down menus. Age and Sex automatically default to Adult and Unknown. → Once all images on the screen with animals have been assessed, the down arrow is used to bring up the next 60 images. → Record an individual as present for every picture in the series it is present, even if it is hidden by vegetation but still in the field of view. → The out-of-range tag is applied when the camera is not within the acceptable orientation range. → For each deployment, to assess whether the camera is within the acceptable orientation range, the last 60 images of the deployment are viewed by the tagger. If these images do not meet the orientation criteria, the tagger will scroll through the images to find the last images with acceptable orientation

	<p>and apply the END tag. The tagger will also examine the page number to see if an out-of-range unique tag has been applied to other images.</p>
<p>QA/QC manual camera tagging effort</p>	<p>→ Errors can occur during the manual tagging process</p> <p>→ To improve the accuracy of manual tagging and the consistency between taggers, QA/QC checks are completed to provide each individual tagger with feedback</p> <p>→ At least 5 random deployments are chosen for each remote camera tagger for assessment of tagging accuracy</p> <p>→ Assessment criteria includes:</p> <ul style="list-style-type: none"> ○ All images available for tagging have been tagged ○ “Staff/Setup” tags have been applied correctly (were applicable) ○ Accurate application of “Unknown”, “None” and species ID tags ○ Tags for age, sex and number of individuals are applied correctly <ul style="list-style-type: none"> ▪ Age tags correctly applied for all species, not including domestic animals, humans and non-mammals ▪ Sex tags for adult deer, moose and elk are applied correctly and not before May 15 or after September 30th unless sex clearly identifiable. ▪ Sex tags are not applied to juveniles, unless clearly identifiable ▪ Sex tags are not applied to species other than moose, elk and deer unless it is very obvious (ie a mother bear with cubs, caribou, etc.) ▪ number of individuals applied correctly to all species, not including domestic animals, humans and non-mammals ○ “Veg” tag applied in concert with “None” tag where appropriate ○ Use of “Out of Range” and “START”/“END” tags accurate ○ “Nice” tag applied at least once for each deployment with images of wildlife <p>→ Specific written feedback is provided to each remote camera tagger to facilitate correction of errors and to improve tagging accuracy</p>
<p>Second pass</p>	<p>→ Images with animals (except human and domestic cow) are reviewed a second time to obtain additional information. If time permits, white-tailed, mule deer are reviewed to confirm/correct species identification.</p> <p>→ Species names are reviewed for spelling/taxonomic errors by SC experts. The list of corrections is provided to the Information Coordinator, and errors are corrected by the database programmer.</p> <p>→ For images of mammals (excluding humans, domestic animals and deer), all images are reviewed to confirm identification.</p> <ul style="list-style-type: none"> ○ For each species images are sorted by the by deployment number, date, and time. ○ Review all images, one species at a time, to confirm they were correctly tagged. ○ If errors are detected (species, sex, age, number of individuals, etc.), update the corresponding data fields.

- The camera tagging system will track any changes applied during the second pass so that all the original data is automatically preserved in a separate data table.
- When verifying species in the images special attention must be paid to species that look similar so that these are identified correctly:
 - Mule and white-tailed deer
 - Red and swift fox
 - Coyote, domestic dog, and Gray wolf
 - Bobcat and lynx
 - Marten and fisher
 - Weasels (3 species) and mink
 - Snowshoe hare and white-tailed jack rabbit

→ For deer, sort the images by deployment number, date, and time.

- Review sequences of unidentified deer to identify species if possible. If deer species can be determined for an unidentified deer, update the species box.
- Supplementary guidance and detail will be provided to taggers for deer identification.

→ Other images including None, humans, and domestic cows are not reviewed, unless time permitting.

Pole Analysis:

→ At un-lured sites only, the location of the individuals in the images in relation to the 5m stake is determined.

→ Human, domestic cow, birds, deer, mule deer, white-tailed deer, moose, elk, pronghorn, coyote, and black bear are not classified.

Uncommon mammals (<=20 images for site/species combinations)

- Determine distance in relation to the stake for all individuals. Distance is determined separately for each individual in the image.
- If there are more than 20 images of a species at a site, then this site/species combination is treated similar to the common species (see description below) and distance is classified for 20 images only.
- Use the “distance” textbox with auto-filled options to record distance into one of the following categories:
 - In front of the pole (F)
 - Behind the pole (B)
 - At the pole (A): This happens most often when the animal is off to the side of the image so that it is hard to compare its distance with the pole. This option is also used when a big animal is oriented so that a substantial amount of its body is in front and behind the pole.
 - Investigating the pole (IP): Use only if clearly investigating the pole.
 - Investigating the camera (IC): Use only if clearly investigating the camera.
 - Not applicable (NA): Use if the pole is moved or is not visible.

Common mammals (>20 images for site/species combination).

- Classify a maximum of 20 individuals at the site.
 - For each species/site combination, images are randomly ordered and distance for the first 20 images is classified using the same categories as above.
 - If the image has more than one individual present, distance is classified per each animal in the textbox with distance codes F/B/A/IP/IC/NA separated by commas.

Gap Analysis:

- Determine whether “gaps” in image sequences are due to the animal leaving the field of view or due to the animal being present but the camera not being triggered.
- Gaps for human, domestic cow, birds, deer, mule deer, white-tailed deer, moose, elk, pronghorn, and coyote are not determined.
 - If the gap between images of a species at a site is <20 seconds, the species is assumed to have stayed in the field of view (unpublished research). No additional editing is required for these gaps.
 - If the gap between images of a species at a site is >120 seconds the species is assumed to have left the field of view and the same, or different individual subsequently re-entering the field of view (unpublished research). No additional editing is required for these gaps.
 - Gaps of 20-120 seconds are checked visually, to determine whether or not the individual left the field of view, or the camera was simply not triggered during that period.
 - For each species and site, the gaps between consecutive detections are determined and the “Gap Start” checkbox identifying the gap length as 20-120 seconds is checked off for the image immediately before the gap. Only gaps of 20-120 seconds are further evaluated.
 - For each species gap 20-120 seconds long, the 5 images preceding the gap and 5 images after the gap are displayed. Note that preceding and post images labeled as ?/?/? (time-lapse) and Auto None are also included.
 - Using the images before and after the gap, the gap is classified as the animal being “present” (P) or “leaving the field of view” (L) or “presence uncertain” (U).
 - Classification is based on what the animal is doing before and after the gap. However, probability of leaving the field of view is expected to be positively related to the length of the gap. If the gap is just over 20 seconds, most animals are expected to be present during the gap. If the gap is close to 120 seconds most animals are expected to have left the field of view.
 - If there are any images taken during the gap where the animal is not visible the animal is classified as having left the field of view.
 - If there is evidence that the individual moved out of the camera’s field of view just before the gap, and/or moved

	<p>back into the field of view just after the gap, the individual is classified as “L” during the gap.</p> <ul style="list-style-type: none"> ▪ In situations where there is a gap because an individual moves to the side of the image, or where the individual moves too far back to trigger the camera, or where the animal disappears behind vegetation, or where the animal disappears under the camera, the animal is classified as “L”. ▪ If the images at the start or end of the gap do not show evidence that the individual left or returned, the animal is classified as “P”. ▪ When the camera detects an individual erratically (this commonly occurs for small animals) there are many small gaps and a few larger gaps. In these circumstances, it is difficult to determine whether or not the animal left the field of view, and the gap is classified as “U”. <ul style="list-style-type: none"> • The dropdown menu is used to identify whether the species left or remained during the gap is filled with the appropriate option P/L/U. • If there are multiple individuals in the image before or after the gap the minimum number that remained during the gap is determined and entered into a numeric text box next to dropdown with P/L/U options (e.g., if 6 individuals were present before the gap and 4 present after, enter “P4” to indicate that 4 individuals were present during the gap). Note this number may be different from the actual number of individuals seen in the given picture. <p>→ After the second pass of tagging is complete the status of the camera is changed from ‘all tagged first pass’ to ‘all tagged second pass’.</p>
<p>Task 8. Data Validation</p>	
<p>Review difficult to identify species</p>	<p>→ Marten and fisher are often misidentified and are reviewed by an expert.</p> <p>→ To facilitate this review, images are presented species-by-species across all cameras in the project.</p> <p>→ Images are reviewed and correct the species codes if required.</p>
<p>Review uncommon species</p>	<p>→ Uncommon species may not be identified accurately during the initial tagging process.</p> <p>→ Uncommon species include Badger, Beaver, Bobcat, Caribou, Cougar, Mink, Musk Rat, River Otter, Porcupine, Raccoon, Skunk, Swift Fox, and Wolverine</p> <p>→ To facilitate review of uncommon species, images are presented species-by-species, sorted by camera and then date/time across all cameras in the project.</p> <p>→ Images are reviewed and the species code is corrected if required.</p> <p>→ After the validation is completed the status of the camera is changed from ‘all tagged first/second pass’ to ‘all validated’.</p>
<p>Review auto-tagged images</p>	<p>→ Auto-tagged images may not be identified accurately during the initial tagging process.</p> <p>→ 5,000 auto-tagged images for each None (Auto), Domestic Cow (Auto), Context-tagged (Auto), Context-tagged (Subsampling) will be reviewed per year. All images will be verified for accuracy, correcting tags if required.</p>

	<p>→ All other images with the tag Auto-None and Auto-Cow are hidden from view and are not reviewed manually.</p>
Review manually-tagged images.	<p>→ Manually tagged images may not be identified accurately during the second tagging process.</p> <p>→ 5,000 manually tagged images for each None (Manual), Domestic Cow (Manual), Mammal (Manual) will be reviewed per year. All images will be verified for accuracy, correcting tags where required.</p> <p>→ A human tagger will view these in groups of 60 and verify the correct species tag has been applied. If all tags are correct, the human tagger clicks verify and moves to the next set of 60 images.</p> <p>→ After manual tagging is completed, status of the deployment is changed from 'Auto-Done' to 'all tagged first pass'</p>
Post QA/QC camera data	<p>→ Errors and inconsistencies can occur during the manual tagging process</p> <p>→ To improve accuracy and consistency of the data, all camera data are QA/QC'd in the database and output in CSV format to correct errors/data conflicts</p> <p>→ QA/QC criteria includes:</p> <ul style="list-style-type: none"> ○ Verifying END/Out of Range/START tags are applied correctly <ul style="list-style-type: none"> ▪ In the CSV file: 1=END; 2=Start; 3=Out of Range ○ Sex and Age fields consistent with # of individual field for all tagged images <ul style="list-style-type: none"> ▪ Example: Female + Unknown tag is only associated with # of individuals ≥2 ○ Check 'suspect' species <ul style="list-style-type: none"> ▪ Any tagged species occurring in a region it is not normally found in (ie. a pronghorn near Fort McMurray) ○ Cross-reference site numbers with tagger tracking spreadsheet to ensure no sites are missing ○ Check that photos needing review have been reviewed ○ Check for appropriate use of the sex tag (see QA/QC manual tagging section for detail) ○ Make sure any image tagged as "None" does not have a tag for # of individuals (ie # of individuals should be "VNA" for all "None") ○ Check that there are no blank motion-triggered images (ie all images that are motion-triggered should either be auto- or manual-tagged) ○ Make sure that the "VNA" code is used correctly (ie. for age and sex tags, "VNA" is only used for domestic animals, birds, humans or "None") ○ Check that the "Veg" tag is always used together with the "None" tag ○ Check that images tagged as having multiple species have a comment with the secondary species
Task 9. Data Export	
Export CSV file	<p>→ Data are exported to a CSV file after quality assessment has been completed.</p> <p>→ Information for all images (including those tagged as Auto-None, Auto-Cow and None) are exported.</p> <p>→ All images with the Human tag are removed from the export data.</p>

	<ul style="list-style-type: none">→ Metadata for the CSV file describes: i) the variables names, ii) the order of variables in the file, iii) the format of the variables in the file, and iv) the acceptable values for each of the variables.→ After the export is completed the status of the camera is changed from 'all validated' to 'all exported'.
--	---

DRAFT

Appendix 2.0 - Species List

- American Crow
- Badger
- Beaver
- Bighorn sheep
- Bison
- Black bear
- Black-billed Magpie
- Bobcat
- Canadian Lynx
- Common Raven
- Cottontail
- Cougar
- Coyote
- Cranes, Rails, and Coots
- Deer
- Domestic Cat
- Domestic Cow
- Domestic Dog
- Domestic Llama/Alpaca
- Domestic Sheep
- Domestic Horse
- Ducks, Swans, Geese
- Elk
- Falcons and allies
- Fisher
- Foxes
- Gray Jay
- Gray Squirrel
- Gray Wolf
- Grizzly bear
- Ground squirrel
- Groundhog
- Grouse, Ptarmigan, and allies
- Other (animals not in the above list; this information may be of little value, but by tagging the image they can easily be found and reviewed if desired).
- Gulls, Terns, and allies
- Human
- Jack rabbit
- Least Chipmunk
- Marten
- Mink
- Moose
- Mountain goat
- Mule deer
- Muskrat
- Owls
- Pelicans, Herons, and Egrets
- Porcupine
- Pronghorn
- Raccoon
- Red Squirrel
- Red fox
- Richardson's Ground Squirrel
- River otter
- Sandpipers, Curlews, Snipe, and Allies
- Snowshoe hare
- Songbird
- Striped Skunk
- Swift fox
- Turkey vulture
- Voles, mice, and allies
- Weasels and Ermines
- White-tailed deer
- White-tailed Jack Rabbit
- Wild Boar
- Wolverine
- Woodland Caribou
- Woodpeckers