**Remote Camera Metadata**

Standards for Alberta

2024

Version 3.0

Prepared by

Cassondra Stevenson and Anne Hubbs

on behalf of the

Alberta Remote Camera Steering Committee (RCSC)

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For more information about the Alberta Remote Camera Steering Committee and these standards, please email [Anne.Hubbs@gov.ab.ca](mailto:Anne.Hubbs@gov.ab.ca).

For further information about The Fisheries and Wildlife Management Information System (FWMIS), please visit the [FWMIS website](https://www.alberta.ca/fisheries-and-wildlife-management-information-system-overview.aspx).

For further information about WildTrax, please visit the [WildTrax website](http://www.wildtrax.ca).

# Preface

These standards were developed by members of the Alberta Remote Camera Steering Committee (RCSC) in collaboration with the Alberta Biodiversity Monitoring Institute (ABMI).

The Alberta RCSC is chaired by Alberta Environment and Protected Areas and comprises a group of remote camera experts from academia, government and not-for-profit organizations who aim to advance the science of remote camera monitoring and research while facilitating collaboration and knowledge sharing among remote camera users in Alberta.

The objective of these Remote Camera Metadata Standards is to provide guidance on the types of data that should be collected and reported when using remote cameras (or "wildlife cameras" or "camera traps") to detect wildlife in Alberta. Consistent collection of remote camera data supports data consolidation and, accordingly, the creation of large spatiotemporal datasets on wildlife distributions across Alberta. This provides opportunities to answer research and monitoring questions within and across jurisdictions, and ultimately at national and global scales. Aiming to align metadata collection standards across western Canada, this document heavily relied on the [Wildlife Camera Metadata Protocol: Standards for Components of British Columbia's Biodiversity No. 44](https://www2.gov.bc.ca/assets/gov/environment/natural-resource-stewardship/nr-laws-policy/risc/wcmp_v1.pdf) (RISC, 2019; "B.C. Metadata Standards" hereafter). The Alberta Standards also follow a hierarchical structure similar to that of the [B.C. Metadata Standards](https://www2.gov.bc.ca/assets/gov/environment/natural-resource-stewardship/nr-laws-policy/risc/wcmp_v1.pdf) (RISC, 2019) and [Wildlife Insights](https://www.wildlifeinsights.org/) (Ahumada et al., 2019).

A companion document to this standard, the [Remote Camera Survey Guidelines: Guidelines for Western Canada](https://cassstevenson.github.io/RCSC-WildCAM_Remote-Camera-Survey-Guidelines-and-Metadata-Standards/intro.html) (RCSC et al., 2024), should be viewed alongside these standards. The guidelines offer advice on appropriate study / Survey Designs, camera deployment methods and data management. They were developed by the Alberta Remote Camera Steering Committee (RCSC) in collaboration with the Alberta Biodiversity Monitoring Institute (ABMI) and [Wildlife Cameras for Adaptive Management (WildCAM](https://wildcams.ca/about-us/); <https://wildcams.ca/about-us/>).

# 

# Acknowledgments

We would like to honour and acknowledge that work contributed by the RCSC took place on the traditional and ancestral land of the nêhiyaw (nay-hee-yow)/Cree, Denesuline (dene-su-lee-neh)/Dene (deh-neyh), Niitsitapi (nit-si-tahp-ee)/Blackfoot, Anishinaabe (ah-nish-in-ah-bay)/Saulteaux (so-toe), Nakota Sioux (na-koh-tah sue), and Métis’ (may-tee) Peoples since time immemorial, and we recognize this history.

We sincerely thank the Government of British Columbia for the use of their [B.C. Metadata Standards](https://www2.gov.bc.ca/assets/gov/environment/natural-resource-stewardship/nr-laws-policy/risc/wcmp_v1.pdf) (RISC, 2019), which formed the basis for the Alberta Remote Camera Metadata Standards. The [B.C. Metadata Standards](https://www2.gov.bc.ca/assets/gov/environment/natural-resource-stewardship/nr-laws-policy/risc/wcmp_v1.pdf) (RISC, 2019) pulled concepts from the Camera Trap Metadata Standards (CTMS; Forrester et al. 2016).

Thank you to the Alberta Biodiversity Monitoring Institute (Kat Villeneuve, Corrina Copp, and Monica Kohler) who prepared the original (version 1.0) Alberta Remote Camera Metadata Standards (2022) with guidance from the Alberta Remote Camera Steering Committee (RCSC).

These Alberta Remote Camera Metadata Standards have been updated to align, where possible, with the most recent versions of other Metadata Standards (e.g., [Wildlife Insights](https://www.wildlifeinsights.org/) [Ahumada et al., 2019], [WildTrax](https://portal.wildtrax.ca)). By standardizing data collection and reporting of remote camera data within and across jurisdictions, we enhance collaborative opportunities to address large-scale management / research questions at regional, national and even global scales.

This document was greatly improved by reviewers from across British Columbia and Alberta. A special thanks to Lonnie Bilyk, Resource Data Biologist with Alberta Environment and Protected Areas for his insights.

All decisions regarding these standards are the responsibility of the Alberta RCSC.

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# Purpose

The purpose of these Remote Camera Metadata Standards is to provide guidance on the types of data that should be collected and documented when using remote cameras to detect wildlife.

There are several benefits to having standardized methods for collection and reporting of metadata, including:

* Enabling province-wide consistency and reliability in data collection;
* Enabling data consolidation amongst [projects](#project) and enhancing the ability to answer large-scale management / research questions;
* Facilitating comparison between surveys or studies;
* Promoting higher quality of data which facilitates data sharing and tracking;
* Enhancing common design standards for reproducible research;
* Allowing for efficient [project](#project) and data review; and
* Ensuring [projects](#project) planning meets required government and research institute standards.

A companion document exists, the [Remote Camera Survey Guidelines: Guidelines for Western Canada](https://ab-rcsc.github.io/RCSC-WildCAM_Remote-Camera-Survey-Guidelines-and-Metadata-Standards/1_survey-guidelines/1_0.1_Citation-and-Info.html) (RCSC et al., 2024; "Remote Camera Survey Guidelines" hereafter), that should be viewed alongside these standards. The purpose of the Guidelines is to provide information on study design and implementation (including equipment and deployment recommendations) for novice to advanced users of remote cameras. The intended audience includes consultants, researchers, and wildlife biologists working for government, non-government agencies and industry.

## Supporting documents

There are several other supporting documents that are consistent with these standards and the [Remote Camera Survey Guidelines](https://ab-rcsc.github.io/RCSC-WildCAM_Remote-Camera-Survey-Guidelines-and-Metadata-Standards/1_survey-guidelines/1_0.1_Citation-and-Info.html) (RCSC et al., 2024), including the following:

* [Remote Camera Survey Guidelines](https://ab-rcsc.github.io/RCSC-WildCAM_Remote-Camera-Survey-Guidelines-and-Metadata-Standards/1_survey-guidelines/1_0.1_Citation-and-Info.html) (RCSC et al., 2024) supporting documents:
  + Camera Deployment Field Datasheet (RCSC et al., 2024)
  + Camera Service/Retrieval Field Datasheet (RCSC et al., 2024),
  + Test Image Sheet (RCSC et al., 2024),
  + Survey123 Template (RCSC et al., 2024; available in summer of 2024), and
  + [EpiCollect Template](https://five.epicollect.net/project/rcsc-and-wildcam-remote-camera-survey-guidelines) (RCSC et al., 2024) (https://five.epicollect.net/project/rcsc-and-wildcam-remote-camera-survey-guidelines)
* [Alberta](https://docs.google.com/spreadsheets/d/1D0dIQY1pu5rwxHs_HC-0bRXScWWE7A2O/edit?usp=drive_link&ouid=104398155365933821384&rtpof=true&sd=true) [Remote Camera Metadata Standards: Metadata Template v3](https://ab-rcsc.github.io/RCSC-WildCAM_Remote-Camera-Survey-Guidelines-and-Metadata-Standards/1_survey-guidelines/1_0.1_Citation-and-Info.html) (RCSC, 2024)

Copies of the field datasheets are available in Appendix A of the [Remote Camera Survey Guidelines](https://ab-rcsc.github.io/RCSC-WildCAM_Remote-Camera-Survey-Guidelines-and-Metadata-Standards/index.html) (RCSC et al., 2024).

# Background

Remote cameras (or "wildlife cameras" or "camera traps") are a valuable tool for detecting a wide range of wildlife species [(Burton et al., 2015; Lahoz-Monfort & Magrath, 2021; O’Connell et al., 2010)](https://www.zotero.org/google-docs/?dLxCxp). Remote cameras consist of a digital camera with an external flash and/or passive infrared detector (sensor; see [Lahoz-Monfort & Magrath, 2021; Rovero et al., 2013](https://www.zotero.org/google-docs/?PtXPPC) for detailed reviews). When animals pass in front of a camera, the sensor is [triggered](#trigger_event), and the resulting images are stamped with the date and time. Date and time stamps are valuable because combining image data with data from Global Positioning Systems (GPS) provides a permanent spatial and temporal record of wildlife occurrences. Although remote cameras are primarily used to detect medium to large-sized mammals, they have also been used to detect small mammals (e.g., [Lazenby et al., 2015; Mills et al., 2016; Tschumi et al., 2018)](https://www.zotero.org/google-docs/?E77ds3) and birds (e.g., [Kruger et al., 2018; Lynch et al., 2015; Suwanrat et al., 2015)](https://www.zotero.org/google-docs/?qutyyR).

Remote cameras have been used to measure presence / absence (e.g., Kucera & Barrett, 2011), relative abundance (e.g., Carbone et al., 2001), density of marked (e.g., Karanth et al., 2006) and unmarked (e.g., Becker et al., 2022) animals, population composition (age/sex ratios; e.g., Duquette et al., 2014), species richness / diversity (e.g., Ahumada et al., 2011), habitat use / distribution (e.g., Bowkett et al., 2008; O'Connell et al., 2006; Whittington et al., 2019), diel / seasonal activity patterns (e.g., Frey et al., 2017), individual breeding status (e.g., Fisher et al., 2014; Muhly et al., 2011), and Behaviour (e.g., Holinda et al., 2020; Murray et al., 2016).

There has been a global push to standardize the collection of remote camera data (Fegraus et al., 2011; McShea et al., 2020; Meek et al., 2014; Steenweg et al., 2017). Here, we developed a Remote Camera Metadata Standards for Alberta based on the [B.C. Metadata Standards](https://www2.gov.bc.ca/assets/gov/environment/natural-resource-stewardship/nr-laws-policy/risc/wcmp_v1.pdf) (RISC, 2019), the Open Camera Trap Metadata Standard (CTMS; Forrester et al. 2016) and [Wildlife Insights Minimum Metadata Standards](https://docs.google.com/spreadsheets/d/1Jg-WybmVeGlWGrbPpwuwJCgranOV1r3M_LrzELttfK0/edit#gid=412365965) (Ahumada et al., 2019).The Alberta Remote Camera Metadata Standards also builds on the experience of remote camera users in Alberta, British Columbia and other jurisdictions and creates the opportunity for data from Alberta to be integrated with regional, national and global remote camera datasets.

# Metadata Standards

These Remote Camera Metadata Standards propose that remote camera data should be organized according to a hierarchical structure consisting of six levels: ([project](#project), [study area](#study_area), [survey](#survey), [sample station](#sample_station) / [camera location](#camera_location), [deployment](#deployment), and image/[sequence](#sequence)) ([Figure 1](#md_standards_fig_1)).

This hierarchy was adapted from the Camera Trap Metadata Standards (CTMS; Forrester et al. 2016), the [B.C. Metadata Standards](https://www2.gov.bc.ca/assets/gov/environment/natural-resource-stewardship/nr-laws-policy/risc/wcmp_v1.pdf) (RISC, 2019), and [Wildlife Insights Minimum Metadata Standards (Ahumada et al., 2019).](https://docs.google.com/spreadsheets/d/1Jg-WybmVeGlWGrbPpwuwJCgranOV1r3M_LrzELttfK0/edit#gid=412365965)

These standards describe the minimum [metadata](#metadata) that should be documented for each of the six levels, as well as how to include optional data fields. Equivalent data fields may appear under different names in different protocols / repositories. To provide user-friendly terminology, a crosswalk table is included ([Appendix A - Table A1](#TOC_md_standards_table_a1)) that can be used to match data fields to commonly used protocol/repositories, to further the potential amalgamation of data from Alberta with global remote camera datasets.

The process for recording and submitting data involves entering deployment and image/sequence information into a standardized data repository to facilitate long-term storage, prevent data loss and enhance the comparability of remote camera data in Alberta.

In Alberta, there are regulatory requirements to submit data to the [FWMIS database](https://www.alberta.ca/fisheries-and-wildlife-management-information-system-overview.aspx) according to existing provincial policies (e.g., Sensitive Species Inventory Protocols, Research and Collection permits). Refer to the Government of Alberta web pages for further information.

All fields described in these Remote Camera Metadata Standards are recommended unless stated as optional.

A screenshot of a computer

Description automatically generated

#### **Figure 1.** Hierarchical structure of remote camera data in the Remote Camera Metadata Standards for Alberta. Based on Forrester et al. (2016), [Wildlife Insights Minimum Metadata Standards](https://docs.google.com/spreadsheets/d/1Jg-WybmVeGlWGrbPpwuwJCgranOV1r3M_LrzELttfK0/edit#gid=412365965) (Ahumada et al., 2019) and the [B.C. Metadata Standards](https://www2.gov.bc.ca/assets/gov/environment/natural-resource-stewardship/nr-laws-policy/risc/wcmp_v1.pdf) (RISC, 2019).

# Project

A [**project**](#project) is a scientific study, inventory or monitoring program that has a certain objective, defined methods, and a defined boundary in space and time. Careful consideration of the objectives and survey design for any remote camera [project](#project) is encouraged. Recommendations on the appropriate survey designs to achieve various objectives are available in the [Remote Camera Survey Guidelines](https://ab-rcsc.github.io/RCSC-WildCAM_Remote-Camera-Survey-Guidelines-and-Metadata-Standards/1_survey-guidelines/1_0.1_Citation-and-Info.html) (RCSC et al., 2024).

## Project Name

The [**Project Name**](#project_name) is a unique alphanumeric identifier for each [project](#project). Ideally, the [Project Name](#project_name) should include an abbreviation for the organization, a brief [project](#project) name, and the year the [project](#project) began (e.g., " uofa\_oilsands\_2018").

## Project Coordinator

The first and last name of the primary contact for the [project](#project).

## Project Coordinator Email

The email address of the [Project Coordinator](#project_coordinator).

## Project Description

Describe the [project](#project) objectives(s) and general methods.

For example: "To compare wolf [occupancy](#occupancy) in the oil sands region of north-eastern Alberta in two areas with high energy development and two reference areas with little development."

# Study Area

A [**study area**](#study_area) is a unique research, inventory or monitoring area (spatial boundary) within a [project](#project). There may be multiple [study areas](#study_area) within a single [project](#project). Several factors may influence the spatial extent of the [study area](#study_area), including the [Survey Objectives](#survey_objectives), landscape features (e.g., habitat type, land uses, etc.), the biology of the [Target Species](#target_species)' (e.g., dispersal ability, habitat preferences, etc.) and proposed method(s) of data analysis.

## Study Area Name

A unique alphanumeric identifier for each [study area](#study_area) (e.g.,"oilsands\_ref1"). If only one area was surveyed, the [Project Name](#project_name) and [Study Area Name](#study_area_name) should be the same.

## Study Area Description

A description for each unique research or monitoring area including its location, habitat type(s), land use(s) and habitat disturbances (where applicable).

For example: "Located in the SE corner of Birch Mountains Wildland Provincial Park in Boreal Highlands subregion. Bogs, pine, aspen and birch forest. No land use disturbance.

# Surveys

A [survey](#survey) is a unique [deployment](#deployment) period (temporal extent) within a [project](#project). There may be multiple [surveys](#survey) in a single [project](#project). However, if multiple [surveys](#survey) are completed in the same [study area](#study_area) and following the same [Survey Design](#survey_design) and methods of data collection, the [project](#project) and [survey](#survey) information may be the same. If a [project](#project) includes more than one type of [survey](#survey), each should be included separately, with a unique [Survey Name](#survey_name) and [survey](#survey)-specific information.

## Survey Name

A unique alphanumeric identifier for each [survey](#survey) period (e.g., "fortmc\_1").

## Survey Objectives

Describe the specific objectives of each [survey](#survey) within a [project](#project), including the [Target Species](#target_species), and [state variables](#state_variable) (e.g., [occupancy](#occupancy), [density](#density)), and proposed [modelling approach(es)](#mods_modelling_approach). [Survey Objectives](#survey_objectives) should be specific, measurable, achievable, relevant, and time-bound (i.e., SMART).’

For example: "To monitor trends in wolf occupancy at 5-year intervals from January – December 2020 to 2023."

## Target Species

The common name(s) of the species that the [survey](#survey) was designed to detect (e.g., "gray wolf").

If there is more than one [Target Species](#target_species), list the species in alphabetical order (e.g., "coyote, moose, mule deer"). Alternatively, use the genus common name where appropriate (e.g., "genus odocoileus" for mule and white-tailed deer).

## Survey Design

[Survey Design](#survey_design) refers to the spatial arrangement of remote cameras within the [study area](#study_area) for an individual survey. If "Hierarchical (multiple)\*" include additional details in the [Survey Design Description](#survey_design_description).

Note that we refer to different configurations of cameras more generally as study design and sampling design; however, the term "[Survey Design](https://ualbertaca-my.sharepoint.com/personal/cjsteven_ualberta_ca/Documents/RCSC_RC-Survey-Guidelines_AB-Metadata-Standards/l)" refers to study design as it applies to an individual [survey](#survey). There may be multiple [Survey Designs](#survey_design) for [survey](#survey) within a [project](#project); if this occurs, the [Survey Design](https://ualbertaca-my.sharepoint.com/personal/cjsteven_ualberta_ca/Documents/RCSC_RC-Survey-Guidelines_AB-Metadata-Standards/l) should be reported separately for each [survey](#survey).

Select **one** of the [Survey Designs](#survey_design) from the list provided:

"[Simple random](#sampledesign_random)" (randomized [camera locations](#camera_location))

"[Systematic](#sampledesign_systematic)" (regular pattern - e.g., grid; across disturbance gradient or reference sites)

"[Stratified](#sampledesign_stratified)" ([camera locations](#camera_location) in pre-defined "strata", e.g., habitat types)

"[Clustered](#sampledesign_clustered)" (multiple [camera locations](#camera_location) at a sample station; can be used with Systematic or [Stratified](#sampledesign_stratified) design)

"[Paired](#sampledesign_paired)" (two [camera locations](#camera_location) in close proximity to one another ("paired cameras"), or when one or more cameras are at two separate [camera locations](#camera_location) that are in close proximity or with some characteristics in common ("paired sites")

"[Targeted](#sampledesign_targeted)" ([camera locations](#camera_location) or [sample station](#sample_station)s with known or suspected high activity levels; e.g., game trails, mineral licks, etc.)

"[Convenience](#sampledesign_convenience)" ([camera locations](#camera_location) or [sample station](#sample_station)s based on logistic considerations; e.g., remoteness, access constraints, and/or costs)

"Hierarchical (Multiple)¶" (e.g., [Systematic](#sampledesign_systematic) and [Stratified](#sampledesign_stratified); describe in [Survey Design Description](#survey_design_description))

"Other¶" (describe in [Survey Design Description](#survey_design_description))

"Unknown"

For additional information on [Survey Designs](#survey_design), refer to the [Remote Camera Survey Guidelines](https://ab-rcsc.github.io/RCSC-WildCAM_Remote-Camera-Survey-Guidelines-and-Metadata-Standards/1_survey-guidelines/1_0.1_Citation-and-Info.html) (RCSC et al., 2024).

## Survey Design Description (optional)

Describe any additional details about your [Survey Design](#survey_design).

If you selected the "Hierarchical (multiple)" option from the [Survey Design](#survey_design) list, report all the [Survey Designs](#survey_design) as a comma delimited list from larger to smaller spatial scales. To help parse out this information later most easily, we recommend using a format that includes a header followed by the various [Survey Designs](#survey_design), e.g., "[survey design](#survey_design)[[Systematic](#sampledesign_systematic),[Convenience](#sampledesign_convenience)]."

For example: "[survey\_design](#survey_design)[[Systematic](#sampledesign_systematic),[Convenience](#sampledesign_convenience)]; one [camera location](#camera_location) within each township. Each location was within 100m of a secondary road or cutline. [Lure](#baitlure_lure) dispensers with Gorman's Gumbo (long line) were set-up at each [camera location](#camera_location) during initial camera [deployment](#deployment) and not revisited during the [survey](#survey) period."

If you selected the "Other" option from the [Survey Design](#survey_design) list, provide information about the design used.

If you set the [Event Type](#event_type) field to "[Sequence](#sequence)," and are using a user-defined time threshold (OR "[inter-detection interval](#inter_detection_interval)", e.g., 30 minutes) to define independent [detection "events"](#detection_event) within a [sequence](#sequence), report the [inter-detection interval](#inter_detection_interval) (or "sequence definition") in the [Survey Design Description](#survey_design_description). Refer to the [Image/Sequence section](# TOC_md_standards_image_sequence) for further details.

## Event Type

Report whether detections were reported as an individual image captured by the camera ("Image"), a "[Sequence](#sequence)," or "[Tag](#tag)".

A "[**tag**](#tag)" refers to when individuals, or groups of individuals, are categorized within an image, regardless of whether the information applies to all of the individuals in the image. A single [tag](#tag) is applied to categorize one or more individuals with the same combination of characteristics (e.g., [Adult](#age_class_adult) Males displaying the same [Behaviour](#behaviour)). Conversely, multiple [tags](#tag) are applied when individuals in an image differ in their characteristics (e.g., an [Adult](#age_class_adult) and a [Juvenile](#age_class_juvenile), all else remaining equal, are tagged separately). This could also occur for [Age Class](#age_class), [Behaviour](#behaviour), [Human Transport Mode/Activity](#human_transport_mode_activity), etc. Since multiple [tags](#tag) can occur for a single image, there may be multiple data rows for the same image (if the [Event Type](#event_type) is at the "[Tag](#tag)" level).

# Sample Station/Camera Location

A **sample station** refers to a grouping of two or more non-independent [camera locations](#camera_location), such as when cameras are [clustered](#sampledesign_clustered) or [paired](#sampledesign_paired). For example, multiple cameras in close proximity to one another for individual animal identification or on/off-trail comparison could be considered a [sample station](#sample_station).

Each [sample station](#sample_station) should have its own unique [Sample Station Name](#sample_station_name) (grouping ID). Within a [sample station](#sample_station), each camera will have a unique [Camera Location Name](#camera_location_name) and location (unless multiple cameras are on the same [camera attachment](#camera_attachment) point; e.g., tree).

## Sample Station Name

A sequential alphanumeric identifier for each grouping of two more non-independent [camera locations](#camera_location) (when cameras are deployed in clusters, pairs, or arrays; e.g., "ss1" in "ss1\_bh1", "ss1\_bh2", "ss1\_bh3" etc.). Leave blank if not applicable.

## Camera Location Name

A unique alphanumeric identifier for the location where a single camera was placed (e.g., "bh1", "bh2").

## Latitude Camera Location

The latitude of the [camera location](#camera_location) in decimal degrees to five decimal places (e.g., "53.78136"). Leave blank if recording the [Northing Camera Location](#northing_camera_location) instead.

## Longitude Camera Location

The longitude of the camera location in decimal degrees to five decimal places (e.g., "-113.46067"). Leave blank if recording the [Easting Camera Location](#easting_camera_location) instead.

## Northing Camera Location

The northing UTM coordinate of the [camera location](#camera_location) (e.g., "5962006"). Record using the NAD83 datum. Leave blank if recording the [Latitude Camera Location](#latitude_camera_location) instead.

## Easting Camera Location

The easting UTM coordinate of the [camera location](#camera_location) (e.g., "337875"). Record using the NAD83 datum. Leave blank if recording the [Longitude Camera Location](#longitude_camera_location) instead.

## UTM Zone Camera Location

The number corresponding to the Universal Transverse Mercator (UTM) grid zone where the camera was placed (e.g., "12"). UTM is a coordinate system that divides the earth into grid zones that are identified with a number (representing a width of latitude) and letter (representing the hemisphere).

In Alberta the UTM zones are either 11, 12, or TTM. Enter all other UTM zones in the [Camera Location Comments](#camera_location_comments) field (e.g., zones 7-10 for British Columbia), or use [Latitude Camera Location](#latitude_camera_location) and [Longitude Camera Location](#longitude_camera_location) instead of UTM coordinates.

## GPS Unit Accuracy (m)

The margin of error of the GPS unit used to record spatial information (e.g., "5" [m]), such as the coordinates of the [camera location](#camera_location). On most GPS units (e.g., "Garmin") this information is provided on the unit's satellite information page. [GPS Unit Accuracy](#gps_unit_accuracy) may vary with the make and model of the GPS unit, surrounding vegetation, infrastructure, atmospheric interference, etc.

## Camera Location Comments (optional)

Describe any additional details about a [camera location](#camera_location) (e.g., in UTM Zone 7 in British Columbia; aspen-dominated; type of "Off-Highway Vehicle Trail" used as a [FOV Target Feature](#fov_target)).

If you selected "Other" from the [FOV Target Feature](#fov_target) field, provide information about that feature (e.g., 2x4 m high woody debris piles within a cutblock).

# Deployment

A [deployment](#deployment) is a unique placement of a camera in space and time (recorded as "Deployment Name"). There may be multiple [deployments](#deployment) for one [camera location](#camera_location). [Deployments](#deployment) are often considered as the time between [visits](#visit) to a [camera location](#camera_location) (i.e., [deployment](#deployment) to service, service to service, and service to retrieval). Any change to [camera location](#camera_location), sampling period, camera equipment (e.g., [Trigger Sensitivity setting](#settings_trigger_sensitivity), becomes non-functioning), and/or conditions (e.g., not [baited](#baitlure_bait) then not [baited](#baitlure_bait) later; camera SD card replaced) should be documented as a unique [deployment](#deployment).

[Metadata](#metadata) information associated with the [deployment](#deployment) level of the hierarchy ([Figure 1](#md_standards_fig_1)) can be grouped into the following subsections:

* [Visit Metadata](#visit_metadata) (collected at deployment and [service/retrieval](#service_retrieval))
* **Equipment Information** (collected at both deployment and [service/retrieval](#service_retrieval); fields vary by [visit](#visit) type)
* **Camera Settings** (collected at deployment)
* **Camera Placement** (collected at deployment)
* **Site Characteristics** (collected at deployment)
* **Equipment Checks** (collected at both deployment and [service/retrieval](#service_retrieval))
* **Image Set Information** (collected as a combination of information from [deployment metadata](#deployment_metadata) and [service/retrieval metadata](#service_retrieval_metadata))

## Deployment - Visit Metadata

[Visit metadata](#visit_metadata) that should be collected each time a [camera location](#camera_location) is [visited](#visit) to deploy, service or retrieve a camera. The relevant data that should be collected may differ depending on the type of [visit](#visit).

### Deployment Name

A unique alphanumeric identifier for a unique camera deployed during a specific [survey](#survey) period (ideally recorded as: "[Camera Location Name](#camera_location_name)"\_"Deployment Start Date"(or ...\_"Deployment End Date") (e.g., "bh1\_17-Jul-2018" or "bh1\_17-Jul-2018\_21-Jan-2019"). Alternative naming conventions may be used, but the goal should be to minimize duplicate [Image Names](#image_name).

### Deployment Crew and Service/Retrieval Crew

The first and last names of all the individuals who collected data during the [deployment visit](#deployment_visit) ("[Deployment Crew](#deployment_crew)") and [service/retrieval visit](#service_retrieval_visit) ("[Service/Retrieval Crew](#service_retrieval_crew)").

Some platforms (e.g., FWMIS) collect this information in one field (e.g., "Crew Names") rather than two. In this case, enter the data in a single data row (each row represents a [deployment](#deployment)) and in a format that will make it easy to distinguish between the [Deployment Crew](#deployment_crew) and the [Service/Retrieval Crew](#service_retrieval_crew) (e.g., "[Deployment Crew](#deployment_crew)[John Smith, Jimmy Smith], [Service/Retrieval Crew](#service_retrieval_crew)[Susie Smith]").

### Deployment Start Date Time (DD-MMM-YYYY HH:MM:SS)

The date and time that a camera was placed for a specific [deployment](#deployment) (e.g., 17-Jan-2018 10:34:22). The [Deployment Start Date Time](#deployment_start_date_time) may not coincide with when the first image or video was collected (i.e., the [Image Set Start Date Time](#image_set_start_date_time)). Recording this field allows users to account for [deployments](#deployment) where no images were captured and to confirm the first date and time a camera was active.

### Deployment End Date Time (DD-MMM-YYYY HH:MM:SS)

The date and time that the data was retrieved for a specific [deployment](#deployment) (e.g., 27-Jan-2019 23:00:00). The [Deployment End Date Time](#deployment_end_date_time) may not coincide with when the last image or video was collected (i.e., the [Image Set End Date Time](#image_set_start_end_time)). Recording this field allows users to account for [deployments](#deployment) where no images were captured and to confirm the last date and time that the camera was active.

If a camera fails (stops functioning), the [Deployment End Date Time](#deployment_end_date_time) should be the date the camera was last known to be operational. For example, if a camera was not operational when it was retrieved on May 5th, the [Deployment End Date Time](#deployment_end_date_time) should be reported as the date and time that the last image or video was captured (e.g., 28-Apr-2023 12:36:27).

On rare occasions, a camera may be non-functioning in the middle of a [deployment](#deployment) period but functioning at the start and end of the [deployment](#deployment) period (e.g., snow covered for a few days). In this case, two unique [deployments](#deployment) should be entered for periods before and after the period the camera was not functioning and with unique [start](#deployment_start_date_time) and [end dates times](#deployment_end_date_time).

To accurately measure [survey](#survey) effort in the event of camera failure, we recommend that users set the camera's [Trigger Mode(s)](#settings_trigger_modes) field to "[Time-lapse Image](#timelapse_image)" to capture at least one image at a consistent time each day. This will allow users to more accurately determine failure dates. For example, it may be difficult to determine a failure date for a camera that is only occasionally [triggered](#trigger_event) by animals (e.g., on a weekly basis). Taking an image at a prescribed interval also provides a consistent record of site conditions over time (e.g., snow cover, vegetation growth).

### Visit Comments (optional)

Describe any additional details about a [visit](#visit) to a [camera location](#camera_location) (e.g., camera snow-covered; [Remaining Battery (%)](#remaining_battery_percent); brand of [lure](#baitlure_lure) reapplied during a [service/retrieval visit](#service_retrieval_visit)).

## Deployment - Equipment Information

### Camera ID

A unique alphanumeric ID (e.g., "reconpc900\_1") for the camera that distinguishes it from other cameras of the same [Camera Make](#camera_make) or [Camera Model](#camera_model).

Referred to as "New [Camera ID](#camera_id)" on the Camera Service/Retrieval Field Datasheet when a camera is replaced. Leave blank if the camera was not replaced.

### Camera Make

The make of a particular camera (i.e., the manufacturer, e.g., "Reconyx" or "Bushnell"). The [Camera Make](#camera_make) is particularly important information for analyses where different types of cameras may result in variable detection probabilities.

Referred to as "New [Camera Make](#camera_make)" on the Camera Service/Retrieval Field Datasheet when a camera is replaced at a [sample station](#sample_station)/[camera location](#camera_location). Leave blank for these fields if the camera is not replaced.

### Camera Model

The model number or name of a particular camera (e.g., "PC900" or "Trophy Cam HD"). The [Camera Model](#camera_model) is particularly important information for analyses where different types of cameras may result in variable [detection probabilities](#detection_probability).

Referred to as "New [Camera Model](#camera_model)" on the Camera Service/Retrieval Field Datasheet when a camera is replaced at a [sample station](#sample_station)/[camera location](#camera_location). Leave blank if the camera is not replaced.

### Camera Serial Number

The serial number of a particular camera, which is usually found inside the camera cover (e.g., "P900FF04152022"). The [Camera Serial Number](#camera_serial_number) helps in differentiating cameras placed on the same [Camera Attachment](#camera_attachment) point (e.g., tree) and in identifying when cameras are replaced at an existing [camera location](#camera_location).

Referred to as "New [Camera Serial Number](#camera_serial_number)" on the Camera Service/Retrieval Field Datasheet when a camera is replaced at a [sample station](#sample_station)/[camera location](#camera_location). Leave blank if the camera is not replaced.

## Deployment - Camera Settings

### Trigger Mode(s)

The camera setting(s) that determine how the camera will [trigger](#trigger_event): by motion ("Motion Image"), at set intervals ("[Time-lapse Image](#timelapse_image)"), and/or by video ("Video"; possible with newer [Camera Models](#camera_model), such as Reconyx HP2X).

Select **one** of the options from the list provided:

"Motion Image"

"Time-lapse Image"

"Video"

"Motion Image + Time-lapse Image"

"Motion Image + Time-lapse Image + Video"

"Time-lapse Image + Video"

"Motion Image + Video"

### Video Length (seconds)

The minimum video duration (in seconds) that the camera will record when [triggered](#trigger_event) (if applicable). Leave blank if not applicable.

### Trigger Sensitivity

The camera setting responsible for how sensitive a camera is to activation (to "[triggering](#trigger_event)") via the infrared and/or heat detectors (if applicable). Select one of the following [Trigger Sensitivity settings](#settings_trigger_sensitivity) common to most cameras (e.g., Reconyx HyperFire): "Low," "Low/Med," "Med," "Med/High," "High," "Very high." Enter "Unknown" if the [Trigger Mode](#settings_trigger_modes) is set to a timer (see the [Motion Image Interval](#settings_motion_image_interval) section) or if the camera does not have a [Trigger Sensitivity](#settings_trigger_sensitivity) setting option.

### Photos Per Trigger

The number of photos taken each time the camera is [triggered](#trigger_event) (integer, e.g., "1", "2", "3" etc.).

### Motion Image Interval (seconds)

The time (in seconds) between images within a multi-image [sequence](#sequence) that occur due to motion, heat, or activation of external detector devices. The [Motion Image Interval](#settings_motion_image_interval) is pre-set in the camera's settings by the user, but the time at which the camera collects images because of this setting is influenced by the presence of movement or heat. For example, if the camera was set to take three images per event at a [Motion Image Interval](#settings_motion_image_interval) of three seconds when the camera detects motion or heat, the first image will be collected (e.g., at 09:00:00), the second image will be collected three seconds later (09:00:03), and the third will be collected three seconds after that (09:00:06). This setting differs from the [Quiet Period](#settings_quiet_period) in that the delay occurs between images contained within a multi-image [sequence](#sequence), rather than between multi-image [sequence](#sequence) (as in [Quiet Period](#settings_quiet_period)). If a [Motion Image Interval](#settings_motion_image_interval) was not set, enter "0" seconds (i.e., instantaneous).

### Quiet Period (seconds)

The user-defined camera setting which provides the time (in seconds) between shutter "[triggers](#trigger_event)" if the camera was programmed to pause between firing initially and firing a second time. Also known as "time lag" (depending on the [Camera Make](#camera_make)/[Model](#camera_model); Palmer et al., 2018). Report as "0" if a [Quiet Period](#settings_quiet_period) was not set. The [Quiet Period](#settings_quiet_period) differs from the [Motion Image Interval](#settings_motion_image_interval) in that the delay occurs between multi-image [sequences](#sequence) rather than between the images contained within multi-image [sequences](#sequence) (as in the [Motion Image Interval](#settings_motion_image_interval)).

## Deployment - Camera Placement

### Camera Height (m)

This is the height from the ground (below snow) to the bottom of the lens (metres; to the nearest 0.05 m).

### Camera Direction (degrees) (optional)

The cardinal direction that a camera faces. Ideally, cameras should face north (N; i.e. "0" degrees), or south (S; i.e., "180" degrees) if north is not possible. The [Camera Direction](#camera_direction) should be chosen to ensure the [Field of View (FOV)](#field_of_view) is of the original [FOV Target Feature](#fov_target).

### Stake Distance (m) (optional)

The distance from the camera to a stake (if applicable; metres; to the nearest 0.05 m). Leave blank if not applicable.

### FOV Target Feature

A specific man-made or natural feature at which the camera is aimed to maximize the detection of wildlife species or to measure the use of that feature. [FOV Target Features](#fov_target) are important to document in case they result in detection biases. Record "None" if a [FOV Target Feature](#fov_target) was not used and "Unknown" if not known. If "Other," describe in the [Camera Location Comments](#camera_location_comments).

Select **one** of the options from the list provided:

"Game Trail"

"Hiking Trail"

"Off-Highway Vehicle Trail" (e.g., all-terrain vehicle, snowmobile, motorbike, 4 x 4 truck)

"Paved Road"

"Dirt/Gravel Road"

"Road Crossing" (e.g., overpass, underpass, or bridge)

"Railway"

"Cutline/Seismic Line"

"Transmission Line"

"Pipeline"

"Wellsite"

"Culvert"

"Beaver Dam"

"Burrow/Den"

"Nest"

"Carcass" (not placed by the crew as [bait](#baitlure_bait)/[lure](#baitlure_lure))

"Natural Mineral Lick"

"Rub Post"

"Other†" (describe in [Camera Location Comments](#camera_location_comments) field)

"None" (when a [FOV Target Feature](#fov_target) was not used)

"Unknown" (not recorded)

### FOV Target Feature Distance (m) (optional)

The distance from the camera to the [FOV Target Feature](#fov_target) (metres; to the nearest 0.05 m). Leave blank if not applicable.

### Bait/Lure Type

The type of [bait](#baitlure_bait) or [lure](#baitlure_lure) used at a [camera location](#camera_location). Record "None" if a [Bait/Lure Type](#baitlure_bait_lure_type) was not used and "Unknown" if not known. If "Other," describe in the Deployment Comments:

Select **one** of the options from the list provided:

"Scent"

"Meal" (including carcass placed by the crew)

"Bait Tree"

"Visual"

"Acoustic"

* **"Other‡"** (describe in [Visit Comments](#visit_comments) fields; "[Deployment Comments](#deployment_comments)" on the Camera Deployment Field Datasheet or "[Service/Retrieval Comments](#service_retrieval_comments)" on the Camera Service/Retrieval Field Datasheet).

"None" (if no [bait](#baitlure_bait) or [lure](#baitlure_lure) was used)

"Unknown" (not recorded)

## Deployment - Site Characteristics

### Camera Location Characteristic(s) (optional)

Record any significant features around the camera at the time of the [visit](#visit). This may include for example, manmade or natural linear features (e.g., trails), habitat types (e.g., wetlands), wildlife structure (e.g., beaver dam).

[Camera Location Characteristic(s)](#camera_location_characteristics) differ from [FOV Target Features](#fov_target) in that [Camera Location Characteristic(s)](#camera_location_characteristics) could include those not in the camera's field of view. Researchers typically record information about the environment at [camera locations](#camera_location) to better understand how this might affect animal occurrence or Behaviour.

List all the characteristics that apply to the [camera location](#camera_location) from the list provided below. If "Other," describe in the Camera Location Comments. List the values alphabetically and separate each entry by a comma and space; e.g., "Building, Forest - Mixedwood, Road, Trail"):

"Trail" (e.g., game, hiking, off-highway vehicle trail)

"Road" (e.g., paved, dirt/gravel, road crossing)

"Railway/Pipeline/Transmission Line"

"Cutline/Seismic Line"

"Wellsite"

"Clearcut"

"Building"

"Forest - Deciduous"

"Forest - Coniferous"

"Forest - Mixedwood"

"Forest - Undefined"

"Meadow"

"Burn"

"Agriculture" (e.g., crop, pasture)

"Shrubland"

"Beaver Dam"

"Wetland" (e.g., bog, fen, marsh/shallow open water, swamp)

"Lentic" (i.e., standing water, e.g., lake, pond)

"Lotic" (i.e., flowing water, e.g., stream, river)

"Other†" (describe in [Camera Location Comments](#camera_location_comments))

"Unknown" (not recorded)

## Deployment - Equipment Checks

A [**walktest**](#walktest) is conducted to ensure the [Camera Height](#camera_height), tilt, etc., adequately captures the desired [detection zone](#detection_zone) (i.e., the area (conical in shape) in which a remote camera can detect the heat signature and motion of an object (Rovero & Zimmermann, 2016). To learn more about [walktests](#walktest) and [detection zones](#detection_zone), refer to the [Remote Camera Survey Guidelines](https://ab-rcsc.github.io/RCSC-WildCAM_Remote-Camera-Survey-Guidelines-and-Metadata-Standards/1_survey-guidelines/1_0.1_Citation-and-Info.html) (RCSC et al., 2024).

### Walktest Distance (m) (optional)

The horizontal distance from the camera at which the [crew](#crew) performs the [walktest](#walktest) (metres; to the nearest 0.05 m). Leave blank if not applicable.

### Walktest Height (m) (optional)

The vertical distance (from the camera at which the [crew](#crew) performs the [walktest](#walktest) (metres; to the nearest 0.05 m). Leave blank if not applicable.

## Deployment - Image Set Information

### Image Set Start Date Time (DD-MMM-YYYY HH:MM:SS)

The date and time of the **first** image or video collected during a specific [deployment](#deployment) (e.g., "17-Jan-2018 12:00:02"). The [Image Set Start Date Time](#image_set_start_date_time) may not coincide with the [Deployment Start Date Time](#deployment_start_date_time). Recording this field allows users to confirm the first date and time a camera was active (reliable if [time-lapse images](#timelapse_image) were collected; especially valuable if the user scheduled a start delay).

### Image Set End Date Time (DD-MMM-YYYY HH:MM:SS)

The date and time of the last image or video collected during a specific [deployment](#deployment) (e.g., "27-Jan-2019 22:10:05"). The [Image Set Start Date Time](#image_set_start_date_time) may not coincide with the [Deployment End Date Time](#deployment_end_date_time). Recording this field allows users to account for [deployments](#deployment) that were conducted but for which no data was found, and to confirm the last date and time a camera was active (if functioning) if no images or videos were captured prior to service/retrieval (especially valuable if users did not collect [time-lapse images](#timelapse_image) or if the camera malfunctioned).

### Deployment Image Count (optional)

The total number of images collected during the [deployment](#deployment), including [false triggers](#false_trigger) (i.e., empty images with no wildlife or human present) and those [triggered](#trigger_event) by a [time-lapse](#timelapse_image) setting (if applicable). This field is important to record to confirm that no data has been lost during file transfers etc.

# Image/Sequence

The **image/**[**sequence**](#sequence) **level** provides information on the data for an image (individual photo) or [sequence](#sequence) of related images (e.g., images that are grouped as part of the same trigger "event").

An **image** may be part of a multi-image [sequence](#sequence).

A [**sequence**](#sequence)refers to a user-defined group of images or video clips that denote a single "[detection event](#detection_event)". Often camera users choose a certain time threshold (or "[inter-detection interval](#inter_detection_interval)") to define independent [detection events](#detection_event); (e.g., 30 minutes (O'Brien et al., 2003; Gerber et al., 2010; Kitamura et al., 2010; Samejima et al., 2012) or 1 hour (e.g., Tobler et al., 2008; Rovero and Marshall, 2009)). This threshold should be recorded in the [Survey Design Description](#survey_design_description) field, if applicable.

When a [Sequence](#sequence) [Event Type](#event_type) is used, only enter data once for the [sequence](#sequence) of images (not for each unique image) and use the first image of the [sequence](#sequence) as the [Sequence Name](#sequence_name), as this is the time of the first detection.

Refer to the [Data Management section](#TOC_md_standards_data_management) for information on [image processing](#image_processing) software, and recommendations on data file structure and naming conventions.

## Image Name

A unique alphanumeric identifier for the image. It is highly recommended that users develop a photo naming convention prior to entering data. It is important to include (at a minimum) the [camera location](#camera_location), date, time, and image number when generating an [Image Name](#image_name) to avoid duplicate file names. For example, the [Deployment Name](#deployment_name) and image number would not be unique for the same [deployment](#deployment) within Reconynx overflow file subfolders (i.e., when the number of images exceeds 9,999, another folder is created [e.g., 101MEDIA] and the numbers in the image file names begin again at img\_001).

We recommend using either of the following naming conventions for [Image Names](#image_name):

1. "[Deployment Name](#deployment_name)"\_"[Camera\_Serial Number](#camera_serial_number)"\_"[Image\_Sequence\_Date\_Time](#image_sequence_date_time)"\_"Image Number" (e.g., "bh1\_17-Jul-2018\_P900FF04152022\_22-Jul-2018\_10:34:22\_img\_100"), or
2. "[Deployment Name](#deployment_name)"\_"[Image\_Sequence\_Date\_Time](#image_sequence_date_time)"\_"Image Number" (e.g., "bh1\_17-Jul-2018\_22-Jul-2018\_10:34:22\_img\_100")

The file name used to create the [Image Name](#image_name) should ideally match the file name of the original image.

## Sequence Name

A unique alphanumeric identifier for a multi-image [sequence](#sequence).

The [**Sequence Name**](#sequence_name) should ideally consist of the [Deployment Name](#deployment_name) and the names of the first and last images and videos in the [sequence](#sequence) (separated by "\_") (i.e., "[Deployment Name](#deployment_name)"\_"img\_#[name of first image in [sequence](#sequence)]"\_"img\_#[name of last image in [sequence](#sequence)]." For example, if a particular [sequence](#sequence) contains five images, the [Sequence Name](#sequence_name) might be "bh1\_22-Jul-2018\_img\_001-img\_005." If "img\_ " prefixes are used to create the [Sequence Name](#sequence_name), they ideally should match the names of the original photos. Leave blank if not applicable.

Even though the first image of a [sequence](#sequence) is the only image used to derive the [Sequence Name](#sequence_name), the remaining images typically also include useful information (e.g., images of all individuals in a group). Therefore, it is ideal to archive all of the images from a [sequence](#sequence). If it is not possible to submit all of the images, users should ideally submit the image(s) from a [sequence](#sequence) that best represents the [sequence](#sequence) (e.g., those that can be used to verify the [Species](#species) and [Individual Count](#individual_count)).

## Image/Sequence Date Time (DD-MMM-YYYY HH:MM:SS)

The date and time of an image, or the image chosen to represent the [sequence](#sequence), recorded as "DD-MMM-YYYY HH:MM:SS" (e.g., 22-Jan-2018 12:00:02).

[Sequence](#sequence) date/time information may be reported for a "representative image" of a [sequence](#sequence) (i.e., the image with the most information). For example, if three images were included in a [sequence](#sequence), but the [Sex Class](#sex_class) could only be discerned in the second image [all else remaining equal], the second image would be the best representative image of the [sequence](#sequence).

The [Image/Sequence Date Time](#image_sequence_date_time) differs from the [Image Set Start Date Time](#image_set_start_date_time) which refers to the **first** image or video collected during a [deployment](#deployment).

## Analyst

The first and last names of the individual who provided the observation data point ([Species](#species) identification and associated information). If there are multiple [Analysts](#Analyst) for an observation, enter the primary [Analyst](#Analyst).

## Species

The common name of the [Species](#species) being categorized ("tagged") in the [tag](#tag), image or [sequence](#sequence) (e.g., "coyote" or "common goldeneye"). If there is more than one wildlife [Species](#species) present in an image/[sequence](#sequence), data for each [Species](#species) should be entered on a unique row but with the same [Image Name](#image_name) or [Sequence Name](#sequence_name) (reporting as [Event Type](#event_type) = "[Tag](#tag)").

For detections where you are unsure of the specific [Species](#species), report the level of lowest taxonomic ranking known (e.g., "class," "order," "family," "genus"), followed by the scientific name of the taxa.

For example, for a detection of an individual that is in the Canidae family, but for which the genus or [Species](#species) or unclear, report "family canidae." Refer to the species\_crosswalk tab of the [Remote Camera Metadata Standards: Metadata Template v3](https://ab-rcsc.github.io/RCSC-WildCAM_Remote-Camera-Survey-Guidelines-and-Metadata-Standards/1_survey-guidelines/1_0.1_Citation-and-Info.html) (RCSC, 2024) for ease of reference.

If no [Species](#species) is present (i.e. blank or empty image), enter "none."

## Individual Count

The number of unique individuals being categorized. Depending on the [Event Type](#event_type), this may be recorded as the total number of individuals, or according to [Age Class](#age_class) and/or [Sex Class](#sex_class).

## Age Class and Sex Class

The age and sex classification of an individual(s) being categorized.

Select one [Age Class](#age_class) from the following:

"[Adult](#age_class_adult)" (animals that are old enough to breed; reproductively mature)

"[Juvenile](#age_class_juvenile)" (animals in their first summer, with clearly [juvenile](#age_class_juvenile) features (e.g., spots); mammals older than neonates but that still require parental care)

"[Subadult](#age_class_subadult)" (animals older than a "[Juvenile](#age_class_juvenile)" but not yet an "[Adult](#age_class_adult)"; a "[Subadult](#age_class_subadult)" may be further classified into "[Young of the Year](#age_class_subadult_youngofyear)" or "[Yearling](#age_class_subadult_yearling)")

"[Subadult - Young of Year](#age_class_subadult_youngofyear)" (animals less than one year old; born in the previous year's spring, but has not yet lived through a winter season; between "[Juvenile](#age_class_juvenile)" and "[Yearling](#age_class_subadult_yearling)")

"[Subadult - Yearling](#age_class_subadult_yearling)" (animals approximately one year old; has lived through one winter season; between "[Young of Year](#age_class_subadult_youngofyear)" and "[Adult](#age_class_adult)")

"Unknown"

Select one [Sex Class](#sex_class) from the following:

"Male"

"Female"

"Unknown"

If there is more than one [Age Class](#age_class) or [Sex Class](#sex_class) in an image/[sequence](#sequence), users can enter either:

1. each unique [Age Class](#age_class)/[Sex Class](#sex_class) combination as a unique row ([Event Type](#event_type) = "Image" or "[Sequence](#sequence)" or
2. each unique combination within the same row under an appropriate field ([Event Type](#event_type) = "[Tag](#tag)")

For example, if an image/[sequence](#sequence) contains 6 elk, 2 of which are [adult](#age_class_adult) females, 3 of which are [juveniles](#age_class_juvenile) of unknown sex and one of which is an [adult](#age_class_adult) male, the data could be entered as 3 unique rows, each with the same [Image/Sequence Date Time)](#image_sequence_date_time) and unique identifier ([Image Name](#image_name) or [Sequence Name](#sequence_name)), where:

* the first row: Count = 2, [Age Class](#age_class) = [Adult](#age_class_adult), and [Sex Class](#sex_class) = Female
* a second row: Count = 3, [Age Class](#age_class) = [Juvenile](#age_class_juvenile), and [Sex Class](#sex_class) = Unknown
* a third row is Count = 1, [Age Class](#age_class) = [Adult](#age_class_adult), and [Sex Class](#sex_class) = Male

Alternatively, the same data could be entered in one single row as:

* Count = 6, [Age Class](#age_class) = Blank, [Sex Class](#sex_class) = Blank, [Adult](#age_class_adult) Males = 1, [Adult](#age_class_adult) Females = 2, and [Juvenile](#age_class_juvenile) - Unclassified Sex = 3.

Deciding how to enter the data is at the user's discretion. However, the recommended approach to entering data where unique individuals are identified (or the [Behaviours](#behaviour) of individuals are identified) is to enter data for each individual as a unique row.

## Behaviour (optional)

The [Behaviour](#behaviour) of the individual(s) being categorized.

Select **one** of the options from the list provided:

"Travelling"

"Standing"

"Running"

"Bedding"

"Drinking"

"Feeding/Foraging"

"Territorial Display"

"Rutting/Mating"

"Vigilant"

"Inspecting Camera"

"Inspecting (Non-specified)"

"Unknown"

"Other§" (describe in [[[Image/Sequence Comments](#image_sequence_comments)](#image-sequence-comments)](#image_sequence_comments) field)

"Multiple§" (describe in [[[Image/Sequence Comments](#image_sequence_comments)](#image-sequence-comments)](#image_sequence_comments) field; e.g., "[Behaviour](#behaviour)[Standing,Vigilant]")

"Unknown" (not applicable or did not collect)

If observing a group of individuals, record the Behaviour of all the individuals in the group or enter the Behaviour of each animal as a unique row (see example in the [Age Class and Sex Class section](#age_class) above).

If an animal is performing multiple [Behaviours](#behaviour), select "Multiple§," and include all the [Behaviours](#behaviour) in the [[[Image/Sequence Comments](#image_sequence_comments)](#image-sequence-comments)](#image_sequence_comments) as a comma delimited list. To help parse out this information later most easily, we recommend using a format that includes a header followed by the [Behaviour](#behaviour)(s), e.g., "[Behaviour](#behaviour)[Inspecting Camera,Travelling]."

## Animal ID (optional)

A unique ID for an animal that can be uniquely identified (e.g., marked in some way). If multiple unique individuals are identified, enter an [Animal ID](#animal_id) for each as a unique row. Leave blank if not applicable.

## Human Transport Mode/Activity (optional)

The activity performed, or mode of transportation used, by a human observed (e.g., hiker, skier, off-highway vehicle, etc.). This categorical field should be populated when data on humans (in addition to wildlife) are collected.

Select **one** of the options from the list provided:

"Activity - Walking"

"Activity - Hiking" (e.g., backpacker)

"Activity - Running"

"Activity - Cycling" (e.g., non-motorized or e-bike)

"Activity - Skiing"

"Activity - Snowshoeing"

"Activity- Fishing"

"Activity - Hunting"

"Activity - Unspecified"

"Transport - Horse/Mule"

"Transport - Off-Highway Vehicle" (e.g., all-terrain vehicle, snowmobile, motorbike, snowmobile, 4 x 4 truck)

"Transport - Passenger Vehicle" (e.g., car, truck without 4x4)

"Transport - Large Commercial Vehicle/Heavy Equipment" (e.g., logging truck, semi-truck, bus)

"Transport - Unspecified"

"Activity/Transport - Other§" (describe in [[[[[Image/Sequence Comments](#image_sequence_comments)](#image_sequence_comments)](#image-sequence-comments)](#image_sequence_comments)](#image_sequence_comments) field)

"Unknown" (not applicable)

Where there are multiple individuals and transport modes within a tag, image, or [sequence](#sequence), enter the data for each individual mode as a unique row. Leave blank if not applicable and record "Unknown" if not known.

## Image/Sequence Comments (optional)

Describe any additional data about the image or [sequence](#sequence).

If you selected the "Multiple§" option from the [Behaviour](#behaviour) field, enter all the [Behaviours](#behaviour) here (e.g., "[Behaviour](#behaviour)[Inspecting Camera,Travelling]").

## Image Trigger Mode (optional)

The type of [Trigger Mode](#settings_trigger_modes) used to capture the image as reported in the image Exif data. This field is categorical; record "Unknown" if not known.

Data should be entered as **one** of the following:

"Motion Detection"

"Time Lapse"

"CodeLoc Not Entered"

"External Sensor"

"Unknown"

## Image Sequence (optional)

The order of the image in a rapid-fire [sequence](#sequence) as reported in the image Exif data (text; e.g., "1 of 1" or "1 of 3"). This field is in text format; leave blank if not applicable.

## Image Infrared Illuminator (optional)

The [Image Infrared Illuminator](#image_infrared_illuminator) is an image metadata field indicating whether the infrared illuminator setting was enabled (if applicable; to obtain greater visibility at night by producing infrared light). Record as reported in the image Exif data (e.g., "On" or "Off"). This field is categorical; leave blank if not applicable and record "Unknown" if not known.

Data should be entered as **one** of the following:

"On"

"Off"

"Unknown"

## Image Flash Output (optional)

The [Image Flash Output](#image_flash_output) is an image metadata field indicating the level of intensity of the flash [if enabled/applicable]). Record as reported in the image Exif data (e.g., "Flash Did Not Fire", "Auto"). This field is in text format; record "Unknown" if not known; leave blank if not applicable.

# Data Management

Data management is a critical component of any [project](#project). Below are recommendations on file naming conventions and file structure to help manage remote camera data. Refer to the [Remote Camera Survey Guidelines](https://ab-rcsc.github.io/RCSC-WildCAM_Remote-Camera-Survey-Guidelines-and-Metadata-Standards/1_survey-guidelines/1_0.1_Citation-and-Info.html) (RCSC et al., 2024) for additional information topics related to data management, including software platforms and tools to help camera users enter [metadata](#metadata) as well as store, process and analyze image data.

## Naming conventions

It is highly recommended that users develop a set of naming conventions prior to entering data. Using naming conventions will minimize the risk of having images from different [deployment](#deployment)s, [study area](#study_area)s, or [survey](#survey)s with the same name. Note that many [metadata](#metadata)/data repositories (e.g., [B.C. Metadata Standards](https://www2.gov.bc.ca/assets/gov/environment/natural-resource-stewardship/nr-laws-policy/risc/wcmp_v1.pdf) [RISC, 2019], [Wildlife Insights Minimum Metadata Standards](https://docs.google.com/spreadsheets/d/1Jg-WybmVeGlWGrbPpwuwJCgranOV1r3M_LrzELttfK0/edit#gid=412365965) [Ahumada et al., 2019], [WildTrax](https://portal.wildtrax.ca)) have required field formats and special character limitations.

Naming conventions are especially important for the following fields:

* [Project Name](#project_name)
* [Study Area Name](#study_area_name)
* [Survey Name](#survey_name)
* [Sample Station Name](#sample_station_name)
* [Camera Location Name](#camera_location_name)
* [Deployment Name](#deployment_name)
* [Image Name](#image_name)
* [Sequence Name](#sequence_name)
* Camera ID
* Animal ID

Refer to the [Special characters section](#_Allowable_formats_&), as well as [Appendix A - Table A2](#TOC_md_standards_table_a2)for examples of recommended naming conventions.

### Allowable formats & Special characters

IDs (i.e., "Name" or "ID" field listed above) and file names should not have spaces or leading zeros. Additional restrictions on special characters are as follows:

* **Supported special characters**: - \_ :
* **Special characters NOT supported**: , . / ( ) [ ] & # @ space

Alternative naming conventions may be used, but the goal should be to minimize duplication of IDs (and/or file names). Note that if you plan to use [Timelapse2](http://saul.cpsc.ucalgary.ca/timelapse/) (Greenberg, 2018), special characters for alphanumeric fields are further restricted to letters, numbers, "\_", and "-".

### Renaming images

If you wish to rename your images, it is highly recommended that renamed images reflect the associated [Image Name](#image_name).

Data entry software can be used for batch processing of image names, which can significantly reduce data processing time compared to renaming images manually (e.g., [Timelapse2](http://saul.cpsc.ucalgary.ca/timelapse/) [Greenberg, 2018], [Reconyx MapView](http://www.reconyx.com/software/mapview;) [Reconyx, Holmen, WI, USA]) or other tools (e.g., [WildCo Lab's Image Renamer](https://github.com/WildCoLab/WildCo_Image_Renamer) [WildCo Lab, 2021b]). Note that it is not always necessary to rename images. For example, renaming would not be required if data are stored in a folder structure that identifies the [camera location](#camera_location) and the [survey](#survey) from which it was collected.

## File structure

Image data ideally should be stored in a hierarchical structure as shown in ([Figure 1](#md_standards_fig_1)). Each level would typically comprise a series of file subfolders containing data from the level below it (e.g., a [project](#project) folder with study area subfolders, with each [study area](#study_area) with [survey](#survey) subfolders etc.). For example, [Figure 2](#md_standards_fig_2) shows the file structure for a [project](#project) that consisted of two [study area](#study_area)s, each with one [survey](#survey) and each [survey](#survey) with two [camera location](#camera_location)s with one [deployment](#deployment) period and two [sequence](#sequence)s per [camera location](#camera_location).

However, this is often not the way we store this information in the form of CSVs (e.g., if there are only one or two [study area](#study_area)s, it might not make sense to store this information in a separate CSV file). These [metadata](#metadata) standards suggest a CSV structure similar to that of other [metadata](#metadata)/data repositories (e.g., [B.C. Metadata Standards](https://www2.gov.bc.ca/assets/gov/environment/natural-resource-stewardship/nr-laws-policy/risc/wcmp_v1.pdf) [RISC, 2019], [Wildlife Insights Minimum Metadata Standards](https://docs.google.com/spreadsheets/d/1Jg-WybmVeGlWGrbPpwuwJCgranOV1r3M_LrzELttfK0/edit#gid=412365965) [Ahumada et al., 2019], [WildTrax](https://portal.wildtrax.ca)) that consists of four CSVs associated with these [metadata](#metadata) standards:

* Project CSV
* Sample Staton/Camera Location CSV
* Deployment CSV
* Image/Sequence CSV (includes Event Type = "[Tag](#tag)")

The information from each CSV can be linked using identifiers for each of the levels in the folder structure/hierarchy (refer to [Figure 3](#TOC_md_standards_fig_3)) so that redundant information does not need to be repeated, and the chance of error is reduced. The connections between the levels and CSVs are also outlined in [Appendix A - Table A2](# TOC_md_standards_table_a2 ).

Refer to the [Remote Camera Metadata Standards: Metadata Template v3](https://ab-rcsc.github.io/RCSC-WildCAM_Remote-Camera-Survey-Guidelines-and-Metadata-Standards/1_survey-guidelines/1_0.1_Citation-and-Info.html) (RCSC, 2024) for the template CSVs and additional information.

A diagram of a structure

Description automatically generated

**Figure 2.** Example of the recommended file structure and naming conventions for a [project](#project) that consisted of two [study area](#study_area)s, each with one [survey](#survey) and each [survey](#survey) with two [camera location](#camera_location)s with one [deployment](#deployment) period and 2 [sequence](#sequence)s per [camera location](#camera_location).

A diagram of a project

Description automatically generated with medium confidence

**Figure 3.** The hierarchical structure of remote camera data in the Remote Camera Metadata Standards for Alberta (based on Forrester et al. [2016], [Wildlife Insights Minimum Metadata Standards](https://docs.google.com/spreadsheets/d/1Jg-WybmVeGlWGrbPpwuwJCgranOV1r3M_LrzELttfK0/edit#gid=412365965) [Ahumada et al., 2019] and the [B.C. Metadata Standards](https://www2.gov.bc.ca/assets/gov/environment/natural-resource-stewardship/nr-laws-policy/risc/wcmp_v1.pdf) [RISC, 2019]) and the linkages with and within the four CSVs included in these [metadata](#metadata) standards ("Project CSV," "Sample Station/Camera Location CSV," "Deployment CSV," and the "Image/Sequence CSV").

## Data storage (archival)

It is strongly encouraged/may be required that remote camera datasets are submitted to an open data repository. There are regulatory requirements to submit data loadforms to the [FWMIS database](https://www.alberta.ca/fisheries-and-wildlife-management-information-system-overview.aspx) (not images, although this is strongly encouraged) according to specific policies (e.g., Sensitive Species Inventory Protocols, Research and Collection permits, etc.). A new FWMIS loadform consistent with these [metadata](#metadata) standards will be available in August 2023. Refer to the Government of Alberta web pages for further information.

There are other cloud or server-based repositories available to house all camera datasets, including [WildTrax](http://www.wildtrax.ca/), [eMammal](https://emammal.si.edu/) (McShea et al., 2015), [Wildlife Insights](https://www.wildlifeinsights.org/) (Ahumada et al., 2019) and others (see Young et al., [2018] for a comparison of 12 available programs for the management of camera data).

All data, including the images, [deployment area photos](#deployment_area_photos) and complete [metadata](#“metadata”), can be uploaded and stored in the [WildTrax repository](http://www.wildtrax.ca). [WildTrax](https://portal.wildtrax.ca) has multiple privacy options and can accommodate all categories of images that users may prefer to manage separately, including "[false trigger](#false_trigger)" and images of humans.

[Appendix 1 - Table A1](#TOC_md_standards_table_a1) contains a crosswalk table linking the data fields from these Alberta Metadata Standards with those from the [B.C. Metadata Standards](https://www2.gov.bc.ca/assets/gov/environment/natural-resource-stewardship/nr-laws-policy/risc/wcmp_v1.pdf) (RISC, 2019), FWMIS, [WildTrax](https://portal.wildtrax.ca) and [Wildlife Insights](https://www.wildlifeinsights.org/) (Ahumada et al., 2019) data repositories.

Refer to the [Remote Camera Survey Guidelines](https://ab-rcsc.github.io/RCSC-WildCAM_Remote-Camera-Survey-Guidelines-and-Metadata-Standards/1_survey-guidelines/1_0.1_Citation-and-Info.html) (RCSC et al., 2024) for more information on data storage.

# Conclusion

These standards provide information on how remote camera data should be collected and documented in Alberta. These standards are closely related to other proposed standards (e.g., Forrester et al., 2016) and strongly align, wherever possible, with the [B.C. Metadata Standards](https://www2.gov.bc.ca/assets/gov/environment/natural-resource-stewardship/nr-laws-policy/risc/wcmp_v1.pdf) (RISC, 2019) and [Wildlife Insights](https://www.wildlifeinsights.org/) (Ahumada et al., 2019). The consistent collection of remote camera data helps support the development of robust study designs and datasets, and enhance opportunities for collaboration across projects to address research and monitoring questions across administrative jurisdictions, including those on a global scale.

# References

Ahumada, J. A., Silva, C. E. F., Gajapersad, K., Hallam, C., Hurtado, J., Martin, E., McWilliam, A., Mugerwa, B., O’Brien, T., Rovero, F., Sheil, D., Spironello, W. R., Winarni, N., & Andelman, S. J. (2011). Community structure and diversity of tropical forest mammals: Data from a global camera trap network. *Philosophical Transactions: Biological Sciences, 366*(1578), 2703–2711. <https://doi.org/10.1098/rstb.2011.0115>

Ahumada, J. A., Fegraus, E., Birch, T., Flores, N., Kays, R., O’Brien, T. G., Palmer, J., Schuttler, S., Zhao, J. Y., Jetz, W., Kinnaird, M., Kulkarni, S., Lyet, A., Thau, D., Duong, M., Oliver, R., & Dancer, A. (2019). Wildlife Insights: A Platform to Maximize the Potential of Camera Trap and Other Passive Sensor Wildlife Data for the Planet. *Environmental Conservation, 47*(1), 1–6. <https://doi.org/10.1017/s0376892919000298>

Alberta Remote Camera Steering Committee (RCSC), Stevenson, C., Hubbs, A., & Wildlife Cameras for Adaptive Management (WildCAM). (2024). Remote Camera Survey Guidelines: Guidelines for Western Canada. Edmonton, Alberta. <https://ab-rcsc.github.io/RCSC-WildCAM_Remote-Camera-Survey-Guidelines-and-Metadata-Standards/1_survey-guidelines/1_0.1_Citation-and-Info.html>

Becker, M., Huggard, D. J., Dickie, M., Warbington, C., Schieck, J., Herdman, E., Serrouya, R., & Boutin, S. (2022). Applying and testing a novel method to estimate animal density from motion-triggered cameras. *Ecosphere, 13*(4), [e4005. https://doi.org/10.1002/ecs2.4005](https://www.zotero.org/google-docs/?j9T7Dd)

Bowkett, A. E., Rovero, F., & Marshall, A. R. (2008). The use of camera-trap data to model habitat use by antelope species in the Udzungwa Mountain forests, Tanzania. *African Journal of Ecology*, *46*(4), 479–487. [https://doi.org/10.1111/j.1365-2028.2007.00881.x](https://www.zotero.org/google-docs/?j9T7Dd)

Burkholder, E. N., Jakes, A. F., Jones, P. F., Hebblewhite, M., & Bishop, C. J. (2018). To Jump or Not to Jump: Mule Deer and White-Tailed Deer Fence Crossing Decisions. *Wildlife Society Bulletin*, *42*(3), 420–429. [https://doi.org/10.1002/wsb.898](https://www.zotero.org/google-docs/?j9T7Dd)

[Burton, A. C., Neilson, E., Moreira, D., Ladle, A., Steenweg, R., Fisher, J. T., Bayne, E., & Boutin, S. (2015). REVIEW: Wildlife Camera Trapping: A Review and Recommendations for Linking surveys to Ecological Processes. *Journal of Applied Ecology*, *52*(3), 675–685. https://doi.org/10.1111/1365-2664.12432](https://www.zotero.org/google-docs/?j9T7Dd)

[Carbone, C., Christie, S., Conforti, K., Coulson, T., Franklin, N., Ginsberg, J. R., Griffiths, M., Holden, J., Kawanishi, K., Kinnaird, M., Laidlaw, R., Lynam, A., Macdonald, D. W., Martyr, D., McDougal, C., Nath, L., O’Brien, T., Seidensticker, J., Smith, D. J. L., Wan Shahruddin, W. N. (2001). The use of photographic rates to estimate densities of tigers and other cryptic mammals. *Animal Conservation*, *4*(1), 75–79. https://doi.org/10.1017/S1367943001001081](https://www.zotero.org/google-docs/?j9T7Dd)

[Clevenger, A. P., & Waltho, N. (2005). Performance indices to identify attributes of highway crossing structures facilitating movement of large mammals. *Biological Conservation*, *121*(3), 453–464. https://doi.org/10.1016/j.biocon.2004.04.025](https://www.zotero.org/google-docs/?j9T7Dd)

Dunne, B. M., & Quinn, M. S. (2009). Effectiveness of above-ground pipeline mitigation for moose ([*Alces alces*](https://www.zotero.org/google-docs/?j9T7Dd)) and other large mammals. *Biological Conservation*[, *142*(2), 332–343.](https://www.zotero.org/google-docs/?j9T7Dd) <https://doi.org/10.1016/j.biocon.2008.10.029>

Duquette, J. F., Belant, J. L., Svoboda, N. J., Beyer Jr., D. E., & Albright, C.A. (2014). Comparison of occupancy modeling and radiotelemetry to estimate ungulate population dynamics. *Population Ecology, 56,* 481-492. [https://www.academia.edu/23421255/](https://www.academia.edu/23421255/Comparison_of_occupancy_modeling_and_radiotelemetry_to_estimate_ungulate_population_dynamics)

[Fegraus, E. H., Lin, K., Ahumada, J. A., Baru, C., Chandra, S., & Youn, C. (2011). Data acquisition and management software for camera trap data: A case study from the TEAM Network. *Ecological Informatics*, *6*(6), 345–353. https://doi.org/10.1016/j.ecoinf.2011.06.003](https://www.zotero.org/google-docs/?j9T7Dd)

[Fisher, J. T., & Burton, C. (2012). *Monitoring Mammals in Alberta: Recommendations for Remote Camera Trapping*. Alberta Innovates - Technology Futures & Alberta Biodiversity Monitoring Institute.](https://www.zotero.org/google-docs/?j9T7Dd) https://doi.org/0.13140/RG.2.1.3944.3680

[Fisher, J. T., Wheatley, M., & Mackenzie, D. (2014). Spatial patterns of breeding success of grizzly bears derived from hierarchical multistate models. *Conservation Biology*, *28*(5), 1249–1259. https://doi.org/10.1111/cobi.12302](https://www.zotero.org/google-docs/?j9T7Dd)

[Forrester, T., O’Brien, T., Fegraus, E., Jansen, P. A., Palmer, J., Kays, R., Ahumada, J., Stern, B., & McShea, W. (2016). An Open Standard for Camera Trap Data. *Biodiversity Data Journal*, *4*, e10197.](https://www.zotero.org/google-docs/?j9T7Dd) <https://doi.org/10.3897/BDJ.4.e10197>

Frey, S., Fisher, J.T., Burton, A.C., & Volpe, J.P. (2017). Investigating animal activity patterns and temporal niche partitioning using camera-trap data: challenges and opportunities. *Remote Sensing in Ecology and Conservation*, 3 (3), 123–132.<https://zslpublications.onlinelibrary.wiley.com/doi/10.1002/rse2.60>

Gerber, B., Karpanty, S.S.M., Crawford, C., Kotschwar, M. & Randrianantenaina, J. (2010). An assessment of carnivore relative abundance and density in the eastern rainforests of Madagascar using remotely-triggered camera traps. *Oryx, 44*(2), 219–222.<https://doi.org/10.1017/S0030605309991037>

[Holinda, D., Burgar, J. M., & Burton, A. C. (2020). Effects of scent lure on camera trap detections vary across mammalian predator and prey species. *PloS One*, *15*(5), e0229055. https://doi.org/10.1371/journal.pone.0229055](https://www.zotero.org/google-docs/?j9T7Dd)

[Karanth, K. U., Nichols, J. D., Kumar, N. S., & Hines, J. E. (2006). Assessing Tiger Population Dynamics Using Photographic Capture–Recapture Sampling. *Ecology*, *87*(11), 2925–2937.](https://www.zotero.org/google-docs/?j9T7Dd) [https://doi.org/10.1890/0012-9658(2006)87[2925:ATPDUP]2.0.CO;2](https://doi.org/10.1890/0012-9658(2006)87%5B2925:ATPDUP%5D2.0.CO;2)

Kitamura, S., Thong-Aree, S., Madsri, S., & Poonswad, P. (2010). Mammal diversity and conservation in a small isolated forest of southern Thailand. *Raffles Bulletin of Zoology, 58*(1), 145–156.<https://www.pangolinsg.org/wp-content/uploads/sites/4/2018/06/Kitamura-et-al._2010_Mammal-diversity-in-small-forest-of-Southern-Thailand.pdf>

[Kruger, H., Vaananen, V.-M., Holopainen, S., & Nummi, P. (2018). The new faces of nest predation in agricultural landscapes - a wildlife camera survey with artificial nests. *European Journal of Wildlife Research*, *64*(6), 76. https://doi.org/10.1007/s10344-018-1233-7](https://www.zotero.org/google-docs/?j9T7Dd)

[Lahoz-Monfort, J. J., & Magrath, M. J. L. (2021). A Comprehensive Overview of Technologies for Species and Habitat Monitoring and Conservation. *Bioscience*, *71*(10), 1038–1062. https://doi.org/10.1093/biosci/biab073](https://www.zotero.org/google-docs/?j9T7Dd)

[Lazenby, B. T., Mooney, N. J., & Dickman, C. R. (2015). Detecting species interactions using remote cameras: Effects on small mammals of predators, conspecifics, and climate. *Ecosphere*, *6*(12), 1–18. https://doi.org/10.1890/ES14-00522.1](https://www.zotero.org/google-docs/?j9T7Dd)

[Lynch, T. P., Alderman, R., & Hobday, A. J. (2015). A high-resolution panorama camera system for monitoring colony-wide seabird nesting behaviour. *Methods in Ecology and Evolution*, *6*(5), 491–499.](https://www.zotero.org/google-docs/?j9T7Dd) <https://doi.org/10.1111/2041-210X.12339>

MacKenzie, D. I., Nichols, J. D., Lachman, G. B., Droege, S., Royle, J. A., & Langtimm, C. A. (2002). Estimating Site Occupancy Rates When Detection Probabilities Are Less Than One. *Ecology, 83*(8), 2248–2255. <https://doi.org/10.2307/3072056>

[McShea, W. J., Shen, X., Liu, F., Wang, T., Xiao, Z., Li, S. (2020). China’s wildlife camera-trap monitoring needs a unified standard. *Biodiversity Science*, *28*(9), 1125–1131. https://doi.org/10.17520/biods.2020188](https://www.zotero.org/google-docs/?j9T7Dd)

[Meek, P. D., Ballard, G., Claridge, A., Kays, R., Moseby, K., O’Brien, T., O’Connell, A., Sanderson, J., Swann, D. E., Tobler, M., & Townsend, S. (2014). Recommended guiding principles for reporting on camera trapping research. *Biodiversity and Conservation*, *23*(9), 2321–2343. https://doi.org/10.1007/s10531-014-0712-8](https://www.zotero.org/google-docs/?j9T7Dd)

[Mills, C. A., Godley, B. J., & Hodgson, D. J. (2016). Take Only Photographs, Leave Only Footprints: Novel Applications of Non-Invasive survey Methods for Rapid Detection of Small, Arboreal Animals. *PloS One*, *11*(1), e0146142.](https://www.zotero.org/google-docs/?j9T7Dd) <https://doi.org/10.1371/journal.pone.0146142>

Moeller, A. K., Lukacs, P. M., & Horne, J. S. (2018). Three novel methods to estimate abundance of unmarked animals using remote cameras. *Ecosphere, 9*(8), Article e02331. <https://doi.org/10.1002/ecs2.2331>

[Muhly, T., Serrouya, R., Neilson, E., Li, H., & Boutin, S. (2015). Influence of In-Situ Oil Sands Development on Caribou (*Rangifer tarandus*) Movement. *PloS One*, *10*(9), e0136933. https://doi.org/10.1371/journal.pone.0136933](https://www.zotero.org/google-docs/?j9T7Dd)

[Muhly, T. B., Semeniuk, C., Massolo, A., Hickman, L., & Musiani, M. (2011). Human activity helps prey win the predator-prey space race. *PloS One*, *6*(3), e17050. https://doi.org/10.1371/journal.pone.0017050](https://www.zotero.org/google-docs/?j9T7Dd)

[Murray, M. H., Hill, J., Whyte, P., & St Clair, C. C. (2016). Urban Compost Attracts Coyotes, Contains Toxins, and may Promote Disease in Urban-Adapted Wildlife. *Ecohealth*, *13*(2), 285–292. https://doi.org/10.1007/s10393-016-1105-0](https://www.zotero.org/google-docs/?j9T7Dd)

[Natural Regions Committee. (2006). *Natural regions and subregions of Alberta* (T/852; p. 264). Government of Alberta.](https://www.zotero.org/google-docs/?j9T7Dd) <https://open.alberta.ca/publications/0778545725>

O’Brien, T. G., Kinnaird, M. F. & Wibisono, H. T. (2003). Crouching tigers, hidden prey: Sumatran tiger and prey populations in a tropical forest landscape. *Animal Conservation, 6*(2), 131-139.<https://doi.org/10.1017/s1367943003003172>

[O’Connell, A. F., Nichols, J. D., & Karanth, K. U. (Eds.). (2010). *Camera traps in Animal Ecology: Methods and Analyses*. Springer.](https://www.zotero.org/google-docs/?j9T7Dd) https://doi.org/10.1007/978-4-431-99495-4

[O’Connell, A. F., Talancy, N. W., Bailey, L. L., Sauer, J. R., Cook, R., & Gilbert, A. T. (2006). Estimating Site Occupancy and Detection Probability Parameters for Meso- And Large Mammals in a Coastal Ecosystem. *Journal of Wildlife Management*, *70*(6), 1625–1633.](https://www.zotero.org/google-docs/?j9T7Dd) [https://doi.org/10.2193/0022-541X(2006)70[1625:ESOADP]2.0.CO;2](https://doi.org/10.2193/0022-541X(2006)70%5B1625:ESOADP%5D2.0.CO;2)

Palmer, M.S., Swanson, A., Kosmala, M., Arnold, T. & Packer, C. (2018). Evaluating relative abundance indices for terrestrial herbivores from large‐scale camera trap surveys. *African Journal of Ecology*, *56*, 791-803.<https://onlinelibrary.wiley.com/doi/abs/10.1111/aje.12566>

Resources Information Standards Committee (RISC). (2019). *Wildlife Camera Metadata Protocol: Standards for Components of British Columbia’s Biodiversity No. 44*. Province of British Columbia Knowledge Management Branch, Ministry of Environment and Climate Change Strategy, and Ministry of Forests, Lands, Natural Resource Operations and Rural Development. Victoria, B.C. www2.gov.bc.ca/assets/download/DABCE3A5C7934410A8307285070C24EA

Rovero, F., & Marshall, A. R. (2009). Camera Trapping Photographic Rate as an Index of Density in Forest Ungulates. *Journal of Applied Ecology*, *46*(5), 1011–1017.<https://www.jstor.org/stable/25623081>

[Rovero, F., Zimmermann, F., Berzi, D., & Meek, P. (2013). "Which camera trap type and how many do I need?" A review of camera features and study designs for a range of wildlife research applications. *Hystrix - The Italian Journal of Mammalogy*, *24*(2):148–156.](https://www.zotero.org/google-docs/?j9T7Dd) <https://doi.org/10.4404/hystrix-24.2-6316>

Rovero, F., & Zimmermann, F. (2016). *Camera Trapping for Wildlife Research*. Exeter: Pelagic Publishing, UK.

Royle, J. A., Nichols, J. D., Karanth, K. U., & Gopalaswamy, A. M. (2009). A hierarchical model for estimating density in camera-trap studies. *Journal of Applied Ecology, 46*(1), 118–127. <https://doi.org/10.1111/j.1365-2664.2008.01578.x>

Samejima, H., Ong, R., Lagan, P. & Kitayama, K. (2012). Camera-trapping rates of mammals and birds in a Bornean tropical rainforest under sustainable forest management. *Forest Ecology and Management, 270*, 248–256.<https://doi.org/10.1016/j.foreco.2012.01.013>

[Scotson, L., Johnston, L. R., Iannarilli, F., Wearn, O. R., Mohd‐Azlan, J., Wong, W. M., Gray, T. N. E., Dinata, Y., Suzuki, A., Willard, C. E., Frechette, J., Loken, B., Steinmetz, R., Moßbrucker, A. M., Clements, G. R., & Fieberg, J. (2017). Best practices and software for the management and sharing of camera trap data for small and large scales studies. *Remote Sensing in Ecology and Conservation*, *3*(3), 158–172. http://dx.doi.org/10.1002/rse2.54](https://www.zotero.org/google-docs/?j9T7Dd)

[Steenweg, R., Hebblewhite, M., Kays, R., Ahumada, J., Fisher, J. T., Burton, C., Townsend, S. E., Carbone, C., Rowcliffe, J. M., Whittington, J., Brodie, J., Royle, J. A., Switalski, A., Clevenger, A. P., Heim, N., & Rich, L. N. (2017). Scaling-up Camera Traps: Monitoring the Planet’s Biodiversity with Networks of Remote Sensors. *Frontiers in Ecology and the Environment*, *15*(1), 26–34. https://doi.org/10.1002/fee.1448](https://www.zotero.org/google-docs/?j9T7Dd)

[Steenweg, R., Whittington, J., & Hebblewhite, M. (2015). *Canadian Rockies remote camera multi-species occupancy project: Examining trends in carnivore populations and their prey*. University of Montana.](https://www.zotero.org/google-docs/?j9T7Dd) <http://parkscanadahistory.com/wildlife/steenweg-2015.pdf>

Sun, C., Beirne, C., Burgar, J. M., Howey, T., Fisher, J. T., Burton, A. C., Rowcliffe, M., & Hofmeester, T. (2021). Simultaneous Monitoring of Vegetation Dynamics and Wildlife Activity with Camera Traps to Assess Habitat Change. *Remote Sensing in Ecology and Conservation, 7*(4), 666-684. <https://doi.org/10.1002/rse2.222>

[Suwanrat, S., Ngoprasert, D., Sutherland, C., Suwanwaree, P., & Savini, T. (2015). Estimating density of secretive terrestrial birds (Siamese Fireback) in pristine and degraded forest using camera traps and distance sampling. *Global Ecology and Conservation*, *3*, 596–606. https://doi.org/10.1016/j.gecco.2015.01.010](https://www.zotero.org/google-docs/?j9T7Dd)

[Tigner, J., Bayne, E. M., & Boutin, S. (2014). Black bear use of seismic lines in Northern Canada. *Journal of Wildlife Management*, *78*(2), 282–292.](https://www.zotero.org/google-docs/?j9T7Dd) <https://doi.org/10.1002/jwmg.664>

Tobler, M. W., Pitman, R. L., Mares, R. & Powell, G. (2008). An Evaluation of Camera Traps for Inventorying Large- and Medium-Sized Terrestrial Rainforest Mammals. *Animal Conservation, 11*, 169–178.<https://doi.org/10.1111/j.1469-1795.2008.00169.x>

[Tschumi, M., Ekroos, J., Hjort, C., Smith, H. G., & Birkhofer, K. (2018). Rodents, not birds, dominate predation-related ecosystem services and disservices in vertebrate communities of agricultural landscapes. *Oecologia*, *188*(3), 863–873.](https://www.zotero.org/google-docs/?j9T7Dd) <https://doi.org/10.1007/s00442-018-4242-z>

Wearn, O. R., & Glover-Kapfer, P. (2017). Camera-trapping for conservation: a guide to best-practices. *WWF conservation technology series*, *1*, 1–181. <http://dx.doi.org/10.13140/RG.2.2.23409.17767>

[Whittington, J., Low, P., & Hunt, B. (2019). Temporal road closures improve habitat quality for wildlife. *Scientific Reports*, *9*](https://www.zotero.org/google-docs/?j9T7Dd)(1)[, 3772.](https://www.zotero.org/google-docs/?j9T7Dd) <https://pubmed.ncbi.nlm.nih.gov/30846820/>

# Glossary

|  |  |
| --- | --- |
| **Field name** | **Definition** |
| **\*Access Method** | The method used to reach the camera location (e.g., on "Foot," "ATV," "Helicopter," etc.). |
| **Adult** | Animals that are old enough to breed; reproductively mature. |
| **Age Class** | The age classification of individual(s) being categorized (e.g., "Adult," "Juvenile," "Subadult," "Subadult - Young of Year," "Subadult - Yearling", or "Unknown"). |
| **Analyst** | The first and last names of the individual who provided the observation data point (species identification and associated information). If there are multiple analysts for an observation, enter the primary analyst. |
| **\*Animal ID** | A unique ID for an animal that can be uniquely identified (e.g., marked in some way). If multiple unique individuals are identified, enter an Animal ID for each as a unique row. Leave blank if not applicable.. |
| Bait | A food item (or other substance) that is placed to attract animals via the sense of taste and olfactory cues (Schlexer, 2008). |
| **Bait/Lure Type** | The type of bait or lure used at a camera location. Record "None" if a Bait/Lure Type was not used and "Unknown" if not known. If "Other," describe in the Deployment Comments. |
| **\*Batteries Replaced** | Whether the camera's batteries were replaced. |
| **\*Behaviour** | The behaviour of the individual(s) being categorized (e.g., "Standing," "Drinking," "Vigilant," etc.). |
| **\*Camera Active On Arrival** | Whether a camera was functional upon arrival. |
| **\*Camera Active On Departure** | Whether a camera was functional upon departure. |
| **\*Camera Attachment** | The method/tools used to attach the camera (e.g., attached to a tree with a bungee cord; reported as codes such as "Tree + Bungee/Strap"). If "Other," describe in the Camera Location Comments. |
| **\*Camera Damaged** | Whether the camera was damaged or malfunctioning; if there is any damage to the device (physical or mechanical), the crew should describe the damage in the Service/Retrieval Comments. |
| **\*Camera Direction (degrees)** | The cardinal direction that a camera faces. Ideally, cameras should face north (N; i.e. "0" degrees), or south (S; i.e. "180" degrees) if north is not possible. The Camera Direction should be chosen to ensure the field of view (FOV) is of the original FOV target feature. |
| **Camera Height (m)** | The height from the ground (below snow) to the bottom of the lens (metres; to the nearest 0.05 m). |
| **Camera ID** | A unique alphanumeric ID for the camera that distinguishes it from other cameras of the same make or model. |
| Camera location | The location where a single camera was placed (recorded as "Camera Location Name"). |
| **\*Camera Location Characteristic(s)** | Any significant features around the camera at the time of the visit. This may include for example, manmade or natural linear features (e.g., trails), habitat types (e.g., wetlands), wildlife structure (e.g., beaver dam). If "Other," describe in the Camera Location Comments.  Camera Location Characteristics differ from FOV Target Features in that Camera Location Characteristics could include those not in the camera's Field of View. If "Other," describe in the Camera Location Comments. |
| **\*Camera Location Comments** | Comments describing additional details about a camera location. |
| **Camera Location Name** | A unique alphanumeric identifier for the location where a single camera was placed (e.g., "bh1," "bh2"). |
| **Camera Make** | The make of a particular camera (i.e., the manufacturer, e.g., "Reconyx" or "Bushnell"). |
| **Camera Model** | The model number or name of a particular camera (e.g., "PC900" or "Trophy Cam HD"). |
| **Camera Serial Number** | The serial number of a particular camera, which is usually found inside the camera cover (e.g., "P900FF04152022"). |
| Clustered design | Multiple cameras are deployed at a sample station. A clustered design can be used within a systematic or stratified approach (i.e., systematic clustered design or as a clustered random design [Wearn & Glover-Kapfer, 2017]). |
| Convenience design | Camera locations or sample stations are chosen based on logistic considerations (e.g., remoteness, access constraints, and/or costs). |
| Crew | The first and last names of all the individuals who collected data during the deployment visit ("Deployment Crew") and service/retrieval visit ("Service/Retrieval Crew"). |
| Density | The number of individuals per unit area. |
| Deployment | A unique placement of a camera in space and time (recorded as "Deployment Name"). There may be multiple deployments for one camera location. Deployments are often considered as the time between visits (i.e., deployment to service, service to service, and service to retrieval). Any change to camera location, sampling period, camera equipment (e.g., Trigger Sensitivity setting, becomes non-functioning), and/or conditions (e.g., not baited then baited later; camera SD card replaced) should be documented as a unique deployment. |
| **\*Deployment Area Photo Numbers** | The image numbers for the deployment area photos (if collected, e.g., "DSC100"). These are optionally documented on a Camera Deployment Field Datasheet for each set of camera deployment area photos. Leave blank if not applicable. |
| Deployment area photos | Photos of the area around the camera location, collected as a permanent, visual record of the FOV Target Features, Camera Location Characteristics, environmental conditions (e.g., vegetation, ecosite, weather) or other variables of interest. The recommendation includes collecting four photos taken from the centre of the target detection zone, facing each of the four cardinal directions. The documentation of the collection of these photos is recorded as "Deployment Area Photos Taken" (Y/N). |
| **\*Deployment Area Photos Taken** | Whether deployment area photos were taken (yes/no; optional). The recommendation includes collecting four photos taken from the centre of the target detection zone, facing each of the four cardinal directions. |
| **\*Deployment Comments** | Comments describing additional details about the deployment. |
| **Deployment Crew** | The first and last names of the individuals who collected data during the deployment visit. |
| **Deployment End Date Time (DD-MMM-YYYY HH:MM:SS)** | The date and time that the data was retrieved for a specific deployment (e.g., 27-Jan-2019 23:00:00). The Deployment End Date Time may not coincide with when the last image or video was collected (i.e., the Image Set End Date Time). Recording this field allows users to account for deployments where no images were captured and to confirm the last date and time that the camera was active. |
| **\*Deployment Image Count** | The total number of images collected during the deployment, including false triggers (i.e., empty images with no wildlife or human present species) and those triggered by a time-lapse setting (if applicable). |
| Deployment metadata | Metadata that is collected each time a camera is deployed. Each deployment event should have its own Camera Deployment Field Datasheet. The relevant metadata fields that should be collected differ when a camera is deployed vs. serviced or retrieved. Refer to Appendix A - Table A5 and Camera Deployment Field Datasheet. |
| **Deployment Name** | A unique alphanumeric identifier for a unique camera deployed during a specific survey period (ideally recorded as: "Camera Location Name"\_"Deployment Start Date" (or …\_"Deployment End Date") (e.g., "bh1\_17-Jul-2018" or "bh1\_17-Jul-2018\_21-Jan-2019").  Alternative naming conventions may be used, but the goal should be to minimize duplicate Image Names. |
| **Deployment Start Date Time (DD-MMM-YYYY HH:MM:SS)** | The date and time that a camera was placed for a specific deployment (e.g., 17-Jan-2018 10:34:22).  The Deployment Start Date Time may not coincide with when the first image or video was collected (i.e., the Image Set Start Date Time). Recording this field allows users to account for deployments where no images were captured and to confirm the first date and time a camera was active. |
| Deployment visit | When a crew has gone to a location to deploy a remote camera. |
| Detection "event" | A group of images or video clips that are considered independent from other images or video clips based on a certain time threshold (or "inter-detection interval"). For example, 30 minutes (O’Brien et al., 2003; Gerber et al., 2010; Kitamura et al., 2010; Samejima et al., 2012) or 1 hour (e.g., Tobler et al., 2008; Rovero & Marshall, 2009). |
| Detection zone | The area (conical in shape) in which a remote camera can detect the heat signature and motion of an object (Rovero & Zimmermann, 2016). |
| **Easting Camera Location** | The easting UTM coordinate of the camera location (e.g., "337875"). Record using the NAD83 datum. Leave blank if recording the Longitude instead. |
| **Event Type** | Whether detections were reported as an individual image captured by the camera ("Image"), a "Sequence," or "Tag." |
| False trigger | Blank images (no wildlife or human present). These images commonly occur when a camera is triggered by vegetation blowing in the wind. |
| Field of View (FOV) | The extent of a scene that is visible in an image; a large FOV is obtained by "zooming out" from a scene, whilst "zooming in" will result in a smaller FOV (Wearn & Glover-Kapfer, 2017). |
| Flash output | The camera setting that provides the level of intensity of the flash (if enabled). |
| **FOV Target Feature** | A specific man-made or natural feature at which the camera is aimed to maximize the detection of wildlife species or to measure the use of that feature. Record "None" if a FOV Target Feature was not used and "Unknown" if not known. If "Other," describe in the Camera Location Comments. |
| **\*FOV Target Feature Distance (m)** | The distance from the camera to the FOV Target Feature (in metres; to the nearest 0.5 m). Leave blank if not applicable. |
| **GPS Unit Accuracy (m)** | The margin of error of the GPS unit used to record spatial information (e.g., "5" [m]), such as the coordinates of the camera location. On most GPS units (e.g., "Garmin") this information is provided on the unit’s satellite information page. |
| **\*Human Transport Mode/Activity** | The activity performed or mode of transportation used by a human observed (e.g., hiker, skier, off-highway vehicle, etc.). This categorical field should be populated when data on humans (in addition to wildlife) are collected. Leave blank if not applicable and record "Unknown" if not known. |
| Image | An individual image captured by a camera, which may be part of a multi-image sequence (recorded as "Image Name"). |
| **\*Image Flash Output** | The Image Flash Output is an image metadata field indicating the level of intensity of the flash [if enabled/applicable]). Record as reported in the image Exif data (e.g., "Flash Did Not Fire", "Auto"). This field is in text format; record "Unknown" if not known; leave blank if not applicable. |
| **\*Image Infrared Illuminator** | The Image Infrared Illuminator is an image metadata field indicating whether the infrared illuminator setting was enabled (if applicable; to obtain greater visibility at night by producing infrared light). Record as reported in the image Exif data (e.g., "On" or "Off"). This field is categorical; leave blank if not applicable and record "Unknown" if not known. |
| **Image Name** | A unique alphanumeric identifier for the image. It is important to include (at a minimum) the camera location, date, time, and image number when generating an Image Name to avoid duplicate file names (e.g., "bh1\_17-Jul-2018\_P900FF04152022\_22-Jul-2018 10:34:22\_img\_100" or "bh1\_17-Jul-2018\_22-Jul-2018\_10:34:22\_img\_100"). |
| Image processing | The series of operations that are taken to extract information from images. In the case of remote camera data, it can include loading the images into a processing platform, extracting information from the image metadata (e.g., the date and time the image was taken), running an artificial intelligence (AI) algorithm to identify empty images, classifying animals or other entities within the image. |
| Image Sequence | The order of the image in a rapid-fire sequence as reported in the image Exif data (text; e.g., "1 of 1" or "1 of 3"). Leave blank if not applicable. |
| **Image Set End Date Time (DD-MMM-YYYY HH:MM:SS)** | The date and time of the last image or video collected during a specific deployment (e.g., "17-Jan-2018 22:10:05").  The Image Set End Date Time may not coincide with the deployment end date time. Recording this field allows users to account for deployments that were conducted but for which no data was found and to confirm the last date and time a camera was active (if functioning) if no images or videos were captured prior to Service/Retrieval (especially valuable if users did not collect Time-lapse images or if the camera malfunctioned). |
| **Image Set Start Date Time (DD-MMM-YYYY HH:MM:SS)** | The date and time of the first image or video collected during a specific deployment (e.g., "17-Jan-2018 12:00:02").  The Image Set Start Date Time may not coincide with the Deployment Start Date Time. Recording this field allows users to confirm the first date and time a camera was active (reliable if Time-lapse images were collected; especially valuable if the user scheduled a start delay). |
| **\*Image Trigger Mode** | The type of trigger mode used to capture the image as reported in the image Exif data (e.g., "Time Lapse", "Motion Detection," "CodeLoc Not Entered," "External Sensor"). Record "Unknown" if not known. |
| **\*Image/Sequence Comments** | Comments describing additional details about the image/sequence. |
| **Image/Sequence Date Time (DD-MMM-YYYY HH:MM:SS)** | The date and time of an image, or the image chosen to represent the sequence, recorded as "DD-MMM-YYYY HH:MM:SS" (e.g., 22-Jul-2018 11:02:02).  Sequence date/time information may be reported for a "representative image" of a sequence (i.e., the image with the most information). For example, if three images were included in a sequence, but the Sex Class could only be discerned in the second image [all else remaining equal], the second image would be the best representative image of the sequence.  The Image/Sequence Date Time differs from the Image Set Start Date Time which refers to the first image or video collected during a deployment. |
| **Individual Count** | The number of unique individuals being categorized. Depending on the Event Type, this may be recorded as the total number of individuals, or according to Age Class and/or Sex Class. |
| Infrared illuminator | The camera setting that can be enabled (if applicable to the camera make and camera model) to obtain greater visibility at night by producing infrared light. This field is categorical; leave blank if not applicable and record "Unknown" if not known. |
| Inter-detection interval | A user-defined threshold used to define a single "detection event" (i.e., independent "events") for group of images or video clips (e.g., 30 minutes or 1 hour). The threshold should be recorded in the Survey Design Description. |
| **Juvenile** | Animals in their first summer, with clearly juvenile features (e.g., spots); mammals older than neonates but that still require parental care. |
| **\*Key ID** | The unique ID for the specific key or set of keys used to lock/secure the camera to the post, tree, etc. |
| **Latitude Camera Location** | The latitude of the camera location in decimal degrees to five decimal places (e.g., "53.78136"). Leave blank if recording Northing instead. |
| **Longitude Camera Location** | The longitude of the camera location in decimal degrees to five decimal places (e.g., "-113.46067"). Leave blank if recording Easting instead. |
| Lure | Any substance that draws animals closer; lures include scent (olfactory) lure, visual lure and audible lure (Schlexer, 2008). |
| Metadata | Data that provides information about other data (e.g., the number of images on an SD card). |
| Modelling approach | The method used to analyze the camera data, which should depend on the state variable, e.g., occupancy models [MacKenzie et al., 2002], spatially explicit capture recapture (SECR) for density estimation [Chandler and Royle, 2013], etc. and the Target Species. |
| **Motion Image Interval (seconds)** | The time (in seconds) between images within a multi-image sequence that occur due to motion, heat, or activation of external detector devices. The Motion Image Interval is pre-set in the camera’s settings by the user, but the time at which the camera collects images because of this setting is influenced by the presence of movement or heat. For example, if the camera was set to take 3 images per event at a Motion Image Interval of 3 seconds when the camera detects motion or heat, the first image will be collected (e.g., at 09:00:00), the second image will be collected 3 seconds later (09:00:03), and the third will be collected 3 seconds after that (09:00:06).  This setting differs from the Quiet Period in that the delay occurs between images contained within a multi-image sequence, rather than between multi-image sequences (as in Quiet Period). If a Motion Image Interval was not set, enter "0" seconds (i.e., instantaneous). |
| **Northing Camera Location** | The northing UTM coordinate of the camera location (e.g., "5962006"). Record using the NAD83 datum. Leave blank if recording the Latitude instead. |
| **\*# Of Images** | The number of images on an SD card. |
| Occupancy | The probability a site is occupied by the species. |
| Paired design | A form of "clustered design" where two cameras that are placed closely together to increase detection probability ("paired cameras"), to evaluate certain conditions ("paired sites", e.g., on- or off trails), etc. Paired placements can help to account for other variability that might occur (i.e., variation in habitat quality). For some objectives, pairs of cameras might be considered subsamples within another sampling design (e.g., simple random, stratified random, systematic). |
| **Photos Per Trigger** | The camera setting that describes the number of photos taken each time the camera is triggered. |
| Project | A scientific study, inventory or monitoring program that has a certain objective, defined methods, and a defined boundary in space and time (recorded as "Project Name"). |
| **Project Coordinator** | The first and last name of the primary contact for the project. |
| **Project Coordinator Email** | The email address of the Project Coordinator. |
| **Project Description** | A description of the project objective(s) and general methods. |
| **Project Name** | A unique alphanumeric identifier for each project. Ideally, the Project Name should include an abbreviation for the organization, a brief project name, and the year the project began (e.g., "uofa\_oilsands\_2018"). |
| **Purpose of Visit** | The reason for visiting the camera location (i.e. to deploy the camera ["Deployment"], retrieve the camera ["Retrieve"] or to change batteries/SD card or replace the camera ["Service"]). |
| **Quiet Period (seconds)** | The user-defined camera setting which provides the time (in seconds) between shutter "triggers" if the camera was programmed to pause between firing initially and firing a second time. If a Quiet Period was not set, enter "0."  Also known as "time lag" (depending on the Camera Make and Camera Model; Palmer et al., 2018). The Quiet Period differs from the Motion Image Interval in that the delay occurs between multi-image sequences rather than between the images contained within multi-image sequences (as in the Motion Image Interval). |
| Random (or "simple random") design | Cameras occur at randomized camera locations (or sample stations) across the area of interest, sometimes with a predetermined minimum distance between camera locations (or sample stations). |
| **\*Remaining Battery (%)** | The remaining battery power (%) of batteries within a camera. |
| Sample station | A grouping of two or more non-independent camera locations, such as when cameras are clustered or paired (recorded as "Sample Station Name"). |
| **Sample Station Name** | A sequential alphanumeric identifier for each grouping of two more non-independent camera locations (when cameras are deployed in clusters, pairs, or arrays; e.g., "ss1" in "ss1\_bh1", "ss1\_bh2", "ss1\_bh3" etc.). Leave blank if not applicable. |
| **\*SD Card ID** | The ID label on an SD card (e.g., "cmu\_100"). |
| **\*SD Card Replaced** | Whether the SD card was replaced. |
| **\*SD Card Status (% Full)** | The remaining storage capacity on an SD card; collected during a camera service or retrieval. |
| **\*Security** | The equipment used to secure the camera (e.g., "Security box," "Bracket," "Bracket + Screws," or "None"). |
| Sequence | A user-defined group of images or video clips considered as a single "detection event" (recorded as "Sequence Name"); often users choose a certain time threshold (or "inter-detection interval") to define independent "events"; e.g., 30 minutes or 1 hour. The threshold should be recorded in the Survey Design Description). |
| **Sequence Name** | A unique alphanumeric identifier for a multi-image sequence. The Sequence Name should ideally consist of the Deployment Name and the names of the first and last images and videos in the sequence (separated by "\_") (i.e., "Deployment Name"\_"img\_#[name of first image in sequence]"\_"img\_#[name of last image in sequence] (e.g., "bh1\_22-Jul-2018\_img\_001-img\_005"). Leave blank if not applicable. |
| Service/Retrieval | When a crew has gone to a location to service or retrieve a remote camera. |
| **\*Service/Retrieval Comments** | Comments describing additional details about the service/retrieval. |
| **Service/Retrieval Crew** | The first and last names of the individuals who collected data during the service/retrieval visit. |
| Service/retrieval metadata | Metadata that should be collected each time a camera location is visited to service or retrieve a camera, including data on any change to the camera location, sampling period, and/or setting type (e.g., not baited and then baited later). The relevant metadata fields that should be collected differ when a camera is deployed vs. serviced or retrieved. Refer to Appendix - Table A5 and the Camera Service/Retrieval Field Datasheet. |
| Service/Retrieval visit | When a crew has gone to a location to service or retrieve a remote camera. |
| **Sex Class** | The sex classification of individual(s) being categorized (e.g., "Male," "Female," or "Unknown"). |
| **Species** | The capitalized common name of the species being categorized ("tagged"). |
| **\*Stake Distance (m)** | The distance from the camera to a stake (in metres to the nearest 0.05 m). Leave blank if not applicable. |
| Stratified design | The area of interest is divided into smaller strata (e.g., habitat type, disturbance levels), and cameras are placed within each stratum (e.g., 15%, 35% and 50% of sites within high, medium, and low disturbance strata). |
| Study area | A unique research, inventory or monitoring area (spatial boundary) within a project (there may be multiple study areas within a single project) (recorded as "Study Area Name"). |
| **Study Area Description** | A description for each unique research or monitoring area including its location, the habitat type(s), land use(s) and habitat disturbances (where applicable). |
| **Study Area Name** | A unique alphanumeric identifier for each study area (e.g.,"oilsands\_ref1"). If only one area was surveyed, the Project Name and Study Area Name should be the same. |
| **Subadult** | Animals older than a "Juvenile" but not yet an "Adult"; a "Subadult" may be further classified into "Young of the Year" or "Yearling." |
| **Subadult - Yearling** | Animals approximately one year old; has lived through one winter season; between "Young of Year" and "Adult." |
| **Subadult - Young of Year** | Animals less than one year old; born in the previous year's spring, but has not yet lived through a winter season; between "Juvenile" and "Yearling." |
| Survey | A unique deployment period (temporal extent) within a project (recorded as "Survey Name"). |
| **Survey Design** | The spatial arrangement of remote cameras within the study area for an individual survey. If "Hierarchical (multiple)\*", include additional details in the Survey Design Description.  Note that we refer to different configurations of cameras more generally as study design and sampling design; however, the term "Survey Design" refers to study design as it applies to an individual survey. There may be multiple Survey Designs for surveys within a project; if this occurs, the Survey Design should be reported separately for each survey. |
| **\*Survey Design Description** | A description of any additional details about the Survey Design. |
| **Survey Name** | A unique alphanumeric identifier for each survey period (e.g., "fortmc\_001"). |
| **Survey Objectives** | The specific objectives of each survey within a project, including the Target Species, the state variables (e.g., occupancy, density), and proposed modelling approach(es). Survey Objectives should be specific, measurable, achievable, relevant, and time-bound (i.e., SMART). |
| Systematic design | Camera locations occur in a regular pattern (e.g., a grid pattern) across the study area. |
| **Tag** | When individuals, or groups of individuals, are categorized within an image, regardless of whether the information applies to all of the individuals in the image. A single tag is applied to categorize one or more individuals with the same combination of characteristics (e.g., Adult Males displaying the same Behaviour). Conversely, multiple tags are applied when individuals in an image differ in their characteristics (e.g., an Adult and a Juvenile, all else remaining equal, are tagged separately). This could also occur for Age Class, Behaviour, Human Transport Mode/Activity, etc. Since multiple tags can occur for a single image, there may be multiple data rows for the same image (if the Event Type is at the "Tag" level). |
| **Target Species** | The common name(s) of the species that the survey was designed to detect. |
| Targeted design | Camera locations or sample stations are placed in areas that are known or suspected to have higher activity levels (e.g., game trails, mineral licks). |
| Test image | An image taken from a camera after it has been set up to provide a permanent record of the visit metadata (e.g., Sample Station Name, Camera Location Name, Deployment Name, Crew, and Deployment Start Date Time [DD-MMM-YYYY HH:MM:SS]).  Taking a test image can be useful to compare the information from the image to that of which was collected on the Camera Service/Retrieval Field Datasheet after retrieval and can help in reducing recording errors. |
| **\*Test Image Taken** | Whether a test image (i.e., an image taken from a camera after it has been set up to provide a permanent record of the visit metadata) was taken. Arm the camera, from ~5 m in front, walk towards the camera while holding the Test Image Sheet. |
| Time-lapse image | Images that are taken at regular intervals (e.g., hourly or daily, on the hour). It is critical to take a minimum of one time-lapse image per day at a consistent time (e.g., 12:00 pm [noon]) to create a record of camera functionality and local environmental conditions (e.g., snow cover, plant growth, etc.). Time-lapse images may always be useful for modelling approaches that require estimation of the "viewshed" ("viewshed density estimators" such as REM or time-to-event (TTE) models; see Moeller et al., [2018] for advantages and disadvantages). |
| Trigger "event" | An activation of the camera detector(s) that initiates the capture of a single or multiple images, or the recording of video. |
| **Trigger Mode(s)** (camera settings) | The camera setting(s) that determine how the camera will trigger: by motion ("Motion Image"), at set intervals ("Time-lapse image"), and/or by video ("Video"; possible with newer camera models, such as Reconyx HP2X). |
| **Trigger Sensitivity** | The camera setting responsible for how sensitive a camera is to activation (to "triggering") via the infrared and/or heat detectors (if applicable, e.g., Reconyx HyperFire cameras have a choice between "Low," "Low/Med," "Med," "Med/High," "High," "Very high" and "Unknown"). |
| **UTM Zone Camera Location** | The number corresponding to the Universal Transverse Mercator (UTM) grid zone where the camera was placed (e.g., "12"). UTM is a coordinate system that divides the earth into grid zones that are identified with a number (representing a width of latitude) and letter (representing the hemisphere).  In Alberta the UTM zones are either 11, 12, or TTM. Enter all other UTM zones in the Camera Location Comments field (e.g., zones 7-10 for British Columbia), or use Latitude and Longitude instead of UTM coordinates. |
| **\*Video Length (seconds)** | If applicable, describes the camera setting that specifies the minimum video duration (in seconds) that the camera will record when triggered. Leave blank if not applicable. |
| Visit | When a crew has gone to a location to deploy, service, or retrieve a remote camera. |
| **\*Visit Comments** | Comments describing additional details about the deployment and/or service/retrieval visits. |
| Visit metadata | Metadata that should be collected each time a camera location is visited to deploy, service or retrieve a camera. Other relevant metadata fields that should be collected differ when a camera is deployed vs. serviced or retrieved.  Refer to Appendix A - Table A5, Camera Deployment Field Datasheet, and Camera Service/Retrieval Field Datasheet. |
| Walktest | A test performed to ensure the camera height, tilt, etc., adequately captures the desired detection zone. The user will 1) activate the walktest mode, 2) attach the camera at the desired height / angle, 3) walk in front of the camera to a specified distance (i.e., the "Walktest Distance," e.g., 5 m), and 4) wave their hand in front of the camera (usually at ground level and a chosen height [i.e., the "Walktest Height," e.g., 0.8 m]) to determine if the camera is activating (a light on the camera will flash). |
| **\*Walktest Complete** | Whether a walktest was performed to ensure the camera height, tilt, etc., adequately captures the desired detection zone. The user will 1) activate the walktest mode, 2) attach the camera at the desired height / angle, 3) walk in front of the camera to a specified distance (i.e., the "Walktest Distance," e.g., 5 m), and 4) wave their hand in front of the camera (usually at ground level and a chosen height [i.e., the "Walktest Height," e.g., 0.8 m]) to determine if the camera is activating (a light on the camera will flash). |
| **Walktest Distance (m)** | The horizontal distance from the camera at which the crew performs the walktest (metres; to the nearest 0.05 m). Leave blank if not applicable. |
| **Walktest Height (m)** | The vertical distance from the camera at which the crew performs the walktest (metres; to the nearest 0.05 m). Leave blank if not applicable. |

# Appendix A

**Table A1.** Metadata crosswalk table showing the corresponding fields used in this Alberta Metadata Standard (2024), and other standards used in Western Canada. An asterisk (\*) denotes an optional field. Hierarchical levels are shown in bold font above each section.

| **Alberta Metadata Standards** (2024) | **B.C. Metadata Standards** (RISC, 2019) | **FWMIS** | **WildTrax** | **Wildlife Insights Minimum Metadata Standards** (Ahumada et al., 2019) |
| --- | --- | --- | --- | --- |
| **Project** | | | | |
| Project Name | Project IDentification Number | Project Name | Project ID (auto populated) | Project ID |
| Project Coordinator | Project Coordinator | Project Coordinator | Project Administrator | Project Admin |
| Project Coordinator Email | - | Project Coordinator Email | Project Administrator, User Email | Project Admin Email |
| Project Description | Location Description, Project Objectives | Project Description | \*Purpose and Methods | Project Stratification/Project Stratification Type |
| **Study Area** | | | | |
| Study Area Name | Study Area Name | Study Area Name | - | Subproject Name |
| Study Area Description | Study Area Description | Study Area Description | \*Purpose and Methods | Subproject Design |
| **Survey** | | | | |
| Survey Name | Survey Name | Survey Name | - | - |
| Survey Objectives | Survey Objectives | Survey Objectives | \*Purpose and Methods | Project Objectives |
| Target Species | Target Species\* | Target Species | Project Species/Project Species Individual |
| Survey Design | Project Objectives | Survey Design | Project Sensor Layout / Project Sensor Cluster |
| \*Survey Design Description | Project Objectives | Survey Design Description | - |
| Event Type | - | Event Type | - | Project Type |
| **Sample Station** | | | | |
| Sample Station Name | Sample Station Label\*, Nested in Sample Station\* | Sample Station Name | - | Subproject Name |
| **Camera Location** | | | | |
| Camera Location Name | - | Camera Location Name | Location ID (auto populated) | Location ID |
| Latitude Camera Location | Easting or Longitude Sample Station | Latitude | Latitude | Latitude |
| Longitude Camera Location | Northing or Latitude Sample Station | Longitude | Longitude | Longitude |
| Northing Camera Location | Northing or Latitude Sample Station | UTM/TTM Northing | - | - |
| Easting Camera Location | Easting or Longitude Sample Station | UTM/TTM Easting | - | - |
| UTM Zone Camera Location | UTM Zone Sample Station | UTM/TTM Ref Meridian | - | - |
| GPS Unit Accuracy (m) | - | Precision (m) | - | - |
| \*Camera Location Comments | Sample Station Comments and Camera Comments\* | Location Comments | \*Location Comments | - |
| **Deployment** | | | | |
| Deployment Name | Deployment Name | Deployment Name | Location, Image Set Start Date | Deployment ID |
| Deployment Crew | Crew Members | Crew Names | \*Crew Name(s) | Recorded By |
| Service/Retrieval Crew | - |
| Deployment Start Date Time (DD-MMM-YYYY HH:MM:SS) | Deployment Start Date | Deployment Start Date Time (DD-MMM-YYYY HH:MM:SS) | \*Visit Date (YYYY-MM-DD) | Camera Deployment Begin Date |
| Deployment End Date Time (DD-MMM-YYYY HH:MM:SS) | Deployment End Date | Deployment End Date (DD-MMM-YYYY HH:MM:SS) | \*Visit Date (YYYY-MM-DD) | Camera Deployment End Date |
| \*Visit Comments | Deployment Comments\* | Visit Comments | \*Visit Comments | Event Description/Event Type/Bait Description |
| Camera ID | Camera Label | Camera ID | \*Equipment Code | Camera ID |
| Camera Make | Camera Make and Model | Camera Make | Equipment Make | Make |
| Camera Model | Camera Model | Equipment Model | Model |
| Camera Serial Number | - | Camera Serial Number | Equipment Serial Number | Serial Number |
| Trigger Mode(s) | - | Trigger Mode(s) | \*Visit Trigger Mode(s) | Project Sensor Method |
| \*Video Length (seconds) | Video Length Setting | Video Length (seconds) | - | - |
| Trigger Sensitivity | Trigger Sensitivity Setting | Trigger Sensitivity | - | - |
| Photos Per Trigger | Photos per Trigger Setting | Photos Per Trigger | [from image metadata; Image Exif Sequence] | - |
| Motion Image Interval (seconds) | - | Motion Image Interval (seconds) | \*Visit Motion Image Interval (seconds) | - |
| Quiet Period (seconds) | Quiet Period Setting | Quiet Period (seconds) | \*Visit Quiet Period (seconds) | Quiet Period Setting |
| Camera Height (m) | - | Camera Height (m) | \*Equipment Height (m) | Height |
| \*Camera Direction (degrees) | - | Camera Direction (degrees) | \*Equipment Direction (degrees) | - |
| \*Stake Distance (m) | - | Stake Distance (m) | \*Stake Distance (m) | - |
| FOV Target Feature | Deployment Feature | FOV Target Feature | \*Target Feature | Project Sensor Layout Targeted Type |
| \*FOV Target Feature Distance (m) | - | FOV Target Feature Distance (m) | - | - |
| Bait/Lure Type | Bait Lure Type | Bait/Lure Type | \*Bait/Lure Type | Project Bait Use / Bait Type |
| \*Camera Location Characteristic(s) | Deployment Feature | Camera Location Characteristics | \*Landscape Feature(s) | Feature Type |
| \*Walktest Distance (m) | - | Walktest Distance (m) | \*Walktest Distance (m) | - |
| \*Walktest Height (m) | - | Walktest Height (m) | \*Walktest Height (m) | - |
| Image Set Start Date Time (DD-MMM-YYYY HH:MM:SS) | - | Image Set Start Date Time (DD-MMM-YYYY HH:MM:SS) | Image Set Start Date Time (YYYY-MM-DD HH:MM:SS) | - |
| Image Set End Date Time (DD-MMM-YYYY HH:MM:SS) | - | Image Set End Date Time (DD-MMM-YYYY HH:MM:SS) | Image Set End Date Time (YYYY-MM-DD HH:MM:SS) | - |
| \*Deployment Image Count | - | Deployment Image Count | Image Set Total Image Count | - |
| **Image/Sequence** | | | | |
| Image Name | Sequence/Image ID | Image Name | Image ID (auto populated) | Image ID |
| Sequence Name | Sequence Name | - | External Sequence ID |
| Analyst | Surveyor | Analyst | Observer, Observer ID (auto populated) | Photo Type Identified by |
| Species | Species | Species | Species Scientific Name | Species/Project Blank Images |
| Individual Count | Count | Individual Count | Individual Count (tag level) | Number of Objects |
| Age Class | Life Stage and Sex Classes\* | Age Class | \*Age Class (tag level) | Age |
| Sex Class | Sex Class | \*Sex Class (tag level) | Sex |
| \*Behaviour | Behaviour\* | Behaviour | \*Behaviour(s) (tag level) | - |
| \*Animal ID | Animal ID\* | Image/Sequence Comments | \*Health/Disease(s), \*Coat Colour(s), \*Coat Attribute(s), \*Collar (Y/N), \*Ear Tag (Y/N), \*Antler Tine Attributes (Antler Location, Tine Count, Tine Count Precision) (all Tag level) | Individual ID/Project Individual Animals |
| \*Human Transport Mode/Activity | Human Transport Mode\*, Human Use Type\* | Human Transport Mode/Activity | - | - |
| \*Image/Sequence Comments | Comments\* | Image/Sequence Comments | \*Tag Comments, \*Image Comments | Individual Image and Animal Notes |
| \*Image Trigger Mode | - | Image Trigger Mode | \*Image Exif Trigger Mode | - |
| \*Image Sequence | - | Image Sequence | \*Image Exif Sequence | - |
| \*Image Infrared Illuminator | - | Image Infrared Illuminator | - | - |
| \*Image Flash Output | - | Image Flash Output | - | - |
| Image/Sequence Date Time (DD-MMM-YYYY HH:MM:SS) | Sequence/Image Start Date, Sequence/Image Start Time | Image/Sequence Date Time (DD-MMM-YYYY HH:MM:SS) | Image Date/Time (YYYY-MM-DD HH:MM:SS) | Date Time Captured |

**Note:** The B.C. Metadata Standards (RISC, 2019) also contain the following fields not found in the Alberta Metadata Standards (2024): Publish Date, Funding Agency\*, Project Start Date, Project End Date\*, Region, Wildlife Permit Number\*, Survey Start Date, Deployment Photos\*, Number of Camera\*, Camera Days, Sequence/Image Temperature and Sequence Definition

**Table A2.** Overview of the structure of the RCSC et al’s Remote Camera Metadata Template (2024) including both the data fields recommended by the [Remote Camera Survey Guidelines: Guidelines for Western Canada](https://ab-rcsc.github.io/RCSC-WildCAM_Remote-Camera-Survey-Guidelines-and-Metadata-Standards/1_survey-guidelines/1_0.1_Citation-and-Info.html) (RCSC et al., 2024) and these metadata standards.

| **Survey Guidelines** | **Metadata Standards** | **Data Group** | **Visit Type** | **Field Code** | **Data Type** | **Data Format1** | **Example** |
| --- | --- | --- | --- | --- | --- | --- | --- |
| Project Name | Project Name | Visit Metadata | Both | proj\_name | [alphanumeric] | [Ideally recorded as: "abbreviated organization name"\_" brief project name"\_"project start year"] | uofa\_oilsands\_2018 |
| Project Coordinator | Project Coordinator | - | - | proj\_coord | [text] | - | John Smith |
| Project Coordinator Email | Project Coordinator Email | - | - | proj\_coord\_email | [text] | - | John.Smith@telus.net |
| Project Description | Project Description | - | - | proj\_desc | [text] | - | To compare wolf occupancy in the oil sands region of north-eastern Alberta in two areas with high energy development and two reference areas with little development. |
| Study Area Name | Study Area Name | - | - | study\_area\_name | [alphanumeric] | - | oilsands\_ref1 |
| Study Area Description | Study Area Description | - | - | study\_area\_desc | [text] | - | Located in the SE corner of Birch Mountains Wildland Provincial Park in Boreal Highlands subregion. Bogs, pine, aspen and birch forest. No land use disturbance. |
| Survey Name | Survey Name | - | - | surv\_name | [alphanumeric] | - | fortmc\_1 |
| Survey Objectives | Survey Objectives | - | - | surv\_obj | [text] | - | To monitor trends in wolf occupancy at 5-year intervals from January – December 2020 to 2023. |
| Target Species | Target Species | - | - | target\_species | [categorical; one-to-many] | [Refer to "species" in "species\_crosswalk"] | gray wolf |
| Survey Design | Survey Design | - | - | surv\_design | [categorical; one-to-one] | Simple Random, Systematic, Stratified, Clustered, Paired, Targeted, Convenience, Hierarchical (Multiple)¶, Other¶, Unknown | Hierarchical (multiple)¶ |
| \*Survey Design Description | \*Survey Design Description | - | - | surv\_design\_desc | [text] | - | survey\_design[Systematic, Convenience]. One camera location within each township. Each location within 100m of a secondary road or cutline. Lure dispensers with Gorman’s Gumbo (long line) at each camera location during initial camera deployment and not revisited during the survey period. |
| Event Type | Event Type | - | - | event\_type | [categorical; one-to-one] | Tag, Image, Sequence | Tag |
| Sample Station Name | Sample Station Name | Visit Metadata | Both | samp\_st\_name | [alphanumeric] | [leave blank if NA] | ss1 |
| Camera Location Name | Camera Location Name | cam\_loc\_name | [alphanumeric] | - | bh1 |
| Latitude Camera Location | Latitude Camera Location | Deployment | cam\_loc\_lat | [decimal] | [5 decimal places] | 53.78136 |
| Longitude Camera Location | Longitude Camera Location | cam\_loc\_long | [decimal] | [5 decimal places] | -113.46067 |
| Easting Camera Location | Easting Camera Location | cam\_loc\_east | [integer] | [no decimal places] | 337875 |
| Northing Camera Location | Northing Camera Location | cam\_loc\_north | [integer] | [no decimal places] | 5962006 |
| UTM Zone Camera Location | UTM Zone Camera Location | cam\_loc\_utm\_zone | [alphanumeric] | ["zone #"] | 12 |
| GPS Unit Accuracy | GPS Unit Accuracy | gps\_accuracy\_m | [integer] | [metres] | 5 |
| \*Access Method | - | access\_method | [categorical; one-to-one] | Foot, ATV, Argo, Truck, Snowmobile, Horse, Boat, Helicopter, Unknown | Foot |
| \*Camera Location Comments | \*Camera Location Comments | Both | cam\_loc\_comments | [text] | - | snowmobile trail |
| Deployment Name | Deployment Name | Visit Metadata | Both | deploy\_name | [alphanumeric] | [ideally recorded as: "Camera Location Name"\_"Deployment Start Date" (or …\_"Deployment End Date")] | bh1\_17-Jan-2018 |
| Purpose Of Visit | - | Service/ Retrieval | visit\_type | [categorical; one-to-one] | Deployment, Service, Retrieval | Deployment |
| Deployment Crew | Deployment Crew | Both | deploy\_crew | [text] | - | Susie Smith |
| Service/Retrieval Crew | Service/Retrieval Crew | Service/  Retrieval | service\_retrieval\_crew | [text] | - | John Smith |
| Deployment Start Date Time | Deployment Start Date Time | Both | deploy\_start\_date\_time | [date/time] | [DD-MMM-YYYY HH:MM:SS] | 17-Jan-2018 10:34:22 |
| Deployment End Date Time | Deployment End Date Time | deploy\_end\_date\_time | [date/time] | [DD-MMM-YYYY HH:MM:SS] | 27-Jan-2019 23:00:00 |
| \*Visit Comments | \*Visit Comments | visit\_comments | [text] | - | - |
| \*Deployment Comments | - | Deployment | deploy\_comments | [text] | - | applied Gorman's Gumbo lure |
| \*Service/Retrieval Comments | - | Service/  Retrieval | service\_retrieval\_comments | [text] | - | reapplied Gorman's Gumbo lure |
| Camera ID | Camera ID | Equipment Information | Deployment | cam\_id | [alphanumeric] | - | reconpc900\_1 |
| Camera Make | Camera Make | cam\_make | [text] | - | Reconyx |
| Camera Model | Camera Model | cam\_model | [text] | - | PC900 |
| Camera Serial Number | Camera Serial Number | cam\_serial | [text] | - | P900FF04152022 |
| \*SD Card ID | - | Both | sd\_card\_id | [alphanumeric] | - | cmu\_100 |
| \*Key ID | - | Deployment | key\_id | [alphanumeric] | - | python1 |
| \*Security | - | security | [categorical; one-to-one] | Security Box, Bracket, Bracket + Screws, None | Security Box |
| \*Camera Active On Arrival | - | Service/  Retrieval | cam\_active\_arrival | [categorical; one-to-one] | Y, N | Y |
| \*Camera Damaged | - | cam\_damaged | [categorical; one-to-one] | Physical‡, Mechanical‡, None | Physical |
| \*SD Card Status (% Full) | - | sd\_status | [integer] | [%] | 56 |
| \*SD Card Replaced | - | sd\_card\_replaced | [categorical; one-to-one] | Y, N | Y |
| \*Remaining Battery (%) | - | battery\_percent | [integer] | [%] | 99 |
| \*Batteries Replaced | - | batteries\_replaced | [categorical; one-to-one] | Y, N | Y |
| New Camera ID | - | new\_cam\_id | [alphanumeric] | [leave blank if NA] | - |
| New Camera Make | - | new\_cam\_make | [text] | [leave blank if NA] | - |
| New Camera Model | - | new\_cam\_model | [text] | [leave blank if NA] | - |
| New Camera Serial Number | - | new\_cam\_serial | [text] | [leave blank if NA] | - |
| \*New SD Card ID | - | new\_ sd\_card\_id | [alphanumeric] | [leave blank if NA] | - |
| Trigger Mode(s) | Trigger Mode(s) | Camera Settings | Deployment | set\_trig\_modes | [categorical; one-to-one] | Motion Image, Time-lapse Image, Video, Motion Image + Time-lapse Image, Motion Image + Time-lapse Image + Video, Time-lapse Image + Video, Motion Image + Video | Motion Image + Time-lapse Image |
| \*Video Length | \*Video Length | set\_video\_length\_s | [integer] | [seconds; leave blank if NA] | 5 |
| Trigger Sensitivity | Trigger Sensitivity | set\_trig\_sensitivity | [categorical; one-to-one] | Low, Low/Med, Med, Med/High, High, Very High, Unknown | High |
| Photos Per Trigger | Photos Per Trigger | set\_photos\_per\_trig | [integer] | [count] | 3 |
| Motion Image Interval | Motion Image Interval | set\_motion\_img\_int\_s | [integer] | [seconds; "0" if not set] | 0 |
| Quiet Period | Quiet Period | set\_quiet\_period\_s | [integer] | [seconds; "0" if not set] | 30 |
| Camera Height | Camera Height | Placement | cam\_ht\_m | [decimal] | [metres; to the nearest 0.05 m] | 1 |
| \*Camera Direction | \*Camera Direction | cam\_dir\_deg | [integer] | [degrees] | 0 |
| \*Camera Attachment | - | cam\_attachment | [categorical; one-to-one] | Tree, Post, Tree + Bungee/Strap, Tree + Screws, Post + Bungee/Strap, Post + Screws, Other† | Tree + Screws |
| \*Stake Distance | \*Stake Distance | stake\_dist\_m | [decimal] | [metres; to the nearest 0.05 m; leave blank if NA] | 4.95 |
| FOV Target Feature | FOV Target Feature | fov\_target | [categorical; one-to-one] | Game Trail, Hiking Trail, Off-Highway Vehicle Trail, Paved Road, Dirt/Gravel Road, Road Crossing, Railway, Cutline/Seismic Line, Transmission Line, Pipeline, Wellsite, Culvert, Beaver Dam, Burrow/Den, Nest, Carcass, Natural Mineral Lick, Rub Post, Other, None, Unknown | Off-Highway Vehicle Trail |
| \*FOV Target Feature Distance | \*FOV Target Feature Distance | fov\_target\_dist\_m | [decimal] | [metres; to the nearest 0.05 m; leave blank if NA] | 10 |
| Bait/Lure Type | Bait/Lure Type | Both | bait\_lure\_type | [categorical; one-to-one] | Scent, Meal, Bait Tree, Visual, Acoustic, Other‡, None, Unknown | Scent |
| \*Camera Location Characteristic(s) | \*Camera Location Characteristic(s) | Site Characteristics | Deployment | cam\_loc\_chars | [categorical; one-to-many] | Trail, Road, Railway/Pipeline/Transmission Line, Cutline/Seismic Line, Wellsite, Clearcut, Building, Forest - Deciduous, Forest - Coniferous, Forest - Mixedwood, Forest - Undefined, Meadow, Burn, Agriculture, Shrubland, Beaver Dam, Wetland, Lentic, Lotic, Other†, Unknown | Building, Forest - Mixedwood, Road, Trail |
| \*Deployment Area Photos Taken | - | deploy\_area\_photos\_taken | [categorical; one-to-one] | Y, N | Y |
| \*Deployment Area Photo Numbers | - | deploy\_area\_photo\_numbers | [text] | [leave blank if NA] | 4 |
| \*Test Image Taken | - | Equipment Checks | Both | test\_image\_taken | [categorical; one-to-one] | Y, N | Y |
| \*Walktest Complete | - | walktest\_complete | [categorical; one-to-one] | Y, N | Y |
| \*Walktest Distance | \*Walktest Distance | walktest\_dist\_m | [decimal] | [metres; to the nearest 0.05 m; leave blank if NA] | 4.95 |
| \*Walktest Height | \*Walktest Height | walktest\_ht\_m | [decimal] | [metres; to the nearest 0.05 m; leave blank if NA] | 0.75 |
| \*Camera Active On Departure | - | Equipment Information | Deployment | cam\_active\_departure | [categorical; one-to-one] | Y, N | Y |
| Image Set Start Date Time | Image Set Start Date Time | Image Set | - | img\_set\_start\_date\_time | [date/time] | [DD-MMM-YYYY HH:MM:SS] | 17-Jan-2018 12:00:02 |
| Image Set End Date Time | Image Set End Date Time | Image Set | - | img\_set\_end\_date\_time | [date/time] | [DD-MMM-YYYY HH:MM:SS] | 17-Jan-2019 22:10:05 |
| \*# Of Images | \*Deployment Image Count | Image Set | - | deploy\_img\_count | [integer] | [count] | 1567 |
| Image Name | Image Name | - | - | img\_name | [alphanumeric] | [Ideally recorded as: "Deployment Name"\_"Camera Serial Number"\_"Image Sequence Date Time"\_"Image Number" - OR - "Deployment Name"\_"Image Sequence Date Time"\_"Image Number"] | bh1\_17-Jul-2018\_22-Jul-2018\_10:34:22\_img\_100 |
| Sequence Name | Sequence Name | - | - | seq\_name | [alphanumeric] | [Ideally recorded as: "Deployment Name"\_"img\_#[name of first image in sequence]"\_"img\_#[name of last image in sequence]"; leave blank if NA] | bh1\_22-Jul-2018\_img\_001-img\_005 |
| Analyst | Analyst | - | - | analyst | [text] | - | Susie Smith |
| Species | Species | - | - | species | [categorical; one-to-one] | [Refer to "species" in "species\_crosswalk"; "NONE" if no species] | COYOTE |
| Individual Count | Individual Count | - | - | individual\_count | [integer] | [count] | 2 |
| Age Class | Age Class | - | - | age\_class | [categorical; one-to-one] | Adult, Juvenile, Subadult - Young of Year, Subadult - Yearling, Subadult, Unknown | Adult |
| Sex Class | Sex Class | - | - | sex\_class | [categorical; one-to-one] | Male, Female, Unknown | Male |
| \*Behaviour | \*Behaviour | - | - | behaviour | [categorical; one-to-one] | Travelling, Standing, Running, Bedding, Drinking, Feeding/Foraging, Territorial Display, Rutting/Mating, Vigilant, Inspecting Camera, Inspecting (Non-Specified), Unknown, Other§, Multiple§, Unknown | Travelling |
| \*Animal ID | \*Animal ID | - | - | animal\_id | [alphanumeric] | [blank if NA] | individual\_1 |
| \*Human Transport Mode/Activity | \*Human Transport Mode/Activity | - | - | human\_tpt\_mode\_activity | [categorical; one-to-one] | Activity - Walking, Activity - Hiking, Activity - Running, Activity - Cycling, Activity - Skiing, Activity - Snowshoeing, Activity - Fishing, Activity - Hunting, Activity - Unspecified, Transport - Horse/Mule, Transport - Off-Road/All-Terrain Vehicle, Transport - Passenger Vehicle, Transport - Large Commercial Vehicle/Heavy Equipment, Transport - Unspecified, Activity/Transport - Other§, Unknown | Activity - Walking |
| \*Image/Sequence Comments | \*Image/Sequence Comments | - | - | img\_seq\_comments | [text] | - | Behaviour[Inspecting Camera,Travelling] |
| \*Image Trigger Mode | \*Image Trigger Mode | - | - | img\_trig\_mode | [categorical; one-to-one] | Motion Detection, Time Lapse, CodeLoc Not Entered, External Sensor, Unknown | Motion Detection |
| \*Image Sequence | \*Image Sequence | - | - | img\_sequence | [text] | [e.g., "0 of 0", "1 of 1", "0 of 0"; leave blank if not applicable.] | 1 of 3 |
| \*Image Infrared Illuminator | \*Image Infrared Illuminator | - | - | img\_infrared\_illum | [categorical; one-to-one] | On, Off, Unknown | On |
| \*Image Flash Output | \*Image Flash Output | - | - | img\_flash | [text] | [e.g., "Flash did not fire, Auto"; "Unknown" if not known; leave blank if not applicable] | Flash did not fire, Auto |
| Image/Sequence Date Time | Image/Sequence Date Time | - | - | img\_seq\_date\_time | [date/time] | [DD-MMM-YYYY HH:MM:SS] | 22-Jul-2018 11:02:02 |

1 The symbols refer to the field in which to provide additional information. I.e., † = in Camera Location Comments; ‡ = deployment OR service/retrieval comments; § = Image/Sequence Comments; ¶ = Survey Design Description