
Wildlife Camera Metadata Protocol

Standards for Components of British Columbia's Biodiversity No. 44

Prepared by
Ministry of Environment and Climate Change Strategy
Knowledge Management Branch
and
Ministry of Forests, Lands, Natural Resource Operations and Rural Development
Forest Analysis and Inventory Branch
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For more information about Wildlife Species Inventory (WSI) please access the WSI website at: www.gov.bc.ca/wildlife-species-information.

For more information or questions about this protocol please email SPI_Mail@gov.bc.ca.

Preface

The objective of this wildlife camera metadata protocol is to provide guidance on the types of data that should be collected when using remote cameras (sometimes also referred to as camera traps) to detect wildlife. The over-arching goal of the protocol is to support the creation of a consistent, consolidated wildlife camera dataset across British Columbia. This protocol does not provide specific guidance on wildlife camera monitoring or research designs. However, documenting wildlife camera data as described in this standard will establish a robust foundation when developing a wildlife camera monitoring or research design. We encourage careful consideration of the objectives and data collection design for any wildlife camera project. Recommendations on appropriate designs to achieve various objectives are available in reports and the scientific literature.

Here we build off recent calls by wildlife scientists from around the world to standardize wildlife camera data collection and develop a specific wildlife camera data collection protocol for British Columbia. We adapt this guidance to the current British Columbia Wildlife Species Inventory (WSI) data management system.

This wildlife camera metadata protocol follows a hierarchical structure, organized as: Project, Study Area, Survey, Deployment, and Sequence/Image. The Project level includes information related to the research or monitoring program objectives and design. The Study Area level includes information on unique research or monitoring areas that occurred within a Project. The Project and Study Area will be the same in cases where only one area was surveyed. Similarly, the Survey level includes information on different surveys completed within the same Project or Study Area. If some aspect of the research or monitoring design changed during the Project, for example the target species, then each Survey is uniquely identified. The Deployment level includes data on each unique camera within a Survey. Any change to camera location, sampling period and/or setting type (e.g., not baited and then baited later) should be documented as a unique deployment. The Sequence/Image level consists of data for groups of images or video clips (i.e., a single detection 'event'), or for single images/videos from camera deployments.

This protocol provides specific information on how wildlife camera data should be collected and documented in British Columbia. The consistent collection of wildlife camera datasets will support the creation of a large spatiotemporal dataset on wildlife distribution across British Columbia. This protocol provides opportunities for further amalgamation of datasets to answer research and monitoring questions across administrative jurisdictions, ultimately at a global scale.

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The Resources Information Standards Committee evolved from the Resources Inventory Committee (RIC), which received funding from the Canada-British Columbia Partnership Agreement of Forest Resource Development (FRDA II), the Corporate Resource Inventory Initiative (CRII), Forest Renewal BC (FRBC), and addressed concerns of the 1991 Forest Resources Commission.

All decisions regarding protocols are the responsibility of the Resources Inventory Standards Committee.

This manual has built upon concepts available in the literature. In particular, guidance has been taken, with permission, from the Camera Trap Metadata Standard (CTMS) proposed by Forrester et al. (2016):

Forrester, T., T. O'Brien, E. Fegraus, P. Jansen, J. Palmer, R. Kays, J. Ahumada, B. Stern and W. McShea. (2016). An Open Standard for Camera Trap Data. *Biodiversity Data Journal*. 4:e10197. <https://doi.org/10.3897/BDJ.4.e10197> (accessed Dec. 2018)

Forrester et al. (2016) is an open access article distributed under the terms of the Creative Commons Attribution License 4.0 (CC-BY).

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1.0 Introduction

The objective of this wildlife camera metadata protocol is to provide guidance on the types of data that should be collected when using remote cameras (sometimes also referred to as camera traps) to detect wildlife (hereafter referred to as wildlife cameras). The over-arching goal of the protocol is to support the creation of a consistent, consolidated wildlife camera dataset across British Columbia. Such data may be invaluable for monitoring wildlife across space and time.

This protocol does not provide specific guidance on wildlife camera monitoring or research designs. The breadth of wildlife camera applications for wildlife monitoring and research (for example, the variety of taxa that can be monitored) make it impossible to create a single design to achieve such a diversity of applications. However, this protocol provides guidance on what data should be documented when using wildlife cameras to detect wildlife. Following this standard will support the development of a robust wildlife camera monitoring or research design.

Wildlife cameras are a valuable tool for detecting a wide range of wildlife species (O'Connell et al. 2010; Burton et al. 2015). Wildlife cameras consist of a digital camera, external flash, and passive infrared sensors (see Rovero et al. 2013 for detailed review). Animals that pass in front of the camera trigger the sensor and the resulting images or video are date and time stamped. Combining images with data from Global Positioning Systems (GPS) provides a permanent spatial and temporal record of wildlife occurrence. Although primarily used to detect medium to large mammals, wildlife cameras have also been used to detect small mammals (e.g., Lazenby et al. 2015; Mills et al. 2016) and birds (e.g., Lynch et al. 2015; Suwanrat et al. 2015).

Wildlife cameras typically yield data on presence/non-detection and relative abundance (e.g., number of detections per camera day) of wildlife. They have been used to measure relative abundance of mammal species (Carbone et al. 2001), density of marked animals (Karanth et al. 2006), mammalian diversity (Ahumada et al. 2011), habitat use (O'Connell et al. 2006; Bowkett et al. 2008), individual breeding status (Fisher et al. 2014), and effects of human activity on distribution (Muhly et al. 2011). In addition, they have been used to assess the response of animals to changes in local habitat features. For example, they have been used to measure wildlife use of linear features (Tigner et al. 2014) and response to linear barriers (Dunne and Quinn 2009), and highway crossing structures (Clevenger and Waltho 2005).

There has been a global push to standardize wildlife camera data collection (Fegraus et al. 2011; Meek et al. 2014; Steenweg et al. 2017). Here we build off the guidance provided in the literature, particularly the open Camera Trap Metadata Standard (CTMS) proposed by Forrester et al. (2016), to develop a specific protocol for British Columbia. We adapt this open standard protocol to the current British Columbia Wildlife Species Inventory (WSI) data management system. The British Columbia Wildlife Camera Metadata Protocol builds on the experience of wildlife camera users in British Columbia and other jurisdictions and creates the opportunity for British Columbia data to be integrated with global wildlife camera datasets.

2.0 Protocols

This Wildlife Camera Metadata Protocol utilizes Forrester et al.'s (2016) proposed hierarchical structure for wildlife camera data, combined with the Government of British Columbia's database structure found within the Wildlife Species Inventory (WSI) data management system. The WSI data management system is comprised of an Oracle database (Species Inventory [SPI] database), a web-based data and document access interface (Species Inventory Web Explorer [SIWE]¹), multiple spatial layers in the BC Geographic Warehouse (BCGW)², a SharePoint data submission website (WSI Submissions SharePoint)³, and a data submission Excel spreadsheet (Wildlife Camera Template)⁴.

Data is organized in a five level hierarchy of: Project, Study Area, Survey, Deployment, and Sequence/Image (Figure 1). Data that should be captured in the WSI data management system is described in this Wildlife Camera Metadata Protocol for each level. In order to provide user-friendly terminology in this Wildlife Camera Metadata Protocol, equivalent data fields may appear under a different name in the WSI database management system and Forrester et al.'s (2016) CTMS. When this happens, the equivalent data field in the WSI database management system has been provided in parenthesis. A crosswalk table (Appendix 1 - Table 1) has been provided for matching data fields used in the Wildlife Camera Metadata Protocol to the WSI database management system, as well as to Forrester et al.'s (2016) CTMS. Crosswalking data fields will help with the potential amalgamation of British Columbia's data with global wildlife camera datasets.

The data recording and submission process involves entering all Deployment and Sequence/Image data into the accompanying Wildlife Camera Template (Excel file)⁴. The completed data template will be submitted to WSI through the WSI Submissions SharePoint website³, along with all photo images, reports, and other project files. The Project, Study Area and Survey data as described below are all recorded through the WSI Submissions SharePoint website³. Once the Province receives a complete data submission, the data will be loaded to the SPI database and be published to SIWE¹ and the appropriate BCGW WSI spatial layer².

All fields described in this Wildlife Camera Metadata Protocol are mandatory unless otherwise stated as optional.

2.1 Project

Data on the Project includes information on the objectives, methods, location, and time period of the monitoring or research program. We encourage careful consideration of the objectives and data collection design for any wildlife camera project. Recommendations on appropriate designs to achieve various objectives are available in reports and the scientific literature (for example, see O'Connell et al. 2010; Fisher and Burton 2012; Rovero et al. 2013; Meek et al. 2014; Burton et al. 2015; Steenweg et al. 2015).

¹ http://a100.gov.bc.ca/pub/siwe/search_reset.do

² <https://catalogue.data.gov.bc.ca/dataset?q=WSI>

³ www.gov.bc.ca/submit-wildlife-data

⁴ www.gov.bc.ca/wildlife-data-templates

2.1.1 Project Identification Number (SPI Project ID)

The Project must first be registered at the WSI Submissions SharePoint website³. A unique project identification number will be provided to the user by the custodian of the WSI database upon submission.

2.1.2 Project Name

This is a unique Project name in text format. For details on appropriate format, refer to the WSI Submissions SharePoint website.

2.1.3 Publish Date

This is the date that the Project was uploaded to the SPI database. It will be auto-generated.

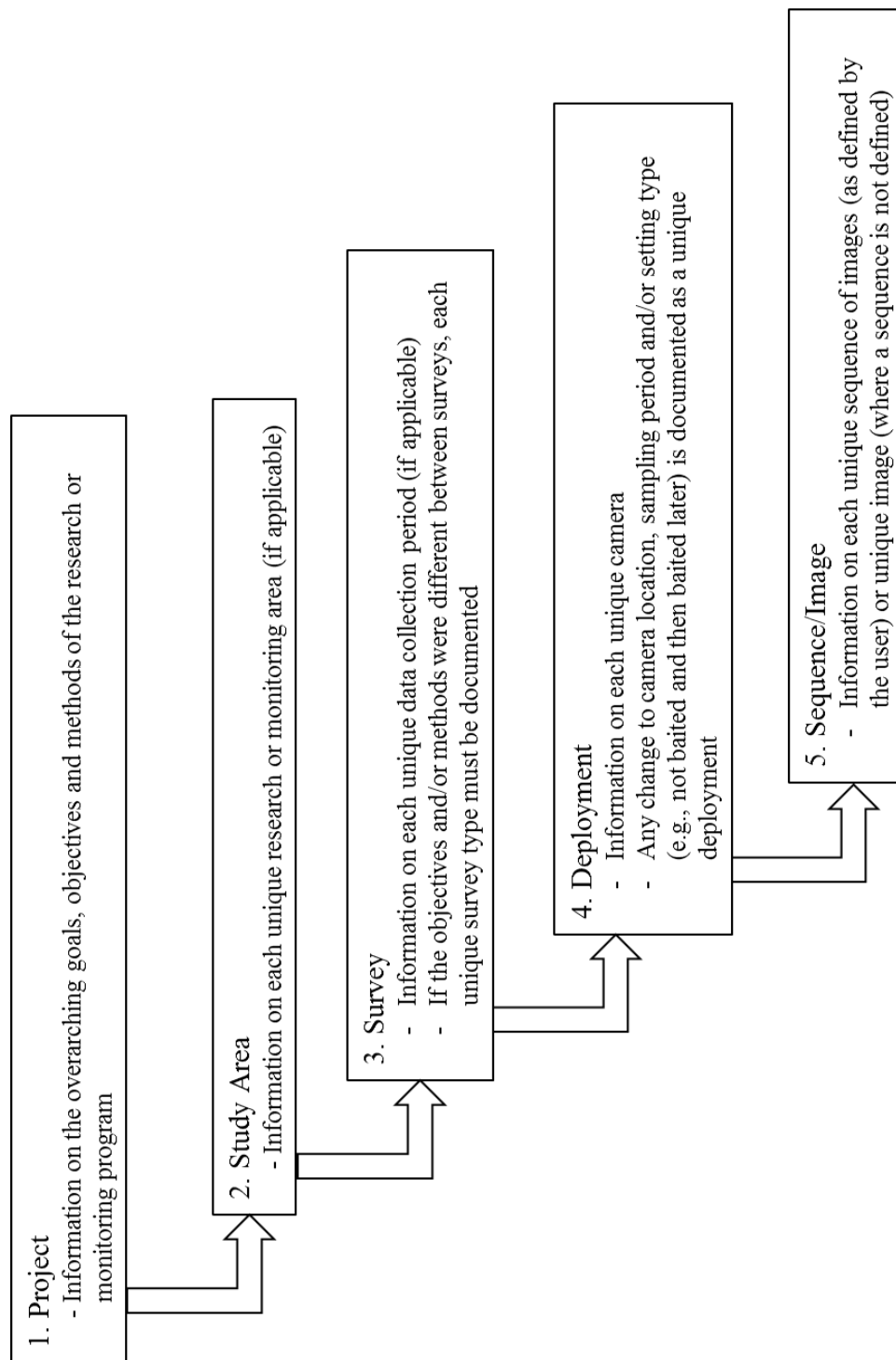


FIGURE 1 Hierarchical structure of wildlife camera data in the Wildlife Camera Metadata Protocol for British Columbia. Based on Forrester et al. (2016) and the Government of British Columbia’s Wildlife Species Inventory (WSI) data management system.

2.1.4 Project Data Use and Constraints (Data Submission Authority, Data Meets FOIPPA Criteria, Data Category, Category Rationale)

All species and ecosystems data and information submitted to the Province are governed by the Species and Ecosystems Data and Information Security policy and procedures (SEDIS; www.gov.bc.ca/species-ecosystems-secure-data). You only have authority to submit data to the WSI database if the data and information has been collected legally and in accordance with Section 1 of the SEDIS procedures.

The SEDIS policy and the procedures documents explain how secure species and ecosystems data and information will be handled, protected and distributed. Most species and ecosystems data and information in the WSI database are available to the public through the Species Inventory Web Explorer, iMap and BC Geographic Warehouse. In cases where data and information either (1) pertain to a species deemed susceptible to persecution or harm, (2) are subject to proprietary interests, (3) would violate provincial or federal statute, or (4) pose a risk to government interests (e.g., legal investigations, treaty negotiations) the Province will secure and manage the release of these data and information types. Proprietary data may include those collected on private or First Nations land, or those awaiting publication (e.g., in a thesis or scientific journal) and may be subject to a Data and Information Sharing Agreement (DISA). Whether data are identified as proprietary and if a DISA is required should be identified during the WSI submission process. Secured data may be distributed to government staff or other professionals with a demonstrated business Need-to-Know subject to the terms and conditions of a Confidentiality and Non-Reproduction Agreement as per the SEDIS policy and procedures.

Data must meet *Freedom of Information and Protection of Privacy Act* (FOIPPA) criteria. By submitting data to WSI you agree that data and information conform to FOIPPA criteria. This agreement is captured during the WSI submission process. Data that cannot be captured, stored and released by the Province due to FOIPPA include photographs of people and vehicle license plates, as well as other personal information, such as names, email addresses and phone numbers. For information on Privacy and Personal Information in the Public Sector including FOIPPA see www.gov.bc.ca/gov/content/governments/services-for-government/information-management-technology/privacy.

2.1.5 Project Coordinator

This text field provides the first and last name of the primary contact person for the Project.

2.1.6 Funding Agency

The name of the agency(ies) that funded the Project and if applicable, the identification number/label used by the funding agency to refer to the Project. These are optional fields.

2.1.7 Project Start Date

The date that the Project was initiated. For example, this may be a contract start date.

2.1.8 Project End Date

The date that the Project ended, if applicable. For example, this may be the deliverable due date. Leave blank if the project is ongoing. This field is optional.

2.1.9 Region

The Ministry of Environment and Climate Change Strategy region(s) where the Project occurred: www.gov.bc.ca/gov/content/environment/air-land-water/land/regional-environment-contacts.

2.1.10 Location Description

A description of the location of the Project, including details about large-scale habitat types and environmental conditions.

2.1.11 Project Objectives

This is a text paragraph that clearly describes the Project objective(s). It should include information on the Project research or monitoring design, including unique Study Areas or Surveys (where applicable) within the Project. It should at a minimum provide details on how camera locations were selected (e.g., random, systematic, or targeted habitat types or features), if cameras were 'clustered' into hierarchical groups with common characteristics (e.g., paired sites), the average, minimum or maximum spacing between cameras, the surveyed area (i.e., study area extent) and how that area was determined (e.g., management unit or minimum convex polygon), and the number of sampled sites (Meek et al. 2014; Forrester et al. 2016). For example:

The objective of this program was to measure moose occupancy of Ungulate Winter Ranges (UWRs) relative to adjacent areas to test whether moose are more likely to occupy UWRs during the winter. The study area extent included British Columbia Wildlife Management Units 8-16, 8-20 and 8-33, and was divided into 1 km grid cells. Sixty cameras were deployed in a sub-set of randomly selected grid cells inside (30 sites with 1 camera per site) and outside (30 sites with 1 camera per site) of UWR U-8-007 in the winters (November 1 to March 30) of 2015/16 and 2016/17. Cameras were deployed on wildlife trails in each selected grid cell and were at least 500 m apart from the nearest camera.

2.1.12 Wildlife Permit Number

If you have a wildlife permit for this survey work, provide the last 6 digits (e.g., 109853) of the permit number here. The last 6 digits are those after the hyphen. Multiple permit numbers must be separated by commas (e.g., 109853, 100126). This field is optional.

2.2 Study Area

The Study Area level includes information on unique research or monitoring areas that occurred within a Project. In some cases, a Project will consist of more than one Study Area. In those cases, the Study Area fields can be used to provide information about each unique area. The Project and Study Area will be the same in cases where only one area was surveyed. The Study Area data is recorded through the WSI Submissions SharePoint website.

2.2.1 Study Area Name

Provide a name for each unique Study Area (where applicable) of the Project. Study Area Names entered in the WSI Submissions SharePoint website must match the Study Area Names entered into the Wildlife Camera Template.

2.2.2 Study Area Description

Describe the habitat of each unique Study Area (where applicable). Identify land uses and habitat disturbances within each Study Area.

2.3 Survey

The Survey level includes information on different surveys completed within the same Project or Study Area. In some cases, a Project or Study Area will consist of more than one type of Survey. In those cases, the Survey fields can be used to provide information about each unique Survey. For example, if some aspect of the research or monitoring design changed during the Project (e.g., the target species or method of data collection) then each Survey is uniquely identified and the data fields are populated for each unique Survey. Ensure that each Survey is linked to the appropriate Study Area Name where projects have multiple Surveys and Study Areas. The Project, Study Area, and Survey may be the same in cases where surveys were always completed in the same area following the same design. However, oftentimes surveys with the same methodology, Study Area and Project are separated on a yearly basis to facilitate annual data submission to WSI. The Survey data is recorded through the WSI Submissions SharePoint website.

2.3.1 Survey Name

The name of each unique Survey (where applicable) completed for the Study Area or Project.

Survey names should follow the following naming convention:

Year – Target Species - Type of Survey - Location

For example, 2017 – Grizzly Bear – Wildlife Camera – Stein Valley.

For multi-species surveys, enter species as *Multi-Species* or enter as the unique group of species that was targeted (e.g., Mustelids, Ungulates, or Carnivores).

Refer to the WSI data submission website for current guidelines on survey naming convention.

2.3.2 Survey Start Date

The date that field work began for each Survey.

2.3.3 Survey Objectives

These are specific objectives and design details of each Survey within a Project. If a Project has only one survey or multiple surveys with identical methods and locations, then Project and Survey objectives and design may be the same. Otherwise, the differences between each unique Survey should be carefully documented.

Where Project and Survey Objectives are not the same, each Survey should, at a minimum, describe how camera locations were selected (e.g., random, systematic, or targeted habitat types or features), if cameras were ‘clustered’ into hierarchical groups with common characteristics (e.g., paired sites), the average, minimum or maximum spacing between cameras, the surveyed area and how that area was determined (e.g., management unit or minimum convex polygon), and the number of sampled sites.

2.3.4 Target Species

A Target Species is the species that each unique Survey was designed to detect. List all targeted species.

Species names can be found using the BC Species and Ecosystems Explorer (www.gov.bc.ca/bcsee). Individual species may be searched for, or alternatively, the entire list of vertebrate species for BC may be downloaded by searching for vertebrates (the “Animals” and “Vertebrates” check boxes should be checked) and downloading the subsequent data table output (click on the “Export Details” button on the bottom right below the table). This field is optional.

2.3.5 Crew Members

List all of the members of the crew that collected or entered data for the Survey. Use complete first and last names. Also include names of staff that provided species identification of photo detections.

2.4 Deployment (Sample Station Information, Camera Information, Camera Setup and Checks)

The Deployment level includes data on each unique camera or set of cameras within a Survey. Any change to camera location, sampling period, and/or setting type (e.g., not baited and then baited later) should be documented as a unique Deployment. The following data fields provide information related to each specific camera Deployment. The Deployment data is recorded by the WSI database through the Wildlife Camera Template. The Sample Station Information worksheet in the Wildlife Camera Template should only be used when multiple cameras are deployed in a non-independent array at the same location (e.g., four cameras on a post each facing in one of the cardinal directions). For most wildlife camera study designs, the Sample Station Information worksheet will not be required.

2.4.1 Sample Station Label

This is a unique alphanumeric identifier for each location at which sampling is conducted using multiple cameras in a non-independent array (i.e., four cameras on a post with the same coordinates). This is the label for the entire array. Each camera in a non-independent array will also require a unique Camera Label (2.4.2 Camera Label). This field is optional and depends on study design

2.4.2 Camera Label

All cameras require a unique alphanumeric Camera Label. Because camera settings, setup, coordinates and survey effort may differ for each camera deployment it is required to give each camera a unique Camera Label and enter corresponding information for each camera in the Wildlife Camera Template in separate rows.

2.4.3 Nested In Sample Station

If multiple cameras are setup in a non-independent array, use this field to indicate which Sample Station (2.4.1 Sample Station Label) each camera belongs to. This will reduce data redundancy as certain information (e.g., coordinates) will only need to be entered once for the Sample Station. This field is optional and depends on study design.

2.4.4 UTM Zone Sample Station

The UTM zone of the location of each Deployment. Only required if providing UTM Easting and Northing coordinates. This should be given either in the Sample Station Information worksheet for a non-independent array or the Camera Information worksheet for an individual camera, but not both.

2.4.5 Easting or Longitude Sample Station

This is a numeric identifier for describing the UTM Easting or Longitude of the Deployment. UTM coordinates must be recorded using the NAD 83 datum. Longitude must be recorded using decimal degrees. There is no need to provide both UTM Easting and Longitude. This should be given either in the Sample Station Information worksheet for a non-independent array or the Camera Information worksheet for an individual camera, but not both.

2.4.6 Northing or Latitude Sample Station

This is a numeric identifier for describing the UTM Northing or Latitude of the Deployment. UTM coordinates must be recorded using the NAD 83 datum. Latitude must be recorded using decimal degrees. There is no need to provide both UTM Northing and Latitude. This should be given either in the Sample Station Information worksheet for a non-independent array or the Camera Information worksheet for an individual camera, but not both.

2.4.7 Number of Cameras

If several cameras were deployed together at a Sample Station, where the group of cameras was acting as the sampling unit (non-independent array) rather than a single camera, then this field can be used to indicate the number of cameras in the sampling unit. This field is optional and depends on study design.

2.4.8 Sample Station Comments and Camera Comments

These text fields allow the user to describe any additional data about the site conditions that were collected at a Deployment location (e.g., recent caribou activity in vicinity of station, lichen-rich habitat in old-growth stand near river). This field is optional.

2.4.9 Camera Make and Camera Model

This is the camera manufacturer and model number, for example, Reconyx PC900 or Bushnell Trophy Cam HD. This data is particularly important for analysis where different types of cameras may provide different detection probabilities. This information is recoded in two separate fields (Camera Make, Camera Model).

2.4.10 Deployment Feature (Habitat Description)

The type of feature, if any, that the Deployment location was associated with. Often cameras are deployed on specific features to maximize detection of wildlife species, or measure use of a specific feature. These are important to document in case of detection biases of specific features. This is a free-form field, but consider using one of these feature types, if applicable: “Paved Road”, “Dirt Road”, “Gravel Road”, “Hiking Trail”, “Game Trail”, “Road Crossing” (e.g., Overpass, Underpass, or Bridge), “Culvert”, “Burrow”, “Nest”, “Den”, “Carcass”, “Bait Tree”, “Water” (e.g., Creek, Wetland, Lake, Seep, or Spring), “Mineral Lick”, “Seismic Line”, “Pipeline Right-of-Way”, “Electrical Transmission Line”, “Railway”, “Clearcut”, “Burn”, or “Fruiting Tree or Shrub.”

2.4.11 Deployment Start Date (Date)

This is the date that the Deployment began. The Deployment could commence on the day the camera was installed or the day that it was checked to download data if that defines a new sampling period. The format should be dd-mmm-yyyy (e.g., 17-Jun-2008). When entering the date into the Wildlife Camera Template (see section 3.1 How to Access the Database) ensure that Microsoft Excel interprets it correctly as date information.

2.4.12 Deployment End Date (End Date)

This is the date that each unique Deployment ended (i.e., camera removed or checked to download data). The format should be dd-mmm-yyyy (e.g., 17-Jun-2008). When entering the date into the Wildlife Camera Template (see section 3.1 How to Access the Database) ensure that Microsoft Excel interprets it correctly as date information. For study designs where camera checks/data download events define a new sampling period for a survey, the Deployment End Date for a Deployment will likely be the same as the Deployment Start Date for the subsequent Deployment sampling period.

Note that if a camera fails (i.e., non-functioning) before the camera was checked or removed then the Deployment End Date is the last known operational date. For example, if the camera was not operational when taken down on May 5th, but the last photo was taken on April 28th, the latter is the Deployment End Date. On rare occasions when a camera was non-functioning in the middle of an intended Deployment period, but functioning at the beginning and end of the Deployment period (for example, if it was covered in snow for a few days), then two unique Deployments should be entered, with a unique start and end date for the periods before and after the period the camera was not functioning.

To accurately measure survey effort in the event of camera failure, we recommend that users consider setting the camera to take one picture per day (i.e., automatically take a picture at a daily interval). This will help the user more accurately determine failure dates. For example, it may be difficult to determine a failure date for cameras that are triggered by animals only occasionally (e.g., on a weekly basis). A daily picture also provides a consistent record of site conditions over time (e.g., snow cover, vegetation growth).

2.4.13 Camera Days (Total Deployment Time and Total Deployment Time Unit)

Provide the number of Camera Days (i.e., 24-hour periods or the difference in days between Deployment End and Start Dates) that the camera was active and functioning properly as the Total Survey Time. This can be calculated from Deployment Start and End Dates. Total Survey Time Unit should always be given as “days.”

2.4.14 Quiet Period Setting

This field provides the time, in seconds, from the end of a recording event (photograph or video) during which the camera will not respond to subsequent trigger events (e.g., motion).. In cases where a quiet period was not specified, it will be 0.

2.4.15 Trigger Sensitivity Setting

This field describes the trigger sensitivity setting for the camera used, where applicable (e.g., Reconyx HyperFire cameras have a choice between ‘low’, ‘low/medium’, ‘medium’, ‘medium/high’ and ‘high’ sensitivity settings). It should be entered as “NULL” if the trigger

is set to a timer (see 2.4.16 Trigger Timing) or if the camera does not have a sensitivity setting option.

2.4.16 Trigger Timing

This field provides the time interval, in seconds, between automated regularly-timed recording events (triggers), when the camera is set to take pictures at defined time intervals. With this setting, the timing of recording events is predetermined and not triggered by the presence of wildlife species. It should be entered as “NULL” if the trigger is set to a sensor (see 2.4.15 Trigger Sensitivity Setting).

2.4.17 Photos per Trigger Setting

This field describes the setting for the number of photos taken each time the camera was triggered.

2.4.18 Video Length Setting

This field describes the minimum video time, in seconds, that the camera should record when triggered. In cases where video was not specified, it will be “NULL”.

2.4.19 Bait Lure Type

The type of bait or lure used at a Deployment location, if applicable. Bait or lure should be documented as one of the following: “None”, “Scent”, “Meal”, “Visual”, “Acoustic”, or “Described in Comments”. If “Described in Comments” is selected please describe the bait or lure type within the “Deployment Comments” section (2.4.20 Deployment Comments). If no bait or lure was used, enter as “NULL”.

2.4.20 Deployment Comments (DCV Comments)

This is a text field that allows the user to describe any additional data that was collected during a Deployment period (e.g., the camera was covered in snow and non-functioning between 01-Jan-2008 and 06-Jan-2008). This field is optional.

2.4.21 Deployment Photos (Design Component Visit Photos)

This optional field offers the opportunity to link a unique Deployment to all of the photos from that Deployment. You should save all of your images for each Deployment to a unique folder on your hard drive that identifies the deployment name (Camera Label), Deployment date and content type (i.e., ‘Camera03_01Dec2017_Photos.zip’) and then zip that file for loading to the WSI data management system. There is a 260 character file path limit. The .zip file will need to be uploaded through the WSI Submissions SharePoint website, but this field provides the required linkage so that the database knows which .zip file on SharePoint is associated with which Deployment record in the database.

To attach the name of the .zip folder, follow these steps. First, ensure Macros are enabled in the Wildlife Camera Template. Then right click in the cell you are interested in linking photos to. Select WSI: Add File Names to Cell. Browse to select your .zip file containing all of the photos associated with that camera Deployment. Adding the file name to the Design Component Photos cell in the Wildlife Camera Template does not attach the file, it only provides reference to the file name. Therefore, you must still upload the .zip file to the WSI Submissions SharePoint website. Image file names submitted for a Deployment must be

consistent with those submitted as Survey Observation Photos (see 2.5.4 Sequence/Image ID).

We strongly encourage users to submit all original images from each Deployment for archiving (with the exception of photos/videos of people and “false triggers” see 3.2 Image and Video Archive).

Acceptable photo file types are .png, .jpg, .bmp, and .gif. Video can be accepted as .avi, .mov, .wmv, and .mp4.

If .zip folders exceed SharePoint file size limits or you are having difficulty uploading your photos to the WSI Submissions SharePoint website, please contact the Provincial Wildlife Information Specialist at SPI_Mail@gov.bc.ca to make alternate arrangements for submission.

2.5 Sequence/Image (Sequence Image Data)

The following fields provide information on the data within an Image, or on the data within a Sequence of related images (i.e., images that are grouped as part of the same trigger “event”). We assume that most users will enter data as Sequences, but the database is flexible for receiving data on single Images. The Sequence Definition (if applicable, see Section 2.5.5) is defined by the user so they can use a Sequence that is appropriate to their research program. Therefore, information on how a Sequence is defined must be provided in the database. When a Sequence Definition is used, only enter data for the Sequence of images, not each unique Image, and use the first image of the Sequence as the Sequence/Image ID (see Section 2.5.4), as this is the time of first detection. The Sequence/Image data is recorded by the WSI data management system through the Wildlife Camera Template.

Note that the user does not need to manually enter each Sequence/Image into the Wildlife Camera Template. Rather, it will be more efficient for the user to input image data into a separate database using wildlife camera specific data entry software (e.g., Timelapse2, <http://saul.cpsc.ucalgary.ca/timelapse/>, or Reconyx MapView, <http://www.reconyx.com/software/mapview> - see also review by Scotson et al. 2017). We do not endorse specific software, but we do highly recommend the use of wildlife camera image processing software to facilitate data entry. The database generated using this software can be transferred into the Wildlife Camera Template, using data conversions where necessary. When using data entry software, we recommend aligning the data field names and data format with this Wildlife Camera Metadata Protocol as much as possible.

2.5.1 Sequence/Image Start Date (Detection Date)

This is the date of the Image or the first image of a unique Sequence. The format of the field is dd-mmm-yyyy (e.g., 17-Jun-2018).

2.5.2 Sequence/Image Start Time (Detection Time)

This is the time (24 hr) of the Image or the first image of a unique Sequence. The format of the field is hh:mm:ss (e.g., 13:01:26).

2.5.3 Sequence/Image Temperature (Air Temperature (C))

The air temperature in degrees Celsius at the time of Sequence/Image observation. Most cameras record this information in the photo metadata. This field is optional.

2.5.4 Sequence/Image ID (Survey Observation Photos)

This is a unique alphanumeric file name for the *Image or the first image of a Sequence*. The photo file names included here must match those of the original photos submitted to the WSI Submissions SharePoint website.

We highly recommend that you develop a photo naming convention prior to entering data. This will minimize the risk of having images from different deployments, study areas or surveys with the same name. We recommend naming each image as “deploymentID_date_time”. File names must not have spaces. As each Deployment has a unique identification, this approach should minimize the risk of duplicate image names. Alternative naming conventions may be used, but the goal should be to minimize duplicate image names. Data entry software (see section 2.5) can be used for batch processing of image names, which can significantly reduce data processing time compared to renaming images manually.

Note that the image file name may be automatically populated using data entry software. Alternatively, you can link the Sequence/Image ID to a photo by right-clicking on the Survey Observation Photo cell in the Wildlife Camera Survey data submission template and selecting 'WSI: Add File Names to Cell' and navigating to the photo. Adding the photo file name to the Survey Observation Photos cell in the Wildlife Camera Survey data submission template does not attach the photo, it only provides reference to the photo file name. Therefore, you must still upload the photos to the WSI Submissions SharePoint website, ideally all contained within a single .zip file attachment (i.e., 'SurveyObservationPhotos.zip').

Even though only the first image of a Sequence is used as the Sequence ID, it is typical that other images within the Sequence provide additional information (e.g., images of all individuals in a group). It is therefore ideal to archive all of the images from a Sequence, not just the first image (see 2.4.21 Deployment Photos for detail on how to archive photos from each unique camera deployment). If it is not possible to submit all images from a Deployment for some reason, we recommend that you at a minimum also submit the image(s) from a Sequence that best represent(s) the Sequence, e.g., can be used to verify the species and number of individuals.

Acceptable photo file types are .png, .jpg, .bmp, and .gif. Video can be accepted as .avi, .mov, .wmv, and .mp4.

If files exceed the SharePoint file size limit or you are having difficulty uploading your photos to the WSI Submissions SharePoint website, please contact the Provincial Wildlife Information Specialist at SPI_Mail@gov.bc.ca to make alternate arrangements for submission.

2.5.5 Sequence Definition

This field provides the amount of time (in seconds) that defines a Sequence of images. All images that are separated by less time than this are considered part of the same Sequence. If no Sequence Definition was used it should be “NULL”.

There are cases where animals spend more time in front of a camera than the length of a Sequence Definition. For example, the same animal may rest or forage in front of a camera for ten minutes (600 seconds), but the Sequence Definition is 5 minutes (300 seconds). In this case the user has two options. They can maintain the Sequence Definition as 300 seconds and enter two rows of data and identify in the comments that the same animal was observed in both Sequences. Alternatively, the user can define the Sequence as 600 seconds for that

particular event, with a comment why the Sequence Definition was changed. We recommend the former approach, as it maintains consistency with how sampling events are defined, which may facilitate data analysis, and events where the same animal(s) stays in front of a camera for very long periods of time are typically rare.

2.5.6 Species

The species code of the species of animal that is being categorized in the Sequence/Image. Valid values can be found using the BC Species and Ecosystems Explorer (www.gov.bc.ca/bcsee). Individual species may be searched for, or alternatively, the entire list of vertebrate species for BC may be downloaded by searching for vertebrates (the “Animals” and “Vertebrates” check boxes should be checked) and downloading the subsequent data table output (click on the “Export Details” button on the bottom right below the table). In cases where there is more than one wildlife species in a Sequence/Image, each species will be identified with a unique row in the Wildlife Camera Survey data submission template (see 2.5.8 Sequence/Image Wildlife Life Stage and Sex Classes), but with the same Sequence/Image ID. Note for domestic animals: humans should be entered as M-HOSA, dogs should be entered as M-CAFA, cats should be entered as M-FECA, horses should be entered as M-EQCA, and cattle should be entered as M-BOTA. In cases where the species cannot be reliably distinguished from another similar species (e.g., bobcat versus lynx), use a higher taxonomic classification such as the genus or family, where appropriate. If the image (or sequence of images) does not allow for the species or higher taxonomic order to be determined, use the code “Unknown” and provide a comment (see 2.5.14 Comments) to explain why the species could not be reliably determined.

2.5.7 Count

The number of unique individuals in the Sequence/Image.

2.5.8 Life Stage and Sex Classes

There are multiple fields for classifying Life Stage (age) and Sex Classes of animals of the same species in the same Sequence/Image. These fields are optional:

- Life Stage
- Sex
- Adult Males
- Adult Females
- Adults - Unclassified Sex
- Juvenile Males
- Juvenile Females
- Juveniles - Unclassified Sex
- Yearling Males
- Yearling Females
- Yearlings - Unclassified Sex
- Males - Unclassified Life Stage
- Females - Unclassified Life Stage
- Unclassified Life Stage and Sex

In cases where there is more than one Life Stage or Sex Class in a Sequence/Image, users can either enter each unique Life Stage/Sex Class combination as a unique row in the database, or enter each unique combination within the same row under an appropriate field.

For example, if a Sequence/Image contains 6 elk, 2 of which are adult females, 3 of which are juveniles of unknown sex and one of which is an adult male, the data could be entered as three unique rows, each with the same Sequence/Image date, time and unique identifier, where:

- one row is entered as: Count = 2, Life Stage = Adult, and Sex = Female;
- a second row is entered as: Count = 3, Life Stage = Juvenile, and Sex = Unknown, and;
- a third row is entered as: Count = 1, Life Stage = Adult, and Sex = Male.

Alternatively, this same data could be entered as one single row where:

- Count = 6, Life Stage = Blank, Sex = Blank, Adult Males = 1, Adult Females = 2, and Juveniles – Unclassified Sex = 3.

It is at the user's discretion how to enter their data. However, we recommend that users who are entering data from wildlife inventories enter data as a single row per Sequence/Image (i.e., the number of each age and sex class are defined in one row). Where unique individuals are identified or the behaviours of each individual are identified then we recommend that users enter data for each individual as a unique row.

2.5.9 Behaviour

We currently recommend that the user populate this field when they are tracking the behaviour (e.g., “Bedding”, “Drinking”, “Feeding”, “Fleeing”, “Standing”, “Traveling”, etc.) of the animal or group of animals in the Sequence/Image. If observing a group, then record the exact, sub-sampled, or estimated mode behaviour of all the individuals in the group, or enter each individual animal as a unique row in the Sequence Image Data worksheet in the Wildlife Camera Template (see section 2.5.8 Life Stage and Sex Classes). This field is optional.

2.5.10 Animal ID

This is a field that can be populated by the user when they can uniquely identify individual animals (e.g., if they are marked in some way). The database can currently only handle one unique individual per row, therefore, where more than one unique individual can be identified in an image, each individual should be entered as a unique row (see 2.5.8 Life Stage and Sex Classes). This field is optional.

2.5.11 Human Transport Mode

This field should be populated by the user when data on humans, in addition to or instead of wildlife is being collected. Use the standard codes provided in the accompanying Wildlife Camera Template to capture information on how humans were travelling at the time of observation (i.e., walking, off-road vehicle). If Human Transport Mode cannot be captured by one of the standard categories, use the “Described in Comments” code. If “Described in Comments” is used please describe the mode of human transportation within the Comments field (2.5.14 Comments). This field is optional.

2.5.12 Human Use Type

This field should be populated by the user when data on humans, in addition to or instead of wildlife is being collected. Use the standard codes provided in the accompanying Wildlife Camera Template to refine the activity being undertaken by the observed humans (i.e.,

industrial, recreation). If Human Use Type cannot be captured by one of the standard codes, use the “Described in Comments” category. If “Described in Comments” is used please describe within the Comments (2.5.14 Comments). This field is optional.

2.5.13 Surveyor

This field allows the user to submit the full name of the surveyor who provided the observation record (species identification and associated information). If there are multiple surveyors for an observation, pick the primary surveyor.

2.5.14 Comments

This is a text field that allows the user to describe any additional data that was collected during an Image or Sequence observation. This field is optional.

3.0 Conclusions

This protocol provides specific information on how wildlife camera data should be collected and documented in British Columbia. The consistent collection of wildlife camera data will support the creation of a large scale dataset on wildlife distribution across British Columbia. This protocol is closely related to other proposed protocols (e.g., Forrester et al. 2016). Thus it provides opportunities for further amalgamation of datasets to answer research and monitoring questions across administrative jurisdictions.

3.1 How to Access the Database

The wildlife camera database is currently integrated with the provincial Wildlife Species Inventory (WSI) data management system. More information is available online for how to submit data⁵ and on the structure of the SPI database in general^{6,7}.

Once uploaded to the SPI database, data from the photos (as an Excel file) and the photos themselves will be downloadable through the Government of British Columbia's Species Inventory Web Explorer (SIWE)⁸ on a project-by-project basis. The database (but not photos) can also be accessed using a spatial tool called iMap⁹, which is accompanied by a user's guide¹⁰. The database and photos are also accessible without needing to access it on a project-by-project basis or using a map by contacting the Provincial Wildlife Information Specialist (email: SPI_Mail@gov.bc.ca).

3.2 Image and Video Archive

The provincial SPI database is available to not only archive, organize and share processed wildlife camera data, but to also archive the images and videos from which the data were collected. Digital image and video can require a large amount of digital memory. Therefore, this database provides users with the opportunity to securely store and back-up their data without needing to use their own digital memory.

Not all image or video data can or should be archived. Images or video that allow for individual identification of people (e.g., faces, vehicle license plates) should not be uploaded to the archive for privacy reasons. Users should follow the *Freedom of Information and Protection of Privacy Act* when collecting and managing data on people. We also ask that users do not archive images or videos that were taken due to false triggers (e.g., wind blowing a tree branch that triggers the camera sensor).

⁵ www.gov.bc.ca/submit-wildlife-data

⁶ www.gov.bc.ca/assets/gov/environment/natural-resource-stewardship/nr-laws-policy/risc/spifml20.pdf

⁷ www.gov.bc.ca/assets/gov/environment/natural-resource-stewardship/nr-laws-policy/risc/spif_errata.pdf

⁸ http://a100.gov.bc.ca/pub/siwe/search_reset.do

⁹ www.gov.bc.ca/gov/content/data/geographic-data-services/web-based-mapping/imapbc

¹⁰ www.gov.bc.ca/assets/gov/data/geographic/web-based-mapping/imapbc/imapbc_training_manual.pdf

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Appendix 1

The following metadata crosswalk (Table 1) maps the data fields used in the Wildlife Camera Metadata Protocol to the equivalent data fields used in other components of the WSI data management system (WSI Submissions SharePoint, WSI Wildlife Camera Template) as well as to the Camera Trap Metadata Standard (CTMS) supplementary material in Forrester et al. (2016).

To use Table 1, start with the data fields in the Wildlife Camera Metadata Protocol column within the “Data Fields” portion of the table. Next, look up the equivalent data fields in the same row from each of the WSI data management system components and the CTMS. Each equivalent data field has been given a superscript reference number that links the data field to the associated section of the WSI data management system component or the CTMS it can be found in, as listed within the “Sections” portion of the table.

TABLE 1 *Wildlife camera metadata crosswalk*

Wildlife Camera Metadata Protocol (Province of BC)	WSI data management system components		CTMS
	WSI Submissions SharePoint (Province of BC)	WSI Wildlife Camera Template (Province of BC)	Camera Trap Metadata Standard Supplementary material (Forrester et al. 2016)
Sections			
2.1 Project; 2.2 Study Area; 2.3 Survey; 2.4 Deployment; 2.5 Sequence/ Image	¹ Projects; ² Surveys	¹ Project Information; ² Sample Station Information; ³ Camera Information; ⁴ Camera Setup and Checks; ⁵ Sequence Image Data	¹ 1. Project; ² 1.1 Project People; ³ 2. Deployment; ⁴ 2.1 Camera Properties; ⁵ 2.2 Camera Deployment Properties; ⁶ 3. Image Sequence; ⁷ 3.1 Image Sequence Animal; ⁸ 4. Images; ⁹ 4.1 Image Animal
Data Fields			
2.1 Project			
2.1.1 Project Identification Number	SPI Project ID ¹	SPI Project ID ¹	projectID ¹
2.1.2 Project Name	Project Name ^{1,2}	Project Name ¹	projectName ¹
2.1.3 Publish Date	Publish Date ¹	N/A	publishDate ¹

TABLE 1 *Wildlife camera metadata crosswalk (continued)*

Wildlife Camera Metadata Protocol (Province of BC)	WSI data management system components		CTMS
	WSI Submissions SharePoint (Province of BC)	WSI Wildlife Camera Template (Province of BC)	Camera Trap Metadata Standard Supplementary material (Forrester et al. 2016)
Data Fields (continued)			
2.1.4 Project Data Use and Constraints	Data Submission Authority ^{1,2} ; Data Meets FOIPPA Criteria ^{1,2} ; Data Category ² , Category Rationale ²	N/A	projectDataUseAndConstraints ¹
2.1.5 Project Coordinator	Project Coordinator ¹	N/A	projectContact ²
2.1.6 Funding Agency	Funding Agency ¹	N/A	N/A
2.1.7 Project Start Date	Start Date ¹	N/A	N/A
2.1.8 Project End Date	End Date ¹	N/A	N/A
2.1.9 Region	Region ¹	N/A	N/A
2.1.10 Location Description	Location Description ¹	N/A	N/A
2.1.11 Project Objectives	Project Objectives ¹	N/A	projectObjectives ¹ ; projectDesign ¹
2.1.12 Wildlife Permit Number	Wildlife Permit Number ²	N/A	N/A
2.2 Study Area			
2.2.1 Study Area Name	Study Area Name ²	Study Area Name ^{2,3,4, 5}	N/A
2.2.2 Study Area Description	Study Area Description ²	N/A	N/A
2.3 Survey			
2.3.1 Survey Name	Survey Name ²	Survey Name ¹	N/A
2.3.2 Survey Start Date	Survey Start Date ²	N/A	N/A

TABLE 1 *Wildlife camera metadata crosswalk (continued)*

Wildlife Camera Metadata Protocol (Province of BC)	WSI data management system components		CTMS
	WSI Submissions SharePoint (Province of BC)	WSI Wildlife Camera Template (Province of BC)	Camera Trap Metadata Standard Supplementary material (Forrester et al. 2016)
Data Fields (continued)			
2.3.3 Survey Objectives	Survey Objectives ²	N/A	N/A
2.3.4 Target Species	Target Species ²	N/A	N/A
2.3.5 Crew Members	Crew Members ²	N/A	N/A
2.4 Deployment		Sample Station Information; Camera Information; Camera Setup and Checks	2. Deployment; 2.1 Camera Properties; 2.2 Camera Deployment Properties
2.4.1 Sample Station Label	N/A	Sample Station Label ²	deploymentLocationID ³
2.4.2 Camera Label		Camera Label ^{3,4,5}	deploymentLocationID ³
2.4.3 Nested in Sample Station		Nested in Sample Station ³	
2.4.4 UTM Zone Sample Station	N/A	UTM Zone Sample Station ^{2,3}	N/A
2.4.5 Easting or Longitude Sample Station	N/A	Easting Sample Station ^{2,3} ; Longitude Sample Station (DD) ^{2,3}	Longitude ³
2.4.6 Northing or Latitude Sample Station	N/A	Northing Sample Station ^{2,3} ; Latitude Sample Station (DD) ^{2,3}	Latitude ³
2.4.7 Number of Cameras	N/A	Number of Cameras ²	N/A
2.4.8 Sample Station Comments and Camera Comments	N/A	Sample Station Comments ² ; Camera Comments ³	Other ⁵
2.4.9 Camera Make and Model	N/A	Camera Make ³ ; Camera Model ³	cameraMake ⁴
2.4.10 Deployment Feature	N/A	Habitat Description ³	Feature ⁵
2.4.11 Deployment Start Date	N/A	Date ⁴	cameraDeploymentBeginDateTime ³

TABLE 1 *Wildlife camera metadata crosswalk (continued)*

Wildlife Camera Metadata Protocol (Province of BC)	WSI data management system components		CTMS
	WSI Submissions SharePoint (Province of BC)	WSI Wildlife Camera Template (Province of BC)	Camera Trap Metadata Standard Supplementary material (Forrester et al. 2016)
Data Fields (continued)			
2.4.12 Deployment End Date	N/A	End Date ⁴	cameraDeploymentEndTime ³
2.4.13 Camera Days	N/A	Total Deployment Time ⁴ ; Total Deployment Time Unit ⁴	N/A
2.4.14 Quiet Period Setting	N/A	Quiet Period Setting ⁴	quietPeriod Setting ³
2.4.15 Trigger Sensitivity Setting	N/A	Trigger Sensitivity Setting ⁴	N/A
2.4.16 Trigger Timing	N/A	Trigger Timing ⁴	N/A
2.4.17 Photos per Trigger Setting	N/A	Photos per Trigger Setting ⁴	N/A
2.4.18 Video Length Setting	N/A	Video Length Setting ⁴	N/A
2.4.19 Bait Lure Type	N/A	Bait Lure Type ⁴	Bait ⁵
2.4.20 Deployment Comments	N/A	DCV Comments ⁴	Other ⁵
2.4.21 Deployment Photos	N/A	Design Component Visit Photos ⁴	N/A
2.5 Sequence/Image		Sequence Image Data	3. Image Sequence; 3.1 Image Sequence Animal; 4. Images; 4.1 Image Animal
2.5.1 Sequence/Image Start Date	N/A	Detection Date ⁵	ImageSequenceBeginTime ⁶ ; dateTimeCaptured ⁸

TABLE 1 *Wildlife camera metadata crosswalk (continued)*

Wildlife Camera Metadata Protocol (Province of BC)	WSI data management system components		CTMS
	WSI Submissions SharePoint (Province of BC)	WSI Wildlife Camera Template (Province of BC)	Camera Trap Metadata Standard Supplementary material (Forrester et al. 2016)
Data Fields (continued)			
2.5.2 Sequence/Image Start Time	N/A	Detection Time ⁵	ImageSequenceBeginTime ⁶ ; dateTimeCaptured ⁸
2.5.3 Sequence/Image Temperature	N/A	Air Temperature (C) ⁵	N/A
2.5.4 Sequence/Image ID	N/A	Survey Observation Photos ⁵	imageSequenceID ⁶ ; imageID ⁸
2.5.5 Sequence Definition	N/A	Sequence Definition (s) ⁵	imageSequenceDefinition ⁶
2.5.6 Species	N/A	Species ⁵	speciesScientificName ^{7,9}
2.5.7 Count	N/A	Count ⁵	ImageSequenceCount ⁷ , imageCount ⁹
2.5.8 Life Stage and Sex Classes	N/A	Life Stage ⁵ ; Sex ⁵ ; Adult Males ⁵ ; Adult Females ⁵ ; Adults – Unclassified Sex ⁵ ; Juvenile Males ⁵ ; Juvenile Females ⁵ ; Juveniles – Unclassified Sex ⁵ ; Yearling Males ⁵ ; Yearling Females ⁵ ; Yearlings - Unclassified Sex ⁵ ; Males – Unclassified Life Stage ⁵ ; Females – Unclassified Life Stage ⁵ ; Unclassified Life Stage and Sex ⁵	N/A

TABLE 1 *Wildlife camera metadata crosswalk (concluded)*

Wildlife Camera Metadata Protocol (Province of BC)	WSI data management system components		CTMS
	WSI Submissions SharePoint (Province of BC)	WSI Wildlife Camera Template (Province of BC)	Camera Trap Metadata Standard Supplementary material (Forrester et al. 2016)
Data Fields (concluded)			
2.5.9 Behaviour	N/A	Behaviour ⁵	N/A
2.5.10 Animal ID	N/A	Animal ID ⁵	N/A
2.5.11 Human Transport Mode	N/A	Human Transport Mode ⁵	N/A
2.5.12 Human Use Type	N/A	Human Use Type ⁵	N/A
2.5.13 Surveyor	N/A	Surveyor ⁵	sequenceIdentifiedBy ⁶ ; photoTypeIdentifiedBy ⁸
2.5.14 Comments	N/A	Comments ⁵	N/A