

Standard Operating Procedure (SOP) 8: Data QA/QC, Formatting, Archiving, Version 1.0

Protocol for Monitoring Brown Bears

Arctic (ARCN) Inventory and Monitoring Network

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The main Narrative for the Protocol for Monitoring Brown Bears in Arctic (ARCN) Inventory and Monitoring Networks is available from the NPS Inventory and Monitoring Arctic Network website (<http://science.nature.nps.gov/im/units/arcn/>) and the Natural Resource Publications Management website (<http://www.nature.nps.gov/publications/nrpm/>)

SOP 8 – Data QA/QC, Formatting and Analysis

Standard Operating Procedure #8

Version 1.0 (September 1, 2017)

Previous Version #	Revision Date	Author	Changes Made	Reason for Change	New Version #
Add rows as needed for each change or set of changes associated with each version.					

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SOP 8.0 Introduction

SOP 8 covers field data processing, data quality assurance and quality control (QA/QC) and instructions for preparation of the data for analysis. These methods closely follow those developed for Dall's Sheep by Rattenbury and Schmidt (2016). For full protocols regarding Brown Bear analysis, see SOP 9 (Data Analysis) and Schmidt et al. (2017).

A general overview of data processing steps appears below with specific procedures described in more detail in the sections that follow.

1. Handle the data after the field effort (SOP 8.1)
2. Initial quality assurance/control (QA/QC) process (0).
3. Verify the geodatabase(s) with hardcopy data (data sheets and photographs) and the pilots' tracklogs and waypoints and edit if necessary (0)
4. Import data into the Brown Bear monitoring database (SOP 8.4).
5. Perform quality control and assurance procedures (0).
6. Prepare data for analysis in program R and WinBUGS (0). If anomalies show up during analysis, another round of data verification, validation and analysis will be initiated.
7. Perform seasonal close out and dataset certification (0).
8. Archive field deliverables in IRMA (SOP 8.8)

SOP 8.1 Post Field Campaign Data Handling

Bear survey data should come from the field well organized according to SOP 7. The first office task is to archive the files on the Network shared drive.

1. Navigate to the brown bear monitoring root directory on the Network shared drive (contact the Network data manager for access information).
2. Field survey data is organized in the bear monitoring network folder first by year, then by survey. If a directory for the current year does not exist, create it under the \data directory. Example: \data\2017.
3. Create a directory in the survey year directory for the current survey if it does not exist already. Give it a logical name using the PI's naming scheme (Bear survey year) or following existing directories. Example: \data\BrownBear2017Survey.
4. In the new survey directory create two subdirectories according to the following naming scheme, one for read-only raw field data to be archived and the other for working copies. The former preserves the data exactly as it came from the field and the other makes them available for processing. You should have two directories similar to the example below:
 - a. \data\BrownBear2017Survey\FieldData-ReadOnly
 - b. \data\BEAR2017Survey\FieldData-Working

5. Compress the files in the \FieldData-ReadOnly directory and give it Read-only attributes.

Table 1 describes in more detail the structure and function of the paired field data directories:

Table 1. Example directory structure under the main Brown Bear monitoring network directory for raw field data files (read-only) and the same files available for processing.

Directory	Purpose
\data\BrownBear2017Survey\FieldData-ReadOnly	Directory for archiving raw field data. Tagged read-only and never modified. Add all field data files to a compressed (zip) archive and tag it and the directory read-only. If there are multiple datasets from multiple flights create logical subdirectories in the zip archive.
\data\BrownBear2017Survey\FieldData-Working	Same files as above but these working files may be modified, and processed for importing into the main loon database. Maintain a change log in a metadata file. If there are multiple datasets from multiple flights create logical subdirectories or a consistent file naming scheme.

Figure SOP8-1 (below) shows an example of the Sheep Itkillik 2011 survey directories (see sheep Figure SOP 11-1). The 'data' directory is organized by year with subdirectories for each survey. Each survey directory has a working and read-only directory. The read-only directory is a zip archive of survey files as they came from the field.

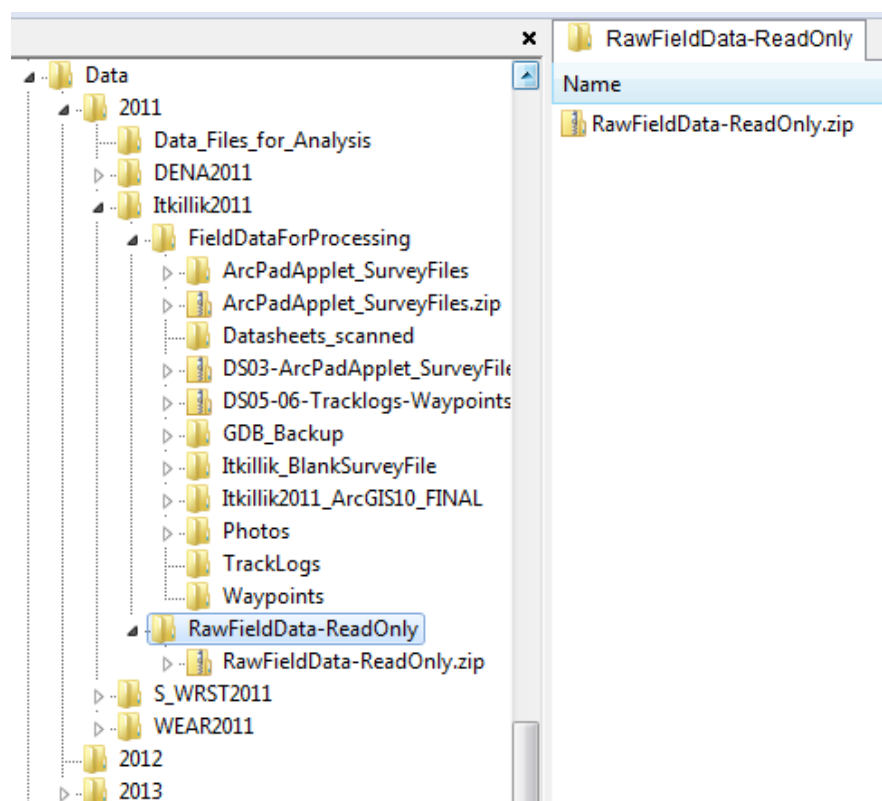


Figure SOP8-1. Example - Survey directory structure for the Sheep 2011 Itkillik survey showing the working and read-only raw data directories. The read-only directory contains the survey files as they came from the field.

Fully processed deliverables and associated metadata from the directories above will be integrated into the main Brown Bear monitoring database and then archived in the IRMA data store during seasonal close-out (0 and 0).

SOP 8.2 Initial Quality Assurance/Control Procedures

Data verification and data validation are two processes used to ensure data quality assurance and control (QA/QC). Data verification checks that data entered into a secondary (e.g., electronic) format match the source data, whereas data validation checks that data make sense. Although data entry and verification can be conducted by personnel with a general familiarity of the data (e.g., survey observers), the validation process requires in-depth knowledge about the project and data collected (i.e., Project Manager, AKA Principal Investigator). Data editing to resolve errors can occur simultaneously with the initial verification process. The final round(s) of data verification and validation should be performed by the project manager.

The Project Manager is responsible for overseeing the initial verification of Brown Bear monitoring data (both physical and electronic sources). The purpose of verifying data is to reduce collection errors thereby enhancing accuracy of data and subsequent analysis and reporting. Physical data (e.g., paper data sheets) are verified for accuracy, legibility and completeness immediately after collection and are then compared with or appended to the data collected in Park Observer on the iPads before being uploaded into the geodatabase. Data are verified first by the observer while in the field (SOP 7), and then by the Project Manager once the survey is complete. The Project Manager is responsible for resolving any errors as soon as possible according to the procedures in this SOP.

The Project Manager(s) will assemble all data following the surveys. S/he will check the datasheets and Park Observer data for legibility and completeness or will delegate this to a technician who was involved with the data collection. A minimum of two people will verify and correct data on bear identification, bear and den location data, number of bears detected and metadata collected from each aircraft. Data from each pilot-observer team will be compared and any discrepancies discussed with the observer who collected the data. These data will then be compared to the geodatabase. Bear or den location or identification may be updated in the verification process.

The Project Manager(s) will then open the ArcMap project associated with the survey and check the data within each sampling unit, by comparing the geodatabase to the data sheets, pilot tracklogs and waypoints, and the Park Observer .csv files. Each aircraft involved in the survey and each observer will provide their GPS and iPad for download and check his/her data with partnering aircraft during the survey. Partnering aircraft should compare sighted bear groups for each unit and determine if they saw any of the same groups, marking “Y” or “N” on the data sheets. Each day will have its own shape file including all tracks and waypoints of all aircraft and bear sighting. There will be one project and geodatabase per survey year, with bear detection data from each aircraft represented as a separate layer or shapefile. The Project Manager should check each of these in separate sessions with the respective sets of data sheets,

tracklogs, waypoints, and Park Observer data. Any discrepancies between the geodatabase, the datasheets, the pilots' tracklogs and waypoints and the Park Observer will be discussed with the observer (if needed), and corrected in an ArcMap editing session (0).

SOP 8.3 Geodatabase Editing

All flight tracklogs and bear location data within the geodatabase are processed and edited as needed before being imported into the main Brown Bear monitoring database. Data will be analyzed using methods similar to those described by Schmidt et al. (2017). Editing the geodatabase may be necessary (1) where there are discrepancies between the geodatabase and the pilots' tracklogs and waypoints, Park Observer data or with the datasheet information or where the external GPS lost satellite coverage or connection with the iPad while flying and (3) when bear detections are happening more rapidly than the Park Observer application can record. This creates a lag for the GPS and the placement of waypoints on the map in Park Observer.

Although the observer may have time to edit the geodatabase for these items while in the field, more often than not, edits are made during the initial QA/QC effort in the office by one of the Project Managers or a technician who was not involved with data collection. The observer should note on the datasheets where geodatabase edits are necessary if s/he does not have time to complete those edits in the field. The observer should be consulted if there are any questions about discrepancies between the geodatabase and other data sheets; therefore it is important to consult with the observer in a timely manner following the survey when his/her memory is freshest.

When there are multiple aircraft involved in the survey and each observer was downloading and checking his/her data separately during the survey, then there will be many files downloaded from each iPad for Park Observer, photos, as well as GPS tracklogs and waypoints from both the pilots and observers from each aircraft. Start with each observer for each aircraft and complete all edits to the Park Observer files and their associated data sheets and GPS tracklogs and waypoints. Then combine all the edited Park Observer files into a single geodatabase in one ArcMap project (step 13):

- 1) Open the ArcMap project (e.g., UpperNOAT2017_BearSurvey.mxd).
- 2) Add the pilot's tracklog and waypoints and the iPad tracklog to the ArcMap project if they are not already there. If the GPS lost signal during the survey flight(s) and data are missing, you can use the pilot's tracklog and waypoints to edit the iPads .gdb file (e.g., ARCN_Bears_2017.gdb) ([see steps 5c-8 below](#)).
- 3) Start an Editing session in ArcMap.
- 4) It is recommended to check each sampling unit one at a time in a systematic fashion for each ArcMap project/geodatabase.

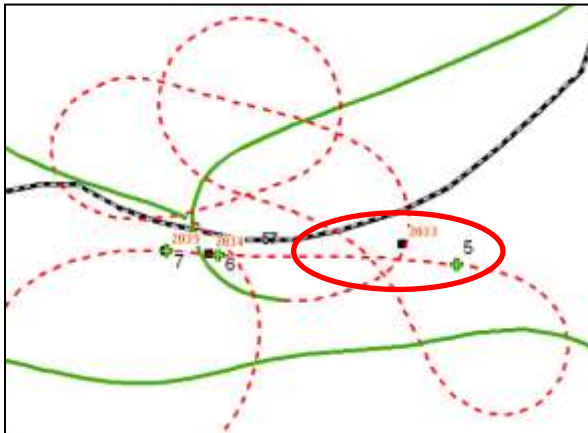
- 5) Examine each sampling unit to make sure that the iPad's .gdb tracklog lines up with the pilot's tracklog.
- You can identify the start and end points of flown trackfiles and the bear locations using the pilot's waypoints and the observer's notes recorded on the data sheet. You can also label the pilot's (point shapefile) tracklog with the LTIME field and use those labels to note the flight line direction for .gdb tracklog.
 - The pilot's Garmin 296/496 tracklog is generally always more accurate and consistent than the GPS of the iPad or external GPS-connection with the iPad and therefore more accurate than the .gdb tracklog.
 - Where there are big differences between the iPad's .gdb tracklog segments and the pilot's tracklogs, click the Edit Tool (black arrow) from the Editor toolbar and select the problematic segment on the map. The segment will be highlighted in light blue.



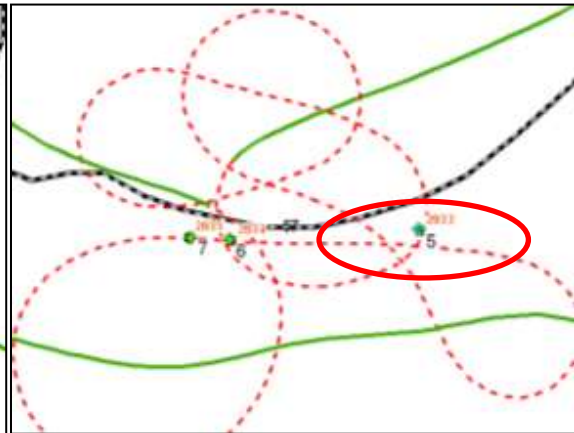
- Click the Edit Vertices tool from the Editor Toolbar. The segment will change from light blue to a series of green vertices that can be moved or deleted to adjust the segment to more accurately reflect the tracklog. To insert vertices, right click on a straight line portion of the iPad's .gdb tracklog segment and select Insert Vertex from the drop-down menu. You only need to edit the on-transect segments.
- 
- 6) If “observing” segments are missing (e.g., no GPS signal transmission) or if a portion of an “observing” segment needs to be re-digitized, you will use the Create Feature tool in ArcMap.
- The Create Feature window may be open on the right side of your ArcMap project window.
 - Double-click on iPad's .gdb tracklog within that window.
 - Use your cursor to trace the portion of the pilot's tracklog that corresponds to the missing portion of the “observing” segment. You only need to digitize the “observing” segments.

- d. Fill in the attributes table for those created segments. Having to do this is not ideal, but it is a way to salvage the data if the GPS loses contact with your iPad during a Park Observer session.
- 7) Examine each bear detection in the iPad's bear feature class.
- a. Compare the species identification, bear and/or den location and total count in the attribute table with the data sheet numbers.
 - b. Check the bear and/or den detections locations with the corresponding pilot's waypoint. The pilot's waypoint number should be on the data sheet. Most pilots take better waypoints for bear and/or den detections than observers can on the iPads (due to the lag). If necessary, move the bear group to the pilot's waypoint. Please see the Sheep example below and specifically sheep group 5.

BEFORE edits:



AFTER edits:



- c. You may have to edit or add bear or den detections information as well by moving or creating points in the iPad .gdb and/or by making edits in it. Be sure that the data sheet corresponds with the attribute table. Mark a simple line through any incorrect data on the datasheet and note the correction beside it.
- 8) Save all edits, close the Editing session and close the ArcMap project.
- 9) Repeat Steps 1-8 for each ArcMap project/geodatabase associated with the survey.
- *NOTE – On the last ArcMap project, be sure to **indicate those sampling units which were not flown** by any pilot-observer teams on the survey.**
- 10) Make sure all the geodatabase information is combined into one final geodatabase for the survey.
- a. Save the ArcMap project.

- 11) When possible, all changes to data will be documented in the edit log (within the comments field of the appropriate geodatabase component) and accompanied by an explanation that includes pre- and post-edit data descriptions. However, time constraints during the field survey period may preclude the Project Manager from entering edits in the electronic log. In these cases, edits should be made on hard copy data forms and later transferred to the electronic log. Allowable changes include those that improve or update the data formats while maintaining data integrity.

SOP 8.4. Importing Field Data to the Master Brown Bear Monitoring IRMA Data Store

Overview

Once field data collection operations cease and initial quality assurance procedures have been done the information is transferred to the ARCN Brown Bear IRMA Data Store. See SOP 8.8 for more details uploading deliverables into the IRMA Data Store for file based management. Please reference the “Product Archival, Seasonal Closeout and Dataset Certification Procedures for the Arctic and Central Alaska Inventory and Monitoring Networks” (Miller 2017) for more details on certifying final data sets and uploading them to the IRMA Data Store in a file-based management system for archival and public access purposes.

Importing Pilot/Observer Waypoints and Tracklogs

Waypoints and tracklogs are important data components that are captured during a survey by the pilot’s GPS units, and these are used in the QA/QC process of reviewing the iPad collected data that have been imported into the .gdb (e.g., ARCN_Bears_2017.gdb). The pilot’s waypoints are a larger set than those collected with the iPad and include bears seen out of the sampling unit, bears missed while “observing” (which may be incorporated into analysis in the future), and other wildlife observations. If there was a problem with the pilot’s tracklogs (or waypoints) then the observer’s should be used in QA/QC of the .gdb files. The section below covers the processing of pilot waypoints. The processing of waypoints and tracklogs captured by the Park Observer application, if required by the PI, are covered elsewhere (SOP 7).

This procedure assumes that the field data collection files have been produced, processed and organized on the Network file share. The pilot/observer waypoint files will consequently be available in the /Waypoints directory and the pilot and observer tracklogs in the /Tracklogs directory.

Importing Waypoints Using the WaypointsToSQL.py ArcTool Procedure

Use the Waypoints to SQL tool in ArcToolbox to convert the pilot’s waypoints into a script file of SQL insert queries.

Important note on duplicate waypoints: Unless a pilot clears their GPS on a daily basis waypoints will accumulate. Each day’s GPS export file will consequently be a partial duplicate of the one

exported the day before. The database has a unique constraint to disallow such duplicates but considerable time and effort can be saved by examining all the waypoint files for a particular pilot during a survey and determining if the last waypoints export file contains all the waypoints collected during a survey. If such is the case you may simply import the data from the latest waypoints file.

SOP 8.5 Final Quality Assurance/Control Procedures

Primary tools used for assuring the quality of Brown Bear monitoring data include manual data verification checks and data visualization checks. Analytical and statistical analyses will also reveal data quality deficiencies and should trigger another round of data quality assurance checks. Validation and quality control efforts should ideally be completed by mid-November for data from the previous summer's surveys. Once the data have been validated by a project manager, they can be certified and analyzed.

SOP 8.6 Data Preparation for Analysis

Analysis of the Brown Bear occupancy data relies on Bayesian modeling techniques and is detailed in Schmidt et al. (2017) and SOP 9. Validation is also an iterative process with analysis. If the estimates show anomalies or trends that do not make sense (basically following validation of analyzed data), the data will be re-verified, re-validated and re-analyzed. If results are reported from data that have not been fully validated (e.g., preliminary results before validation of the model estimates), a statement and explanation should be included to caution users regarding data quality. Program R and WinBUGS or OpenBUGS are the primary tools for analyzing the bear data. Formatted data used in analysis are organized in simple spreadsheets and can be produced from the full dataset spreadsheet.

SOP 8.7 Seasonal Close Out and Dataset Certification

Data certification is a benchmark in the monitoring project data life cycle that indicates that: a) the data are complete for the period of record; b) they have undergone and passed the quality assurance checks; and c) that they are appropriately documented and in a condition for archiving, posting and distribution as appropriate.

Seasonal close out is the best time to bring SOPs up to date and version their IRMA references if new data management tools or methods have been developed.

Procedure:

1. Verify the Brown Bear monitoring protocol and SOPs are all up to date and versioned in IRMA.
2. Verify QA/QC procedures have been performed to the satisfaction of the project leader.
3. Verify deliverables are documented and archived in IRMA with metadata (0).
4. Review data products and IRMA references for sensitive information and isolate them appropriately.

5. The Brown Bear monitoring program should have a single dataset reference in IRMA to which the latest certified snapshot of the monitoring database is attached. If this reference does not exist the PI or data manager should create it. Ensure it is tagged 'sensitive' and 'operations'. The PI and data manager fill out the reference's metadata.
 - a. The PI fills out a data certification form and signs it (Appendix C). This form is scanned and uploaded to the dataset IRMA reference above.
 - b. A human readable copy (SQL script) of the main sheep monitoring database is uploaded to the loon monitoring program's dataset reference and versioned. This copy is the certified database.

SOP 8.8 Archiving Field Deliverables in IRMA

Field data files should be archived on IRMA in a private Dataset reference with each deliverable from the data deliverables schedule (see narrative). Please reference the "Product Archival, Seasonal Closeout and Dataset Certification Procedures for the Arctic and Central Alaska Inventory and Monitoring Networks" (Miller 2017). for more details on certifying final data sets and uploading them to the IRMA Data Store in a file-based management system for archival and public access purposes.

Creating a Field Deliverables Dataset Reference in IRMA

1. Create a new IRMA Dataset Reference and title it informationally similar to '2017 Arctic Network Brown Bear Survey Dataset.'
2. Fill out as much metadata as possible.
3. **Ensure the Dataset is tagged as 'Sensitive' under the Information Resource Evaluation tab with the justification of 'Commercial Value.'** Also tick the 'Operations' justification as we don't want raw, unprocessed data available to the public (certified data will be available minus the sensitive data through the main Brown Bear

monitoring dataset in IRMA).

Step 2: Create a Generic Dataset (Required)

Core **Information Resource Evaluation** Units and Geographical Keywords Permissions

Sensitivity Evaluation

☐ Non-Sensitive ☒ Sensitive ☐ Unknown

If Sensitive, Check 1 or More

☒ Operations	☐ Archeological	☐ Endangered	☐ Security
☐ Personal Info	☐ Indian Sacred Sites	☐ Threatened	☒ Commercial Value
	☐ Wells	☐ Cultural	☐ Paleontological

4. Upload the data deliverables from the Deliverables Schedule above, one by one. Tag them with the date and deliverable ID in the filename and especially the holding description. An example would be “DS01: NPS.gdb (ESRI personal geodatabase, 10 mb)”

Upload New Files

Name	Status	Size	Progress
NPS.gdb.zip	Complete	10 MB	clear

Total: 1 10 MB of 10 MB

Select Files Upload Clear All Rows

1 File Uploaded

File Name: NPS.gdb.zip

Description: DS01: NPS.gdb (ESRI personal geodatabase, 10mb)

5. Remove all permissions except for the PI and data manager (to reduce the risk of accidental publication of sensitive data).
6. Activate the reference.

7. Note the ReferenceCode.
8. Open the main Brown Bear monitoring IRMA reference at:
<https://irma.nps.gov/DataStore/Reference/Profile/2210687>
9. Navigate to the Products section and click Manage Products.
10. The Manage Products form appears. Use the form's tools and the ReferenceCode noted above to search for, and link to the dataset created above.
11. Save and exit the Manage Products form.
12. Verify the dataset appears as a product of the main bear monitoring reference.
13. Activate the reference.
14. Enter the IRMA reference code into the Surveys table of the sheep monitoring database for the associated survey.

Your finished reference should be well documented, marked internal, active and sensitive and have a list of holdings that matches the list of data deliverables in the Brown Bear monitoring protocol narrative. Below is a screenshot of Figure SOP11-9 from ARCN sheep. The sheep example is incomplete, but shows how annual monitoring deliverables should be archived. Having everything listed in one place will simplify annual closeout and data certification. **Error! Reference source not found.** If done well the annual closeout procedure will be little more than a glance at this reference.

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Add Digital File | Add Child | View XML | Clone | Add To Collection

Edit Details | Change Type | Manage Link | Inactivate | Quarantine | Activate

Rattenbury K. 2015. 2011 Itkillik Preserve Dall's Sheep Survey Dataset. National Park Service Arctic Inventory and Monitoring Program. Fairbanks, AK. Generic Dataset-2222131.

Generic Dataset

Reference Code: 2222131

Reference Status as of 05/18/2015: Active

Visibility: Internal

Core Information

Holdings

Digital

DS08-SurveyDatasheets (pdf, 2mb)

Digital

DS01: NPS.gdb (ESRI personal geodatabase, 10mb)

Information Resource Evaluation

Sensitivity

Commercially Valuable - Park-specific, location-specific, and non-public information about a resource traded or sold in legal or illegal markets such that unauthorized removal of the resources from a potential of civil or criminal penalties.
Operations - Important to the internal business operations of the NPS

The dataset should contain as much metadata as possible, all the deliverables from the protocol's deliverables schedule, with metadata where needed, and tagged 'Sensitive' and 'Operations'

Link the Field Deliverables Reference as Product of the Master Sheep Monitoring Project Reference

The seasonal data deliverables Dataset references in the IRMA Data Store must be linked as a product of the master sheep monitoring Project reference in the IRMA Data Store. Please reference the “Product Archival, Seasonal Closeout and Dataset Certification Procedures for the Arctic and Central Alaska Inventory and Monitoring Networks” (Miller 2017). for more details on certifying final data sets and uploading them to the IRMA Data Store in a file-based management system for archival and public access purposes.

Procedure:

1. Using a browser, navigate to the seasonal deliverables Dataset reference created in the section above.
2. Record the reference's reference code.
3. Navigate to the main brown bear monitoring IRMA reference at (the example below is for Sheep): <https://irma.nps.gov/App/Reference/Profile/2216938>.
4. Ensure you have editing privileges.

5. Scroll to the Products section.
6. Click 'Manage Products'
7. Click 'Create New Link'.
8. Search for the reference to attach using the reference type and reference code from above.

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SD Miller

Link This Project to an Existing Reference (i.e., Bundle Products)

Search for a Reference of...

Type: Geospatial Dataset Search Text or Code: 2224484 Search Search Tips **New!**

Select a Reference to Link

☐	Code	Display Citation
☒	2224484	Rattenbury KL. 2015. 2011 Wrangell-St. Elias National Park Dall's Sheep Survey Data Deliverables. National Park Service Central Alaska Network Inventory and Monitorin...

Link Selected Done

Reference(s) linked successfully

9. Check the correct reference and click Link Selected.
10. Click Done and back out of the remaining forms.
11. Check that the deliverables Dataset exists as a product of the master Project reference.
12. The deliverables dataset reference should not appear on the Brown Bear monitoring web profile on the ARCN website because it was tagged 'Operations' and 'Sensitive.' Verify that it does not appear publicly at <https://science.nature.nps.gov/im/units/arcn/vitalsign.cfm?vsid=18>

SOP 8.9 Literature Cited

- Miller, S. D. 2017. Product archival, seasonal closeout and dataset certification procedures for the Arctic and Central Alaska Inventory and Monitoring Networks, DMSOP-1. Natural Resource Report NPS/ARCN-CAKN/NRR-2017/xxxx. National Park Service, Fairbanks, Alaska.
- Schmidt, J. H., K. L. Rattenbury, H. L. Robison, T. S. Gorn, and B. S. Shults. 2017. Using non-invasive mark-resight and sign occupancy surveys to monitor low-density brown bear populations across large landscapes. *Biological Conservation* 207(3):47-54.
- Walsh, P., J. Reynolds, G. Collins, B. Russell, M. Winfree, and J. Denton. 2010. Application of a double-observer aerial line-transect method to estimate brown bear population density in southwestern Alaska. *Journal of Fish and Wildlife Management* 1:47-58.

SOP 8.10 Appendix C: Dataset Certification Form

Please reference the “Product Archival, Seasonal Closeout and Dataset Certification Procedures for the Arctic and Central Alaska Inventory and Monitoring Networks” (Miller 2017). for more details on certifying final data sets and uploading them to the IRMA Data Store in a file-based management system for archival and public access purposes. Data certification is a benchmark in the project data life cycle that indicates that:

- The monitoring data are complete, up to date and ready for analysis and publication
- The data have passed quality assurance checks
- The data are appropriately documented
- All aspects of the monitoring program that generated the data, including the protocol, standard operating procedures and data management systems are in order, documented and up to date.

Certification is not intended to imply that the data are completely free of errors or inconsistencies which may or may not have been detected during quality assurance reviews. This certification form must be uploaded to the monitoring dataset’s IRMA reference in scanned pdf format.

Certification date:

Certified by:

Title: _____

Affiliation: _____

Project title:

Range of dates for certified data:

Description and scope of data being certified:

____ This certification refers to data in accompanying files. Check all that apply, and indicate file names to the right:

____ Database file(s): _____

_____ Spatial data file (s): _____

_____ Geodatabase file(s): _____

_____ Other (specify): _____

Is there any sensitive information in the certified data which may put resources at greater risk if released to the public (e.g., spotted owl nest sites, cave locations, rare plant locations)?

_____ No _____ Yes

Details: _____

9) Description of data processing, quality assurance measures, and results and summary of quality assurance reviews, including details on steps taken to rectify problems encountered during data processing and quality reviews.