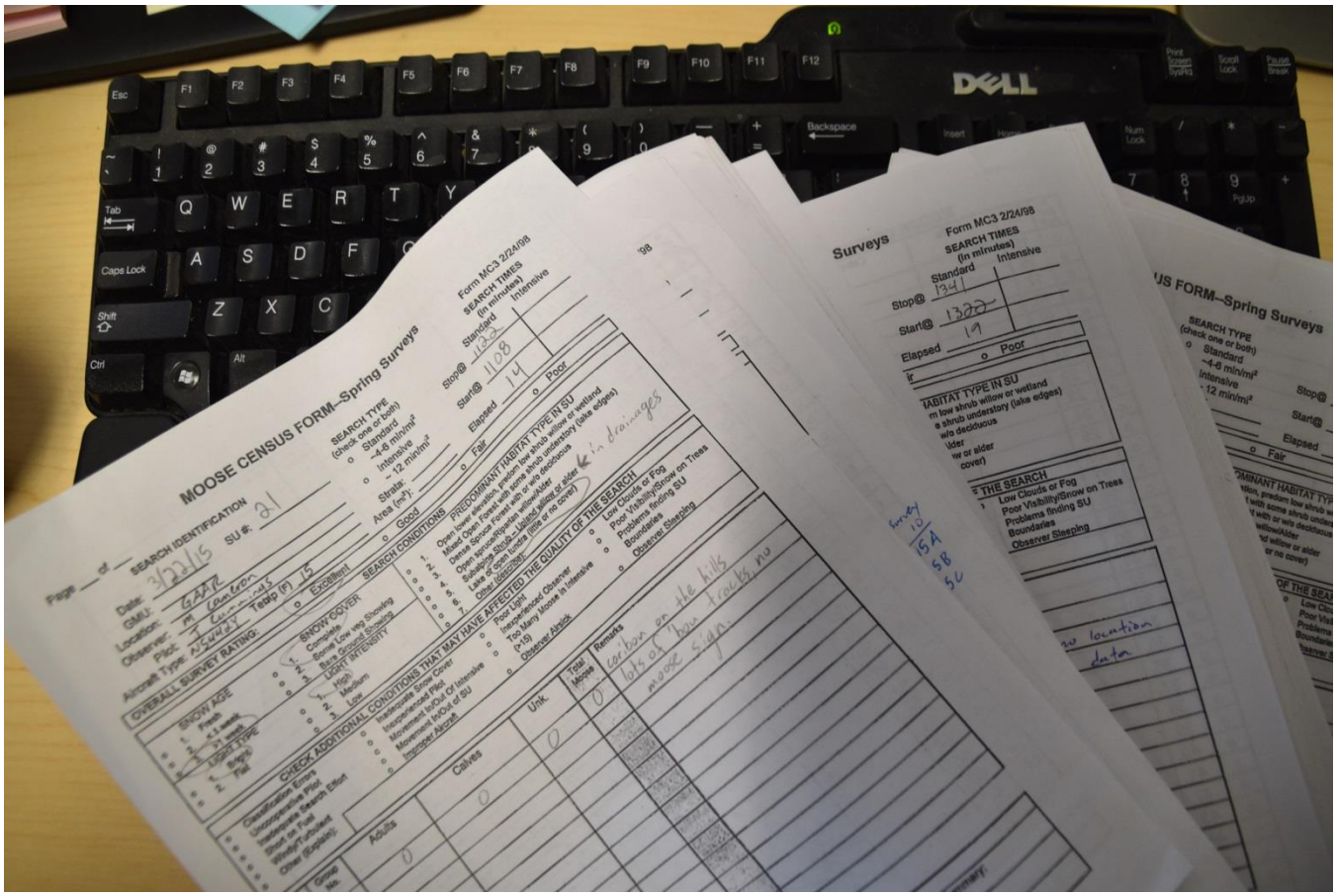
National Park Service
U.S. Department of the Interior

Natural Resource Stewardship and Science

Moose Monitoring Protocol for the Arctic Inventory and Monitoring Network

Standard Operating Procedure (SOP) # 4 Data Management



ON THE COVER
Running the numbers back at the office in Fairbanks.
NPS photograph by Matt Cameron.

Moose Monitoring Protocol for the Arctic Inventory and Monitoring Network

Standard Operating Procedure (SOP) # 4 Data Management

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National Park Service
Natural Resource Stewardship and Science

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Overview

This Standard Operating Procedure describes data management procedures for the Moose Monitoring Protocol for the Arctic Inventory and Monitoring Network (ARCN MMP). Data deliverables (Table 1) are created in the field during aerial moose abundance surveys, then saved on a field laptop and processed for quality. Data are uploaded to GSPE software and analyzed. After the survey campaign is complete the deliverables are copied to the moose monitoring network directory and the data are integrated with the master database. During closeout, the deliverables are documented, uploaded to the IRMA Data Store and the project leader certifies the dataset for analysis and publication (Figure 3, ARCN MMP).

The system architecture consists of a designated network directory for file storage, a client/server database, an enterprise digital asset management system (IRMA Data Store, Figure 1, ARCN MMP) and GSPE analytical software (ADFG).

Deliverables Schedule

The analytical goals of the moose monitoring protocol demand the repeated collection of specific data deliverables (Table 1). Specifications for these deliverables are described further in this SOP. Deliverable processing tasks follow a Builder-Validator-Certifier model. The Builder will collect or generate the deliverable, the Validator ensures the deliverable meets minimum standards and the Certifier authorizes the deliverable for integration with the master database and archival in the IRMA Data Store.

Table 1. Moose monitoring field data deliverables schedule.

Identifier	Deliverable	SOP	Version	Format	Schedule	Responsibility
M-01	Survey units	4	1.00	Shapefile and GeoJSON text file, with FGDC metadata.	Sample date +1 year	PI
M-02	Paper data collection forms	4	1.00	Hard copy	Sample date +1 year	PI
M-03	Scans of field data collection forms	4	1.00	PDF or Tag Image File Format (TIFF)	Sample date +1 year	PI
M-04	Field data collection results in digital CSV text file format	4	1.00	Text file of comma separated values	Sample date +1 year	PI
M-05	GPS waypoints	4	1.00	Shapefile and GeoJSON text file, with FGDC metadata.	Sample date +1 year	PI
M-06	GPS Tracklogs	4	1.00	Shapefile and GeoJSON text file, with FGDC metadata.	Sample date +1 year	PI

Deliverables Specifications

Deliverable M-01: Survey units

SOP: 4 Version: 1
Schedule: Sample date +1 year
Responsibility: PI

Description: The moose survey units deliverable consists of spatial layers describing survey unit polygons in both shapefile and human-readable text formats. Survey units are typically supplied by ADFG. The files should define the survey unit polygons and identifying attributes including stratification and randomized selection schema. The text file may be in GeoJSON or comma separated values with polygons described in Well Known Text (OGC 2013) format. Deliverable M-01 must be archived with valid FGDC metadata.

Format: Shapefile and GeoJSON text file, with FGDC metadata.

File naming scheme: Name the survey units file according to the following scheme: 'M-01_SurveyUnits_' followed by a description of the survey year and survey area and conservation units.

Archival plan: Each moose abundance and composition count survey campaign is documented in a unique Dataset reference in the NPS IRMA Data Store. Each deliverable in the moose monitoring protocol's data deliverables schedule is built, validated, certified and then uploaded as a holding to the Dataset reference. This Dataset reference is then linked as a product of the master moose monitoring Project reference (https://irma.nps.gov/App/Reference/Profile/2222140).

Quality control: Check the data visually, and/or with Python scripts s to assure the deliverable is complete.

Builder tasks: The Builder is responsible for generating the survey units shapefile according to the specifications of GSPE software. The files are copied into the moose survey's *\Data\M-01 Survey units* directory. Once the shapefile is generated, the builder will document it with FGDC metadata using the metadata tools in ArcGIS. The Builder validates the metadata. Once the units shapefile have passed validation checks the builder exports the shapefile to a GeoJSON text file using the arcpy.FeaturesToJSON_conversion tool. A sample script appears below:

```
import arcpy
import os
arcpy.FeaturesToJSON_conversion("C:/M-01_SurveyUnits.shp","C:/M-
01_SurveyUnits.json","FORMATTED")
```

See *http://pro.arcgis.com/en/pro-app/tool-reference/conversion/features-to-json.htm* for more information

Upon archival, the builder compresses the units shapefile into a single zip archive with an arbitrary filename that is prepended by 'M-01_SurveyUnits_'. The JSON file should be uploaded as a separate holding from the .zip archive, with a filename that is also prepended by 'M-01_SurveyUnits_'.

Validator tasks: Validator ensures the following:

- Deliverable M-01 is a shapefile of moose survey units and is documented with valid FGDC metadata.
- The deliverable is in WGS84 Geographic Coordinate System.
- The deliverable is compressed and the filename prepended with 'M-01-SurveyUnits'.
- Deliverable M-01 also contains the shapefile's contents in human-readable GeoJSON format with filename prepended with 'M-01-SurveyUnits' and with '.json' extension.

Certifier tasks: Certifier creates a new Dataset reference in the IRMA Data Store for the survey campaign's deliverables, if one has not been created already. The Certifier documents the Dataset reference and ensures the reference is tagged "internal" and the files restricted. The Certifier then uploads the deliverable files as Dataset holdings and removes permissions on the Dataset reference excepting the moose monitoring project leader, the Network data manager, and the Network program manager. The certifier then links the deliverables Dataset reference as a Product of the moose monitoring master Project reference.

Deliverable M-02: Paper data collection forms

SOP: 4 Version: 1
Schedule: Sample date +1 year
Responsibility: PI

Description: Hard copies of field data collection forms.

Format: Hard copy of paper data collection forms with a backup photocopy of each form.

Archival plan: The original paper data collection forms comprising deliverable M-02 are stored by the project leader in a fireproof safe. Photocopies are stored in a separate, off-site location at the discretion of the project leader.

Builder tasks: The Builder collects the paper data collection forms once data entry is finished and annotations are complete. The Builder then orders them by date and unit and then makes copies of each. Optionally a disk containing Deliverable M-03 (scans) could be included in the file folder holding the forms.

Validator tasks: Validator ensures the collection of paper data forms received from the Builder is complete and that a copy of each form exists and is legible.

Certifier tasks: Certifier must be the project leader. The project leader will file the paper data forms in his or her main duty station office and will ensure the backup photocopies are filed in an off-site location.

Deliverable M-03: Scans of field data collection forms

SOP: 4 Version: 1
Schedule: Sample date +1 year
Responsibility: PI

Description: Scans of field data collection forms in Portable Document Format (PDF) file format. All scans should be combined into a single document. Photographs in Tag Image File Format (TIFF) are also acceptable if a scanner is not available. TIFFs should be zipped into a compressed file archive.

Format: PDF or Tag Image File Format (TIFF)

File naming scheme: Files prepended with 'M-03_ScannedDataForms_' and then arbitrary descriptive information. Example: 'M-03_ScannedDataForms_2016NOATMooseFallAbundanceSurvey.pdf'.

Archival plan: Each moose abundance survey campaign is documented in a unique Dataset reference in the NPS IRMA Data Store. Each deliverable in the moose monitoring protocol's data deliverables schedule is built, validated, certified and then uploaded as a holding to the project's Dataset reference. This Dataset reference is then linked as a product of the master moose monitoring Project reference (https://irma.nps.gov/App/Reference/Profile/2222140).

Builder tasks: The Builder assembles the field data collection forms, orders them by unit and then scans them into a single PDF file. The files are copied into the moose survey's directory [*\Data\M-03 Scanned data forms*].

Validator tasks: The Validator ensures it is complete and legible and in the proper format and directory before notifying the Certifier.

Certifier tasks: Certifier creates a new Dataset reference in the IRMA Data Store for the survey campaign's deliverables, if one has not been created already. The Certifier documents the Dataset reference and ensures the reference is tagged "internal" and the files restricted. The Certifier then uploads the deliverable files as Dataset holdings and removes permissions on the Dataset reference excepting the moose monitoring project leader, the Network data manager, and the Network program manager. The certifier then links the deliverables Dataset reference as a Product of the moose monitoring master Project reference.

Deliverable M-04: Survey results in digital CSV text file format

SOP: 4 Version: 1
Schedule: Sample date +1 year
Responsibility: PI

Description: Field data collection results in digital CSV text file format with metadata describing the columns and units. Deliverable M-04 will usually be a text file version of the field database or spreadsheet used as input to GSPE software.

Format: Text file of comma separated values.

File naming scheme: Deliverable M-04 should be named according to the following scheme: 'M-04_SurveyResults_' followed by an arbitrary description of the survey year and survey area and any other pertinent information.

Archival plan: Each moose abundance survey campaign is documented in a unique Dataset reference in the NPS IRMA Data Store. Each deliverable in the moose monitoring protocol's data deliverables schedule is built, validated, certified and then uploaded as a holding to the project's Dataset reference. This Dataset reference is then linked as a product of the master moose monitoring Project reference (https://irma.nps.gov/App/Reference/Profile/2222140).

Builder tasks: Deliverable M-04 will usually be built in the field using Microsoft Excel or Access with the intent of uploading it to GSPE software. The files are copied into the moose survey's*\Data\M-04 Survey data* directory. The Builder performs quality control procedures on the deliverable to ensure that it has no errors and accurately reflects what was recorded on the field data collection forms (Deliverable M-02). The Builder performs column and row summing cross-checks and compares them to the same sums on the paper data forms in order to spotlight possible errors. The Builder then documents the spreadsheet with metadata and exports the data to a comma separated values (CSV) text file format and names it the same as above but with a

.csv extension. Tabular metadata may be built using Morpho software (KNB, 2016) or similar tool.

Validator tasks: The Validator ensures deliverable M-04 is complete, is in human readable CSV format and documented with metadata. Data verification (summing the total moose seen in a unit and the totals for each age and sex class) is done in the airplane on the data sheet and again when the data are entered into the database. The abundance survey datasheet is designed to keep track of the number and composition (adult:calf ratio) of moose seen and the location of moose groups. A separate datasheet is used for each sample unit. The datasheet has a total column for each group of moose seen and a total row at the bottom to sum each sex and age category/column. This design allows error checking by verifying that the grand sum of columns is the same as the grand sum of rows. If the two totals are not the same, a data entry or addition error has been made. The addition errors are not much of a problem because the data analysis software does this same addition, but the calculation of total moose seen in a unit helps ensure that the data entry is correct. When errors are found, they are corrected on the datasheets as well as in the database.

Certifier tasks: Certifier creates a new Dataset reference in the IRMA Data Store for the survey campaign's deliverables, if one has not been created already. The Certifier documents the Dataset reference and ensures the reference is tagged "internal" and the files restricted. The Certifier then uploads the deliverable files as Dataset holdings and removes permissions on the Dataset reference excepting the moose monitoring project leader, the Network data manager, and the Network program manager.. The certifier then links the deliverables Dataset reference as a Product of the moose monitoring master Project reference.

Deliverable M-05: GPS waypoints

SOP: 4 Version: 1
Schedule: Sample date +1 year
Responsibility: PI

Description: Shapefiles and comma separated values text files of GPS waypoints collected during a moose survey.

Format: Shapefile (DNRGPS standard export format) and GeoJSON text file, with FGDC metadata. Waypoint shapefiles must be exported in the standard format output from DNRGPS software (see DNRGPS documentation) and WGS84 Geographic Coordinate System to facilitate integration with the master moose monitoring database using scripts.

File naming scheme: Files are prepended with 'M-05_Waypoints_' and then the survey date in yyyy-mm-dd format and then the aircraft tail number. Example: 'M-05-Waypoints_2015-10-01_N6789.shp'.

Archival plan: Each moose abundance survey campaign is documented in a unique Dataset reference in the NPS IRMA Data Store. Each deliverable in the moose monitoring protocol's data deliverables schedule is built, validated, certified and then uploaded as a holding to the

campaign's Dataset reference. This Dataset reference is then linked as a product of the master moose monitoring Project reference (https://irma.nps.gov/App/Reference/Profile/2222140).

Builder tasks: The Builder downloads each crew's GPS unit(s) using DNRGPS software and exports the waypoints in WGS84 Geographic Coordinate System to a shapefile. The builder then builds FGDC metadata and saves the files in the moose survey's *\Data\M-05 GPS waypoints* directory. Comma separated values (CSV) text files are created for each shapefile and named the same as the shapefile but with a .csv extension. Once the survey is complete the Builder moves all the files into a compressed file archive and prepends the filename with 'M-05_Waypoints_' and the survey date in yyyy-mm-dd format.

Validator tasks: Validator ensures the following:

- A shapefile of waypoints and text file equivalent exists for each survey-day crew.
- Spatial coordinates are in WGS1984 Geographic Coordinate System (lat./lon.)
- FGDC metadata exists for each waypoint file.
- Irrelevant waypoints have been deleted.
- Files are named correctly.
- Files are archived correctly.

Certifier tasks: Certifier creates a new Dataset reference in the IRMA Data Store for the survey campaign's deliverables, if one has not been created already. The Certifier documents the Dataset reference and ensures the reference is tagged Internal and the files restricted. The Certifier then uploads the deliverable files as Dataset holdings and removes permissions on the Dataset reference excepting the moose monitoring project leader, the Network data manager, and the Network program manager. The certifier then links the deliverables Dataset reference as a Product of the moose monitoring master Project reference.

Deliverable M-06: GPS Tracklogs

SOP: 4 Version: 1
Schedule: Sample date +1 year
Responsibility: PI

Description: Shapefiles and comma separated values text files of flight tracklogs collected with a GPS during a moose survey.

Format: Shapefile and GeoJSON text file, with FGDC metadata. Shapefiles must be in the standard format as exported from DNRGPS software to facilitate integration with the master moose monitoring database.

File naming scheme: Files prepended with 'M-06_Tracklog_' and then the date in yyyy-mm-dd format and then the aircraft tail number. Example: 'M-06-Tracklog_2015-10-01_N6789.shp'.

Archival plan: Each moose abundance survey campaign is documented in a unique Dataset reference in the NPS IRMA Data Store. Each deliverable in the moose monitoring protocol's data deliverables schedule is built, validated, certified and then uploaded as a holding to the

campaign's Dataset reference. This Dataset reference is then linked as a product of the master moose monitoring Project reference (https://irma.nps.gov/App/Reference/Profile/2222140).

Builder tasks: The Builder downloads each crew's GPS unit(s) using DNRGPS software and exports the tracklog in WGS84 Geographic Coordinate System to an appropriately named shapefile. The exported files are copied into the moose survey's field or network directory in a folder prepended with 'M-06_Tracklogs'. Comma separated values (CSV) text files are created for each shapefile and named the same as the shapefile but with a .csv extension. Once the survey is complete the Builder moves all the files into a compressed file archive and prepends the filename with 'M-06_Tracklog' and the survey's last day in yyyy-mm-dd format.

Validator tasks: Validator ensures the following:

- A shapefile of tracklogs and text file equivalent exists for each survey-day crew.
- Spatial coordinates are in WGS84 Geographic Coordinate System
- FGDC metadata exists for each file.
- Irrelevant data have been deleted.
- Files are named correctly.
- Files are archived correctly.

Certifier tasks Certifier creates a new Dataset reference in the IRMA Data Store for the survey campaign's deliverables, if one has not been created already. The Certifier documents the Dataset reference and ensures the reference is tagged Internal and the files restricted. The Certifier then uploads the deliverable files as Dataset holdings and removes permissions on the Dataset reference excepting the moose monitoring project leader, the Network data manager, and the Network program manager.. The certifier then links the deliverables Dataset reference as a Product of the moose monitoring master Project reference.

Field Data Deliverables Handling

Field data files should be downloaded, organized and backed-up daily at each survey's base station using a designated field laptop and one or more external storage drives for backup (Figure 1). On the first day of the survey campaign the project leader designates a primary field data deliverables manager whose job is to oversee daily file management activities such as downloading GPS units, collecting paper data forms and organizing them on the field laptop. A backup field data manager is responsible for making sure deliverable files are copied and backed up daily to one or more external storage drives. The backup manager also ensures that the backup drives are stored securely and separately from the field laptop and originals.

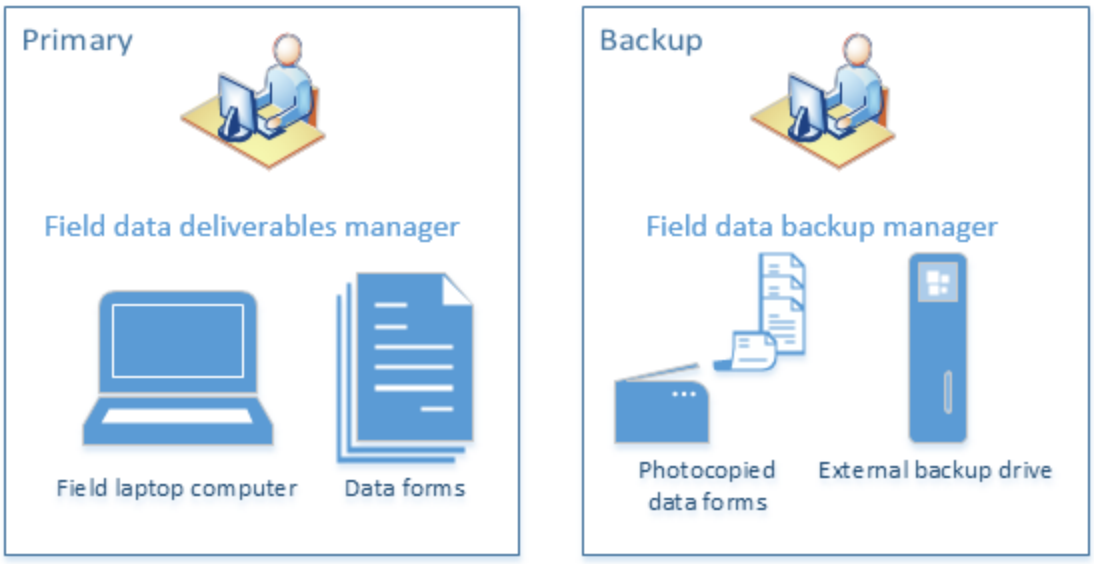


Figure 1. Field data management tasks and roles. The project leader designates two separate people to fill the roles of primary and backup field data deliverables managers. These two people are responsible for safeguarding and securing field data deliverables on a daily basis.

Meticulously organizing and naming deliverables on the field laptop is important. Data processing scripts and software tools automatically extract information from files and rely on data deliverables being in specific formats and locations. If the data on the field laptop is well curated then permanent archival is relatively straightforward without a great deal of time spent on reorganizing and identifying inconsistent methods. Following file naming and organizational specifications has the added benefit of causing inconsistencies to jump out at the eye revealing problems in the field where the possibility of remedy still exists.

Initial Setup (Day 1)

At the beginning of the moose survey, create a top-level directory on the field laptop (Figure 2). Create a *Data* subdirectory and another subdirectory for each data deliverable (M-01 through M-06, See *Data Deliverables Schedule*, Figure 2). Label them according to the data deliverables schedule found in the protocol narrative.

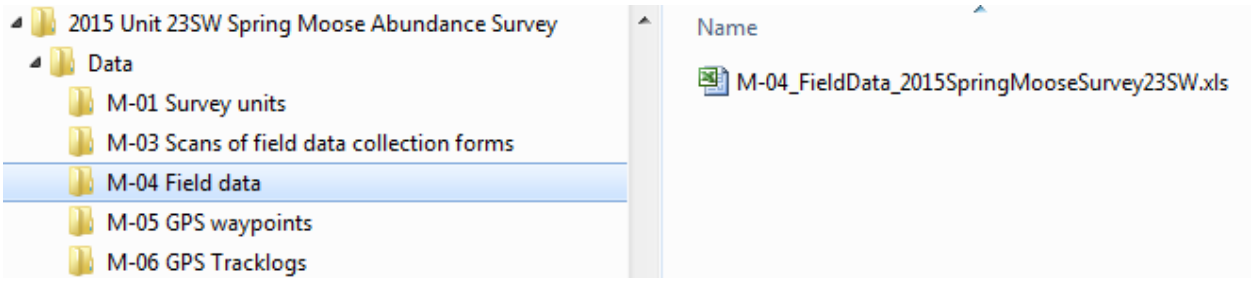


Figure 2. Example of typical moose survey directory structure (Deliverable M-02 consists of paper data forms and therefore does not have a directory).

The *Data* directory is strictly for deliverables and final certified datasets. Create other directories as needed above \Data for planning, correspondence and other files.

Procedure (Day 1)

1. Designate roles
    a. Designate a single person to be primary field data deliverables manager.
    b. Designate a backup data deliverables manager.
2. Designate hardware
    a. Designate a single field laptop as the authoritative repository for all data files for the remainder of the survey.
    b. Designate an external drive as the authoritative backup repository for field data files.
3. Create survey directory structure
    a. Create a survey campaign master directory on the field laptop and label it informatively. An example is *'2006 Upper Kobuk Spring Moose Abundance Survey'*.
    b. Create a */Data* subdirectory below the main directory created above. All daily deliverables will be stored in the */Data* directory. Create a directory for each deliverable in the deliverables schedule. Example: *\MainDirectory\Data\M-04 Survey data*.

Table 2 Table 2 contains a windows batch file script to that will automatically create the deliverables directories.

Table 2. Windows batch file script to create deliverable directories.

```
REM Windows batch file script to create moose monitoring field data
REM deliverables directories
REM Execute in the field survey's \Data directory using a command
REM prompt or batch (.bat) file
mkdir  ".\M-01 Survey units"
mkdir  ".\M-03 Scans of field data collection forms"
mkdir  ".\M-04 Survey data"
mkdir  ".\M-05 GPS waypoints"
mkdir  ".\M-06 GPS Tracklogs"
```

<u>Daily field data deliverables procedure</u>
Once the field laptop is configured and the main survey directories created the daily data deliverables can be processed and stored.

Procedure (Primary field data manager or delegate)

1. Build the deliverables *(see Deliverables Specifications)*:
    a. M-02 (Field data collection forms):
        i. Gather the field data sheets and organize by unit and strata.
        ii. Check the data collection forms for legibility and completeness and organize them by stratum and unit number.
        iii. Mark corrections on copied data sheets with red pen. Any corrected errors, or changes made by the data "proofer" (to be entered differently into the database than they appeared on the original data sheet) should be circled

and corrected using a red fine-point Sharpie marker. Notes, in red ink, should be written on the margins or in the comments section whenever necessary to document the reason for the corrections.

b. M-04 (Field data spreadsheet):
    i. Enter the data from the corrected field data collection forms into the field data spreadsheet.
    ii. Perform data validation checks including visual checks and cross-summing. Correct errors and update the data sheets if any errors are found.
    iii. Copy the spreadsheet into the *\M-04 Survey data* directory.
    iv. Analyze using GSPE, if required
c. M-05 and M-06 (Waypoints and tracklogs)
    i. Download waypoints and tracklogs and convert to shapefiles using DNRGPS software. Ensure they are in WGS1984 Geographic Coordinate System. Remove extraneous waypoints.
    ii. Rename and save the files according to the deliverable specifications.

2. Deliver the data collection forms to the backup field data manager to photocopy and/or photograph.
3. Secure the field laptop in a safe location.
4. Retrieve the paper data collection forms and secure them with the field laptop.

Procedure (Backup field data manager)

1. Build deliverable M-03 (scans of data collection forms) by scanning the field data sheets and copy the resulting files to *\Data\ M-03 Scans of field data collection forms* (If a scanner is not available, or as an extra precaution, photograph the field data sheets).
2. Verify there is a legible scan for each data form.
3. Photocopy (or photograph) the data forms.
4. Return the original data forms to the primary field data manager.
5. Reconcile each of the remaining field data deliverables by checking physical and digital files against the deliverables schedule and specifications and the master survey directory.
6. Back up the main survey directory on the laptop to the backup device.
7. Store the backup device in a safe location separate from the field laptop.

Daily analysis

The field database is used as the input file to GSPE for the final analysis of the survey data (Ver Hoef 2000) as well as for the master moose monitoring database. Currently, GSPE may only be accessed and run via ADFG's "Winfonet" website (*http://winfonet.alaska.gov*). If internet is available, the data should be run through GSPE to get a daily population estimate and confidence interval to help determine when sufficient data has been collected.

Office Deliverables Handling

If the field data management procedures are followed then the field data deliverables will arrive in the office organized and in good order for integration with the main moose monitoring database.

Procedure

1. Copy the master survey directory from the field laptop to the *\Data* subdirectory of the master ARCN moose monitoring directory.
2. Archive the paper data collection forms in the fireproof safe designated by the project leader.
3. Integrate the field data deliverables with the master moose monitoring SQL Server database. Because the tools, applications and software used to process and integrate deliverables with the master database constantly change they are stored in a GitHub code repository at https://github.com/NPS-ARCN-CAKN/ARCN-Moose). The tools and documentation are immediately available for download; no account or knowledge of GitHub is required.
4. Validate the deliverables and reconcile the field data with the database.
5. Before the final analysis can be done the project leader must certify the dataset. Certification involves isolating working database records from finished records and publishing the releasable portions to the IRMA Data Store (see the section on sensitive data above, and on certification below). Analysis and reporting may only be done on certified data and releasable portions of such data must be published with metadata in tandem with any report or journal article (NPS 2016).
6. Certified data suitable for importing into GSPE for analysis is available from the ARCN_Moose database as an exportable view (query). Export the data from the view to an Excel or CSV text file.

Quality Control

Quality control procedures include:

- Cross-summing data sheet values with database query results.
- Examining the data and data transcription accuracy by eye.
- Performing preliminary data analyses and investigating unexpected results.
- Running database quality reports and stored procedures that interrogate the records for logical consistency and consistency with business rules. The moose monitoring database has a stored procedure called DBQualityReport that provides an exhaustive report on database quality. Run the report and fix or document errors until the results are acceptable. A copy should then be signed by the project leader and included as a PDF with the latest certified database snapshot in the IRMA Data Store.

Data Analysis

GSPE software is used for the final analysis using a geo-spatial analysis routine (Ver Hoef 2000, 2001, 2002, Delong 2006). GSPE software may only be used via ADFG's website (see above) and a username and password are required. This free service is administered through Rob Delong (ADFG 2015). Once access has been granted users can upload their own files onto the website and run the analysis. An example file can be found in the 'Supplemental materials' folder on the ARCN drive: *ExampleDataFileGeoSpatialAnalysis.xls*. See GSPE documentation (Kellie and Delong 2006) for analytical procedures.

Closeout and Certification

Field Data Deliverables

Closeout will happen annually. Field deliverables are organized, documented and uploaded to "private" Dataset references in the IRMA Data Store (Figure 3). These Dataset references are then linked to the master moose monitoring Project reference as a product. See the deliverables specifications section for details.

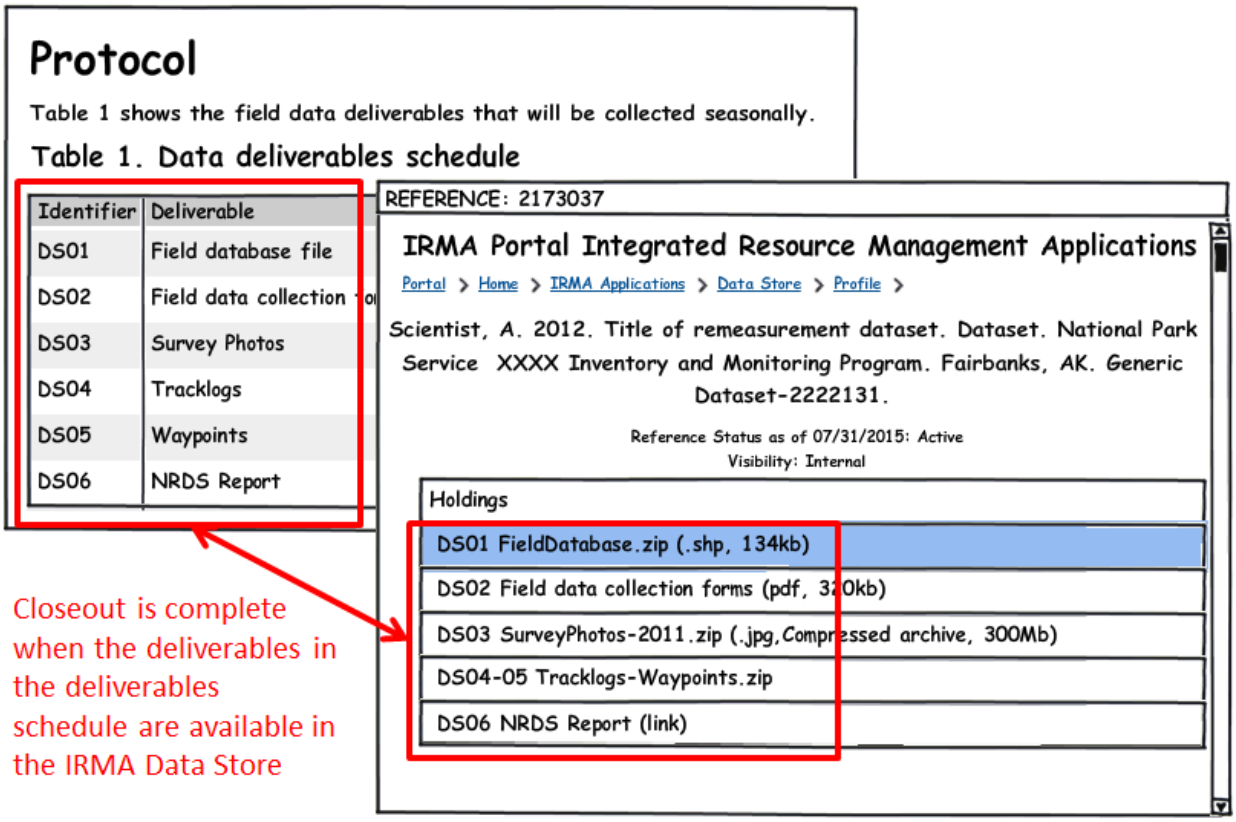


Figure 3. Closeout is complete when the deliverables in the protocol's deliverables schedule are available in the IRMA Data Store (Note: example deliverables are shown, not actual moose monitoring deliverables).

Certified Database Snapshot

A database snapshot, in human readable text format and with metadata and a certification and data quality report signed by the project leader is published to the moose monitoring certified Dataset reference seasonally. The old snapshot file is deprecated.

Database Administration and File Management

This section of the SOP addresses administration of all data and electronic files relating to the Moose Monitoring Protocol. The data management procedures common to all monitoring protocols implemented by the ARCN monitoring program are outlined in the Network Data Management Plan (NPS 2008).

Data Maintenance

Working files are stored in the moose monitoring directory on the ARCN shared drive. Finished and/or certified products such as field data deliverables, reports and master database snapshots are documented and uploaded to the IRMA Data Store as archives. Any editing of archived data is accomplished jointly by the Project Leader and Data Manager. Every change must be documented in an edit log and accompanied by an explanation that includes pre- and post-edit data descriptions. All data collected using this protocol is subject to the following two caveats: 1) only make changes that improve or update the data while maintaining data integrity, 2) once archived, document any changes made to the data set.

Version Control.

The master moose monitoring database may be accessed by numerous software front end applications such as Microsoft Access, ESRI ArcGIS, R, and most similar software packages. Permissions, security and backups are managed by the Network data manager. Applications, scripts and tools are versioned using Git. The moose monitoring Git repository is at https://github.com/NPS-ARCN-CAKN/ARCN-Moose. This repository will always have the most up to date applications and tools for download.

Backups

Database and file backups are made on a rotating schedule by FAC IT and I&M data management staff. Backup tapes are secured to offsite locations.

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