Data Management Plan

Name of Contractor: University of Wyoming, Wyoming Migration Initiative
Name of the Project: Investigating Potential Solutions to the Barrier Effect of Interstate 80 on Pronghorn Movements
Project Duration: Start Date: 02/21/2018   End Date: 03/31/2021
DMP Version: V2
Date Amended, if any: January 14th, 2021
Name of all authors, and ORCID number for each:

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WYDOT Project Number: RS08218

- **Dataset URL, if available:**
  https://www.movebank.org/
    Wyoming Interstate-80 Pronghorn; Movebank ID 1397659471
  https://migrationinitiative.org/dataviewer

What constitutes data will be determined by the Principle Investigator, Project Champion, and the Research Manager. In general, your plan should address final research data. This includes recorded factual material commonly accepted in the scientific community as necessary to validate research findings. Final research data do not include laboratory notebooks, partial datasets, preliminary analyses, drafts of scientific papers, plans for future research, peer review reports, communications with colleagues, or physical objects, such as gels or laboratory specimens. As part of your research, you may also generate unique data, which are data that cannot be readily replicated. Your DMP should also address unique data that may arise from your research.

WYDOT expects the timely release and sharing of data to be no later than the acceptance for publication of the main findings from the final dataset, unless the Principle Investigator will be embargoing the data. In such a case, the data cannot be embargoed for a period longer than 12 months. See Chapter 11 for information on retention and embargos.

1.   Introduction

The purpose of this research project is to:

Interstate 80 is a barrier to the movements of pronghorn and mule deer due to the right-of-way and game-proof fencing and high traffic load. Such barriers can impede the facility of pronghorn and mule deer to access habitats that would otherwise be available to them. Limiting such movements can have severe long-term repercussions on populations, particularly in the winter when migratory ungulates need access to novel habitats free of snow. Previous studies have indicated that pronghorn, in particular, are highly affected by this movement barrier. We studied the movement barrier of pronghorn (*Antilocapra americana*) and the effects of Interstate-80 on pronghorn. Likewise, we monitored movements of pronghorn and mule deer (*Odocoileus hemionus*), and other large ungulates at selected underpasses along Interstate 80.

Our research looks at the movement behavior of pronghorn relative to Interstate 80. Given this information, we aim to inform potential locations that would be optimal as mitigation of this barrier either through wildlife overpasses or underpasses. Our research objectives are the following:
1. Use GPS-collars to collect a baseline understanding of the movements of pronghorn along Interstate 80 between Evanston, Wyoming and Table Rock, Wyoming. Particularly in the areas east and west of Rock Springs, there remain critical gaps of knowledge in regards to how pronghorn in these areas are affected by the interstate. We identified pronghorn migrations from this dataset to identify locations most similar to migration corridors to retroactively inform the most productive sites for a wildlife crossing structure. t
2. Use camera traps within underpasses along Interstate 80 to identify where movement under the interstate may already be occurring. To further fill gaps in our knowledge, we aim to identify where movement under the interstate may already be occurring through the use of interchanges and underpasses. Doing this will let us identify locations that could be retrofitted to further improve movement across Interstate 80.

2.   **Definitions**

   a.   Code or scripts include code used in the collection, manipulation, processing, analysis or visualization of data, but may also include software developed for other purposes.
   b.   Copyright is a set of legal rights extended to copyright owners that govern such activities as reproducing, distributing, adapting, or exhibiting original works fixed in tangible forms.
   c.   Data means the recorded factual material commonly accepted in the scientific community as necessary to validate research findings, but not any of the following: preliminary analyses, drafts of scientific papers, plans for future research, peer reviews, communications with colleagues. Recorded material

excludes physical objects (e.g. laboratory samples). Research data also does not include trade secrets, commercial information, materials necessary to be held confidential; and personnel and medical information and similar information the disclosure of which would constitute a clearly unwarranted invasion of personal privacy.

d. Data Archive is a site where machine-readable materials are stored, preserved or possibly redistributed to individuals interested in the materials.

e. Data Management Plan is a document that specifies your plans for managing your data and files for a research project.

f. Dataset means collection of data.

g. Metadata refers to structured data about data that helps define administrative, technical, or structural characteristics of the digital content.

3. Data Types and Storage

The types of data and/or datasets generated and/or used in this project include …

A. GPS-Collar data. These GPS-collar data include the movements of n = 89 pronghorn, collared either March of 2017 or 2018 and tracked until natural mortality or programmed drop-off of the collar. These data are stored in comma-separated value files and will be made available through the Wyoming Migration Initiative's Migration Viewer (https://migrationinitiative.org/dataviewer). Additionally, these data and associated metadata (collar serial number, animal id, date of collaring, etc) are privately stored on the server MoveBank (https://www.movebank.org/). These data are stored under the project name "Wyoming Interstate-80 Pronghorn". Contact information is publicly available, but data are restricted to view only for collaborators. Therefore we have multiple backups for GPS-collars. Processing and visualizing these data is easiest through program R, however options exist to process through ArcGIS, QGIS, or other geographic information systems. Original hard GPS data will be stored as one spreadsheet with all animal ids and each location recorded for every collar. Every collar was programmed to collect a location every 1–2 hours from activation until drop-off or mortality.
Available collar data will continue to change as we collect more collars. As of January, 2021 there remain n = 6 active collars still on pronghorn, which we will collect either when collars drop-off (March 2021) or after natural mortality.

B. Camera trap pictures and data. We have collected nearly two years of camera trap pictures. These pictures are stored as .jpegs. We have backed up these pictures using Google Drive through the Wyoming Cooperative Fish and Wildlife Research Unit and through a University of Wyoming server.
Pictures are also stored on local disk space and an external hard drive as backups.
The results of our classifications of camera trap pictures are two shapefiles: "UnderpassCountsWYDOTwithBoxes_Autumn2018" and "UnderpassCountsWYDOTwithBoxes_Spring2019" which have the summarized

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counts of pronghorn and mule deer use through each of the 23 (autumn) or 24 (spring) underpasses we monitored.

Likewise, the results of our classifications used to make the summary tables are stored in two separate files: "PicClassificationDecember_2018.csv" and "PicClassificationJune_2019.csv". These two spreadsheets include the classifications of each camera monitored (23 in the autumn, 24 in the spring) between October and December 2018 and March and June 2019. Each picture is at least one row in the spreadsheet, with additional rows for each individual animal (ignoring small mammals such as rabbits) within the picture. Associated metadata will be included with the spreadsheets explaining the classifications and how data were stored in these spreadsheets.

At the project's end, we will store all pictures as well as their associated metadata and summary tables onto an external hard drive to share with Wyoming Department of Transportation.

C. Results of analysis. Our analysis included predictive maps and models from our research. We stored all of these data (raster images, figures, R statistical models, etc) onto an external hard drive along with their metadata and R scripts to share with Wyoming Department of Transportation. Analyses are completed.

Provide a description of the data that you will be gathering in the course of your project. You should address the nature, scope, and scale of the data that will be collected. Describe the characteristics of the data, their relationship to other data, and provide sufficient detail so that reviewers will understand any disclosure risks that may apply. Discuss value of the data over the long-term. Please provide the name of all repositories where the data will be housed during the lifetime of the project.

Checklist
- What type of data will be produced?
- How will data be collected? In what formats?
- How will the data collection be documented?
- Will it be reproducible? What would happen if it got lost or became unusable later?
- How much data will it be, and at what growth rate? How often will it change?
- Are there tools or software needed to create/process/visualize the data?
- Will you use pre-existing data? From where?
- Storage and backup strategy?

4.   Data Organization, Documentation, and Metadata

The plan for organizing, documenting, and using descriptive metadata to assure quality control and reproducibility of these data include …

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A. GPS-collar metadata. These metadata include descriptions for animal identification number, serial number of collar, very-high frequency telemetry frequency, collar model, programmed drop-off date, date pronghorn was released, date of mortality, programmed mortality period (how long the animal has to be inactive before a mortality alert), capture number, tag color and number (if any), herd unit, whether or not the collar has been retrieved (0, no and 1, yes), and further comments including whether the collar was dropped off ('Dropped'). GPS-collar dataset includes the full dataset of locations pre-cleaning, as well as a 'flag' column which identifies erroneous points (where 0 means a 'clean' point and 1 means a point collected prior to captures, after mortality, bad GPS fixes from low satellite count, etc). Thus, while the hard data is available the GPS collar data can also be easily cleaned by removing any point with flag = 1. Date and time columns in the GPS collar data are stored as Greenwich Mean Time Zone (GMT). Data on external hard drives will include a "Read_Me.txt" file to describe metadata of GPS data and the meaning of each column.

B. Camera metadata. All pictures are stored within folders identifying the camera they were collected from. These are then stored in folders identifying the date that the camera pictures were collected (e.g., December 2019 has pictures up to December). Camera metadata includes the unique filename of each camera picture, what camera they came from, and how they were classified. Additionally, camera metadata includes the name given to each camera, the underpass and mile marker where they were placed, where and how the camera was placed along Interstate 80, the coordinates of the underpass, and notes. Data on external hard drives will include a "Read_Me.txt" file to describe metadata of summary tables from camera classifications and the meaning of each column.

C. Results of analysis. We plan to include "Read_Me.txt" files to describe the results of our analysis, how to interpret them, and how to use the R scripts used to produce the results. File naming standards will include the date of when the file was produced. All R scripts include the date that they were last edited.

All data are managed by graduate student Benjamin Robb (institutional contact brobb1@uwyo.edu , non-institution contact benjaminsrobb@gmail.com) with backups/external links available to all collaborators. With the exception of publication quality maps (which will use ArcMap), all analysis will be carried out in the open-source environment program R.

Your DMP should describe the anticipated formats that your data and related files will use. To the maximum extent practicable, and in accordance with generally accepted practices in your field, your DMP should address how you will use platform-independent and non-proprietary formats to ensure maximum utility of the data in the future. If you are unable to use platform-independent and non-proprietary formats, you should specify the standards and formats that will be used and the rationale for using those standards and formats.

NOTE: Attach the Metadata Schema, URL for data generated, and all peer reviewed publications from this project.

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Checklist
- What standards will be used for documentation and metadata?
- Is there good project and data documentation format/standard?
- What directory and file naming convention will be used?
- What project and data identifiers will be assigned?
- Is there a community standard for metadata sharing/integration?

5.   Data and/or Database Access and Intellectual Property
What access and ownership concerns are there…

A. GPS-collars. These data are overseen by the principal investigator Matthew Kauffman and the Wyoming Migration Initiative. Contact for these data is graduate student Benjamin Robb. These data are publicly viewable (not accessible) through the Migration Viewer, which allows visualizing the data through a web server. Collaborators can access these data through permission on MoveBank. These data are secure. There are no special privacy requirements for these data and no embargo periods.

B. Camera pictures. These data are overseen by the principal investigator Matthew Kauffman and the Wyoming Migration Initiative. Contact for these data is graduate student Benjamin Robb. Individual pictures can be accessed through Google Drive with permission granted to collaborators. Metadata and summary data can be accessed as a .csv and .xlsx spreadsheet. There are no special privacy requirements for these data and no embargo periods.

C. Results of analysis. These results will be amended as analysis continues. They will be made available to publication when our results are published. These data are overseen by the principal investigator Matthew Kauffman and the Wyoming Migration Initiative. Contact for these data is graduate student Benjamin Robb. There will be no special privacy requirements and no embargo periods.

Protecting research participants and guarding against the disclosure of identities and/or confidential business information is an essential norm in scientific research. Your DMP should address these issues and outline the efforts you will take to provide informed consent statements to participants, the steps you will take the protect privacy and confidentiality prior to archiving your data, and any additional concerns. If necessary, describe any division of responsibilities for stewarding and protecting the data among Principal Investigators.

If you will not be able to identify the data in a manner that protects privacy and confidentiality while maintaining the utility of the dataset, you should describe the necessary restrictions on access and use. In general, in matters of human subject research, your DMP should describe

how your informed consent forms will permit sharing with the research community and whether additional steps, such as an Institutional Review Board (IRB), may be used to protect privacy and confidentiality.

Checklist
- What steps will be taken to protect privacy, security, confidentiality, intellectual property or other rights?
- Does your data have any access concerns? Describe the process someone would take to access your data.
- Who controls it (e.g., PI, student, lab, University, funder) ?
- Any special privacy or security requirements (e.g., personal data, high-security data) ?
- Any embargo periods to uphold?

6.   Data Sharing and Reuse

The data will be released for sharing in the following way …

Intellectual property rights are held by Matthew Kauffman, USGS, Wyoming Cooperative Fish and Wildlife Research Unit at the University of Wyoming. No copyrights exist nor will they exist for this project.

A. GPS-collar data. These data will be released for viewing through the Wyoming Migration Initiative's Migration Viewer, which allows viewing the GPS data through a web server. Additionally, our contact information is publicly available on the MoveBank data archive for those interested in further sharing of the hard data.

B. Camera photos. The pictures are stored on Google Drive as well as backup hard drive. More useful for reuse will be the metadata and summary tables, which are stored as two spreadsheets.

C. Results of analysis. We plan to publish in open-access journals. These data will be included either in the publications or in the supplementary materials. We plan to publish results in spring 2021.

Describe who will hold the intellectual property rights for the data created by your project. Describe whether you will transfer those rights to a data archive, if appropriate. Identify whether any copyrights apply to the data, as might be the case when using copyrighted instruments. If you will be enforcing terms of use or a requirement for data citation through a license, indicate as much in your DMP. Describe any other legal requirements that might need to be addressed.

Checklist
- If you allow others to reuse your data, how will the data be discovered and,

shared?
- Any sharing requirements (e.g., funder data sharing policy) ?
- Audience for reuse? Who will use it now? Who will use it later?
- When will I publish it and where?
- Tools/software needed to work with data?

7.   Data Preservation and Archiving

The data will be preserved and archived in the following ways …

A. GPS-collar data. These data are archived both in Migration Viewer and Movebank archives. File formats will be comma-separated value files.
B. Camera photos. These data are archived and backed up on Google Drive and several external hard drives. File formats of every image will be .jpegs, and summary tables from the resulting classifications will be stored as comma separated value files.
C. Results of analysis. These data are archived and backed up on Google Drive and several external hard drives. File formats of all resulting models form analyses will be stored as .RData, comma separated value files, and predictive maps will be stored as either .grd or .tiff files.

Describe how you intend to archive your data and why you have chosen that particular option. You may select from a variety of options including, but not limited to:

- Use of an institutional repository.
- Use of an archive or other community-accepted data storage facility.
- Self-dissemination.

You must describe the dataset that is being archived with a minimum amount of metadata that ensures its discoverability. Whatever archive option you choose, that archive must support the capture and provision of the National Transportation Library metadata requirements. In addition, the archive you choose must support the creation and maintenance of persistent identifiers and must provide for maintenance of those identifiers throughout the preservation lifecycle of the data. Your plan should address how your archiving and preservation choices meet these requirements.

Checklist
- How will the data be archived for preservation and long-term access?
- How long should it be retained (e.g., 3-5 years, 10-20 years, permanently) ?
- What file formats? Are they long-lived?
- Are there data archives that my data is appropriate for (subject-based? Or

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institutional)?

- Who will maintain my data for the long-term?

NOTE:

Researchers evaluating data repositories as the option(s) for storing and preserving their data should examine evidence demonstrating that the repository:

a. Promotes an explicit mission of digital data archiving.

b. Ensures compliance with legal regulations, and maintains all applicable licenses covering data access and use, including, if applicable, mechanisms to protect privacy rights and maintain the confidentiality of respondents.

c. Has a documented plan for long-term preservation of its holdings.

d. Applies documented processes and procedures in managing data storage.

e. Performs archiving according to explicit workflows across the data life cycle.

f. Enables the users to discover and use the data, and refer to them in a persistent way through proper citation.

g. Enables reuse of data, ensuring appropriate formats and application of metadata.

h. Ensures the integrity and authenticity of the data.

i. Is adequately funded and staffed, and has a system of governance in place to support its mission.

j. Possesses a technical infrastructure that explicitly supports the tasks and functions described in internationally accepted archival standards like Open Archival Information System (OAIS).

NOTE: This DMP is created as a derivative from the DMP belonging to the University of Minnesota and can be found at https://www.lib.umn.edu/datamanagement/DMP

Metadata Schema A: GPS-Collars

Title[1]	GPS-Collar Data of Pronghorn Along Interstate-80
Creator/contact point	Matthew Kauffman mkauffm1@uwyo.edu
Publication Date(s)	March 2021
Description/Abstract	GPS data collected from collared pronghorn along Interstate 80. Pronghorn were captured either in March 2017 or March 2018 and were monitored either until natural mortality or programmed drop-off (March 2020 or March 2021). GPS collars collected points every 1–2 hours. This includes the full dataset, however data cleaning can be quickly achieved be removing points flagged as potentially erroneous (low number of fixes, unlikely movement, etc.) by removing any point where the column 'flag' = 1.
Subject and Keywords	GPS; Pronghorn; Migration; Barrier; Movement
Identifier[2] **and/or source**	Movebank.org Study "Wyoming Interstate-80 Pronghorn" Movebank ID 1397659471 Migration Viewer
Collection and Related Documents	
Edition	August 2020
Related Documents	
Coverage	Longitude -109.270, Latitude 41.573 March 2018 – March 2020
Language	English
Publisher/Distributor	Wyoming Department of Transportation List all other publishing companies that this publication has been sent to.
Funding agency	Wyoming Department of Transportation, Wyoming Game and Fish Department, Knobloch Family Foundation, Wyoming Governor's Big Game License Coalition, and Wyoming Migration Initiative.

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[1] *To include alternate title; conference title; and journal title, if they are different.*

[2] *To include record numbers; report numbers; NTIS number; TRIS Accession Number; OCLC Number; ISBN; ISSN; contract number; and DOI if available.*

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Access Restrictions	Publicly viewable, restricted non-public access to original data.
Intellectual Property and Other Rights	Anyone in the public can freely view the results of these GPS-collar pronghorn movements online through Migration Viewer. However, permission is needed to download data.
License	
Code and software needs	No special software is needed to view the data. A geographic information system is needed if data are accessed with permissions.
Format	File format in comma separated values file.
Choice of Repository	MoveBank and WMI Migration Viewer.

Metadata Schema B: Camera trap pictures

Title[3]	Camera trap pictures of wildlife underpass use along interstate 80
Creator/contact point	Matthew Kauffman mkauffm1@uwyo.edu
Publication Date(s)	Spring 2021
Description/Abstract	Camera trap pictures from study on wildlife use of underpasses along Interstate 80 in southern Wyoming. Pictures include, but are not limited to, wildlife which includes mule deer, pronghorn, moose, feral horses, cattle, sheep, and other wildlife. We also include the summary tables of the classifications with counts of the number of wildlife using each underpass as well as their timing and direction. We also include metadata with the names and coordinates of each underpass.
Subject and Keywords	Camera; Photo; Picture; Pronghorn; Mule Deer; Underpass; Culvert; Interchange; Migration; Movement
Identifier[4] **and/or source**	Google Drive and external hard drive
Collection and Related Documents	

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[3] *To include alternate title; conference title; and journal title, if they are different.*

[4] *To include record numbers; report numbers; NTIS number; TRIS Accession Number; OCLC Number; ISBN; ISSN; contract number; and DOI if available.*

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Edition	August 2020
Related Documents	
Coverage	Interstate 80, southern Wyoming August 2019 –2020
Language	English
Publisher/Distributor	Wyoming Department of Transportation
Funding agency	Wyoming Department of Transportation, Wyoming Game and Fish Department, Knobloch Family Foundation, Wyoming Governor's Big Game License Coalition, and Wyoming Migration Initiative.
Access Restrictions	Non-public
Intellectual Property and Other Rights	While the analysis and results will be made public, we do not find it necessary to make all images publically available.
License	The license or non-license (i.e. Public Domain) status with which the dataset or API has been published.
Code and software needs	No special software is needed.
Format	Images stored as .jpegs, spreadsheets of metadata stored as .csv
Choice of Repository	Google Drive

Metadata Schema C: Results of Analysis

Title[5]	Results of Analysis on Pronghorn Movements along Interstate 80 Barrier.
Creator/contact point	Matthew Kauffman mkauffm1@uwyo.edu
Publication Date(s)	Spring 2021 – Summer 2021
Description/Abstract	This will be amended with publication of our research.

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[5] *To include alternate title; conference title; and journal title, if they are different.*

Subject and Keywords	Pronghorn; Mule deer; Migration; Barrier; Home range; Interstate; Road; Step selection function
Identifier[6] and/or source	This will be amended with publication of our research.
Collection and Related Documents	This will be amended with publication of our research.
Edition	This will be amended with publication of our research.
Related Documents	This will be amended with publication of our research.
Coverage	Interstate 80, Southern Wyoming. March 2017 – March 2021.
Language	English
Publisher/Distributor	Wyoming Department of Transportation, This will be amended with publication of our research.
Funding agency	Wyoming Department of Transportation, Wyoming Game and Fish Department, Knobloch Family Foundation, Wyoming Governor's Big Game License Coalition, and Wyoming Migration Initiative.
Access Restrictions	Public with publication
Intellectual Property and Other Rights	This will be amended with publication of our research
License	This will be amended with publication of our research
Code and software needs	A geographic information system may be needed to view predictive maps.
Format	This will be amended with publication of our research
Choice of Repository	This will be amended with publication of our research

NOTE: Each separate report, dataset, collection, existing collection, and software developed must have its own table. All fields in this Schema must be completed at the time of the final report.

NOTE: This Metadata Schema is created as a derivative from the Common Core required fields which can be found at https://project-open-data.cio.gov/schema/.

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[6] *To include record numbers; report numbers; NTIS number; TRIS Accession Number; OCLC Number; ISBN; ISSN; contract number; and DOI if available.*