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: 12/31/2020
DMP Version: V1
Date Amended, if any:
Name of all authors, and ORCID number for each: Benjamin Robb (0000-0003-1419-3918**), William Rudd, and Matthew Kauffman**
WYDOT Project Number: 1003849-13403 and 1003849A-13403

- **Dataset URL, if available:**

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:

We are studying the movement barrier of Interstate 80 and its effects on pronghorn (*Antilocapra americana*), mule deer (*Odocoileus hemionus*), and other large ungulates. Due to its heavy daily traffic and fences, Interstate 80 is a barrier to the movements of pronghorn and mule deer. 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 when snowpack challenges foraging. Pronghorn, in particular, have been shown to be most affected by this movement barrier.

Our research looks at the movement behavior of Interstate 80 on pronghorn ecology. 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 Mountain Home and Evanston, 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 hope to use these GPS-collar data to identify locations that are highly frequented (hotspots of activity) and act as the greatest barriers to pronghorn so that we may identify potential mitigation areas.
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 know 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 wildlife permeability.

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 software. Actual hard GPS data will be stored as one spreadsheet with all animal ids and each location recorded for every collar, where every collar is programmed to collect a location every 2-4 hours from activation until dropoff or mortality.
Collar data available will continue to change as we collect more collars. As of August, 2019 there remain N = 46 active collars still on pronghorn, which we will collect either when collars dropoff (March 2020, 2021) or after natural mortality.

B. Camera-trap pictures. As of August, 2018 we have collected over 300 Gb of pictures from our camera traps (N = 40). These pictures are stored as .jpegs. These pictures will be stored on Box through the Wyoming Cooperative Fish and Wildlife Research Unit (https://wyocoopunit.box.com/s/8fmo175s5602qvx7kdkqbezpruxi9vyk)
At the project's end, we will store all pictures as well as their associated metadata onto an external hard drive to share with Wyoming Department of Transportation. Pictures are also stored on local disk space and an external hard drive as backups. Data will continue to change as we monitor these cameras, every 3 –4 months.

C. Results of analysis. Our analysis will include predictive maps and models from our research. We will store 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. Because these analysis are not yet completed still, we will amend our data management for results as we continue analysis.

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 …

A. GPS-collar metadata. These metadata include descriptions for: animal identification number, serial number of collar, very-high frequency telemetry frequency, collar model, programmed dropoff 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, and whether or not the collar has been retrieved (0, no and 1, yes). 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, etc). Thus, while the hard data is available the GPS collar data can also be easily cleaned by removing any point with flag = 1.
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 (ie January 2018). 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.
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 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.

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 Box 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 deidentify 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 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 300 Gb of pictures are stored on Box as well as backup hard drive. More useful for reuse will be the metadata and summary tables, which will be stored as a spreadsheet.
C. Results of analysis. We plan to publish in open-access journals managed either through Ecological Society of America or British Ecological Society. These data will be included either in the publications or in the supplementary materials. We plan to publish results in spring 2020.

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.
B. Camera photos. These data are archived and backed up on Box and several external hard drives.
C. Results of analysis. For the time being these results do not yet exist, but will be archived in either publication or supplementary materials as well as an external hard drive as backup.

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 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 2020
Description/Abstract	Human-readable description (e.g., an abstract) with sufficient detail to enable a user to quickly understand whether the asset is of interest. May include abstract, table of contents, reference to a graphical representation of content or a free text account of the content.
Subject and Keywords	GPS; Pronghorn; Migration; Barrier; Movement
Identifier[2] **and/or source**	Movebank.org Study "Wyoming Interstate-80 Pronghorn" Movebank ID 658382667 Migration Viewer
Collection and Related Documents	
Edition	March 2019
Related Documents	
Coverage	Longitude -109.270, Latitude 41.573 March 2018 – March 2020
Language	English
Publisher/Distributor	FHWA and Wyoming Department of Transportation List all other publishing companies that this publication has been sent to.
Funding agency	FHWA and Wyoming Department of Transportation, Wyoming Game and Fish Department, Knobloch Family Foundation
Access Restrictions	Publicly viewable, restricted non-public access to original data.
Intellectual Property and	Anyone in the public can freely view the results of these

[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.*

Other Rights	GPS-collar pronghorn movements online through Migration Viewer. However, permission is needed to download data.
License	
Code and software needs	
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 2020
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**	Box.com
Collection and Related Documents	
Edition	August 2019
Related Documents	
Coverage	Interstate 80, southern Wyoming

[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.*

	August 2019 –2020
Language	English
Publisher/Distributor	FHWA and Wyoming Department of Transportation
Funding agency	FHWA and Wyoming Department of Transportation, Wyoming Game and Fish Department, Knobloch Family Foundation, 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 species programs needed.
Format	Images stored as .jpegs, spreadsheets of metadata stored as .csv
Choice of Repository	Box

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 2020 – Autumn 2020
Description/Abstract	This will be amended with publication of our research.
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.

[5] *To include alternate title; conference title; and journal title, if they are different.*
[6] *To include record numbers; report numbers; NTIS number; TRIS Accession Number; OCLC Number; ISBN; ISSN; contract number; and DOI if available.*

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 2020.
Language	English
Publisher/Distributor	FHWA and Wyoming Department of Transportation, This will be amended with publication of our research.
Funding agency	FHWA and Wyoming Department of Transportation, Wyoming Game and Fish Department, Knobloch Family Foundation, 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	
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/.