**NASA DEVELOP National Program**

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NASA Langley Research Center

**Spring 2016**

**Short Title: Southern Rockies Ecological Forecasting II**

**Subtitle:** Tracking Mule Deer for Wildlife Corridors between Seasonal Habitats in the Southern Rockies

**VPS Title:** Oh Deer! Where are the Mule Deer Going?

**Project Team & Partners**

**Project Team:**

Tyler M. Rhodes (Project Lead), Tyler.M.Rhodes@NASA.gov

Mike Sclater

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**Advisors & Mentors:**

Dr. Kenton Ross (NASA DEVELOP National Science Advisor)

**Past or Other Contributors:**

Ross Reahard (Project Lead)

Teresa Fenn

Jeri Wisman

**Partner Organizations:**

Southern Rockies LCC (End-User), POC: John Rice

Western Association of Fish and Wildlife Agencies (WAFWA) Mule Deer Working Group (End-User) POC: Jim Heffelfinger

**Project Details**

**Applied Sciences National Applications Addressed:** Ecological Forecasting

**Study Area:** Southern Rocky Mountains (ID, WY, UT, CO, AZ, NM)

**Study Period:** 01/2011 – 12/2015

**Earth Observations & Parameters:**

Aqua, MODIS – Spectral vegetation indices and phenology products

Terra, MODIS – Global elevation datasets, spectral vegetation indices, phenology products

Landsat 5 and 8, TM and OLI – Spectral vegetation, land cover classifications

**Ancillary Datasets Utilized:**

* USGS National Land Cover Dataset (NLCD) - land cover
* NASA ForWarn system - Vegetation phenology
* NASA Digital Elevation Model (DEM) - digital elevation model
* SRLCC GPS data - collar data from mule deer

**Models Utilized:**

* Lifemapper Species Distribution Modeling (LmSDM)

**Software Utilized:**

ERDAS IMAGINE - land classification of Landsat imagery

ArcGIS - raster manipulation/analysis, image enhancement & map creation

**Project Overview**

**80-100 Word Objectives Overview:**

Mule deer (Odocoileus hemionus) are considered a keystone species and a symbol of the west therefore, their disappearance would be detrimental to the Southern Rockies. Wyoming has seen a 36% decrease in mule deer population from 1991-2012. The goal is to create migratory corridors to maintain the current population because fragmented habitats have aided in the decrease of mule deer throughout the region. The final mapping products will examine mule deer migration to help identify ideal conservation areas.

**Abstract:**

Mule deer are migratory animals that are capable of traveling as far as a few hundred miles from their summer to winter habitats. Mule deer are both economically and ecologically important to the Southern Rockies, thus their corridors need to be conserved. Declining mule deer populations caused by anthropogenic features have created a need for mapping mule deer habitats. NASA DEVELOP provided map production for the aid in the conservation of mule deer and their habitats in support of Southern Rockies Landscape Conservation Cooperative (SRLCC) and the Western Association of Fish and Wildlife Agencies (WAFWA) Mule Deer Working Group. The scope of the project was in the southern Rocky Mountains in Idaho, Wyoming, Utah, Colorado, Arizona, and New Mexico from 2011 to 2015. The objective of this project was to develop an increased understanding of why the mule deer numbers are declining by utilizing NASA Earth observation satellites. Aqua and Terra Moderate Resolution Imaging Spectroradiometer (MODIS) data were primarily used to evaluate vegetation phenology and Normalized Difference Vegetation Index (NDVI) to see how they influence migratory patterns. Terra ASTER data were utilized to create a Digital Elevation Model (DEM) to aid in determining suitable habitats. Landsat 5 TM and 8 OLI were utilized to determine current and historical land use, land cover, patch size, and winter to summer connectivity corridors. Additionally, GPS collar data was provided by the mule deer working group and the Southern Ute Indian Tribe. These factors were incorporated into a species distribution model and mule deer range maps. Finally, a methodology and tutorial for the use of the Lifemapper Species Distribution Modeler was created.

**Community Concerns:**

* Mule deer numbers are declining in the Southern Rocky Mountains. They are economically and ecologically important to the Southern Rockies because of the revenue of hunting licences and species diversity for the ecosystem that they are part of.

**Current Management Practices & Policies**:

Currently, land managers are attempting to track where mule deer migrate in order to conserve land and create corridors. These land managers are limited in their research because they are unable to identify the extent to which human involvement has played a role in the mule deer’s migratory patterns. John Rice has established a need for a landscape-scale solution that will allow for the development of a predictive habitat for the restoration and conservation of these mule deer habitats.

**Decision Support Tools & Benefits:**

|  |  |  |
| --- | --- | --- |
| **End-Product** | **Earth Observations Used** | **Benefit & Impact** |
| Mule Deer Range Maps | Landsat 5 TM & 8 OLI  Terra ASTER (DEM)  Aqua/Terra MODIS | An accurate Mule Deer Range Map of current and historical migration patterns will aid our partners in establishing conservation areas and connectivity corridors for mule deer |

**Project Imagery**

**[Insert image here]**

**Caption:** [Insert Caption Here. Max of 25 words.] Image Credit: [Insert project short title] Team.

**Image:** File Name (Please submit your image as a separate .jpeg as well as inserting it in this document)

**Software Release Requirements**

What category do the tools your project is creating fall within? No software development involved

*If your decision support tools fall within Category IV, fill out this section:*

**Software Title:** Insert here (ex. DEVELOP National Program Python Package)

**Software Abbreviation:** Insert here (ex. dnppy)

**Technical Point of Contact:** Insert full name, permanent email, and node here. Also include whether employed through SSAI or Wise County. (Team member who knows the most about the software.)

**Brief Description of the Software:** Insert here (ex. The dnppy package will be used to functionalize common programming tasks in the geospatial community, specifically for working with NASA data products. It will include functions for processing satellite data and assist in structuring analysis to reduce the startup time for DEVELOP teams to learn programming and create tools for end users.)

**Type of Code:** *Executable Code* and/or *Source Code* (Select one or both)

**Will the software include any embedded computer databases?** *Yes* or *No* (Select one)

**Does the software use or call any open software or libraries?** *Open Source* and/or *Proprietary/Commercial* (Select one or both)

**List the software or libraries used, under what license they were obtained, and the URL for the license in the table below:**

|  |  |  |
| --- | --- | --- |
| **Name** | **License** | **License URL** |
| Ex. Arcpy module | Ex. group license through ArcGIS | http://www.esri.com/software/arcgis |
| Ex. Python | Ex. Open source license | http://opensource.org/licenses/Python-2.0 |
|  |  |  |

**Full Software Description and Plan**

**Introduction/Objective:**

What motivated the creation of this software, what problem does it address?

**Applications and Scope:**

Where and how will this software be used to influence decisions?

**Capabilities:**

What can it do better than what was previously available?

**Interfaces:**

How is one expected to use the software? For example, command line, GUI, script execution, etc.

**Assumptions, limitations, & Errors:**

What areas that the software could be improved upon in the future? This is where limitations of the theory, model, science, etc should be briefly documented. If the tools only work for a specific scenario, say so.

**Testing:**

What validation techniques and testing strategy will be used to build confidence in the software?