**NASA DEVELOP National Program**

**** NASA Goddard Space Flight Center

**Fall 2015**

**Short Title: Montana Ecological Forecasting**

**Subtitle:** Utilizing NASA Earth Observations to Forecast the Effects of Climate Change on Northern Goshawk Nesting Habitat

**VPS Title:** Forecasting Northern Goshawk Nesting Sites, One Model at a Time

**Project Team & Partners**

**Project Team:**

Erika Higa (Project Lead), erika.y.higa@nasa.gov

Sean McCartney

Amanda Clayton

**Advisors & Mentors:**

Dr. Ross Nelson (NASA GSFC)

Dr. John Bolten (NASA GSFC)

**Partner Organizations:**

University of Nebraska at Kearney (Collaborator & Boundary Organization), POC: Nate Bickford

USDA Forest Service (End-User), POC: Victor Murphy

Oulu University Researchers (End-User & Boundary Organization), POC: Nate Bickford

**Project Details**

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

**Study Area:** Lewis and Clark National Forest, MT

**Study Period:** February 1985 – June 2015

**Earth Observations & Parameters:**

GPM, DPR/GMI – Precipitation Measurements

Terra/Aqua, MODIS – Land Surface Temperature

Landsat 8, OLI – Land Cover Change, Beetle Infestation

**Ancillary Datasets Utilized:**

* USDA Forest Service, Region 1 Aerial Insect and Disease Detection Survey (ADS), - Mountain Pine Beetle Infestation Data
* USDA Forest Service, Region 1 Existing Vegetation Map Products (VMap) - Vegetation Data
* USDA Forest Service, IW-FIA Predicted Forest Attribute Maps - Vegetation Data
* USDA Forest Service, DEM for Region 1 - Elevation Data
* Nate Bickford, Northern goshawk nest habitat locations - Nest Data
* Nate Bickford, Ground truth vegetation data - Vegetation Data

**Models Utilized:**

* NCAR CCSM3 IPCC Climate Change Commitment Scenario Ensembles
* AT&T Research, Maximum Entropy for Habitat Suitability Modeling (Maxent)
* Clark Labs, Mahalanobis Typicality for Habitat Suitability Modeling
* Alexandre Hirzel, Biomapper for Habitat Suitability Modeling (Biomapper)

**Software Utilized:**

ArcGIS – Raster manipulation/analysis, image enhancement and map creation of Landsat imagery

Biomapper – Habitat suitability analysis and modeling

ENVI – Land classification of Landsat and MODIS imagery and raster processing

Maxent – Habitat suitability analysis and modeling

TerrSet – Raster manipulation/analysis, habitat suitability analysis and modeling

**Project Overview**

**80-100 Word Objectives Overview:**

This project explored the capability of using NASA Earth observations to forecast the effects of climate change on the nesting habitat of the northern goshawk (*Accipiter gentilis*) in the Lewis and Clark National Forest, Montana. The team examined different environmental variables that directly affect the northern goshawk nesting habitat and determined areas that are most suitable for nesting using multiple habitat suitability modeling software. Additionally, future climate trends were analyzed to forecast and understand the impact of climate change based on mountain pine beetle encroachment on goshawk habitat by the year 2050.

**Abstract:**

The northern goshawk (*Accipiter gentilis*) is currently identified as both a Sensitive Species and a

Management Indicator Species in the Lewis and Clark National Forest (LCNF) land and resource management plans. Goshawks are important top-tier predators in the LCNF and changes in the forest habitat greatly affect their survival and population. The Montana Ecological Forecasting team at the Goddard Space Flight Center partnered with researcher Nate Bickford of the University of Nebraska at Kearney and the US Forest Service (USFS) to examine the potential of using NASA Earth observations to locate and model suitable nesting habitat for the goshawk. Currently, Nate Bickford and the USFS do not use remote sensing to identify or forecast goshawk nesting habitat, and the tools they use are limited to topographic maps and *in situ* data. In response, the team identified various environmental variables that were input into several habitat suitability models, using Biomapper, Maxent, and TerrSet, to identify areas of suitable habitat for nesting goshawks. Landsat 8 Operational Land Imager (OLI), Terra/Aqua Moderate Resolution Imaging Spectroradiometer (MODIS), and GPM Dual-frequency Precipitation Radar/Global Microwave Imager (DPR/GMI) imagery were used to create land cover, land surface temperature, and precipitation change maps to forecast how the goshawk nesting habitat is impacted by climate change. The results from this project will augment current decision making practices in forest management in the LCNF and assist in understanding how climate change will affect the goshawk nesting habitat in the future.

**Community Concerns:**

* Northern goshawks are a top-tier predator and serve as a bioindicator of ecosystem health. As climate change causes a change in forest habitat and insect blight, this negatively affects goshawk nesting sites.
* Mountain pine beetle outbreak infects trees where goshawks commonly nest, and hotter and drier summers and milder winters spur this infestation.
* Cold wet springs can delay the timing when goshawks lay their eggs and this can be fatal to the survivorship of fledglings when they hatch at later months than usual.

**Current Management Practices & Policies**:

Under Montana’s State Wildlife Action Plan (SWAP), the northern goshawk, and its associated habitat, are identified as a species and community type of Greatest Conservation Need. The goshawk is also listed as a sensitive species in all National Forests and on all Bureau of Land Management lands and is designated as a Montana Species of Concern. Current monitoring protocols within the Lewis and Clark National Forest are unable to accurately estimate goshawk population size and trend. Because of a lack of baseline population data, there is not a species-specific management plan. General vegetation management practices within the forest, including increased timber harvest, can negatively impact available nesting habitat. The end-users for this project, Nate Bickford and the US Forest Service, currently do not utilize remote sensing methods to analyze and forecast goshawks nesting sites. Instead, they conduct time-consuming field observations of nest site locations and take note of the surrounding vegetation.

**Decision Support Tools & Benefits:**

|  |  |  |
| --- | --- | --- |
| **End-Product** | **Earth Observations Used** | **Benefit & Impact** |
| Habitat suitability model | Landsat 8 OLI; GPM DPR/GMI; Terra/Aqua MODIS | Three separate habitat suitability models will provide new methodologies for end-users to locate new nesting areas in order to better monitor goshawk distributions in the LCNF. |
| Habitat suitability maps | Landsat 8 OLI; Terra/Aqua MODIS | These maps will help conservation researchers to find potentially new nesting sites in order for them to better monitor goshawk distributions in the LCNF. The identified suitable habitats in these maps will also help forest managers decide on best forest management practices. |
| Land cover change maps | Landsat 8 OLI; Terra/Aqua MODIS; GPM DPR/GMI | These end-products will show the change in land cover due to climate change and other forest disturbances, and these maps will be used to understand how goshawk nesting sites have moved in response to land cover change. This information can be used by forest managers to better monitor and protect goshawk habitat. |

**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? [Category I to V]

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