**NASA DEVELOP National Program**

**2017 Spring Project Proposal**

**BLM at Idaho State University GIS TReC**

**Intermountain West Ecological Forecasting**

*Using NASA Earth Observations to Identify Current Habitat Areas and Forecast Habitat Suitability for the Yellow-Billed Cuckoo in Semiarid Environments*

**Project Overview**

***Project Synopsis*:** Observations of western yellow-billed cuckoo (a threatened species) are rare in Idaho, Wyoming, and Oregon; in fact they have not been observed in Idaho since 2001. Because cuckoos are secretive birds and spend only a small period of the year in Idaho (albeit one of the most important periods, nesting), observations can be difficult even through solicited survey methods. By modeling suitable cuckoo habitat, survey efforts can be focused on locations with the greatest likelihood of cuckoo occurrence, thus enabling more efficient and effective surveys. This proposed project would create current habitat suitability maps while also concentrating team efforts to make predictive suitability maps that also reflect current-to-future precipitation and water availability predictive trends. This project will use Landsat 5 TM and 8 OLI, MERRA, and TRMM in ArcGIS while ecological forecasting will be completed in TerrSet.

***Community Concern:*** The recent listing of the yellow-billed cuckoo’s (*Coccyzus americanus*) western populations as a threatened species has shown the need for further conservation efforts. The western yellow-billed cuckoo (YBC) was once common along western streams and rivers, however the population has declined due to habitat loss. The decline of this once prevalent bird represents a changing environment, which includes water scarcity, a prevalent concern across the western US. The declining cuckoo population can act as an indicator of riparian health, and therefore points toward future water conservation. Spatial modeling of suitable habitat and areas of low quality but restorable habitat are necessary for these efforts. The cottonwood/willow complex, where these birds live, is dynamic and requires a specific hydrograph for regeneration and recruitment. Understanding where these habitat complexes are not supporting cuckoo will give site specific information to guide land management agencies on how they can manage more effectively for cuckoo.

***Source of Project Idea:*** This project idea was proposed during the summer 2016 closeout when a visitor, Evan Ohr, a biologist at the US Fish and Wildlife Service (FWS), approached DEVELOP about a future partnership. After learning about DEVELOP’s program and mission, Ohr and the local FWS office presented the team with this modeling need. In September 2016, DEVELOP reached out to the FWS for project planning and learned about previous research by Johnson (2012). This project then evolved to include Matthew Johnson’s previous research while adding an additional ecological forecasting effort.

***National Application Areas Addressed:*** Ecological Forecasting, Water Resources

***Study Location:*** Intermountain West (ID, WY, OR)

***Study Period:*** 2000 to 2016 (April – September); Forecasting to 2030

***Advisors:*** Keith Weber (GIS Training and Research Center; Idaho State University), Matthew Johnson (Colorado Plateau Research Station; Northern Arizona University)

**Partner Overview**

***Partner Organizations:***

|  |  |  |  |
| --- | --- | --- | --- |
| **Organization** | **POC (Name, Position/Title)** | **Partner Type** | **Boundary Org?** |
| US Fish and Wildlife Service (USFWS)- Eastern Idaho Field Office | Evan Ohr, Fish and Wildlife Biologist | End-User | No |
| US Fish and Wildlife Service (USFWS)- Ecological Services Wyoming Field Office | Patricia Sweanor, Energy Program Coordinator | End-User | No |
| US Fish and Wildlife Service (USFWS) – Utah Ecological Services Field Office | Amy Defreese, Ecologist | End-User | No |
| Bureau of Land Management (BLM) – Pocatello Field Office | David Price, Wildlife Biologist  Michele Mavor, Fire Ecologist | End-User | No |
| Idaho Department of Fish and Game (IDFG)- Pocatello Office | Scott Bergen, Principal Wildlife Research Biologist | End-User | No |
| NASA RECOVER Science Team | Keith Weber, GIS Director  John Schnase, Senior Computer Scientist  Mark Carroll, SR. Support Scientist | Collaborator | No |

***End-User Overview***

***End-User’s Current Decision-Making Process:***In response to a large decline in population, these end-user organizations have increased habitat monitoring of the species. The users rely upon field monitoring of species observations; however, critical habitat for the yellow-billed cuckoo has not been mapped, and therefore monitoring efforts have not been focused. In addition, these birds are characterized by their secretive nature, adding further difficulties to any monitoring efforts.

***End-User’s Capacity to Use NASA Earth Observations:***

*US Fish and Wildlife Service* (USFWS) – These USFWS field offices do not use NASA Earth observations in any capacity for YBC decision support, but is familiar with spatial data. This project will familiarize USFWS with these remote sensing resources and show how they can use them in the future. This project will demonstrate DEVELOP’s capacity for partnership and use of NASA Earth observations, contributing to future project partnerships that will further the USFWS’ remote sensing capacity.

Bureau of Land Management (BLM) – The BLM - Pocatello field office has been using GIS software for approximately 10 years. However, their use of satellite remote sensing data is limited and essentially constrained to viewing products produced for their use e.g., fire severity maps for the BLM are typically produced by USGS. This project will enhance the BLM’s ability to use NASA Earth observations within wildlife habitat management.

Idaho Department of Fish and Game (IDFG) – The IDFG has been using GIS software for many years to track wildlife movement. They have used satellite remote sensing data on a limited basis in the past, including in species suitability mapping. This project will enhance the IDFG’s ability to use NASA Earth observations within wildlife habitat management by standardizing the practice of using NASA products.

Colorado Plateau Research Station (CPRS) – The CPRS has used Landsat imagery in the past to create cuckoo suitability maps; however, their process is slow and does not fully utilize the capacity of satellite bands. They have limited their modeling to raw bands and NDVI, and process one Landsat scene at a time. This project will give them the ability to add automated processing and enhance their studies through the use of ecological forecasting.

***Collaborator & Boundary Organization Overview***

***Collaborator Support:***

NASA RECOVER Science Team – RECOVER will provide data on habitat restrictions due to wildfires and will have an advisory role and will provide expert knowledge on techniques to leverage Earth observations to identify surface water features.

***Project Communication & Transition Overview***

***In-Term Communication Plan*:** Communication between DEVELOPers and project partners will occur every two weeks via teleconference, in-person meetings, or email communications. Lines of communication will remain open if questions arise but these meetings will primarily involve project updates and high level results. The center lead will be responsible for setting up the first project participant in-person meeting within the first two weeks of the term, and then the project lead will take over. Initial communications will be collaborative, involving all partners to determine study area and key project goals. As the term progresses the team lead will contact individual partners to develop project methods specific to each study area. There will also be bi-weekly project meetings between DEVELOPers and science advisors.

***Transition Plan*:** Our end-users will have access to the data via the ISU GIS TReC Spatial Data Library or directly through electronic transfer devices. Either method will provide them with the data along with the final draft of the technical paper and VPS. Final images and maps will be handed off during closeout and an e-mail containing the same data will be sent so the end products and data can be used for planning purposes as soon as possible. Currently, software development is not necessary because dnppy, the DEVELOP script archive, has provided most of the code necessary of the project attempts scripting.

**Earth Observations Overview**

***Earth Observations:***

|  |  |  |
| --- | --- | --- |
| **Platform & Sensor** | **Parameter(s)** | **Use** |
| **TRMM and GPM** | HUC 12 level rainfall | Past and current TRMM and GPM rainfall climatology to inform the estimation of future habitat areas |
| **MERRA** | Precipitation | Find past and current precipitation trend for study area so that future predictions can be made |
| **Landsat 5 TM & Landsat 8 OLI** | Spectral classification | Examine spatial resolution and its capability to classify suitable habitat |
| **SRTM Version 2** | Elevation | Provide elevation threshold requirement for suitable habitat |

***Ancillary Datasets:***

US Geological Survey: Multi-Resolution Characteristic Consortium – National Land Cover Database – Forest cover change

US Geological Survey: National Elevation Dataset (NED) – 10 meter DEM – A current copy of these data already exists at the GIS TReC and is in active use as part of the NASA RECOVER DSS

***Modeling:***

TerrSet Land Change Modeler (POC: Keith Weber, Idaho State University GIS TReC)

***Software & Scripting:***

IDRISI TerrSet – prediction of suitable habitat in 2030 based on previous trends of precipitation and image analysis

Esri ArcGIS – imagery analysis and classification

**Decision Support Tool & End Product Overview**

***End Products:***

|  |  |  |  |
| --- | --- | --- | --- |
| **End Products** | **Partner Use** | **Datasets & Analyses** | **Software Release Category** |
| Current Suitable Habitat Map | The partner will use this to help better understand the extent of suitable habitat for the yellow-billed cuckoo and identify areas that require better monitoring practices | Landsat 5 TM and 8 OLI, 2011 National Land Cover Database- Forest and water cover | N/A |
| Forecasted Habitat Map | The partner will use this for better information on management and protection practices. | Landsat 5 TM and 8 OLI; 2001, 2006, 2011 National Land Cover Database- Forest cover change | N/A |
| Habitat Change Maps | The partner will use this to help assess areas where suitable habitat has been declining. | Landsat 5 TM and 8 OLI; 2001, 2006, 2011 National Land Cover Database- Forest cover change | N/A |
| Habitat Fragmentation Map | The partner will use this to help assess areas where suitable habitat has been fragmented. | Landsat 5 TM and 8 OLI; 2001, 2006, 2011 National Land Cover Database- Forest cover change | N/A |
| Habitat Suitability Model and Tutorial | Partner will be able to use this model to replicate current suitable habitat maps in other study areas. | Landsat 8 OLI | N/A |

***End-User Benefit*:** Field work is time intensive and expensive. Using Earth observations will decrease field requirements by limiting sampling efforts to areas most probable to host yellow-billed cuckoo. The frequency of Earth observations in combination with the results from this project will provide end-users the most up to date information on current suitable habitat. The outcome of this project will not only create a suitability map and a model builder for future use, but it will also predict the future habitat extents of this species. Having this information will aid end-users when deciding where to field monitor for bird siting’s and where to concentrate protection measures.

**Project Timeline & Previous Related Work**

***Project Timeline:*** 1 Terms: 2017 Spring

***Related DEVELOP Work:***

2015 Spring (SSC) - Mississippi Water Resources: Utilizing NASA Earth Observations to Assist the Audubon Mississippi Coastal Bird Stewardship Program with Habitat Monitoring and Restoration Planning Activities

2014 Spring (UGA) – South Africa Ecological Forecasting: Understanding Landscape Changes in Elephant Habitat within the Kruger National Park through NASA Earth Observing Systems

**Notes & References:**

***References:***

Johnson, M. J. (2009). Understanding the Habitat Needs of the Declining Western Yellow-Billed Cuckoo, 2. Retrieved from http://pubs.usgs.gov/fs/2009/3091/

Johnson, M. J., Hatten, J. R., Holmes, J. A., & Shafroth, P. B. (2012). Development of a GIS-based Model of Yellow-billed Cuckoo Breeding Habitat within the Lower Colorado River Multi-Species Conservation Area, San Pedro River and Verde River, AZ, (March).