**NASA DEVELOP National Program**

**2017 Summer Project Proposal**

**USGS at Colorado State University**

**Alaska Climate**

*Utilizing NASA Earth Observations to Predict Habitat Suitability for Newly Observed Invasive Species in Alaska to Aid in Monitoring and Eradication Efforts*

**Project Overview**

***Project Synopsis*:** Alaskan wetlands are at risk of encroachment by invasive species, particularly purple loosestrife (*Lythrum salicaria*) and reed canarygrass (*Phalaris arundinacea L*.). These species were not observed in abundance in the state until recently and both pose ecologic and economic threats. Risks of invasive species include increased competition with native wetland flora, decreased cover and forage for fauna, and depreciated aesthetic and recreation value of the region. The objective of this project is to map suitable habitat for these newly observed invasive species throughout Alaska using data collected by Terra and Aqua MODIS and SRTM V2. Project partners with the US Fish and Wildlife Service (USFSW), Alaska Region will use end products produced through this project in their “*Early Detection, Rapid Response*” program, which seeks to expedite monitoring and eradication efforts in areas of greatest need.

***Community Concern:*** Alaska contains approximately 60% of all land area classified as a wetland ecosystem type within the United States. These biodiverse and unique systems are critical to the maintenance of native wildlife and plant populations and are of great importance to Alaska’s recreational resources and tourism industry. Land managers at the US Fish and Wildlife Service have become increasingly concerned about the effects that a changing climate will have on Alaska’s fragile wetland ecosystems. Recently, land managers have located invasive species in Alaskan wetlands that were previously thought to have been present at invasive levels only within the continental United States and Canada. While large portions of Alaska were previously thought to be climatically unsuitable for these invasive species, their recently observed presence in scattered locations throughout the southern portions of the state may be a warning sign that their spread and establishment are imminent.

***Source of Project Idea:*** In 2009, the US Fish and Wildlife Service prepared a policy document titled “Invasive Plant Species Response to Climate Change in Alaska,” exploring the potential range of multiple invasive species based on current and future forecasted climate scenarios. These models were based on climate data, and did not incorporate other environmental covariates that can be derived from NASA Earth observations to enhance prediction of suitable habitats for potential and current invaders. Our USFWS partner requested assistance from Dr. Evangelista and the DEVELOP program to incorporate NASA Earth observations in their habitat suitability models for invasive species.

***National Application Areas Addressed:*** Climate, Ecological Forecasting

***Study Location:*** Alaska (AK)

***Study Period:*** July 2016 – August 2017

***Advisors:*** Dr. Paul Evangelista (Colorado State University, Natural Resource Ecology Laboratory), Dr. Amanda West (Colorado State University, Natural Resource Ecology Laboratory)

**Partner Overview**

***Partner Organization:***

|  |  |  |  |
| --- | --- | --- | --- |
| **Organization** | **POC (Name, Position/Title)** | **Partner Type** | **Boundary Org?** |
| US Fish and Wildlife Service, Alaska Region | Aaron Martin, Aquatic Division Program Coordinator | End-User | No |

***End-User Overview***

***End-User’s Current Decision-Making Process:*** The USFWS, Alaska Region is tasked with “working with others to conserve, protect and enhance fish, wildlife, plants and their habitats for the continuing benefit of the American people*.”* The Aquatic Division uses the “*National Fish Habitat Action Plan*” to prioritize conservation and management activities within Alaska’s wetland environments, where invasive species management is a top priority for the agency. While the agency currently relies on field based vegetation monitoring and surveillance programs to detect and eradicate invasive wetland species, they have not conducted a remote sensing based analysis of suitable habitat for new invasive species, and no map is currently available to guide new management policies regarding purple loosestrife (*Lythrum salicaria*) and reed canarygrass (*Phalaris arundinacea L*.).

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

*US Fish and Wildlife Service, Alaska Region* – Our points of contact at the USFWS, Alaska Region are familiar with NASA Earth observations; however, to date they have not used them to evaluate habitat suitability for potential invasive species, relying solely on climatic projections in their past evaluations. This project will create a robust, replicable methodology that will build their capacity to apply NASA Earth observations to evaluate habitat suitability for additional invasive species that are beyond the scope of this project, as well as enhance their invasive species management and monitoring efforts.

***Project Communication & Transition Overview***

***In-Term Communication Plan*:** Dr. Evangelista has established a long-term working relationship with the USFWS, Alaska Region, and can facilitate team and partner communication via e-mail, telephone, and web conferences. The team will communicate with the partners at the USFWS frequently throughout the term.

***Transition Plan*:** At the end of this term, the team will hand off map products and a tutorial describing replicable methodology to the end-users either in-person or via web-conferencing and online data sharing. Partners have also expressed interest in funding a trip by the Center or Team Lead to their Anchorage, Alaska office to share results and to conduct a hands-on workshop with USFWS staff.

**Earth Observations Overview**

***Earth Observations:***

|  |  |  |
| --- | --- | --- |
| **Platform & Sensor** | **Parameter(s)** | **Use** |
| **Terra MODIS** | Normalized difference vegetation index (NDVI), Enhanced vegetation index (EVI), Land Cover | Terra MODIS will support habitat suitability mapping efforts for Purple Loosestrife and Reed Canarygrass across Alaska. |
| **Aqua MODIS** | Normalized difference vegetation index (NDVI), Enhanced vegetation index (EVI), Land Cover | Aqua MODIS will support habitat suitability mapping efforts for Purple Loosestrife and Reed Canarygrass across Alaska. |
| **Shuttle Radar Topography Mission V3** | Elevation, slope, aspect, compound topographic index | SRTM will support habitat suitability mapping efforts for Purple Loosestrife and Reed Canarygrass across Alaska. |

***Ancillary Datasets:***

USFWS, Alaska Region – Presence/absence data for invasive species – habitat suitability prediction

Global Biodiversity Information Facility – Presence/absence data for invasive species – habitat suitability prediction

National Snow and Ice Data Center – land cover type – habitat suitability prediction

***Modeling:***

Random Forest (POC: Dr. Amanda West, Colorado State University, Natural Resource Ecology Laboratory)

Boosted Regression Tree (POC: Dr. Amanda West, Natural Resource Ecology Laboratory)

***Software & Scripting:***

Software for Assisted Habitat Modeling (SAHM)

Esri ArcGIS – data processing and analysis; map creation

Exelis ENVI – processing imagery

R – index calculation

**Decision Support Tool & End Product Overview**

***End Products:***

|  |  |  |  |
| --- | --- | --- | --- |
| **End Products** | **Partner Use** | **Datasets & Analyses** | **Software Release Category** |
| **Habitat Suitability Map for Purple Loosestrife** | Will be used to evaluate potential habitat for purple loosestrife in Alaska and guide future monitoring and eradication efforts | Random Forests and Boosted Regression Tree models will be trained with field survey data and indices created from SRTM and Aqua and Terra MODIS to create maps of potential habitats suitable for purple loosestrife. | I |
| **Habitat Suitability Map for Reed Canarygrass** | Will be used to evaluate potential habitat for reed canarygrass in Alaska and guide future monitoring and eradication efforts | Random Forests and Boosted Regression Tree models will be trained with field survey data and indices created from SRTM and Aqua and Terra MODIS to create maps of potential habitats suitable for reed canarygrass. | I |
| **Habitat Suitability Mapping Tutorial** | Enable end-users to replicate this study in future years and for additional invasive species | The tutorial will cover data collection and processing, fitting statistical models to the data, and interpretation of model output. | I |

***End-User Benefit*:** End products produced through this project will guide the USFWS’s preemptive monitoring efforts, allowing them to focus their staff’s limited monitoring resources in areas that are most likely to have been recently invaded by purple loosestrife and reed canarygrass. The project will save our partners time and money by reducing the amount of area required to be surveyed and increase the likelihood of detection. Tutorials produced from this project will provide the USFWS with robust, replicable methods for evaluating invasive species habitat suitability and to increase invasive species management effectiveness and efficiency in future years.

**Project Timeline & Previous Related Work**

***Project Timeline:*** 1 Term: 2017 Summer

***Related DEVELOP Work:***

Summer 2016 (USGS at Colorado State University) – Laramie Mountains Ecological Forecasting: Modeling Aspen Distribution Utilizing NASA Earth Observations to Identify Critical Habitat for Mule Deer and Elk in the Laramie Range, Wyoming

Fall 2014 (USGS at Colorado State University) – Arizona Ecological Forecasting II: Using Landsat 8 OLI and TIRS to Enhance Invasion Risk Assessment of Tamarisk (Tamarix spp.) in Topock Marsh, Havasu National Wildlife Refuge

Summer 2014 (USGS at Colorado State University) – Alaska Ecological Forecasting: Applying Novel Modeling Techniques for Invasive Species Risk Assessment in the Yukon Flats National Wildlife Refuge

**References:**

Morisette, J. T., Jarnevich, C. S., Ullah, A., Cai, W., Pedelty, J. A., Gentle, J. E., Schnase, J. L. (2006). A tamarisk habitat suitability map for the continental United States. *Frontiers in Ecology and the Environment, 4*(1), 11-17.