**NASA DEVELOP National Program**

 USGS at Colorado State University

*Summer 2017*

**Short Title: Alaska Climate**

**Subtitle:** Utilizing NASA Earth Observations to Model Potential Suitable Habitat of Invasive Species Threatening Alaskan Wetlands

**VPS Title:** Artic Invaders

**Project Team**

**Project Team:**

Emma Hatcher (Project Lead), ezink29@gmail.com

Sarah Carroll

Timothy Mayer

Audrey Martinez

**Advisors & Mentors:**

Dr. Paul Evangelista (Natural Resource Ecology Laboratory, Colorado State University)

Dr. Amanda West (Natural Resource Ecology Laboratory, Colorado State University)

**Past or Other Contributors:**

Brian Woodward

**Project Overview**

**80-100 Word Objectives Overview:**

This project aims to map current suitable habitat across the United States and Canada for purple loosestrife (*Lythrum salicaria*) and reed canarygrass (*Phalaris arundinacea L.)*; two invasive species affecting aquatic ecosystems. The Alaska Climate project created suitability maps utilizing climatic, topographic, environmental, and spectral environmental data derived from Terra and Aqua MODIS, SRTM V3, and ClimateNA v5.21 datasets as a means to support decision making and management processes for the Alaska Fish and Wildlife “Early Detection, Rapid Response” invasive species program.

**Abstract:**

The rapid expansion of purple loosestrife (*Lythrum salicaria*) and reed canarygrass (*Phalaris arundinacea L.*) into aquatic and wetland systems has reduced native plant abundance, decreased species diversity, and degraded wildlife habitats for birds and amphibians throughout North America. The expansion of these invasive species into northern latitudes as a result of changing climate trends poses mitigation challenges to natural resource managers. In the United States, this trend is particularly concerning in Alaska, where wetlands are of major economic and ecological importance. This project developed habitat suitability models utilizing spectral data from Terra and Aqua MODIS in conjunction with topographic and climatic variables to map historic and current suitable habitat for purple loosestrife and reed canarygrass across Canada and the United States. The resulting habitat suitability maps will support decision making and the planning of management actions by partners at the Alaska Region US Fish and Wildlife Service in the “Early Detection, Rapid Response” program for invasive species management.

**Keywords:**

Remote sensing, MaxEnt, BRT, RF, invasive aquatics, MODIS, habitat suitability modeling

**Partner Organizations:**

|  |  |  |  |
| --- | --- | --- | --- |
| **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 |

**Community Concerns:**

* Purple loosestrife and reed canarygrass, previously limited to lower latitudes, have been documented in Alaska for the first time within the past decade.
* A changing climate will disturb wetland ecosystems and decrease land area occupied by wetlands, creating additional suitable locations for invasive species in Alaska.
* Encroachment of invasive species will reduce wetland biodiversity and pose a risk to human livelihoods.
* Aesthetic and recreational value of wetland regions may depreciate in Alaska as a result of increased prevalence of aquatic invasive species.

**Current Decision-Making Practices & Policies**:

In 2009, the US Fish and Wildlife Service prepared a policy document titled “Invasive Plant Species Response to Climate Change in Alaska” that explored the potential expansion of the ranges of multiple invasive species the state. Currently, the Aquatic Division of USFW oversees invasive wetland species and implements the “National Fish Habitat Action Plan”, which relies on field-based monitoring and surveillance programs to locate invasive species and to prioritize management actions. To date, no remote sensing analyses of suitable habitat for new invasive species have been conducted, and no map is currently available to guide new management policies and actions for managing purple loosestrife and reed canarygrass.

**Decision Support Tools & Benefits:**

|  |  |  |  |
| --- | --- | --- | --- |
| **End Product** | **Earth Observations Used** | **Partner Benefit & Use** | **Software**  **Release** |
| Habitat Suitability Map for Purple Loosestrife | Terra MODIS, Aqua MODIS, and SRTM V2 | The habitat suitability map will be employed to evaluate potential spatial distribution of Purple Loosestrife in Alaska and guide future monitoring and eradication efforts. | N/A |
| Habitat Suitability Maps for Reed Canarygrass | Terra MODIS, Aqua, MODIS, and SRTM V2 | The habitat suitability map will be employed to evaluate potential spatial distribution for Reed Canarygrass in Alaska and guide future monitoring and eradication efforts. | N/A |
| Habitat Suitability Mapping Tutorial | N/A | The tutorial covers data collection and processing, statistical modeling approaches, and interpretation of model output. The tutorial is designed to guide partners through the modeling efforts. | N/A |

**Project Benefit to End User**:

The habitat suitability maps created through this project will support the USFWS’s management and monitoring efforts, allowing them to focus their staff’s limited resources in areas that are most likely to have been recently invaded by purple loosestrife and reed canarygrass. This project will benefit the partner by reducing costs associated with the monitoring and mitigation of invasive plant species by identifying target areas for survey, and increase the likelihood of detection in those target areas. The tutorial detailing project methodology will provide partners at the USFWS with replicable methods for evaluating habitat suitability for additional invasive species, and will support effective and efficient invasive species management in future years.

**Project Details**

**Applied Sciences National Application Addressed:** Climate

**Study Area:** Alaska (statewide)

**Study Period:** 2016 – 2017

**Earth Observations & Parameters:**

|  |  |  |
| --- | --- | --- |
| **Platform & Sensor** | **Parameter(s)** | **Use** |
| SRTM V3 | Elevation, slope, aspect, and compound topographic index | STRM will support habitat suitability mapping efforts for purple loosestrife and reed canarygrass across North America. |
| 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 North America. |
| 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 North America. |

**Ancillary Datasets Utilized:**

* USFWS, Alaska Region & *in situ* data – presence data for invasive species, habitat suitability prediction
* Global Biodiversity Information Facility (GBIF) & presence data for invasive species – habitat suitability prediction
* Biodiversity Information Serving our Nation (BISON), USGS & presence data for invasive species – habitat suitability prediction
* Alaska Natural Heritage Program (AKNHP) & presence data for invasive species in Alaska – habitat suitability prediction
* ClimateNA v5.21 & gridded climate normal – habitat suitability prediction

**Models Utilized:**

* Random Forest Classification Model
* Maximum Entropy (MaxEnt)
* Boosted Regression Trees Model

**Software Utilized:**

* Software for Assisted Habitat Modeling (SAHM) – suitability Mapping
* Google Earth Engine API – acquiring mosaicked MODIS data for Canada and the United State, deriving vegetation index predictor layers for models
* ClimateNA – deriving climate normal for study period and area
* R – processing topographic raster datasets to make them compatible with ClimateNA input formatting requirements
* Esri ArcGIS – data processing and visualization

**Project Handoff Package**

**Transition Plan:**

At the end of this term, the DEVELOP team will hand off map products and a tutorial describing a replicable methodology to the end users,para specifically Aaron Martin Aquatic Division of the US Fish and Wildlife Service. This transaction will occur either in-person or via web-conferencing and online data sharing. The project will also be presented at the July 2017 Fish and Wildlife Conference in Anchorage, Alaska followed by a hands-on workshop with USFWS staff.

**Team POC:** Emma Hatcher, ezink29@gmail.com

**Partner POC**: Aaron Martin, aaron\_e\_martin@fws.gov

**Handoff Package:**

* Habitat Suitability Maps for purple loosestrife
* Habitat Suitability Maps for reed canarygrass
* Habitat Suitability Mapping Tutorial