**NASA DEVELOP National Program**

**2018 Spring Project Proposal**

**Virginia – Langley**

**Amistad Ecological Forecasting**

*Using Landsat and Sentinel to Identify and Detect Giant Cane in Amistad National Recreation Area for Future Management*

**Project Overview**

***Project Synopsis*:** Amistad National Recreation Area in Texas is preparing to use biological controls to better manage and eradicate giant cane (*Arundo donax*) along the Rio Grande river within the park boundaries. Prior to introducing these controls, the park is interested in better understanding the current and historic distributions of the invasive species. By applying Landsat 5 TM, Landsat 7 ETM+, Landsat 8 OLI, Sentinel-1 C-SAR and Sentinel-2 MSI data to create a time series of past and current distributions of *A. donax*, the National Park Service will be better prepared to monitor and introduce management controls in the future.

***Community Concern:*** The National Park Service is tasked with maintaining and managing the original ecosystems and vegetation regimes within protected areas. To combat the threat of invasive species, the park requires the most up-to-date science available to make informed decisions about active management practices. Prior to starting biological control introductions, park staff are interested in differentiating locations that are recently invaded from long-lasting monocultures to prioritize their management efforts.

***Source of Project Idea:*** The idea for this project stemmed from a conversation between Amistad National Recreation Area and DEVELOP.

***National Application Area Addressed:*** Ecological Forecasting

***Study Location:*** Amistad National Recreation Area, TX

***Study Period:*** January 1995 – December 2017; Forecasting to 2025

***Advisor:*** Dr. Kenton Ross (NASA Langley Research Center)

**Partner Overview**

***Partner Organization:***

|  |  |  |  |
| --- | --- | --- | --- |
| **Organization** | **POC (Name, Position/Title)** | **Partner Type** | **Boundary Org?** |
| **National Park Service, Amistad National Recreation Area** | Sarah Howard, Biologist | End User | No |

***End-User Overview***

***End User’s Current Decision-Making Process:***The National Park Service has a draft environmental assessment to treat giant cane with herbicides, chainsaws, biological control insect, and prescribed fire. They are interested in prioritizing work areas based on habitat type, patch size, and adjacent resources of interest. Once identified, those areas will have a restoration plan written that details existing conditions and how to achieve desired conditions (e.g., goals like reducing invasive biomass by 30%).

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

*National Park Service, Amistad National Recreation Area* – Amistad National Recreation Area is currently not using NASA data in their decision-making processes; however, they are aware of NASA data and interested in applying it to various ecological issues, including invasive species monitoring.

***Project Communication & Transition Overview***

***In-Term Communication Plan*:** The Center Lead and the Project Lead will be the main POCs for the project. Weekly emails and biweekly telephone calls will be used to discuss project progress and receive feedback from the partner.

***Transition Plan*:** A handoff at the end of the term will be conducted virtually via WebEx. All end products and project deliverables will be emailed to the partner after this handoff meeting, allowing time for feedback.

**Earth Observations Overview**

***Earth Observations:***

|  |  |  |
| --- | --- | --- |
| **Platform & Sensor** | **Parameter(s)** | **Use** |
| **Landsat 5 TM** | Surface reflectance | Landsat 5 will be used to identify giant cane and assess long-term trends.  |
| **Landsat 7 ETM+** | Surface reflectance | Landsat 7 will be used to identify giant cane and assess long-term trends. |
| **Landsat 8 OLI** | Surface reflectance | Landsat 8 will be used to identify giant cane, assess long-term trends, current distributions, and compare to Sentinel-2. |
| **Sentinel-2 MSI** | Surface reflectance | Sentinel-2 will be used to identify current giant cane distributions and compare to Landsat-based results. |
| **Sentinel-1 C-SAR** | Ground range data | Sentinel-1 will be used to identify giant cane distributions, and compare to Landsat-based results. |

***Ancillary Datasets:***

National Park Service, Amistad National Recreation Area *in situ* vegetation data – validate remote sensing measurements

***Modeling:***

TerrSet Land Change Modeler (LCM) (POC: Dr. Kenton Ross, NASA Langley Research Center)

***Software & Scripting:***

Esri ArcGIS 10.5 – vegetation classification, map creation, and imagery analysis

**Decision Support Tool & End Product Overview**

***End Products:***

|  |  |  |  |
| --- | --- | --- | --- |
| **End Products** | **Partner Use** | **Datasets & Analyses** | **Software Release Category** |
| **Annual Giant Cane Coverage Maps** | Amistad will use annual coverage maps to assess historic trends in *A*. *donax.* | Landsat 5 TM, Landsat 7 ETM+, Landsat 8 OLI, Sentinel-2 MSI, and Sentinel-1 C-SAR will be used to create vegetation classifications between 1995 and 2017. Spatial forecasting will be used to project *in situ* data to areas without validation measurements. | N/A |
| **Giant Cane Coverage Change Analysis**  | Amistad will use the change analysis of *A*. *donax* to identify areas of persistent and ephemeral stands. | Landsat 5 TM, Landsat 7 ETM+, Landsat 8 OLI, Sentinel-2 MSI, and Sentinel-1 C-SAR will be used to create vegetation classifications over time, which will result in trend analysis to shows long- and short-term trends. | N/A |
| **Current Giant Cane Coverage Map**  | Amistad will use the current coverage map to inform their biological control introduction management strategies. | Landsat 8 OLI, Sentinel-2 MSI, and Sentinel-1 C-SAR will be used to create vegetation classifications for the most recent growing season. Spatial forecasting will be used to project *in situ* data to areas without validation measurements.  | N/A |
| **Giant Cane Mapping Tutorial & Guide** | Amistad will use the write-up of the project methodology to continue using NASA Earth observations in the future to inform their management efforts. |  N/A | N/A |
| **2025 Giant Cane Coverage Forecast**  | Amistad will use the forecasted coverage map to better understand where potential areas of invasive concern are located in the park. | Landsat 5 TM, Landsat 7 ETM+, Landsat 8 OLI, Sentinel-2 MSI, and Sentinel-1 C-SAR will be used to create a time series of vegetation classifications, which will be incorporated into the forecasted distribution map. | N/A |

***End-User Benefit*:** Amistad National Recreation Area will be able to use the information about historic and current distributions of giant cane to better plan their biological control management efforts. By understanding which monocultures are longer-standing and resilient, they can focus their efforts on newly-formed stands that have a greater likelihood of successful eradication. The workflow document will allow the end users to continue monitoring *A*. *donax* into the future.

**Project Timeline & Previous Related Work**

***Project Timeline:*** 1 Term: 2018 Spring

***Related DEVELOP Work:***

2016 Summer (LaRC) – Southwest US Ecological Forecasting: Mapping Invasive Species to Efficiently Monitor Southwestern National Park Areas

**Notes & References:**

***Notes*:**

Sentinel-1 data available through GEE API, Alaska Satellite Facility DAAC, and Earthdata Search.