**NASA DEVELOP National Program**

****USGS at Colorado State University

*Spring 2017*

**Short Title: Arizona Water Resources**

**Subtitle:** Utilizing NASA Earth Observations to Delineate Riparian Corridors and Evaluate Tamarisk Cover in the Verde River Watershed

**VPS Title:** A Ripple of Green: Mapping Riparian Corridors in the Verde Watershed

**Project Team & Partners**

**Project Team:**

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**Advisors & Mentors:**

Dr. Paul Evangelista (Colorado State University)

Dr. Amanda West (Colorado State University)

**Past or Other Contributors:**

Brian Woodward

**Partner Organizations:**

|  |  |  |  |
| --- | --- | --- | --- |
| **Organization** | **POC (Name, Position/Title)** | **Partner Type** | **Boundary Org?** |
| Walton Family Foundation | Peter Skidmore, Program Officer | End-User | No |
| USGS, Fort Collins Science Center | Dr. Catherine Jarnevich, Research Ecologist | Collaborator | No |
| USGS, North Central Climate Science Center | Dr. Gabriel Senay, Research Physical Scientist | Collaborator | No |

**Project Details**

**Applied Sciences National Applications Addressed:** Water Resources

**Study Area:** Verde River watershed; transecting Yavapai, Gila and Maricopa County, AZ

**Study Period:** 2006 – 2016 (May – November)

**Earth Observations & Parameters:**

Shuttle Radar Topography Mission (SRTM) Version 2 – elevation, slope, integrated moisture index

Landsat 8 Operational Land Imager (OLI) – land cover

Landsat 8 Thermal Infrared Sensor (TIRS) – thermal bands

Landsat 7 Enhanced Thematic Mapper Plus (ETM+) – land cover

Landsat 5 Thematic Mapper (TM) – land cover

Sentinel-2 MultiSpectral Instrument (MSI) – NDVI; red-edge bands

**Ancillary Datasets Utilized:**

* USGS National Land Cover Database (NLCD) – land cover
* USGS National Hydrography Dataset (NHD) – flowlines and waterbodies
* USGS National Elevation Dataset (NED) – 10m DEM
* NRCS Soils Classification – soil types
* Global Biodiversity Information Facility (GBIF) – Publicly available occurrence data of invasive species and native riparian species

**Software Utilized:**

* Software for Assisted Habitat Modeling – Random Forest, MaxEnt, and Boosted Regression Tree Modeling
* ESRI ArcGIS – data processing and analysis, map creation, raster manipulation/analysis
* R-CAT (Riparian Condition Assessment Tool) ArcGIS Toolbox – valley bottom delineation
* Exelis ENVI – imagery processing
* R – index calculations

**Project Overview**

**80-100 Word Objectives Overview:**

The objectives of this project are to delineate the maximum potential riparian corridor area and to map both riparian vegetative cover and invasive Tamarisk (*Tamarix spp*.) cover in the Verde River Watershed. Riparian corridors play an essential role in maintaining biodiversity and enabling important ecological processes; however, these corridors are being threatened by the proliferation of invasive species, particularly Tamarisk. Prompted by the concern of land management organizations, the Arizona Water Resources Project mapped the current potential extent of riparian corridors, riparian vegetative cover, and invasive tamarisk to assist end-users in determining management best practices of riparian habitat and invasives in the Verde River Watershed.

**Abstract:**

Riparian corridors in the semiarid Colorado River Basin act as an interface between terrestrial and aquatic systems, play an important role in maintaining biodiversity and wildlife habitat, and contribute to controlling erosion and buffering pollutant and nutrient runoff. However, the proliferation of invasive species such as Tamarisk (*Tamarix spp.*) within these corridors disrupts biodiversity and essential ecological and hydrogeomorphic processes, including water balance and sediment and nutrient loads. This project utilized terrain data from SRTM, spectral and thermal indices derived from NASA’s Landsat 5, Landsat 7, and Landsat 8, and multispectral imagery from Sentinel-2 to map the current maximum potential riparian corridor area, riparian vegetation, and invasive Tamarisk cover in the Verde River watershed, which feeds major Colorado river tributaries in the lower Colorado River Basin. Potential riparian corridors and Tamarisk cover were mapped for both 2016 and 2006 to enable partners at the Walton Family Foundation to prioritize future ecological restoration areas as well as to evaluate the efficacy of previous management efforts in the Verde watershed. In addition, the team produced a tutorial detailing project methodology that can be replicated by partners to support their efforts to manage riparian habitat and invasive species across the entire Colorado River Basin and in future years.

**Keywords:**

Riparian corridor, invasive species mapping, habitat suitability modeling, Tamarisk

**Community Concerns:**

* Riparian areas threatened by invasive species are of high concern to farmers, land managers, and surrounding communities due to the important role they play in controlling erosion, flooding, and in buffering pollutant and nutrient runoff.
* Tamarisk invasion has altered riparian habitats throughout the Colorado River Basin, and in the Verde River watershed it is endangering rare, native cottonwood-willow communities.
* The Verde River headwaters and upper catchment are threatened by encroaching development and rapid population growth, increasing demands on the health and sustainability of the watershed.
* Controlling invasive species and restoring native riparian areas in the Colorado River Basin presents a possibility for a cost-effective method of securing ecological and human water needs.

**Current Management Practices & Policies**:

In 1984, a large section of the Verde River was designated “Wild and Scenic”, providing federal protection to maintain critical wildlife habitat and the unregulated flow of the river. However, several land and water conservation groups are now concerned by the threat that development and invasive species pose to riparian habitats across the larger Verde watershed. The Walton Family Foundation has acted as a private granting organization for multiple Verde River conservation organizations that work to restore, preserve, and promote the recreational value of the Verde by exploring management practices that will sustain the Verde River System. Currently, the WFF relies on a patchwork of publically available data and associated information regarding the locations of riparian corridors and invasive as well as native species presence throughout the Colorado River Basin. The organization is familiar with NASA Earth observations; however, to date they have not used them to quantify riparian areas or invasive species cover.

**Decision Support Tools & Benefits:**

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| --- | --- | --- | --- |
| **End-Product** | **Earth Observations Used** | **Benefit & Impact** | **Software**  **Release** |
| Potential Riparian Corridors Map | SRTM, Landsat 8 OLI, and Sentinel-2 | The mapping and quantification of total potential riparian area across the Verde River basin will enable end-users to locate and prioritize future ecological restoration. | N/A |
| Riparian Vegetation Cover Maps for 2010 and 2016 | Indices from SRTM, Landsat 8 TIRS, Landsat 7 ETM+, Landsat 5 TM, and Sentinel-2 | Evaluation of riparian vegetation for both 2010 and 2016 will enhance prioritization of new riparian habitat management efforts and provide insight into changes in riparian vegetation over time. | N/A |
| Species Cover Modelling Tutorial | The tutorial will cover data collection and processing of Earth observations, fitting statistical models to the data, and interpretation of model output | Enables end-users to replicate these methods to and apply them across other regions, and for future dates. | N/A |