**NASA DEVELOP National Program**

**** NASA John C. Stennis Space Center

**Summer 2015**

**Mississippi Ecological Forecasting**

**Subtitle:** Using NASA Earth Observations to Locate Potential Habitat for the Dusky Gopher Frog

**VPS Title:** Ponds, Pines, and Precipitation: A Dusky Gopher Frog Investigation

**Project Team & Partners**

**Project Team:**

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**Past or Other Contributors:**

Shelby Barrett

**Partner Organizations**

The Nature Conservancy (End-User, POC: Jim Lee)

USDA Forest Service: DeSoto Ranger District (Boundary Organization, POC: Ed Moody)

US Fish and Wildlife Service (Collaborator, POC: Linda LaClaire)

US Army Corps of Engineers (Boundary Organization, POC: Danny Hartley)

**Project Details**

**Applied Sciences National Applications Addressed:** Ecological Forecasting

**Study Area:** Jackson, Harrison, and Hancock Counties, MS and St. Tammany Parish, LA

**Study Period:** January 2005 - Present

**Earth Observations & Parameters**

Landsat 8, OLI – Land Use Land Cover (LULC), Vegetation Indices

Landsat 5, TM – Historical Imagery, Vegetation Indices (NDVI), LULC

Terra, ASTER – Vegetation Indices (NDVI), Water Quality Indices, 30m DEM

Space Shuttle, SRTM – Elevation Data and DEMs

**Ancillary Datasets Utilized**

* USGS Gap Analysis Program (GAP)
* USGS LANDFIRE Landcover Dataset – USGS
* USGS EarthExplorer – Elevation ASTER DEM
* LiDAR Elevation Dataset – Bare Earth DEM - WebGIS
* Historical precipitation data – PRISM
* Existing locations and extent of DGF Ponds – USFS, USFWS
* Location of previously surveyed areas for DGF habitat - USFS, USFWS
* High Resolution Aerial and SatelliteData – USGS, EarthData International
* NOAA CSC - Coastal Change Analysis Program (CCAP) Regional Land Cover product, NED

**Models Utilized**

* Probability Model - ArcGIS

**Software Utilized**

ERDAS IMAGINE – Mosaicked and clipped scenes to study area for imagery, used different indices (NDWI, NDPI, WV-WI) for summer and winter, changed detection of indices for imagery.

ArcGIS - Raster Manipulation/Analysis, Image Enhancement & Map Creation of all layers (Soil, Elevation, Precipitation, Land Use/Land Cover, and Imagery) clipped to study area, Statistical Analysis on all layers and final overlaid layers, and Map Algebra to compute probabilities of overlaid habitat model. Used existing dusky gopher frog ponds to quality check results and determine the most effective index

ENVI – Stacked and corrected for top of atmosphere reflectance for imagery.

**Project Overview**

**80-100 Word Objectives Overview**

The dusky gopher frog (DGF), *Lithobates sevosus*, is the most endangered species of frog in North America and is listed as one of the top 100 endangered species in the world. The reduction of longleaf pine forests, coupled with the highly specific habitat requirements oftheDGF*,* makes it especially challenging for federal land wildlife managers to maintain existing populations. Threatened by many factors, the DGF is currently at risk of becoming extinct. In response, this project used NASA Earth observations to locate potential habitat for the dusky gopher frog.

**Abstract**

The dusky gopher frog (DGF), *Lithobates sevosus*, is currently found in only four ponds in south Mississippi. This small, wild population is threatened by high risk of inbreeding depression due to genetic isolation, loss of habitat due to land development, wildfire suppression, and runoff from surrounding roadways. Historically, these frogs inhabited longleaf pine ecosystems and utilized burrows from the gopher tortoise (*Gopherus polyphemus),* which is also endangered. In response, this project used NASA Earth observations to locate potential habitat for the DGF. Landsat 8 OLI was used to calculate vegetation indices and produce updated land cover classifications. ASTER imagery and Landsat 5 data were also used to calculate vegetation indices and water quality indices for the study area. NASA Earth observations were utilized to identify ponds, canopy cover, proximity to roadways, proximity to developed land, proximity to other bodies of water, appropriate pond hydrology over the course of the year, and emergent and submerged vegetation. NAIP aerial data were assessed for ability to detect ponds smaller than those detectable at the Landsat scale. This project will augment current decision-making practices regarding where relocation and reintroduction ponds for the dusky gopher frog should be established in order to aid in monitoring, protection, and restoration of this critically endangered species. Using this information, partnering organizations will be able to identify and map areas with the ideal land cover, water quality, and elevation characteristics for DGF habitation.

**Community Concerns**

* The dusky gopher frog (DGF), *Lithobates sevosus*, is the most endangered species of frog in North America and is listed as one of the top 100 endangered species in the world.
* Currently, this species is found to inhabit and breed in only two, genetically-isolated ponds in Harrison County, Mississippi.
* Diseases known to frogs, such as chytrid fungus, are also known to cause mortality in the DGF. Should wild DGF populations experience a severe outbreak of chytrid fungus, it has the potential to drive the species to extinction.
* Historically, these frogs inhabited the longleaf pine ecosystems and utilized burrows from the gopher tortoise (*Gopherus polyphemus),* which is also endangered.
* The reduction of longleaf pine forests, coupled with the highly specific habitat requirements of *Lithobates sevosus* and the currently typical forestry management practices, makes it especially challenging to federal land wildlife managers to maintain existing populations and increase the number of viable populations through reintroduction and establishment of new populations.

**Current Management Practices & Policies**

On September 10, 2014, the US Fish and Wildlife Service released a draft recovery plan for the dusky gopher frog (DGF) outlining proposed steps and goals to locate existing ponds, stabilize existing populations, and establish new populations by introducing DGF into modified habitats. In this document, the U.S. Fish and Wildlife Service specifically include goals to incorporate GIS and remote sensing into the DGF recovery plan. This includes obtaining and housing GIS data relevant to DGF conservation, using remote sensing and GIS to locate potential populations and suitable habitat for reintroduction, and locating existing populations that were previously unknown. In the past, all restoration efforts have been limited to field surveys and manual efforts to locate potential DGF habitat.

**Decision Support Tools & Benefits**

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| **End-Product** | **Earth Observations Used** | **Benefit & Impact** |
| Updated Landcover Classifications | Landsat 8 OLI | Provide end-users with the most current land cover information and extent of cover types |
| Vegetation Indices | Landsat 5 TM  Landsat 8 OLI | Provide end-users with current and past health of vegetation surrounding both current and potential gopher frog ponds |
| Topographical Map | ASTER DEMs  SRTM | Provide end-users with a clearer understanding of existing topography at current and potential sites in order to best determine if and how sites need to be hydrologically altered in order to best suit DGF habitat specifications |
| Current Extent of Suitable Habitat Maps | Landsat 5 TM  Landsat 8 OLI  ASTER Imagery | Provide end-users with the most updated highlight areas currently suitable for DGF habitation |
| Suitable Habitat Forecast | Landsat 5 TM  Landsat 8 OLI  ASTER Imagery | Provide end-users with maps highlighting of the location of potential sites for reintroduction |

**Project Imagery**

**[Insert image here]**

**Caption:** Image showing overlaid layers for this project. The layers include existing ponds, longleaf and loblolly forests and potential habitat.

Image Credit: Mississippi Ecological Forecasting Team

**Image:** 