NASA DEVELOP National Program
2024 Spring Project Proposal

North Carolina – NCEI
Rhode Island Ecological Conservation
Methods for Monitoring Rhode Island Habitats: Contributing to a Framework for Targeted Conservation and Management

Project Overview

Project Synopsis: The Audubon Society of Rhode Island (ASRI) is implementing a research program that incorporates scientific methods into a strategic plan to support avian conservation in Rhode Island. In doing so, ASRI collects baseline data on bird species-habitat associations across managed properties and on "responsibility bird" species (RBS), which require additional monitoring and management and whose protection may support the conservation of other species. Currently, ASRI is working to create detailed monitoring schemes for nine identified RBS and wants to incorporate remote sensing frameworks with Earth observation data into their habitat monitoring methods. These methods could allow ASRI to highlight areas of conservation importance for RBS and prioritize areas for land acquisition and management. Towards achieving this capacity, ASRI is partnering with NASA DEVELOP to investigate the feasibility of leveraging imagery from Landsat and Sentinel-2 satellites to monitor historical landcover cover change statewide and model landcover change in the future.

Study Location: RI
Study Period: January 2013 – January 2024, Forecasting to TBD

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Partner Overview

Partner Organization:

Organization	Contact (Name, Position/Title)	Partner Type	Sector
Audubon Society of Rhode Island	Dr. Charles Clarkson, Director of Research	End User	Non-profit

End User Overview
End User's Current Decision-Making Process & Capacity to Use Earth Observations: ASRI is an independent non-profit dedicated to environmental education, conservation, and advocacy to promote wildland and aquatic bird conservation. The ASRI currently manages approximately 10,000 acres of wildlife habitat in Rhode Island (roughly 1.2% of the area of Rhode Island), making it one of the largest private landowners in the state. To support proactive stewardship, ASRI has enacted the Audubon Avian Research Initiative with the prerogative of creating meaningful management plans through comprehensive data collection and detailed monitoring. ASRI is interested in partnering with DEVELOP to improve its capacity to use remote sensing for these purposes. ASRI is familiar with using software, imagery, and data for geospatial and statistical analysis and is interested in gaining the capacity to integrate remote sensing data into landcover maps to guide land acquisition, conservation, and management. This capacity will ultimately enhance ASRI's efforts to mitigate declines in breeding and migratory bird populations and contribute to state and regional RBS population growth.

Earth Observations Overview

Earth Observations:

Platform & Sensor	Parameter(s)	Use
Landsat 8 OLI	Landcover surface reflectance profiles, spectral indices	Spectral vegetation indices e.g., Normalized Difference Vegetation Index (NDVI) will be used to assess changes in land use land cover over the study period.
Landsat 9 OLI-2	Landcover surface reflectance profiles, spectral indices	Spectral vegetation indices e.g., Normalized Difference Vegetation Index (NDVI) will be used to assess changes in land use land cover over the study period.
Sentinel-1 MSI	Synthetic aperture radar	SAR data are a potential source of information for delinating wetlands in classification schemes.

Ancillary Datasets:
- NOAA Coastal Change Analysis Program (C-CAP) – Analyze land use land cover change in Rhode Island over the study period
- USDA Cropland Data Layer (CDL) – Potential source of land use land cover change over the study period
- USGS LANDFIRE – Potential source of land use land cover change over the study period

Modeling:
- Clark Labs, TerrSet Land Change Modeler (POC: Sean McCartney, Analytical Mechanics Associates, NASA Goddard Space Flight Center) – Model future land use

Decision Support Tool & End Product Overview

End Products:

End Product	Partner Use	Datasets & Analyses
Land Use Land Cover Change Maps	Enhanced capacity to investigate historical and contemporary landcover composition and evaluate recent changes in land use land cover across Rhode Island.	Surface reflectance imagery from Landsat 8 OLI and Landsat 9 OLI-2, synthetic aperture radar data from Sentinel-1, and land use land cover data from NOAA C-CAP will be used to assess changes in land use land cover over the study period at a timestep determined through

		conversations with the project partner.
Forecasted Land Use Land Cover Change Map	The partners utilize forecasted land cover change to prioritize land acquisition and management efforts that support avian conservation.	The team will input historical NOAA C-CAP land use land cover change into TerrSet to model future land use land cover.

Project Timeline & Previous Related Work

Project Timeline: 1 Term: 2024 Spring

Similar Past DEVELOP Projects:
- 2017 Spring ID – Intermountain West Ecological Forecasting
- 2017 Fall LaRC – Pacific Southwest Cross-Cutting II
- 2018 Fall JPL – Mojave Desert Ecological Forecasting
- 2019 Spring GA – Talamanca-Osa Ecological Forecasting (Internal DEVELOPedia link)
- 2019 Summer MSFC – Conecuh National Forest Ecological Forecasting (Internal DEVELOPedia link)
- 2021 Summer ID – Mark Twain National Forest Ecological Forecasting (Internal DEVELOPedia link)
- 2021 Spring GSFC – Western Montana Ecological Forecasting (Internal DEVELOPedia link)
- 2022 Summer GSFC – Maine Ecological Forecasting III (Internal DEVELOPedia link)

References:

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Clarkson, C. (2023). The State of Our Birds Part 1: Breeding and Overwintering. Audubon Society of Rhode Island Research Initiative, pp 97.

Liu H., Gong, P., Wang, J, Wang, X., Ning, G., & Xu, B. (2021). Production of global daily seamless data cubes and quantification of global land cover change from 1985 to 2020 – iMap World 1.0. *Remote Sensing of Environment,* 258, 112364.

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2024 Spring Project Work Plan

Data

A starting point for partner discussions may be determining which datasets the ASRI would like to use to monitor change in land use land cover (LULC).

NOAA Coastal Change Analysis Program (C-CAP)

The ASRI The State Of Our Birds Report describes that the ASRI classifies habitats in ASRI Wildlife Refuges based on habitat definitions used in the NOAA C-CAP land cover inventories. More information about this program is available on the [NOAA C-CAP website](#).

- Basics
    - [StoryMap overview of C-CAP](#)
    - [Frequently Asked Questions](#)
    - [C-CAP Classification Scheme and Class Definitions](#)
    - [Discussion of C-CAP, Landsat, and NLCD data](#)
- Data
    - [C-CAP Land Cover Atlas](#)
    - [Digital Coast: Data Access Viewer](#)
- Technical support:
    - [How to Clip Land Cover in ArcGIS](#)
    - [Excel worksheets for basic analysis of change data](#)
- Programming support:
    - [Blog: Exploring the C-CAP Land Cover Atlas using Machine Learning and Python Part 1: Retrieving Data from an API](#)
    - [Blog: Exploring the C-CAP Land Cover Atlas using Machine Learning and Python Part 2: Cleaning the Data](#)
    - [Blog: Exploring the C-CAP Land Cover Atlas using Machine Learning and Python Part 3: Exploring the Data with Unsupervised Machine Learning](#)

Project Suggestions from Joe Spruce:

Pre-existing land cover maps include those by the USGS for their NLCD and LCMAP product lines. The LCMAP data has a similar classification scheme specificity to the Dynamic World land cover maps. The US Forest Service also produces basic land cover maps from Landsat data as part of its LCMS project. NOAA C-CAP produces coastal LULC maps for the US with higher classification scheme specificity for the wetland classes, relative to NLCD. C-CAP is in the process of transitioning from 30-meter Landsat based maps to 1-meter maps derived from NAIP data (https://coast.noaa.gov/digitalcoast/data/ccaphighres.html). Apparently, a version-1 C-CAP high spatial resolution (1-meter?) map for Rhode Island as of 2016 is available for download at: https://coastalimagery.blob.core.windows.net/ccap-landcover/CCAP_bulk_download/High_Resolution_Land_Cover/Version_1_Data/CONUS/index.html. If more detailed land cover maps are needed than what is already available (in terms of classification scheme specificity are), it would help if the partner could provide training data on where examples of critical habitats are located. This could be something to discuss in the next partner telecom.

In addition to vegetation indices, there are many water and snow detection indices. A water index may be of use for deriving a land-water mask so that land classifications can be just for land areas as opposed to land and water areas.

A telecon with the partner…could help clarify what partners would like. I think they would like LULC mapped for two dates and perhaps a change map that shows changes that occurred between the beginning

and end dates. I am not sure also if the end-user has experience with RS and GIS. If so, a basic tutorial would be good to include as a deliverable. Maybe it could be an appendix to the final report.