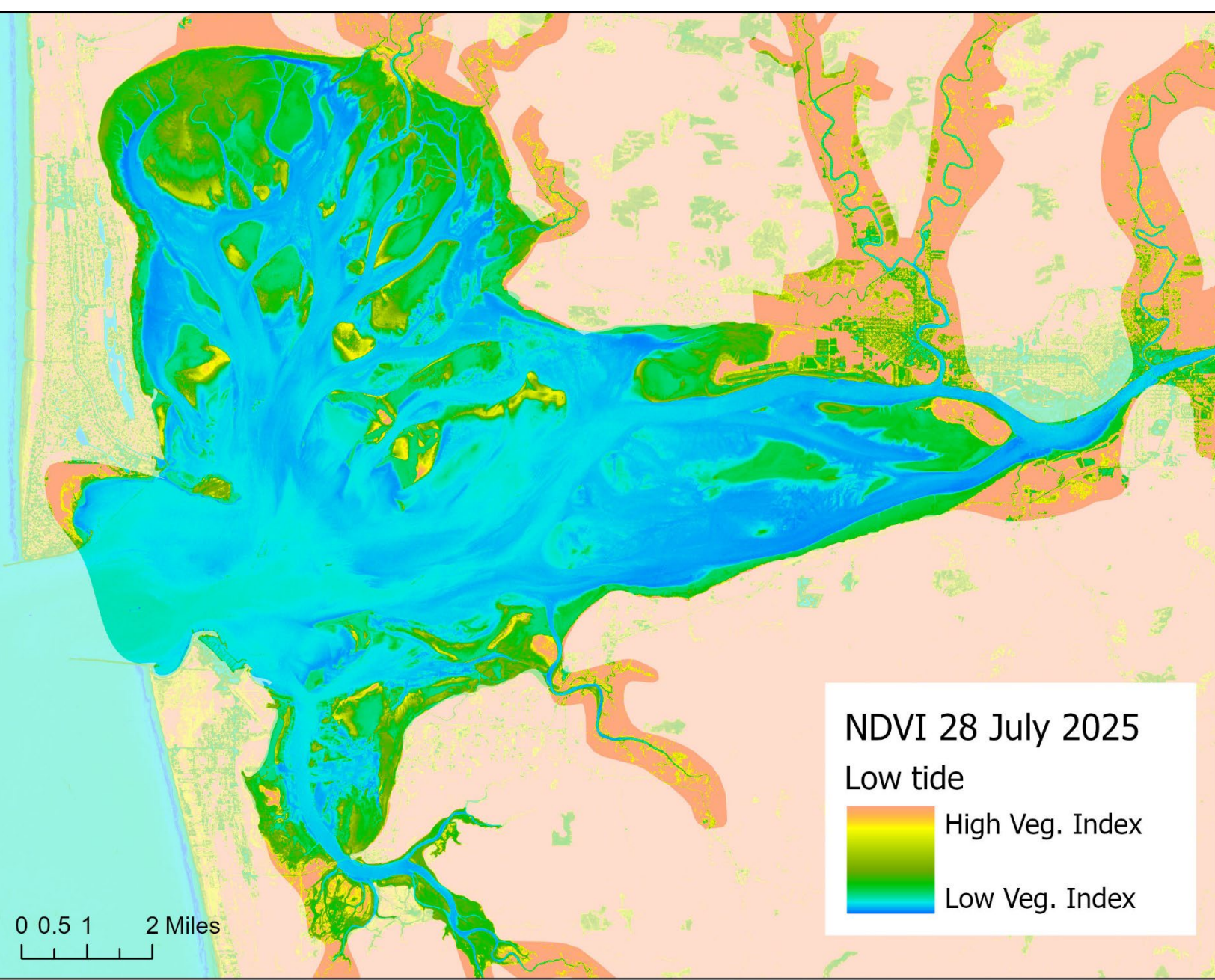
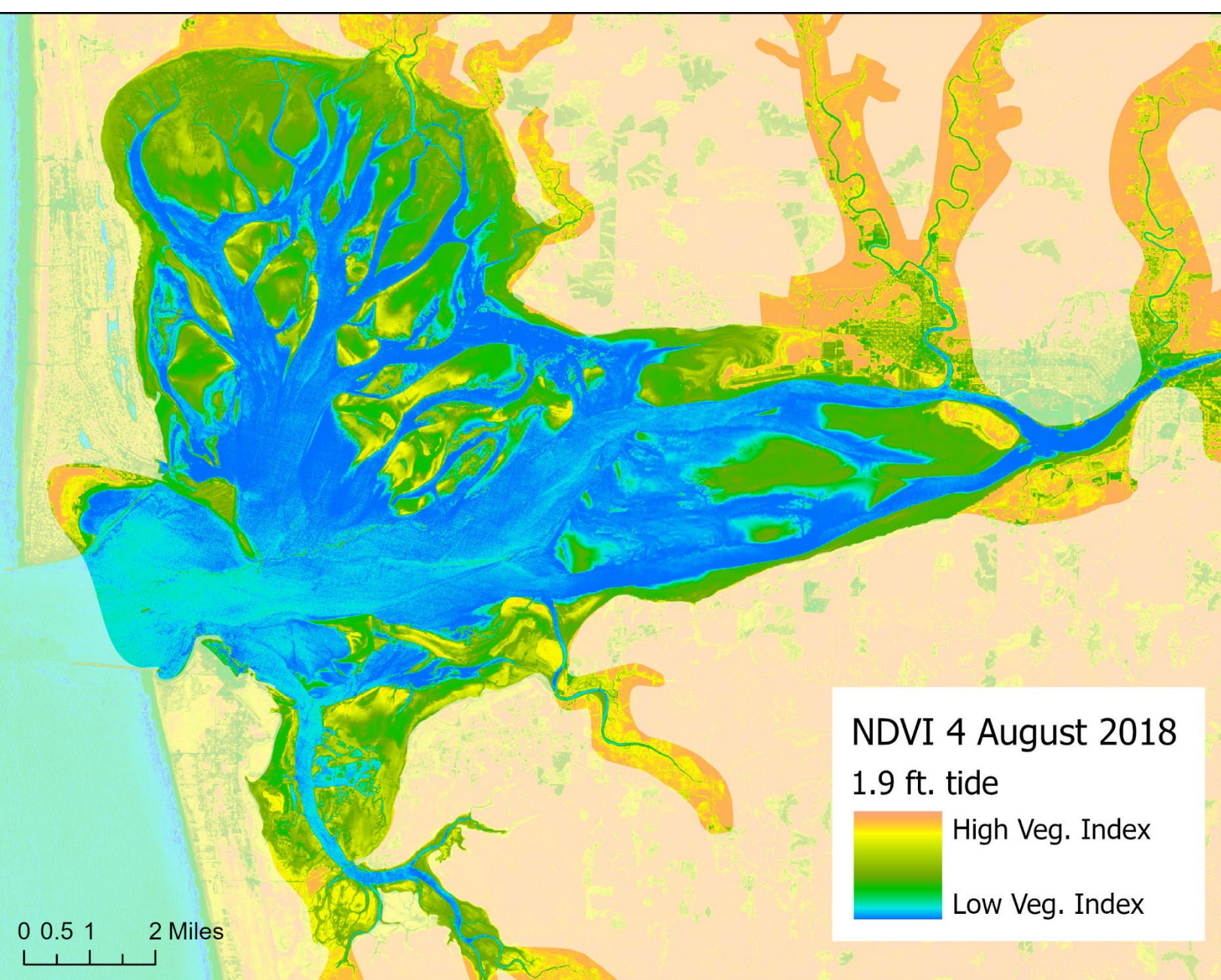
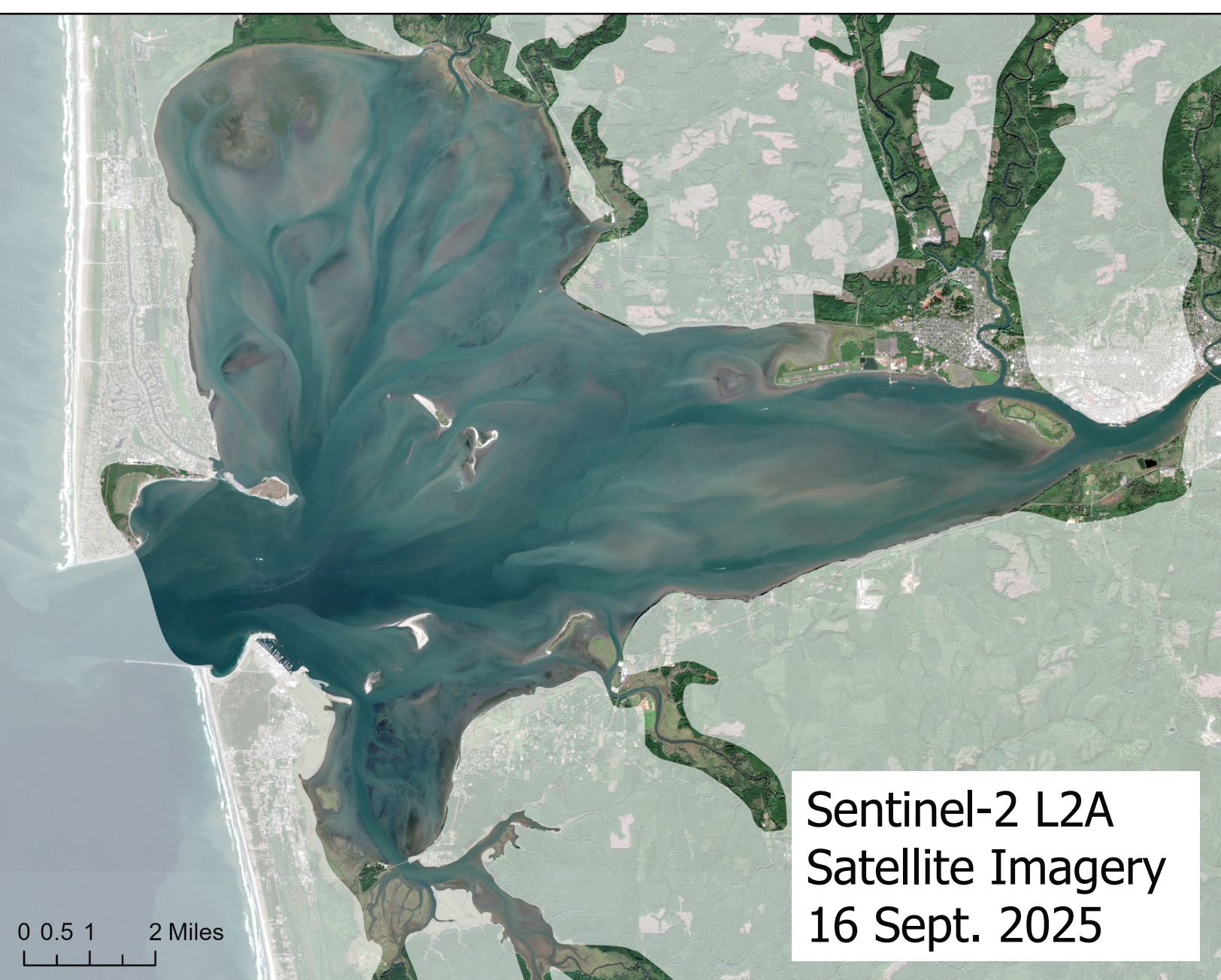


Grays Harbor Habitat Mapping Using Sentinel-2 Satellite Imagery



Goal: Map Grays Harbor Estuary Habitat

To support the ASRP and project sponsors in developing plans for protecting and restoring habitat in the Estuary Ecological Region, an effort was undertaken to update habitat mapping as most existing mapping is based on 20+ year old data.

One of the challenges with mapping habitat in estuaries is their size and dynamism. The estuary ecological region is 182 square miles, difficult to access on the ground, and habitats frequently change from human and natural forces.

To address this challenge, we evaluated Sentinel-2 L2A imagery to map habitats. Sentinel-2 is a European satellite mission consisting of a constellation of two satellites that provide high-resolution, multispectral imagery for monitoring Earth's land surfaces and coastal waters. The two satellites have a less than 5-day revisit time at mid-latitudes, and capture data in 13 spectral bands, 4 of which are 10-meter resolution (red, blue, green, and NIR). Each image is collected in a 290 km wide swath making it possible to view most of the Washington coast at a single point in time, and the data is publicly and freely available.

The high revisit time and large swath size provides advantages over other freely available imagery (e.g., NAIP) that is collected less frequently and not at a single tidal level.

Evaluation: Sentinel-2

Sentinel-2 has been collecting imagery since 2017, so we wrote code to clip and download all cloud-free usable images of the estuary as 5-band raster's (red, blue, green, NIR, SWIR) between 2017 and 2024. We obtained 57 high quality images and correlated images to tide at Westport.

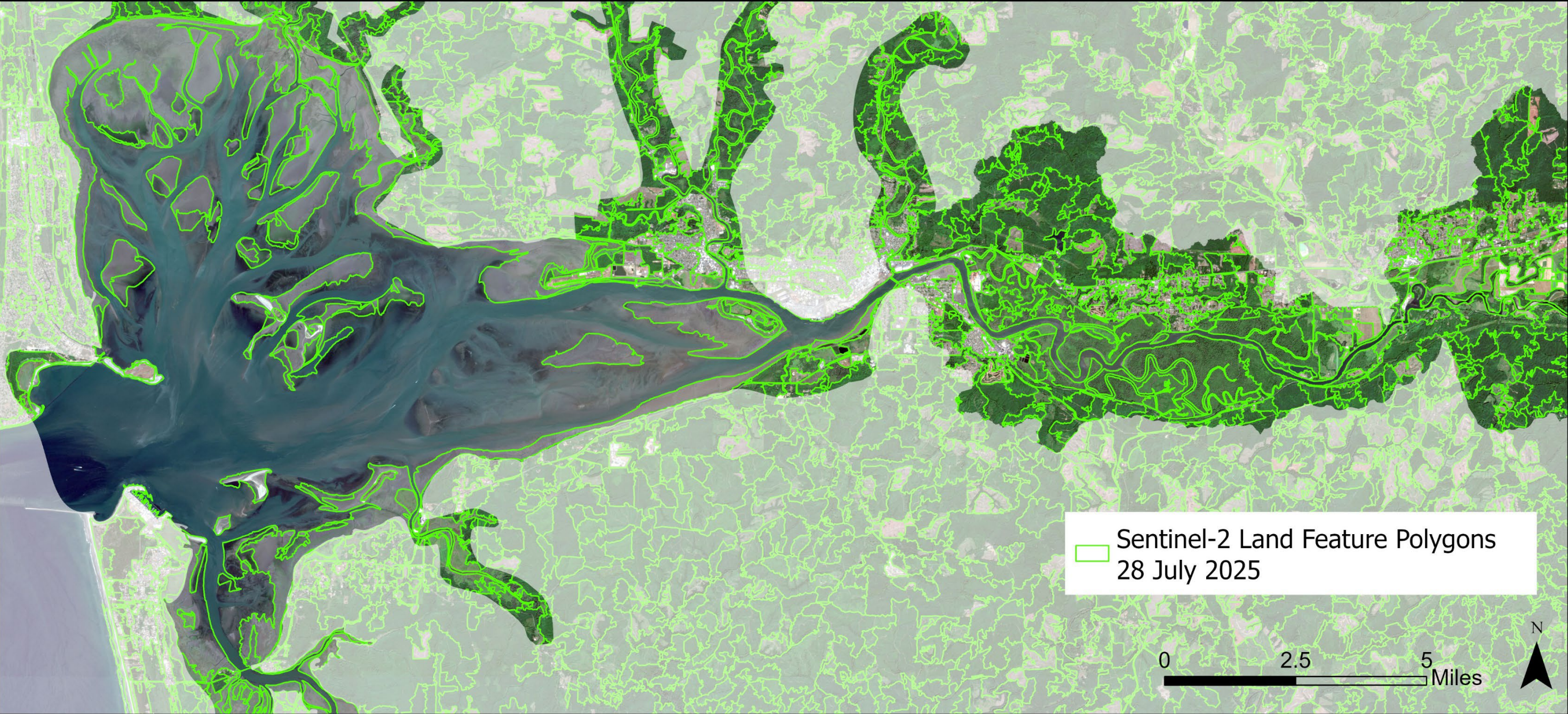
When we compare low-tide imagery from 2018 to 2024 using a Normalized Difference Vegetation Index (NDVI—where yellow is set to approximate the reflectance of aquatic vegetation bed), we see large differences in the amount and location of aquatic habitats through time. We also see large differences from older estuarine habitat mapping efforts (e.g., PMEP) when compared against current conditions.

Because of Sentinel-2's high revisit time, we can obtain recent imagery during cloud-free periods including imagery collected just 2 weeks ago, though not always at low-tide.

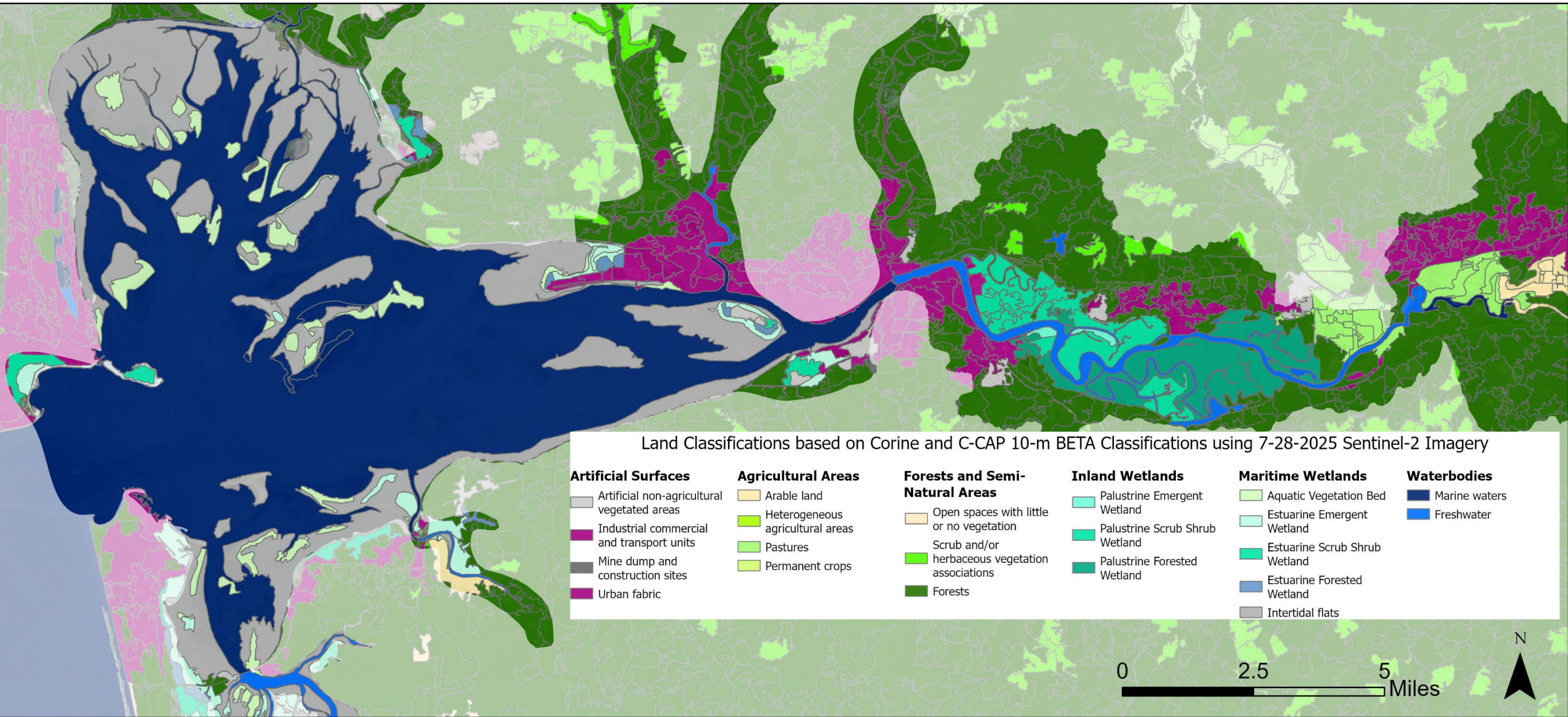
Habitat Mapping Approach –Object-based Machine Learning

Leverage new object-based machine learning approaches to repeatedly identify and classify habitats as new imagery becomes available.

1. Using Normalized Difference Vegetation Index (NDVI) Normalized Difference Water Index (NDWI), and Visible Atmospherically Resistant Index (VARI) as inputs, computer digitizes 53,000 polygons representing spatially distinct features.



2. Use existing data and knowledge to refine and classify polygons in a schema appropriate to the purpose and resolution of the resolution of the underlying data (e.g., Corine Land Cover and NOAA C-CAP BETA 10-meter classifications).



3. Develop, correct and update models. Note: The biggest challenge in classifying polygons is spatial and temporal incongruency. Without a good model, once the existing classifications become stale, you run the risk of having to start from scratch.