Oregon Coastal Wetland and Habitat Loss as a Result of Sea Level Rise

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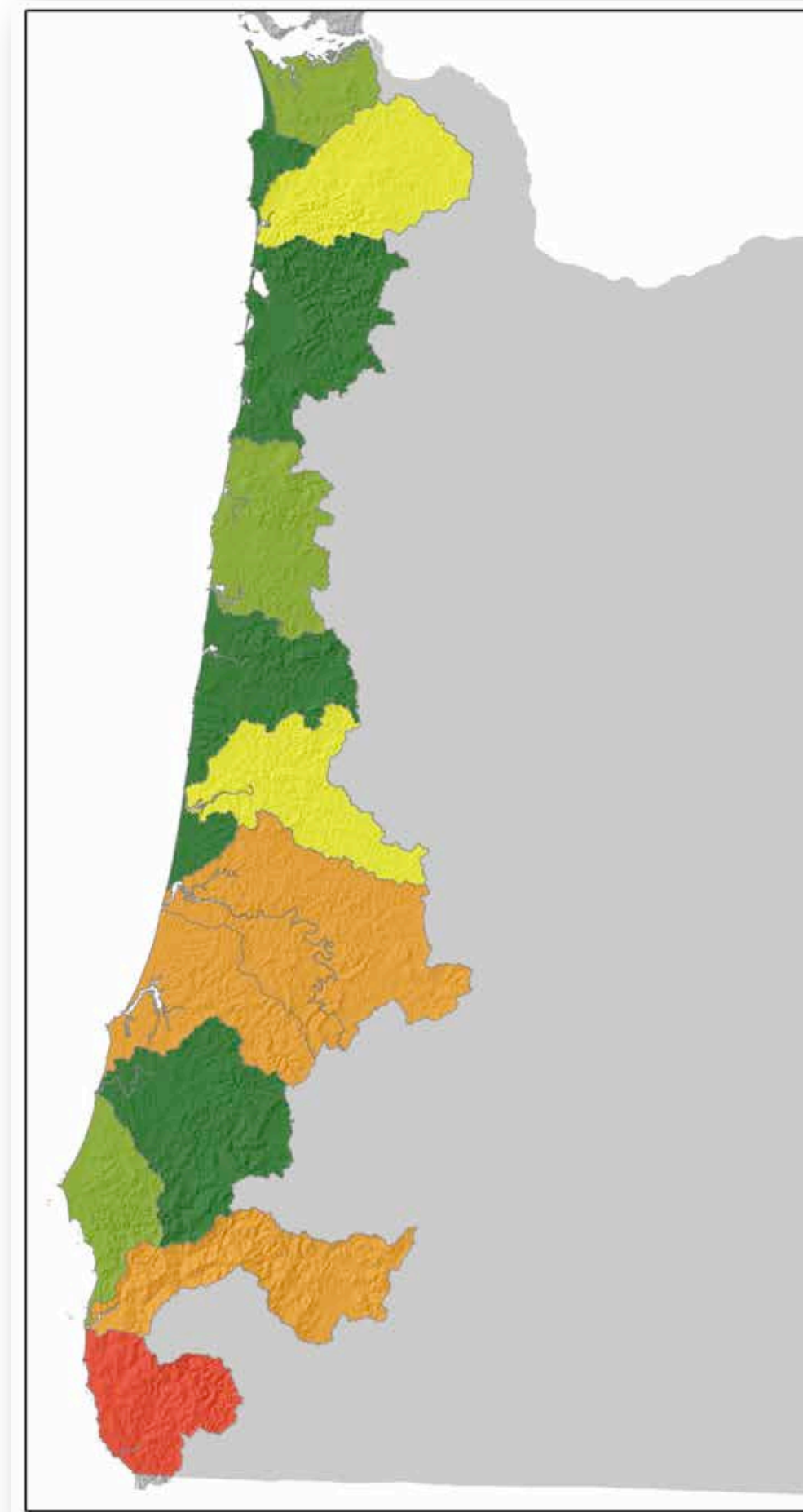Portland State University
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Introduction:

Coastal wetlands are areas of land from which water drains directly to the ocean by way of estuary or bay. These areas are of great importance as some of the most productive ecosystems on Earth. More than half of commercially harvested Pacific Ocean fish depend on coastal wetlands for spawning grounds, nursery habitat, shelter, and food at some stage of their lives. Despite their economic and ecologic importance, these wetlands have suffered degradation and loss due to land use changes. As climate change continues, the resulting sea level rise (SLR) is likely to further negatively impact these areas.
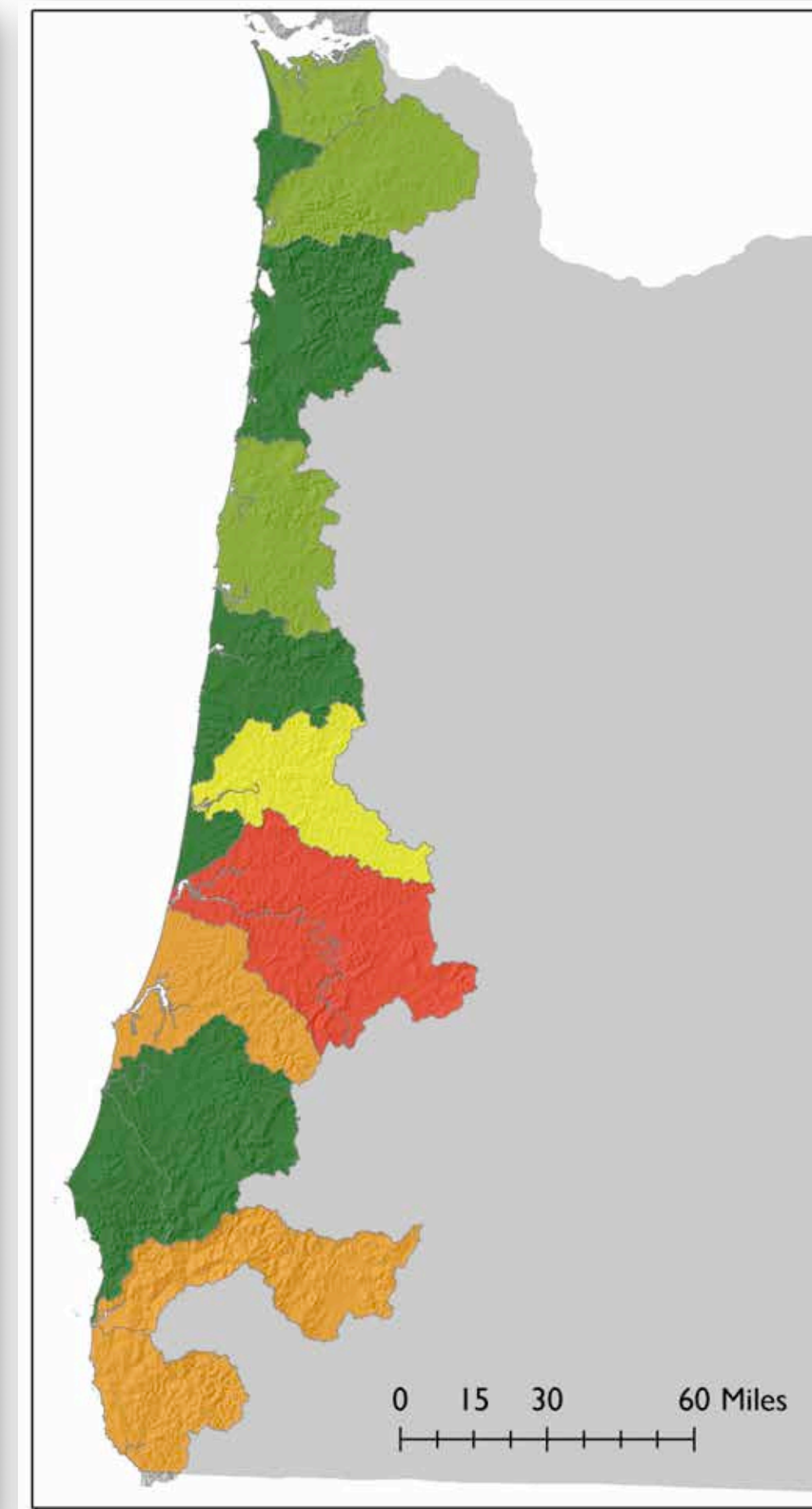
For our analysis, we selected 14 Oregon watersheds (HUC-8) that have either large estuarine or coastal influence. The Intergovernmental Panel on Climate Change has recently (2007) published several sea level rise scenarios that most literature considers to be conservative estimates. For our project, we utilized these sea level rise scenarios, 0.28 meter (low SLR), 0.69 meter (mid SLR) and 1.5 meter (high SLR) to estimate the potential loss to wetland area in Oregon's coastal watersheds. In order to focus our analysis on the areas within the watersheds that are likely to be the most impacted by sea water inundation, we were concerned only with areas within each coastal watershed that were below 10 meters in elevation.

The goal of this project is to map the potential wetland losses across the sea level rise scenarios to provide coastal land managers a suggested priority ranking for restoration and mitigation activities. We included the current salmonid river length density for each portion of the 14 watersheds below 10 meters, as several salmon are currently endangered and management is actively selecting areas for targeted restoration.

Analysis Methods:

Target Area:

10m DEM of Oregon Watersheds → Reclassify DEM → Raster-to-Polygon → Dissolve by Gridcode → Result: Target Watershed Shapefile

Wetlands:

NLCD 2011 Dataset → Reclassify → Raster-to-Polygon → Clipped to Target Area

Sea Level Rise Scenarios:

10 m DEM → Raster Calculator → Reclassify → Raster-to-Polygon → Dissolve by Gridcode → Export above 0 m

Percent Wetland Loss for SLR Scenarios:

Clip Wetlands to above 0 m → Recalculate by Geometry → Spatial Join all Scenarios → Calculate Percent Loss

Salmonid Index:

NHD Surface Stream Shapefile → Clip and Dissolve by Watershed → Calculate Geometry → ODFW Salmonid Stream Runs → Dissolve by Watershed → Calculate Percent Salmon per River

Low SLR Prediction

Mid SLR Prediction

High SLR Prediction

Risk of Wetland Loss
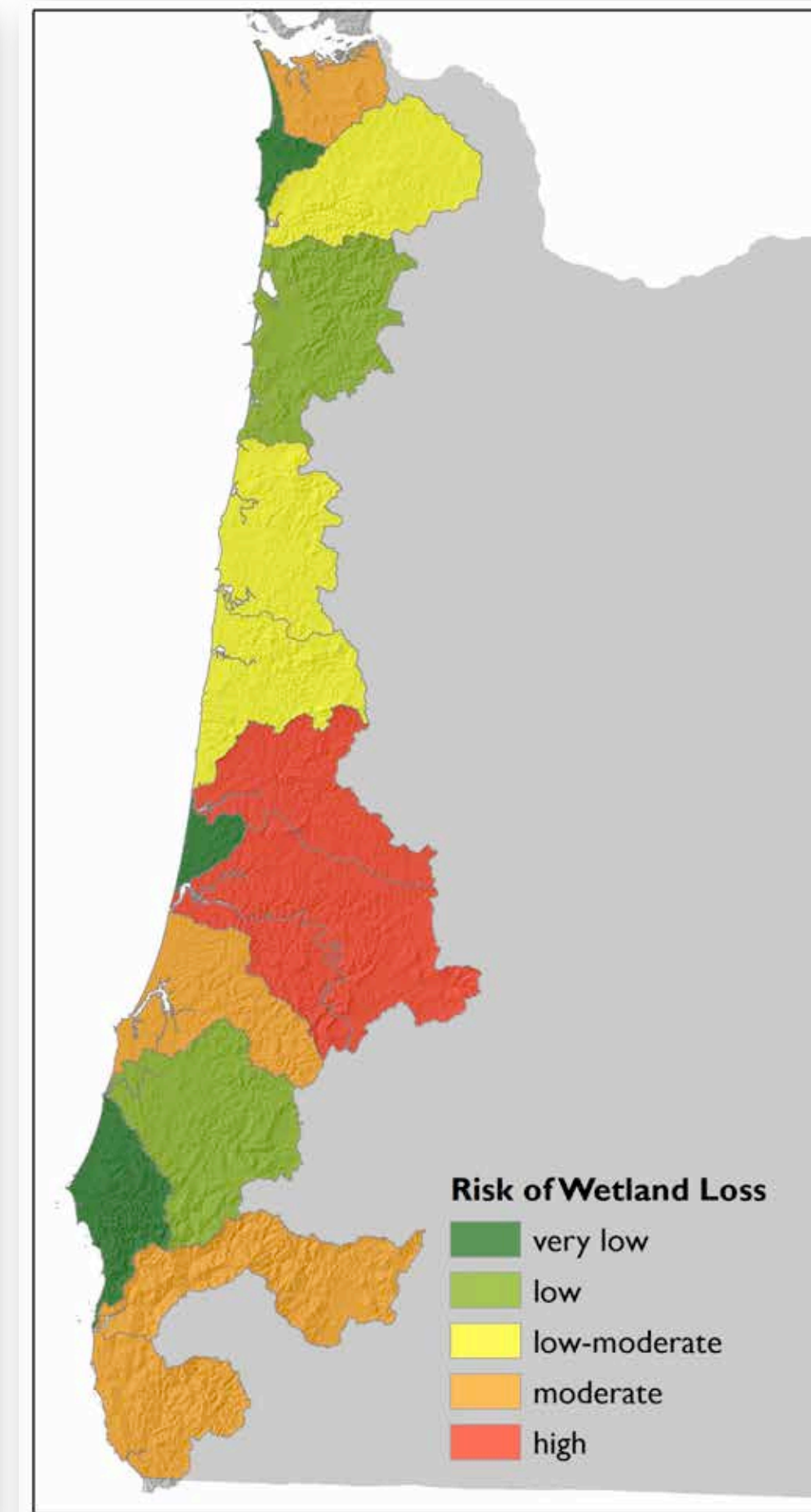- very low
- low
- low-moderate
- moderate
- high

Figure 1. Choropleth maps illustrating the potential loss of wetlands below 10 meters elevation for each Oregon coastally influenced watershed. Risk was assessed using IPCC low, medium, and high SLR predictions to calculate the percentage of wetland area lost under each scenario. Green indicates the least amount of wetland loss while red indicates the most wetland loss.

Coastal Wetland loss

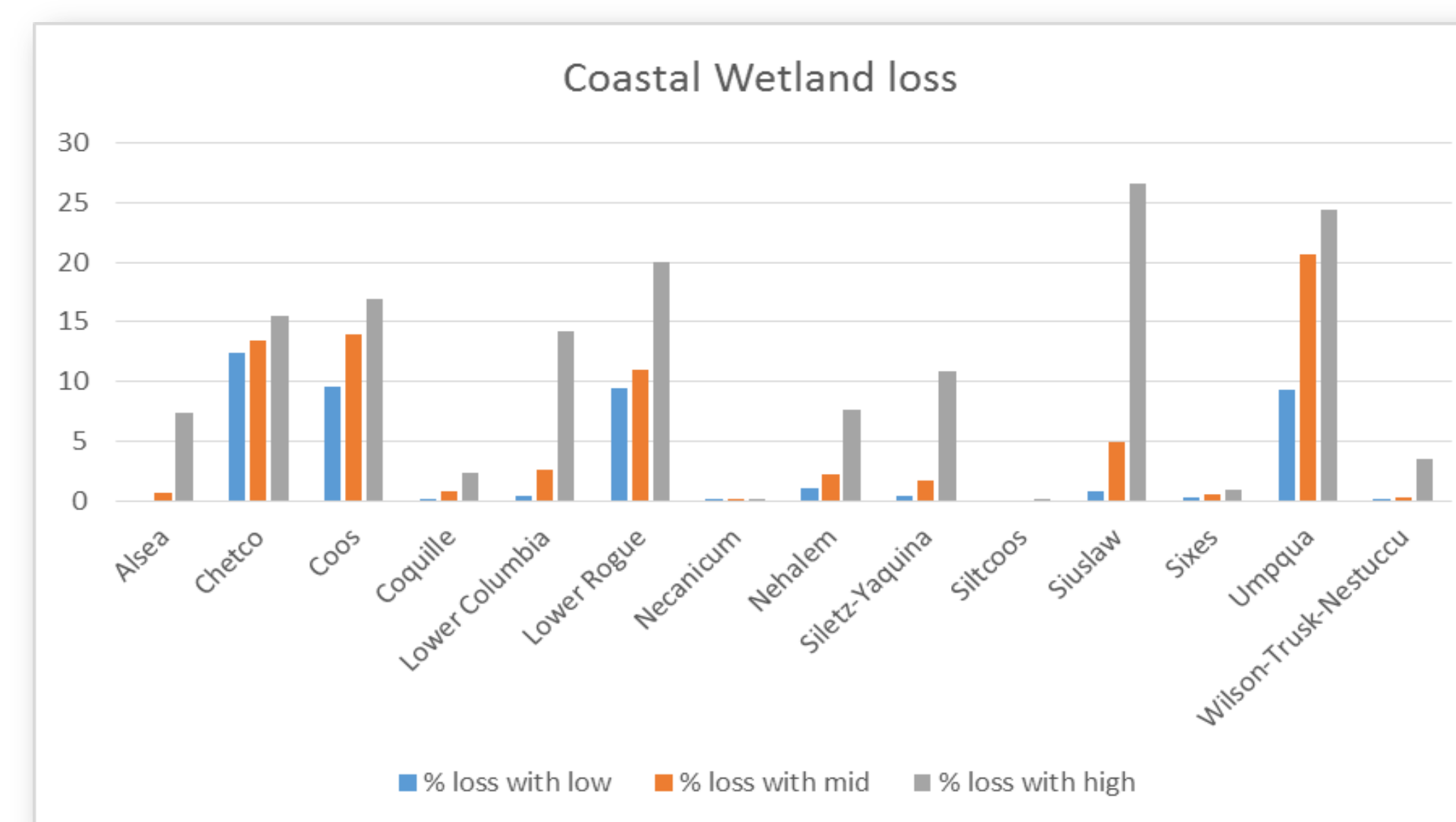- % loss with low
- % loss with mid
- % loss with high

Figure 2. Percent loss of Oregon's coastal wetlands based on low, mid, and high SLR predictions.

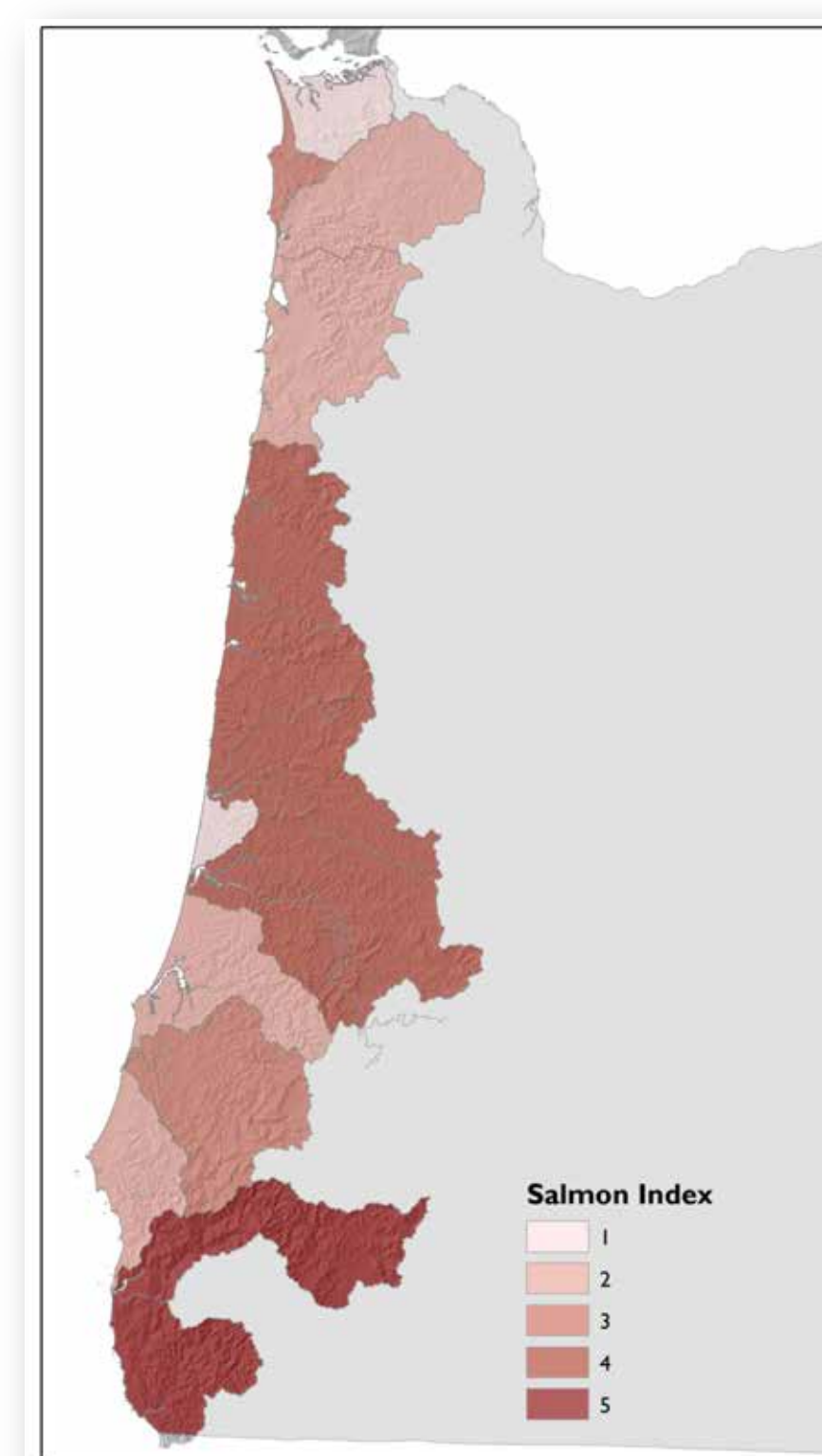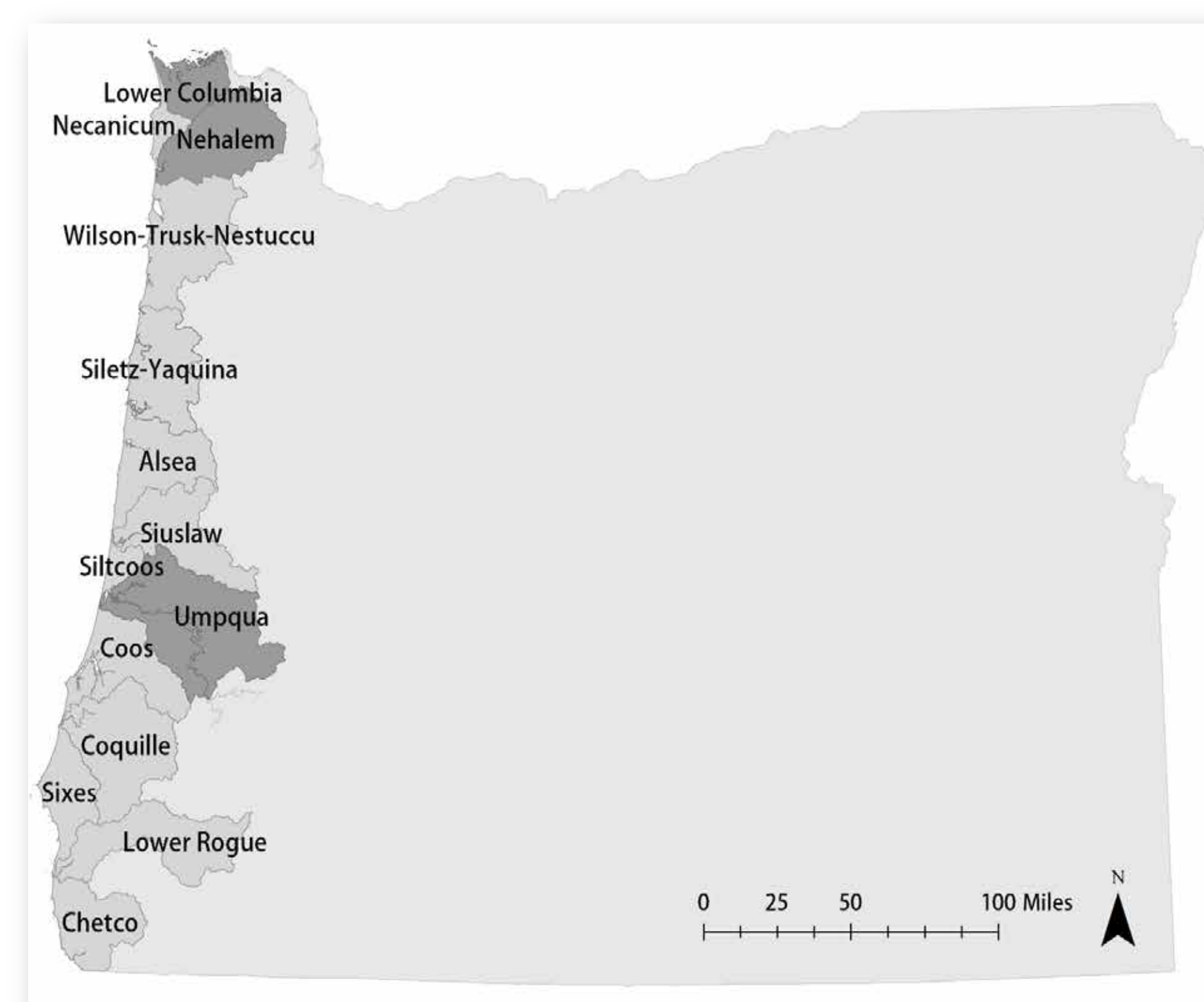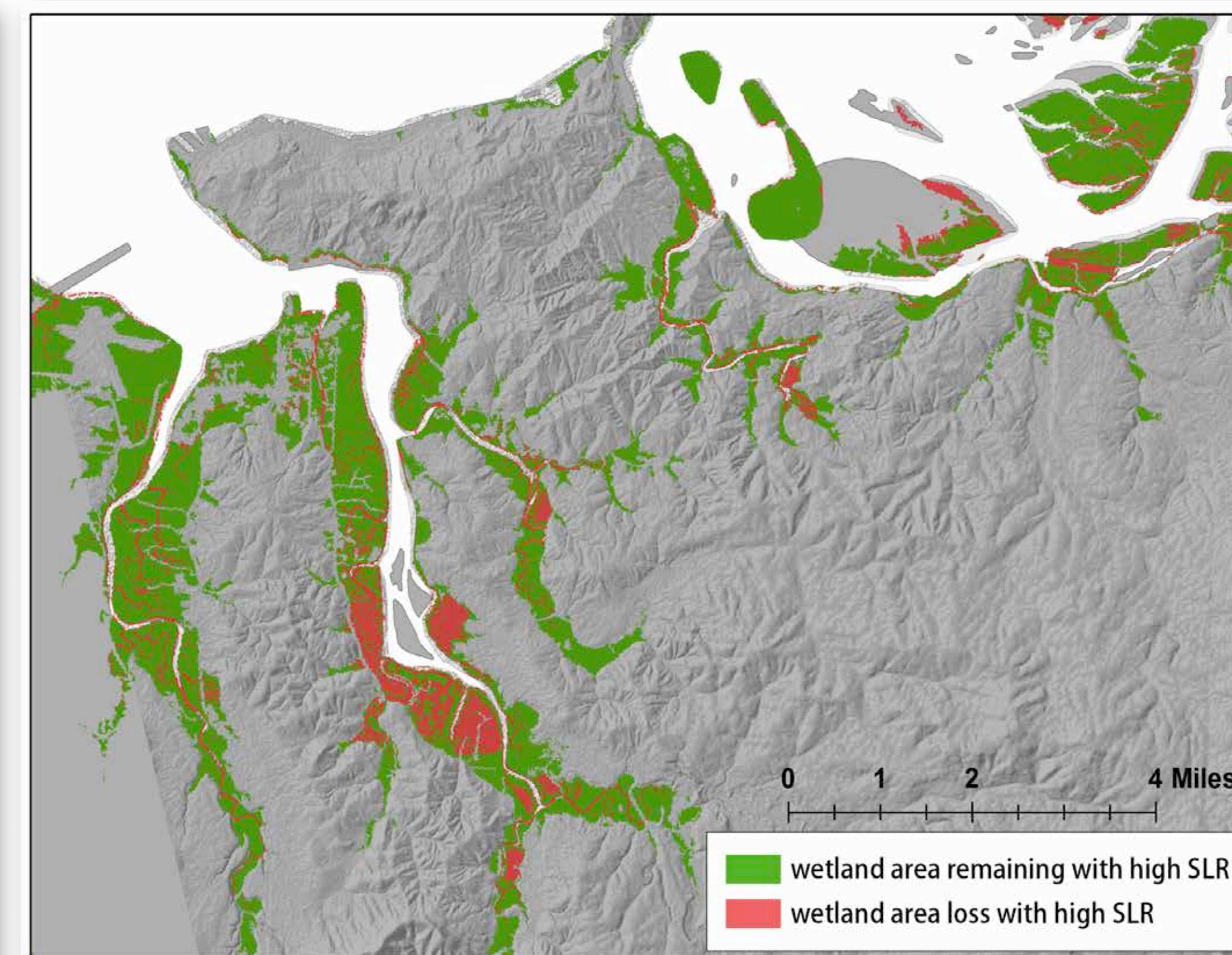Figure 3. Oregon coastal watershed salmon run density (low to high).
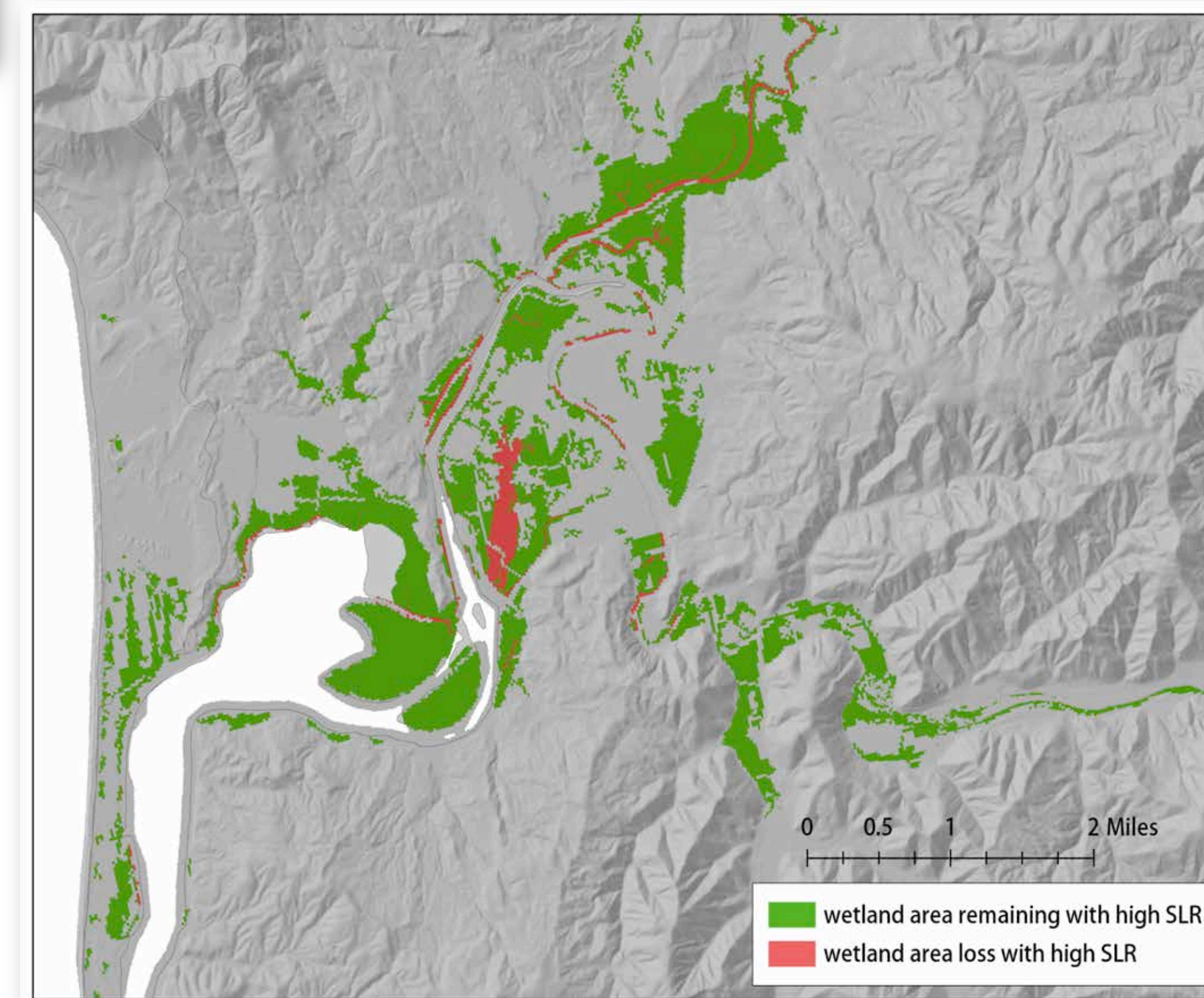
Salmon Index
1, 2, 3, 4, 5

Figure 4. State of Oregon with the 14 coastal watersheds selected for analysis.

Lower Columbia Watershed

- wetland area remaining with high SLR
- wetland area loss with high SLR

Nehalem Watershed

- wetland area remaining with high SLR
- wetland area loss with high SLR

Umpqua Watershed

- wetland area remaining with high SLR
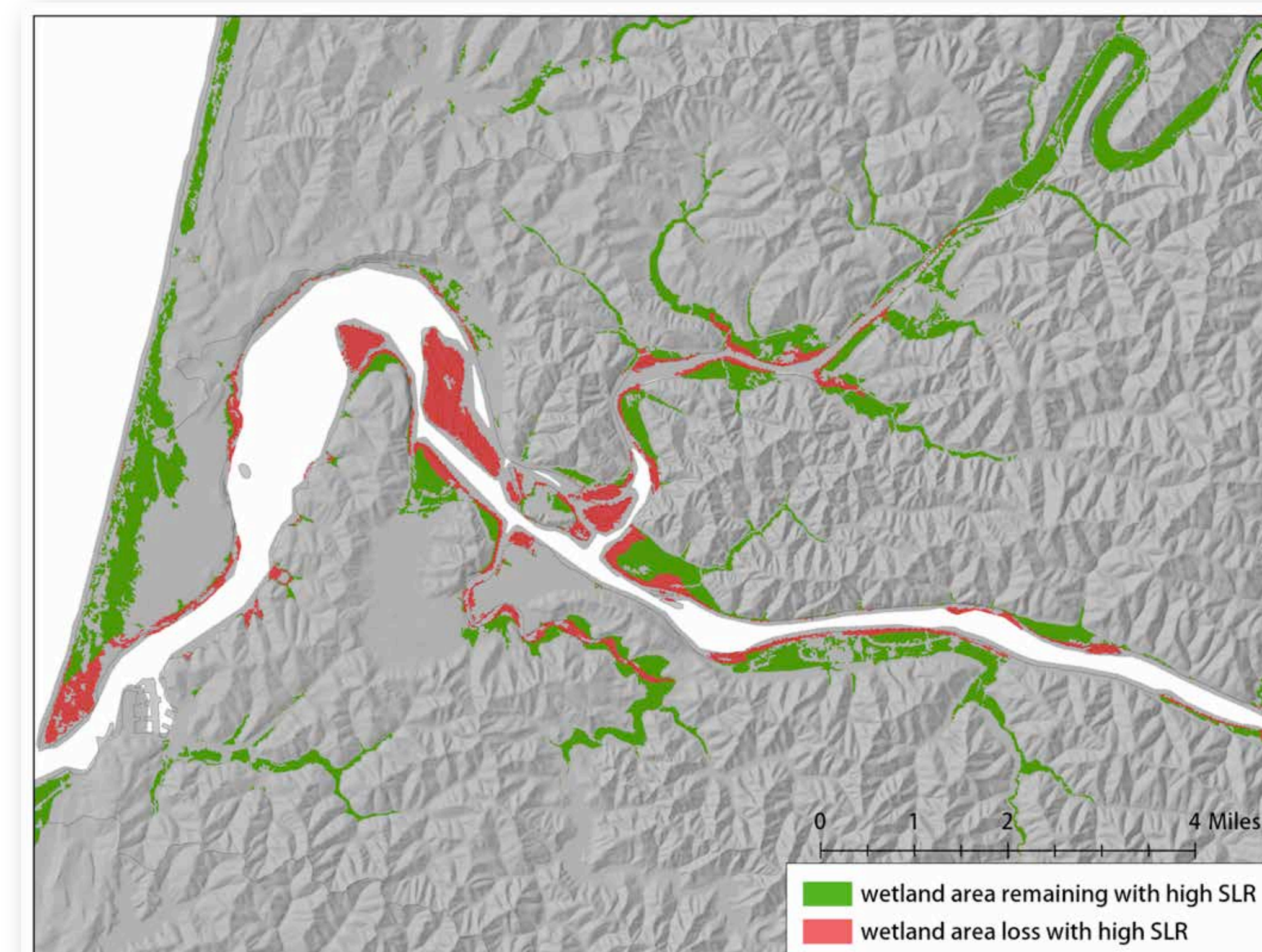- wetland area loss with high SLR

Figure 5. Wetland area remaining and lost for Umpqua, Nehalem, and the Lower Columbia watersheds based on high SLR predictions.

Conclusions and Implications for Management:

Based on our coarse analysis, we concluded that the Lower Columbia, Nehalem, and Umpqua watersheds were of the highest relative importance for restoration and mitigation activities in order to reduce potential wetland and salmonid habitat losses with the predicted future sea level rise conditions. Potential actions could take the form of dike and dam removal, hard surface shoreline armoring and impediment removal.

Coastal land managers will need to consider many additional factors such as local ecology and geography, pollution inputs, population growth, proximity to development among others in order to make decisions on how to best reduce impacts of climate change on wetlands in the Pacific Northwest. Restoration actions need to include future climate uncertainties, potential for habitat migration upland, preserving buffers, enhancing shoreline protection, and discouraging future development in coastal areas. A cursory examination of developed areas within the same area, below 10 meters of elevation, for the 14 watersheds showed that several watersheds will be impacted by sea level rise . For example, the Chetco, Umpqua, Nehalem, and Coos watersheds will each have some developed land impacted by low, mid, and high sea level rise predictions.
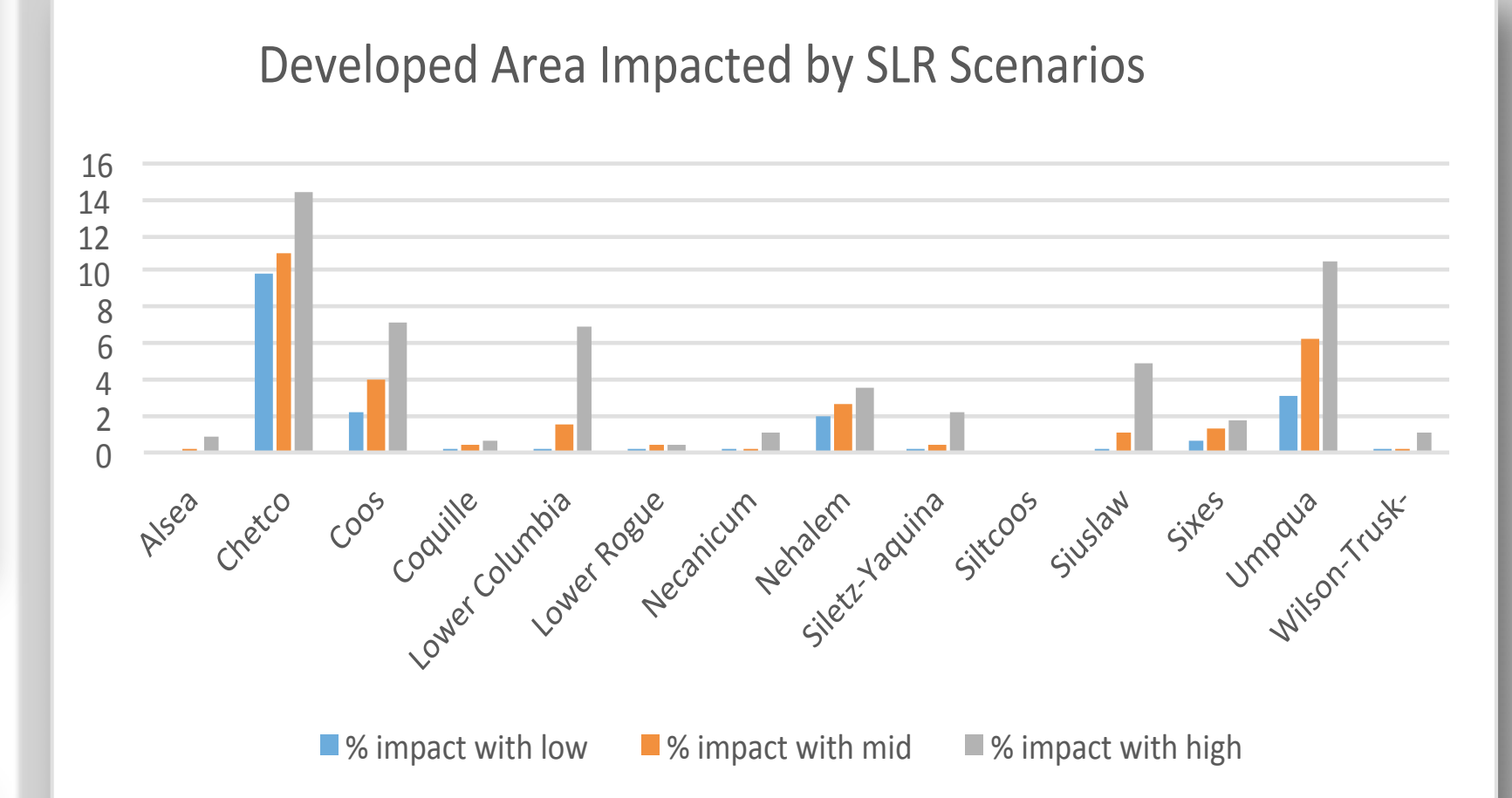
Developed Area Impacted by SLR Scenarios

- % impact with low
- % impact with mid
- % impact with high

Figure 6. Percent of developed areas within Oregon's coastal wetlands that will be impacted based on low, mid, and high SLR predictions
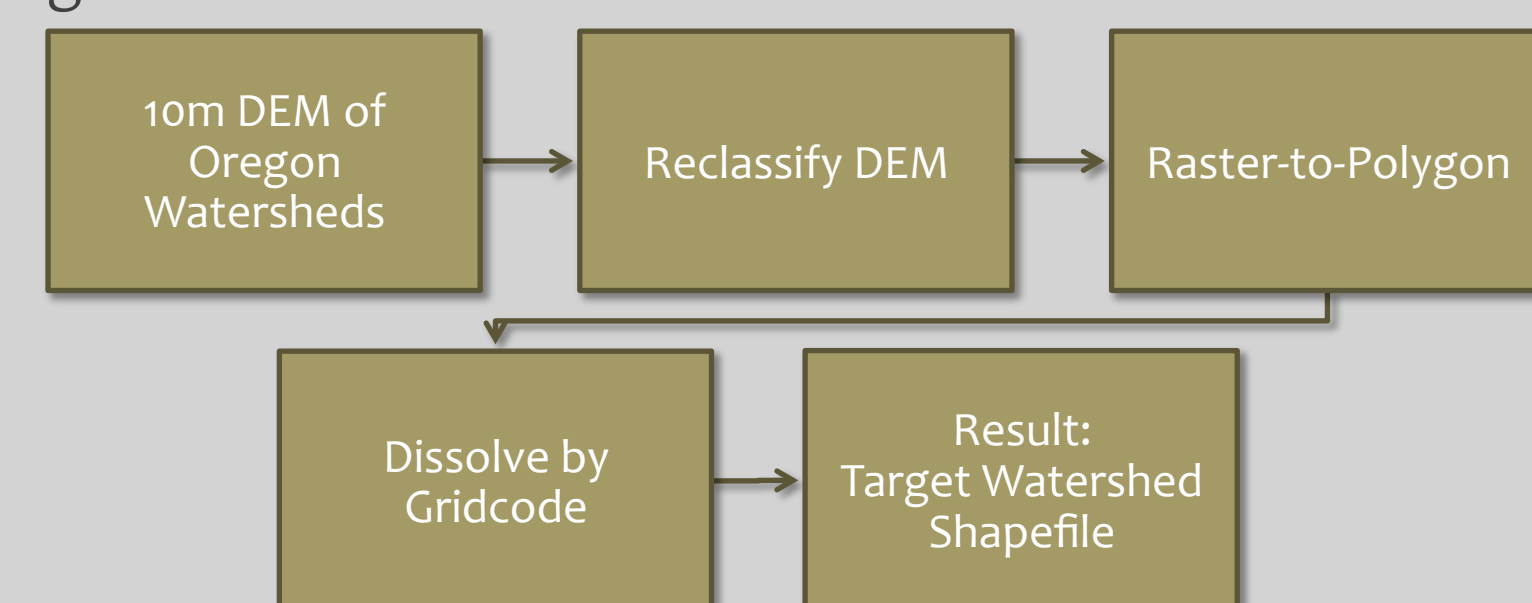
Datasets & References:

- Oregon Department of Fish and Wildlife: Fish habitat distribution-all anadromous salmonids
- National Hydrography Dataset for HUC 8 Watersheds, with coastal influence. Identified 14
- National Land Cover Database 2011
- Census Data 2010 Oregon Population by Census Block
- Intergovernmental Panel on Climate Change (2007), Climate Change 2007: The Scientific Basis. Edited by S. Solomon et al., Cambridge Univeristy
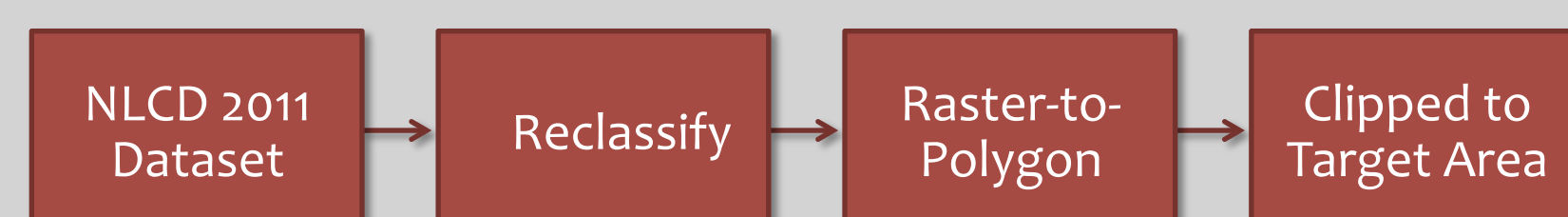
Acknowledgments: