

# POTENTIAL IMPACTS OF SEA-LEVEL RISE TO TRADITIONAL CULTURAL LANDSCAPES, PROPERTIES, and RESOURCES

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# Introduction

- ▶ Background
  - ▶ Concerns about Sea Level Rise
  - ▶ Tribal Approaches and Methods
    - ▶ Landscape Understanding
    - ▶ Resource Understanding
  - ▶ Sea Level Rise Impacts
  - ▶ Results and Discussion
  - ▶ Recommendations for Future Work
- ▶ Confederated Tribes of Grand Ronde
    - ▶ Ratified Treaties of 1855-56
    - ▶ Consists of Over 27 Tribes and Bands
    - ▶ Stewardship Responsibilities Across Ancestral Lands
    - ▶ Concerns with Sea-Level Rise



# Objectives

## Project Objectives

- ❑ Develop a visual model of potential inundation.
  - ❑ develop a model of increased erosion impacts
- ❑ Identify habitats and ecotone boundaries
  - ❑ hypothesize future directions of movement
- ❑ Examine cultural practices and potential impacts
  - ❑ identify potential changes

## Presentation Objectives

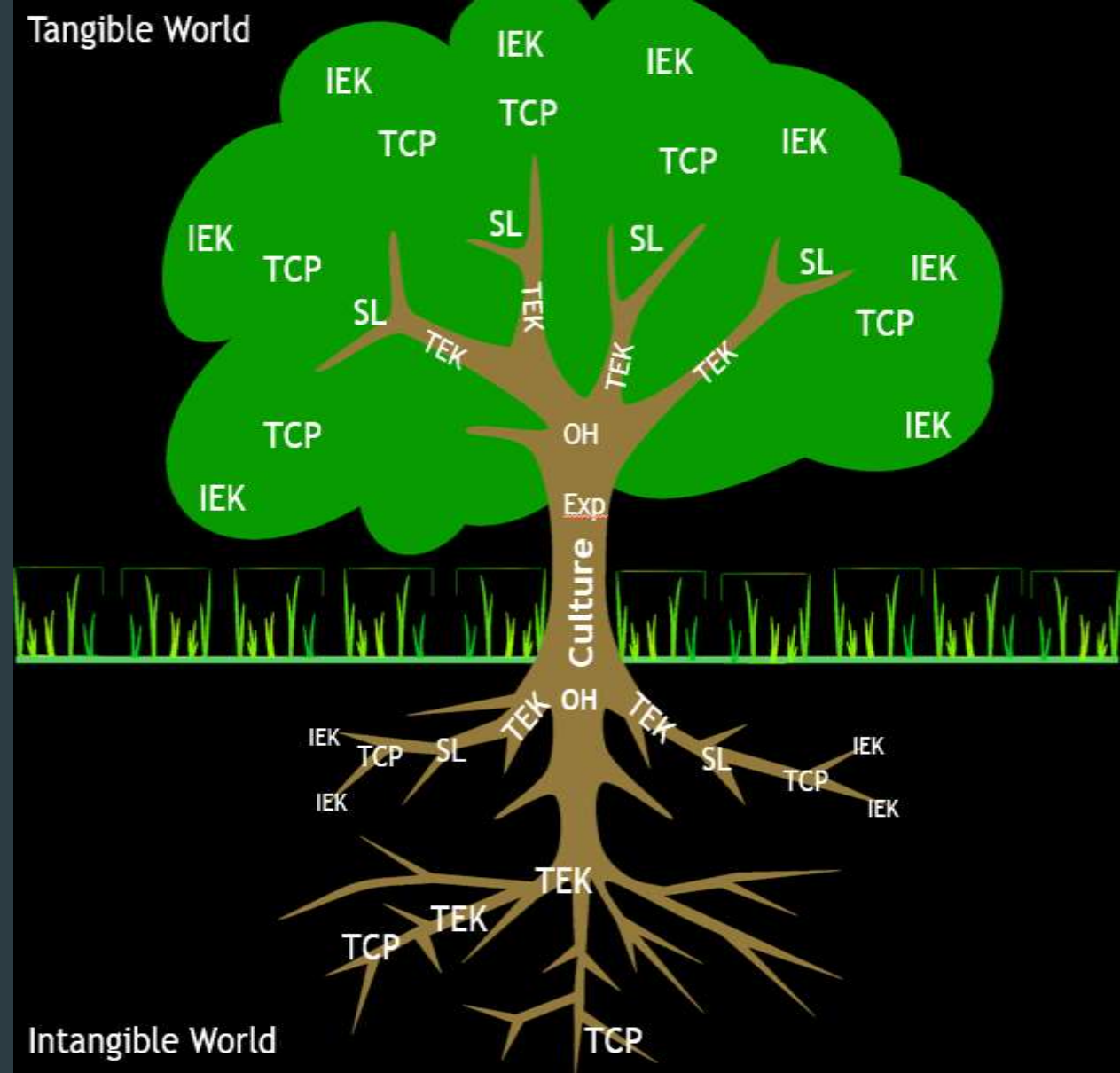
- ▶ Reconsideration of 'Cultural Resources'
- ▶ Introduction of Proxy Data Sources

# Approaches and Methods

Seeking to understand, identify and protect *Practice*.

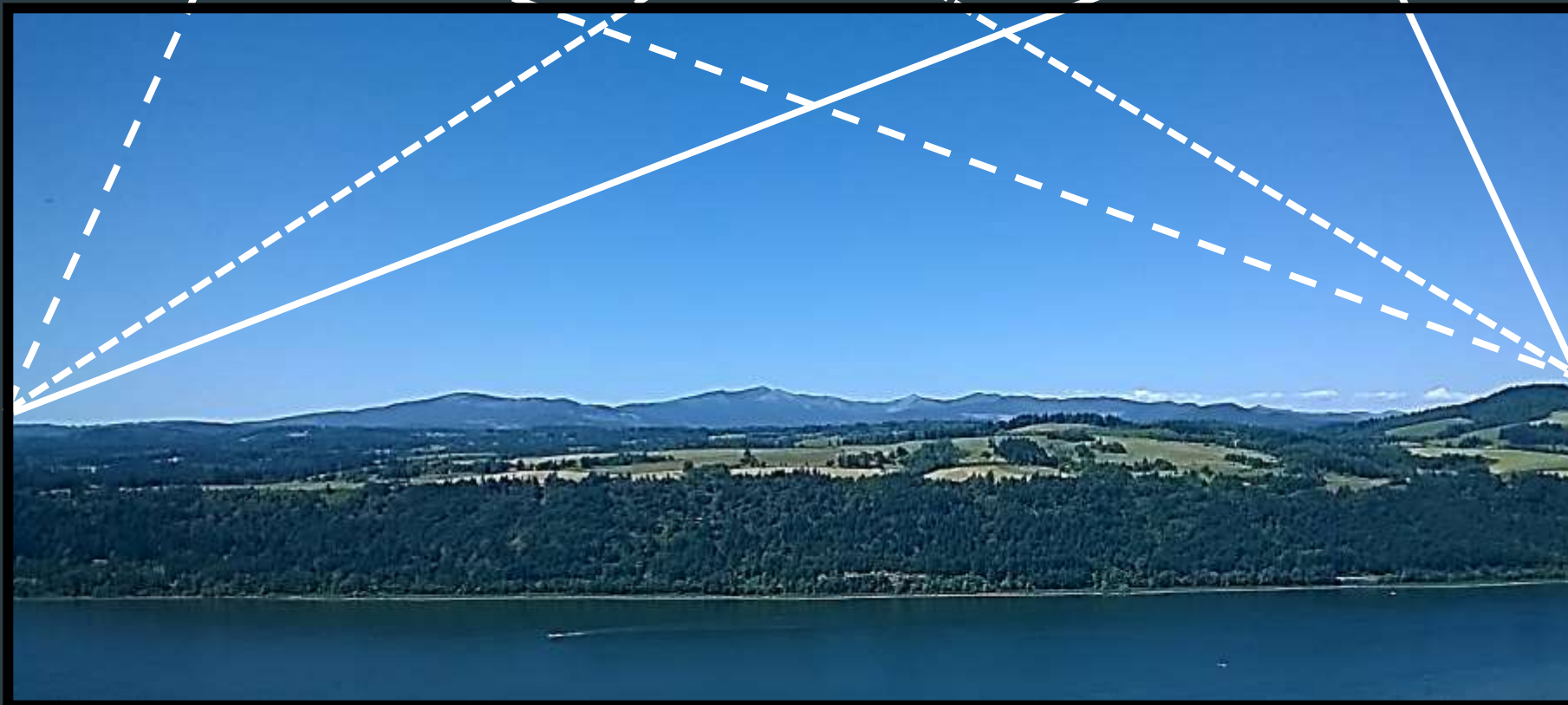
Understanding or acceptance of Practice and activity leads to identification of place and resources.

*The past informs the present.*



-----Tangible-----	-----Intangible-----
Intimate Ecological Knowledge = IEK	Experience
Traditional Cultural Property = TCP	Oral Tradition = OH
Sacred Landscape = SL	Traditional Ecological Knowledge = TEK
Traditional Ecological Knowledge = TEK	Sacred Landscapes = SL
Oral Tradition = OH	Traditional Cultural Property = TCP
Experience	Intimate Ecological Knowledge = IEK

# Understanding landscape through time

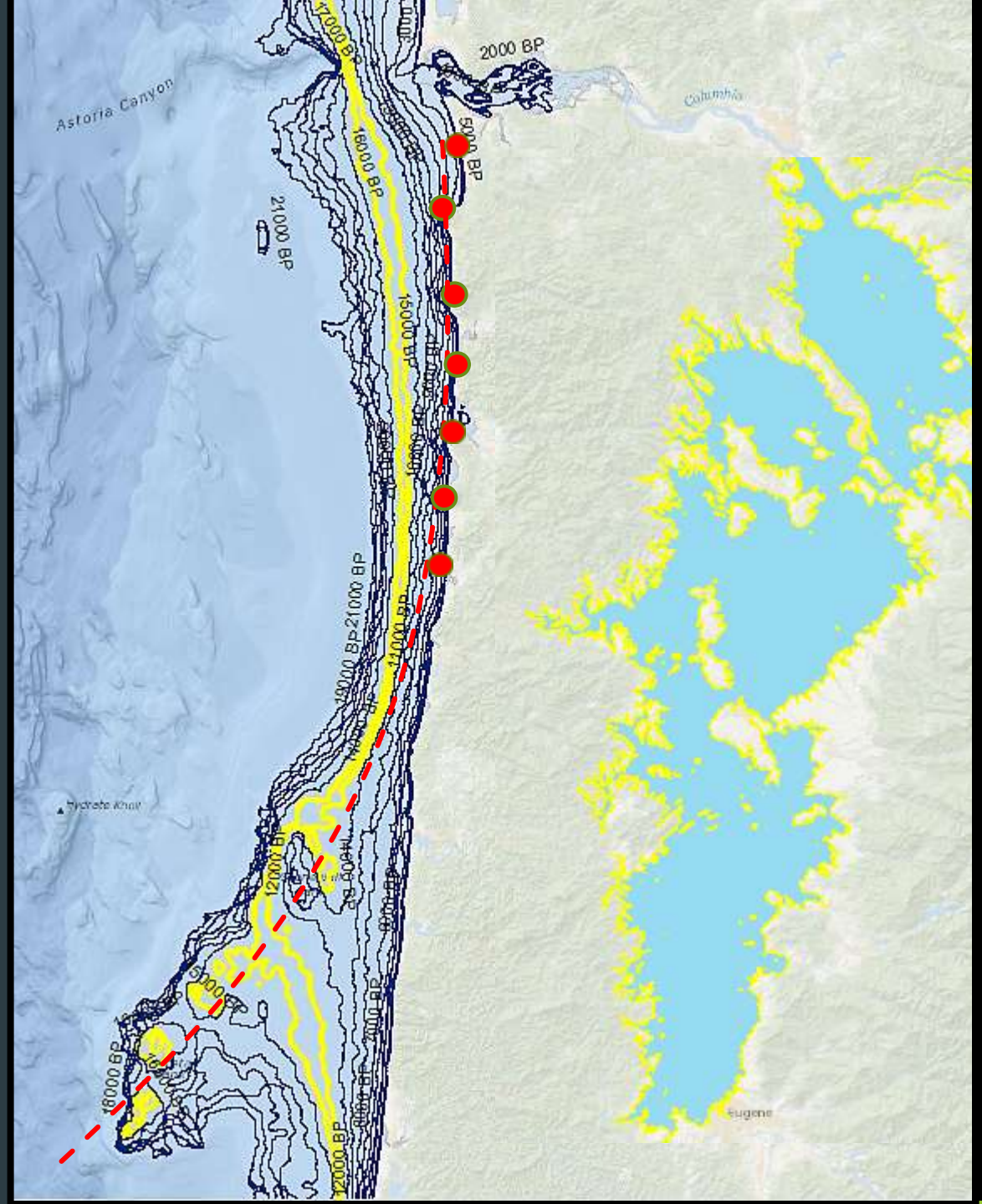


Visual representation of landscape understanding through the Grand Ronde Tribal Cultural Lens.



# Source Materials Applied

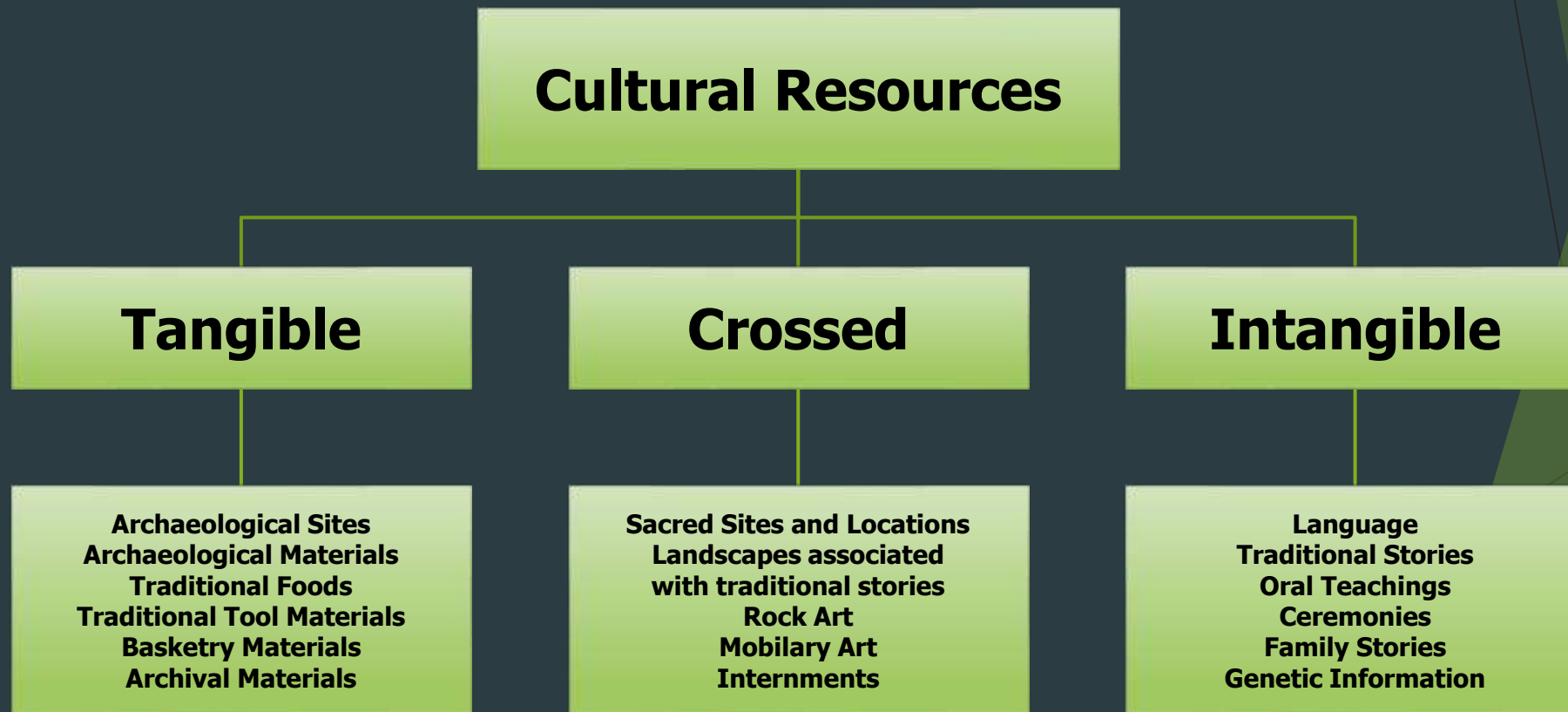
- ▶ This is the landscape past generations and ancestors knew
- ▶ stories talk about change
  - ▶ South Wind Epic
  - ▶ Coyote Stories
  - ▶ Bretz Floods
- ▶ Still connected today



# Cultural Resources

Tribally specific and Tribally defined

- ▶ Tangible = Cultural Resources with a physically tangible aspect
- ▶ Intangible = Cultural Resources lacking a physically tangible aspect
- ▶ Crossed = Cultural Resources with both tangible and intangible components



It should be noted these are not distinct or separate categories and by no means consistent in their inclusion of their individual components.



# Data Sources

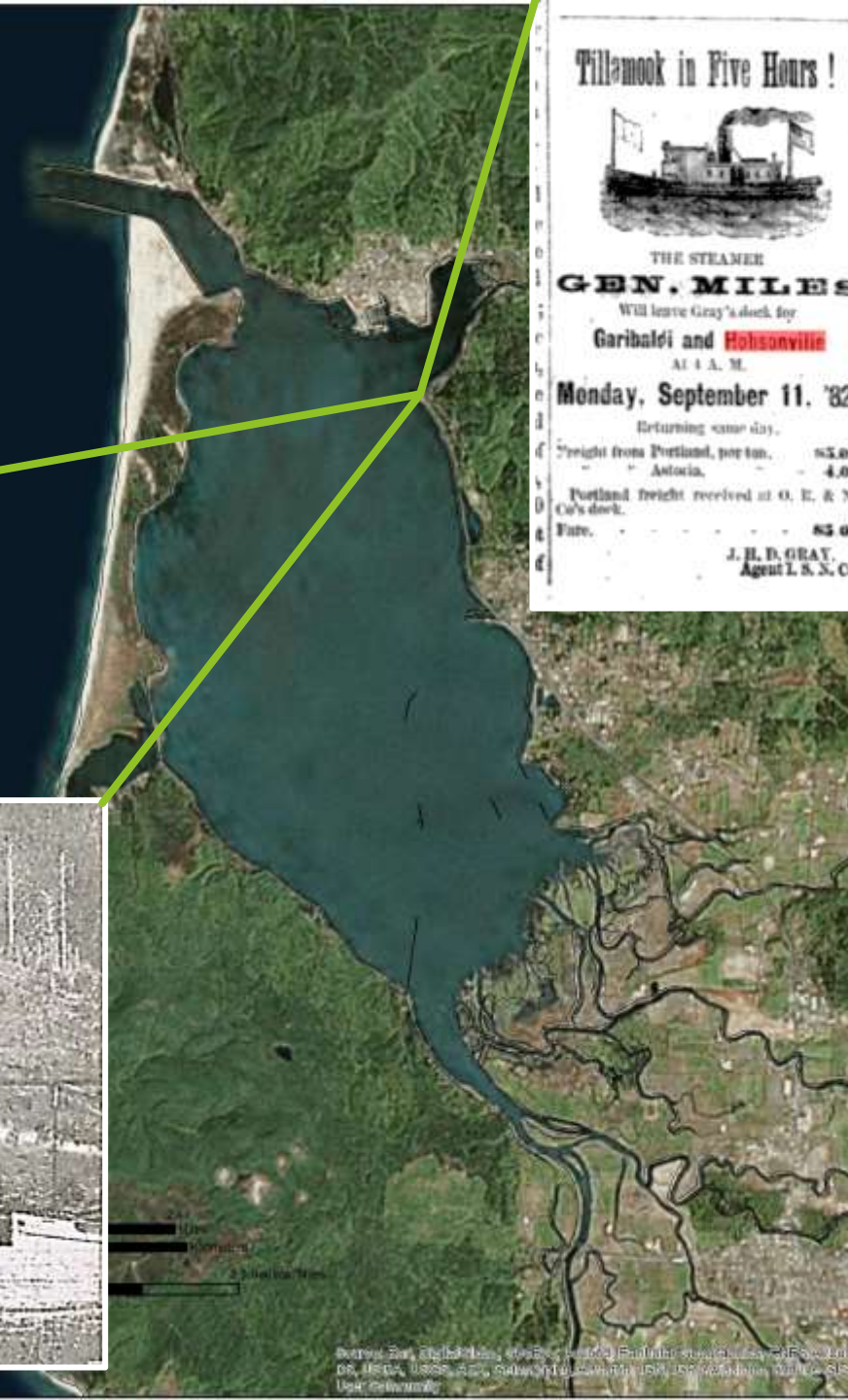
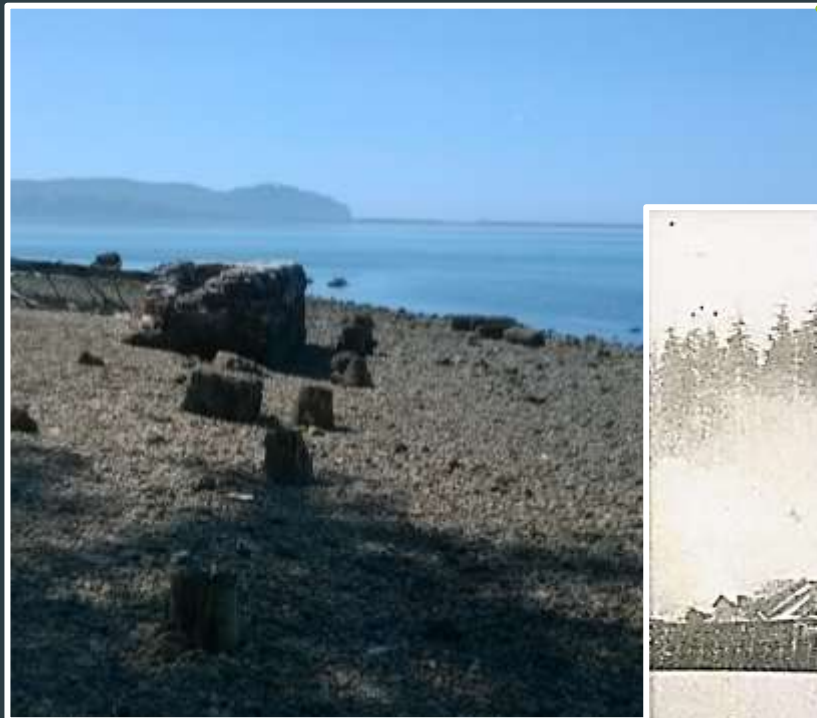
- ▶ Continued Practices
- ▶ Language Distribution & Vocabulary
- ▶ Oral Tradition - Songs, Stories, Practices, Designs, etc.
- ▶ Stories - Transcribed, Told/re-told (●)





# Data Sources

- ▶ Ethnohistoric/Historic Accounts (Newspapers, researcher notes, diaries/journals, agency records, etc.)
- ▶ Archaeological (excavations, artifacts, reports, etc.)



Tillamook in Five Hours !

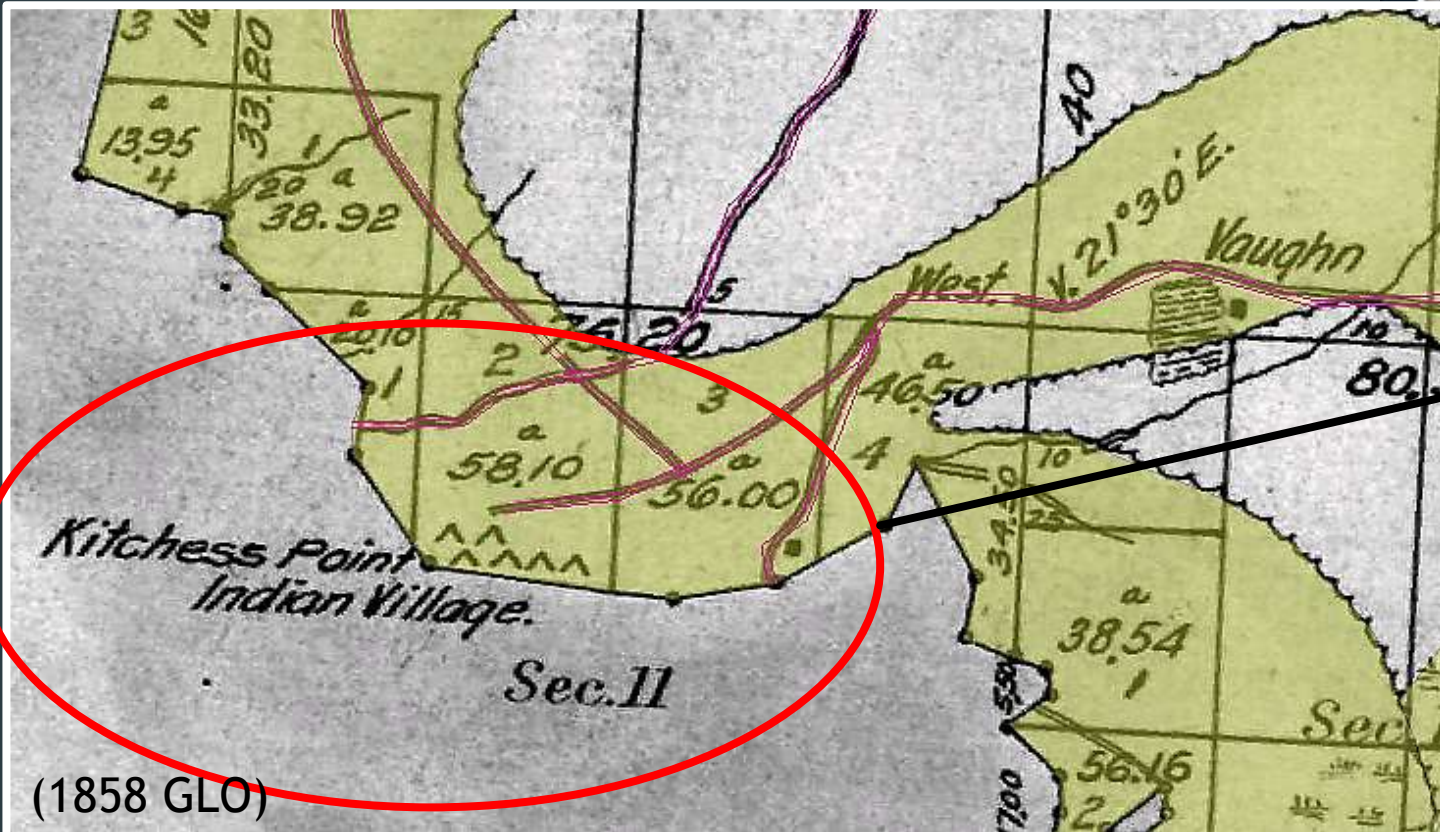


THE STEAMER  
**GEN. MILES**  
Will leave Gray's dock, for  
**Garibaldi and Hobsonville**  
At 4 A. M.  
**Monday, September 11, '82**  
Returning same day.  
Freight from Portland, per ton. \$5.00  
Astoria, 4.00  
Portland freight received at O. R. & N. Co's dock. \$3.00  
Fare. \$3.00  
J. H. D. GRAY,  
Agent U. S. S. C.



# Data Sources

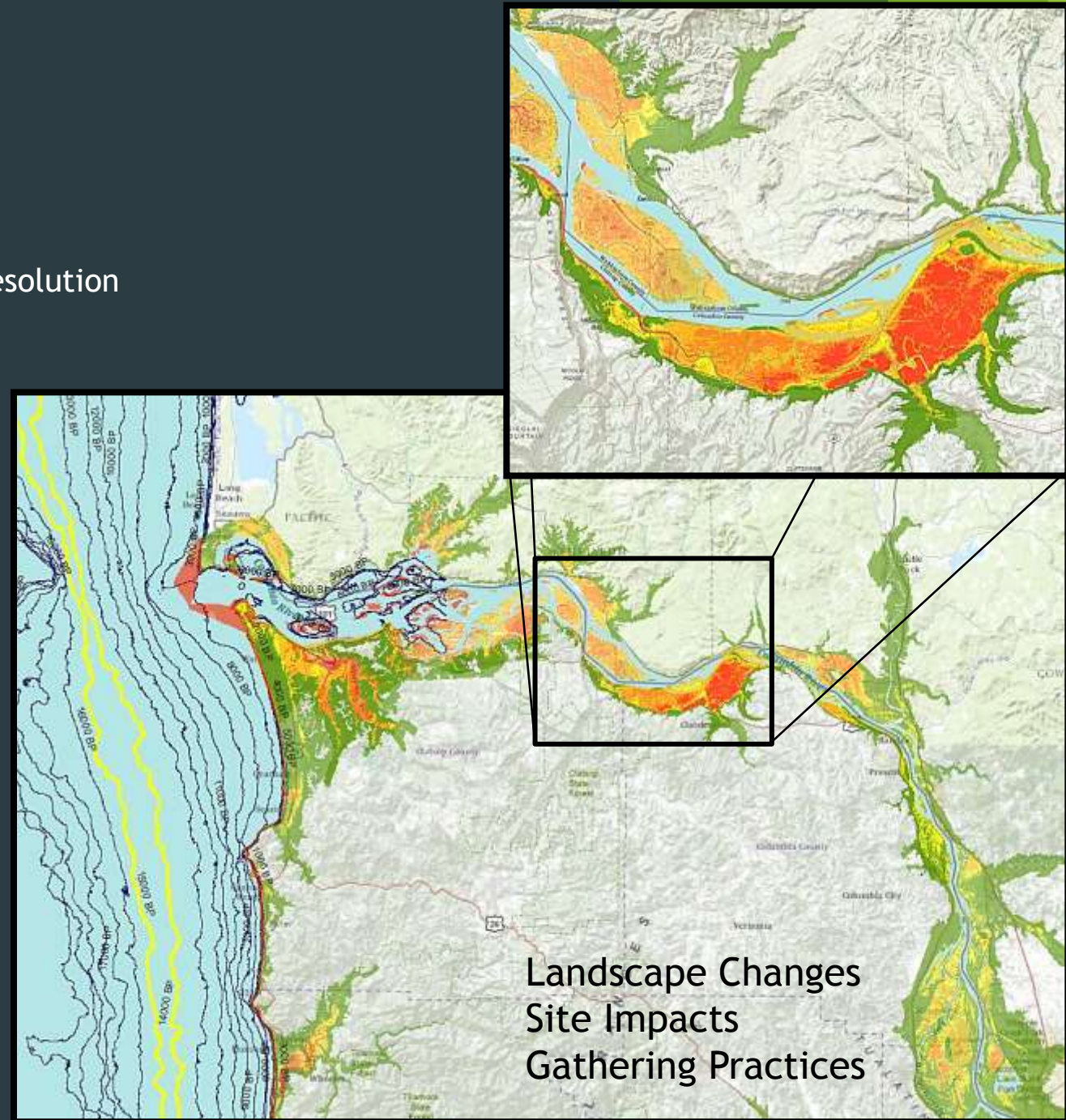
- ▶ Visual (Maps, Photos, Drawings, etc.)





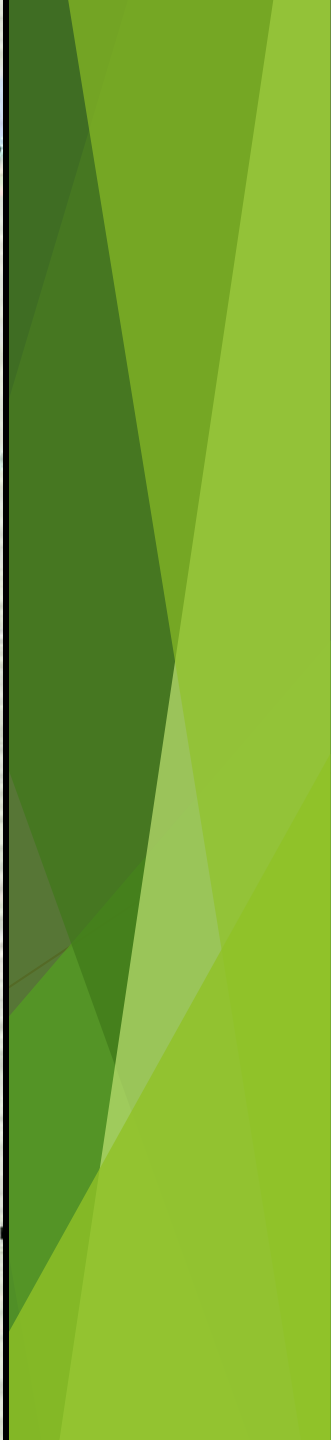
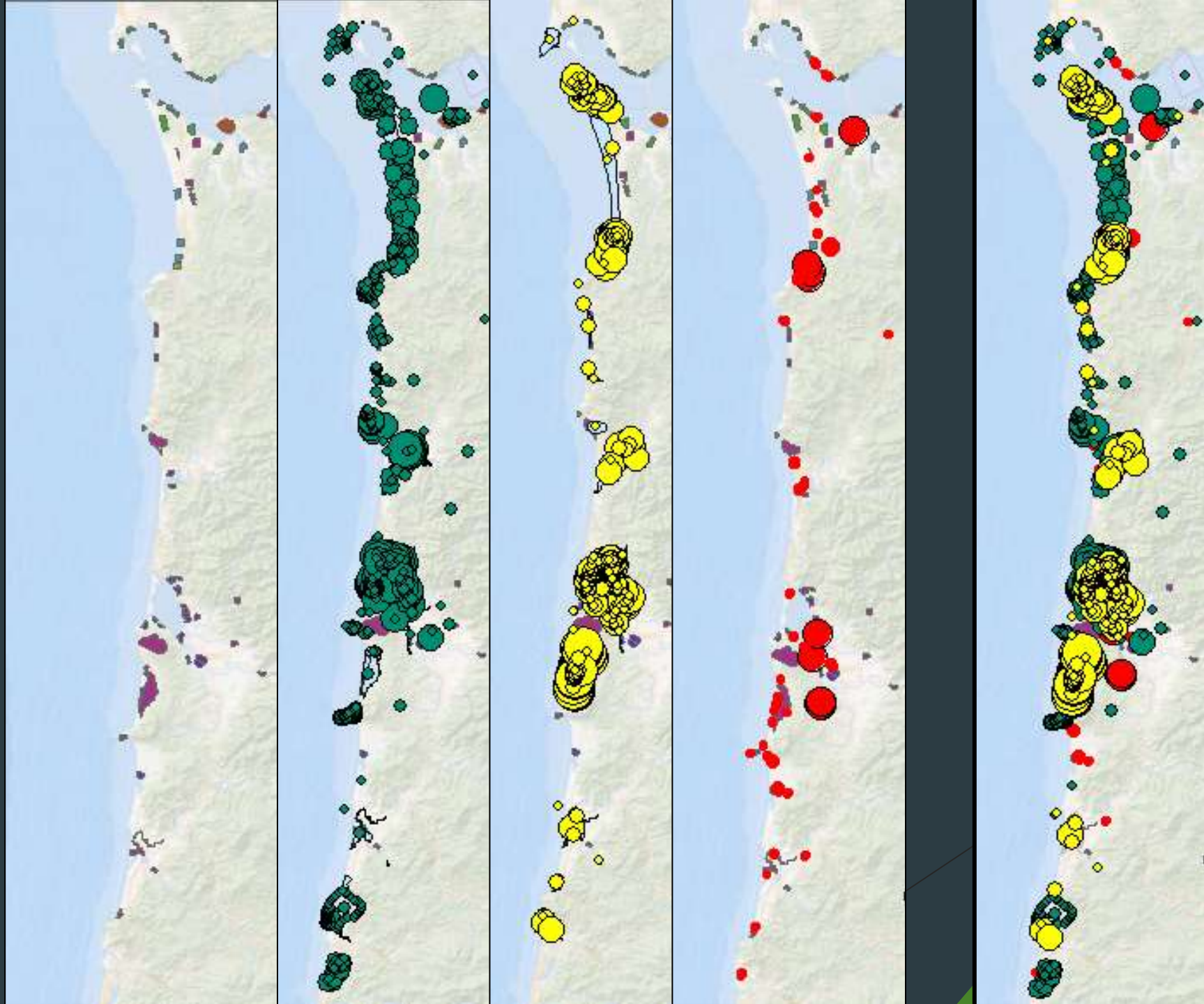
# Methods

- ▶ Sea-Level Rise Model
  - ▶ Basic Bathtub Model
  - ▶ Resample of LiDAR DEMs from 1 meter to 3 meter resolution
  - ▶ Combine individual LiDAR DEMs into mosaic raster
  - ▶ Reclassify Raster into distinct elevation zones.
  - ▶ Elevation zone given a severity ranking
- ▶ Traditional Cultural Properties and Landscapes
  - ▶ Provided by the CTGR
  - ▶ Based on direct evidence or literature review
  - ▶ Separated into categories
    - ▶ Flora, Fauna, Named Places, and archeological sites
- ▶ Level of Impact
  - ▶ Analysis was performed on twice
  - ▶ Weighted severity analysis
  - ▶ Percent of total area effected





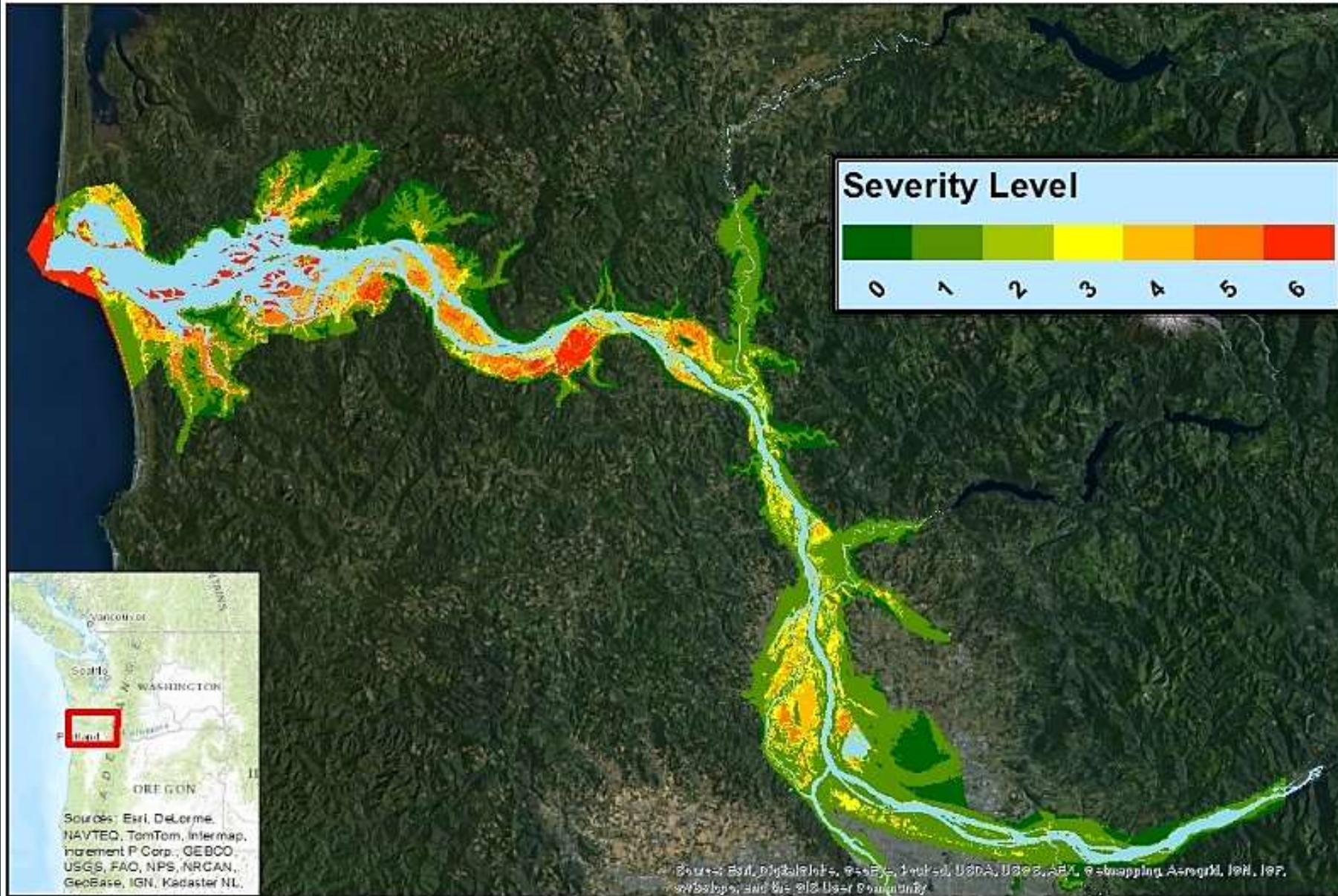
# Cultural Landscapes (TCLs)





# Columbia River

## Sea-Level Rise Severity



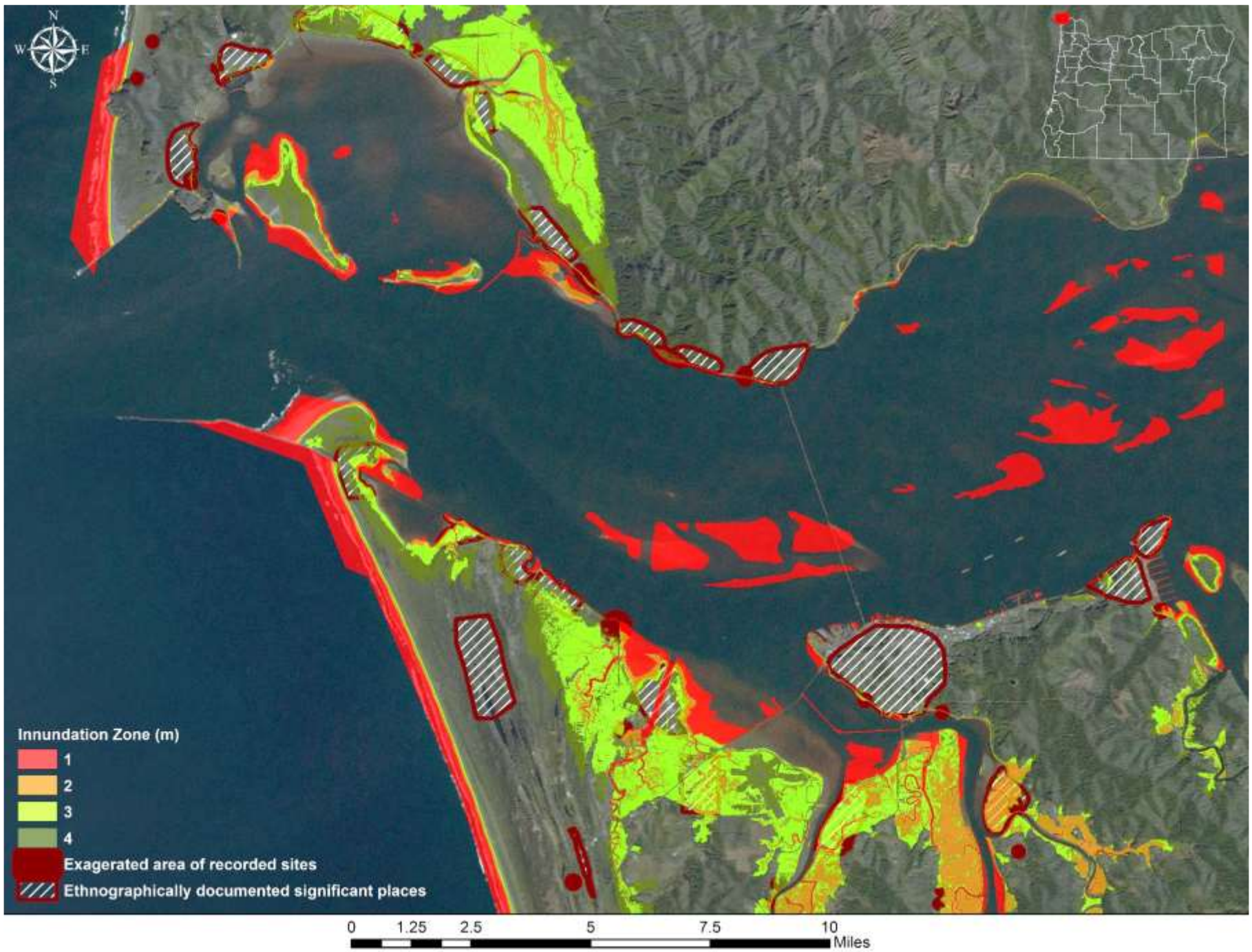
Coordinate System: Lambert Conformal Conic  
Datum: North American Datum 1983  
Units: Meters



Sources: Esri, DigitalGlobe, GeoEye, Earthstar, USDA, U.S.G.S., AeroGRID, IGN, 1997, Swirebird, and the GIS User Community

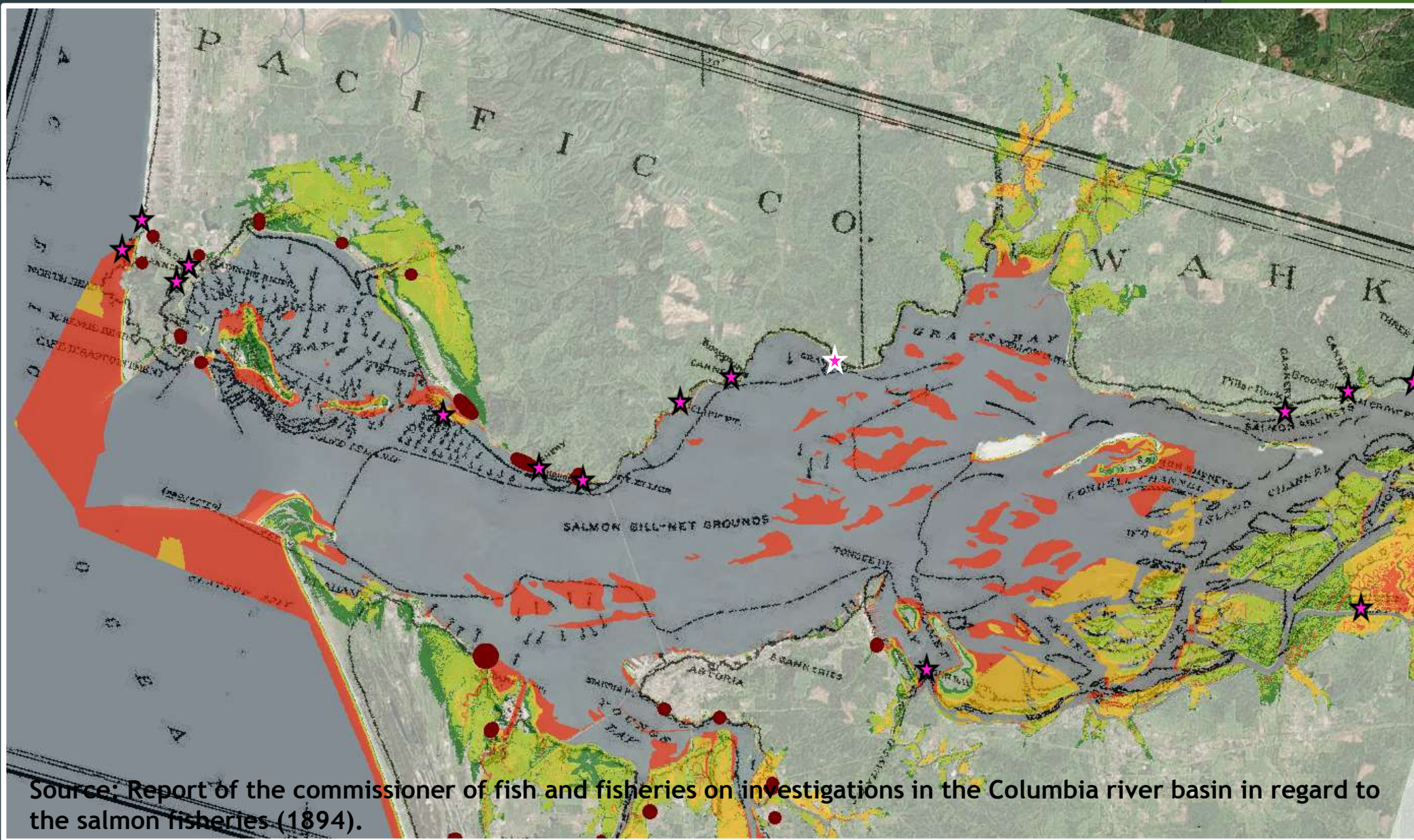
Sources: U.S. Army Corps of Engineers  
Produced By: Christopher S Parazoo





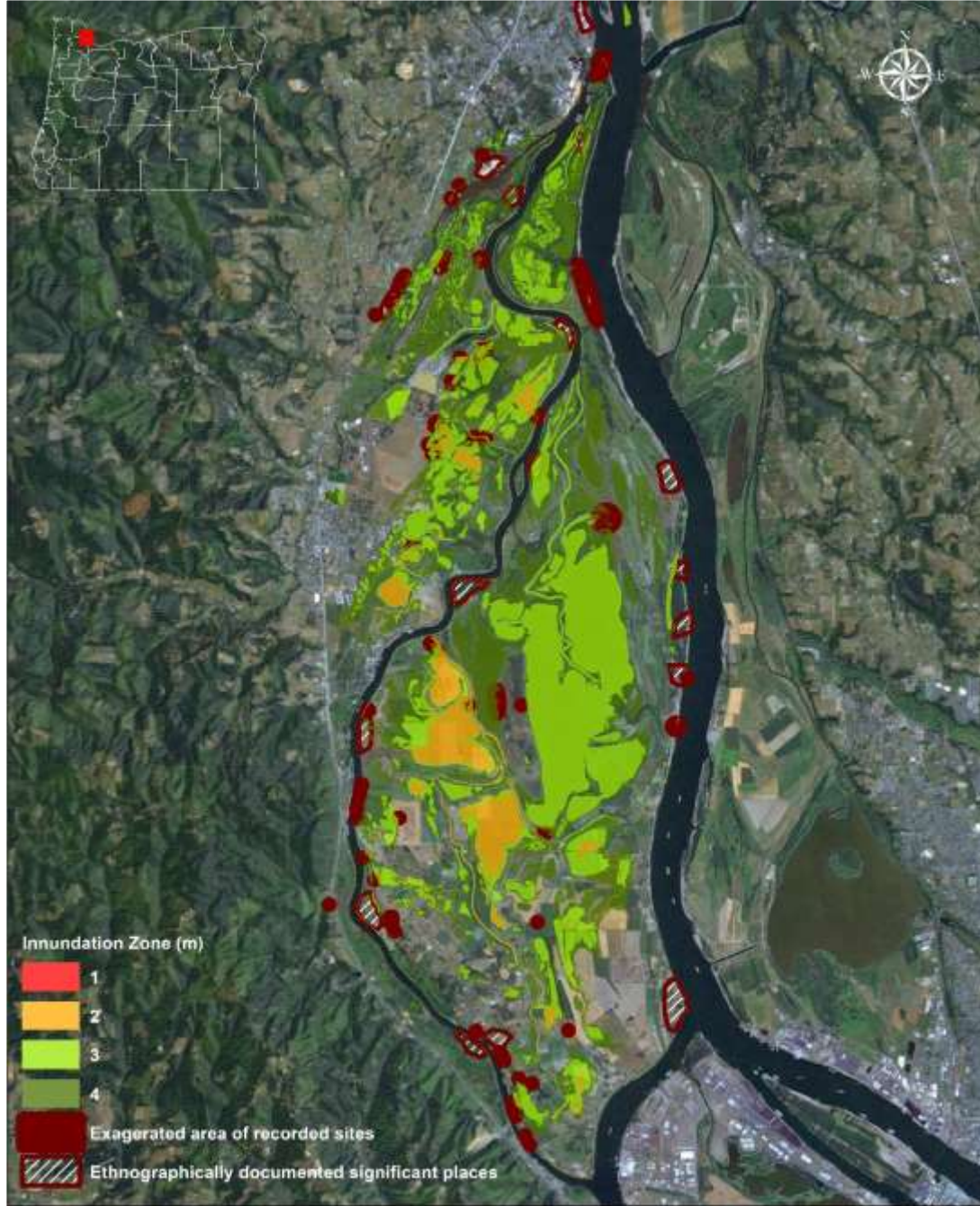


# Pre-Historic and Historic Salmon sites



Source: Report of the commissioner of fish and fisheries on investigations in the Columbia river basin in regard to the salmon fisheries (1894).

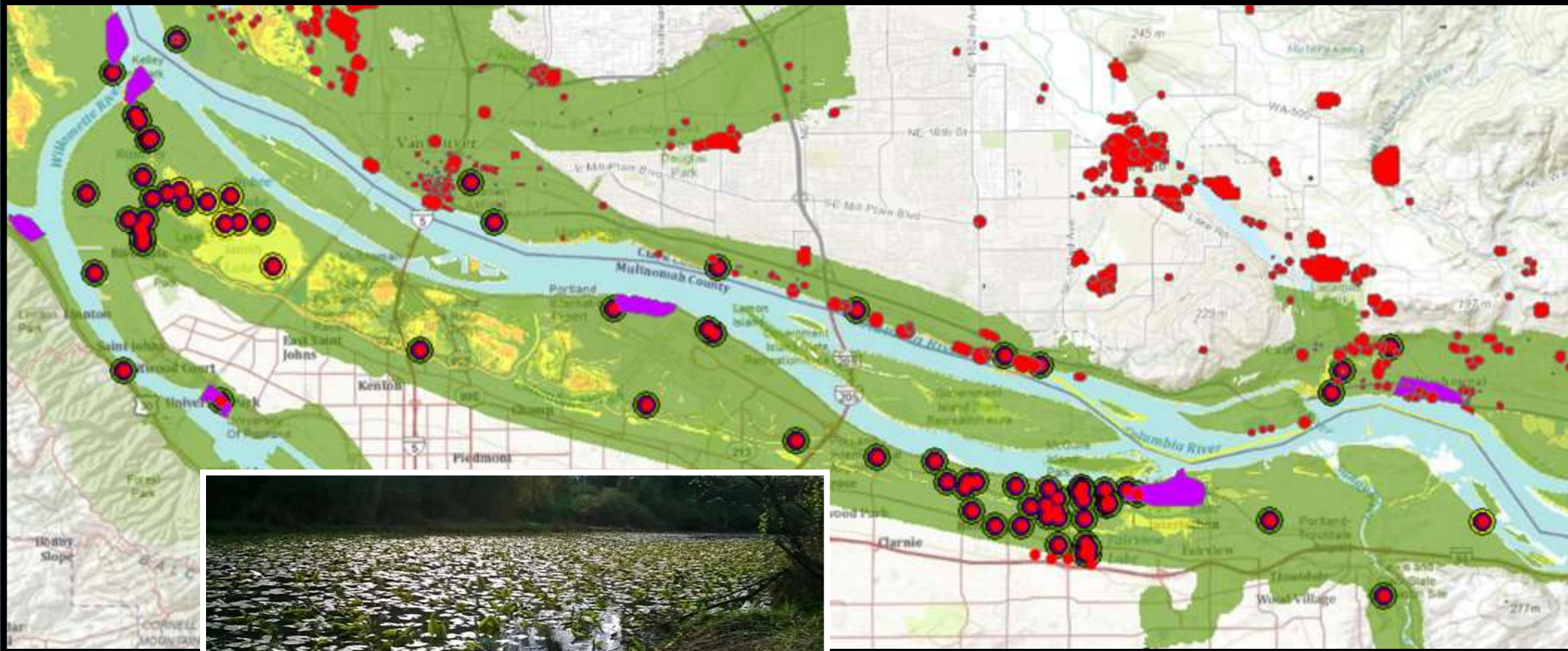




0 1.25 2.5 5 7.5 10 Miles



# Cultural Resource Impacts



Increased Wave Energy  
Storm Intensity  
Severity of Erosion  
Resource Inundation



# Flora Weighted impact







Weighted severity level is derived by the following equation

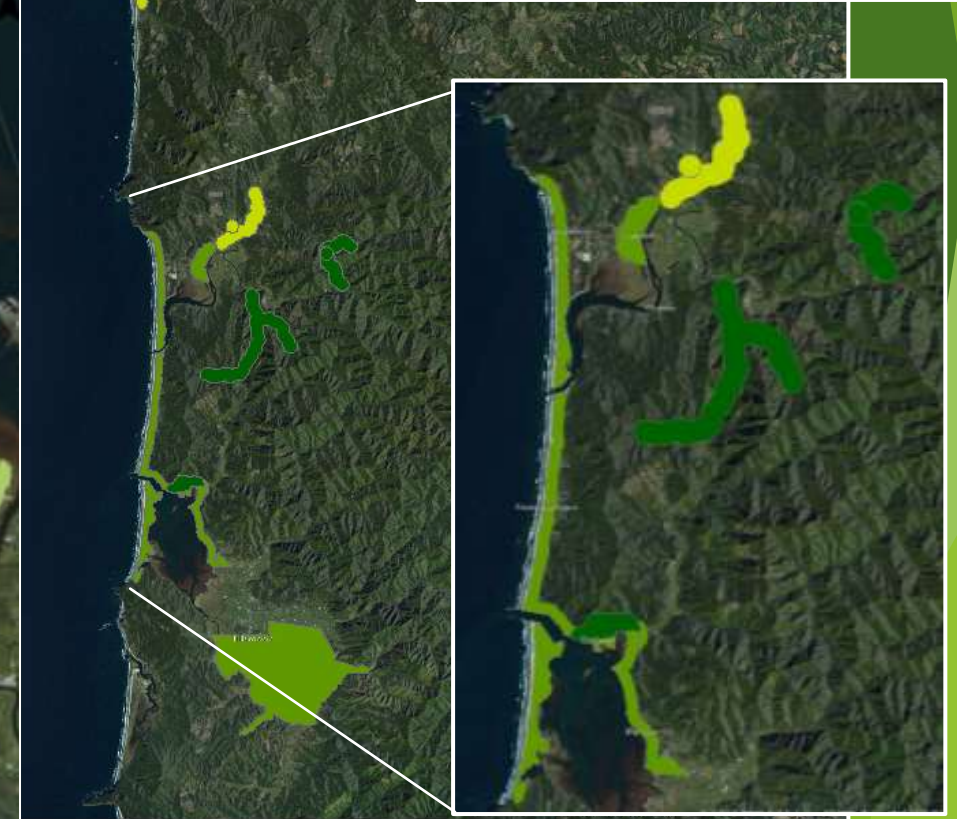
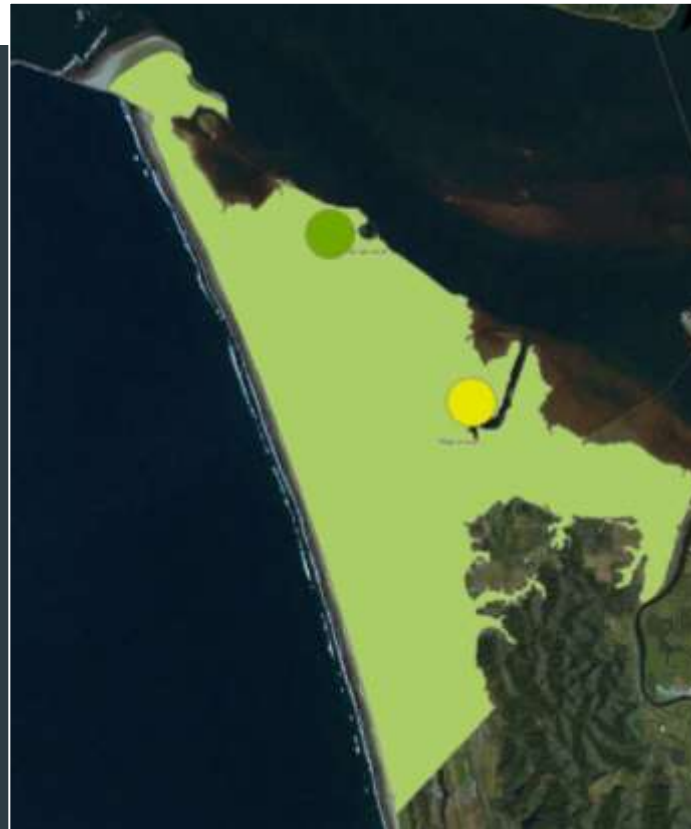
$$\left(\frac{Z_1 A}{TA}\right) \times SL_1 + \left(\frac{Z_2 A}{TA}\right) \times SL_2 + \left(\frac{Z_3 A}{TA}\right) \times SL_3 + \text{etc ...}$$

Where  $Z_x A$  is the area of each elevation zone in a specific place,  $TA$  is the total area of place, and  $SL$  is the severity level.

## Legend

### Weighted Impact

	0.00 - 1.00 Low
	1.01 - 2.00
	2.01 - 3.00
	3.01 - 4.00
	4.01 - 5.00
	5.01 - 6.00 High



Coordinate System: Lamber Conformal Conic  
Datum: North American Datum 1983  
Units: Feet

0 2.25 4.5 9 13.5 18 Miles

Source: U.S. Census  
Produced by: [unclear]

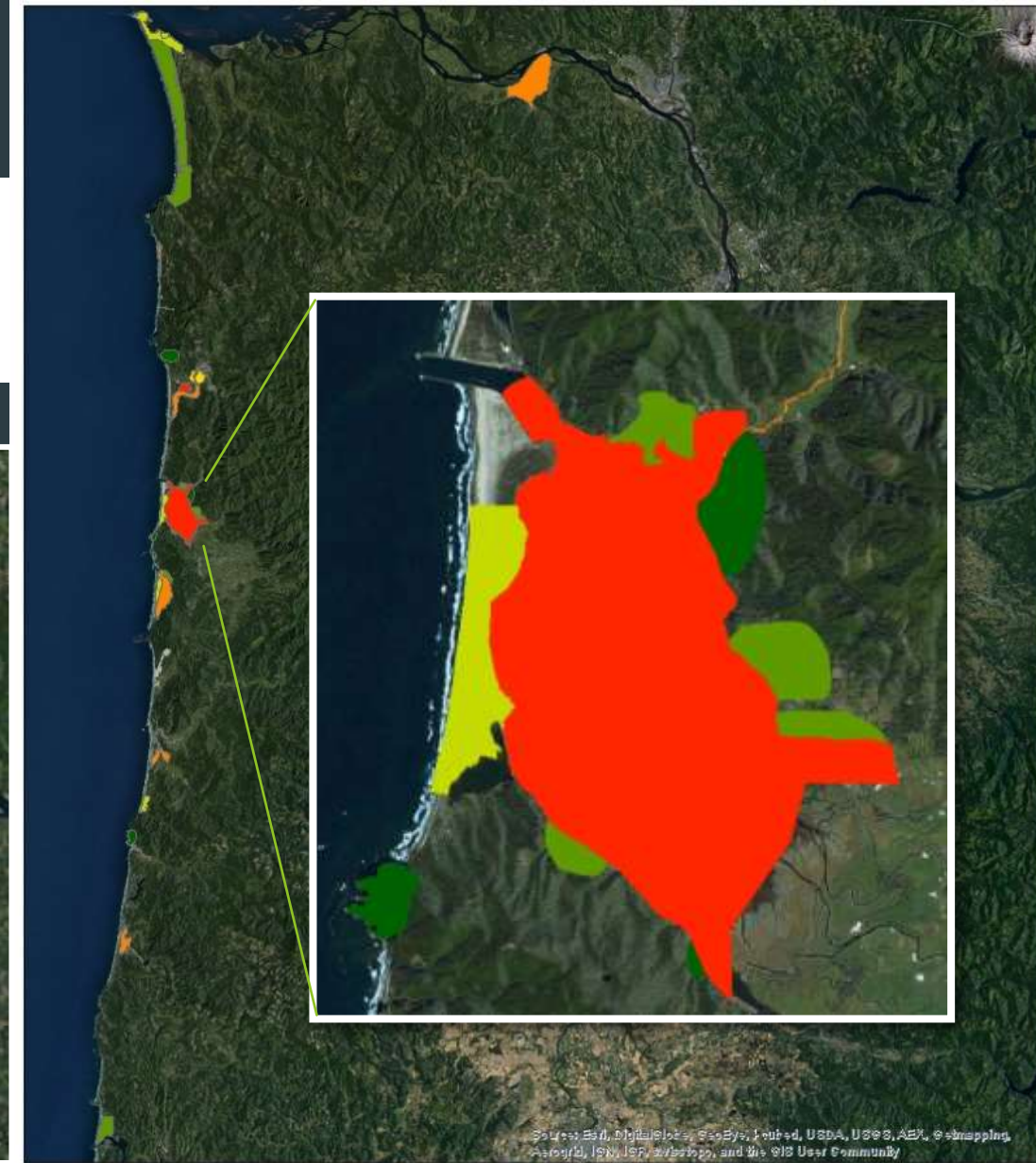
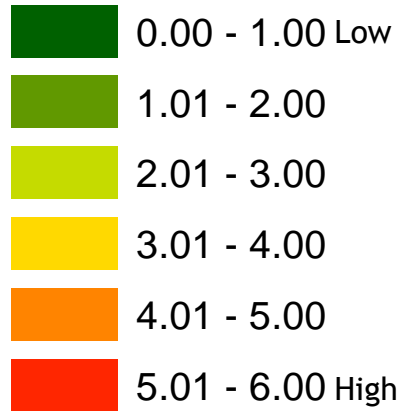
# Fauna Weighted Impact

Weighted severity level is derived by the following equation

$$((Z_1 A)/(TA) \times SL)_1 + ((Z_2 A)/(TA) \times SL)_2 + ((Z_3 A)/(TA) \times SL)_3 + etc ...$$

Where  $Z_x A$  is the area of each elevation zone in a specific place, TA is the total area of place, and SL is the severity level.

## Legend Weighted Impact



Coordinate System: Lamber Conformal Conic  
Datum: North American Datum 1983  
Units: Feet



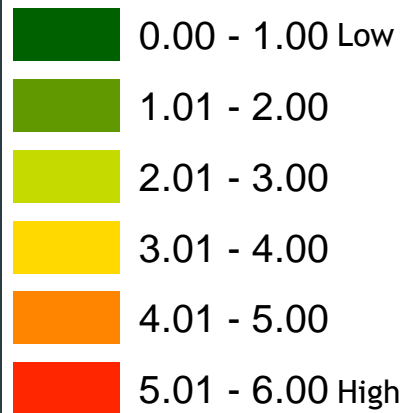
Source: U.S. Army Corps of Engineers  
Confederated Tribes of Grand Ronde  
Department of Geology and Mineral Industry  
Produced By: Christopher S Parazoo



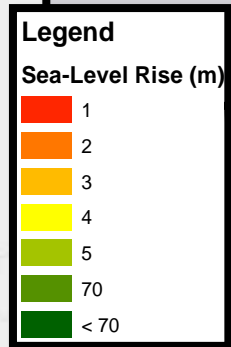
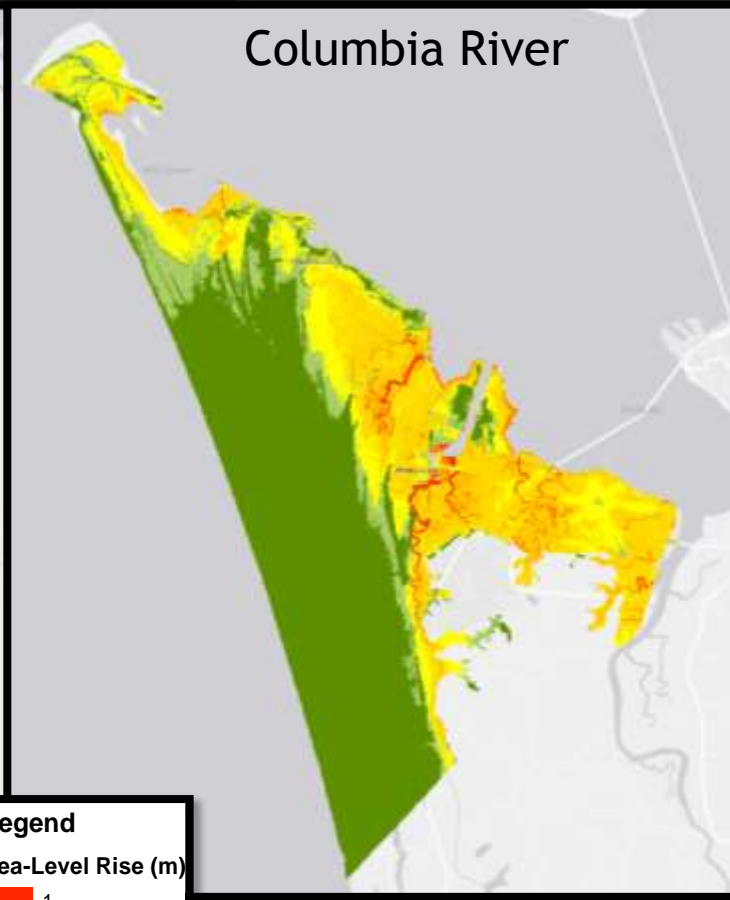
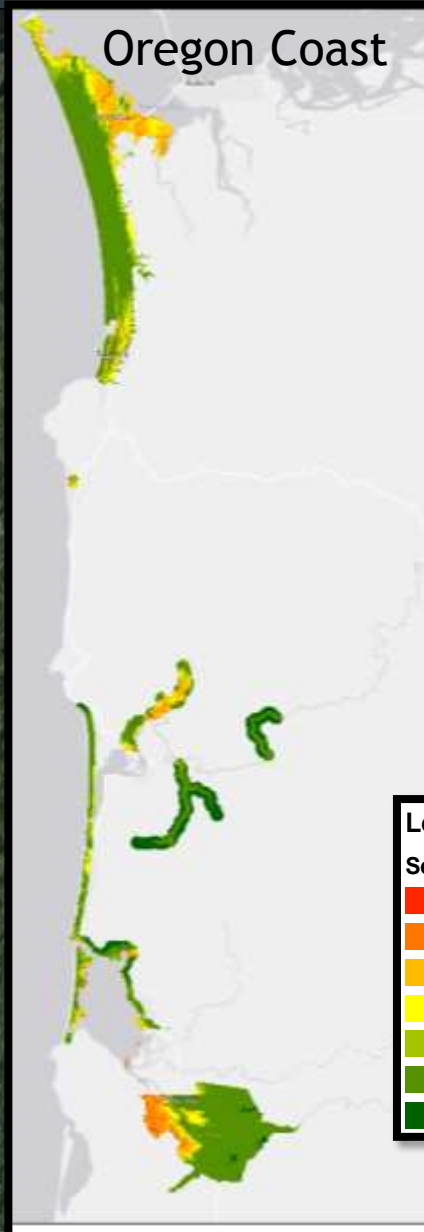
# Geography Weighted Impact

## Legend

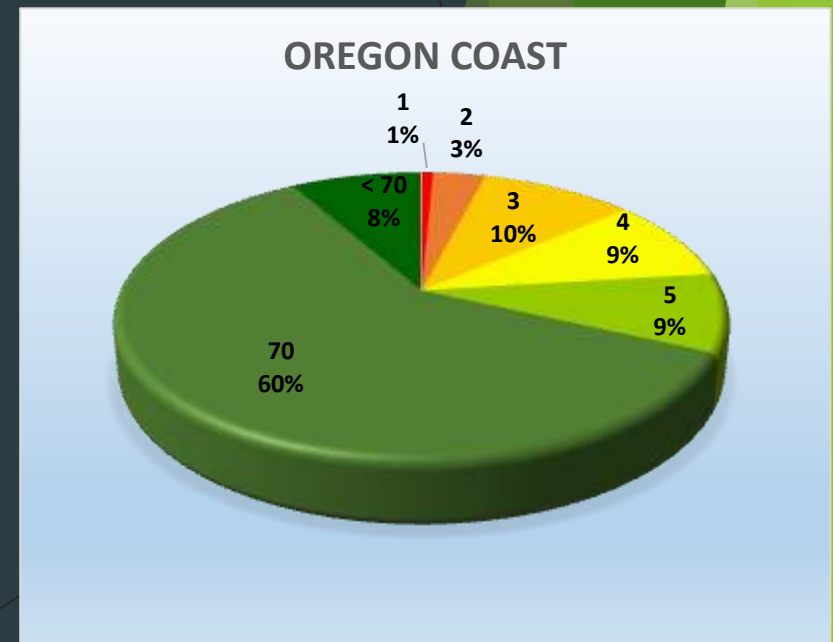
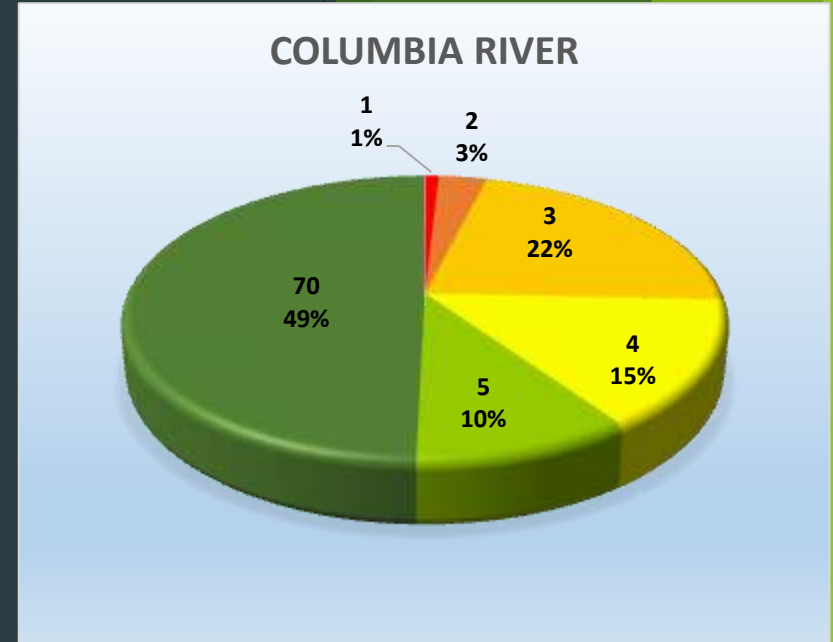
### Weighted Impact



# Flora: Percent of Total Area Affected By Elevation Zones

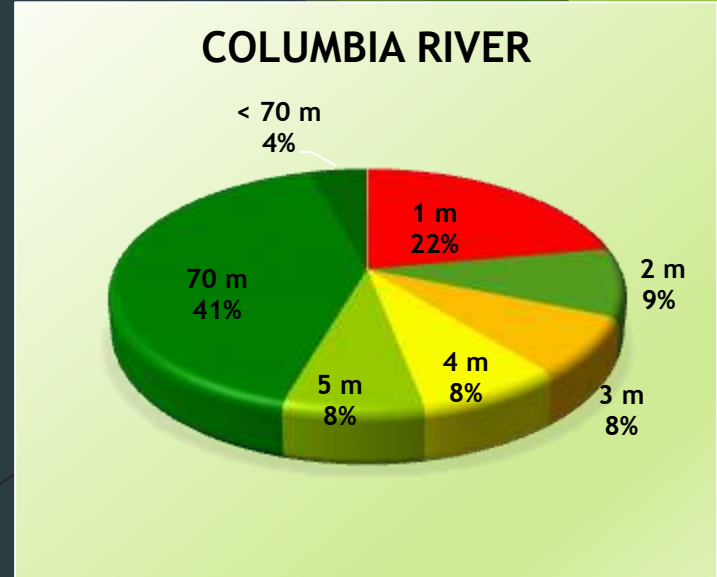
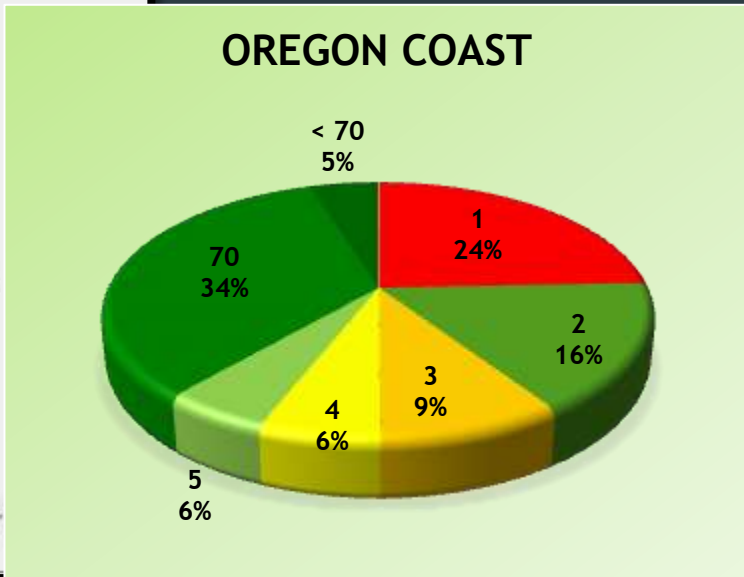
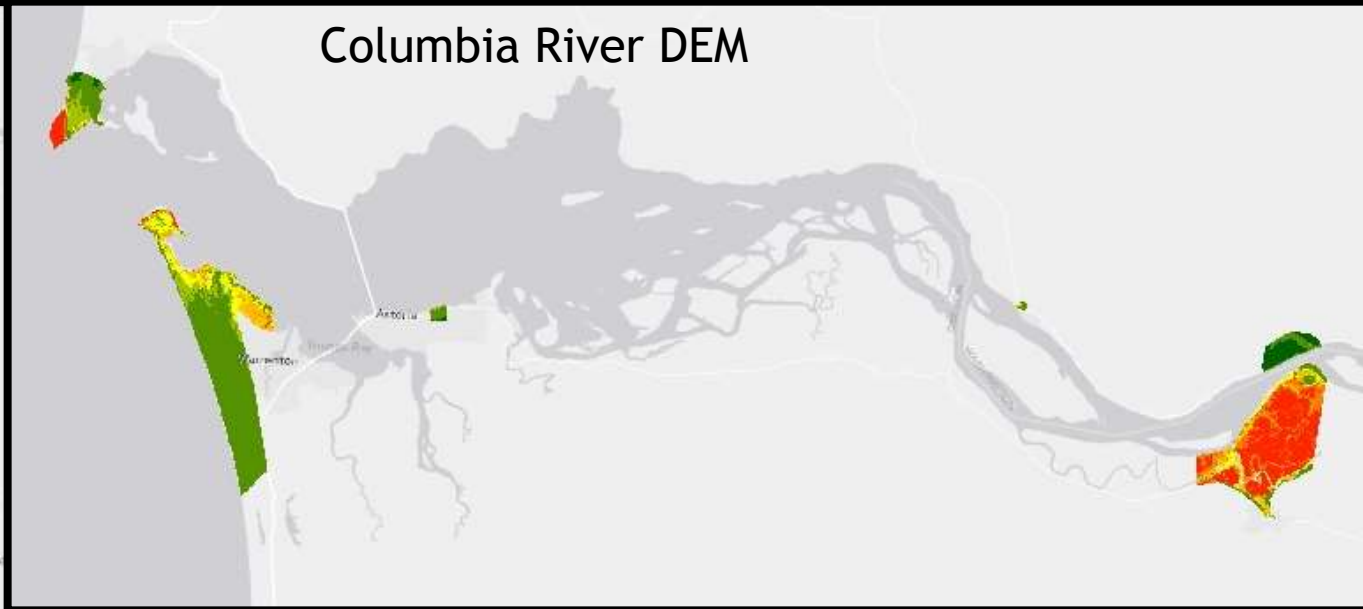


Source: U.S. Army Corps of Engineers  
 Confederated Tribes of Grand Ronde  
 Department of Geology and Mineral Industry  
 Produced By: Christopher S Parazo



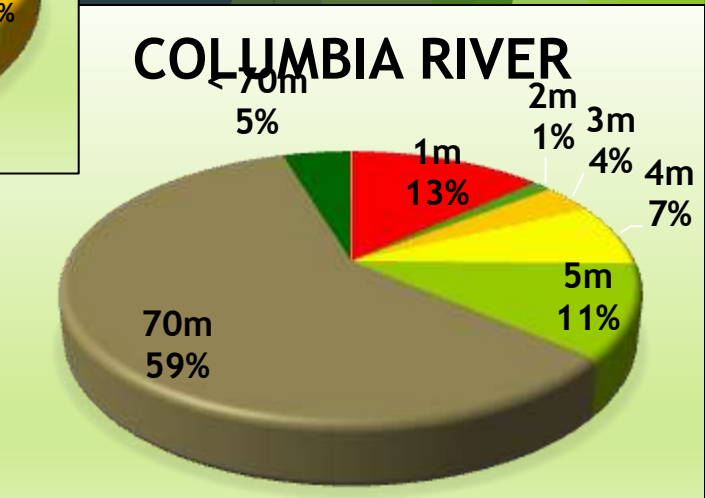
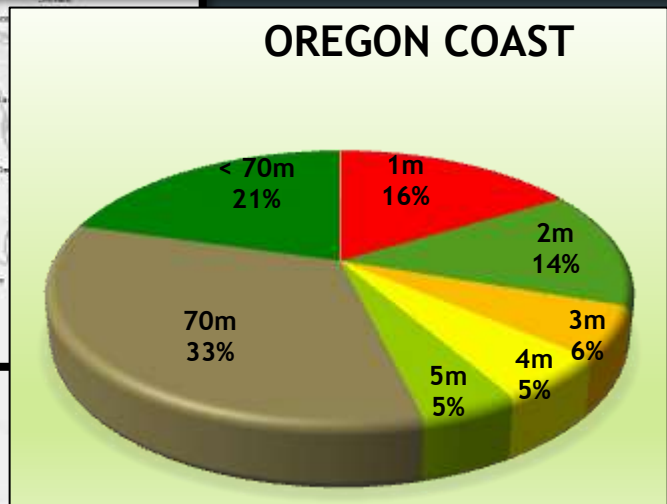
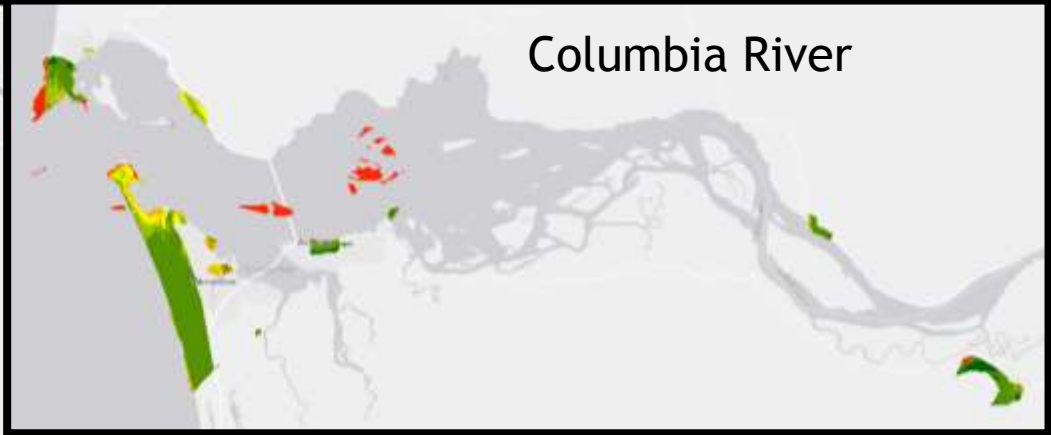
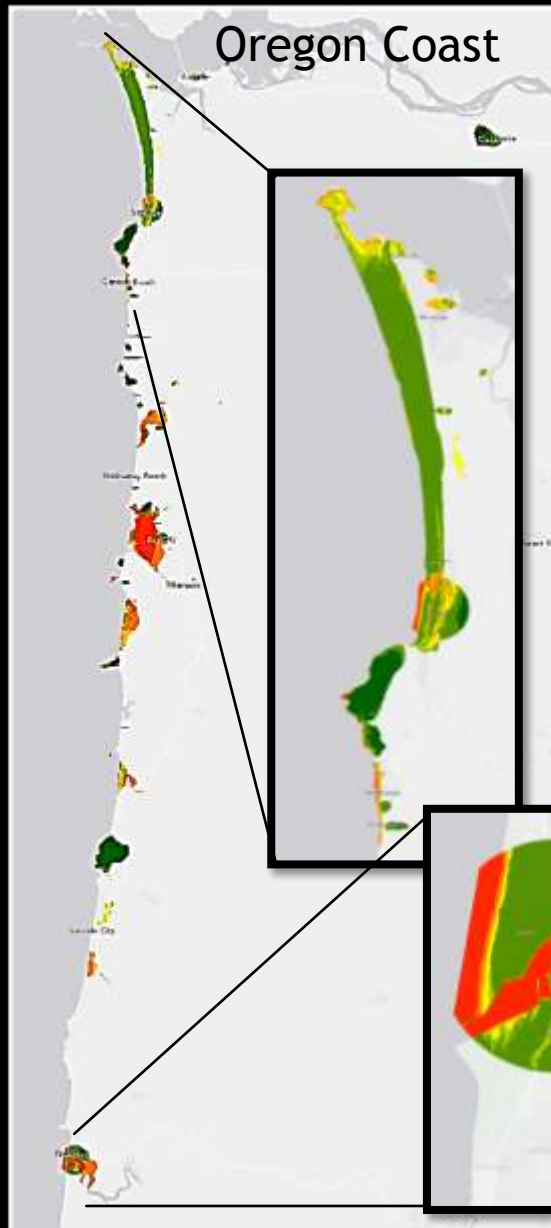
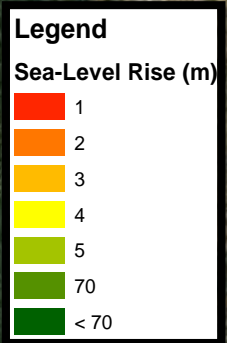


# Fauna: Percent of Total Area Affected By Elevation Zones

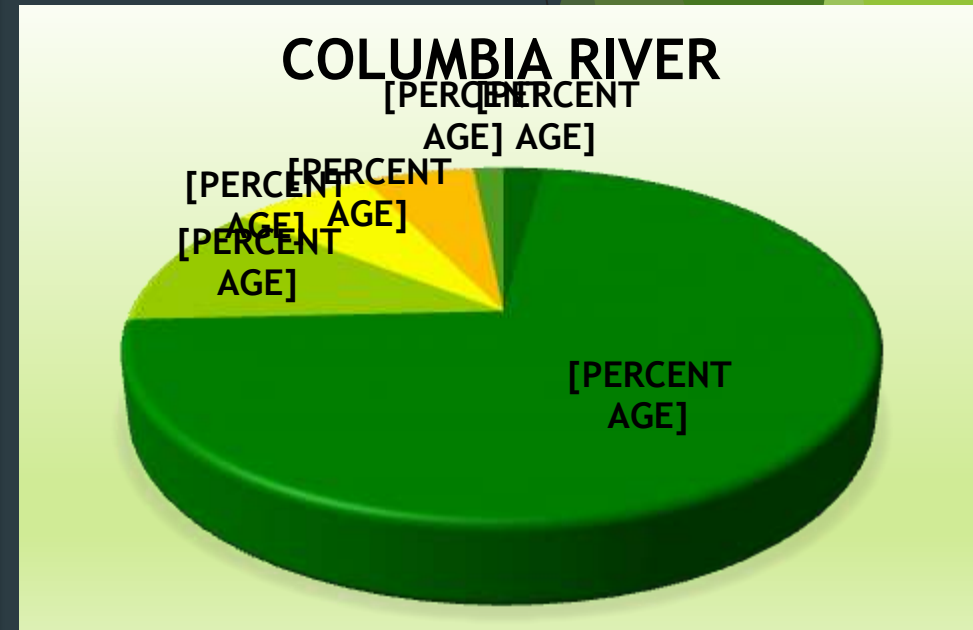
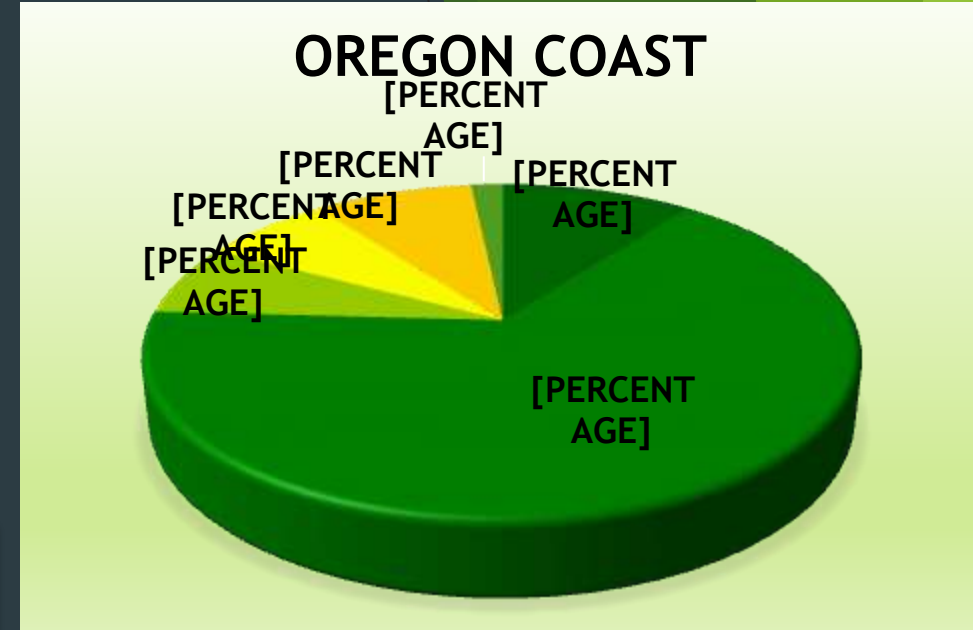
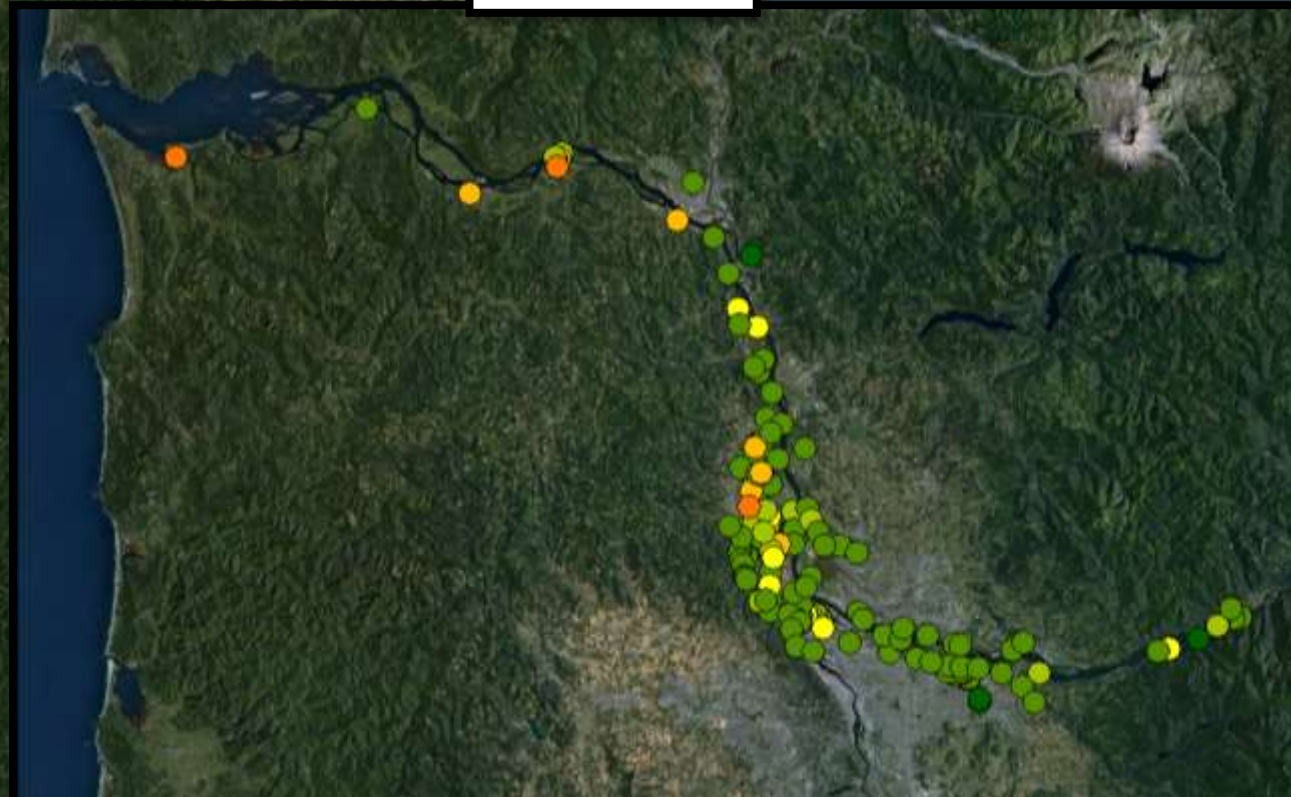
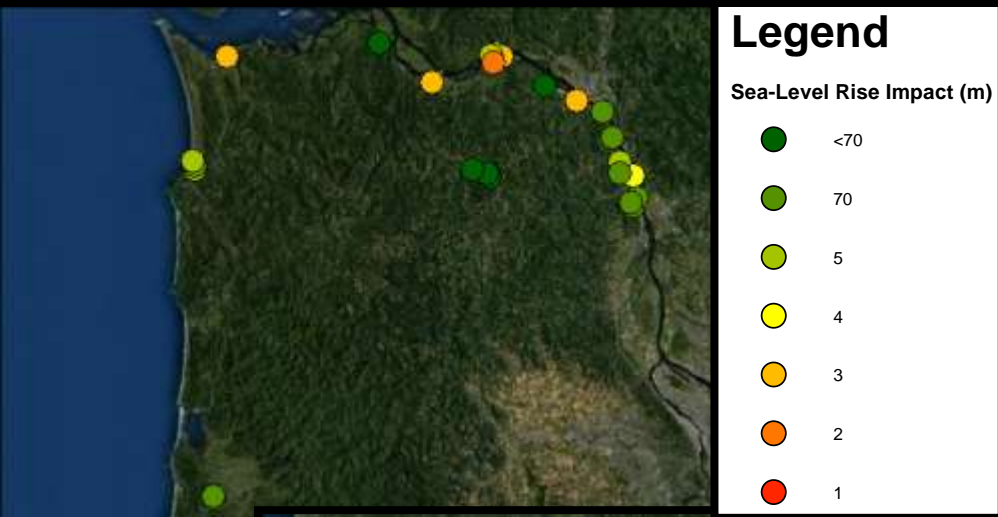




# Geography: Percent of Total Area Affected By Elevation Zones



# Archeological Sites: Percent Effectuated By Elevation Zones



# Conclusions

## Summary

- ▶ Cultural resources (flora, fauna, and places) are being impacted.
- ▶ Tribes have a connection and understanding of these changes.

## Resources:

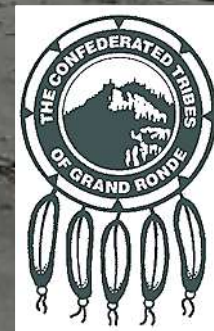
- ▶ <http://www.boem.gov/Pacific-Completed-Studies/>
- ▶ <http://www.boem.gov/2015-047/>
- ▶ <http://sanctuaries.noaa.gov/maritime/cultures.html>
- ▶ <http://ics.webcast.uwex.edu/Mediasite7/Play/9646c24eec5e41a5befc6e67e896ea631d>
- ▶ <http://marineprotectedareas.noaa.gov/toolkit/>
- ▶ <http://nationaladaptationforum.org/other-adaptation-events/webinars/importance-traditional-ecological-knowledge-adaptation-planning>

## Acknowledgements and Thanks

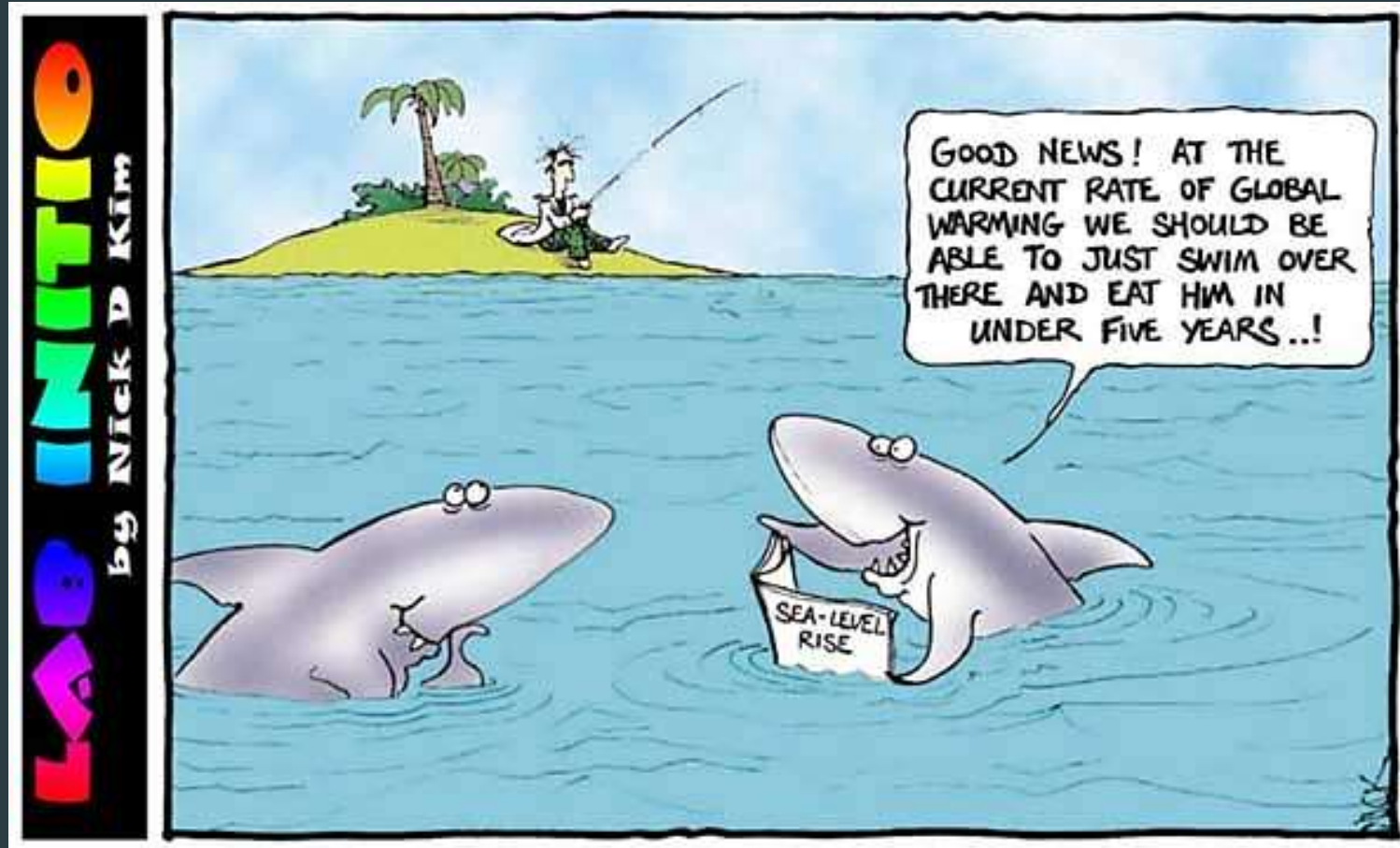
- ▶ Chris Parazoo (2014 Intern)
- ▶ Dustin Kennedy (CTGR 2013-15)
- ▶ NOAA MPA for bathymetric layers
- ▶ USACoE and DOGAMI for LiDAR
- ▶ BOEM (Project 2015-047)



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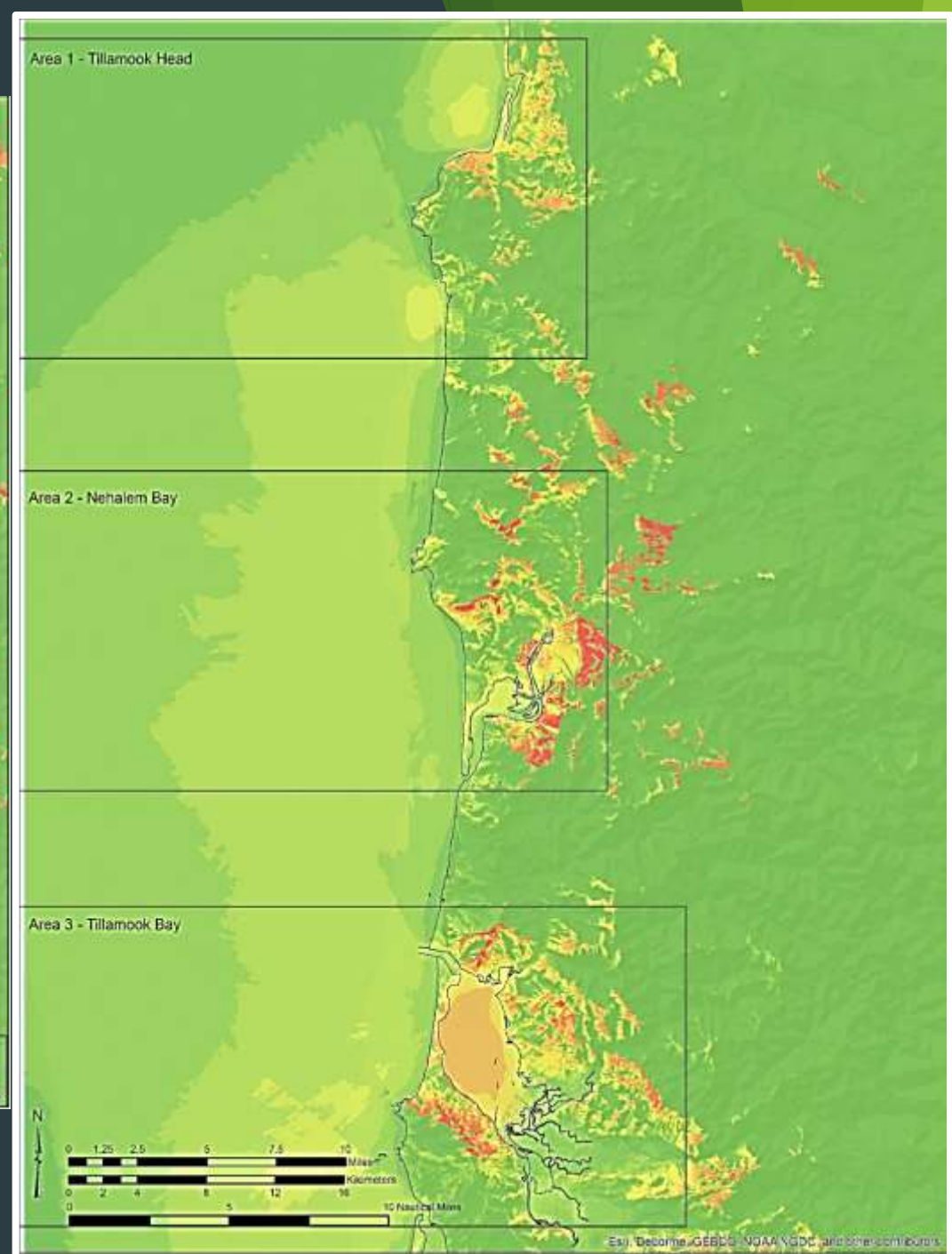
# Questions...?







Esri, DeLorme, GEBCO, NOAA, VGC, and other contributors



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