Integrating Sea Level Rise Predictions into Our Habitat Coverage Targets

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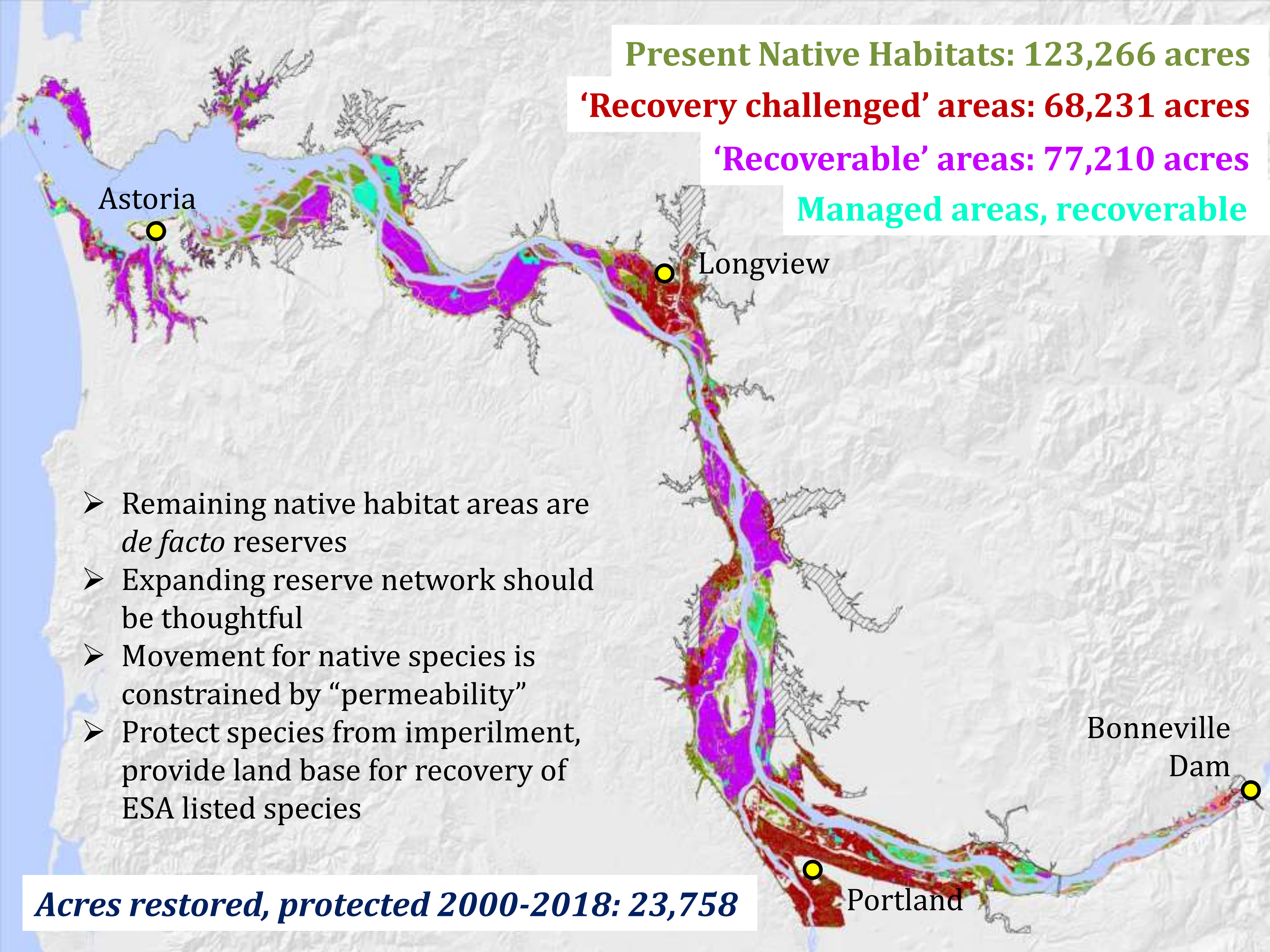
Science Work Group

Present Native Habitats: 123,266 acres

‘Recovery challenged’ areas: 68,231 acres

‘Recoverable’ areas: 77,210 acres

Managed areas, recoverable



- Remaining native habitat areas are *de facto* reserves
- Expanding reserve network should be thoughtful
- Movement for native species is constrained by “permeability”
- Protect species from imperilment, provide land base for recovery of ESA listed species

Acres restored, protected 2000-2018: 23,758

Considerations for Our Reserve Network

- Maintaining viable, intact ecosystems more efficient, economical and effective than species-by-species, site-by-site or threat-by-threat conservation approach (see Noss 2000)
  - If ecosystem degraded significantly, ecosystem restoration required
  - Understanding of impacts needed to stop trajectory of degradation (e.g., habitat change analysis from Marcoe and Pilson 2017)
- Habitat protection and restoration efforts are creating *de facto* reserve network
  - Requires well thought-out, comprehensive and long-term approach:
    - Native species are limited in ability to relocate when site conditions change or become unfavorable
    - Native species do not have homogeneous habitat requirements; habitat diversity is critical for biodiversity
  - Despite 23,758 acres restored OR protected, still increasing number of imperiled species
    - 24 species in 2004, 32 species in 2010, 40 species in 2015 (from EP State of the Estuary Report 2015)

Vision for the lower Columbia – Biological Integrity

➢ Biological Condition Gradient for Assessment of Integrity

(USEPA: Davies and Jackson 2006)

- Similar to Index of Biological Integrity (Karr 1981)
- ***2-Day Workshop in April 2012 at OHSU to identify key ecosystem attributes that embody biological integrity***

  a. **Natural Habitat Diversity, Historical Habitat Mosaic**
  b. **Focal Species:** e.g., Pacific salmonids, Col. White-tailed deer, Pacific Flyway species (NPCC 2004)
  c. **Water Quality**
  d. **Ecosystem Processes**

Three Basic Approaches for Identifying Critical Areas for Inclusion in Reserve Network:

Protection of special elements (e.g., rare species hotspots)

→ Identify areas w/ large number of species use, esp. endemic species not found elsewhere

Representation of all habitats, vegetation types, species

→ Identify types and severity of habitat loss through human disturbance

Meeting habitat requirements of focal species

→ Identify types, locations and extent of habitats essential to focal species

- ➢ These can point to different habitats for protection and restoration

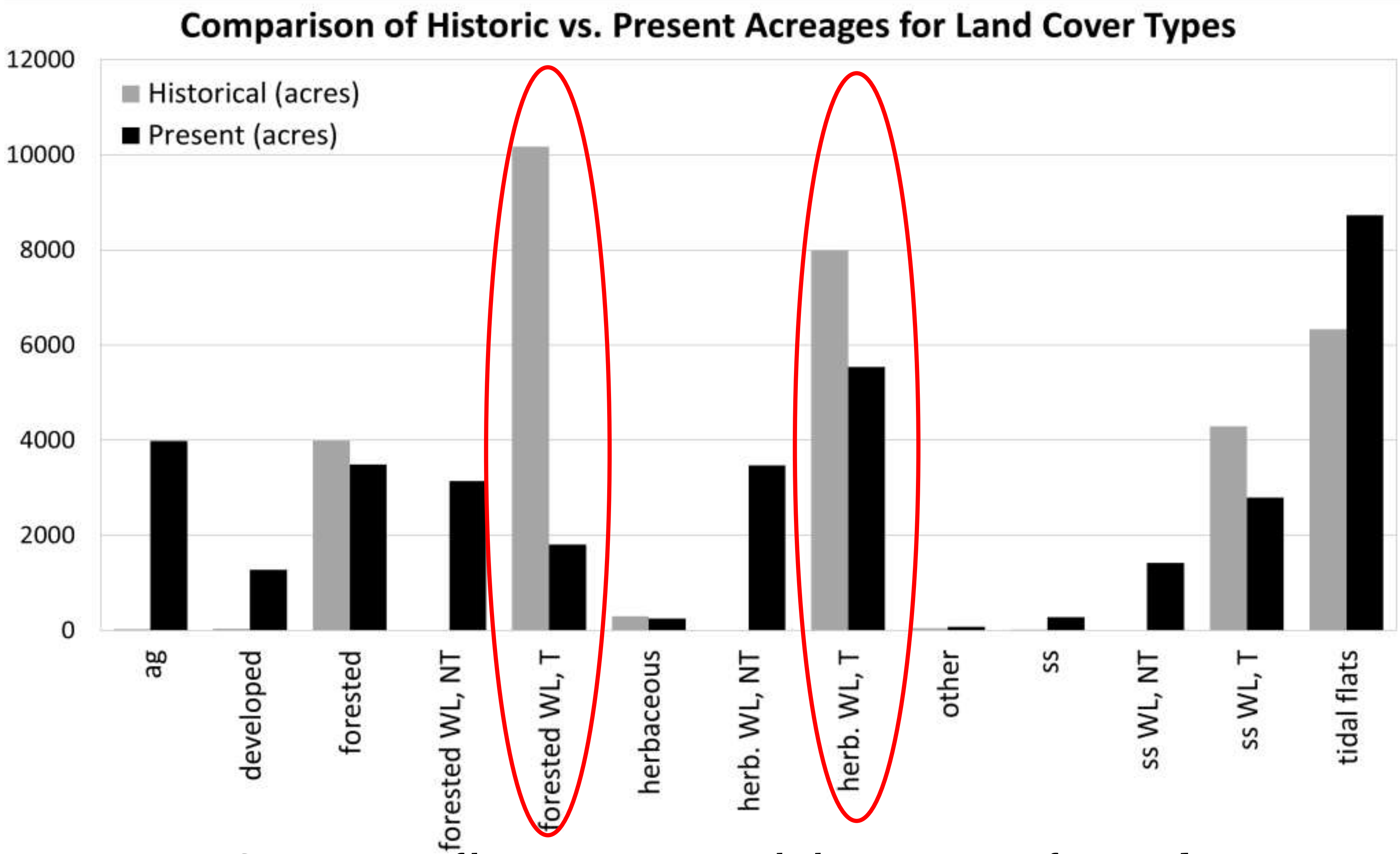
Adapted from R. Noss 2000

Define Quantifiable Conservation Targets

a. Natural Habitat Diversity, Historic Habitat Mosaic

- **Integral for other attributes (e.g., focal species)**
  - Native species evolved with historic habitat conditions; restoring to those conditions should be protective of those native species
- **Completed Habitat Change Analysis comparing 1870s habitat coverage to 2010 (Marcoe and Pilson 2017)**
  - Historic habitat coverage is proxy for natural habitat diversity
  - Identified significant losses and types
  - Protect remaining intact native habitats; recover lost habitats in areas where practical

Prioritized Habitats by Severity of Loss by Reach, Region and Entire Lower River



Comparison of historic vs. current habitat coverage for **Reach B**

Priority Habitats to Recover Historic Habitat Diversity:

Reach	Priority Habitats			
	1	2	3	4
A	herbaceous tidal WL	wooded tidal WL		
B	wooded tidal WL	herbaceous tidal WL		
C	wooded tidal WL	herbaceous tidal WL		
D	herbaceous tidal WL	wooded tidal WL	forested	herbaceous
E	herbaceous	forested	shrub-scrub	herbaceous tidal WL
F	forested	herbaceous	herbaceous WL	shrub-scrub
G	forested	herbaceous	herbaceous WL	
H	wooded WL			

Habitat Coverage Targets

- **No net loss of native habitats (2009 baseline; 114,050 acres lost since 1870)**
- **Recover 30%* of historic extent for priority habitats by 2030; 40%* of historic extent by 2050**
  - *Representation* of priority habitats
  - *Representation* of rare, vulnerable habitats
  - Ensure many examples of habitats in each region for *redundancy*
  - Restore quality, condition of habitats - *resiliency* of habitats to persist through disturbance
- **Other aspects:**
  - Multiple large "reserves" with smaller patches interspersed that fill gaps, provide corridors, connectivity
  - *Identify minimum size criterion for anchor areas, minimum number of occurrences by region*

**Based on species-area curve (MacArthur and Wilson 1967)*

Habitat Coverage Targets by Reach

Reach	Available Recoverable Habitat	Total Acres Restored	Total Acres Protected	PH1 Habitat Type	PH1 Hist. Extent	PH1 Current Extent	PH1 Target 30% recovery	PH1 Target 40% recovery	PH2 Habitat Type	PH2 Hist. Extent	PH2 Current Extent	PH2 Target 30% recovery	PH2 Target 40% recovery	**Acre Margin for 30% recovery**	**Acre Margin for 40% recovery**
A	10062	491	1539	HWT	8031	1480	929	1732	WWT	3578	219	854	1212	8278	7117
B	10417	556	3658	WWT	14459	4589	(251)	1195	HWT	7983	5533	(3138)	(2340)	10417	9222
C	18837	338	1764	WWT	13876	2226	1937	3324	HWT	11753	1353	2173	3348	14727	12164
D	1098	23	0	HWT	2570	133	638	895	WWT	2740	283	539	813	(79)	(610)
E	9173	173	1629	H	5243	416	1157	1681	F	7473	3462	(1220)	(473)	7483	6662
F	24567	2799	603	F	29253	9095	(319)	2606	H	9688	2070	836	1805	23628	19846
G	2510	2048	142	F	18790	6429	(792)	1087	H	7537	1578	683	1437	1827	(14)
H	546	203	0	WW	3342	1132	(129)	205						546	341
				PH3					**PH4**						
D	1098	23	0	F	8164	3399	(950)	(133)	H	3135	1293	(353)	(39)		
E	9173	173	1629	S	1680	166	338	506	HWT	1290	192	195	324		
F	24567	2799	603	HW	11604	6189	(2708)	(1547)	S	2069	518	103	310		
G	2510	2048	142	HW	3392	1967	(949)	(610)							

- **TOTAL: Restore 10,382 by 2030; 22,480 acres of priority habitats by 2050**
- **Results in 60% of historic habitat coverage**

Notes:

- Negative Values are shown in Red - indicate enough of this habitat type exists to meet recovery goals
- Negative Acres Margin values (Reaches D, G)indicate there is insufficient Recoverable Habitat to meet recovery goals for the Reach.
- Restored Acres do not reflect quality of restoration.
- Protected Acres do not reflect habitat type. Protected habitats may not be Priority Habitats.
- Protected Acres include land acquisitions and conservation easements. Federal Wildlife Refuges are not counted.

Habitat Coverage Targets by Reach

Reach	Future Habitat with Targets							
	30% Target				40% Target			
	Priority Habitat	Other Habitat	Total	% of Historic	Priority Habitat	Other Habitat	Total	% of Historic
A	3,483	11,825	15,308	**81.6**	4,644	11,825	16,469	**87.8**
B	10,122	12,032	22,154	**82.8**	10,122	12,032	22,154	**82.8**
C	7,689	10,806	18,495	**58.7**	10,252	10,806	21,058	**66.8**
D	5,108	2,097	7,205	**42.6**	6,644	2,097	8,741	**51.7**
E	4,706	2,700	7,406	**44.7**	6,274	2,700	8,974	**54.1**
F	17,872	7,976	25,848	**41.9**	21,046	7,976	29,022	**47.1**
G	9,974	2,991	12,965	**39.6**	11,888	2,991	14,879	**45.5**
H	1,132	4,301	5,433	**80.8**	1,337	4,301	5,638	**83.9**
All	60,085	54,728	114,813	**54.3**	72,205	54,728	126,933	**60.0**

Habitat Coverage Targets

Focus Restoration of Priority Habitats in Historic Locations:

Reach A

- Focus HWT on Chinook, Youngs, Lewis and Clark tributaries
- Focus WWT on northern Lewis and Clark tributary

Reach B

- Hold the line, keep on doing great work

Reach C

- Focus WWT on western end of reach (potentially leverage work in eastern reach B)
- Focus HWT on eastern end of reach

Reach D

- Hold the line on H and F
- Focus all recoverable areas on HWT and WWT

Reach E

- Hold the line on F
- Focus H and SS just north of Woodland area
- Focus HWT with a smattering of SS and H on Deer Island area

Reach F

- Hold the line on HW
- Focus F on St Helens, Scappoose, Warren areas with some around Vancouver Lake
- Focus SS and H on fringes, ridge and scroll
- H,SS and F could be all on same patches depending on management objectives

Reach G

- Hold the line on HW
- Focus H and F on recoverable areas (Government Island and Steigerwald)

Reach H

- Focus WW on recoverable areas

Three Basic Approaches for Identifying Critical Areas for Inclusion in Reserve Network:

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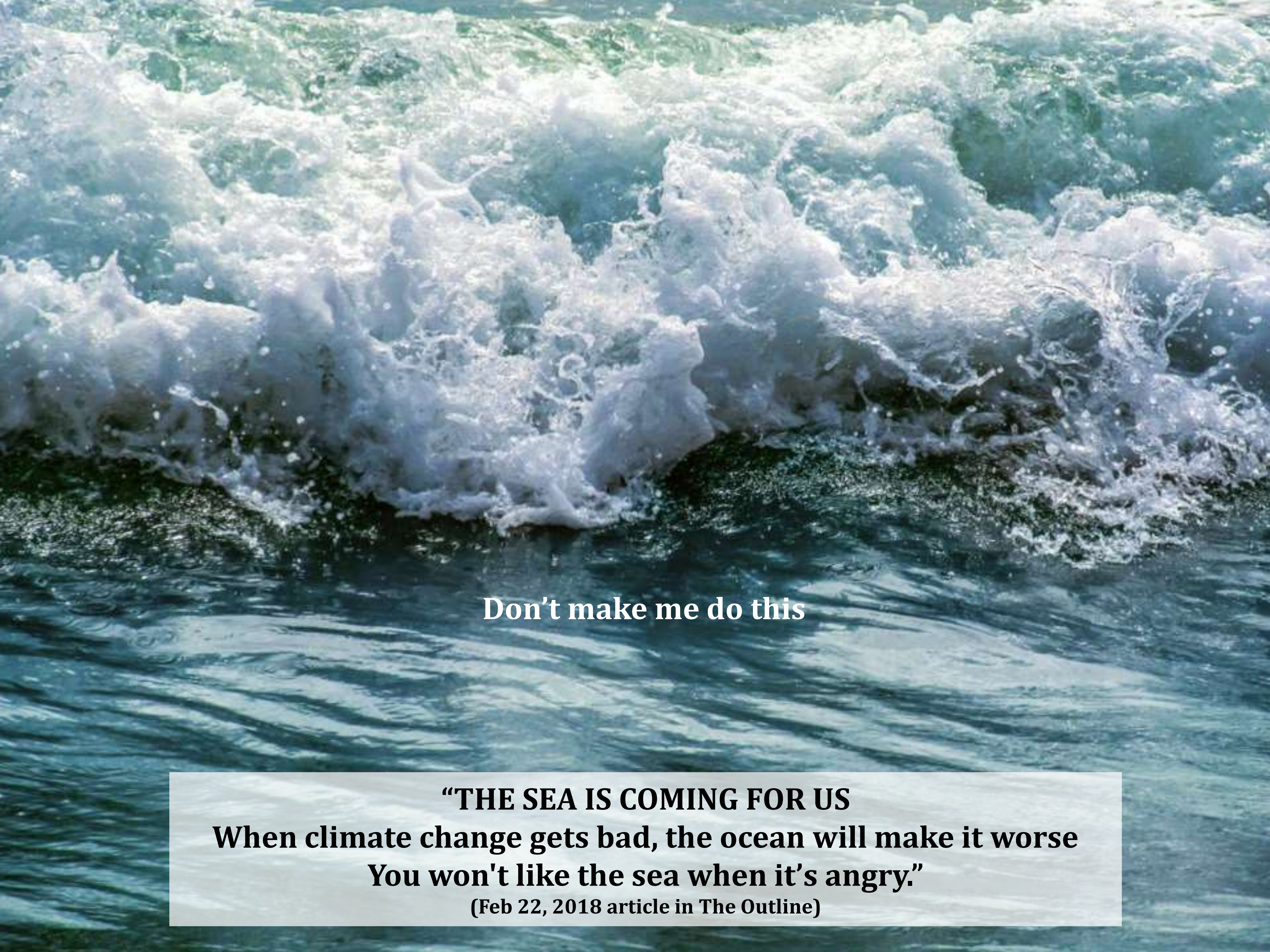

Don’t make me do this
“THE SEA IS COMING FOR US
When climate change gets bad, the ocean will make it worse
You won't like the sea when it’s angry.”
(Feb 22, 2018 article in The Outline)

Shifting Ecosystem Conditions:

- **Sea level rise** and more intense storms, increased wave energy, increased erosion (National Climate Assessment 2017)
  - **Further loss of floodplain habitats -** Increased flooding, conversion, submersion and erosion of floodplain habitats
  - **Ocean acidification and hypoxia** (OAH) – Changes to shellfish, ocean food web, fish behavior
- **Marine heatwaves** changing ocean food web, predation, disease
- **Changes to California Current-** patterns of upwelling, timing and duration;
  - Changes to thermal stratification, ocean acidification and hypoxia
- **Warmer temperatures, changing precipitation patterns**
  - More intense events, more variable weather
  - More precipitation falling as rain, lower snow packs in mountains
  - Increased drought
- **Increased pest invasions**, tree dieoffs, and larger, more severe forest fires

➢ ***Widespread ecosystem shifts are likely and may be abrupt (e.g., large disturbances such as wildfires, insect outbreaks, diseases)***

Moving from Managing for Preservation to Managing for Change:

- Conservation has traditionally focused on preserving conditions and suite of species that occurred before major human alterations

- Historical targets no longer make sense when climate change will profoundly alter the site and which species can survive at that site

- Major shifts in climate will occur no matter how vigorously greenhouse-gas emissions are reduced (NRC 2010; IPCC 2018)

➢ **Idea that ecosystems fluctuate within a defined and constant range of variability (or "stationarity") is DEAD** (from Stein et al. 2013)

➢ **Cumulative impact of existing stressors - habitat loss, pollution, invasive species, and overharvest - and rapid, directional changes in environmental conditions from climate change are disrupting ecosystem processes, increase risk of species extinctions and contribute to biome changes** (Stein et al. 2014)

Moving from Managing for Preservation to Managing for Change:

- **Plant and animal ranges are shifting or expanding, often poleward and to higher elevations**
  - Higher elevations at a median rate of 0.011 km per decade
  - Higher latitudes at median rate of 16.9 km per decade (Chen et al. 2011)

- **Earlier timing of life-history events (e.g., phenological changes)**
  - Plants leafing out and blooming earlier
  - Wildlife breeding or migrating earlier (research cited in Stein et al. 2014)

- **Changing hydrological conditions are effecting life-cycle events**
  - Shifts in “monsoon” rains delaying blooming in arid regions of Southwest
  - Earlier peak streamflow in snowmelt-driven rivers disrupting timing of fish migration (research cited in Stein et al. 2014)

“Conservation planning is always an exercise in decision making in the face of limited and uncertain data, and especially so in the case of planning for climate change.”

(Carroll et al. 2017)

- Uncertainties in CO_2 emission reductions
- Uncertainties with model predictions of climate change
- Uncertainties how ecosystems will respond to aspects of climate change
- Uncertainties how ecosystems will respond to conservation actions we take

Climate-Smart Conservation

- **Needs to be intentional** – Move away from trusting traditional practices are sufficient
- **Needs to be integrated into every aspect of conservation programs**
  - Reconsider goals, objectives, targets, actions within the face of climate change
- ***Manage for change*, not just persistence**
- **Forward-thinking goals -** allow for ecosystem transformations and novel species assemblages

➢ ***Anticipatory vs reactionary adaptation***

Good resource is: Stein, B.A., P. Glick, N. Edelson, and A. Staudt (eds.). 2014. *Climate-Smart Conservation: Putting Adaptation Principles into Practice.* National Wildlife Federation, Washington, DC

Climate Adaptation Framework

(from Schmitz et al. 2015)

- Distills 42 proposed approaches of climate adaptation into 6
- Works across 3 levels of ecological organization (species, ecosystems and landscapes)
- Conserves biophysical features and processes as well as species and habitats
- First 2-3 approaches build upon classic conservation actions
  - Third approach is new to us, but has been used by TNC in Columbia Plateau; very commonly recommended in recent conservation biology
- Last 3 approaches address climate futures BUT require scenario analyses

Climate Adaptation Framework

(from Schmitz et al. 2015)

1. Protect current patterns of biodiversity

- Need this to protect species now, under current conditions
- Traditional methods are still critical “no-regrets” strategies

2. Protect large, intact, natural landscapes and ecological processes

- Or assembling connected portfolio of smaller, undeveloped spaces
- More “resilient” to disturbances, changes, and protect larger assemblages of species

3. Maintain and establish ecological connectivity

- Connecting areas with corridors, stepping stones, or working lands to create permeability for species movement, range shifts
- ➢ Identify where species might move to meet climate niche and evaluate current corridors, landscape permeability to identify whether they can move or whether additional lands are needed

Climate Adaptation Framework

(from Schmitz et al. 2015)

4. **Identify and protect areas providing future climate space for species expected to be displaced by climate change**
   - Identify where species might move to meet climate niche
   - Identify if these areas are managed to protect these species or ecological conditions

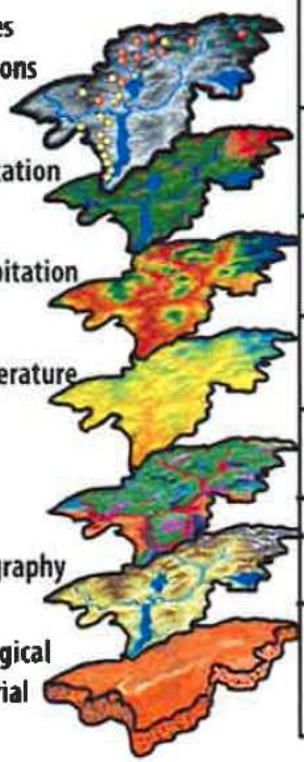
5. **Identify and protect climate refugia**
   - Specific places where climate and associated conditions are likely to remain stable OR
   - Areas that change but will still be suitable to species in surrounding region

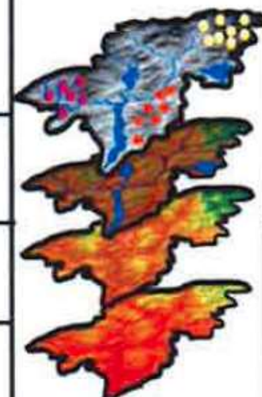
6. **Protect geophysical settings (land facets)**
   - Species presence depends on suite of factors, e.g., soil chemistry, topographic positions, aspect, slope, elevation
   - Premise is that as climate changes, these locations are enduring features because geology and soils will not change
   - TNC used soil order, elevation and slope to map in Columbia Plateau

Climate Adaptation Framework

(from Schmitz et al. 2015)

Available Input Layers





Current Conditions	Protect current patterns of biodiversity	Protect large, intact & natural landscapes	Protect the geophysical setting	Future Conditions	Maintain & restore ecological connectivity	Identify & manage future climate space for species	Identify & protect climate refugia
Species Locations	✓				✓	✓	✓
Vegetation	✓	✓			✓	✓	
Precipitation	✓					✓	✓
Temperature	✓					✓	✓
Soil			✓				
Topography		✓	✓		✓		
Geological Material		✓	✓		✓		

Initial Climate-Smart Conservation Actions for the Lower Columbia River

- **Identify where in target species' life-histories they are vulnerable to climate change**
  - Mapped cold water refuge locations and identified spatial gaps (completed)
  - Testing technique to enhance tributary confluences to fill gaps

- **Reconsider goals and objectives in light of climate change:**
  - Assess vulnerability of lower Columbia River floodplain habitats to sea level rise (complete) & increased fluvial flooding (planned)
  - Constraints to meeting habitat coverage targets (underway)
  - Develop engineering design criteria, best practices for conservation activities that integrate SLR and fluvial flooding (planned)
  - Test drought-tolerant vegetation mixes to ensure *functions* (e.g., pollination) (planned)

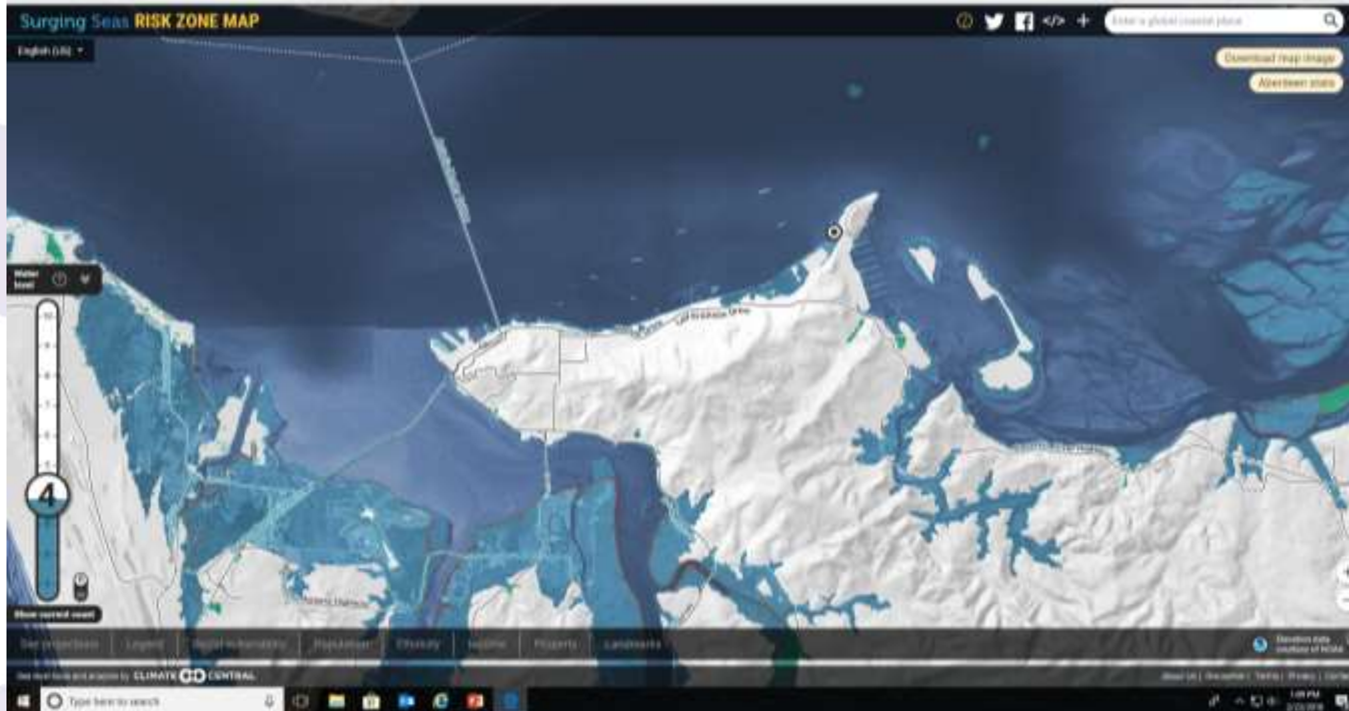
Generalized Predictions of Sea Level Rise:

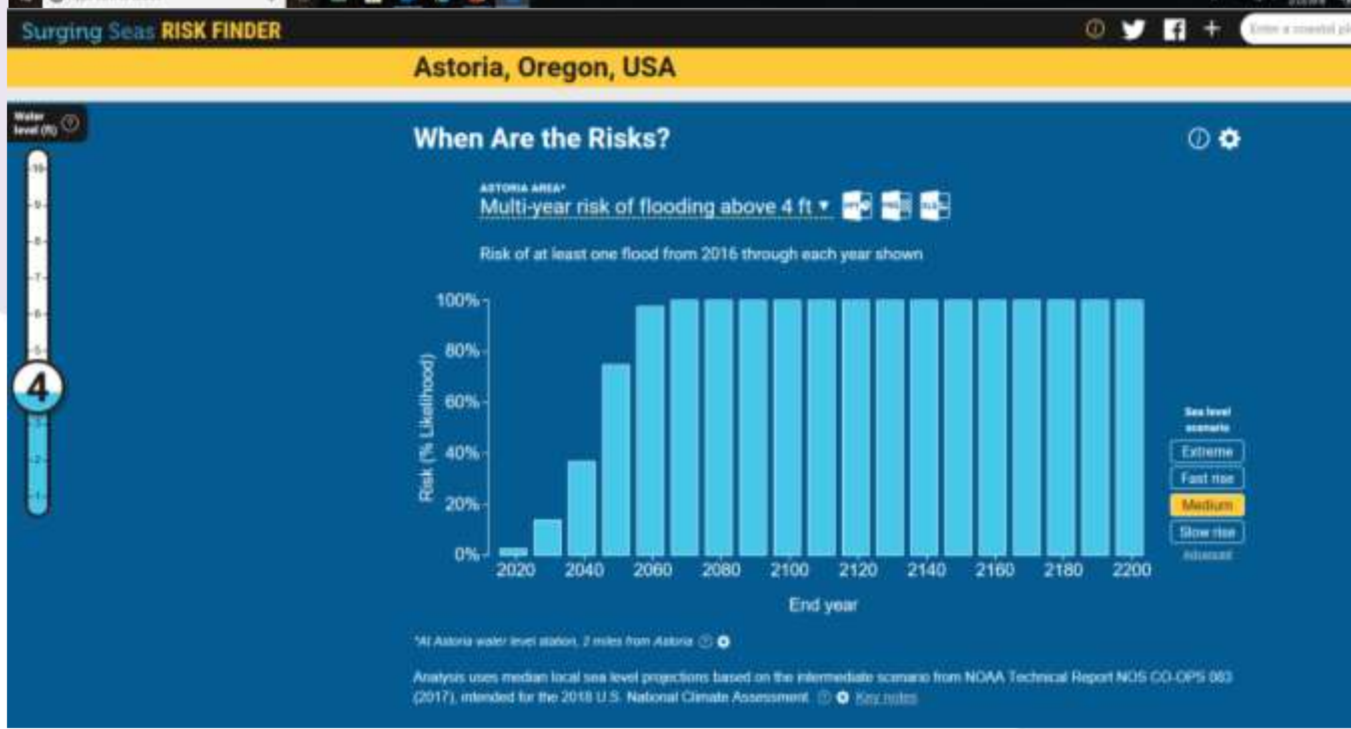
- **NWF 2007 - Modeled SLR for Puget Sound to Tillamook Bay**
- Demonstrates likelihood of significant loss of floodplain habitats
  - Inundation, conversion and erosion
- Good first step BUT need more site specific, detailed information
  - SLAM model
  - Lower Columbia composited with Willapa down to Tillamook Bay (1.4 million acres)
  - Covered only up to Cathlamet
- **Surging Seas Risk Finder & NOAA Sea Level Rise Viewer**
  - Really cool citizen-friendly graphics and risk projections
  - Not sufficient for local landuse plans (do not use downscaled data and projections)

Generalized Predictions of Sea Level Rise:

- **Surging Seas Risk Finder**

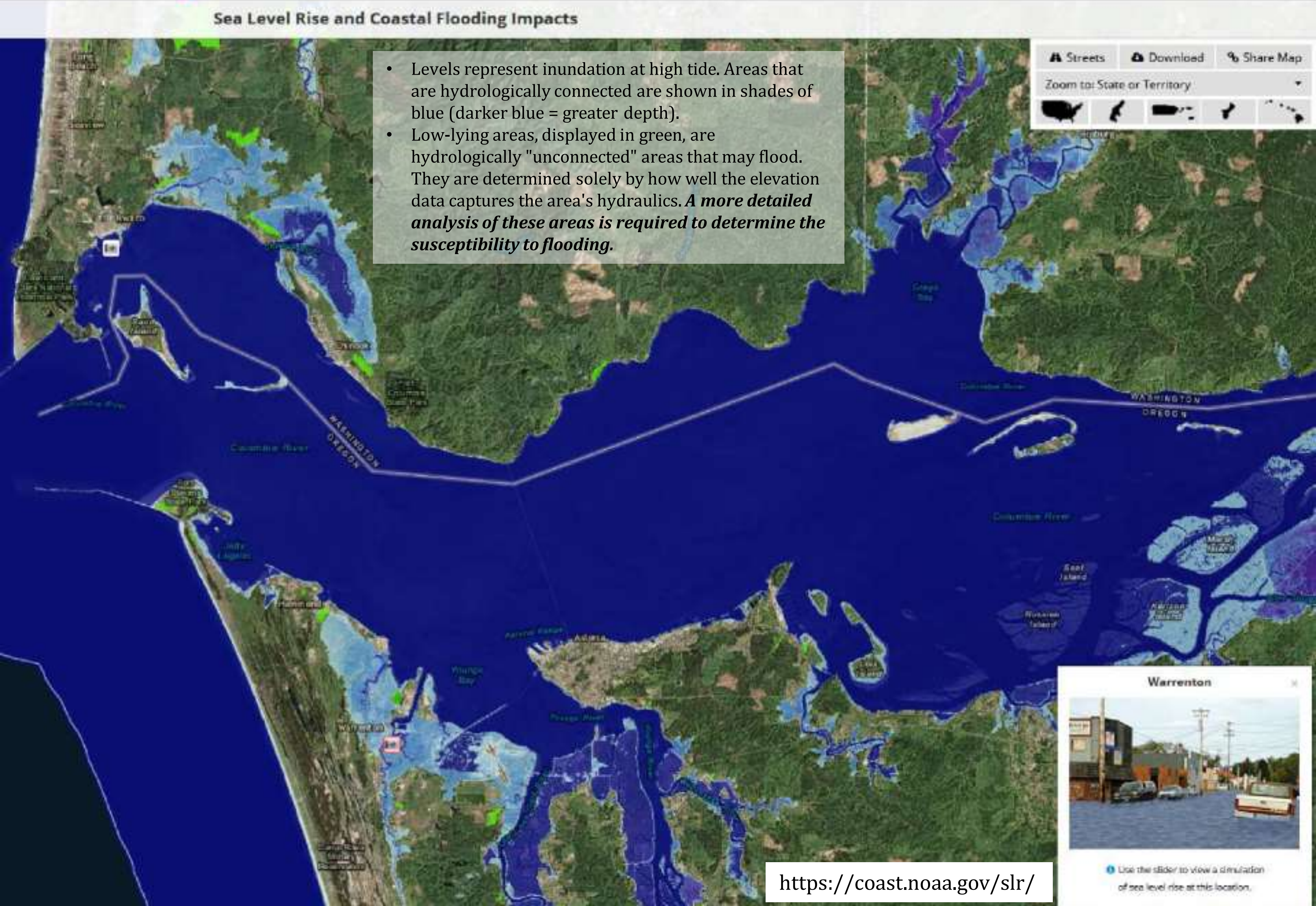
https://riskfinder.climatecentral.org/





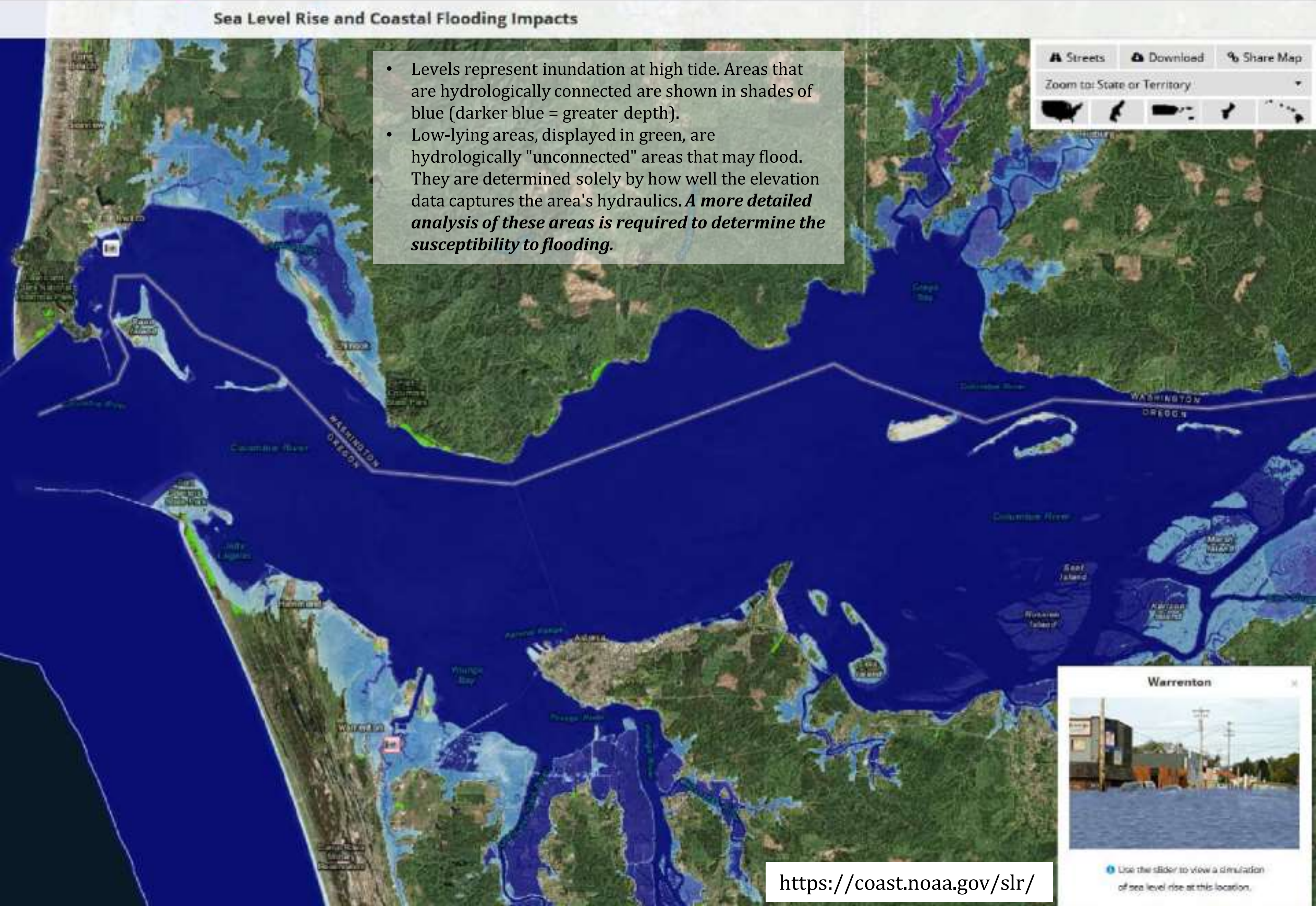
3ft Sea Level Rise

- Levels represent inundation at high tide. Areas that are hydrologically connected are shown in shades of blue (darker blue = greater depth).
- Low-lying areas, displayed in green, are hydrologically "unconnected" areas that may flood. They are determined solely by how well the elevation data captures the area's hydraulics. ***A more detailed analysis of these areas is required to determine the susceptibility to flooding.***



https://coast.noaa.gov/slr/

6ft Sea Level Rise



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Questions?

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