Lower Columbia Estuary Partnership

Integrating Multi-Species and Climate Change Impacts into Restoring the Lower Columbia River Ecosystem

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Considerations for Restoration

- Protection and restoration have been focused on a few species (waterfowl, salmon), restoring historic conditions
- Paradigm shift to integrate predicted climate change impacts
  - Allow wetland migration inland to offset future losses with sea level rise and coastal squeeze
  - Protection, restoration of cold water refuges, sources
  - Allow for species shifts, encourage adaptation to changing climate conditions – reduce "preservationist" mindset
- Shift to multi-species approach going forward
  - Creating *de facto* reserve system - species are much more limited in ability to relocate when site conditions change, become unfavorable
  - Restoration is expensive, limited land base to meet conservation objectives - avoid the need to retrofit projects in future for other species
  - Limited funding
  - Growing number of imperiled species; heterogeneous habitat needs

Climate Change Considerations

Climate change impacts:

- **Sea level rise –**
  - Further loss of estuarine and coastal habitat through submersion, conversion and erosion
  - More intense storms, increased wave energy, increased erosion
- **Changes in upwelling patterns** off coast -
  - Increased intrusion of hypoxia and acidification into estuaries
  - Increased influence with lower summer flows w/precipitation changes
- **Warmer temperatures**–
  - Less habitat for cold water species (salmon, steelhead, trout)
  - Species shifts, migration, mortality, increased competition
- **Changing precipitation patterns** –
  - More precipitation falling as rain, lower snow packs in mountains
  - Higher winter flows, lower summer flows
  - Altered timing and rates of change in flow events
  - More and more severe droughts
  - Increased pest invasions of forests
  - Larger, more severe forest fires

➢ ***Vast changes to native habitat conditions and flora/fauna***

Paradigm Shift

Mitigating for Climate Change:

- To maintain floodplain wetlands, will need to **allow wetlands to migrate inland**
  - Assess sea level rise, marsh erosion, submersion
  - Identify areas - urban, productive agricultural - that will be protected
  - Protect more inland, upland areas behind current habitats
  - Strategic levee and dike modification
- Identify ways to support **species ability to adapt**
  - Provide diversity of habitats to support resiliency of species using them
  - Protect, restore base flow, groundwater inputs to tributaries, alluvial fans to provide cold water refugia
  - Understand likely changes in habitat structure with increasing temperatures, changing precipitation and inundation, flow patterns
  - Understand likely species shifts, migration, mortality, competition
  - *Adapt management strategies – focus on restoring historic conditions will not be protective of native species in the long term*

Orderly Proactive Transition vs Abrupt Reactive Change

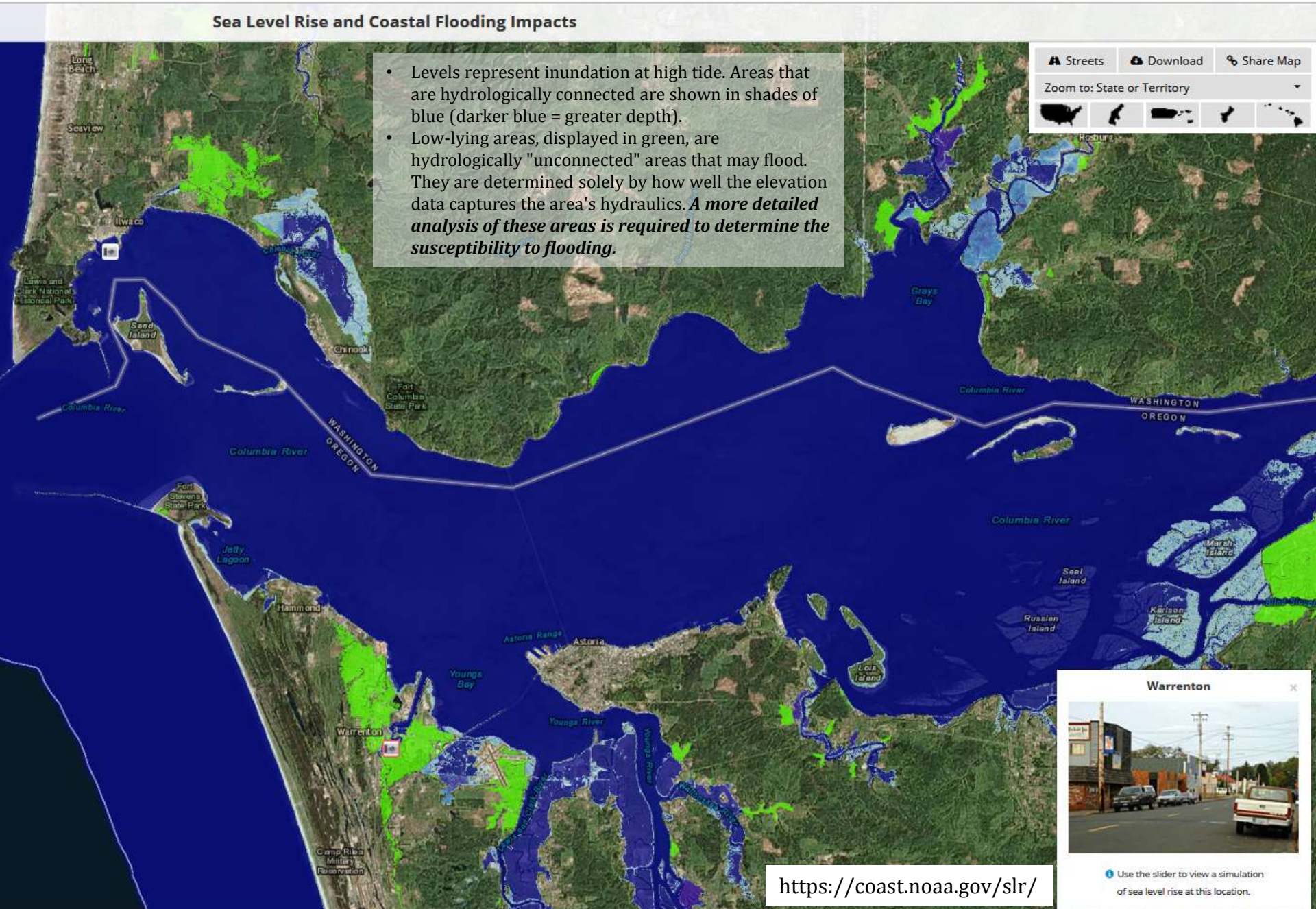
- **Knowledge** and **leadership** is key

Mitigating for Climate Change– Sea Level Rise

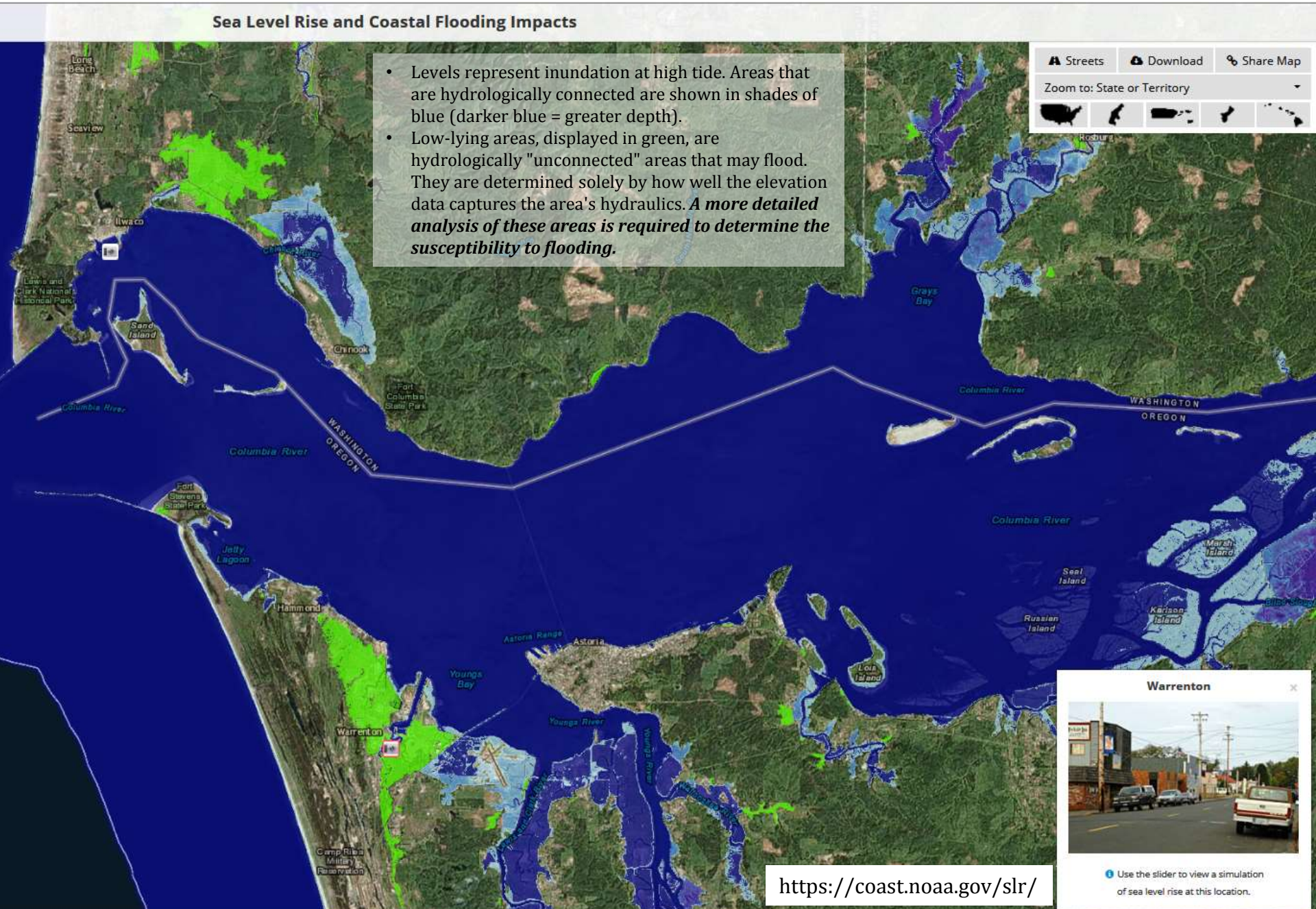
- **NWF 2007 - Modeled SLR for Puget Sound to Tillamook Bay**
- Demonstrates likelihood of significant loss of floodplain habitats
  - Inundation, conversion and erosion
  - Flooding of urban areas in Astoria, Ilwaco, etc
- Good first step BUT need more site specific, detailed information
  - Lower Columbia composited with Willapa down to Tillamook Bay (1.4 million acres)
  - Covered only up to Cathlamet
  - *Local planners, officials, funders, restoration practitioners, cannot make significant investment decisions based on these data alone*

Current MHHW

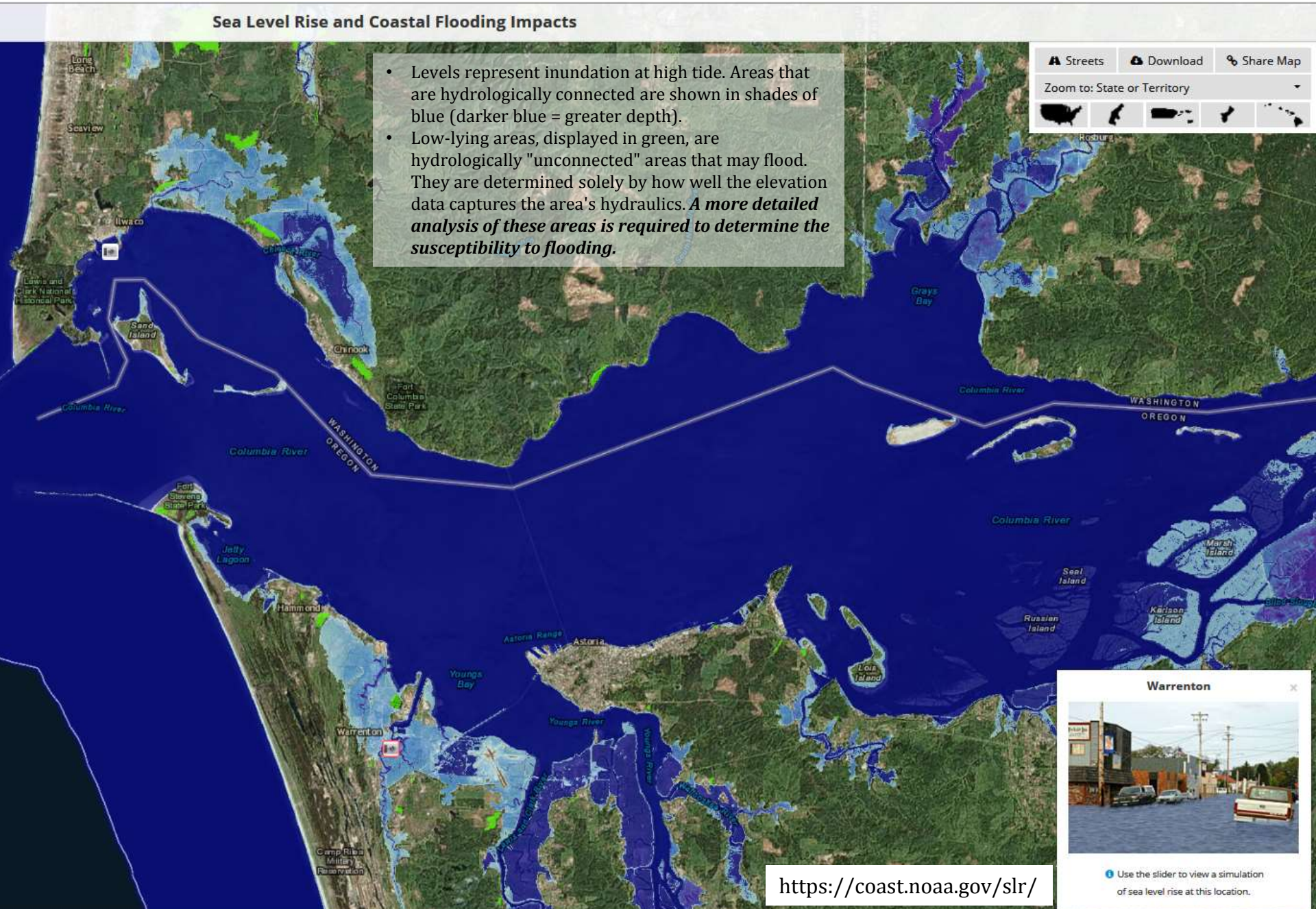
1ft Sea Level Rise



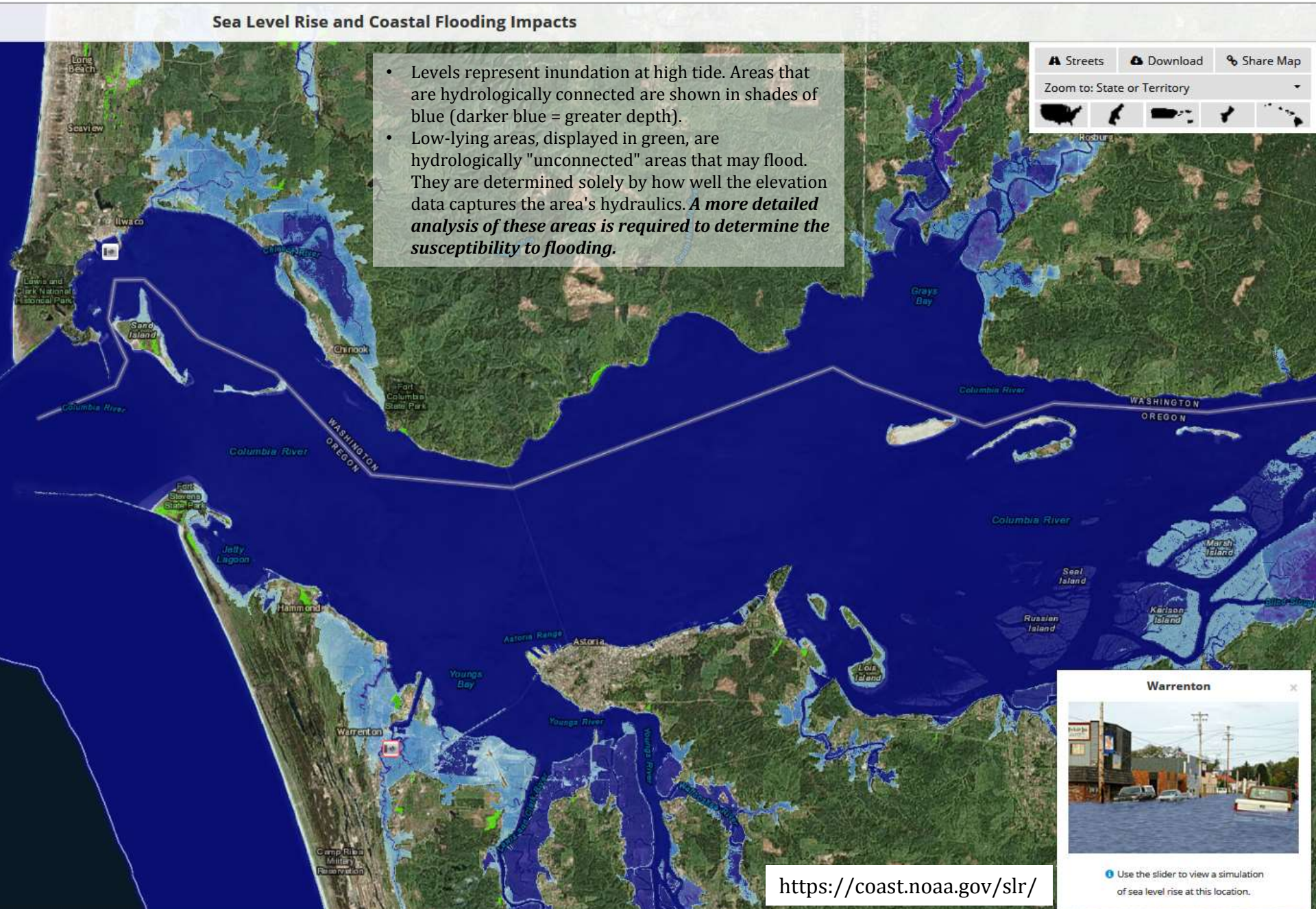
2ft Sea Level Rise



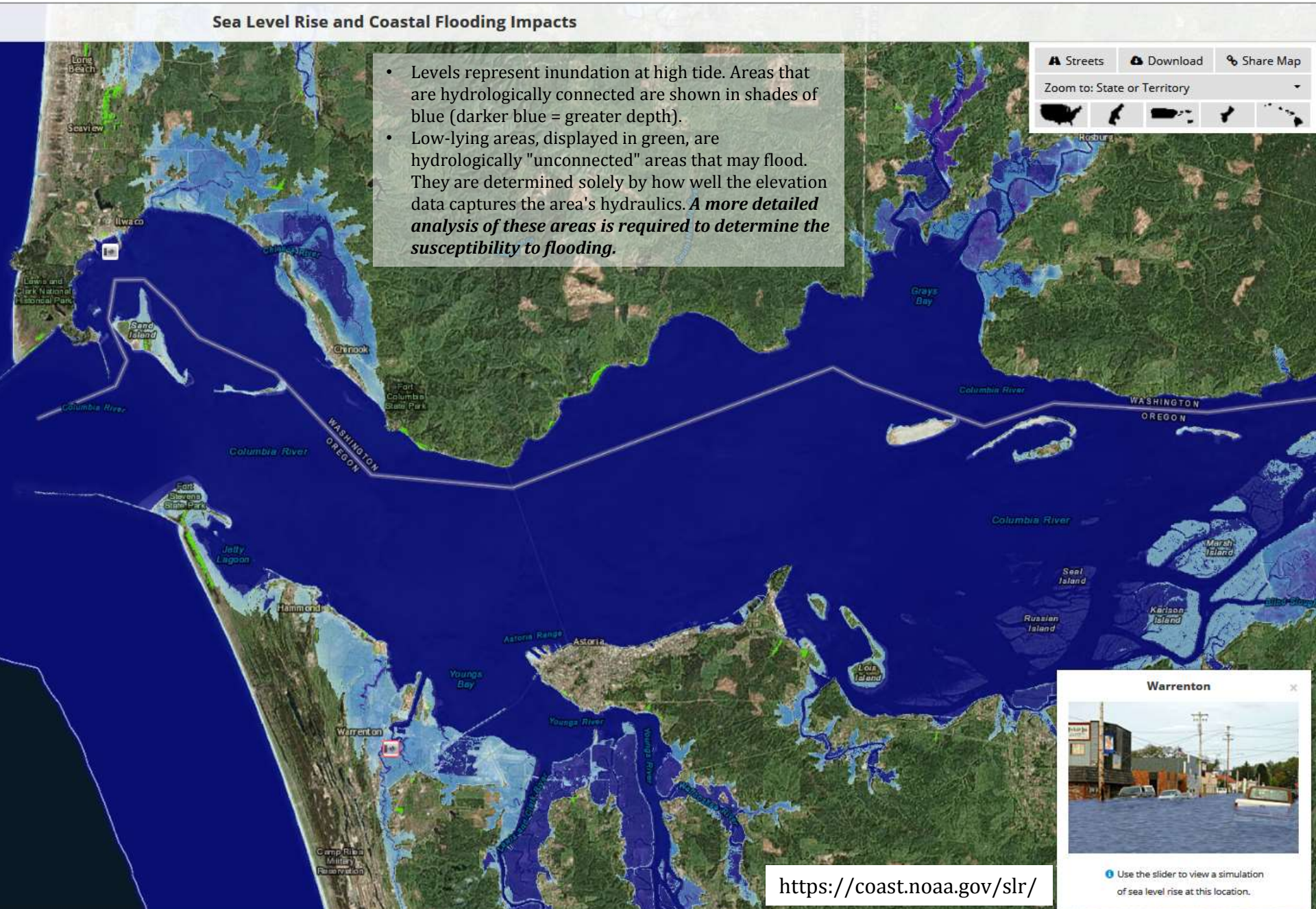
3ft Sea Level Rise



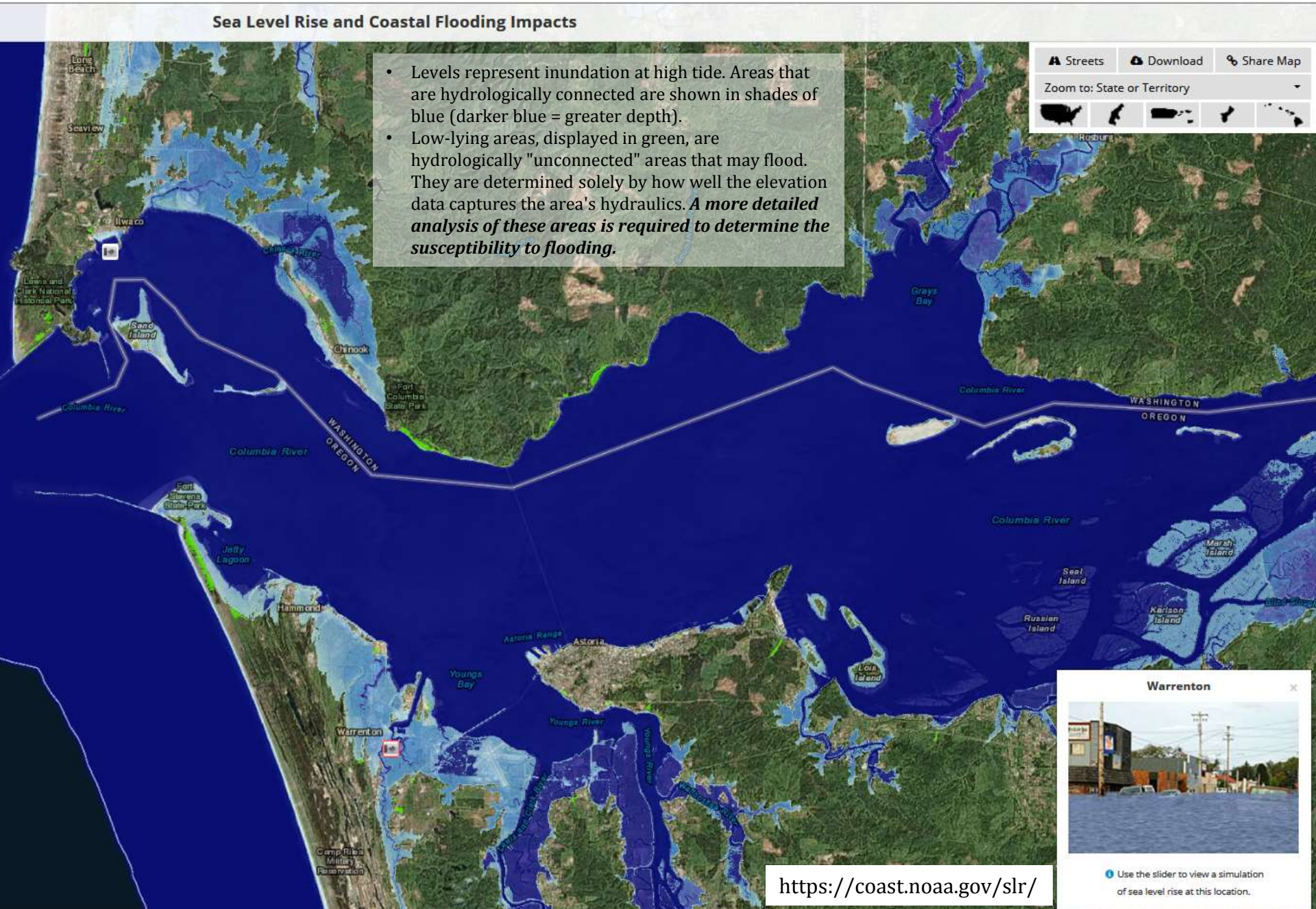
4ft Sea Level Rise



5ft Sea Level Rise

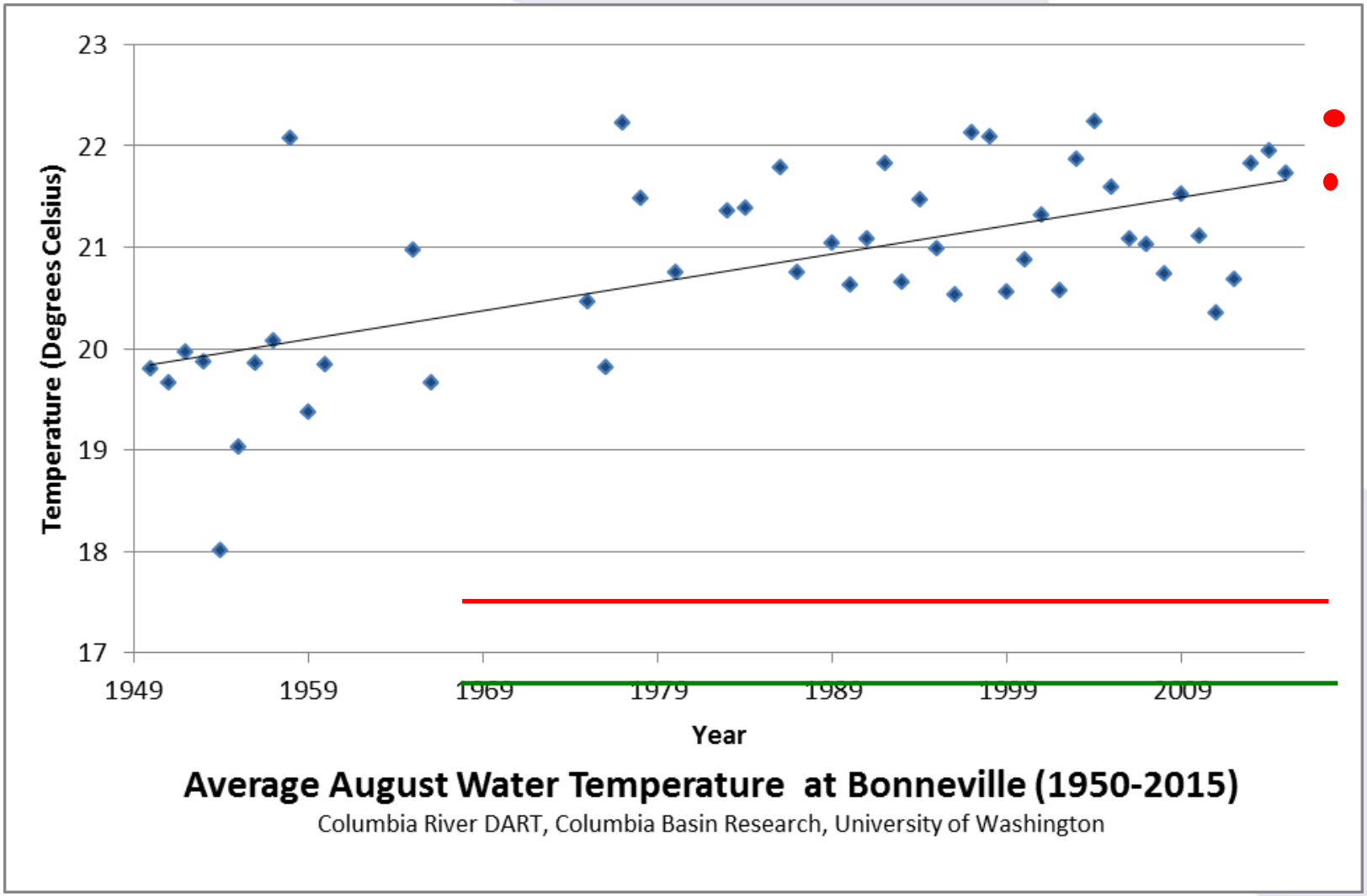


6ft Sea Level Rise



Mitigating for Climate Change– Thermal Refuges

1. **Most natural systems have spatially variable thermal profiles, i.e., not homogenous and not linear (Fullerton et al. 2015)**
2. **Mainstem temperatures have increased over the last 60-70 years**

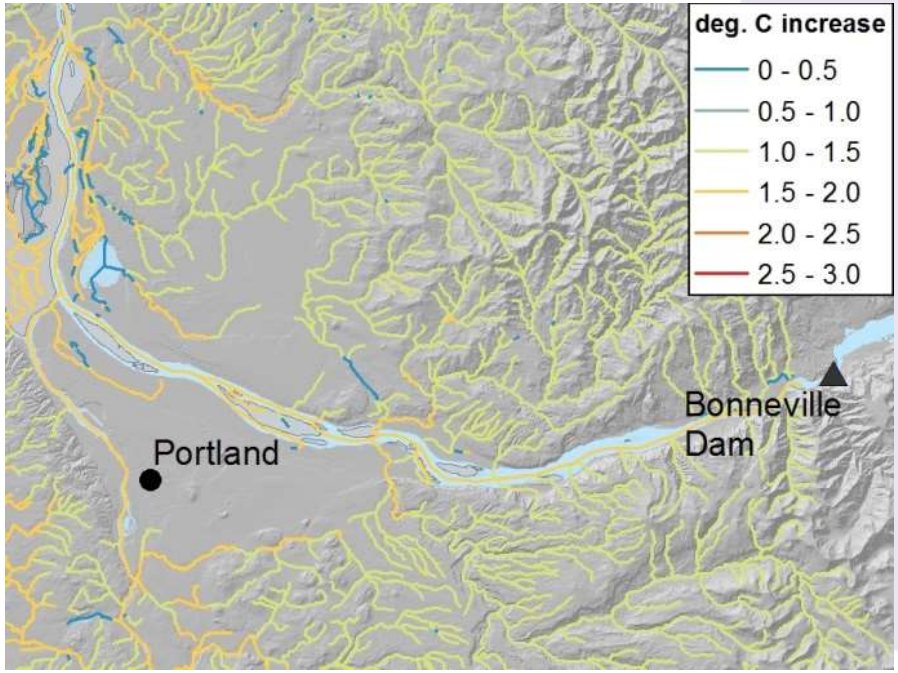


Average August Water Temperature at Bonneville (1950-2015)

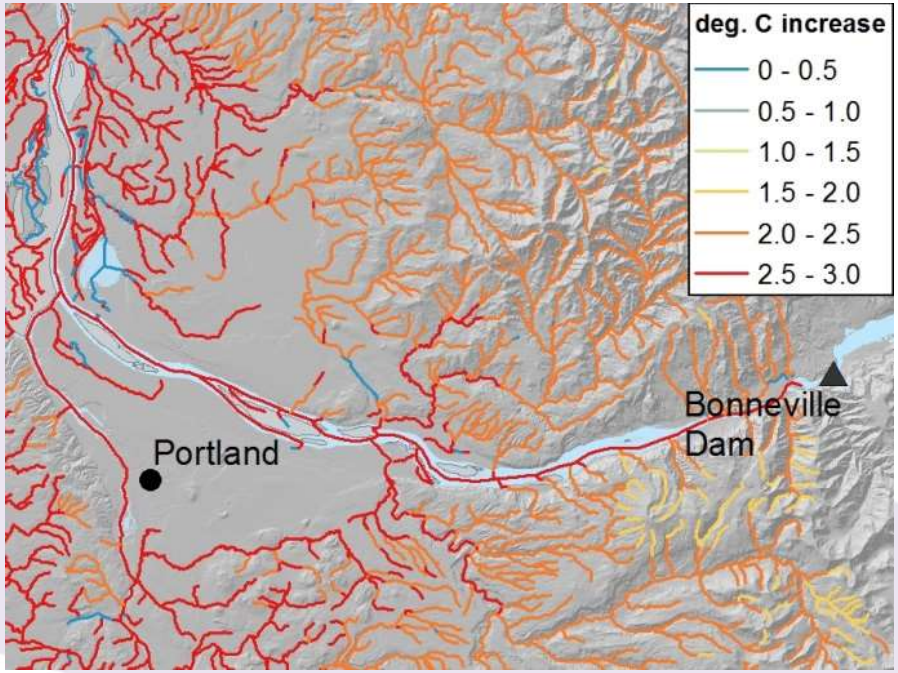
Columbia River DART, Columbia Basin Research, University of Washington

Mainstem thermal regime

1. **Most natural systems have spatially variable thermal profiles, i.e., not homogenous and not linear (Fullerton et al. 2015)**
2. **Mainstem temperatures have increased over the last 60-70 years**
3. **Mainstem temperatures are predicted to increase over the next century**



Predicted increase by 2040



Predicted increase by 2080

Source: USFS Rocky Mountain Research Station NorWeST Stream Temperature Model.

Mainstem thermal regime during adult returns

- ~50% of steelhead used thermal refugia when temperatures were 19-21°C.
- *>70% used tributaries when temperatures were > 21°C.*
- Duration of use ex*tended to weeks during the warmest times*.

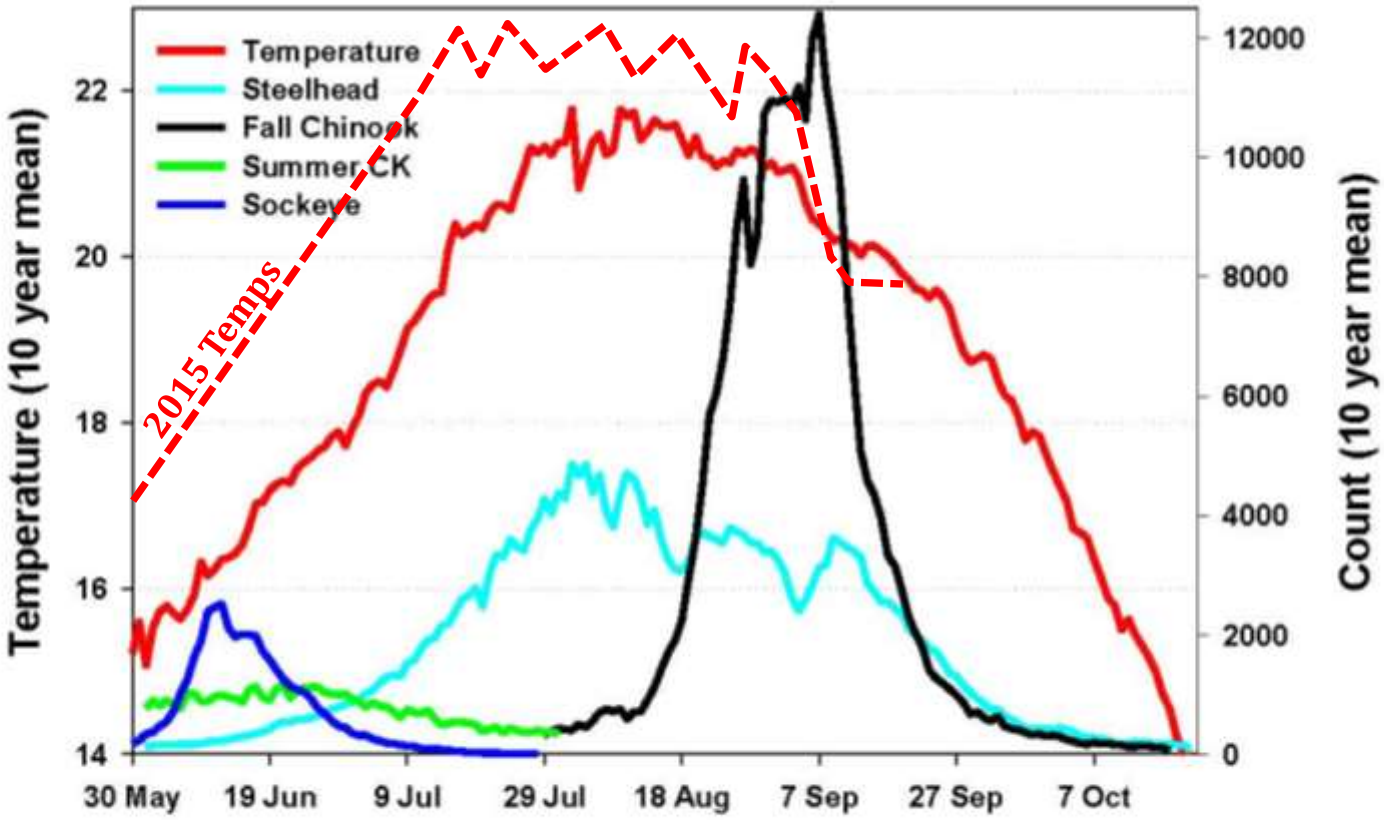
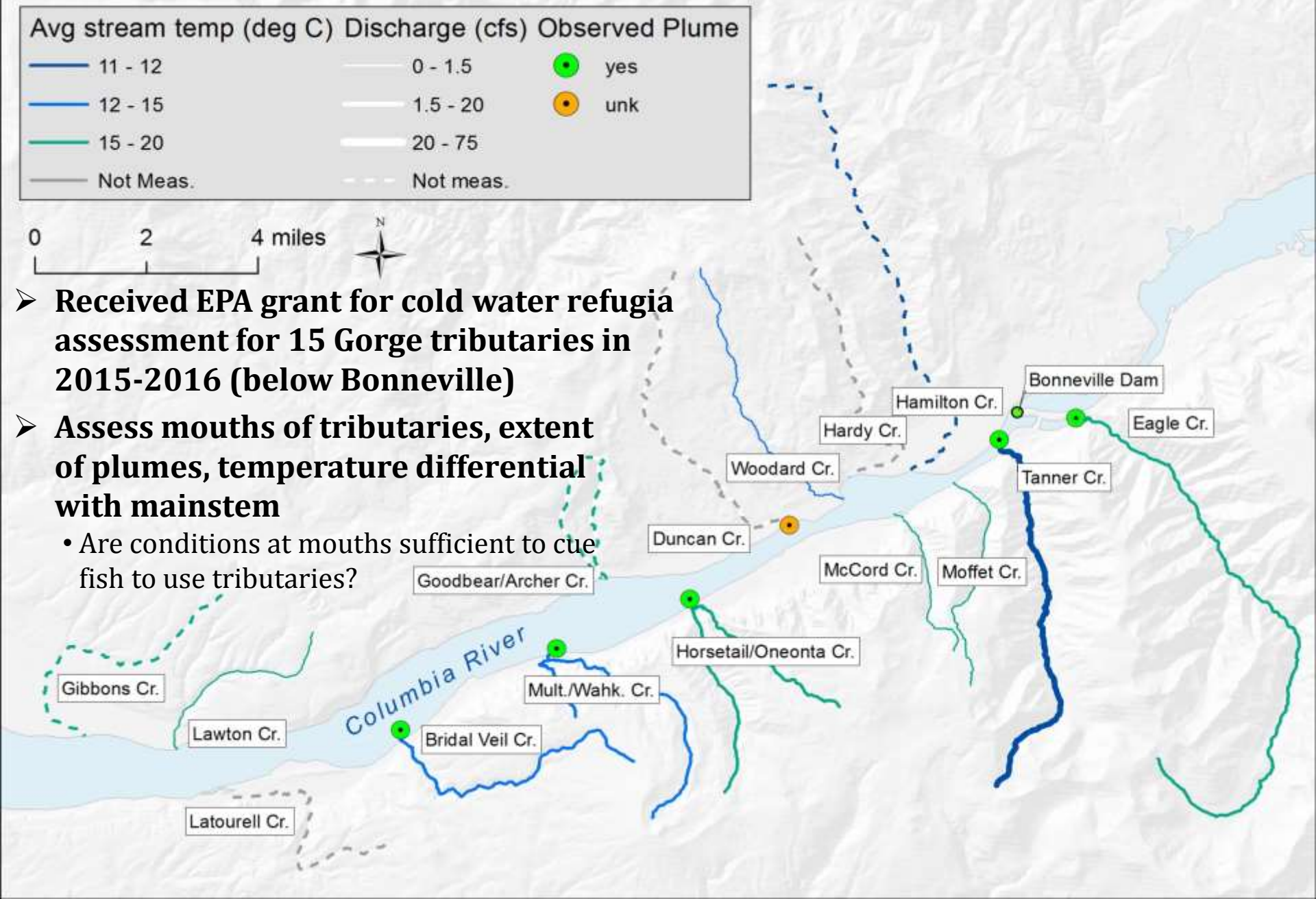


Figure 2. Ten-year (1996-2005) mean lower Columbia River water temperature (°C) and mean run size and timing of adult summer Chinook salmon, fall Chinook salmon, sockeye salmon, and summer steelhead at Bonneville Dam. Thermal refugia use by many adult populations has been associated with

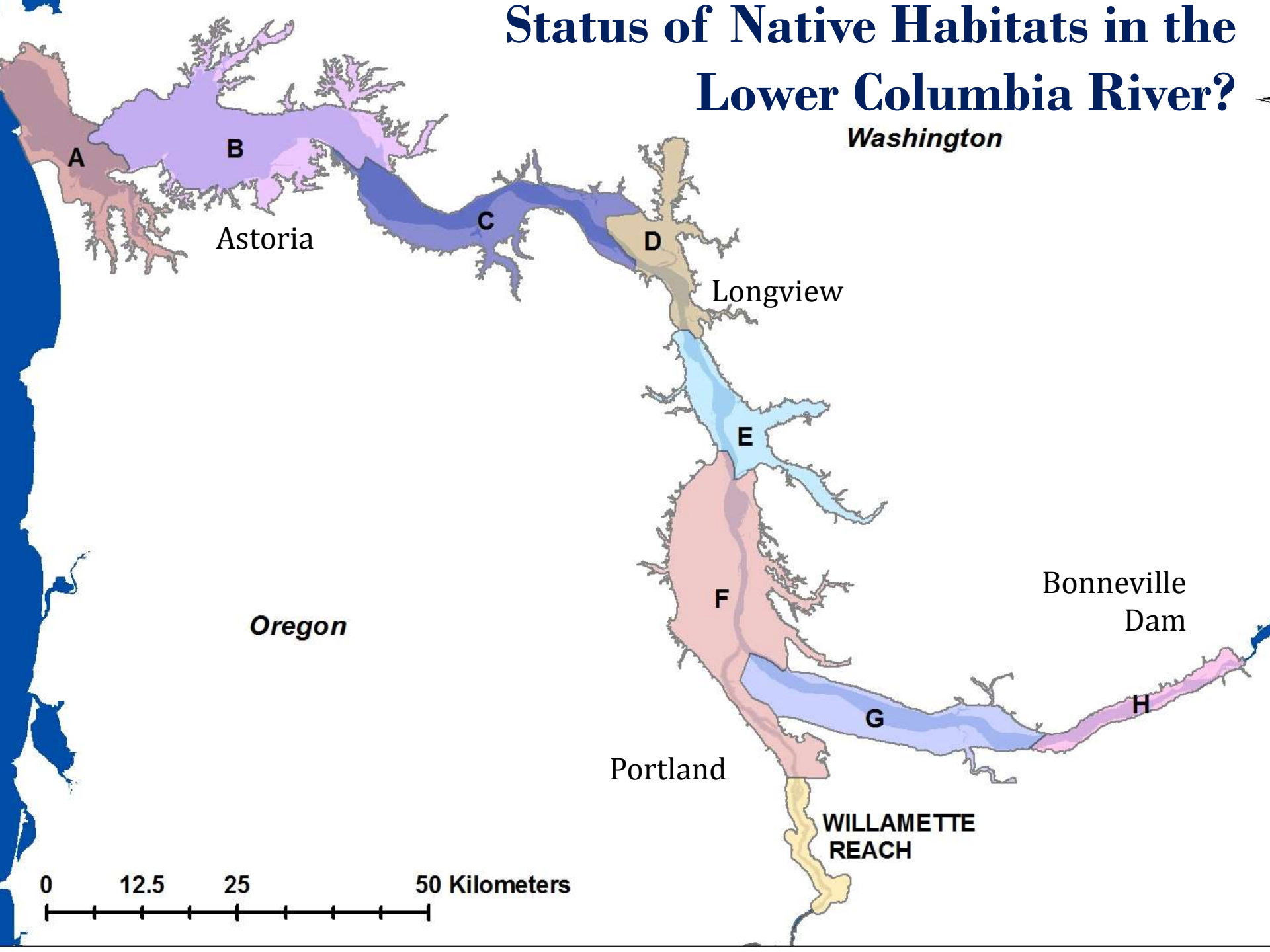
Graph and text copied from Keefer et al. 2011.

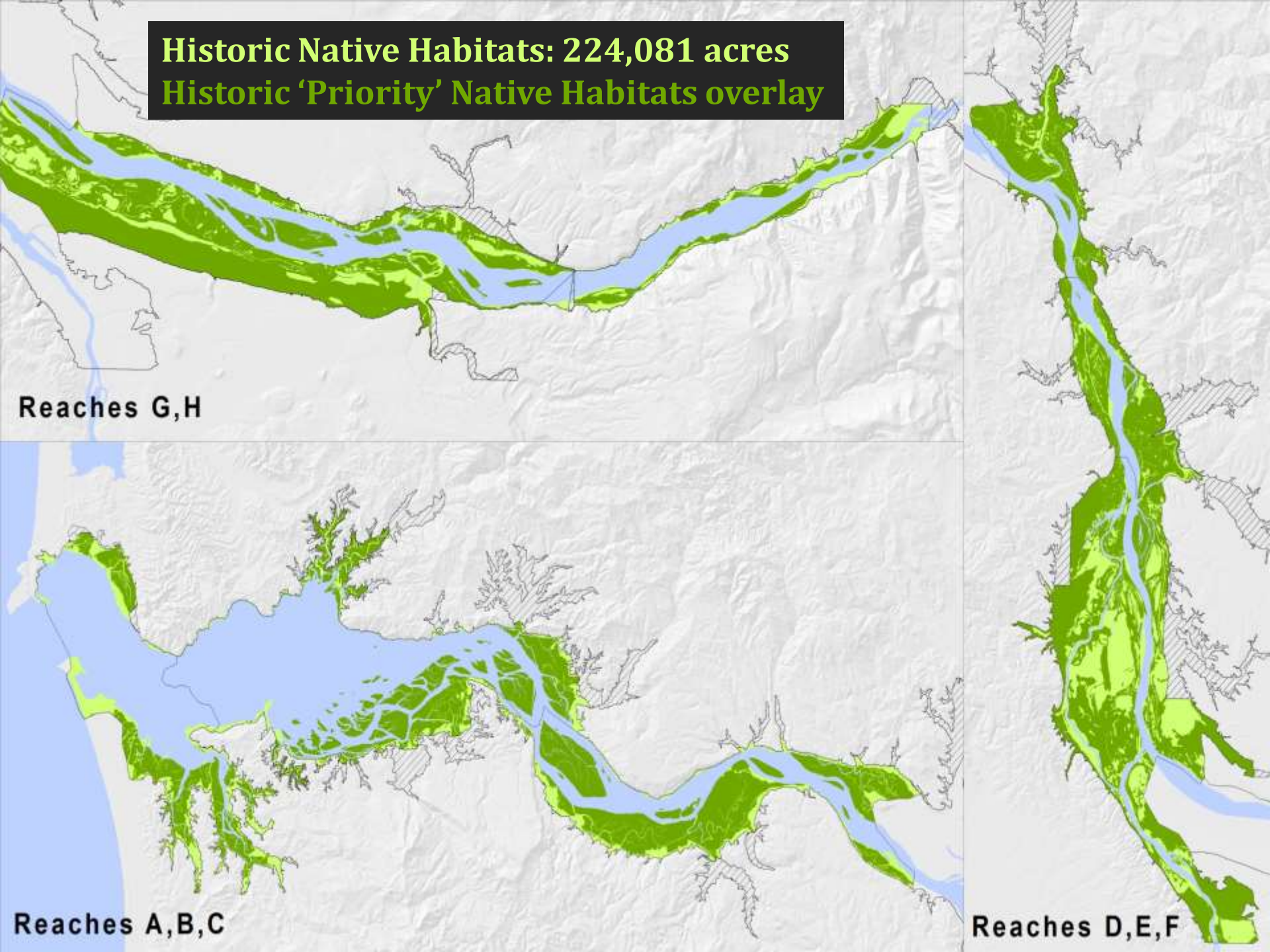
Monitoring Results Summary (Temperature, Discharge, Plume)

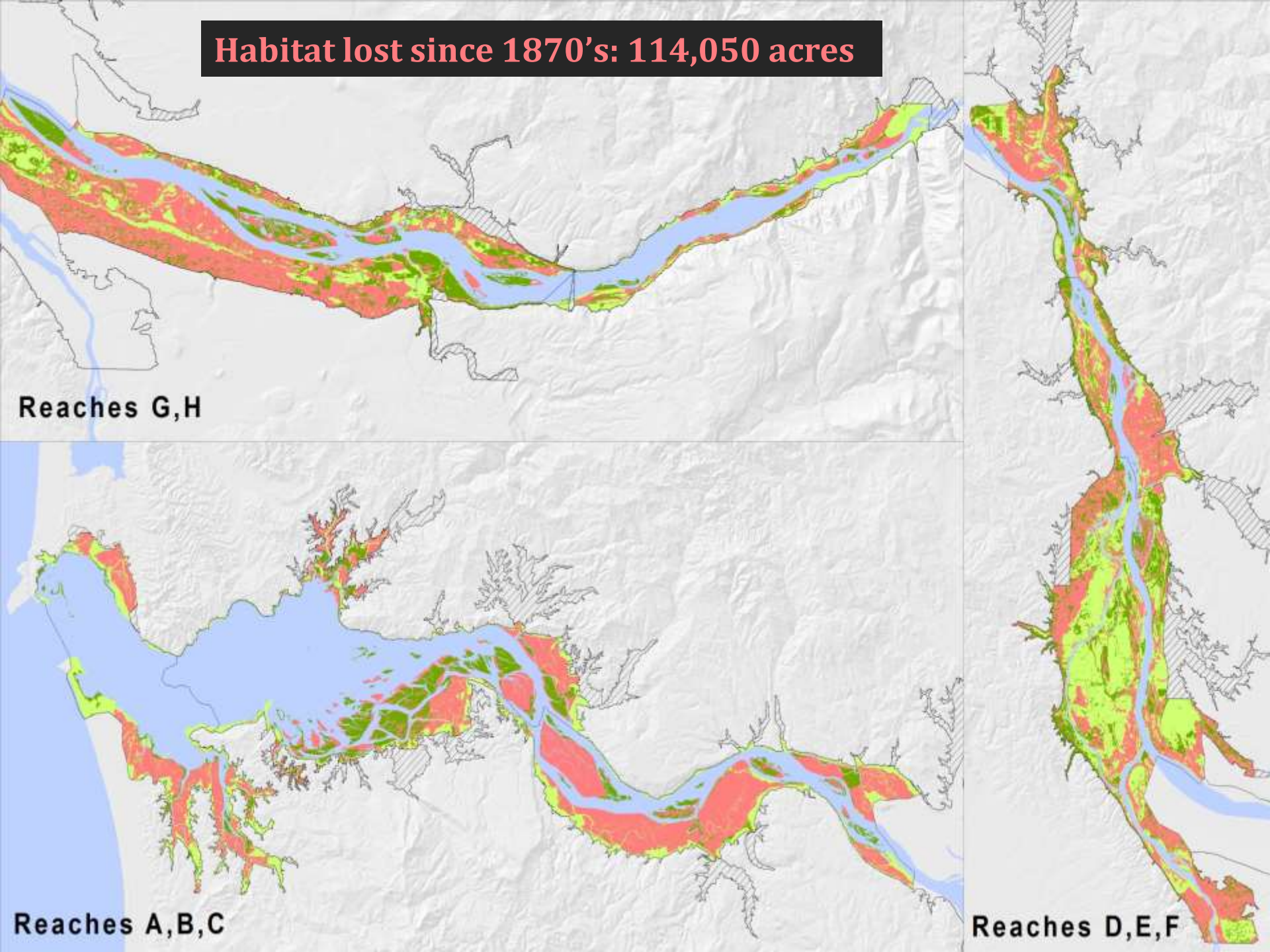


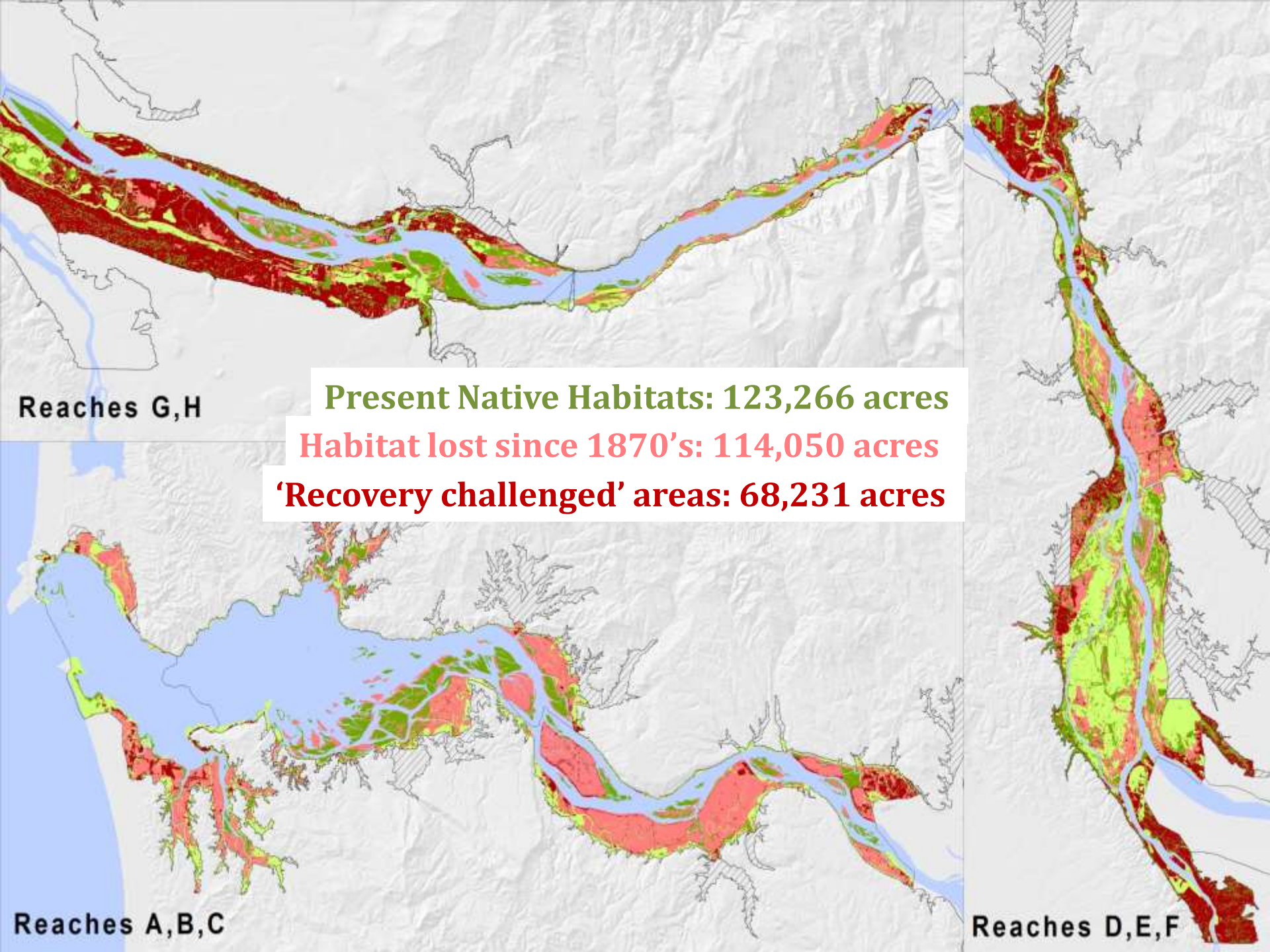
- **Received EPA grant for cold water refugia assessment for 15 Gorge tributaries in 2015-2016 (below Bonneville)**
- **Assess mouths of tributaries, extent of plumes, temperature differential with mainstem**
  - Are conditions at mouths sufficient to cue fish to use tributaries?

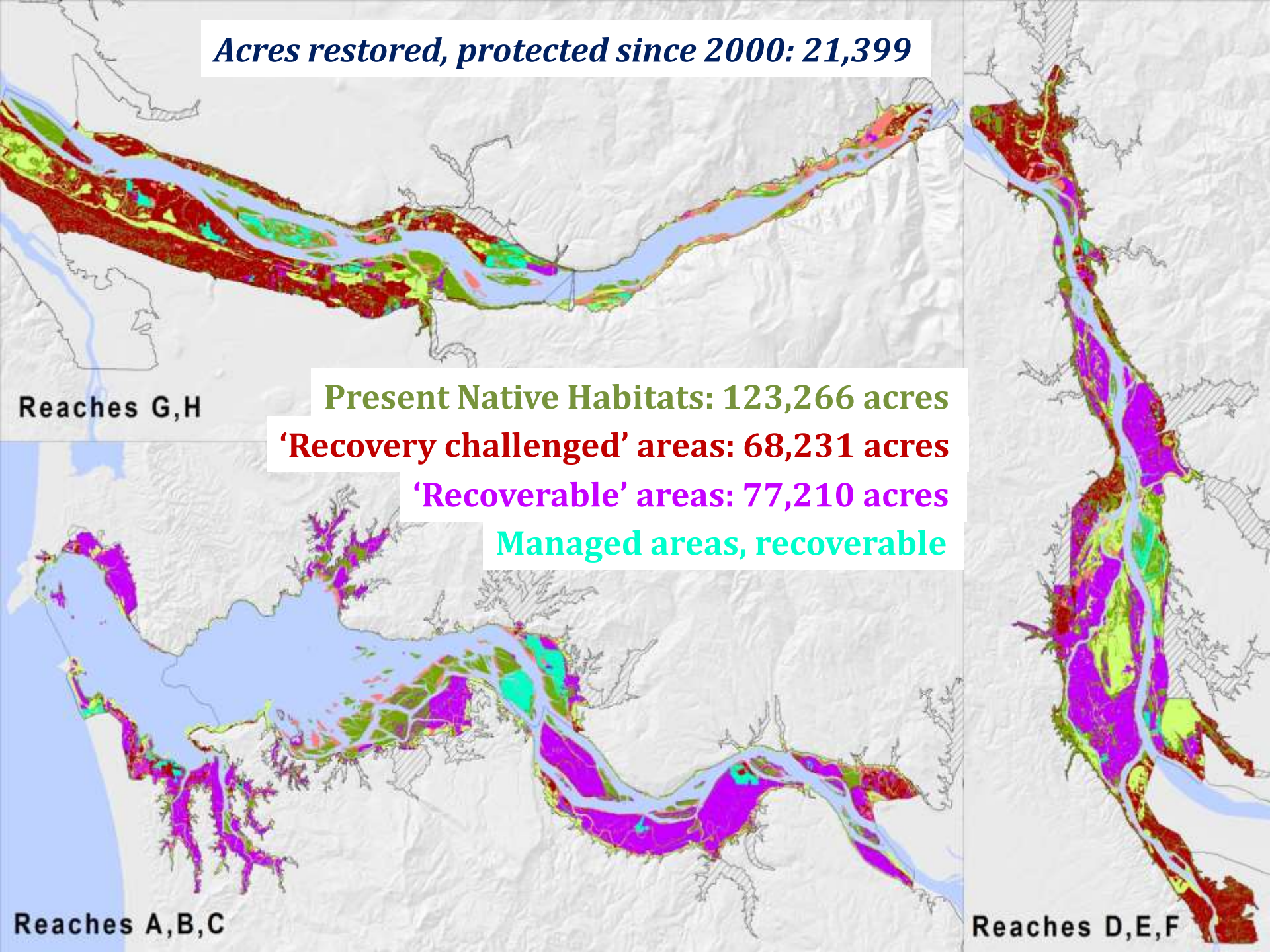
Status of Native Habitats in the Lower Columbia River?

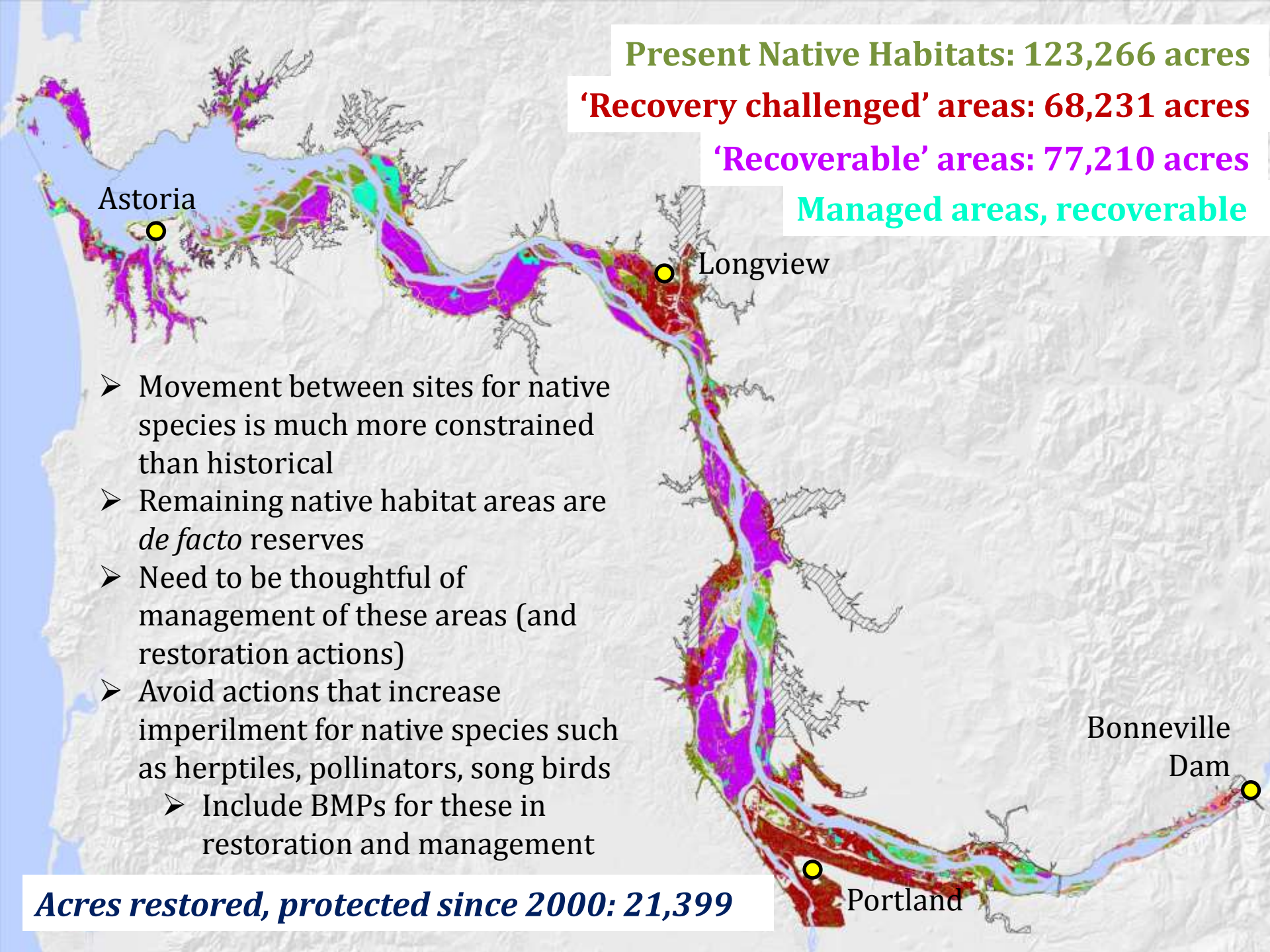



Historic Native Habitats: 224,081 acres
Historic 'Priority' Native Habitats overlay
Reaches G,H
Reaches A,B,C
Reaches D,E,F


Habitat lost since 1870's: 114,050 acres
Reaches G,H
Reaches A,B,C
Reaches D,E,F


Reaches G,H
Present Native Habitats: 123,266 acres
Habitat lost since 1870's: 114,050 acres
'Recovery challenged' areas: 68,231 acres
Reaches A,B,C
Reaches D,E,F


Acres restored, protected since 2000: 21,399
Reaches G,H
Present Native Habitats: 123,266 acres
'Recovery challenged' areas: 68,231 acres
'Recoverable' areas: 77,210 acres
Managed areas, recoverable
Reaches A,B,C
Reaches D,E,F



- Movement between sites for native species is much more constrained than historical
- Remaining native habitat areas are *de facto* reserves
- Need to be thoughtful of management of these areas (and restoration actions)
- Avoid actions that increase imperilment for native species such as herptiles, pollinators, song birds
  - Include BMPs for these in restoration and management

Acres restored, protected since 2000: 21,399

Approved NEW Habitat Coverage Targets

- **No net loss of native habitats (2009 baseline; 114,050 acres lost since 1870)**
- **Recover 30%* of historic extent <u>for priority habitats</u> 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)*

Challenge for Restoration in Short Term

➢ Integrate multiple species in project designs

- Funding may be focused on single species (e.g., Pacific salmon, steelhead, avian) BUT
- Responsibility of practitioners to not cause harm to other native species (e.g., amphibians, turtles)
- Practitioners can integrate BMPs or other aspects into restoration design to benefit other species
  - EXAMPLE - survey for frog egg masses and design intertidal reconnections so that tidal fluctuations will not cause desiccation of eggs; add large wood for turtles, beaver, others
  - CHECK OUT- Matt's presentation on assessing restoration actions for multi-species

➢ Protect, restore cold water refuges

- Protect, restore instream baseflow to tributaries
- Remove diversions, weirs that dewater downstream areas
- Remove barriers, improve riparian conditions, increase complexity

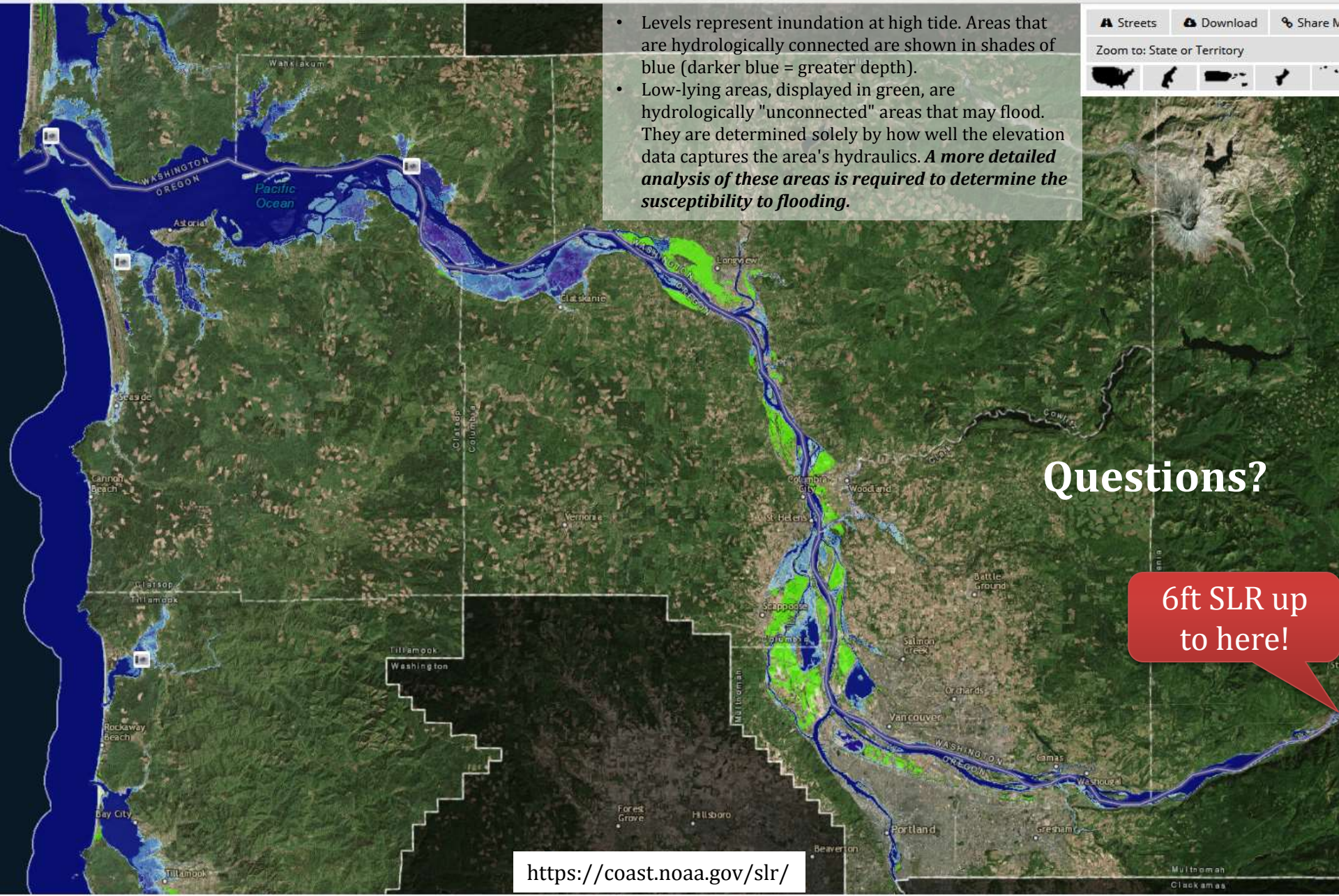
• Consider species shifts in management, restoration actions

CHECK OUT - see Marshall's, Amy's presentations

➢ Protect future wetlands - wetland migration inland with sea level rise

Sea Level Rise and Coastal F...

Sea Level Rise and Coastal Flooding Impacts



- 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/