Northwest **Power** and **Conservation** Council

October 6, 2015

MEMORANDUM

TO: **Fish and Wildlife Committee Members**

FROM: **Kendall Farley, Washington State Staff**

SUBJECT: **Restoring the Lower Columbia River Ecosystem – current status and future challenges in mitigating for climate change impacts**

BACKGROUND:

Presenter: Catherine Corbett, Chief Scientist and Debrah Marriott, Executive Director, Lower Columbia Estuary Partnership (LCEP)

Summary: In 2011, LCEP completed a habitat change analysis comparing 1870s lands survey data with 2009 lands cover resulting in 114,050 acres (approx. 50%) of native habitat (inc.70% of vegetated tidal wetlands and 55% of forested uplands) had been converted to agriculture, industry and urban development. Results were used to identify priority habitats for restoration and protection for the eight river reaches, based on severity of loss.

They then identified 77,210 acres in the lower Columbia as “recoverable” areas, where low impact land use areas could be restored if landowners are willing, and LCEP provides guidance for restoring these habitats. An additional 68,231 acres have been converted to impervious surface, and are “recovery-challenged” and are much more costly to restore. Most of these acres lie within the Portland to Longview corridor where native habitats are scarce but critically important to providing refugia in migratory corridors as species make their way up and down the lower river.

LCEP then developed quantitative habitat coverage targets by river reach, focusing on protecting common species from becoming imperiled and do not yet include recovery targets for ESA-listed species. They include: 1) no net loss of native habitats per the 2009 baseline, 2) recover 30% of historic coverage of priority habitats by 2030 and 3) recover 40% of the historic coverage of priority habitats by 2050. In meeting these targets, they will reach 46-88% of historic habitat coverage by 2050, depending on river reach, with an overall average of 60% recovery.

The next step is to integrate the impacts of climate change into their restoration approach. These impacts include further loss of floodplain habitats through the submersion, conversion and erosion of estuarine habitats by rising sea levels; introduction of low dissolved oxygen (hypoxia) and ocean acidification through increased tidal exchange with sea level rise; reductions in cold water refugia, vital for cold water species such as salmon and steelhead; and alterations to habitat structure (ie: vegetation) by changing precipitation, temperature and CO_2.There is a lack of detailed data necessary to integrate climate change impacts into restoration approaches in the lower Columbia. These data gaps need to be filed in order to protect past restoration and current and future investments.

Relevance: 2014 F&W Program emerging program priorities *#2: Implement adaptive management (including prioritized research on critical uncertainties) throughout the program by assessing the effectiveness of ongoing projects, developing program objectives when appropriate and taking into account the effects of climate change.*

Workplan: 2. Promote regional fish and wildlife recovery - implement new 2014 Fish and Wildlife Program.

Background: The lower Columbia River and estuary is designated as an “estuary of national significance” by the EPA. LCEP, as a regional collaboration of stakeholders identified a primary goal of restoring *biological integrity* of the lower Columbia ecosystem. Integral to achieving this goal is reestablishing and maintaining native habitat *quantity* and *diversity.* Since 1999, LCEP and regional partners have restored 21,399 acres of habitat, mostly on habitat to recover ESA listed salmonids. Today, most projects on publically managed lands have been completed, and restoration now often requires purchasing lands from private landowners, or working with private landowners to improve conditions for native species. They are currently collecting and analyzing data to help the region strategically prioritize habitats to restore and developing quantifiable habitat coverage targets.

Lower Columbia Estuary Partnership

Restoring the Lower Columbia River Ecosystem- Current Status and Future Challenges

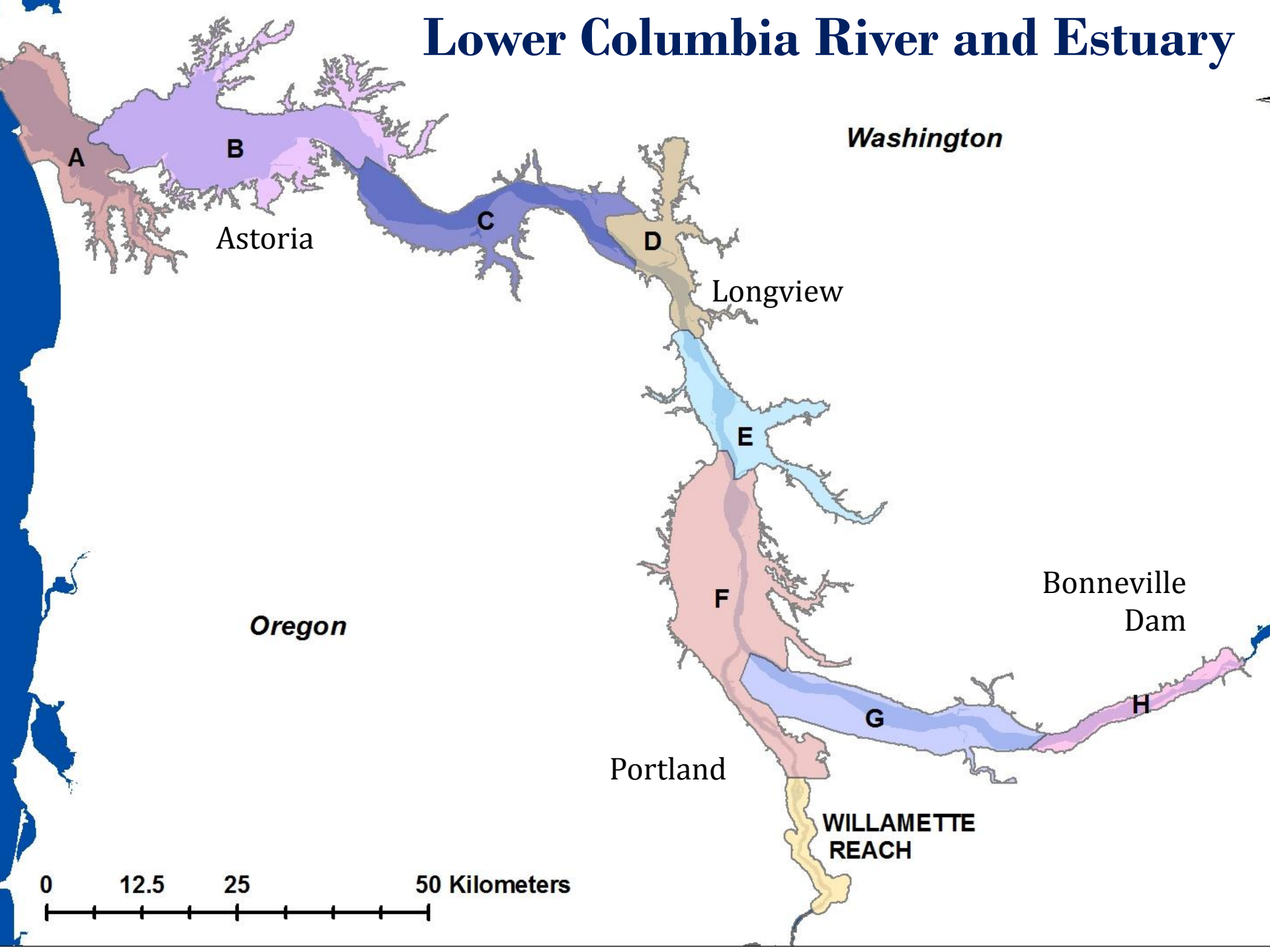
Catherine Corbett and Debrah Marriott

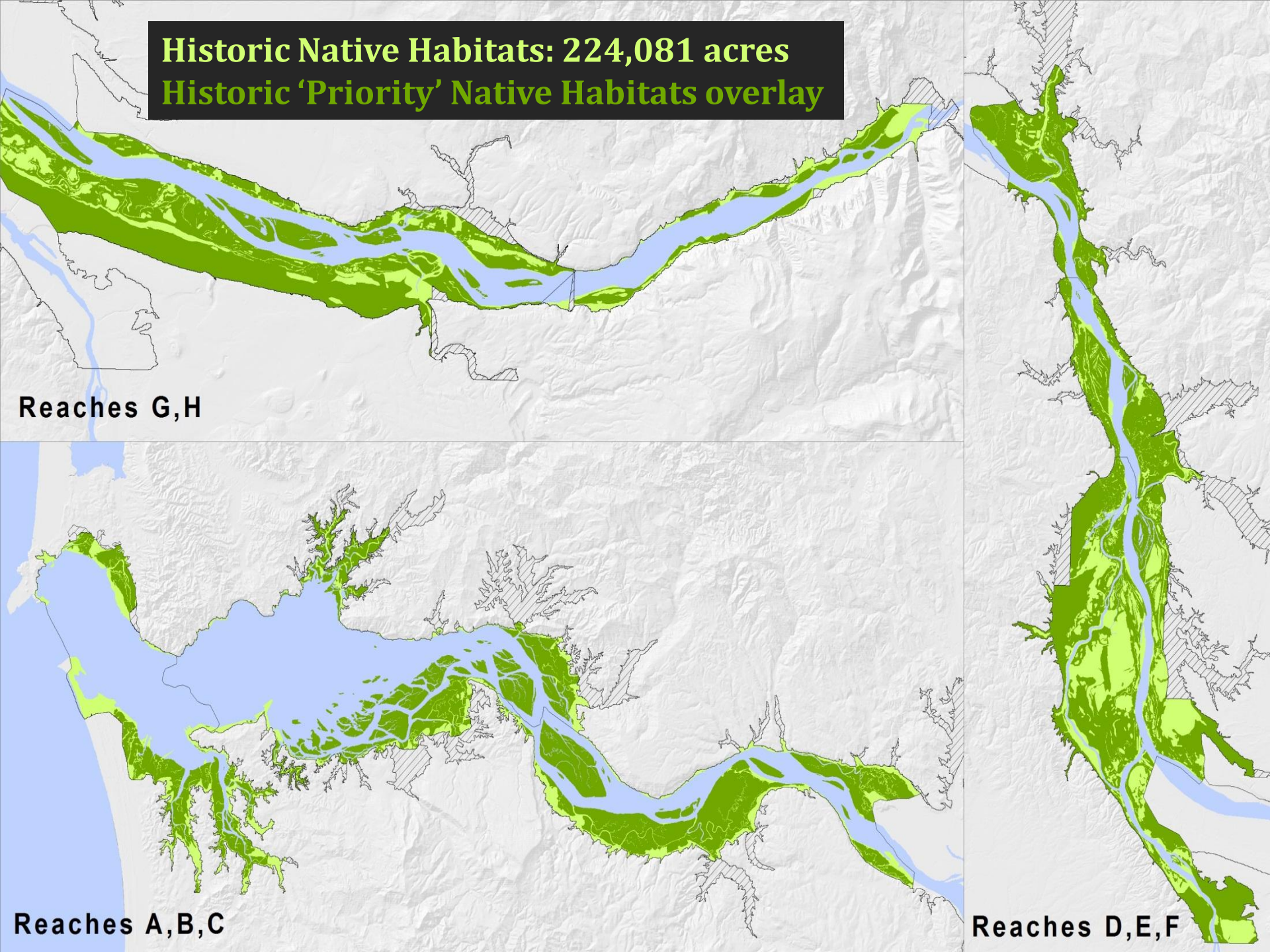
October13, 2015

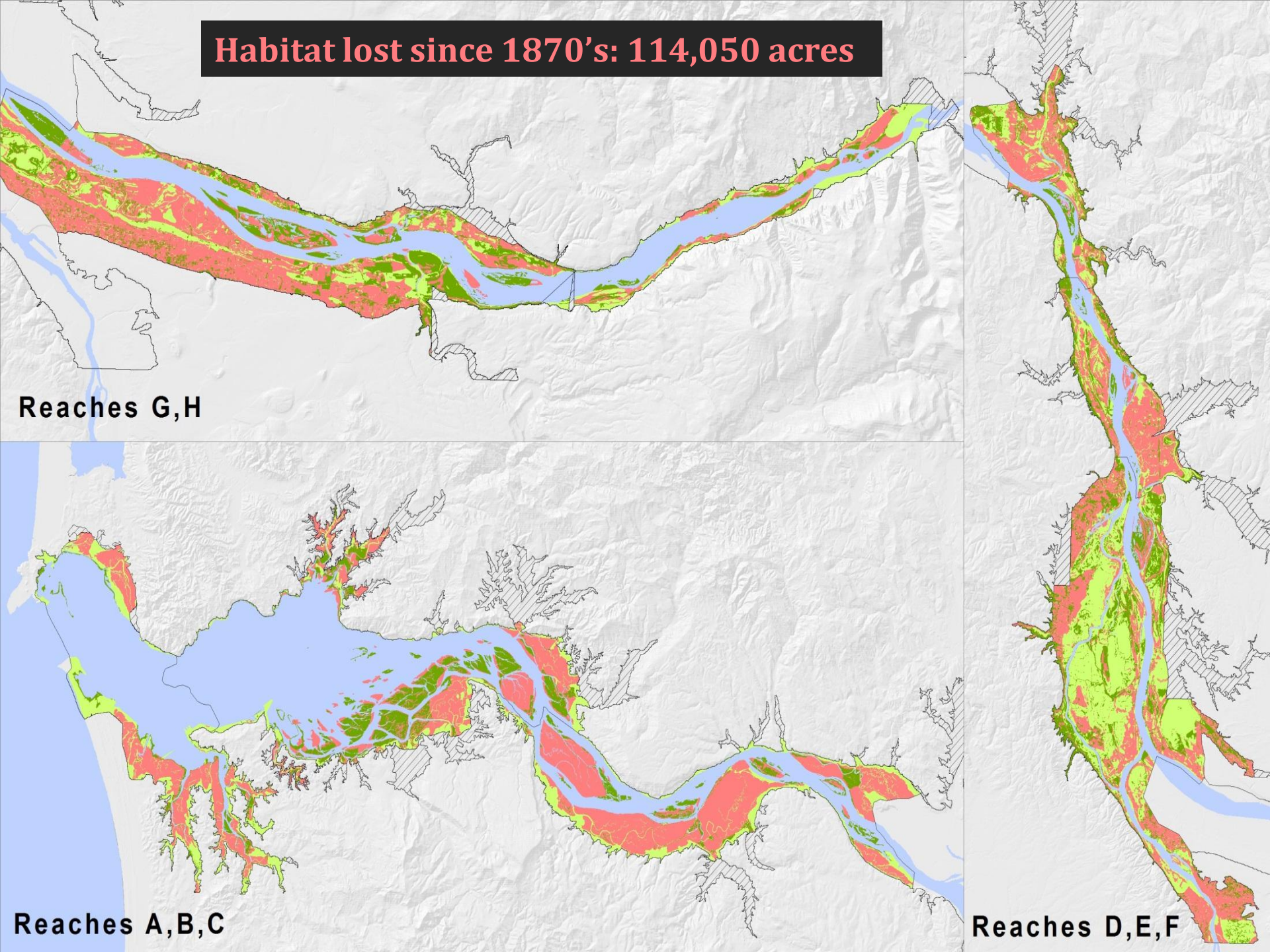
Central Message

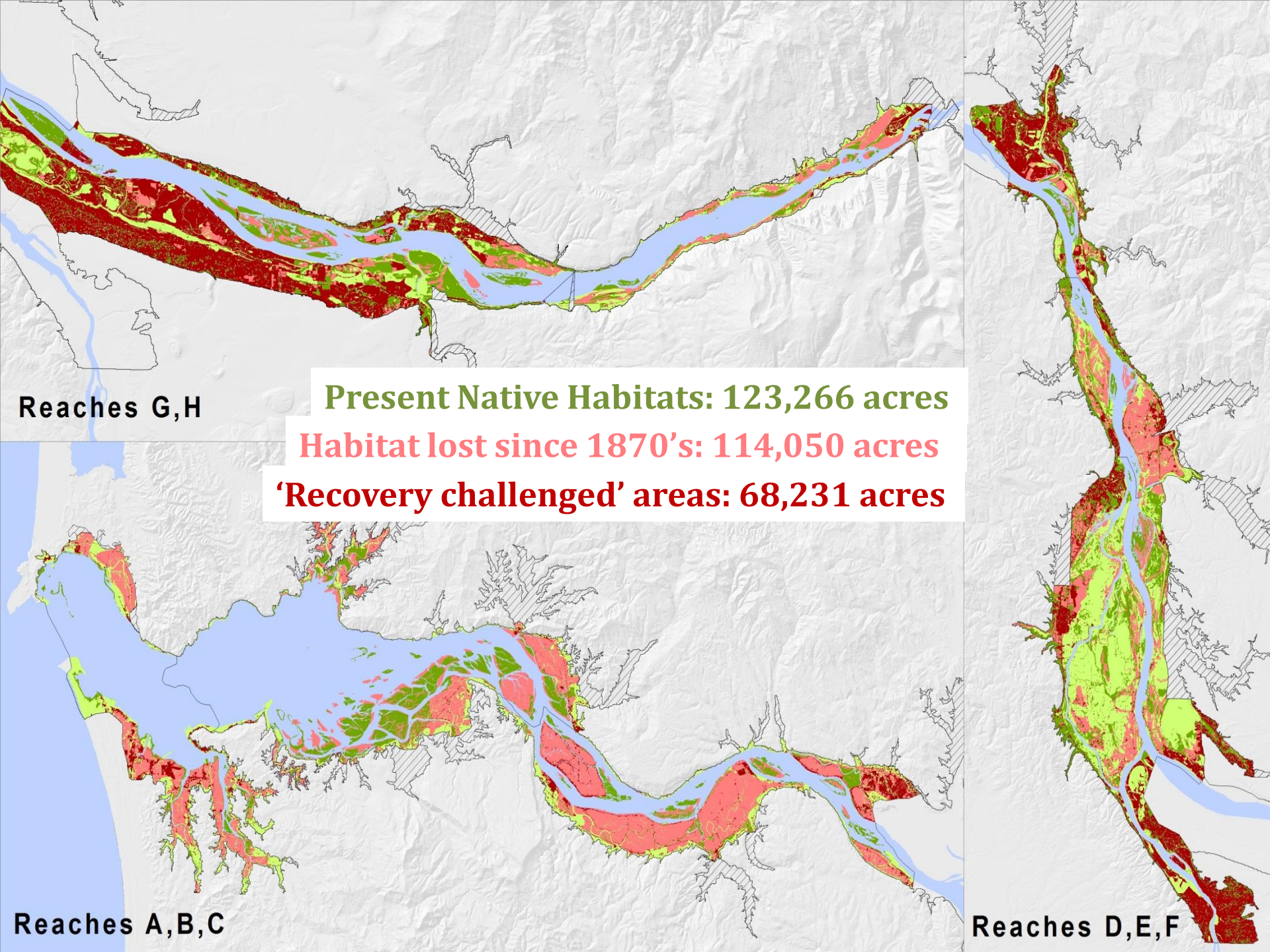
- Protection and restoration have historically been focused on single species, faunal guilds, restoring historic conditions
  - Ex: Waterfowl, Columbia White-tailed Deer, Pacific salmon
- Shift to multi-species approach going forward
  - Restoration is expensive, avoid the need to retrofit projects
  - Limited funding
  - Many imperiled species w/ differing habitat needs
  - Protect common species from becoming imperiled
- Shift to integrate climate change impacts
  - Allow wetland migration inland
  - Protection, restoration of cold water refugia
  - Adapt approach for species shifts

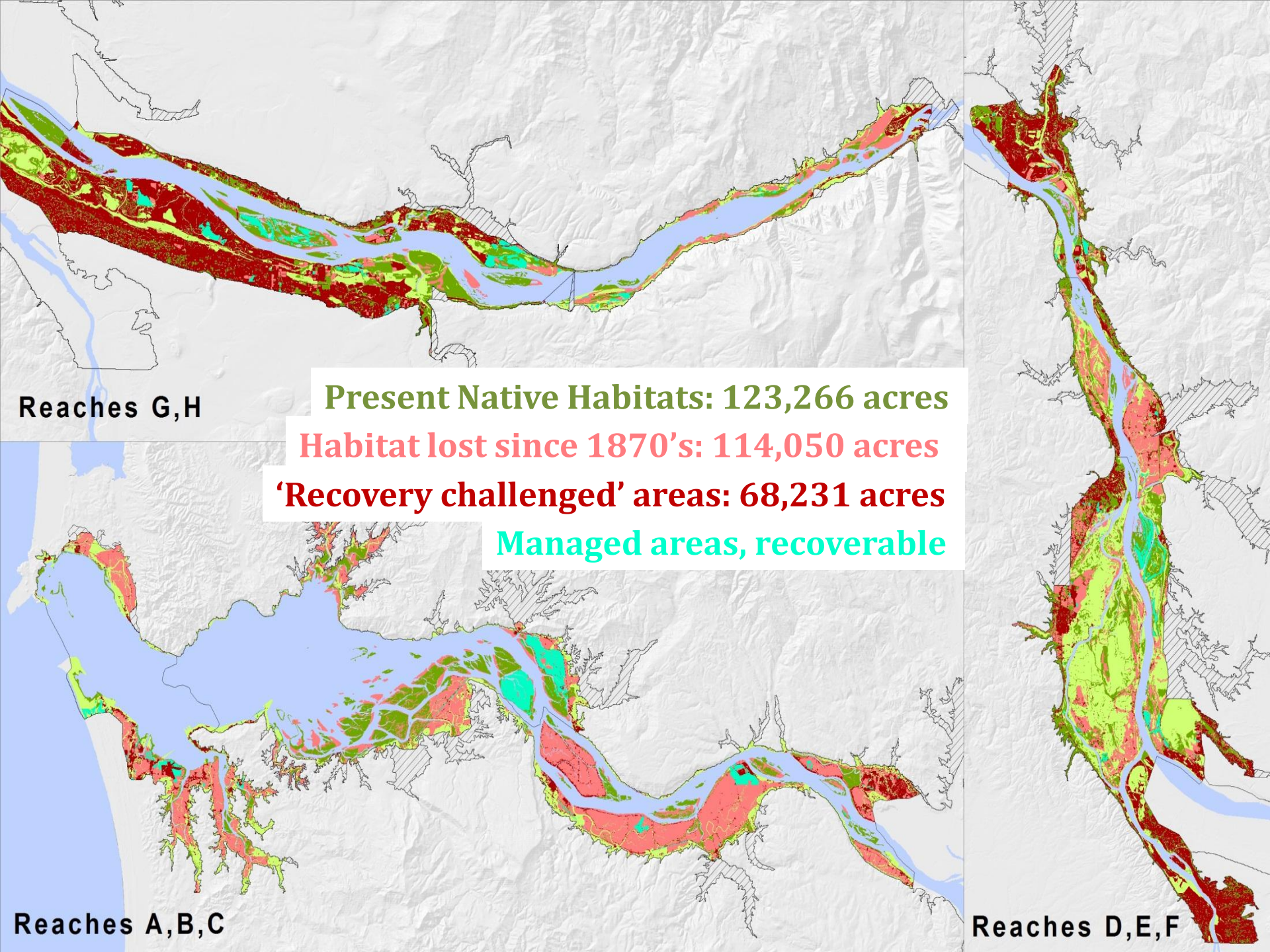
Lower Columbia River and Estuary




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


Reaches G,H
Present Native Habitats: 123,266 acres
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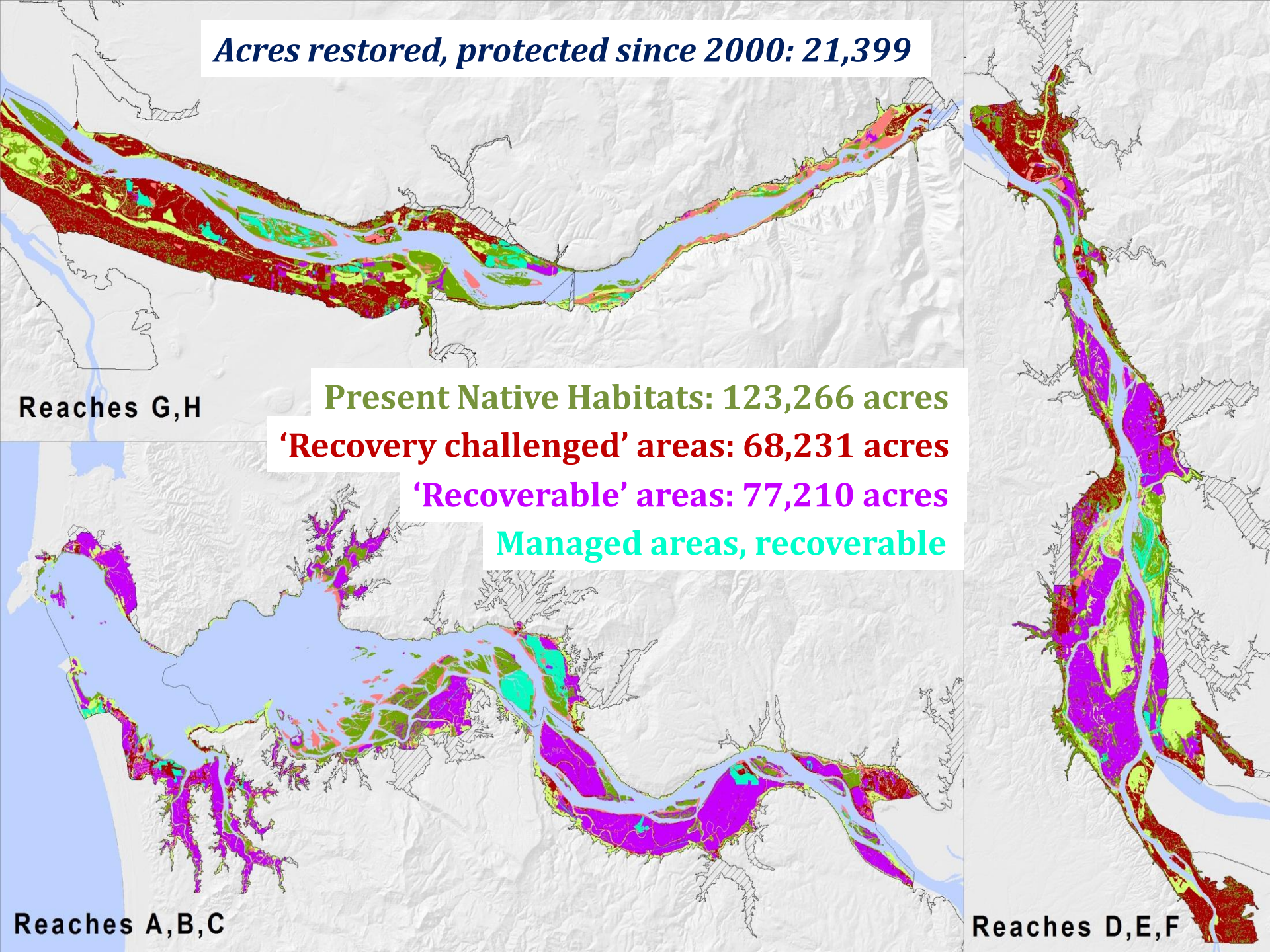
'Recovery challenged' areas: 68,231 acres
Managed areas, recoverable
Reaches A,B,C
Reaches D,E,F


Acres restored, protected since 2000: 21,399
Reaches G,H
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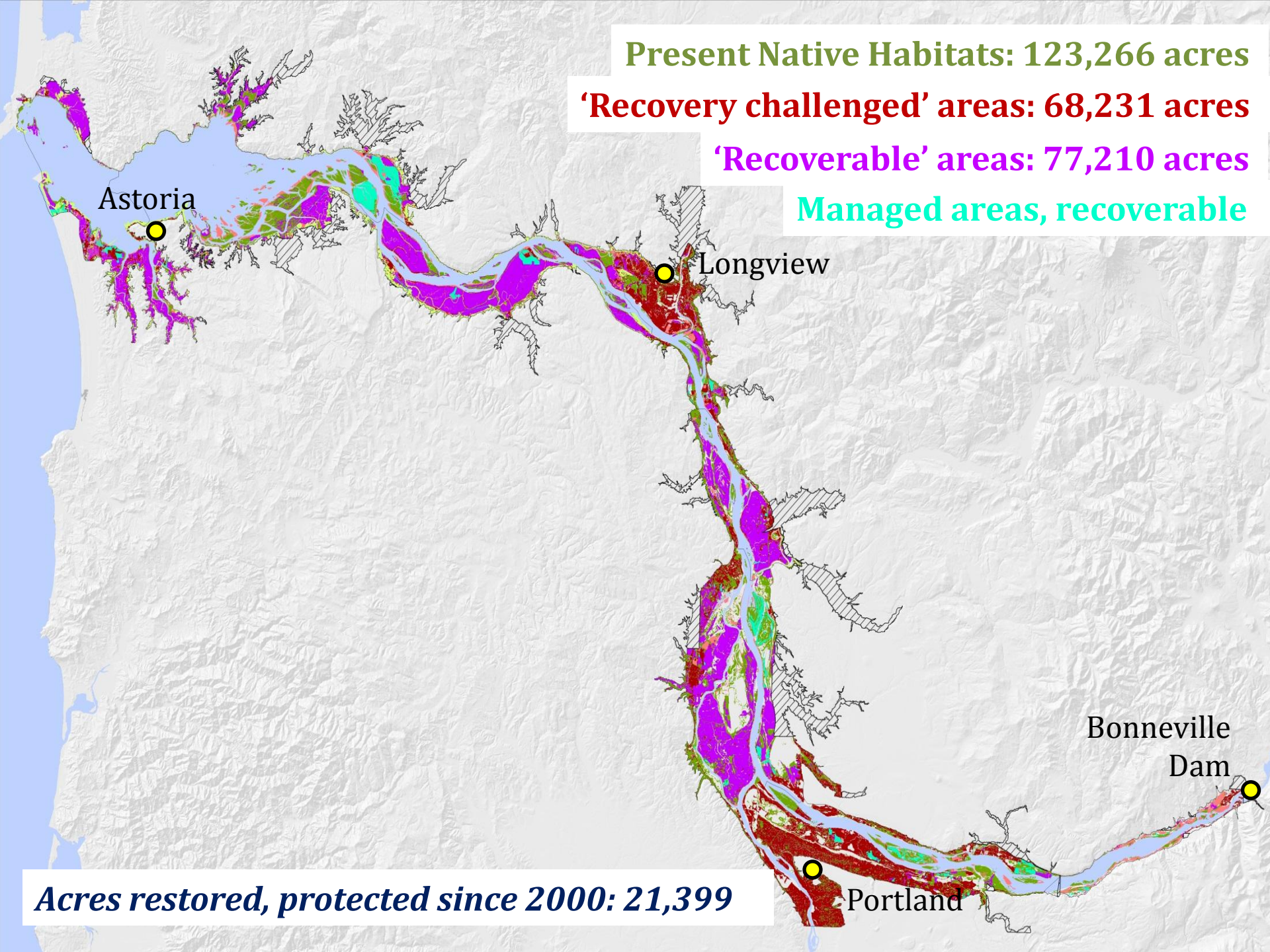

Present Native Habitats: 123,266 acres
'Recovery challenged' areas: 68,231 acres
'Recoverable' areas: 77,210 acres
Managed areas, recoverable
Astoria
Longview
Bonneville Dam
Portland
Acres restored, protected since 2000: 21,399

Estuary Partnership Management Plan

- **Biological Integrity is Ultimate Goal**
- **Biological Condition Gradient for Assessment of Integrity**

(USEPA: Davies and Jackson 2006)

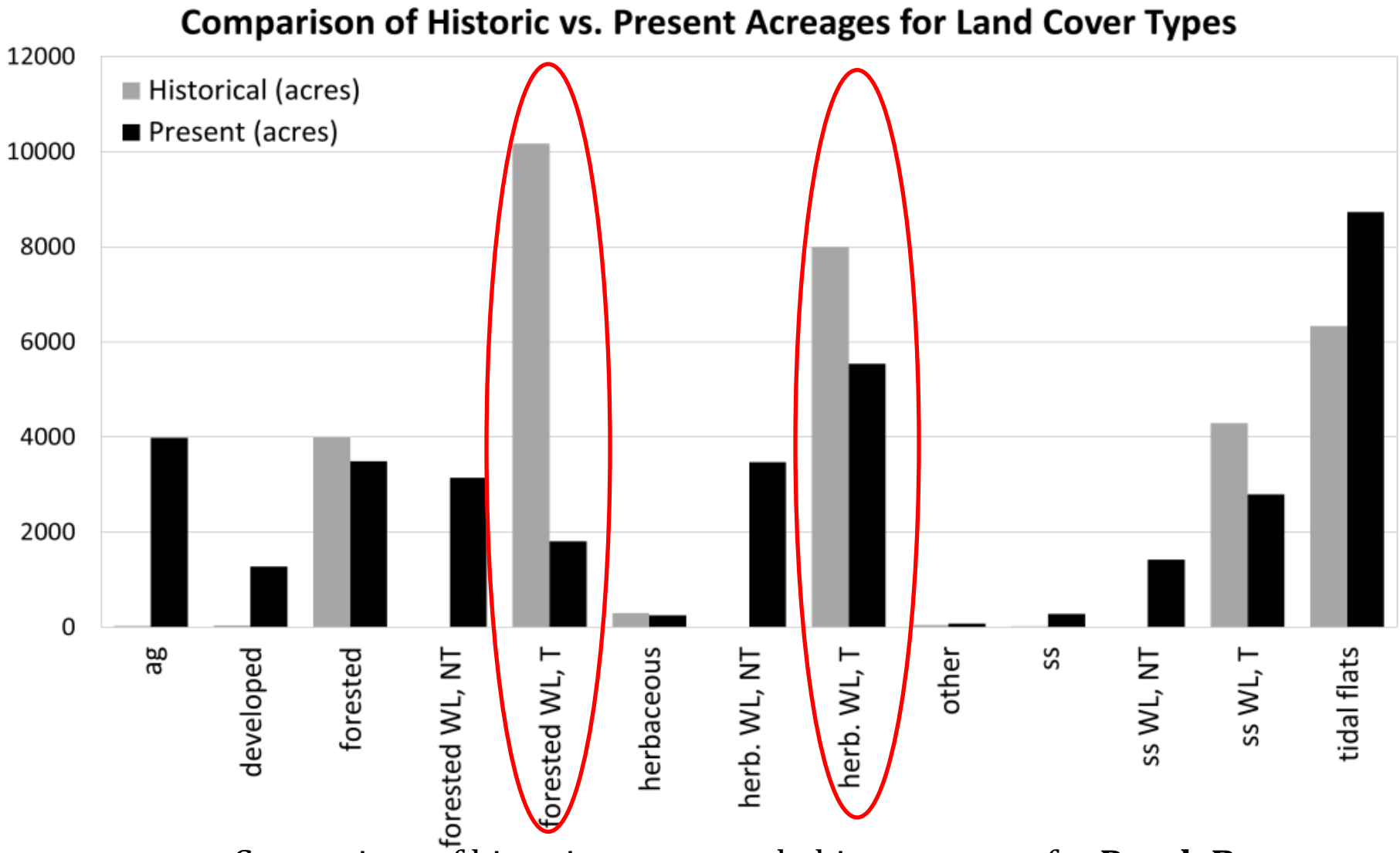
- Similar to Index of Biological Integrity (Karr 1981)
- ***Science Community identifies key ecosystem attributes***
  a. **Natural Habitat Diversity, Historical Habitat Mosaic**
  b. **Focal Species:** e.g., Pacific salmonids, Col. White-tailed deer, Pacific Flyway species (NPCC 2004)
  c. **Water Quality**
  d. **Ecosystem Processes**

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**
  - Historic habitat coverage is proxy for natural habitat diversity
  - Identify significant losses and types
  - Protect remaining intact habitats; recover lost habitats in areas where practical

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



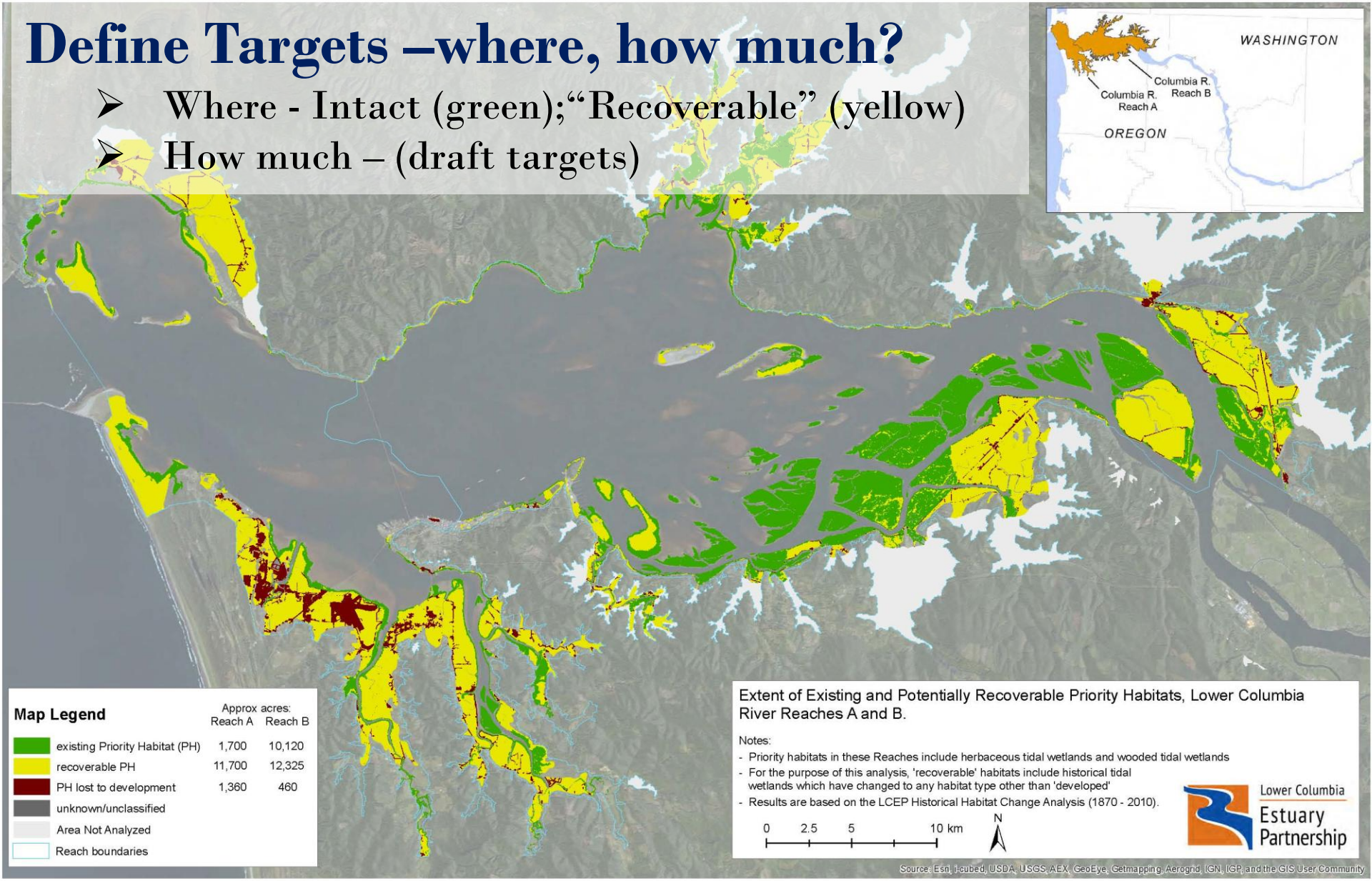
Comparison of historic vs. current habitat coverage for **Reach B**

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			

Define Targets –where, how much?

- Where - Intact (green);"Recoverable" (yellow)
- How much – (draft targets)



Priority Habitats for Recovering Habitat Diversity

Available from website: http://www.estuarypartnership.org/historical-habitat-change

Draft Habitat Coverage Targets (April 2014)

- **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 AND 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)*

Next Steps

- **Identify minimum size criterion for larger "reserves" and small patches of habitats**
  - Encourage implementation of anchor areas
- **Identify minimum number of occurrences of habitats by region**
- **Identify gaps in habitats, key corridors**
- **Have targets peer reviewed (*planned*)**
- Track implementation of targets
- Monitor effectiveness of targets in reaching goal (i.e., *restoring biological integrity of lower Columbia*)
- *Develop targets for focal species and add "layer" to these targets*

That's Great, But…

Climate change impacts:

- **Sea level rise –**
  - Submersion and conversion of habitats

- **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 intense storms, increased wave energy, increased erosion

- **Changes in upwelling patterns** off coast -
  - Increased potential intrusion into estuary of hypoxia and acidification
  - Increased influence with lower summer flows w/precip changes

- **Warmer temperatures**–
  - Less habitat for cold water species
  - Species shifts, migration, mortality, increased competition

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*

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*

Mitigating for Climate Change– Thermal Refugia

Water temperature trends – mainstem Columbia River

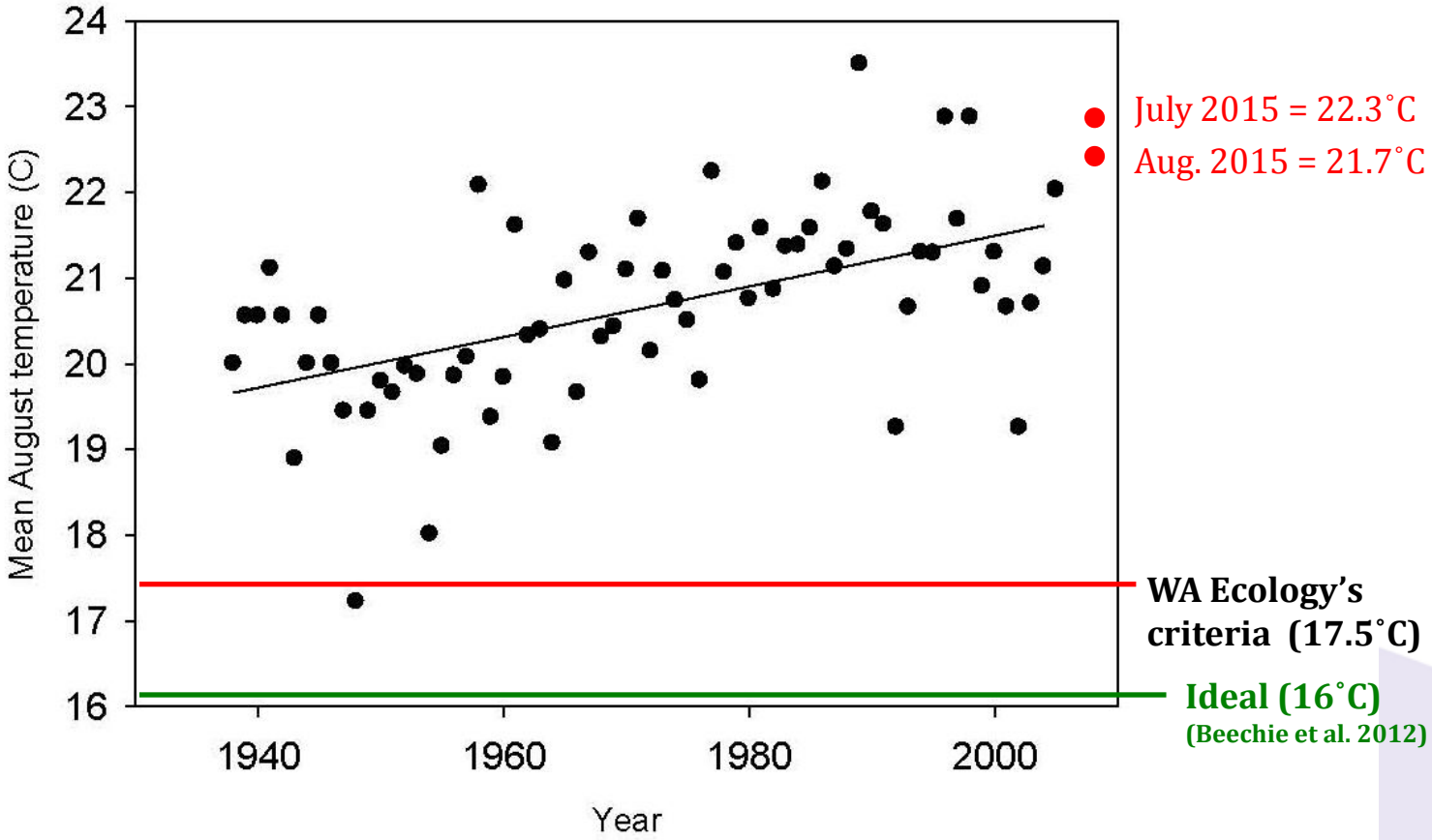


Figure 1. Mean August water temperature (°C) at Bonneville Dam, 1938-2005. Source: Columbia River DART.

Graph copied from Keefer et al. 2011

Mitigating for Climate Change– Thermal Refugia

Potential benefits of thermal refugia

- ~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*.

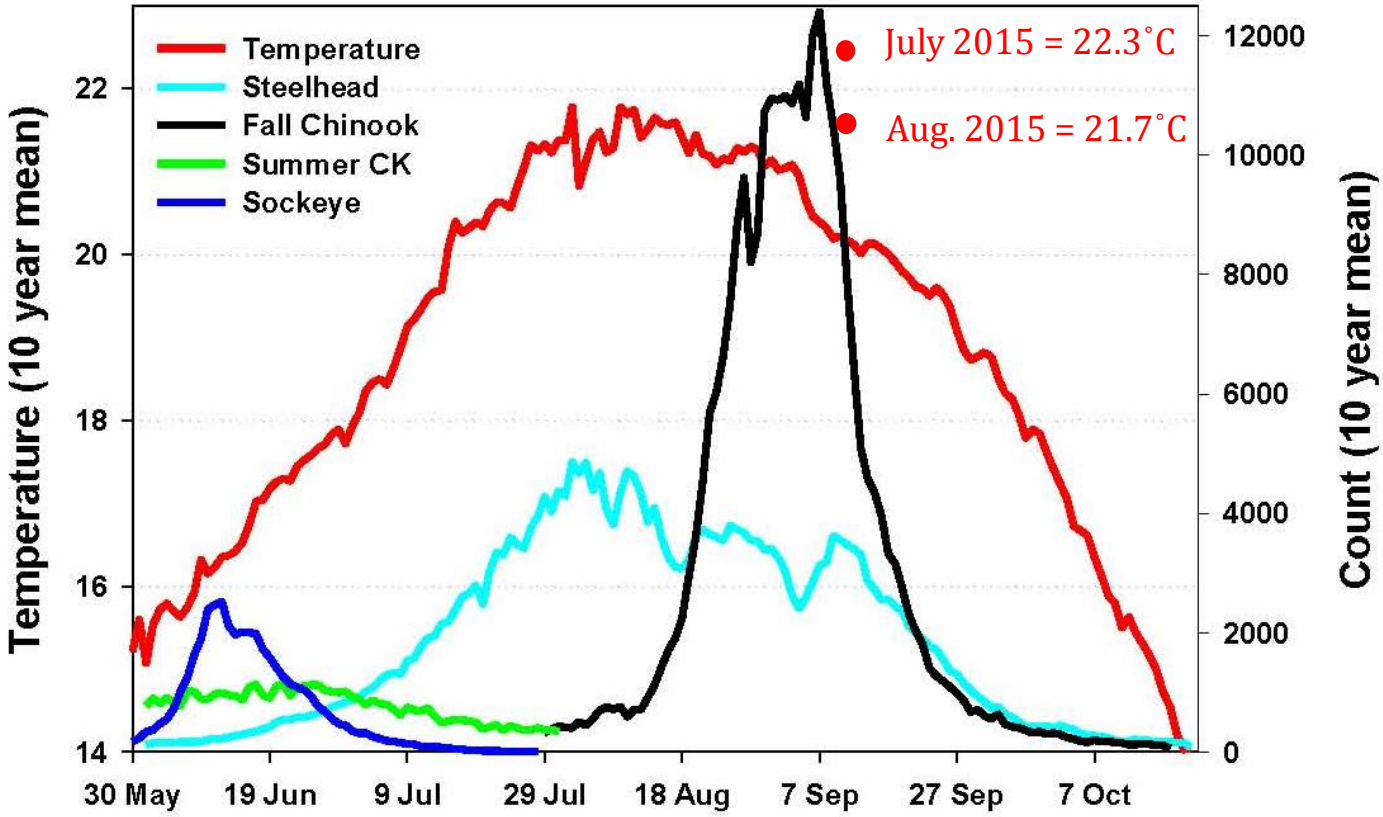


Figure 2. Ten-year (1996-2005) mean lower Columbia River water temperature (°C) and mean run size and timing of adult summer Chinook salmon, fall Chinook salmon, sockeye salmon, and summer steelhead at Bonneville Dam. Thermal refugia use by many adult populations has been associated with

Graph and text copied from Keefer et al. 2011

Mitigating for Climate Change– Thermal Refugia

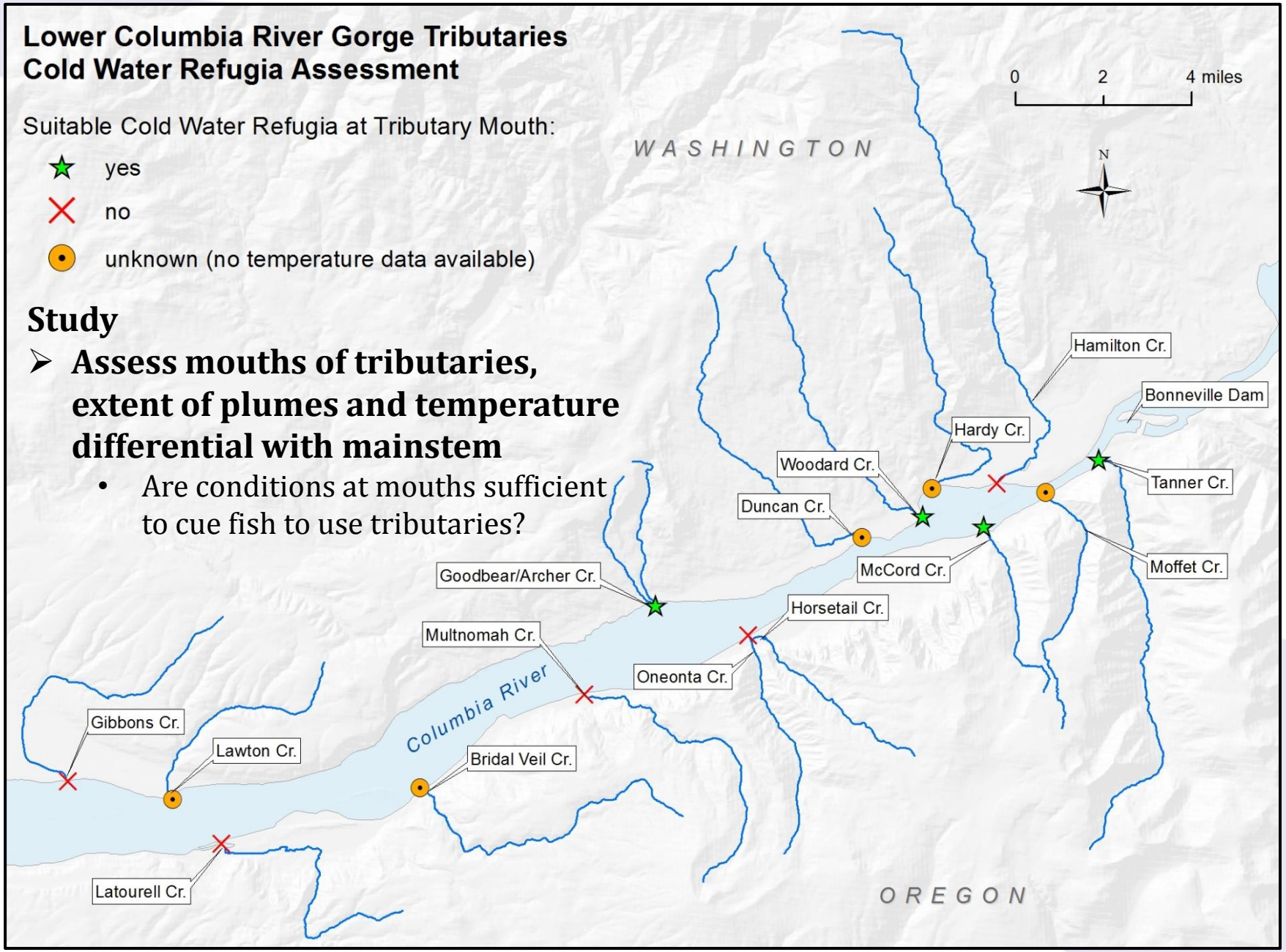
Potential benefits of thermal refugia

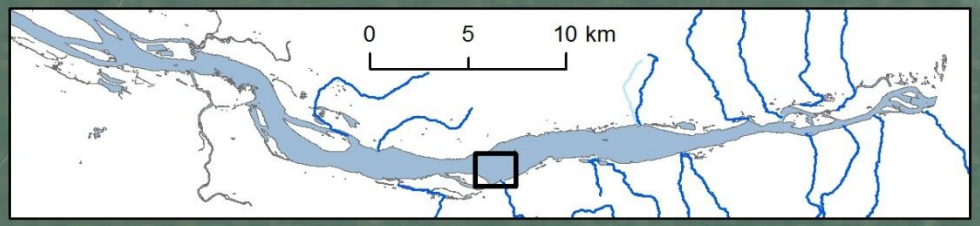
Fullerton et al. (2015): Most natural systems have a spatially variable thermal profile, i.e., <u>not homogenous and not linear</u>

- "Cold-water organisms may be able to use thermal diversity in rivers to survive in a warming climate…"
- "….more homogenized thermal landscapes may not provide sufficient variety of conditions for organisms to adapt" to climate change

➢ ***Received EPA grant for cold water refugia assessment for 14 Gorge tributaries in 2015-2016***

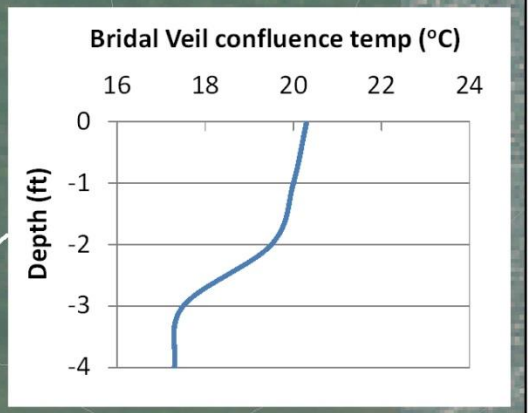
Current and Potential Thermal Refugia in Reach H



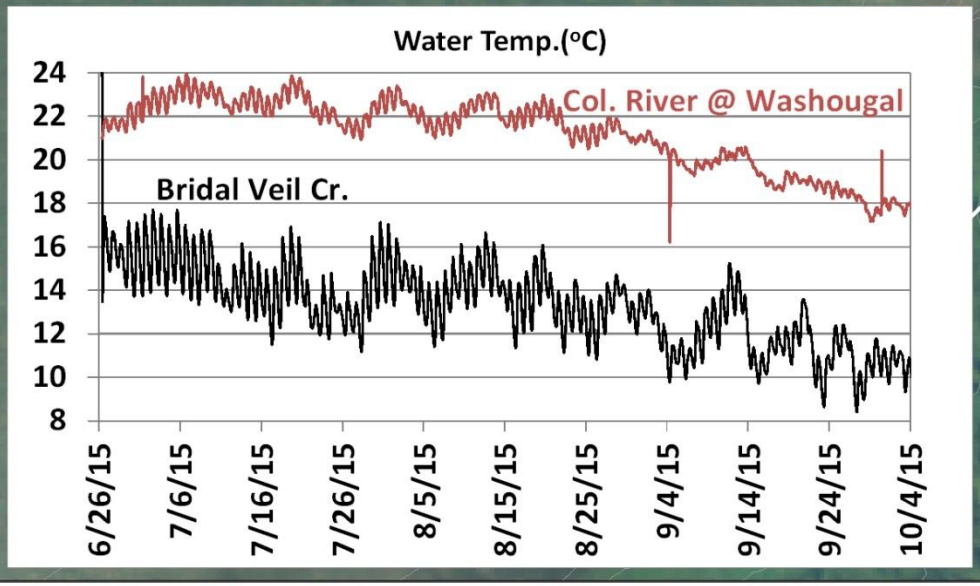


0 50 100 m

Imagery
Source: NAIP. Date: 09/10/2009
Elevation Data
Source: USACOE Date: <2009



0.5 acres



Discharge Meas. Loc.

Bridal Veil Cr.

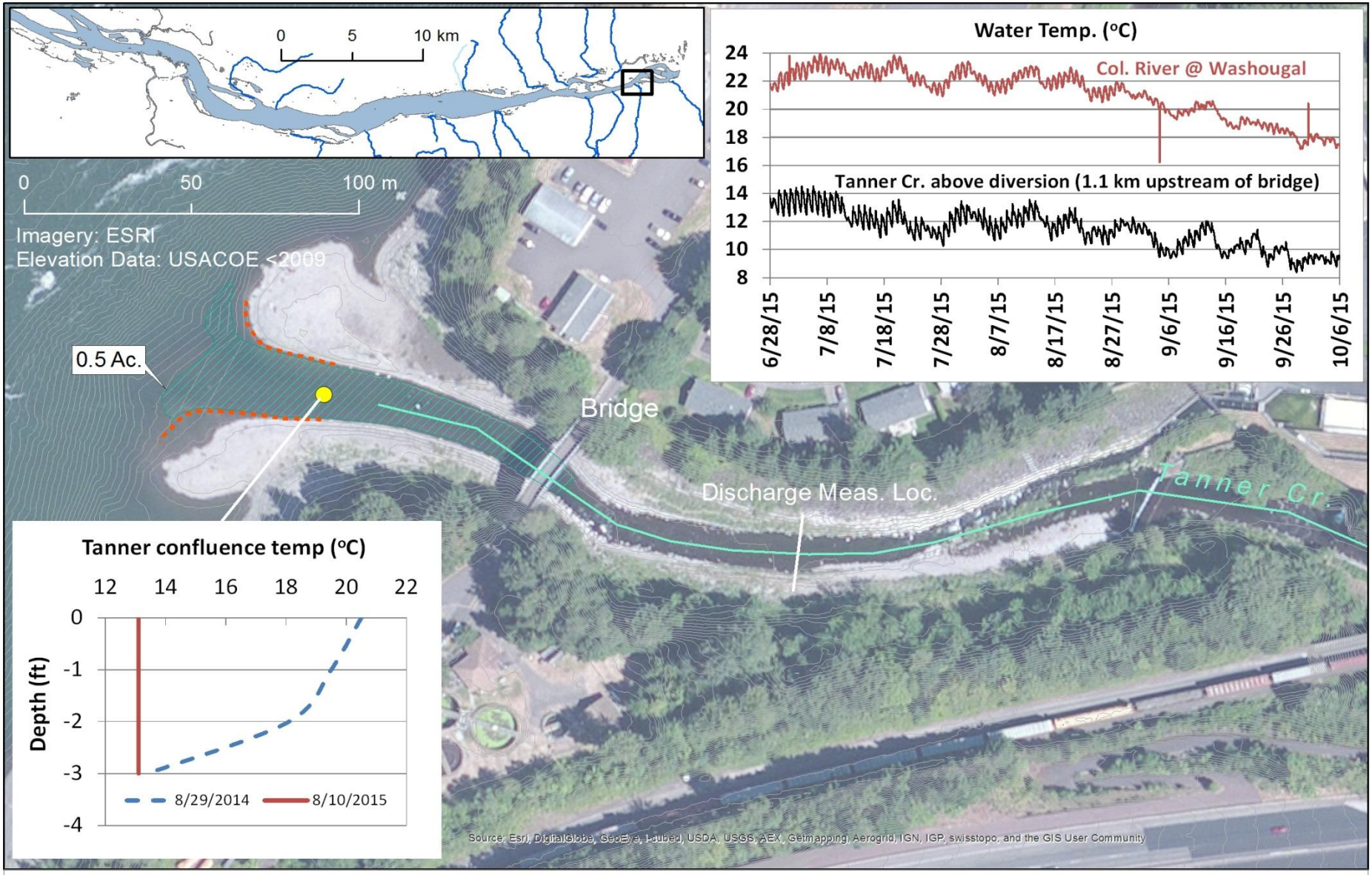
Cold Water Discharge at Bridal Veil Creek Outlet: 08/5/2015 @ 10:30 hrs.

Approx. cold water extent @ 3 ft. depth (T < 20 C)

Approx. water edge at time of survey

0.5 m elev. contours

Lower Columbia Estuary Partnership



Cold Water Discharge at Tanner Cr. Outlet: 08/29/2014 @ 10:30 hrs., 08/5/2015 @ 13:00 hrs.

Approx. cold water extent @ 3 ft. depth (T < 20 C)

Approx. water edge at time of survey

0.5 m elev. contours

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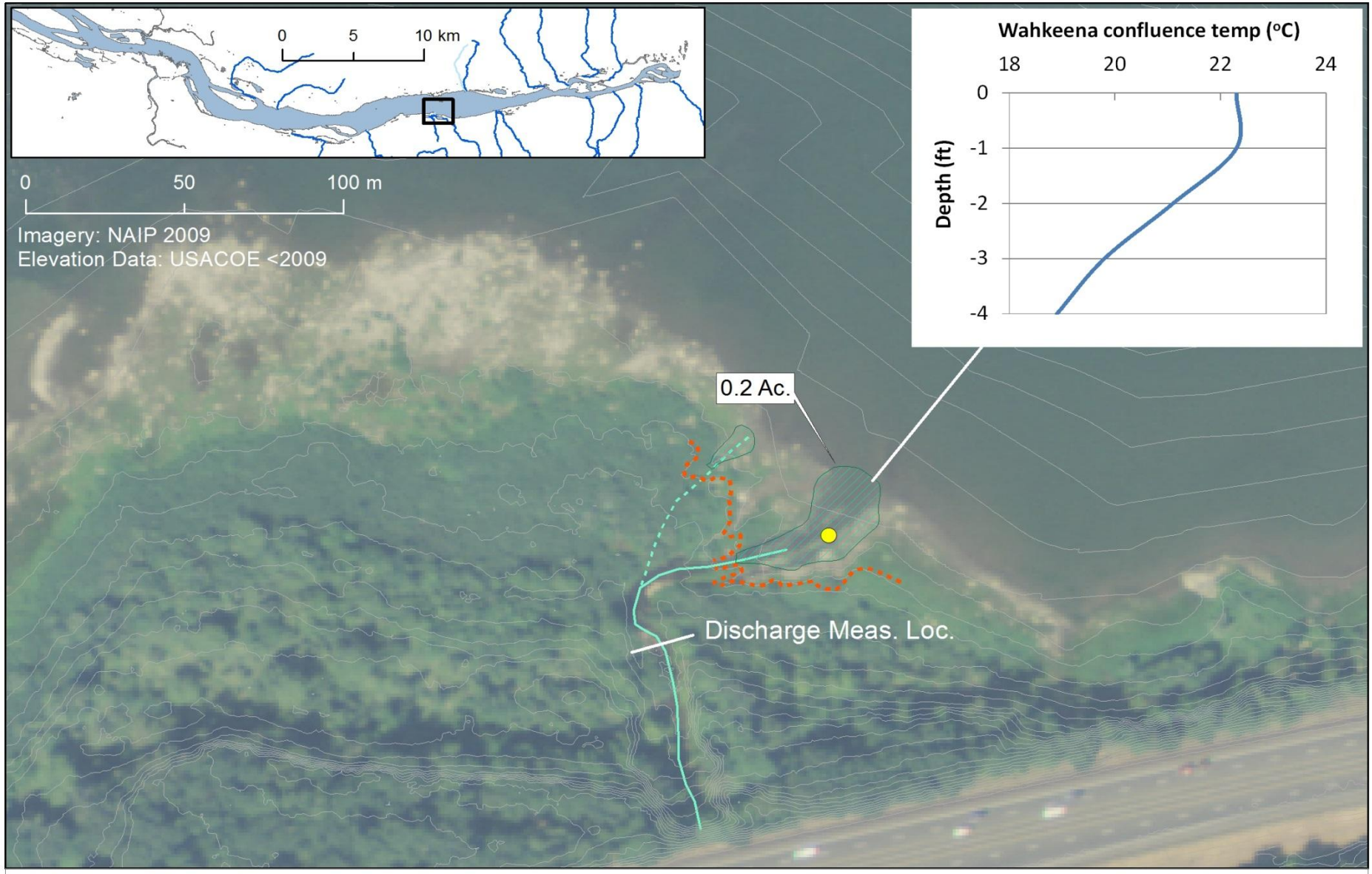


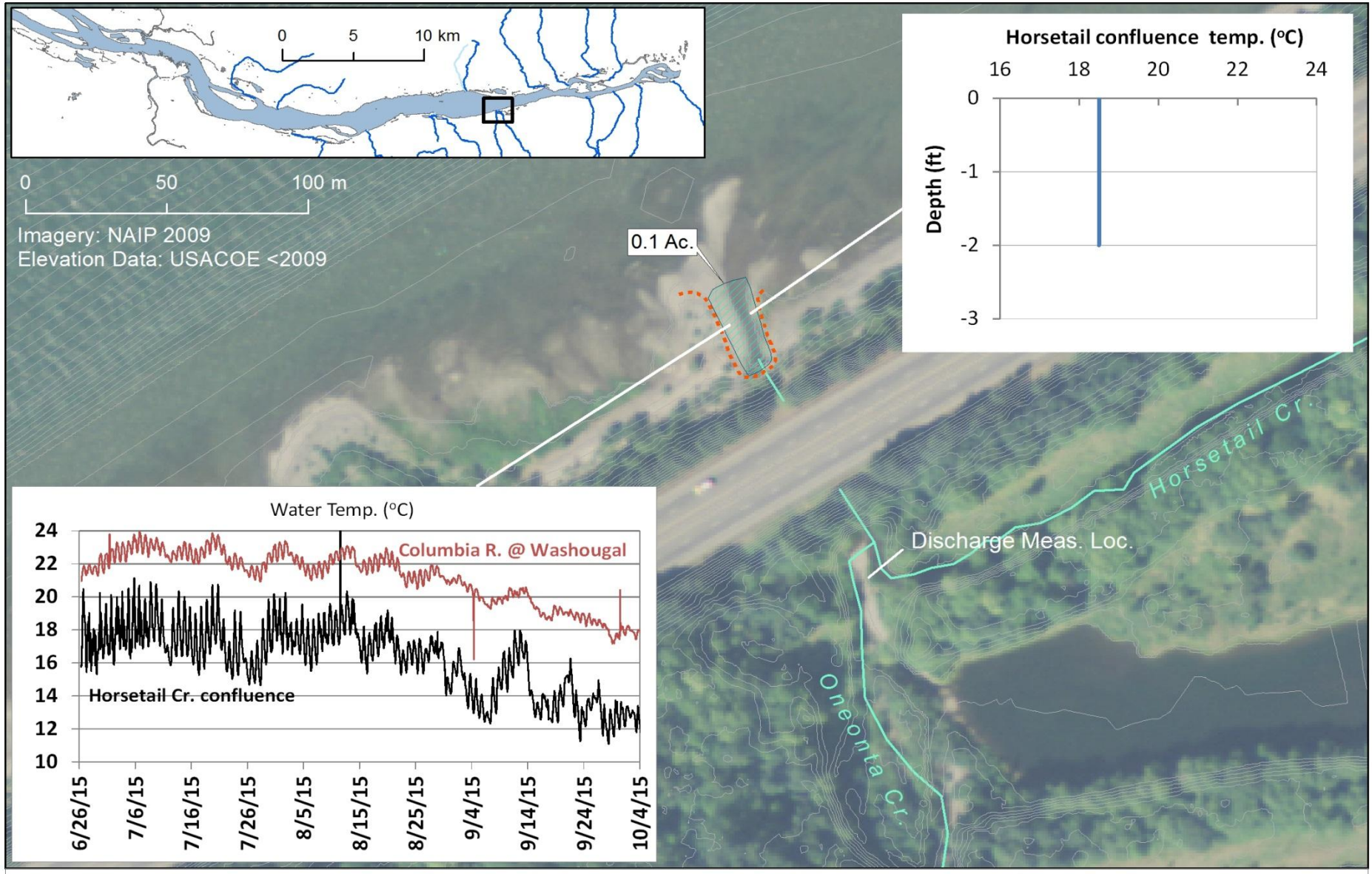
Cold Water Discharge at Wahkeena Cr. Outlet: 07/29/2014 @ 10:30 hrs.

Approx. cold water extent @ 3 ft. depth (T < 20 C)

Approx. water edge at time of survey

0.5 m elev. contours

Lower Columbia Estuary Partnership



Cold Water Discharge at Horsetail Cr. Outlet: 08/11/2015 @ 14:00 hrs.

Approx. cold water extent @ 3 ft. depth (T < 20 C)

Approx. water edge at time of survey

0.5 m elev. contours

Lower Columbia Estuary Partnership

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)
  - Sponsors can integrate aspects into design to benefit other species
    - Ex. - 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
- **Protect, restore cold water refugia**
  - Protect, restore instream baseflow to tributaries
  - Remove diversions, weirs that dewater downstream areas
  - Remove barriers, improve riparian conditions, increase complexity
- **Protect future wetlands - wetland migration inland with sea level rise**
- **Fill gaps in habitat diversity, expand protected areas for larger "anchor areas" for resiliency**


Questions?
Please contact:
Catherine Corbett or Debrah Marriott
(503) 226-1565