Lower Columbia Estuary Partnership

Implementing Habitat Coverage Targets for the Lower Columbia River

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Considerations for Future Implementation

- 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

Estuary Partnership Management Plan

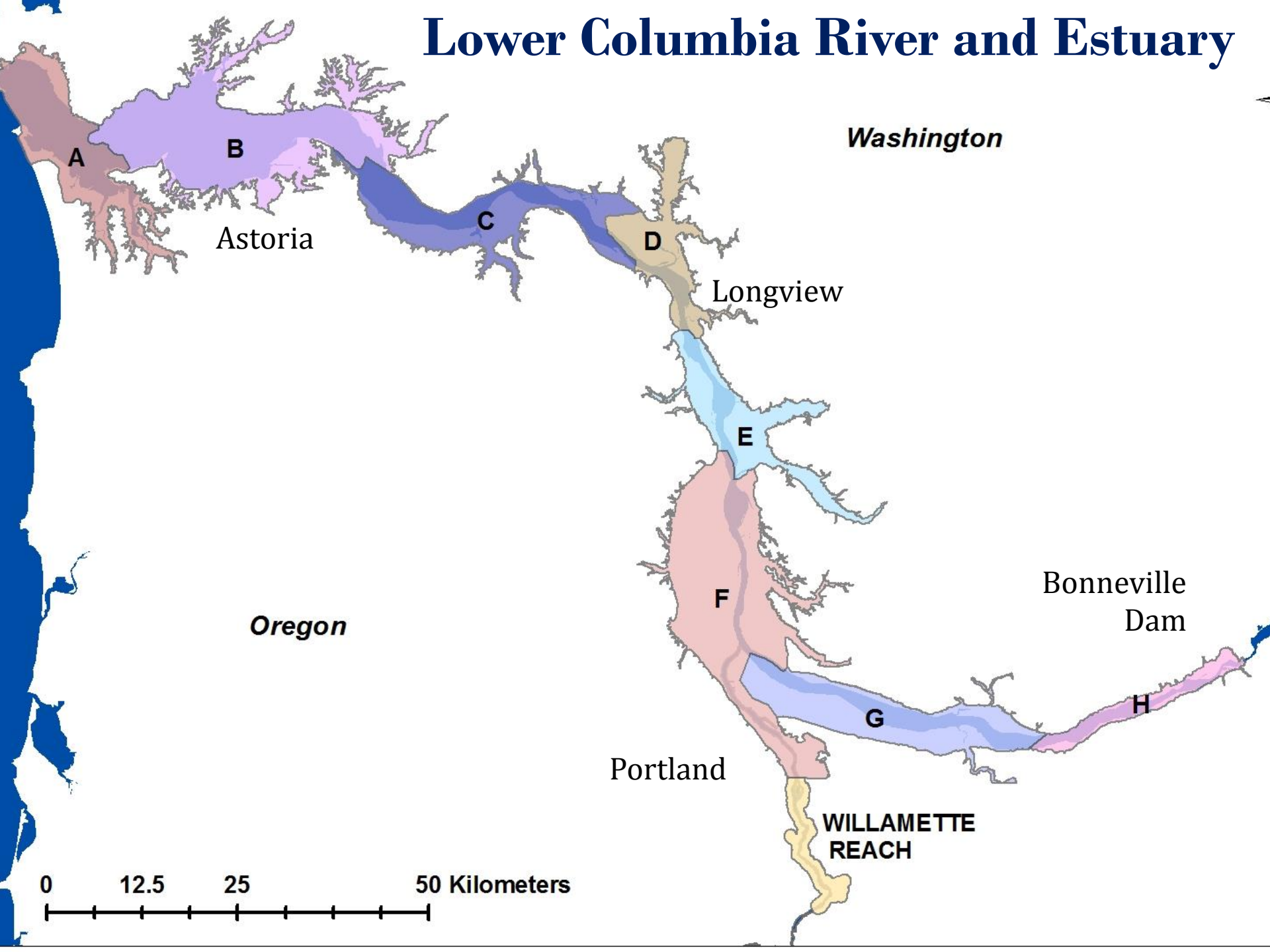
Actions in Management Plan call for:

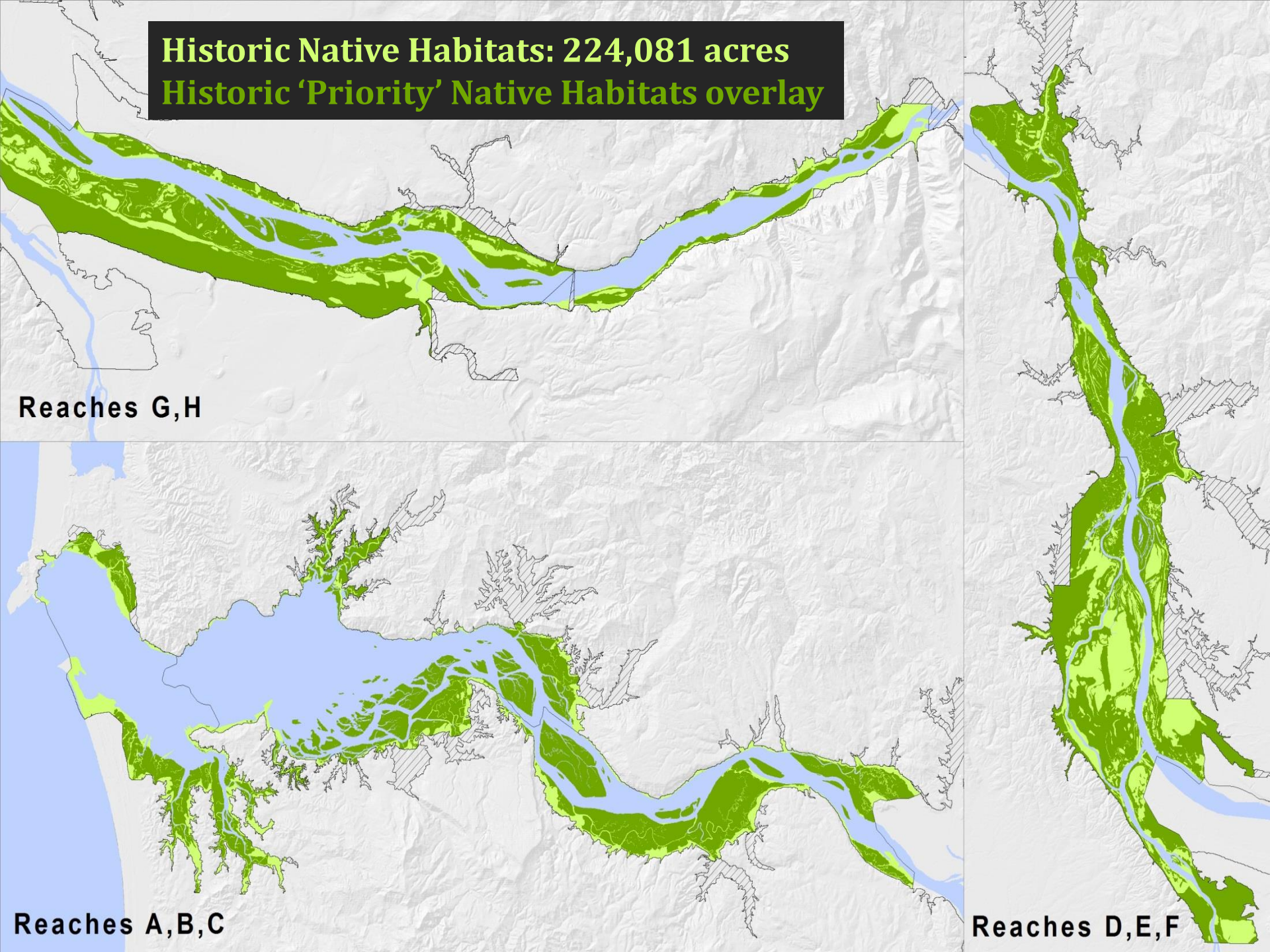
- √ **Inventory and prioritize habitat types**
- √ **Monitor status and trends of conditions**
- – **Protect, restore or enhance:**
  - ✓16,000 acres of habitat by 2010
  - ✓19,000 acres of habitat by 2014
  - ➢25,000 acres of habitat by 2025
- √ **Protected and/or restored 21,399 acres since 2000**

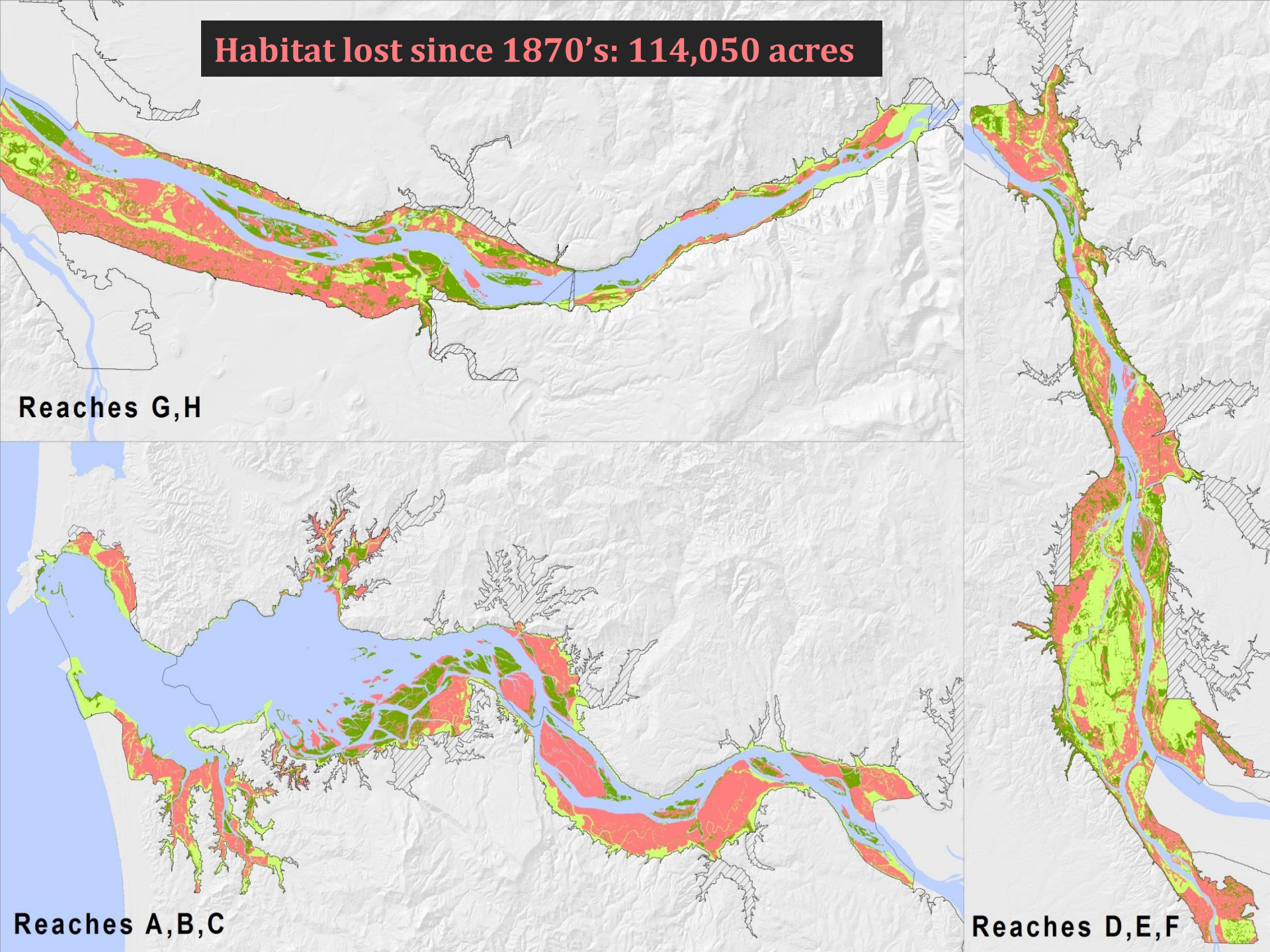
➢*New (approved February 2016):*

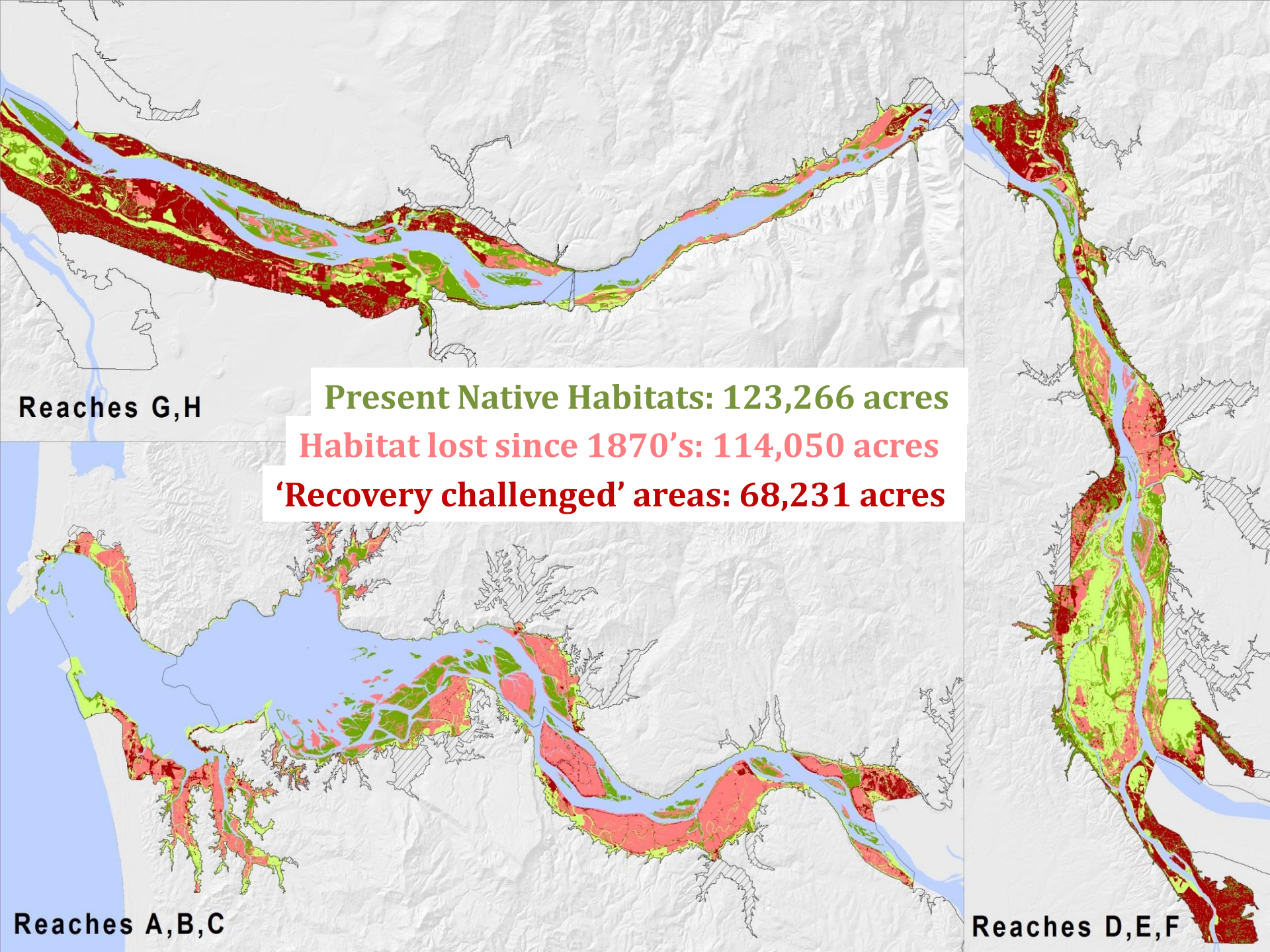
- No net loss as of 2009 (50% loss, or 114,050 loss)
- Restore 10,382 acres of priority habitats by 2030
- Restore 22,480 acres of priority habitats by 2050

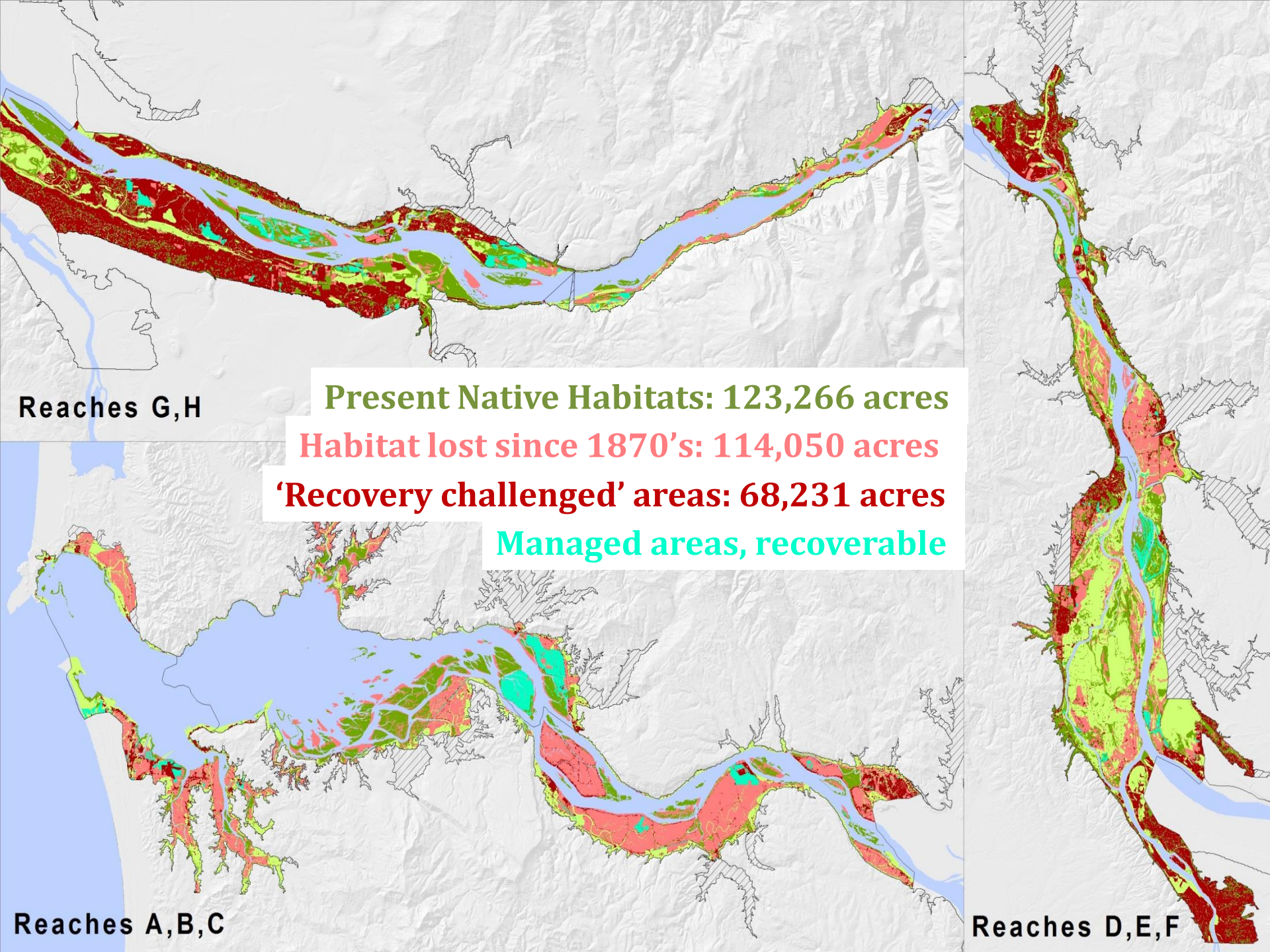
Lower Columbia River and Estuary

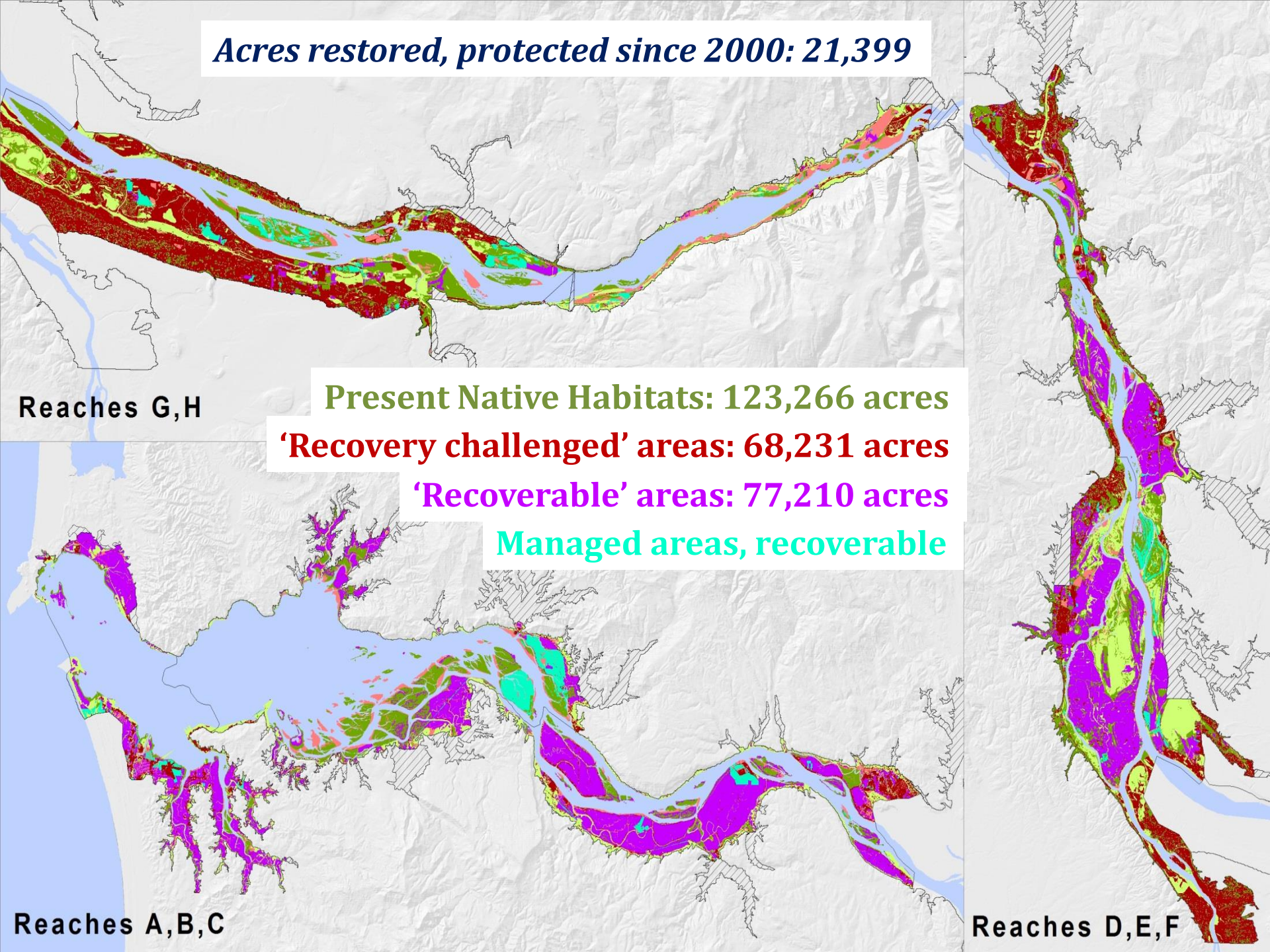


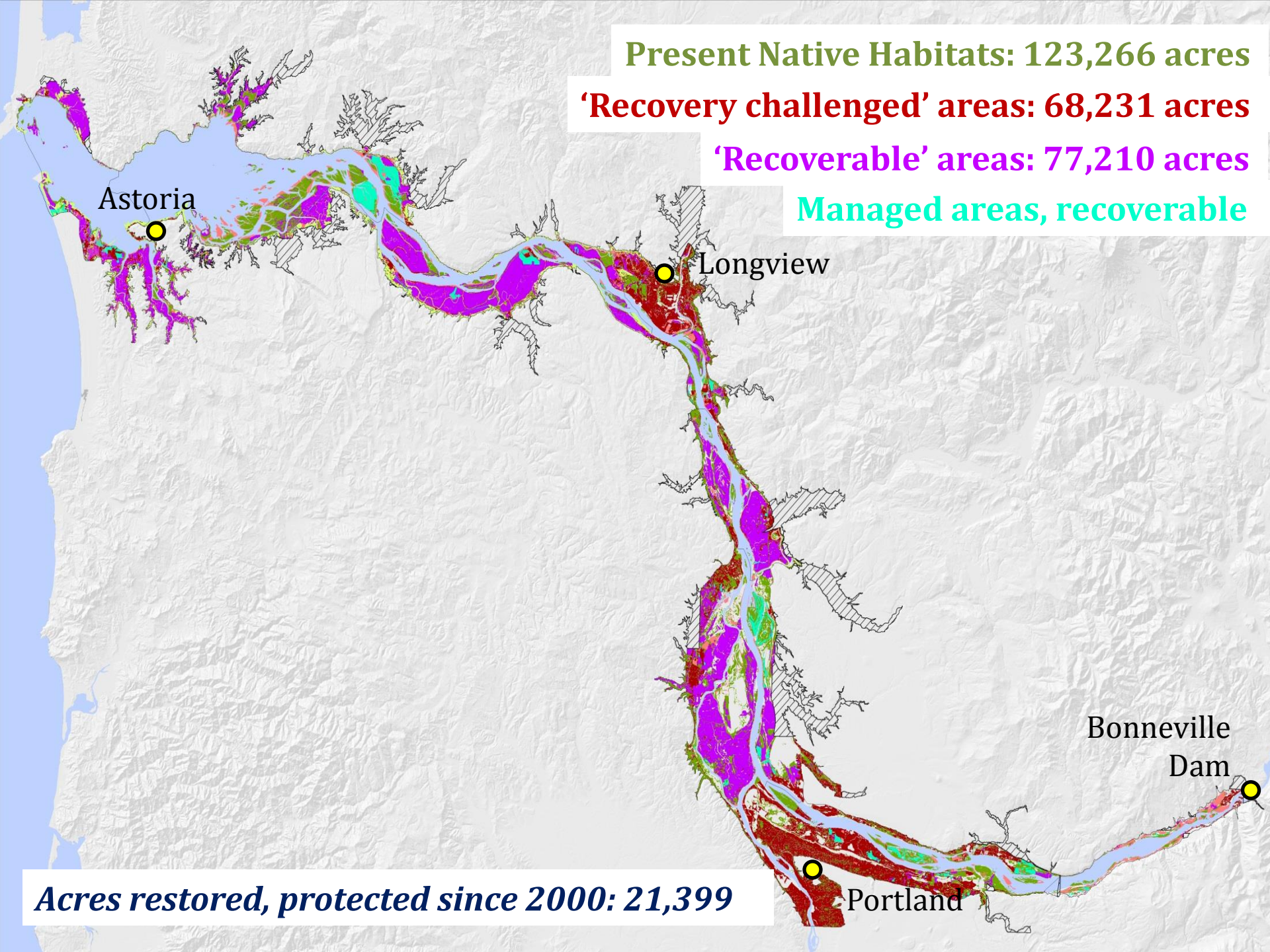

Historic Native Habitats: 224,081 acres
Historic 'Priority' Native Habitats overlay
Reaches G,H
Reaches A,B,C
Reaches D,E,F


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
Habitat lost since 1870's: 114,050 acres
'Recovery challenged' areas: 68,231 acres
Managed areas, recoverable
Reaches A,B,C
Reaches D,E,F


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

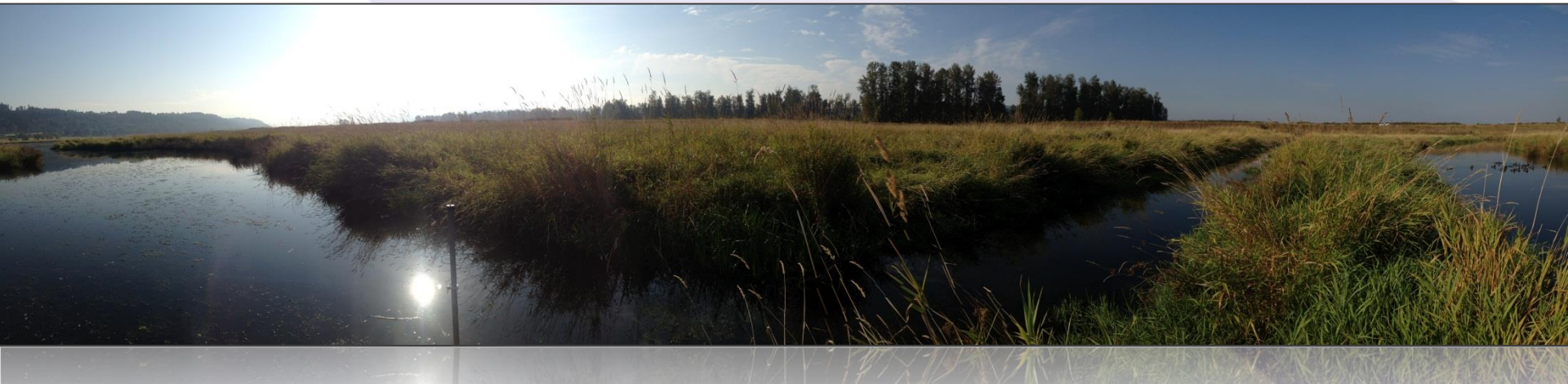

Present Native Habitats: 123,266 acres
'Recovery challenged' areas: 68,231 acres
'Recoverable' areas: 77,210 acres
Managed areas, recoverable
Astoria
Longview
Bonneville Dam
Portland
Acres restored, protected since 2000: 21,399

Vision for the lower Columbia – Biological Integrity

What is Biological Integrity?

- **USEPA definition -** the ability of an aquatic ecosystem to support a **balanced, integrated, adaptive community of organisms** having a **species composition, diversity, and functional organization** that is **comparable to natural habitat** in the region

  (Karr and Dudley 1981; Frey 1977)

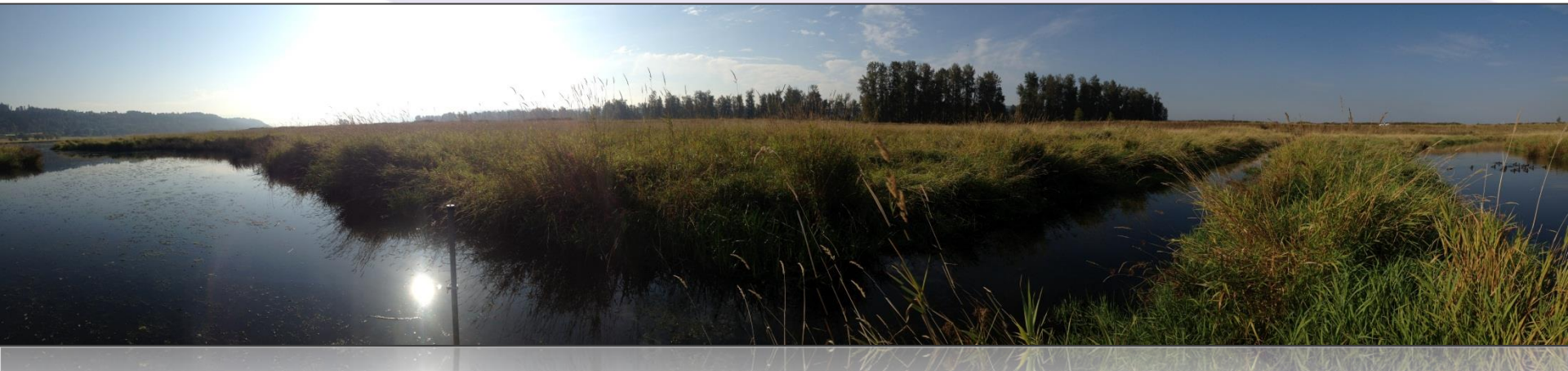


Estuary Partnership Management Plan

- **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**

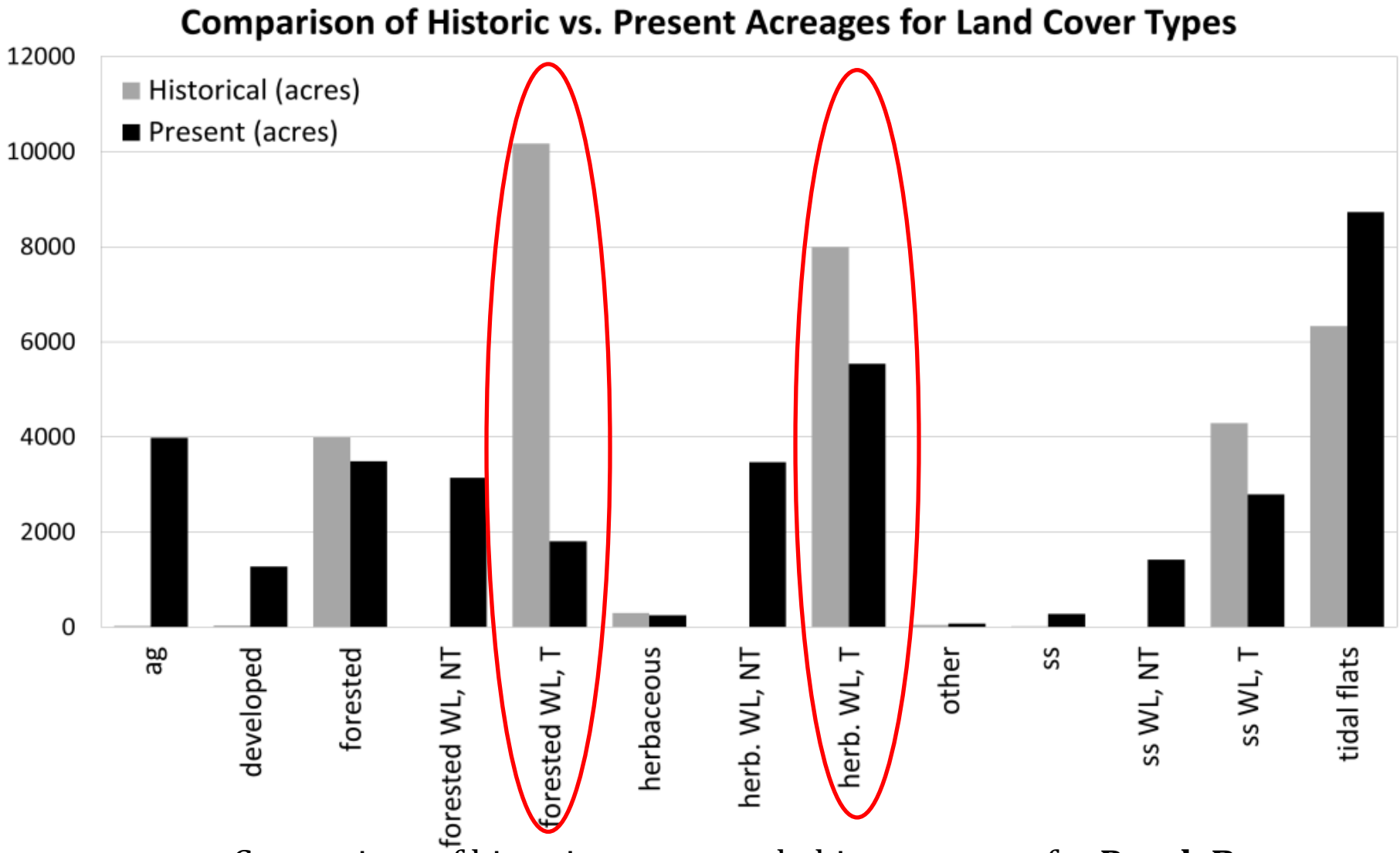


Define Quantifiable Conservation Targets

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



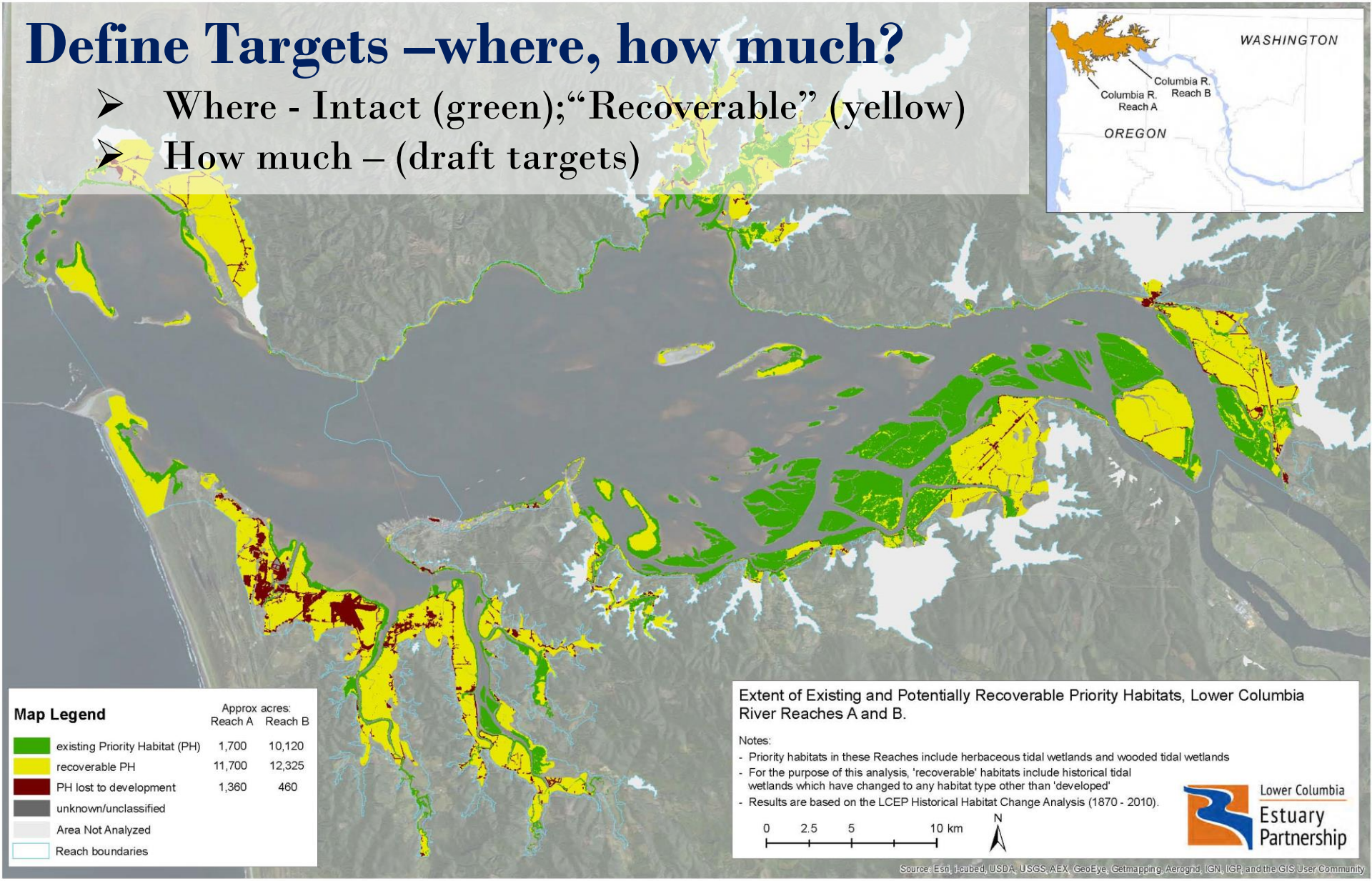
Comparison of historic vs. current habitat coverage for **Reach B**

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

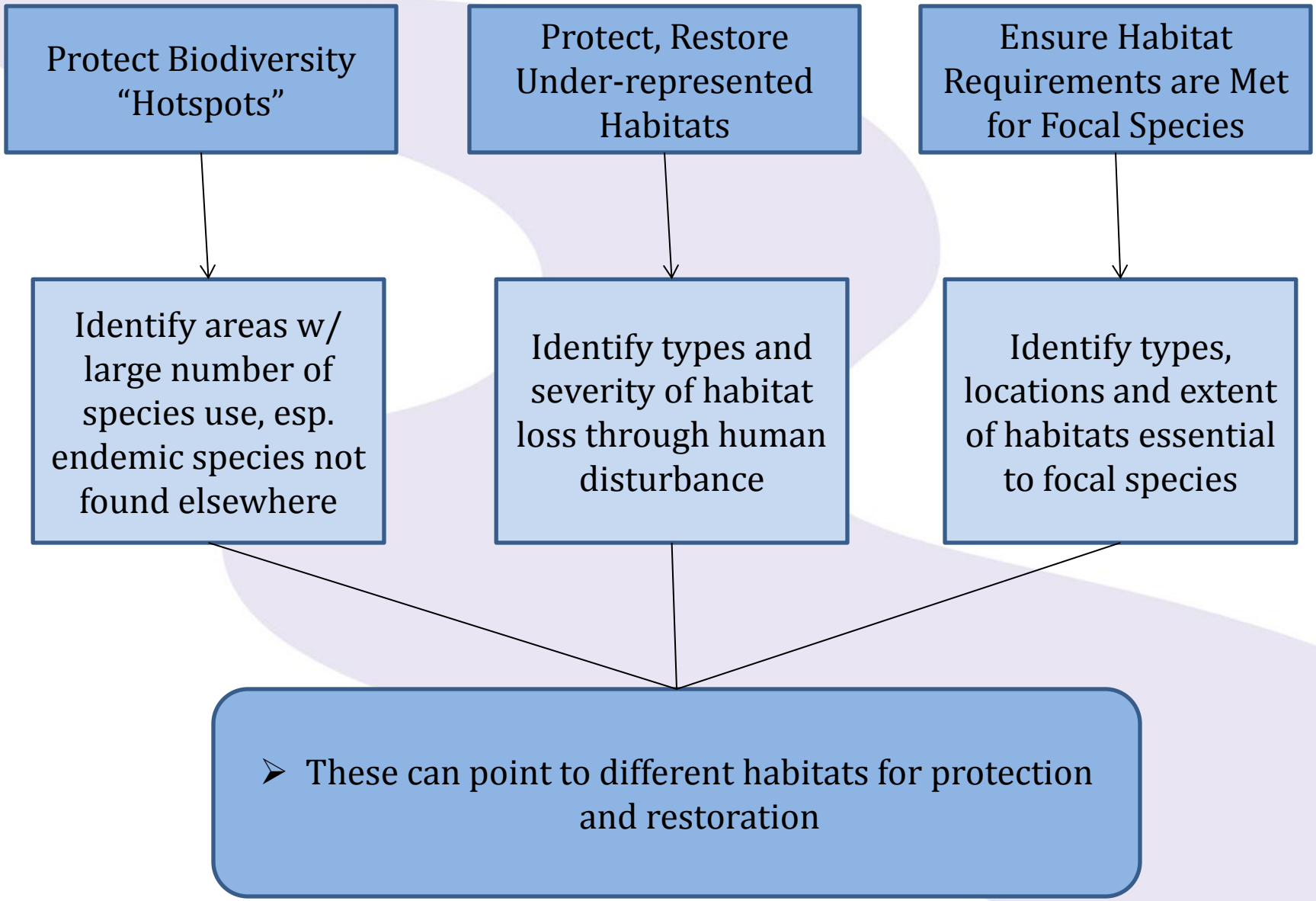
Available from website: http://www.estuarypartnership.org/historical-habitat-change

Methods for Setting Measureable Targets

- **Regulatory threshold -** e.g., water quality "not-to-exceed" thresholds, or type-for-type replacement in ESA, wetland mitigation
- **Reference site conditions -** analogous undeveloped ecosystems
- **Biodiversity "hot spots"–** large number of endemic species not found elsewhere
- **Resource –based -** Three Overarching Approaches:

1. **Single species** - identify population goals (e.g., minimum viable population, population viability analyses), then identify habitat needs to meet population goals as basis for targets
2. **Multiple Species -** similar to #1, but identify focal or target species, population targets, habitat needs
3. **Ecosystems** - protect percentage of historic habitat extent and if sufficient will be protective of species using those habitats
   - Pre-large-scale development or some period where data exists for ecosystem (e.g., Tampa Bay 1950s habitats)
   - 12% on national scale (WCED 1987); 10% (IUCN 1993)
   - 30% – 42% based on evidence-based approaches (e.g., species-area curves [MacArthur and Wilson 1967])

Approach for Setting Measurable Targets



Adapted from R. Noss 2000

Standards for Credible Targets

1. **Use best available science**
   - Underlying reasoning is scientifically valid
   - Theory or technique can be (or has been) tested
   - Subjected to peer review and publication
   - Known or potential error rate and existence of standards
   - Attracted widespread acceptance within relevant scientific community
2. **Follow scientific method**
3. **Evaluate multiple alternatives**
4. **Set targets for short (1-25 years) and long time periods**
   - Population viability analyses often use 95% probability of persistence to >100 years
5. **Incorporate "three R's":**
   - **Representation** – capturing some of everything
   - **Redundancy** – reduce risk of losing representative components
   - **Resilience** – refers to condition, quality of component, ability to persist through disturbances
6. **Evaluate errors and uncertainties**
7. **Anticipate change**

Adapted from Tear et al. 2005

Example: The Nature Conservancy

- **Southern Rocky Mountain Ecoregion; National Wildlife Refuges explored this same approach**

➢ **Coarse-filter/fine-filter approach** – conserving full array of natural habitats will adequately support the vast majority of species

- Coarse filter –representation of all native ecosystem types and communities
- Fine filter – add areas for rare and vulnerable species that are inadequately represented by coarse filter

➢ For *resiliency*, minimum size criterion for each ecosystem type

➢ For *representation* and *redundancy*, target number of occurrences for each ecosystem type, stratified by region

➢ Overall target of 30% of an ecosystem type's historic (1850s)extent

- Based on mathematical relationship between habitat area and the number of species an area can support or "species-area curve" (MacArthur and Wilson 1967)
- Researchers evaluated 10% and 30% of each ecosystem's historic extent to determine if protective of ecoregion's more common species
- Chose 30% - 1) additional habitat exist outside reserve network; 2) species and communities tend to occur across multiple ecoregions; 3) published thresholds generally suggest # of discrete locations where species occur range from 10 - >80

From Tear et al. 2005

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)*

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**

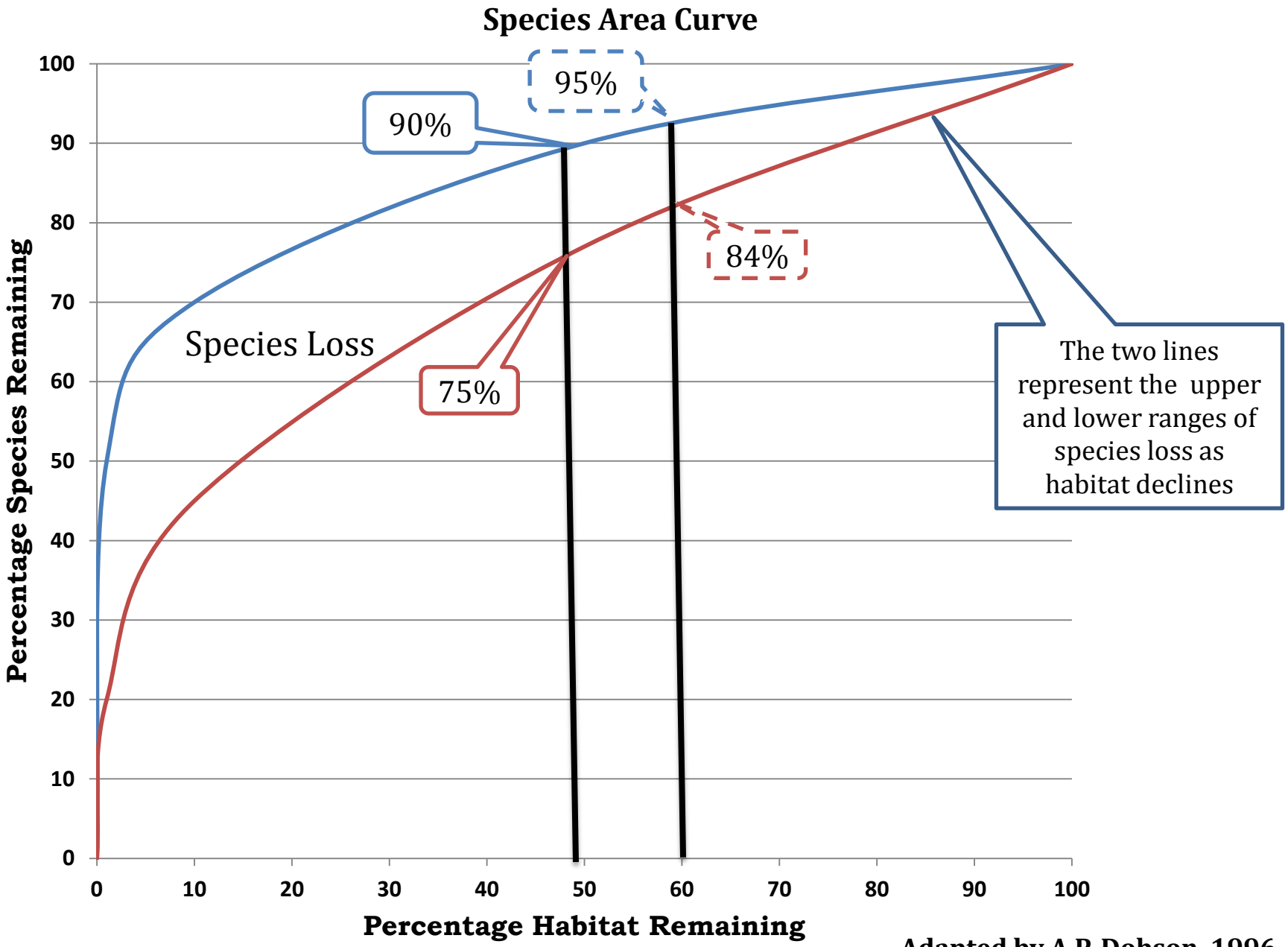
Notes:

- 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**

Draft Habitat Coverage Targets (2015)



Adapted by A.P. Dobson, 1996

Restoration Target = 22,480 acres by 2050 = 3,306 acres/5 years

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

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*

Geographic Priorities for Attributes 2-3 (focal species, water quality, ecosystem processes)

1. **Juvenile salmonid Habitat Suitability Index model *(complete)***
   - Identify locations in mainstem of optimum water velocities, temperature, and depth, adapting regional criteria, employing OHSU SELFE model results
2. **Priority tributaries in OR and WA Salmonid Recovery Plans *(complete)***
   - Tidal reaches of tributaries priority for chum and fall/late fall Chinook (subyearling life history strategy that rear extensively in tidal areas); weighted system on mainstem based on Skagit data
3. **Columbia White-tailed deer habitat (USFWS) (*complete*)**
4. **Priority Toxic Contaminant Clean up sites (Yakama Nation) (*draft*)**
5. **Habitats Priority for Pacific Flyway, Avian (USFWS) (*planned*)**
6. **Amphibian habitat suitability (states, USFWS) (*planned*)**
7. **Climate change impacts**
   - Sea level rise and landward migration of wetlands (***planned***)
   - Mapping and assessment of cold water refugia (***underway***)
   - Changes to habitat structure with increased CO_2, temperature, changes in precipitation (***underway***)

Considerations for Developing Geographic Priorities

- Protection of intact habitat versus restoration of impacted areas
- Creating anchor areas (large reserves) versus filling gaps, migration corridors
- Integrate climate change impacts –sea level rise may inundate, erode or shift areas…need to integrate estuarine, wetland landward migration
- Priorities based on ecological uplift alone without consideration of community support, existing efforts
  - Without community support and active restoration community, can prioritize areas all you want, but little implementation of priorities will occur
- Recommended – keep priorities in mind but allow for the impromptu good project

➢ ***Key – clearly articulated and defined vision, goals and objectives…priorities are derived from these***

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*

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

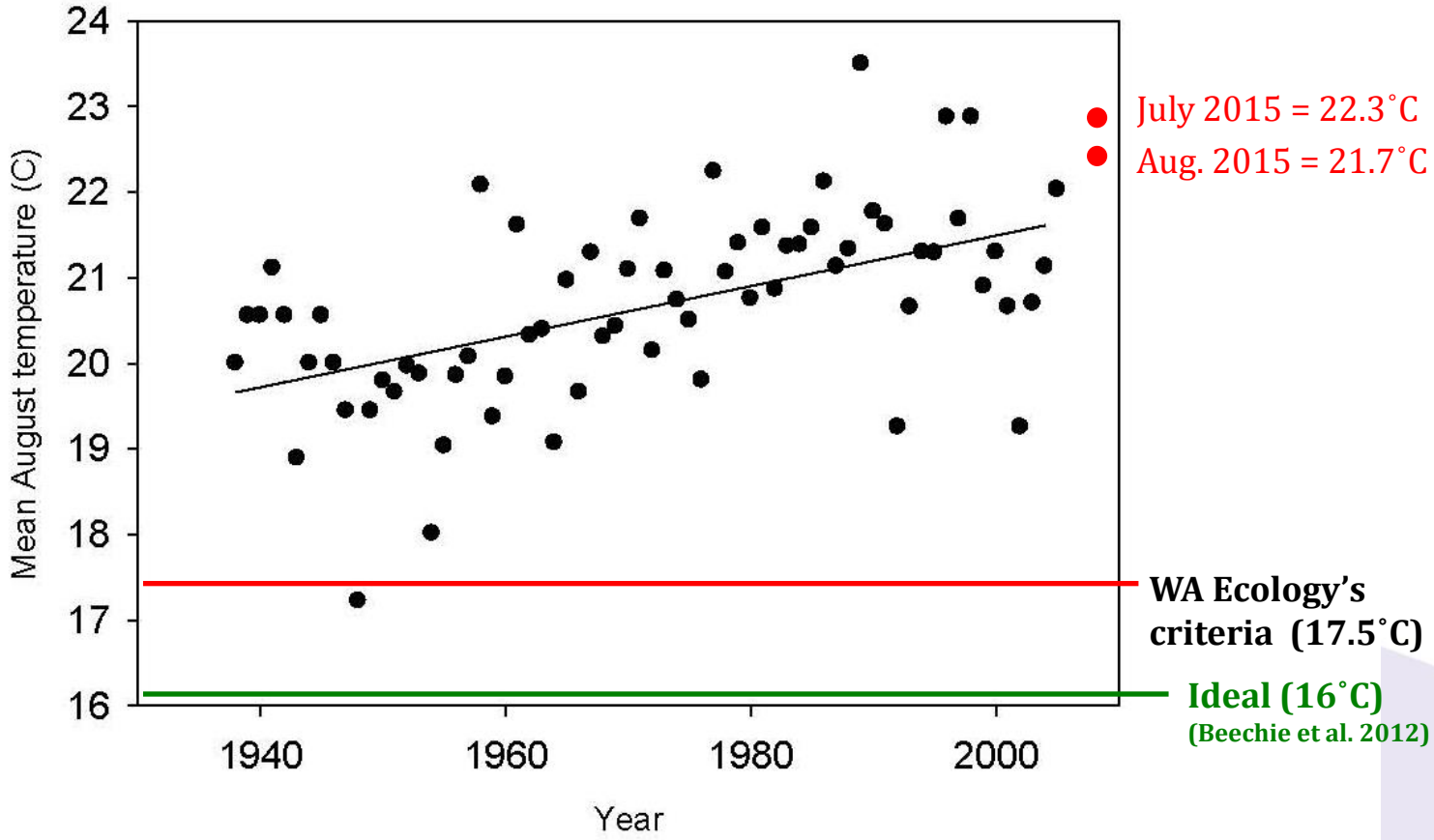


Figure 1. Mean August water temperature (°C) at Bonneville Dam, 1938-2005. Source: Columbia River DART.

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*.

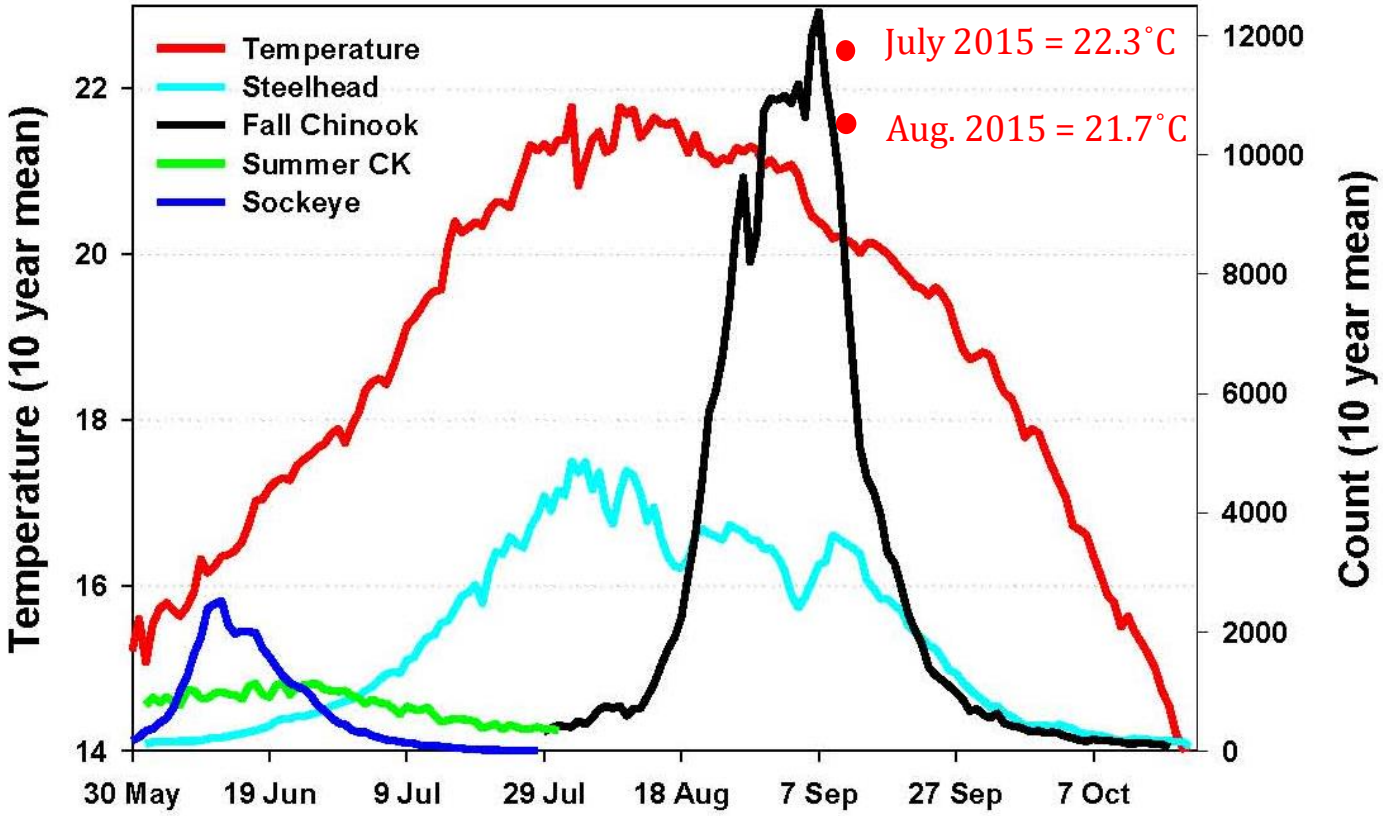
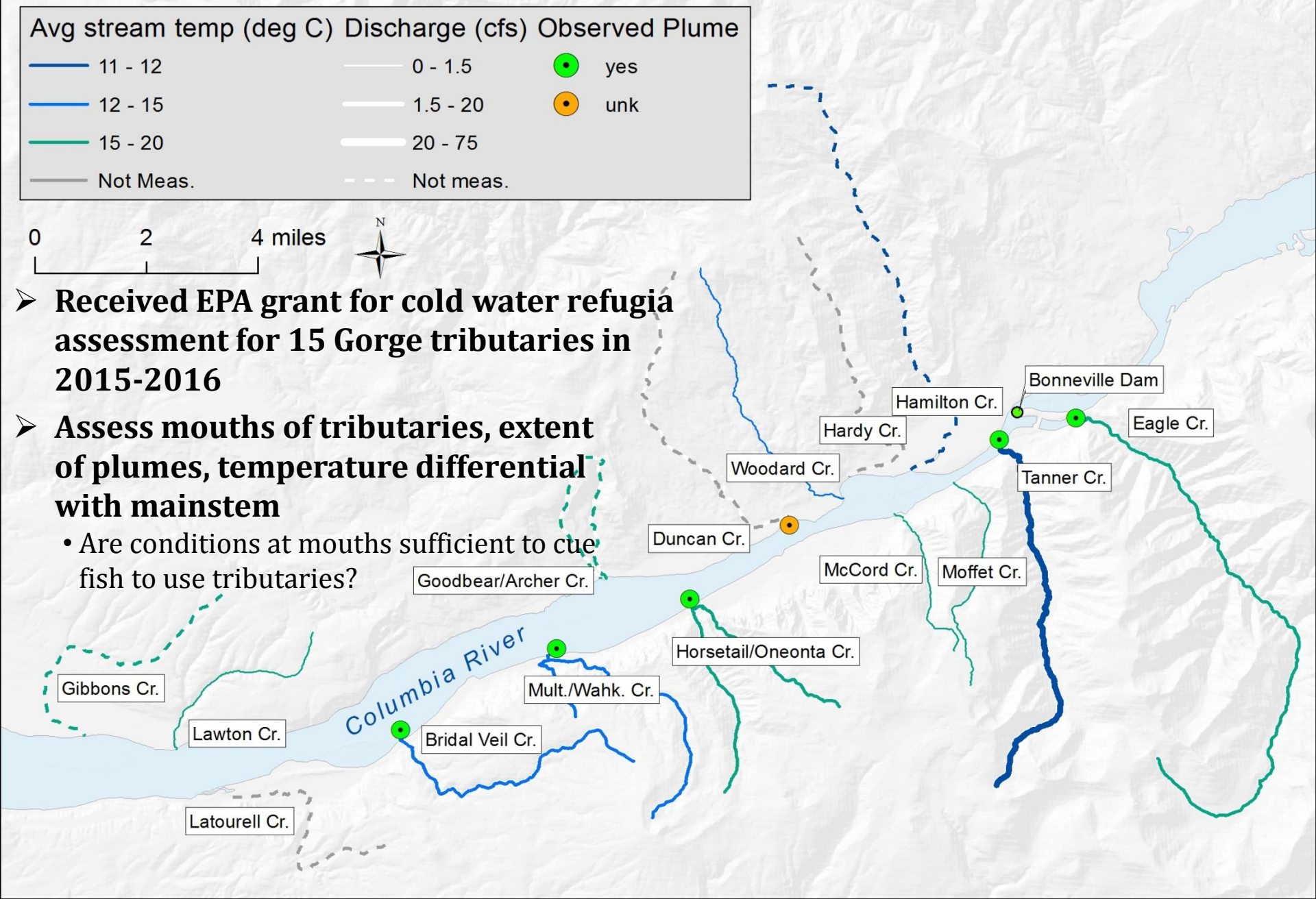


Figure 2. Ten-year (1996-2005) mean lower Columbia River water temperature (°C) and mean run size and timing of adult summer Chinook salmon, fall Chinook salmon, sockeye salmon, and summer steelhead at Bonneville Dam. Thermal refugia use by many adult populations has been associated with

Graph and text copied from Keefer et al. 2011

Monitoring Results Summary (Temperature, Discharge, Plume)

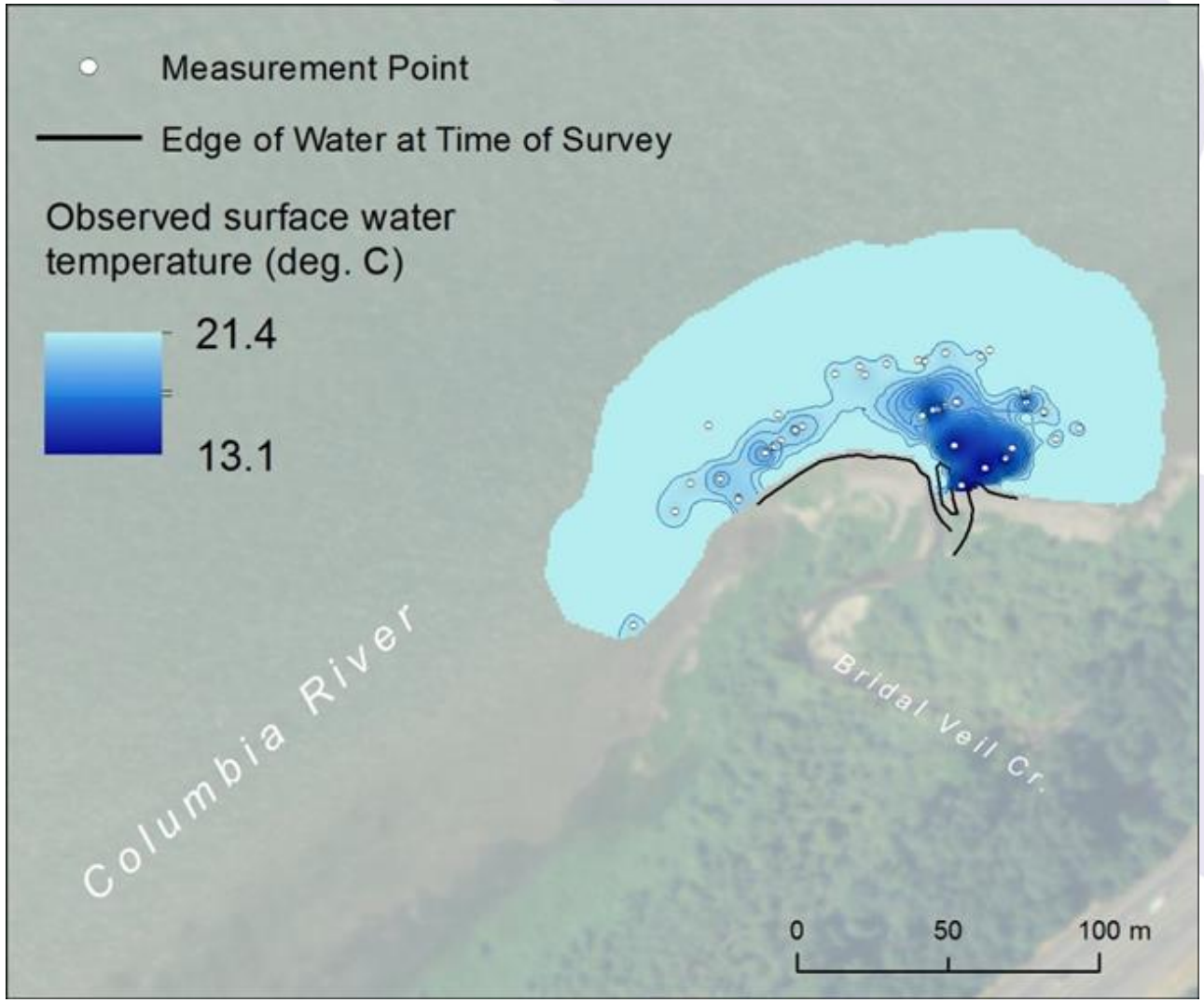


- **Received EPA grant for cold water refugia assessment for 15 Gorge tributaries in 2015-2016**
- **Assess mouths of tributaries, extent of plumes, temperature differential with mainstem**
  - Are conditions at mouths sufficient to cue fish to use tributaries?

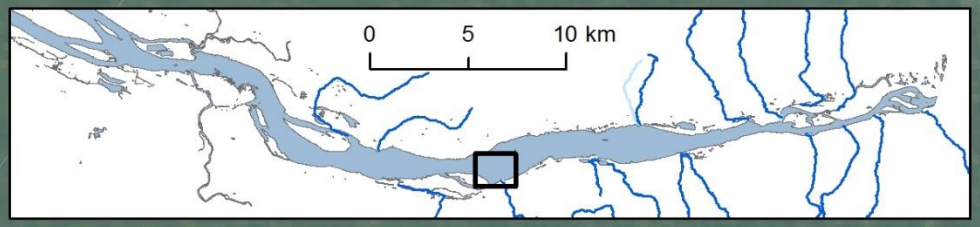
Cold Water Plume Observations

Bridal Veil Creek Confluence

Mapped on 8/5/2015 Columbia River temperature = 21.4 °C

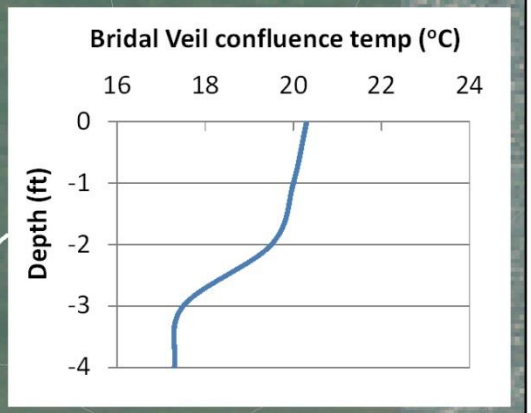


Surface Water Temperature (°C)	Acres
< 20	0.6
< 18	0.3
< 16	0.1

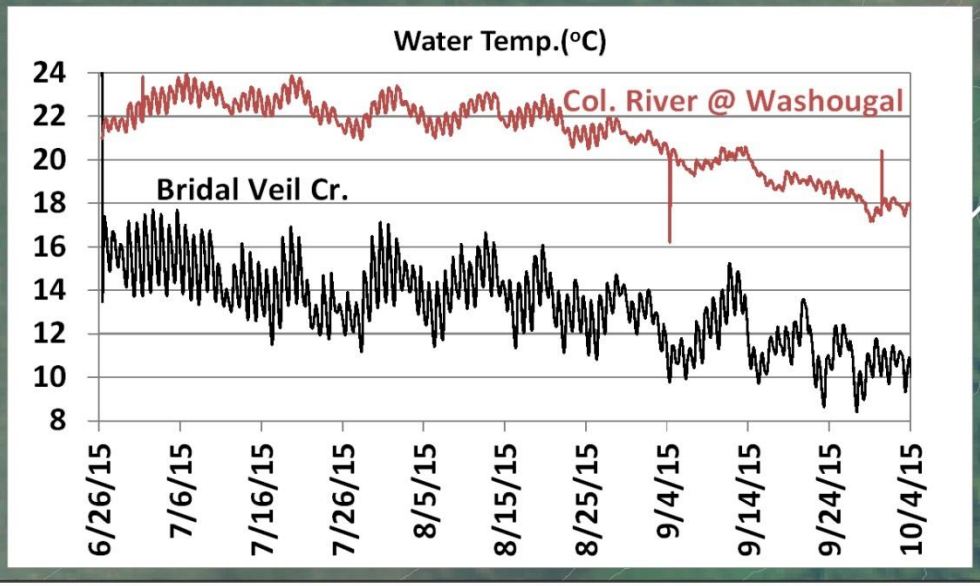


0 50 100 m

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

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 refuges**
  - 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**

Discussion