Lower Columbia Estuary Partnership

Lower Columbia River Ecosystem Restoration Program

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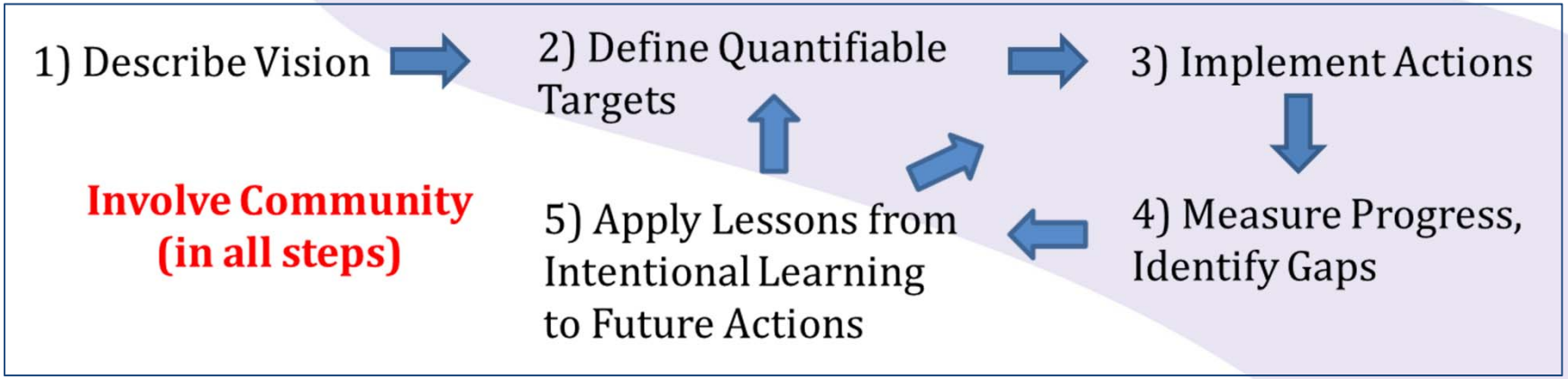
Ecosystem-Based Management (EBM)

Requires these conditions (UNEP 2006):

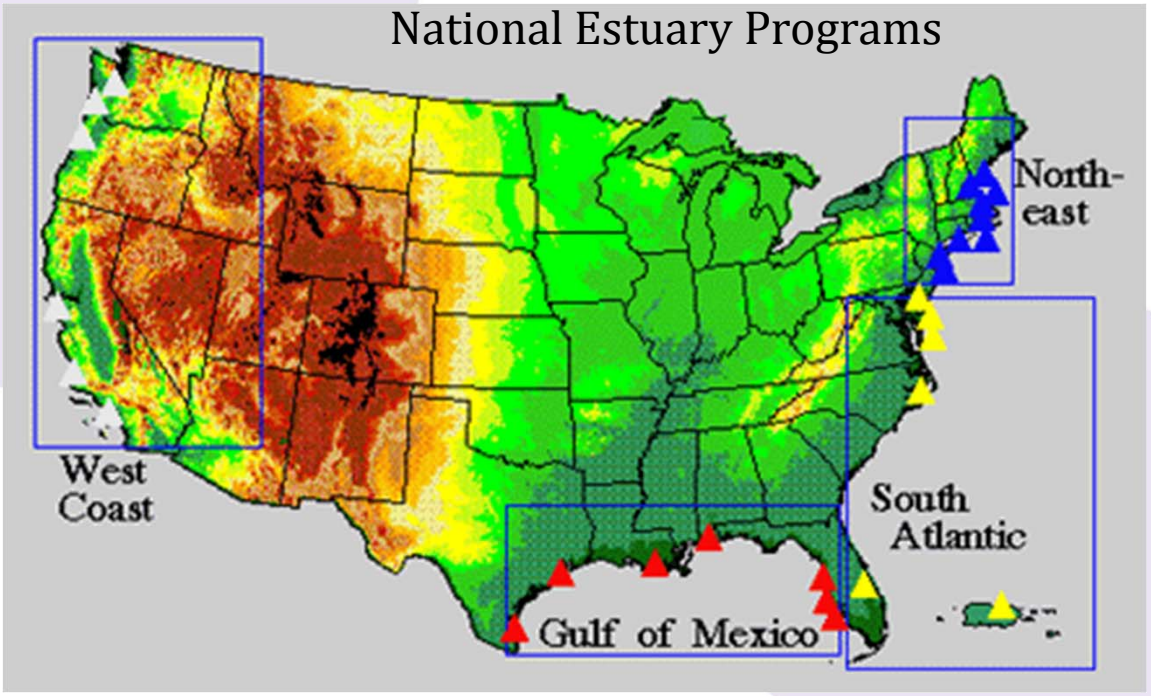
- **holistic vision/plan** - comprehensive description of system, articulation of management objectives
- **community** - effective engagement of policy makers, managers, stakeholders, scientists
- **foundation** - legal framework, management institutions, financial resources, effective communications
- **process** - effective adaptive management



NEP Governance Structure Provides EBM Framework

Estuary Partnership:

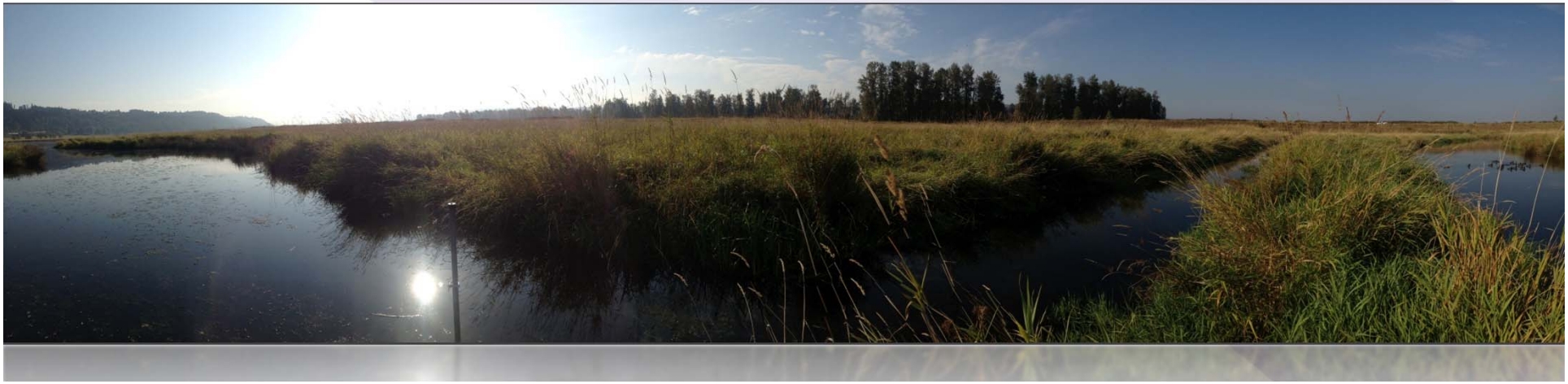
- One of 28 NEPs, authorized under Clean Water Act, §320
- Established in 1995 by governors of Washington, Oregon and USEPA
- Stakeholders develop, implement a *Comprehensive Conservation and Management Plan (CCMP)*
  - Includes vision, actions and targets (e.g., 19,000 acres of habitat protected, restored by 2014)
- Includes long term monitoring strategy to track ecosystem condition, effectiveness of implemented actions for adaptive management



1) Define Vision for the lower Columbia

- **CCMP Vision –**
  - *Integrated, resilient, and diverse biological communities are restored and maintained*
  - *Habitat supports self-sustaining populations of plants, fish and wildlife*

➢ **Restoring the *biological integrity* of the lower Columbia and estuary is the ultimate goal of the Estuary Program**

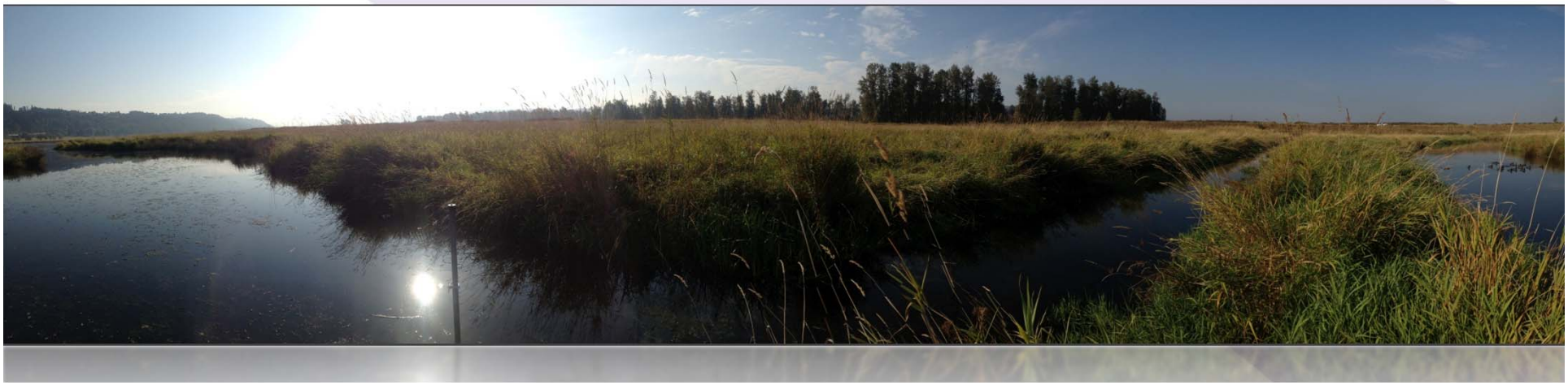


1) Define Vision for the lower Columbia

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

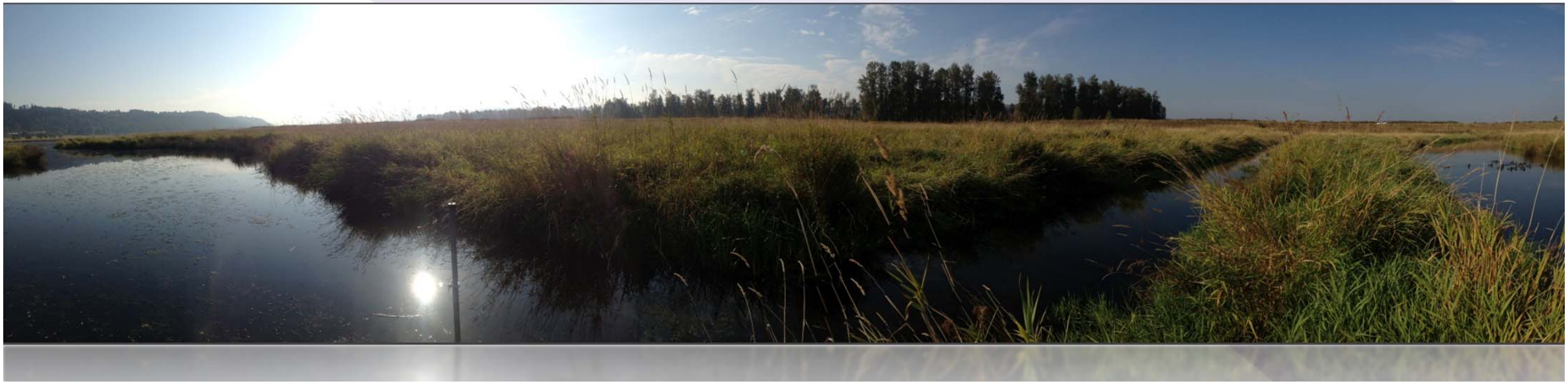
  (Karr and Dudley 1981; Frey 1977)



1) Define Vision for the lower Columbia

How do we Measure Biological Integrity?

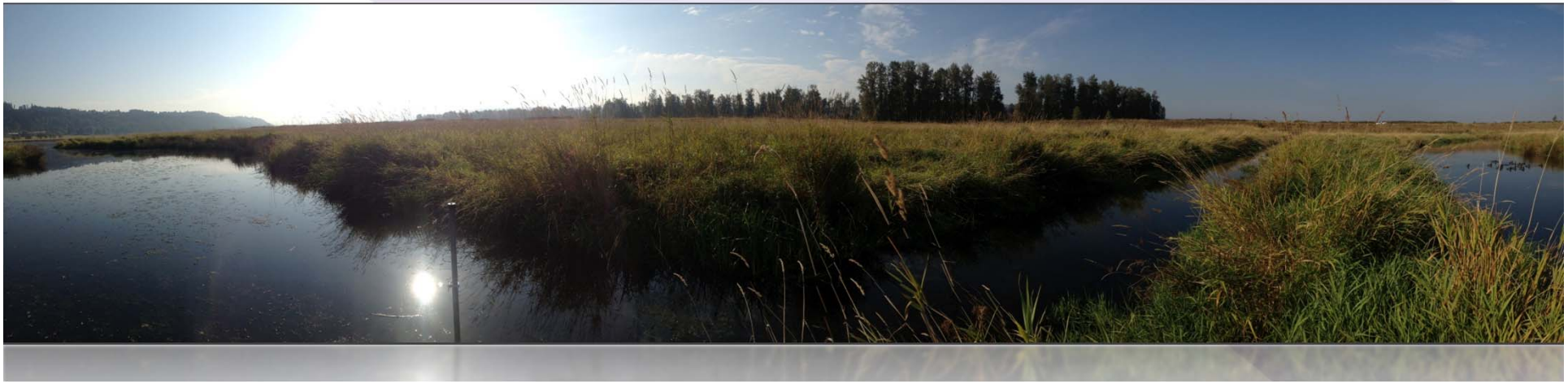
- **Biological Condition Gradient** (USEPA: Davies and Jackson 2006)
  - Similar to Index of Biological Integrity (Karr 1981)
  - Used in freshwater streams; USEPA adapting it to estuaries
  - ***Science Community identifies key ecosystem attributes***
    a. **Natural Habitat Diversity**, Historical Habitat Mosaic
    b. **Focal Species:** e.g., Pacific salmonids, Col. White-tailed deer, Pacific Flyway species (NPCC 2004)
    c. **Water Quality**
    d. **Ecosystem Processes**



2) Define Quantifiable Targets

a. Natural Habitat Diversity, Historic Habitat Mosaic

- **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



2) Define Quantifiable Targets

a. Natural Habitat Diversity, Historic Habitat Mosaic

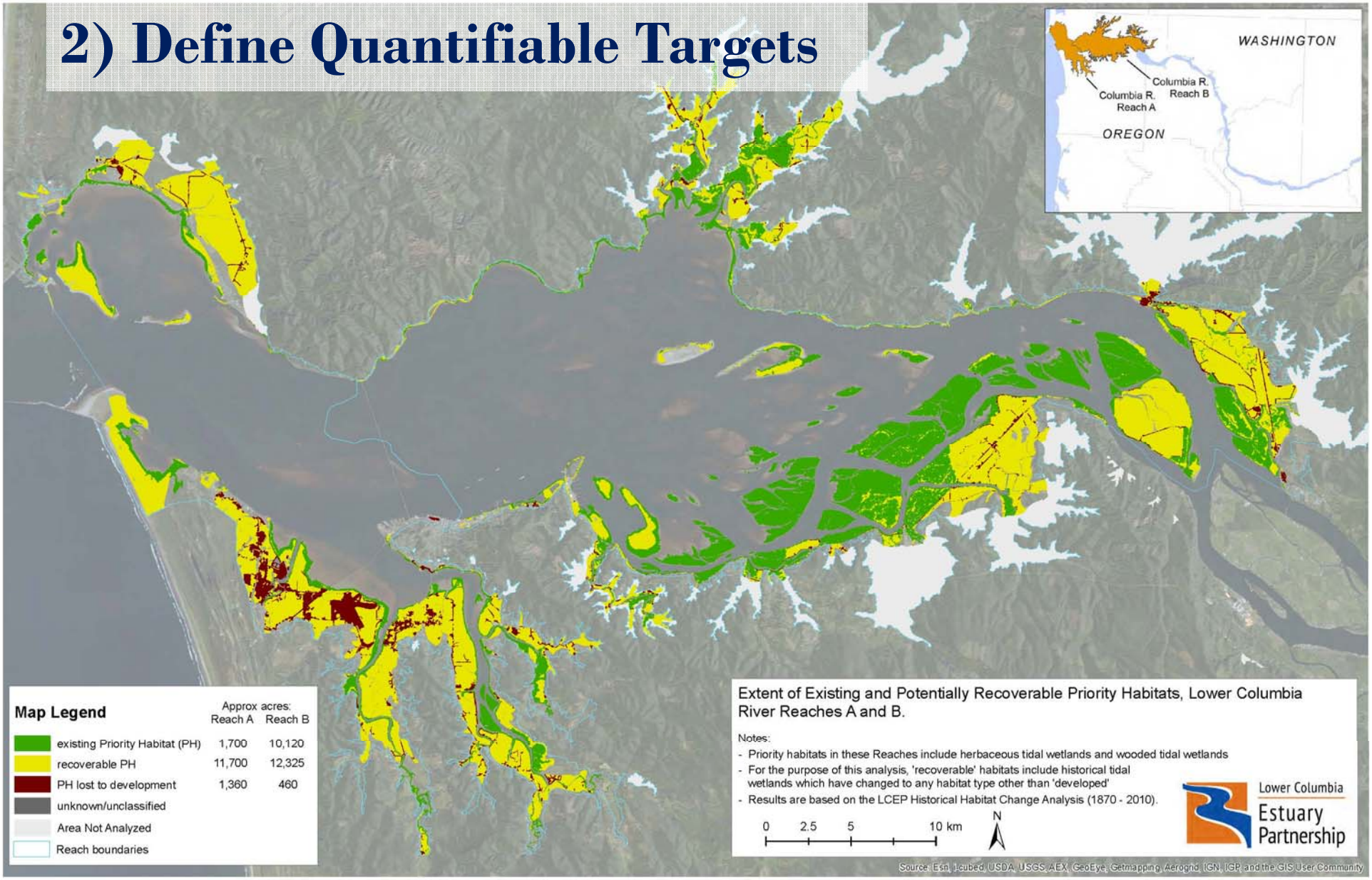
- Forested
- Non-tidal and tidal forested wetlands
- Herbaceous
- Non-tidal and tidal herbaceous wetlands
- Shrub scrub
- Non-tidal shrub scrub
- Tidal shrub scrub
- Tidal flats
- *Deep water*
- *Other (bare ground)*
- *Aquatic areas that support life stages:*
  - *Spawning habitats*
  - *Cold water refugia*
  - *Rearing habitats*
  - *Shallow, slow velocity*
- Site or landscape specific mosaic, gradient along channel/slough; channel complexity, elevation gradient; description of this per reach;
- Landscape metrics, patch size, across lower river, averages

Priority habitats to protect

Habitat	Relevant Reaches
Tidal herbaceous wetlands	A – E, G
Tidal wooded wetland	A - D
Forested	A, D - G
Herbaceous	D - G
Shrub scrub	E, F
Non-tidal herbaceous wetland	F
Non-tidal wooded wetland	H

See Estuary Partnership 2012 for details
http://www.estuarypartnership.org/habitat-restoration-strategy

2) Define Quantifiable Targets

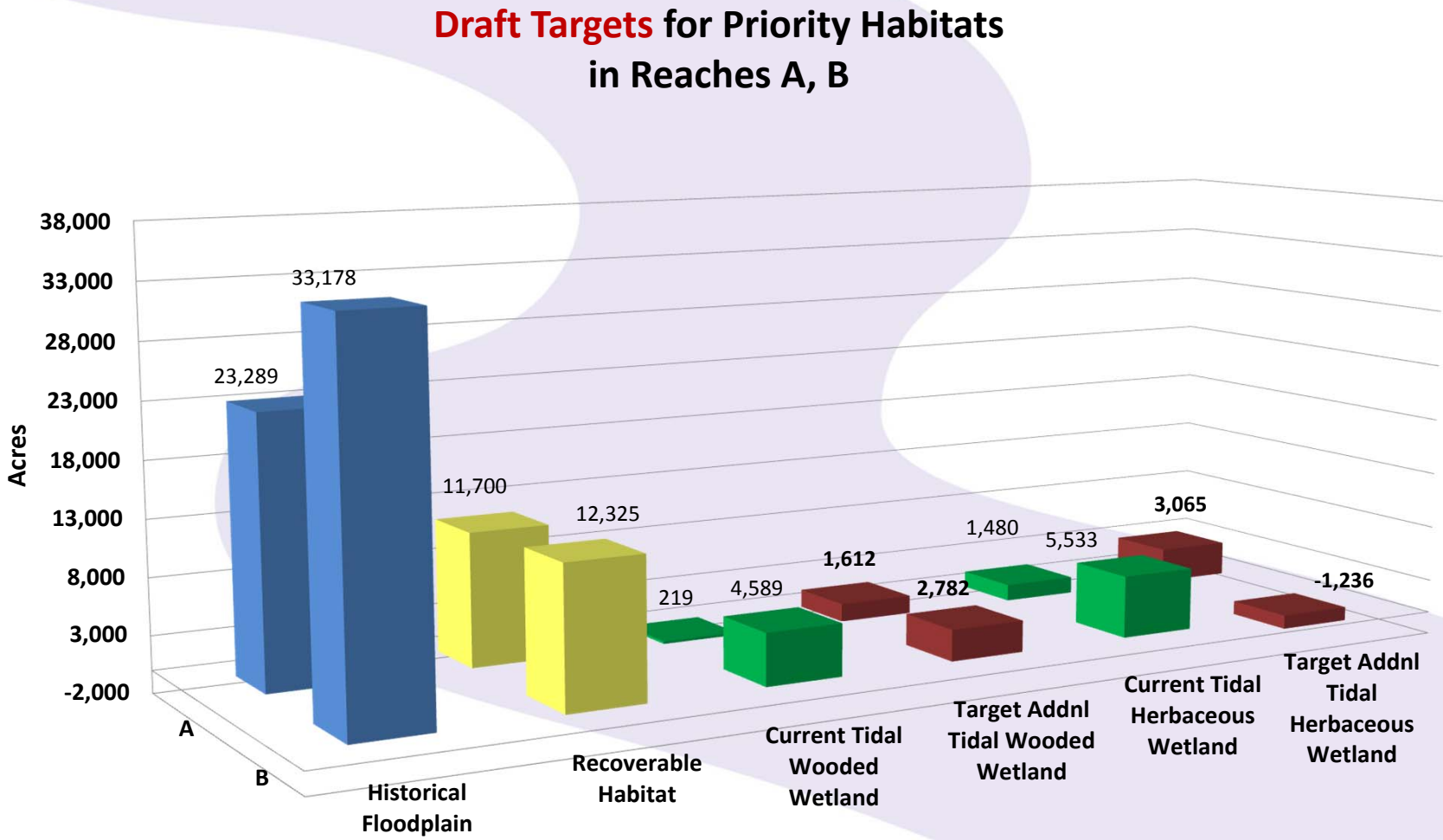


Application of Lines of Evidence 1 – Priority Habitats for Recovering Habitat Diversity

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

2) Define Quantifiable Targets

a. Natural Habitat Diversity, Historic Habitat Mosaic



➢Need to integrate sea level rise and wetland migration inland

2) Define Quantifiable Targets

– Targets for Identified Attributes:

b. Focal Species:

- **Pacific salmon -**
  - **Juvenile Pacific 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
  - **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
- **Columbia White-tailed deer habitat (USFWS) (*underway*)**
- **Pacific Flyway Habitats (PCJV, USFWS) (*planned*)**

c. Water Quality:

- **Priority Toxic Contaminant Clean up sites (Yakama Nation) (*underway*)**

– Sea level rise and climate change (*planned*)

– ***See Estuary Partnership 2012 for details*** http://www.estuarypartnership.org/habitat-restoration-strategy

b. Focal Species Attribute

Focal Species

- Chinook, chum steelhead, coho
- Pacific lamprey
- Green and white sturgeon
- Bald eagle
- Columbia White-tailed deer

Ecologically Significant

- N. Pikeminnow
- Shad
- Eluachon
- Caspian tern
- Osprey
- Yellow warbler
- Red-eyed vireo
- Dusky Canada goose
- Sandhill crane
- River otter

***Focal Species and Other Indicator Species Identified through NPCC Sub-basin Plan (2004)**

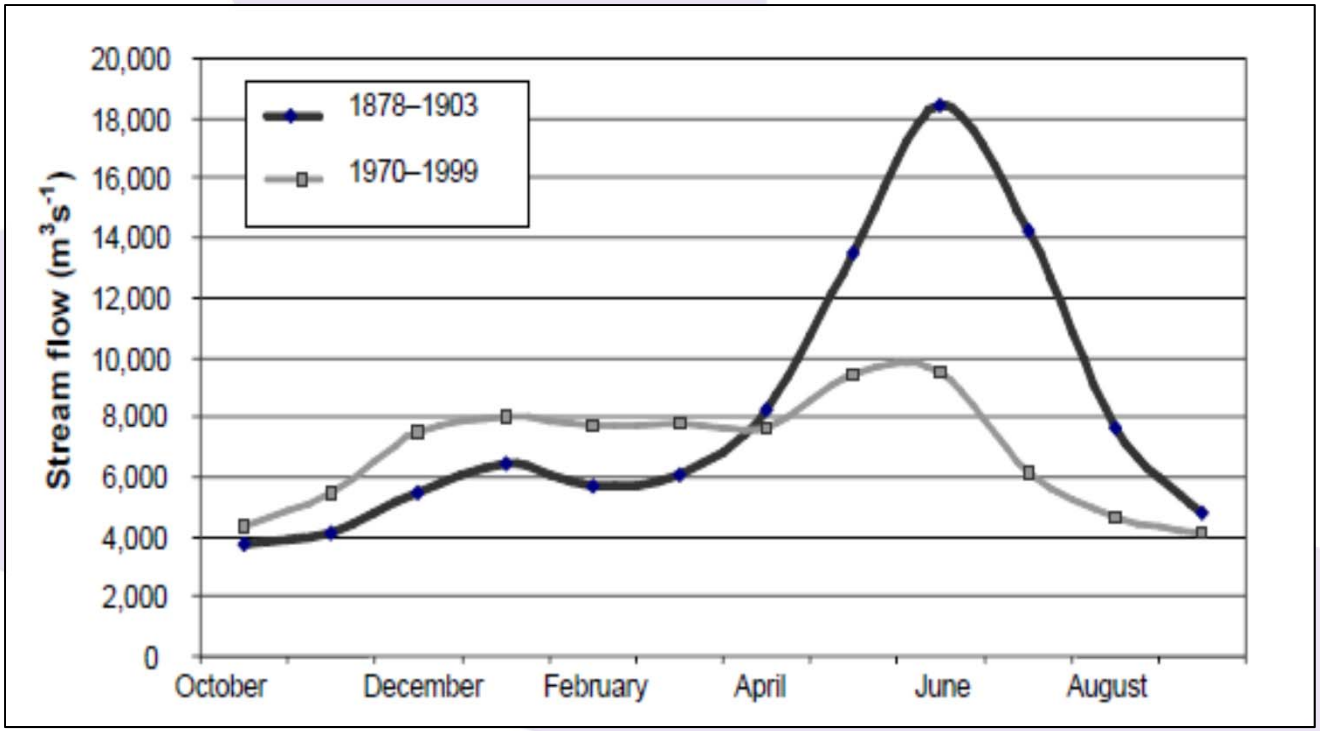
d. Ecosystem Processes Attribute

- **Natural Hydrologic Processes and Sediment Dynamics**
  - Timing, magnitude, duration, frequency, rate of change
  - Recurrent, frequent flooding of floodplain, including freshet
  - Sufficient bed material transport to facilitate bar formation and channel migration; dynamic channel migration, wider mouth, more sediment transport to the nearshore ocean
  - Sufficient suspended material transport to enable widespread floodplain deposition
  - Sufficient material transport of large woody debris and organic matter
  - Connectivity between ecosystem types to mainstem, floodplain; fish opportunity
  - Plume dynamics
  - Natural stream bank processes such as erosion
- **Food web and trophic processes**
  - Local production of macrodetritus, transported by flows/connectivity to mainstem; vascular plants/macrodetritus – based food web
  - Natural trophic cascades
  - Natural habitat capacity
  - Natural water properties such as nutrients, pH, DO, chlorophyll, turbidity
  - Little invasive species impact on food web
  - Natural inter and intra competition and predation amongst species
- **Habitats and habitat forming processes**
  - Natural habitat distribution and abundance - balance
  - Habitat diversity -- high diversity, presumably
  - Wetland marshes, swamps, etc. -- see historical condition in Keith's maps
  - Shallow water sloughs and channels -- high productivity, cold water refugia.
  - LWD trapping sediment, seeding, nurselogs
  - Beaver dams/ponds – prevalent
  - Natural barriers
  - Natural stream bank processes such as erosion
  - Abundance of riparian for nearshore cooling

d. Ecosystem Processes Attribute

- **Natural Hydrologic Processes and Sediment Dynamics**
- **Natural Food web and trophic processes**
- **Natural Habitats and habitat forming processes**

➢ Natural annual hydrograph, flooding of floodplain habitats is fundamental for natural ecosystem processes



Changes in the annual Columbia River flow at Beaver Army Terminal, 1878–1903 vs. 1970–1999. (from Bottom et al. 2005.)

Steps 1 -2 Summary

We can accomplish the following over the next decade:

√ Vision for the lower Columbia over the long term

√ Ecological attributes of importance for protection

- Natural Habitat Diversity, Historic Habitat Mosaic
- Focal species (e.g., P. salmonids, C. White-tailed deer)
- Water Quality
- Ecosystem Processes (e.g., more normative flows, floodplain inundation, sediment transport)

➢ Specific quantifiable and spatially explicit targets for attributes

3) Implement Actions

Approach:

1. **Restoration Prioritization Strategy**–compiles quantifiable targets and priority geographic areas for restoration and protection
2. **Technical assistance program** supports partners' capacity in implementing plan
3. **Rigorous scientific review process** ensures technically sound restoration and protection actions are implemented

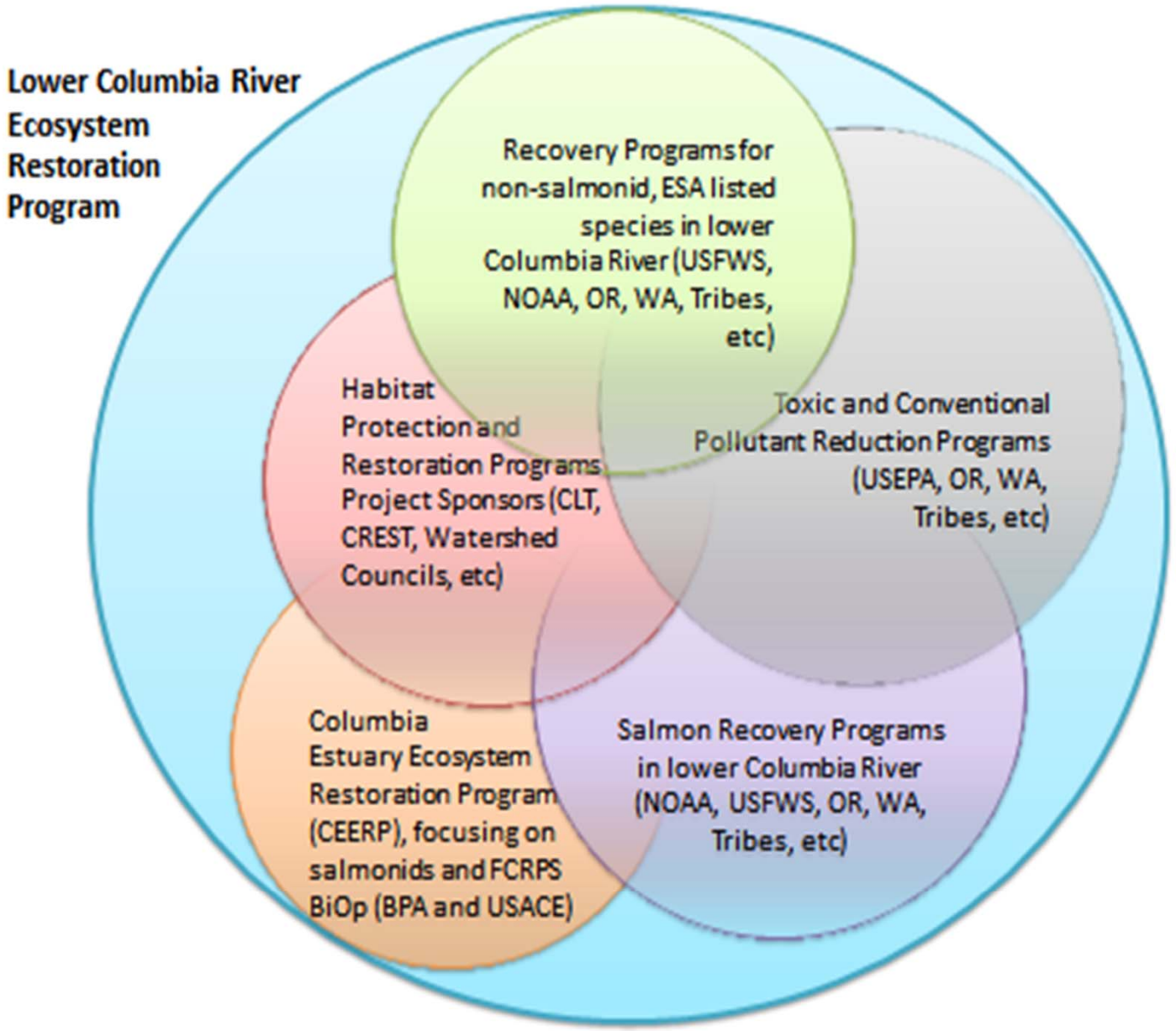


Illustration of the major programs and partners in the Lower Columbia River Ecosystem Restoration Program (from Estuary Partnership 2012)

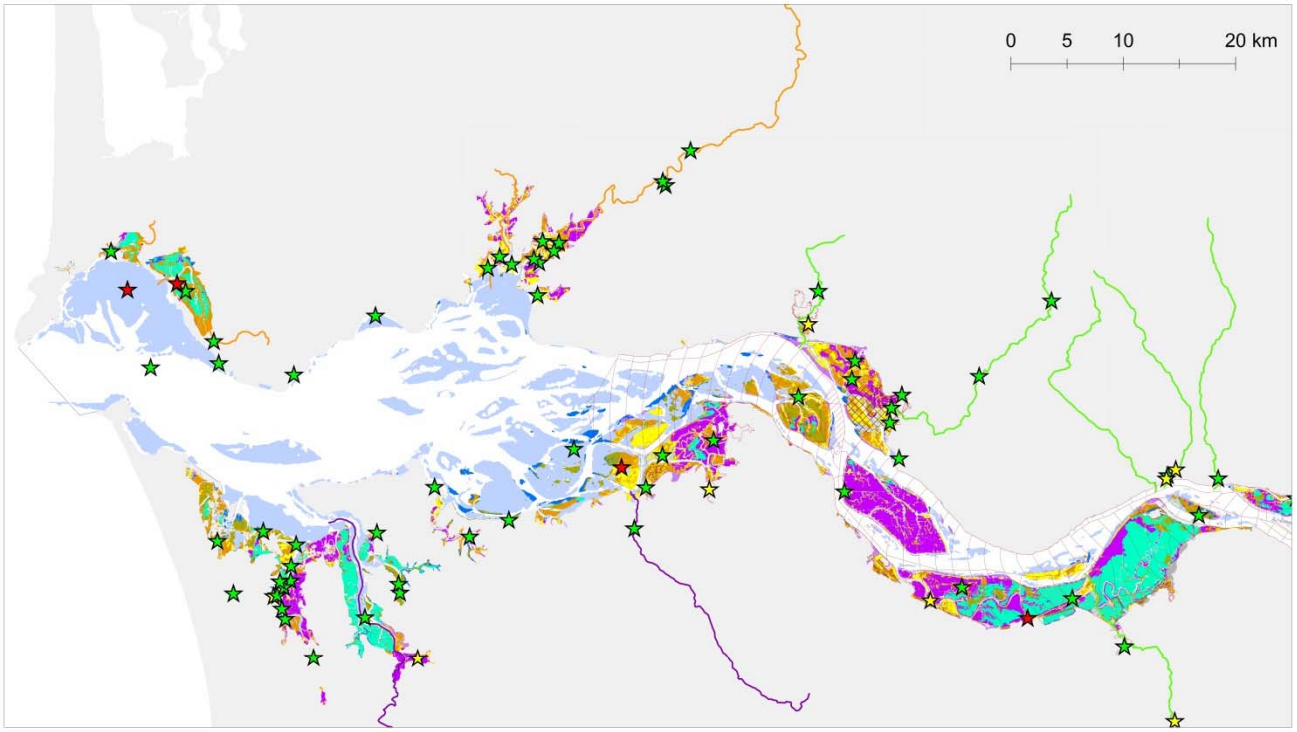
4) Measure Progress, Identify Gaps

Restoration Inventory Geodatabase:

Track restoration and protection actions, allows us to track and report progress and identify gaps

Salmon-focused actions overlaid on results of Restoration Prioritization Strategy

Restoration Strategy Lines of Evidence (LOE) GIS Layers, Shown With Current Inventory of Fish Targeted Restoration Projects (completed and in-progress)



4) Measure Progress, Identify Gaps

a) ecosystem monitoring

- Answers fundamental questions about spatial and temporal variability of habitats in lower river and their importance in juvenile salmon life histories
- Provides end points or reference conditions for restoration actions, comparison with action effectiveness data
- Status and trends of ecosystem condition
- Provides context for other research and monitoring efforts in estuary
- Assesses habitat opportunity, capacity and realized function for juvenile salmonids

b) action effectiveness monitoring

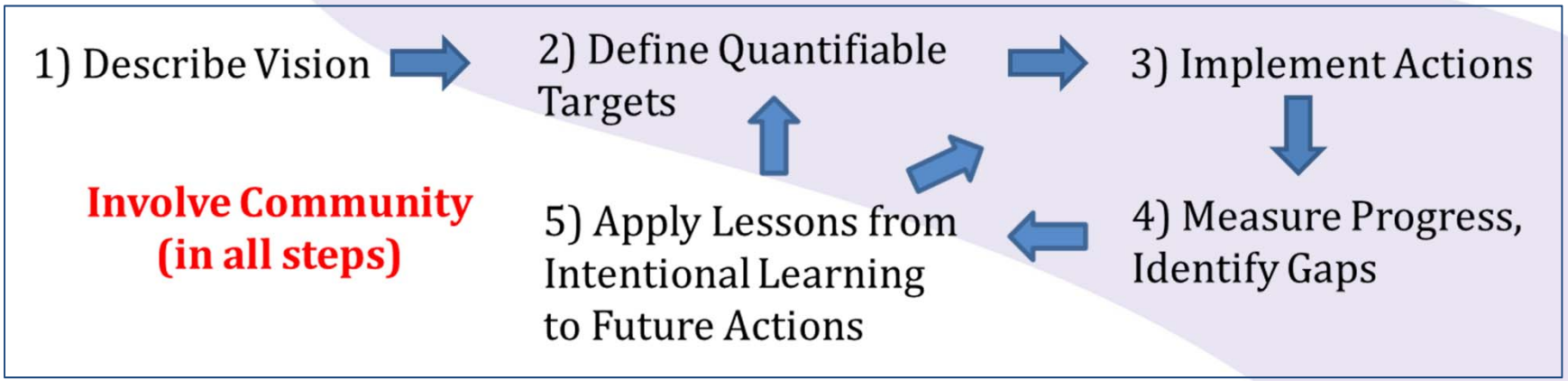
- Assess efficacy of restoration actions in lower river
- Designed for evaluating individual sites vs reference and/or control sites
- Data collection using standardized methods, allow comparisons across sites and time and roll –up for cumulative impacts evaluation

c) critical uncertainties research (via USACE AFEP projects)

5) Apply Lessons from Intentional Learning to Future Actions

Estuary Partnership Governance Structure:

- Ensures communication across partners
- Ensures coordination amongst partners
- Allows integration of lessons learned, emerging science findings in future actions



Considerations

Climate change impacts:

- **Sea level rise**

- **Changing precipitation patterns** –
  - More precipitation falling as rain, lower snow packs in mountains
  - Higher winter flows, lower summer flows
  - Increased frequency, duration, magnitude of floodplain inundation
  - Altered timing and rates of change in flow events
  - More intense storms, increased wave energy, increased erosion

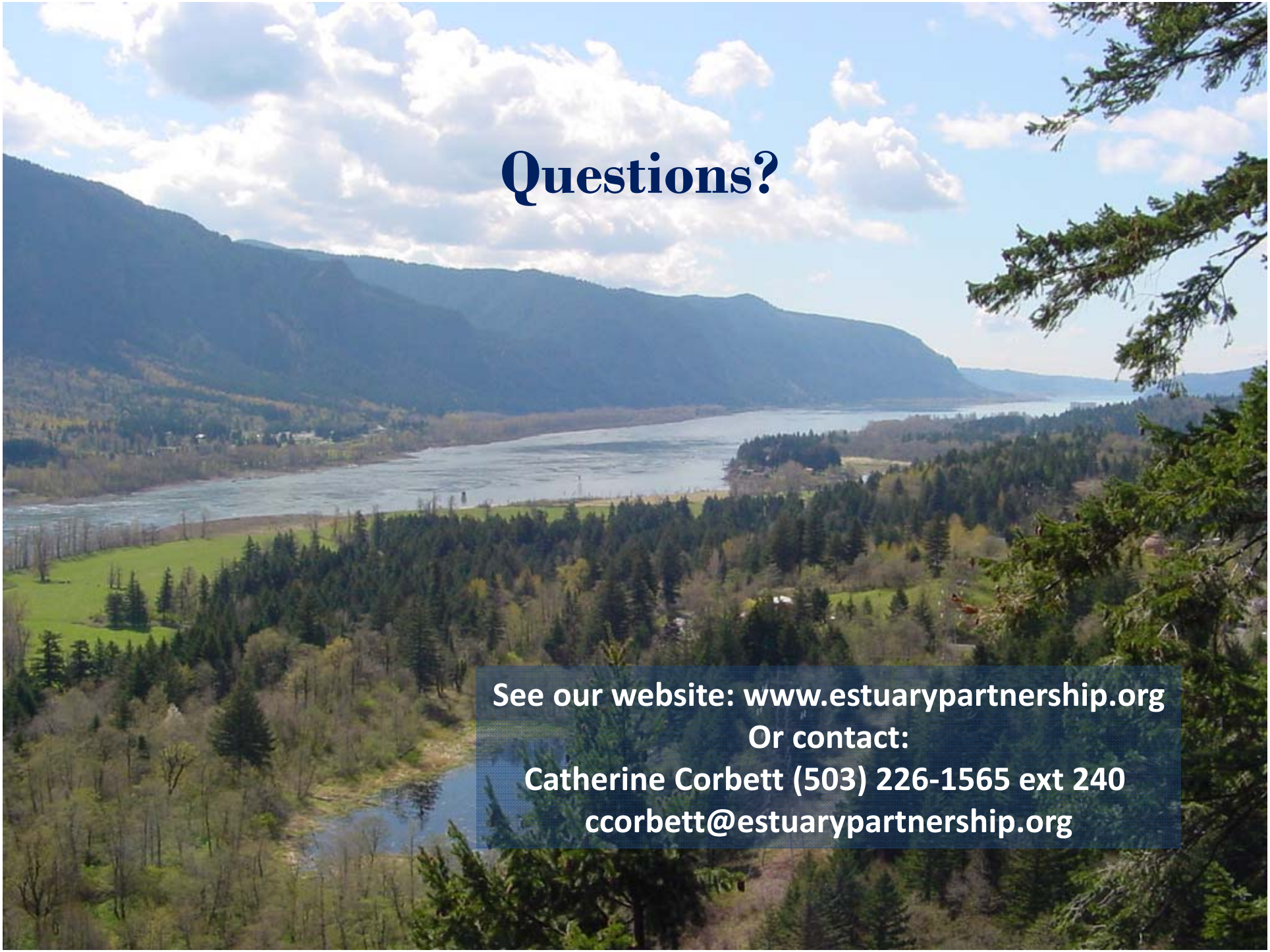
- **Changes in upwelling patterns** off coast -
  - Increased potential intrusion into estuary of hypoxia and acidification

- **Warmer water temperatures**–
  - Less habitat for cold water species

Considerations

Mitigating for Climate Change:

- To maintain floodplain wetlands extent, will need to **allow wetlands to migrate inland**
- **Strategic levee and dike modification** to allow inland migration and floodplain inundation by involving communities early
- Support **aquatic species ability to adapt** to changes in annual hydrograph?
  - Diversity of life history strategies important for resiliency of salmon species
  - Will timing of juvenile salmon migration alter to avoid warmer summer water temperatures?
    - *How will this affect adult returns?*
  - Provide sufficient cold water refugia in tributaries to aid adult returns in summer?


Questions?
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