Columbia Estuary Ecosystem Restoration Program (CEERP) in Oregon and Washington states

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Where, Why, & What, is CEERP?

- Objectives
  - **Improve habitat for migrating juvenile salmonids**
  - **Increase the opportunity for access by aquatic organisms to, and for export of materials from, shallow-water habitats**
  - **Increase the capacity and quality of estuarine and tidal-fluvial ecosystems**
  - **Improve ecosystem realized functions**

- Original and Primary Strategy
  Floodplain reconnections close to the mainstem

Kandoll Farm – Columbia Land Trust

Who supports CEERP?

crest
COLUMBIA RIVER ESTUARY STUDY TASKFORCE

COWLITZ INDIAN TRIBE

Columbia Land Trust
CONSERVING THE NATURE YOU LOVE

Lower Columbia Estuary Partnership

Pacific Northwest
NATIONAL LABORATORY

Washington Department of FISH and WILDLIFE

W2R
WOLF WATER RESOURCES

Who, cont'd:
CEERP's Expert Regional Technical Group (ERTG)

Senior scientists with estuary expertise (ODFW, WDFW, NOAA, USFWS, PNNL, CLT)

- Evaluate and assign benefits to restoration projects
- Articulate, document, and publish scoring criteria
- Define and prioritize scientific uncertainties
- Produce focused work products (Landscape Principles, Site Revisits)
- Regular interaction with restoration practitioners and program managers

ELSEVIER

Journal of Environmental Management
Volume 188, 1 March 2017, Pages 337-350

Research article

An expert panel process to evaluate habitat restoration actions in the Columbia River estuary

Kirk L. Krueger [a], Daniel L. Bottom [b], W. Gregory Hood [c], Gary E. Johnson [d], Kim K. Jones [e], Ronald M. Thom [f]

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https://doi.org/10.1016/j.jenvman.2016.11.028

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The adaptive management framework of CEERP

Littles et al. 2022

Restoration Ecology
THE JOURNAL OF THE SOCIETY FOR ECOLOGICAL RESTORATION

RESEARCH ARTICLE

Published in 2017

Estuary ecosystem restoration: implementing and institutionalizing adaptive management

Blaine D. Ebberts[1,2], Ben D. Zelinsky[3], Jason P. Karnezis[3], Cynthia A. Studebaker[1], Siena Lopez-Johnston[3], Anne M. Creason[3], Lynne Krasnow[4], Gary E. Johnson[5,6], Ronald M. Thom[7]

RESTORATION ECOLOGY
The Journal of the Society for Ecological Restoration

Published in 2022

UN DECADE ON ECOSYSTEM RESTORATION

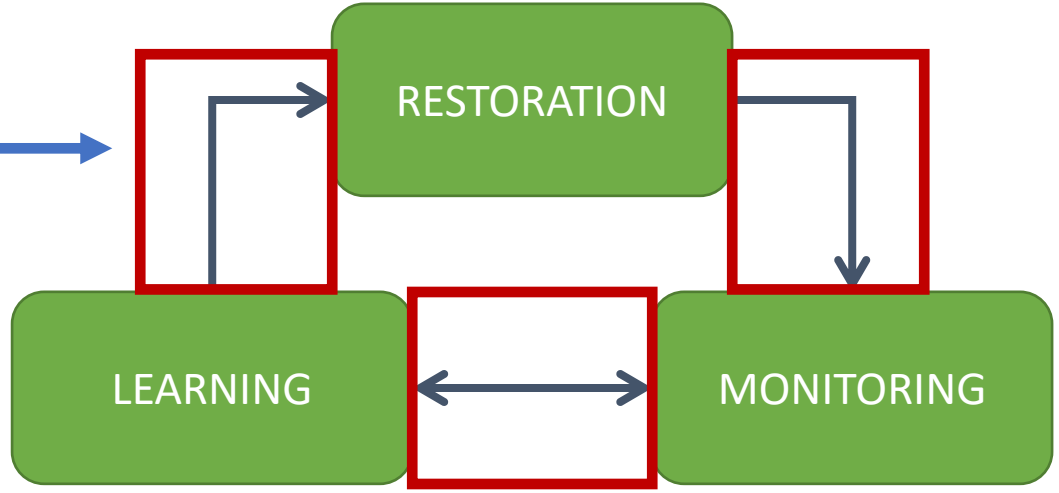
TECHNICAL ARTICLE

Adaptive management of large-scale ecosystem restoration: increasing certainty of habitat outcomes in the Columbia River Estuary, U.S.A.

Chanda Littles[1,2], Jason Karnezis[3], Katie Blauvelt[4], Anne Creason[3], Heida Diefenderfer[5], Gary Johnson[6], Lynne Krasnow[7], Phil Trask[4]

How do we CEERP?

Annual cycle



Key Principles for CEERP's continued evolution

1. Frequently engage partners on Restoration and Monitoring priorities
2. Seek lessons learned, especially failures
3. Foster collaborative, iterative approaches to complex challenges
4. Provide and attend multiple forums to exchange ideas
5. Document everything – encourage primary publications, capture institutional knowledge
6. Make it better, every year

cbfish.org - Columbia Basin Fish & Wildlife Program - Estuary Program

CEERP is now entering its third decade of restoration and monitoring efforts

- 80 +projects completed
- 11,100 + acres of reconnected tidally influenced floodplain habitats

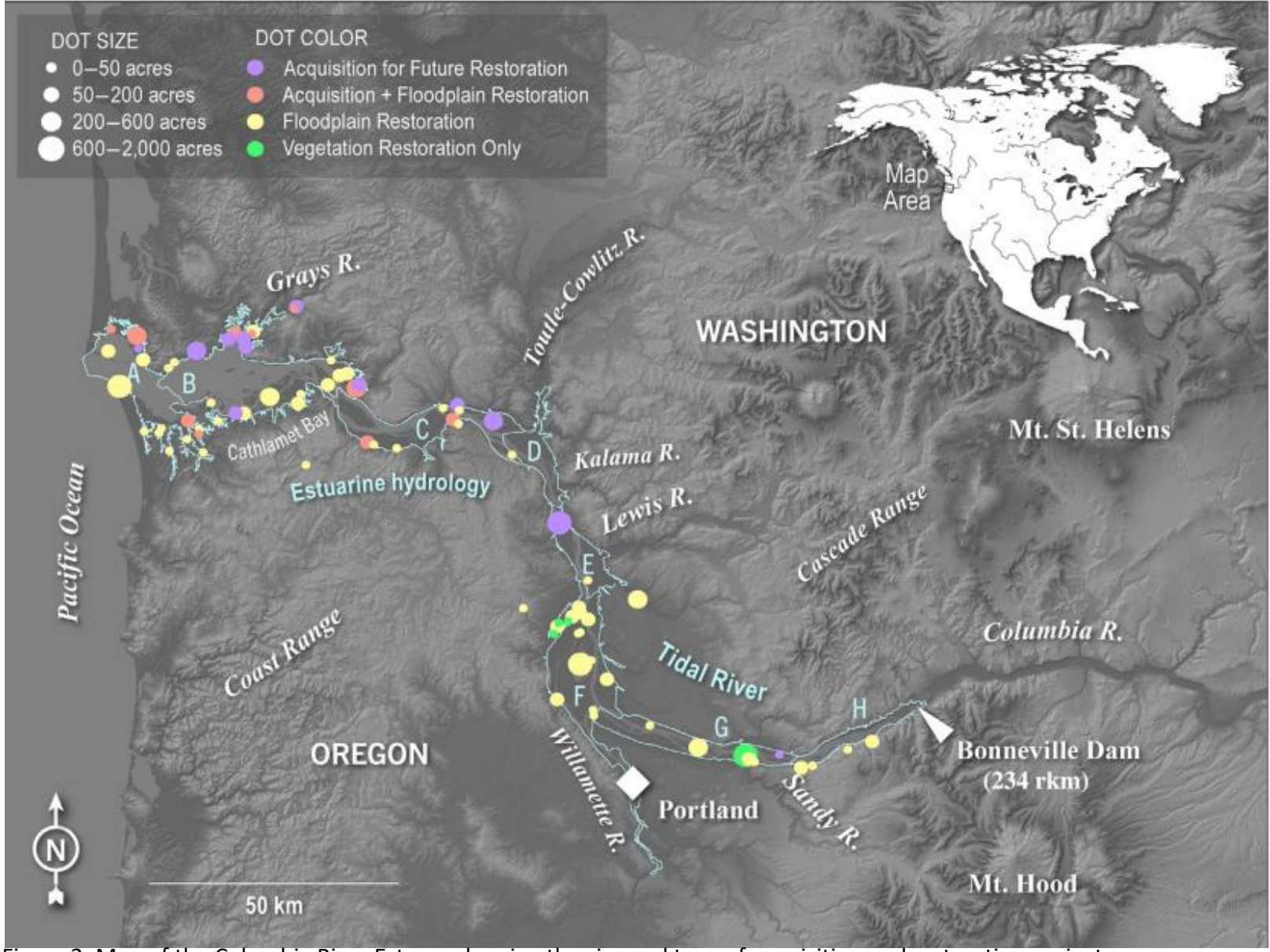


Figure 2. Map of the Columbia River Estuary showing the size and type of acquisition and restoration projects implemented by CEERP, 2000–2020. Hydrogeomorphic reaches (Simenstad et al. 2011) A through H are labeled. "Floodplain Restoration" refers to hydrological restoration (i.e. breach levees or upgrade culverts, etc.) and "Vegetation Restoration Only" refers to invasive vegetation removal, native plantings, and riparian enhancements. One project with acquisition and vegetation restoration only was lumped into the "Acquisition + Floodplain Restoration" category.

CEERP Adaptive Management

Ebberts et al. 2017, https://doi.org/10.1111/rec.12562
Littles et al. 2022, https://doi.org/10.1111/rec.13634

CEERP AM | Restoration | Uncertainties | Pilot Studies | Data Sharing

“Adapting the Program”

Continue advancing tools and strategies to support robust restoration projects *Updates to Site Evaluation Cards, Renewed emphasis on landscape principles when assessing restoration opportunities*

Better leverage the expertise of CEERP practitioners and support strategic collaborations *Work at Steigerwald and other sites often involves numerous sponsors and partner organizations; Corps, BPA, LCEP, and USFWS actively working to restore habitat for multi-species benefits*

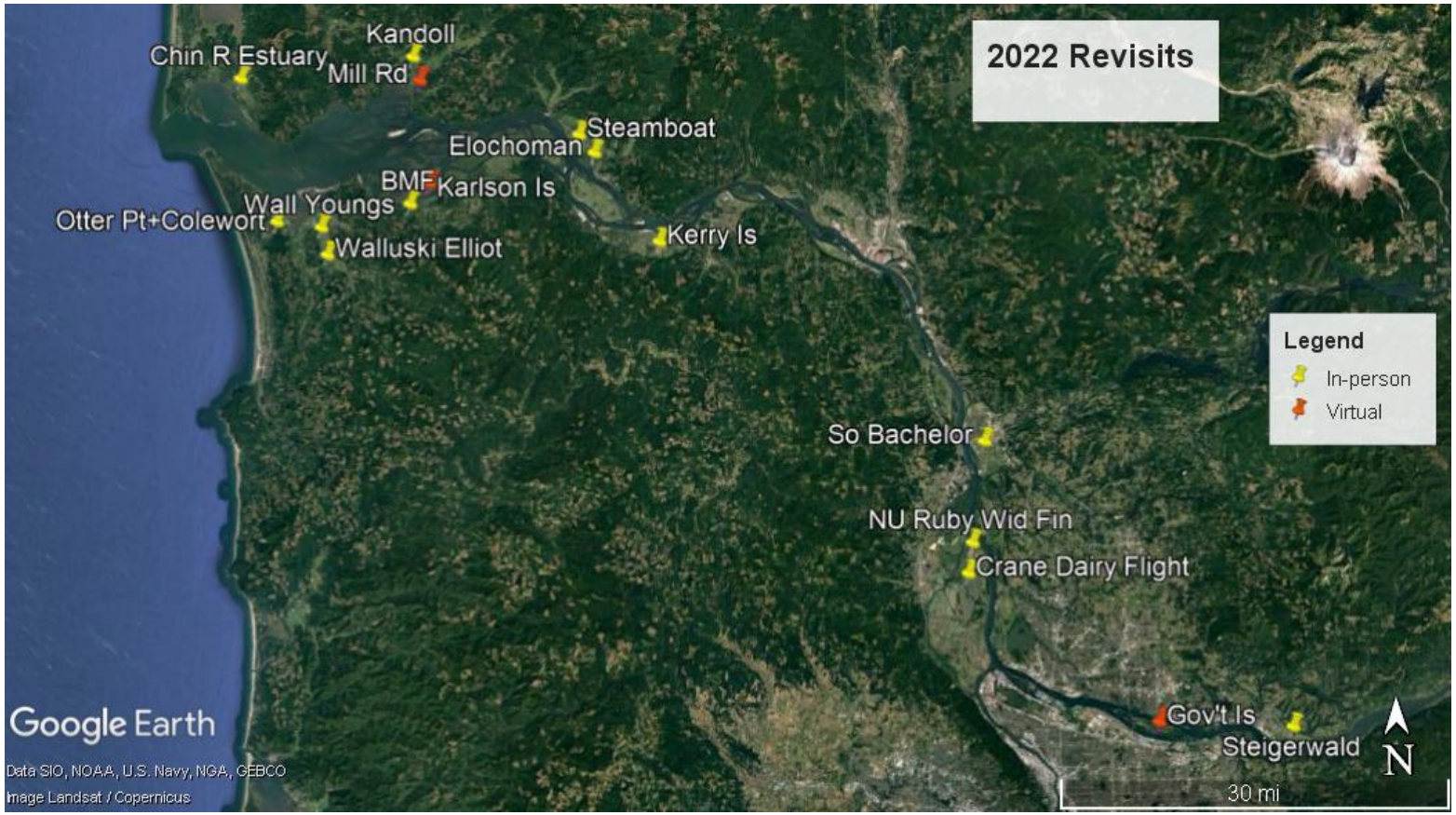
Increase emphasis on climate-smart restoration projects *Incorporate climate adaptation potential into project review*

Improve the system for tracking the flow (and retention) of institutional knowledge *Concerted effort to ensure significant overlap between new ERTG + SC members and those retiring from their roles*

Enhance opportunities for pilot studies that may address emerging uncertainties *Ongoing work to monitor and learn from Woodland Islands and other BUDM, along with potential new pilots*

Steigerwald floodplain reconnection, Photo credit: LCEP

Restoration Project Revisits



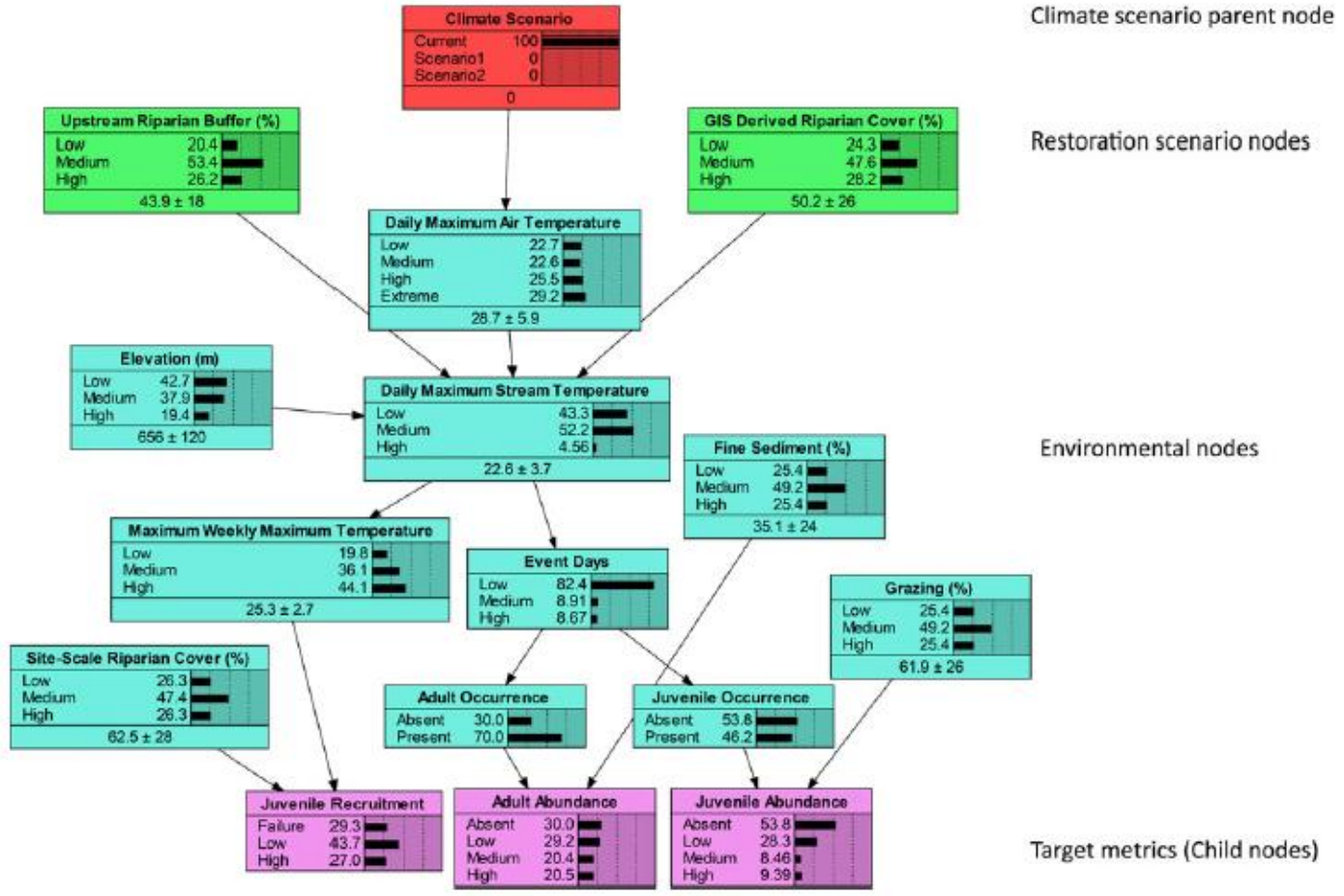
Priority CEERP Uncertainties

- How will climate change affect the LCRE ecosystem and restoration strategy and what actions could be taken to mitigate for adverse effects? *[System]*
- How does reconnecting fragmented estuarine landscapes improve life history variation and adult survival in naturally produced populations? *[Estuary]*
- How do transitional habitats in the designated priority areas (e.g., priority reaches, tributary junctions) compare in importance to other salmonid rearing habitats in the estuary? *[Estuary]*
- How does patch size and travel distance between habitats influence salmon use, access, and performance? *[Landscape]*
- What are the functions of shoreline matrix habitats for juvenile salmon along channel margins of the mainstem river and tributaries and what is the restoration potential? *[Habitat]*

ERTG (Expert Regional Technical Group). 2022. Uncertainties. ERTG #2022-02, prepared for the Bonneville Power Administration, National Marine Fisheries Service, and the U.S. Army Corps of Engineers. Portland, Oregon. Available from https://www.cbfish.org/EstuaryAction.mvc/Documents

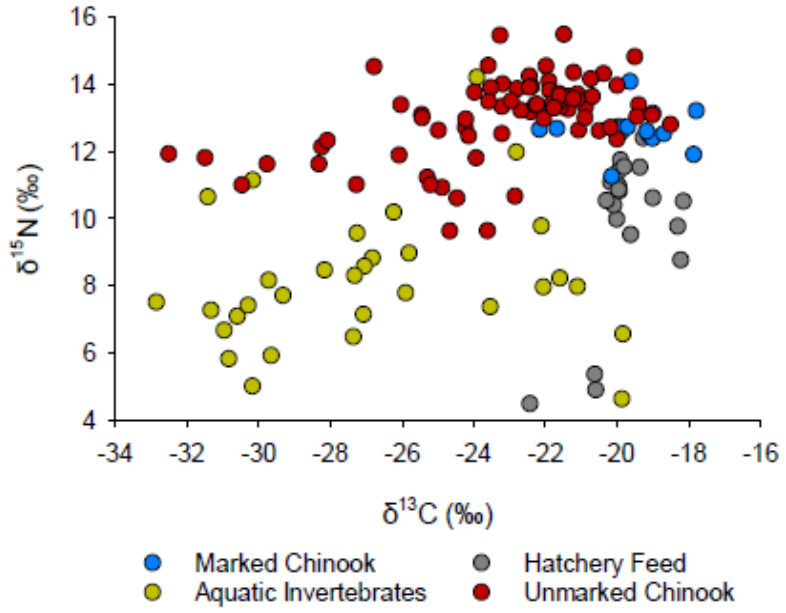
Climate Change

- Apply predictive models to examine ecosystem responses to various climate change scenarios
- Monitor long-term trends in water level, temperature, and sedimentation
- Incorporate climate resiliency into project designs and CEERP restoration strategy



Turschwell et al. 2017, Bayesian belief network (BBN) model to predict how riparian restoration could help mitigate effects from climate warming, https://doi.org/10.1002/aqc.2864

Linking Estuary Habitat to SALMON life history variation and adult survival



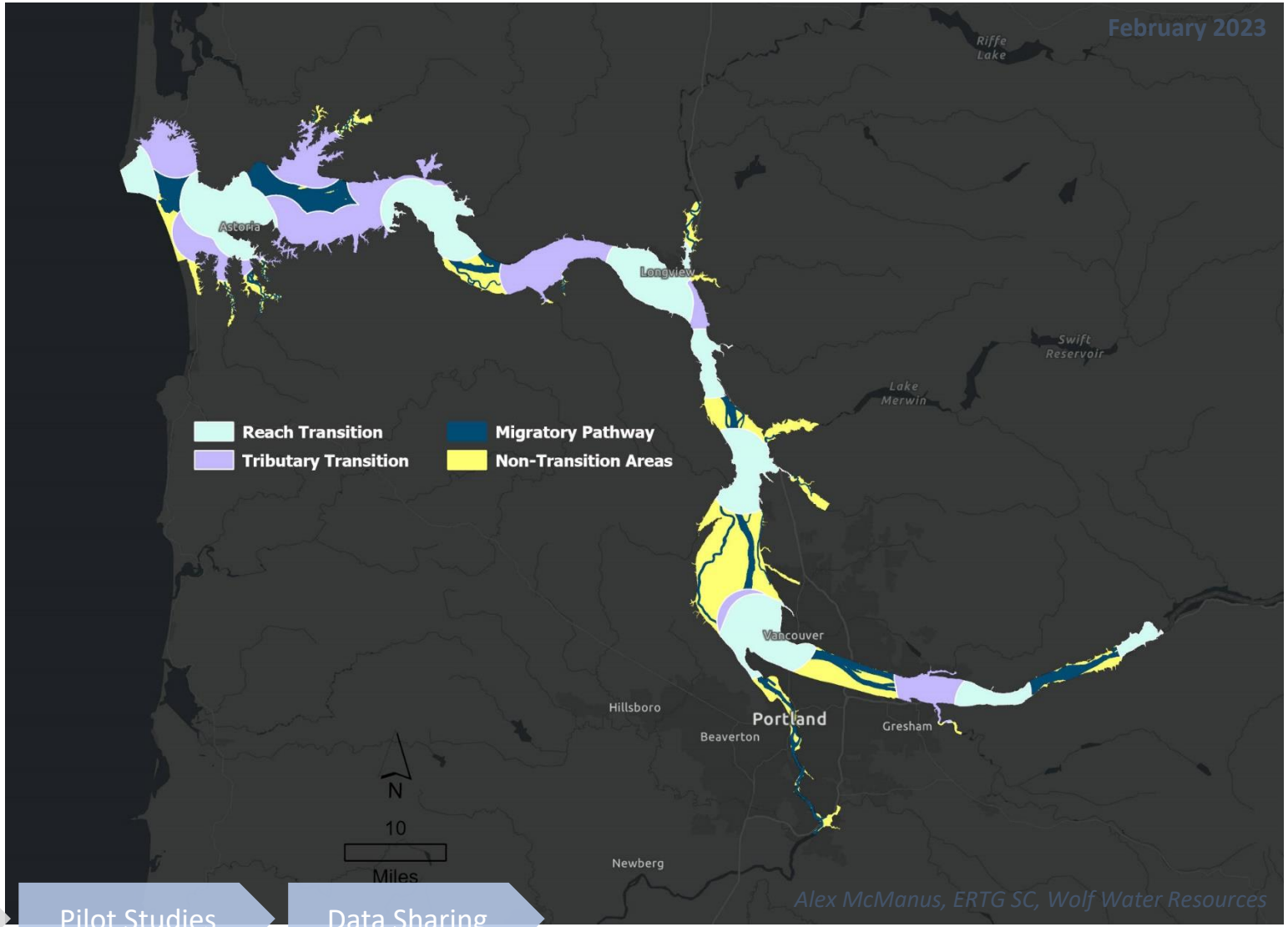
Nitrogen ($\delta^{15}N$) and carbon ($\delta^{13}C$) isotopic values of marked and unmarked chinook in the main and wetland channels from June 2017, wetland invertebrates from April - June 2017 and hatchery feed.

- Objective: use chemical signatures (isotopic markers) in adult otoliths to determine whether prey during juvenile rearing/migration originated in wetlands versus mainstem
- Begin with a workshop series to overview methods, limitations, and suitability for this purpose
- Identify potential chemical indicators and select target populations (e.g., by watershed or ESU) for a future pilot study
- Sampling program across multiple juvenile cohorts, ESUs, and years to identify markers and assess the significance of estuarine rearing habitat to adult returns

Sather er al. 2020. *Differential habitat use by subyearling chinook salmon in the lower Columbia River and estuary*. Chapter 7 in Restoration Action Effectiveness Monitoring and Research in the Lower Columbia River and Estuary, 2016-2017.
Barnett-Johnson et al. 2010, *Genetic and otolith isotopic markers identify salmon populations in the Columbia River at broad and fine geographic scales*, https://doi.org/10.1007/s10641-010-9662-5

Relative Importance of Transitional Habitats for Salmonid Rearing

- Test the hypothesis that salmon habitat use and performance increase near reach transition boundaries and tributary junctions compared to other locations.

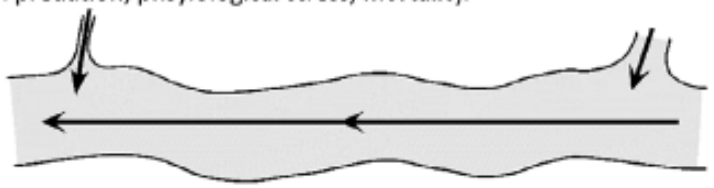


Hood et al. 2021. *Using landscape ecology principles to prioritize habitat restoration projects across the Columbia River Estuary*. Restoration Ecology 30(3): e13519. https://doi.org/10.1111/rec.13519

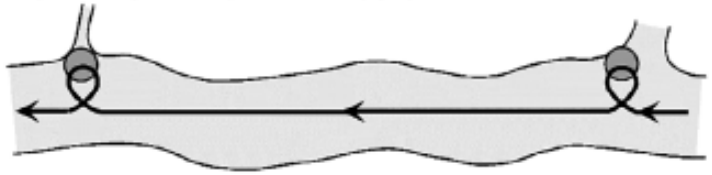
Patch size and travel distance Effects on salmon use, access, and performance

Test the underlying assumption that more patches and shorter distances between available habitat will ultimately improve juvenile salmon use/survival as they migrate through the estuary.

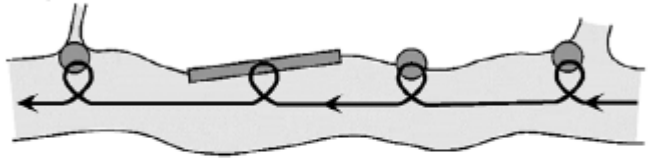
1. Initial condition--no habitat: short residence; low feeding opportunity; high predation, phsyiological stress, mortality.



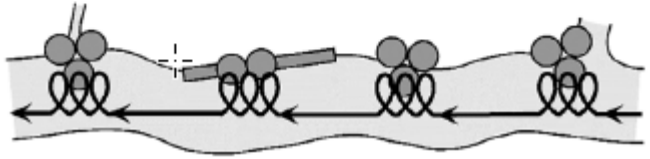
2. Initial priority--restoration at tributary junctions: some habitat; some residence, feeding, refuge; use by multiple stocks; high fish density due to proximity to tributary population sources.



3. Stepping stone corridor: some residence, feeding, refuge in each stepping stone; long residence in system of stepping stones; reduced travel time and mortality risk between stepping stone refuges. Riparian shoreline matrix habitat restoration with comparable overall residence time to a patch can substitute for wetland floodplain stepping-stone habitat patch restoration.



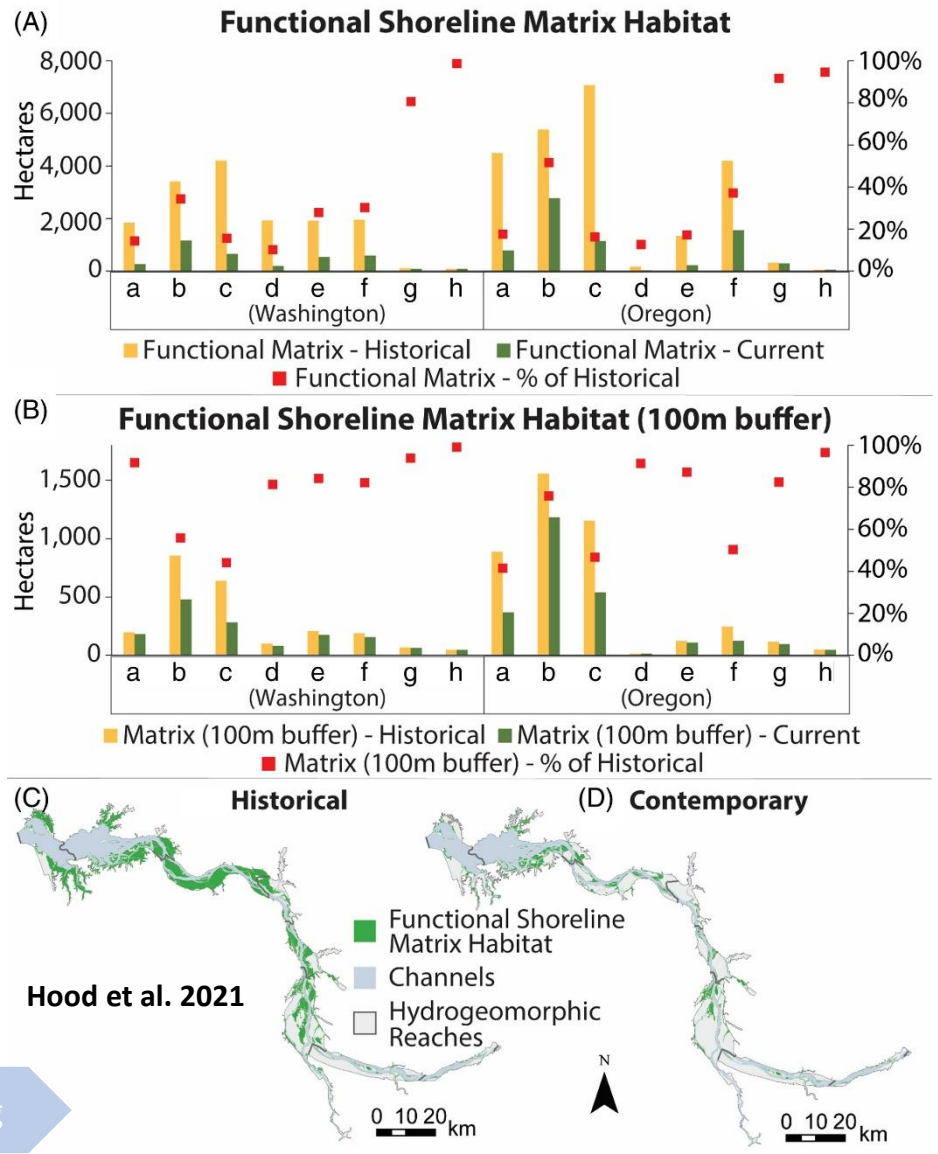
4. Mature system restoration--large, well-connected habitat patches: long residence in large habitat patches, long residence in stepping stone corridor; low stress and mortality within and between large, well-connected habitat patches.



Conceptual model of stepping-stone habitat adapted from Hood et al. 2021.

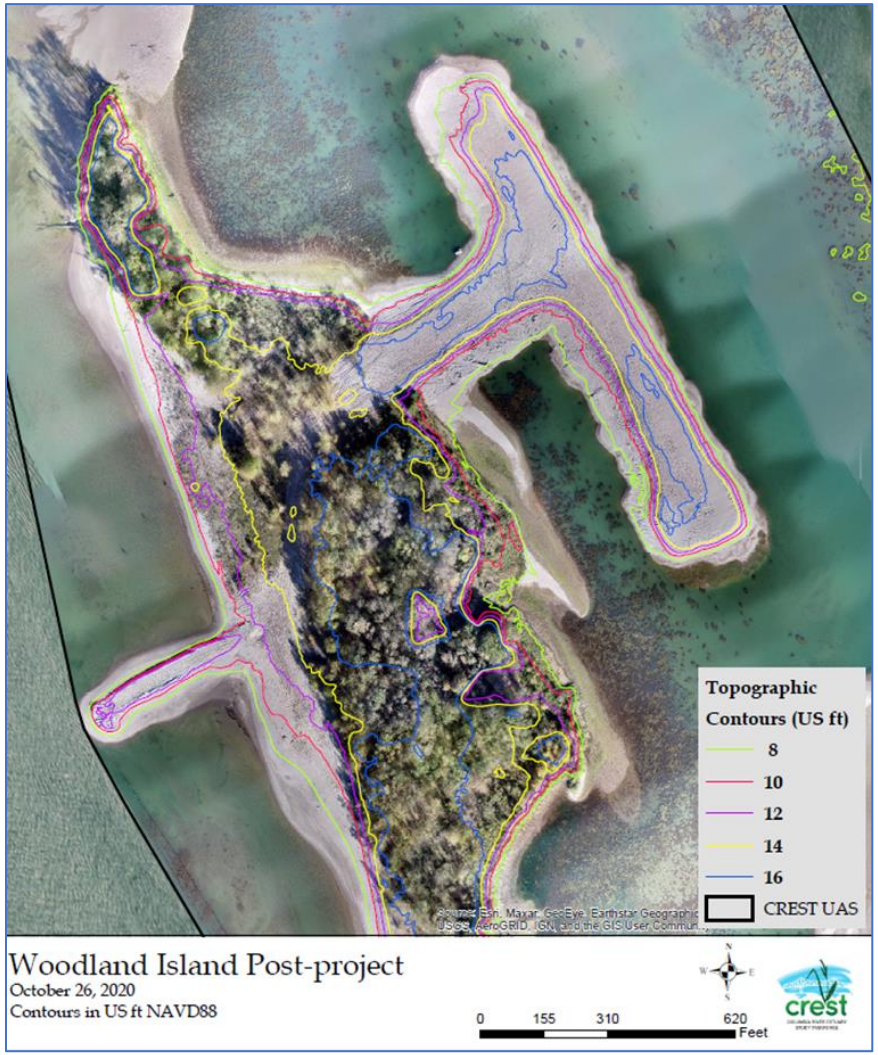
Functions and Restoration Potential of shoreline matrix habitats for juvenile salmon

- Perform a global literature review of matrix (i.e., narrow fringing wetlands and riparian forests, armored or riprapped banks) restoration projects in estuaries
- Restore select matrix sites in the estuary, and design protocols to monitor use by juvenile salmon
- Investigate whether matrix habitat may have a role in providing thermal refugia for out-migrating salmon.



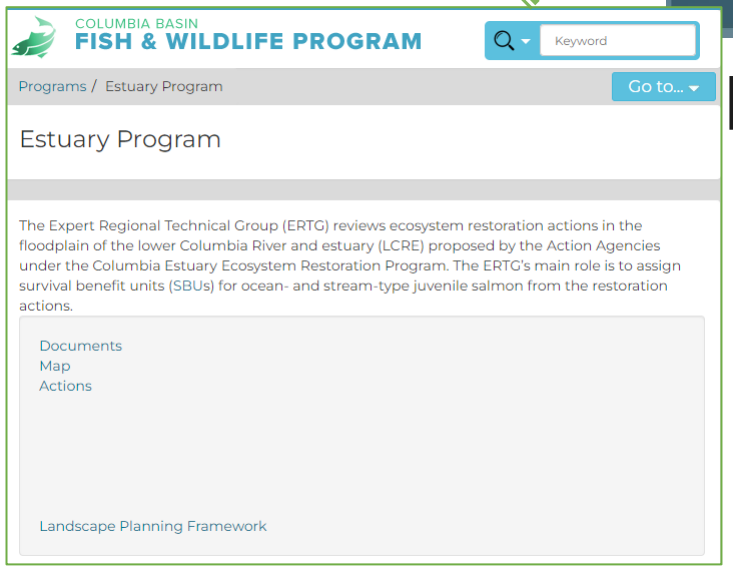
Woodland Islands BUDM Site

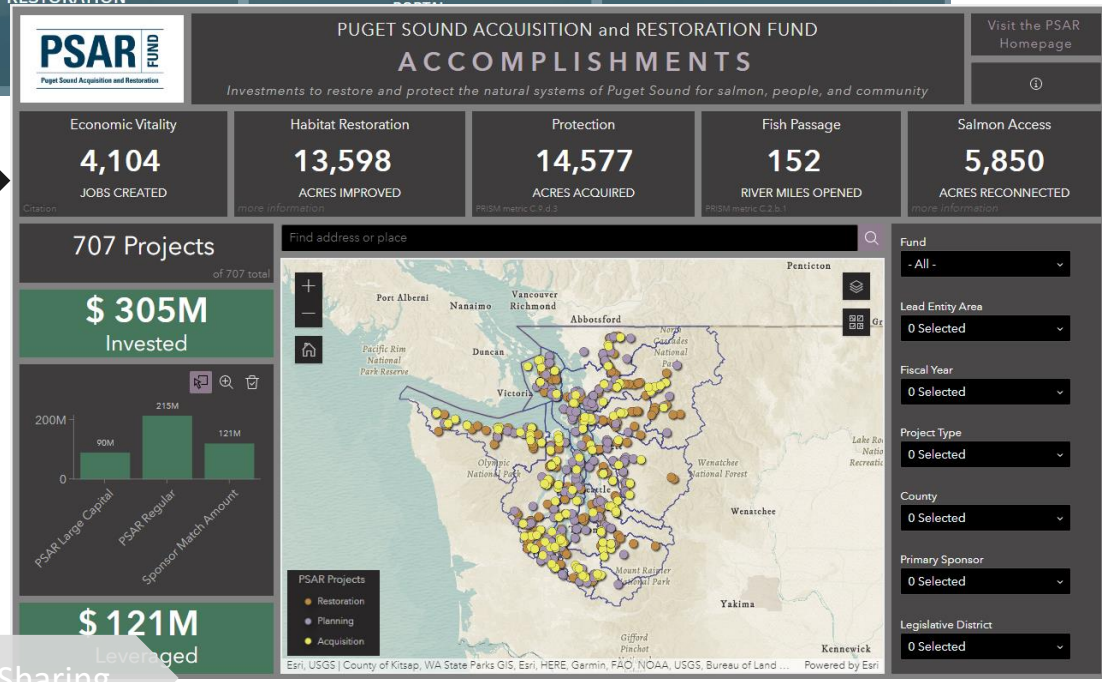
- Benthic monitoring (PNNL)
  - Sediments
  - Macroinvertebrates
  - Hydrographic data (CTD), surface/floor
- Avian monitoring
  - Aerial surveys conducted by Corps' Fish Field Unit
- Topography and bathymetry
  - Fall 2021-2026
- Vegetation
  - CREST planting, winter 2021-22 and winter 2022-23
  - Multispectral analysis 2024-2026
- Fish
  - USGS sampling in spring 2022, 2023, and 2025
  - Environmental parameters, juveniles, predators, prey, genetics



CEERP Data Sharing and Transparency

- Initiating the development of an informational website to highlight CEERP's adaptive management, conceptual foundation, progress towards meeting restoration goals, new learning, monitoring results, and project details provided by Sponsors
- Goal to improve upon the current website that serves more as a repository for CEERP sponsored papers, and other work products.
- Looking to other estuary programs (Puget Sound) as an example for how to structure information to increase transparency and accessibility.





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