May 1st, 10:30 AM - 12:00 PM

Progressing from multidisciplinary to interdisciplinary restoration science: monitoring and applied studies on the Nisqually River Delta

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Speaker

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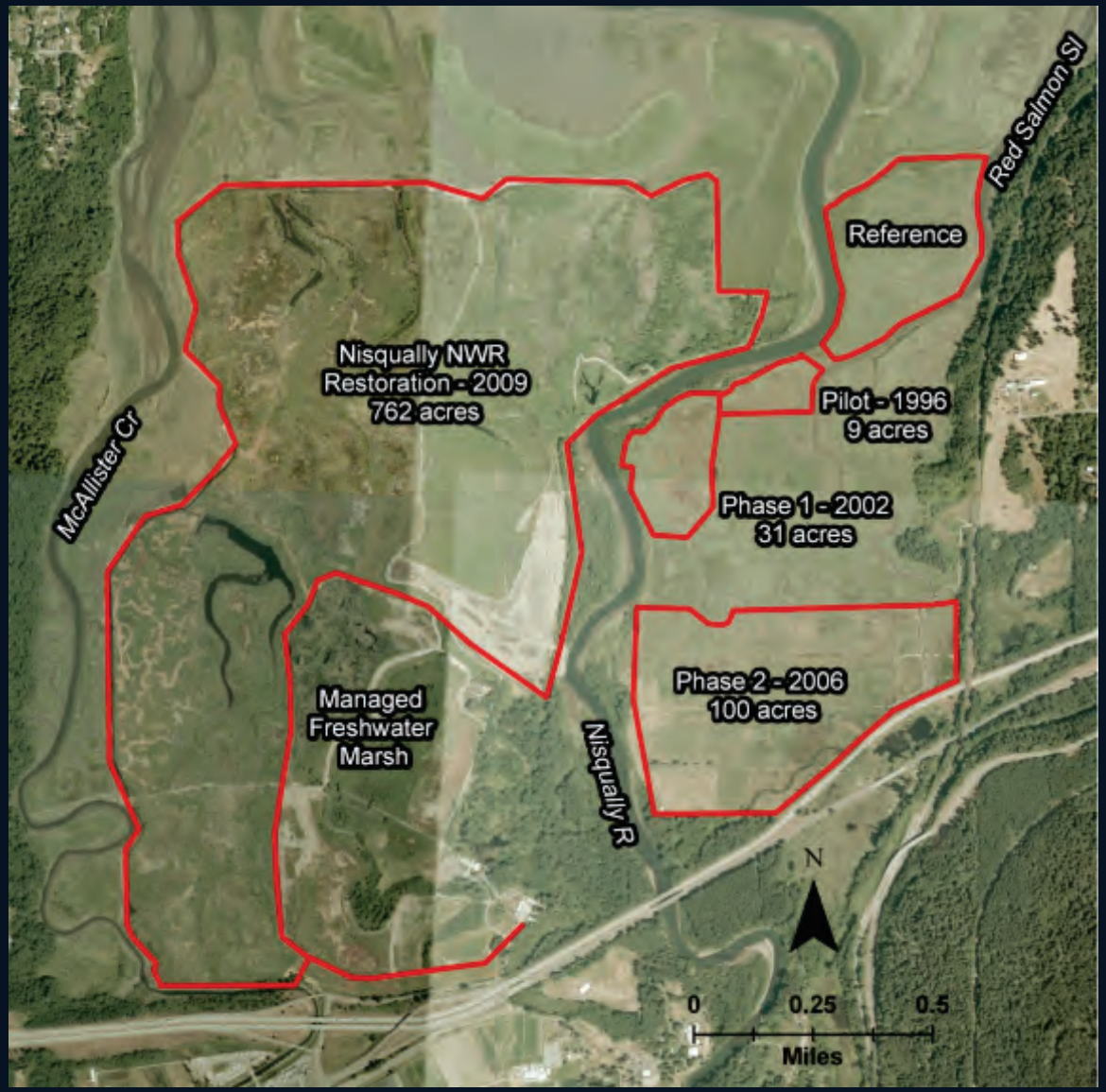
USGS Western Ecological Research Center, Nisqually Indian Tribe, Nisqually National Wildlife Refuge, USGS Western Fisheries Research Center, University of Washington, USGS Pacific Coastal and Marine Science Center, USGS Washington Water Science Center, Nisqually River Foundation, Evergreen State College, USGS Menlo Park Center, San Francisco State University

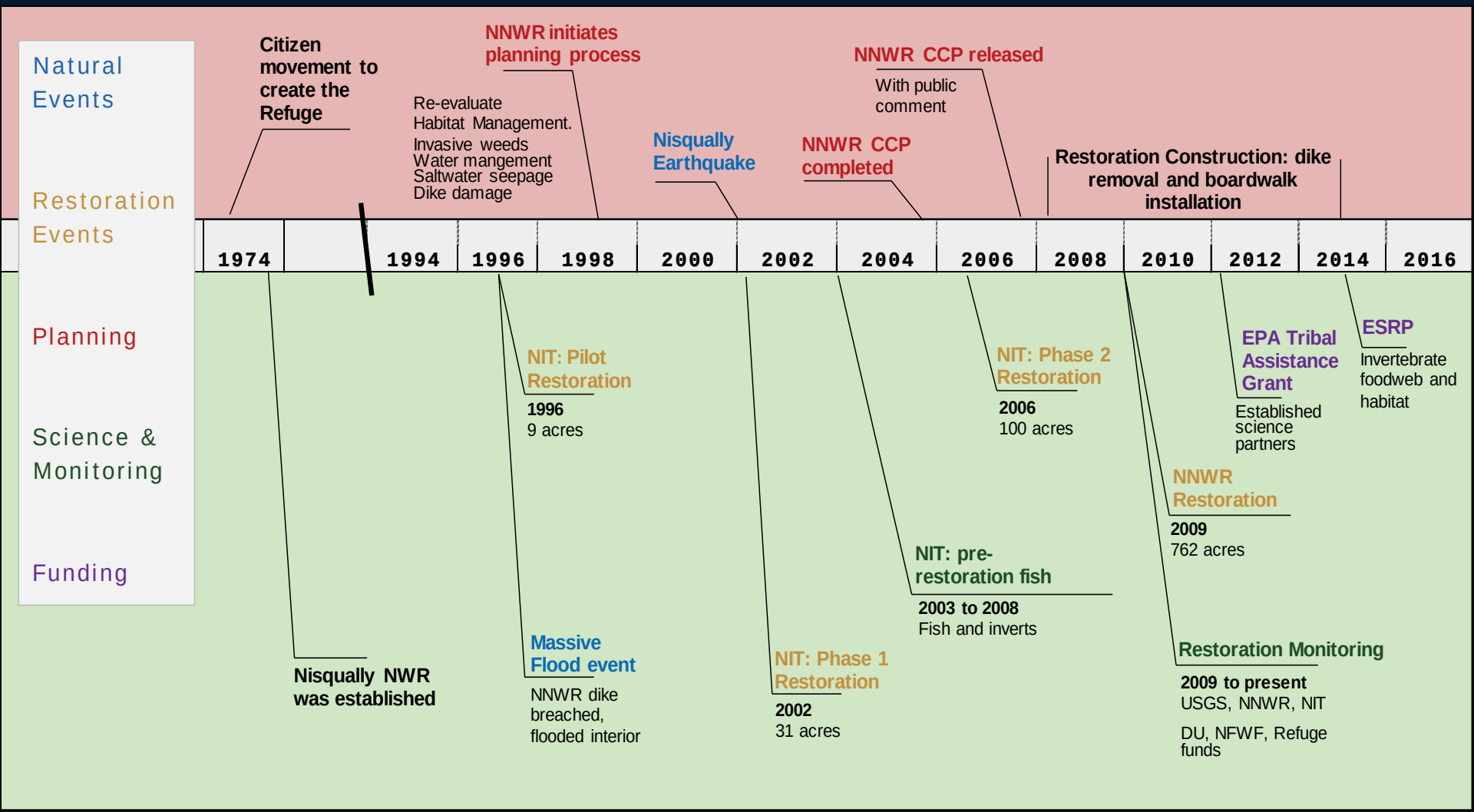
Nisqually Delta Restoration

Nisqually Indian Tribe and National Wildlife Refuge since 2009 are restoring > 360 ha of estuarine habitats on the Nisqually Delta to comprise one of the largest tidal wetland restorations in the Pacific Northwest



Nisqually Delta Restoration

Restoration and Monitoring Timeline



Monitoring and Applied Studies Objectives

1. Determine effects of restoration through measurements of changing conditions

2. Optimize insights while minimizing sampling effort

3. Assess linkages between habitat structure and fish and wildlife use by incorporating applied studies

4. Promote information sharing and outreach

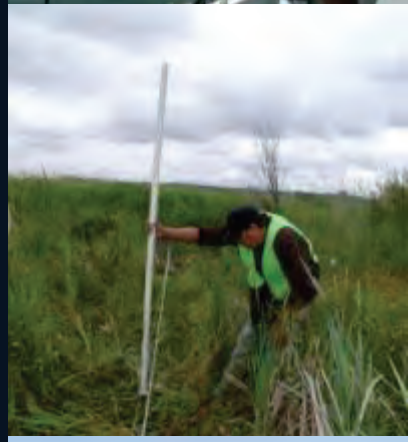
Why monitor?

Monitoring has been described as the financial equivalent of accounting, and is critical for project evaluation (Lee 1993)

Monitoring provides information:

- *on restoration progress*
- *on the effectiveness of restoration actions*
- *as a measure of accountability*
- *for land managers to help make decisions*

Monitoring not only provides the basis for formulation of science-based environmental policy, but continued monitoring also permits evaluation of whether the policy has had its intended effect and has been cost-effective. (Lovett et al 2007)



Monitoring by phase

Pre-restoration (1-5 yrs):
- Compile historic datasets
- Collect baseline for designs, before-after studies

Construction:
- Regulatory compliance
- Adaptive monitoring

Early post-restoration (3-5 yrs):
- Monitoring focus – frequent, widespread, unique
- High public interest, adaptation period

Post-restoration (5yrs - mature):
- Applied studies focus – less frequent, fewer sites
- Assessment of goals

USGS
science for a changing world

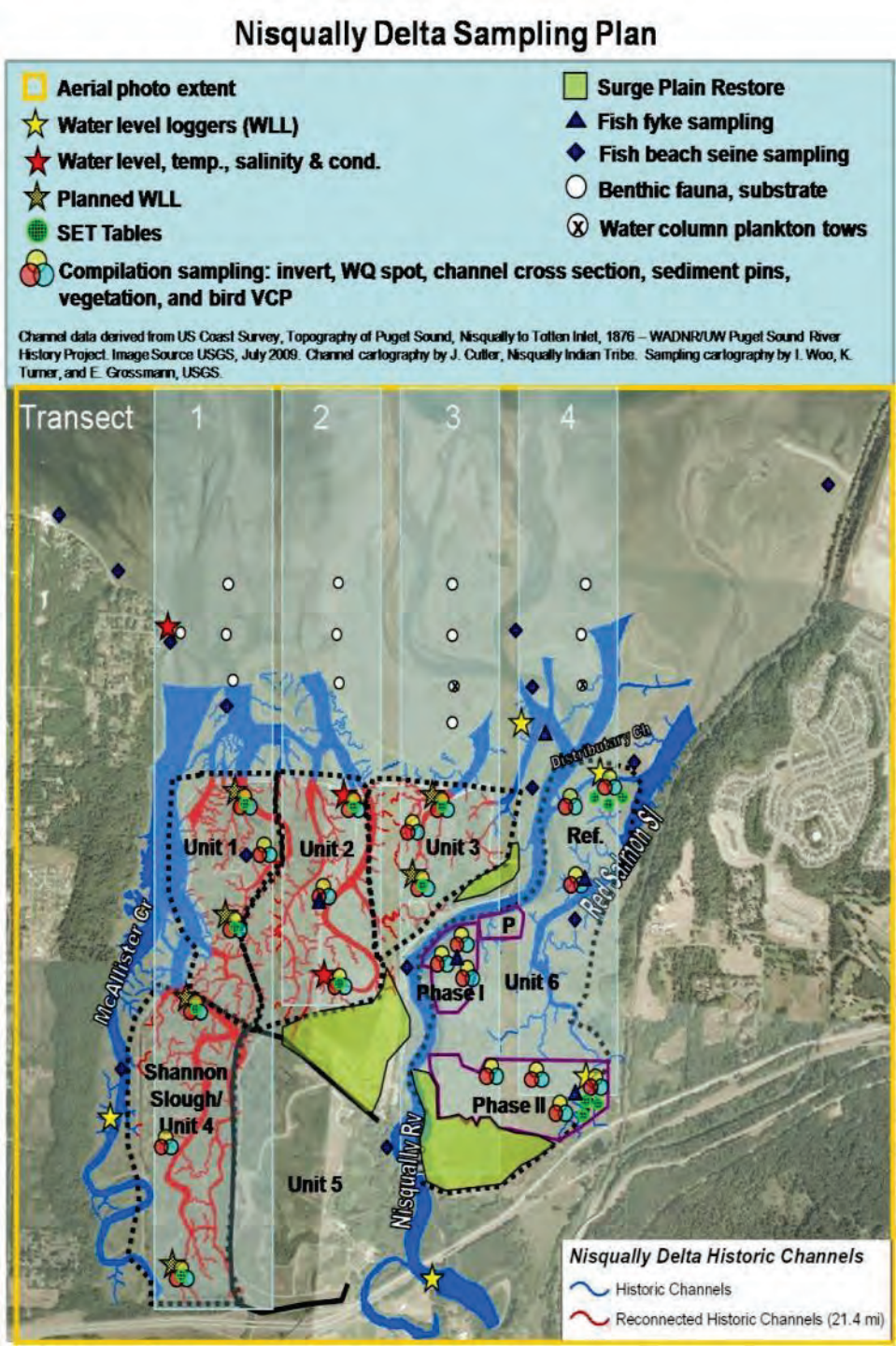
Monitoring by scale

Change Detection through Monitoring

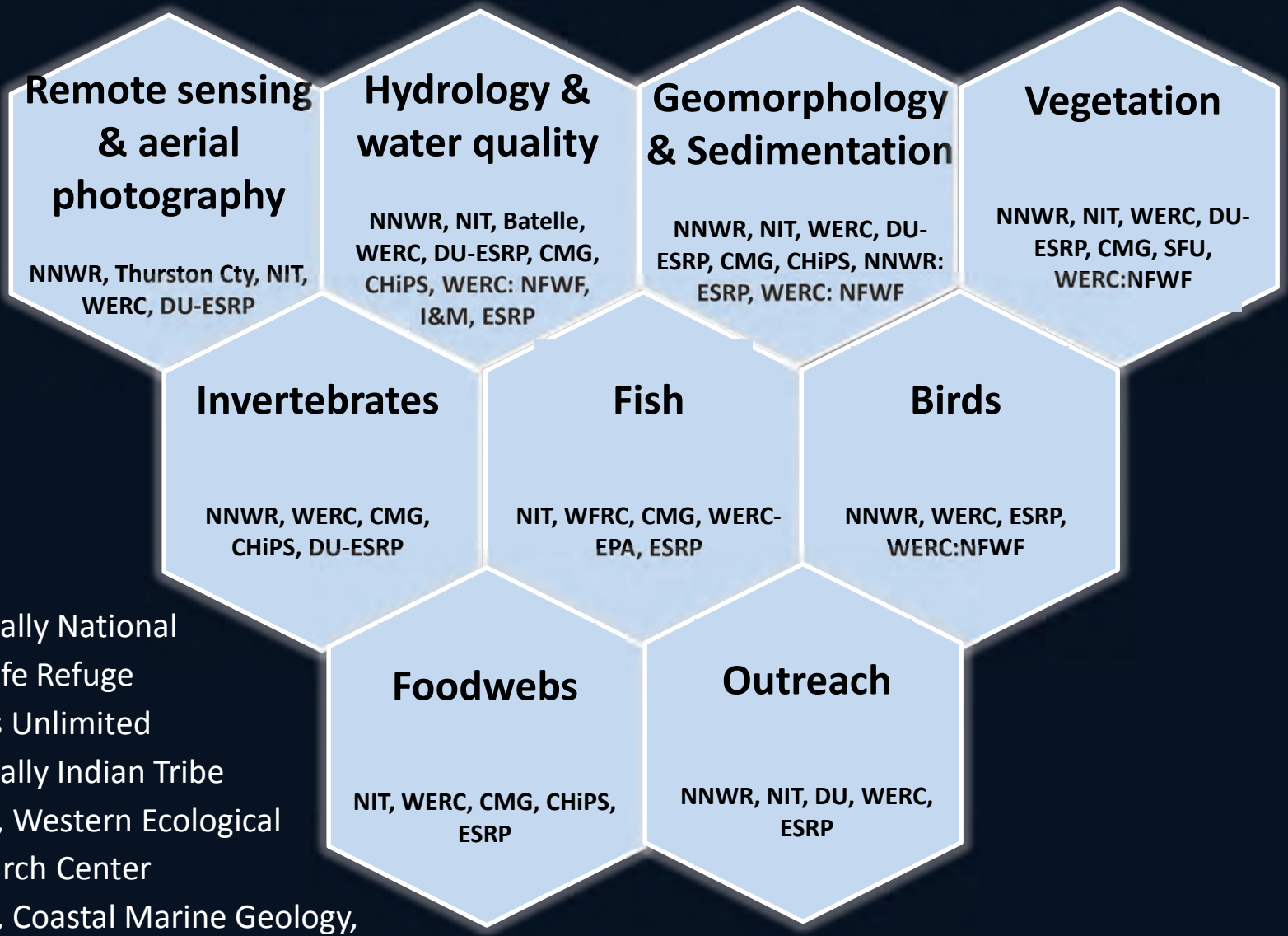
Delta-scale studies: Geomorphology, fish, inverts birds, foodwebs

Site Scale: Opportunity, Capacity, Realized fn Restorations trajectories Rapid vs. Intensive

Within site scale: Veg experiment



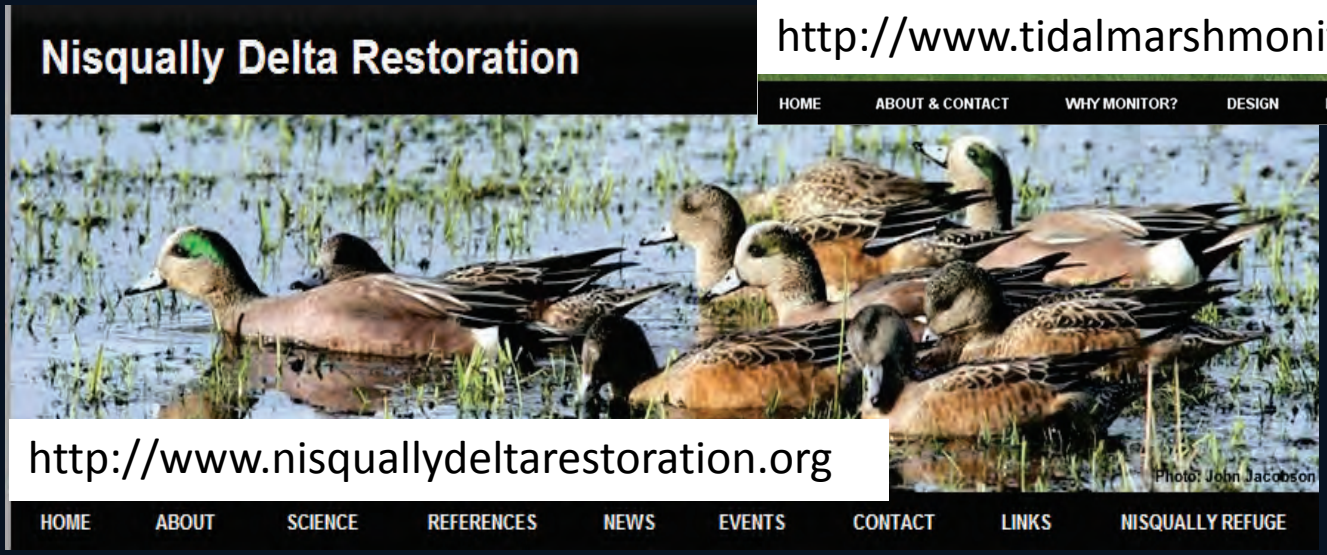
Monitoring by discipline



NNWR	Nisqually National Wildlife Refuge
DU	Ducks Unlimited
NIT	Nisqually Indian Tribe
WERC	USGS, Western Ecological Research Center
CMG-	USGS, Coastal Marine Geology,
CHiPS	Coastal Habitats in Puget Sound
WFRC	Western Fisheries Research Center

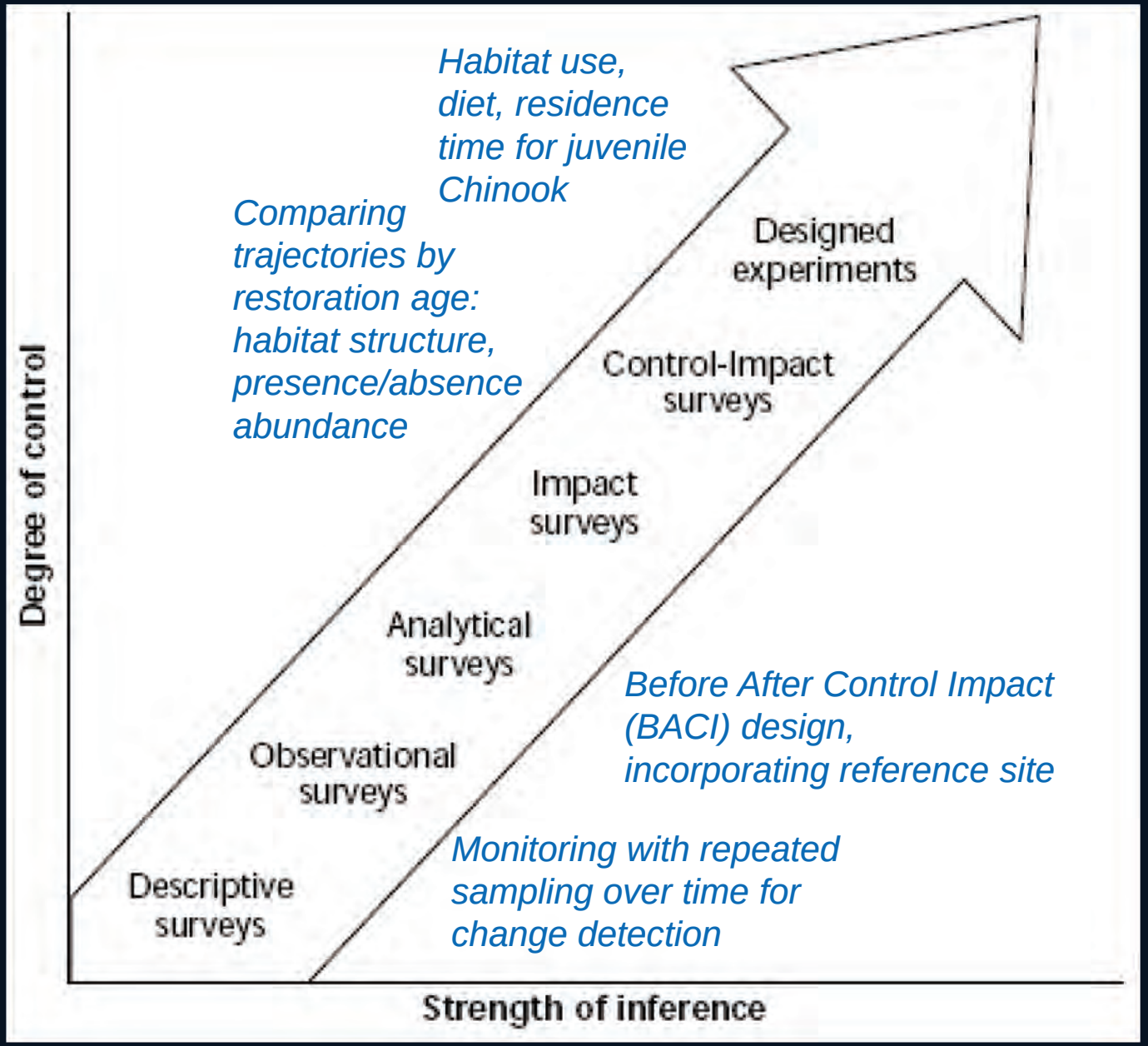
Monitoring information transfer and outreach

- For restoration scientists
- For practitioners
- For the public



Strength of inference varies with study design

Monitoring provides a foundation to examine change while applied studies address targeted questions



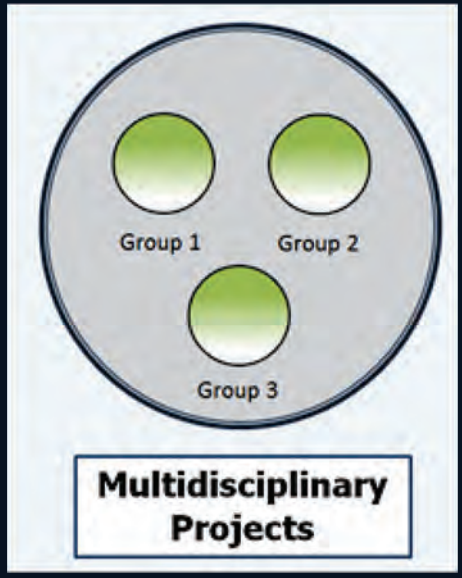
(Sit, V. and B. Taylor (eds). 1998. Statistical methods for adaptive management studies. BC For. Res. Bur., Land Mgmt 42).

mul·ti·dis·ci·pli·nar·y

adjective

\məltiˈ-di-sə-plə-ner-ē\

involving several academic or professional specializations in an approach to a topic or problem

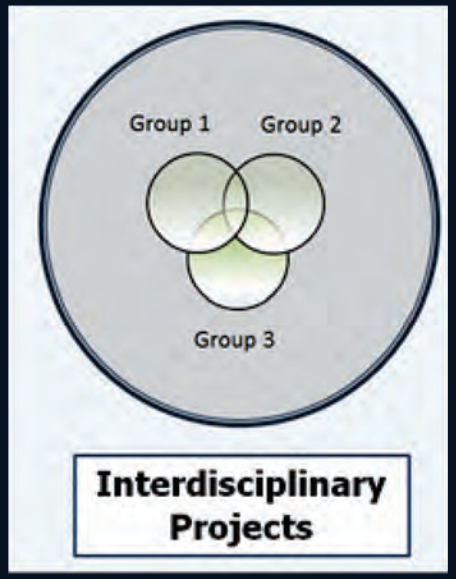


in·ter·dis·ci·plin·ary

adjective

\intərˈ-di-sə-plə-ner-ē\

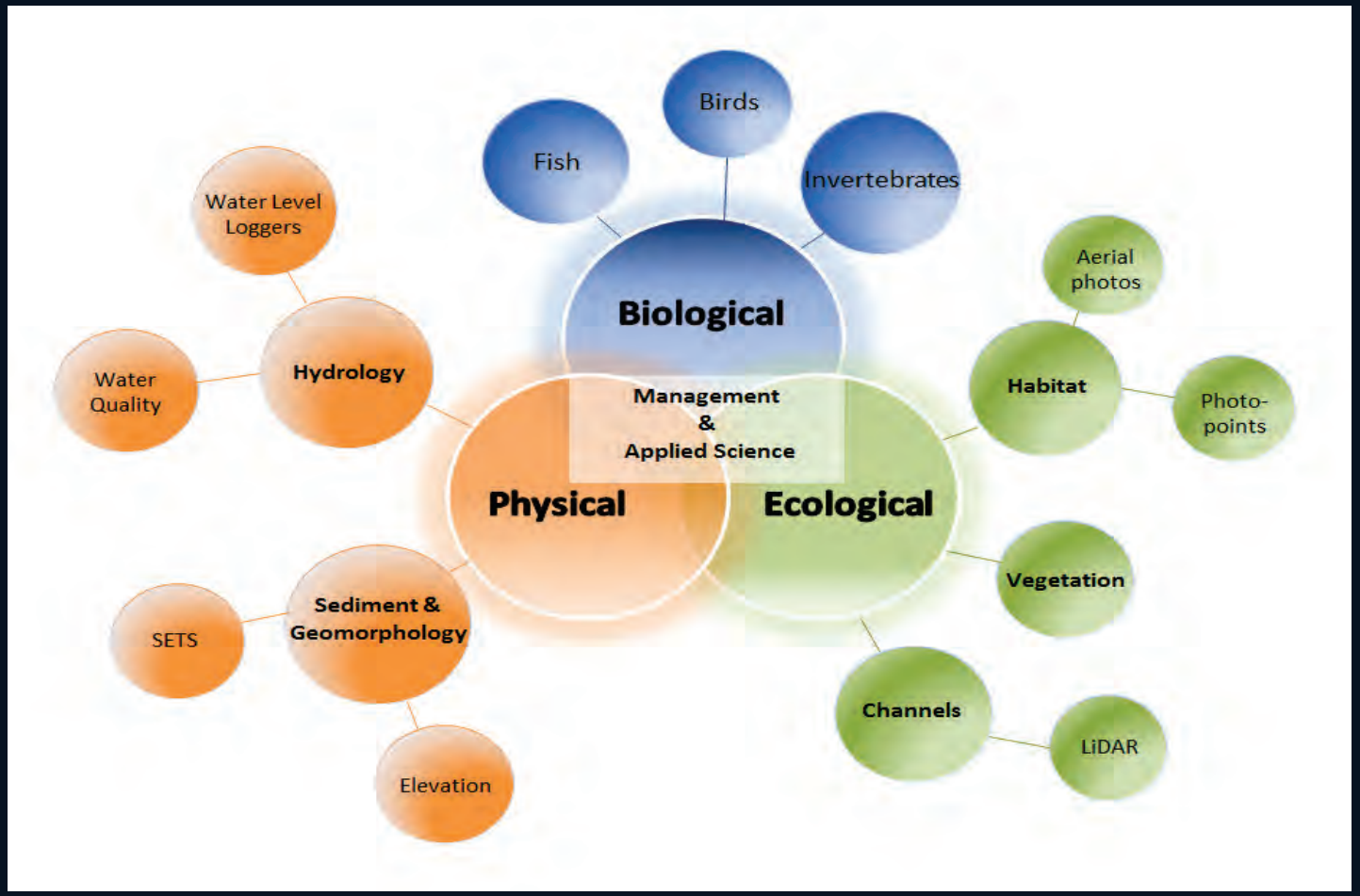
integrating two or more academic, scientific, or artistic areas of knowledge : combining two or more disciplines



Nisqually Delta Restoration

Have we achieved an interdisciplinary approach?

Combining knowledge from multiple disciplines to achieve maximum success by simultaneously considering physical, ecological, and anthropogenic effects at multiple levels



Why Are Interdisciplinary Studies Difficult?

1. Terminology – understanding specific to each field
2. Priorities -- individual specialties different than team
3. Integration -- requires more time for coordination, analysis
4. Project needs – focus on construction
5. Science needs -- competition among specialties
6. Contracting – across-group difficulties

What Makes Interdisciplinary Studies Work?

1. Project commitment to science for accountability
2. Regulatory requirements to conduct assessments
3. Science and monitoring plan with integration as a goal
4. Cultivation of interpersonal relationships
5. Focus on common targets
6. Seek funding in partnership
7. Patience!

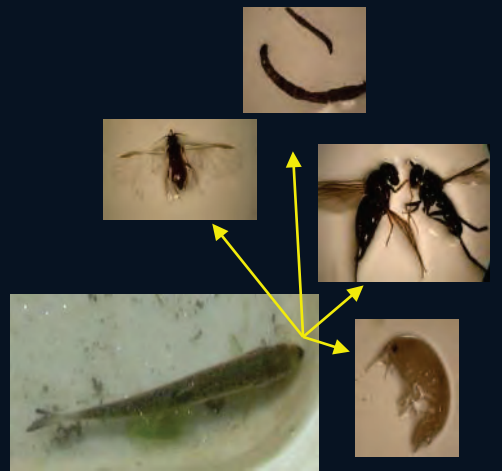
Applied studies: assessing restoration effectiveness

- **Opportunity to access restored and reference sloughs determined by monitoring fish temporal distribution and abundance**
- **Site specific capacity of sloughs measured by determining prey resource availability**
- **Realized function of sloughs measured by examining the feeding behavior of target fish (hatchery and unmarked Chinook)**

Opportunity:
Fyke trapping

Capacity:
Invert surveys (fall out traps)

Realized function:
Diet, otoliths for residence time



Applied studies to examine restoring habitats and response of fish and wildlife

- Opportunity
  - Channel connectivity, integration of elevation and hydrology
- Capacity
  - Vegetation colonization
  - Invertebrate production
- Realized Function
  - Linkages between vegetation and invertebrate prey
  - Linkages between invertebrate prey and Chinook
  - Trajectories of wetland function

Measuring restored opportunity

Restoration of the Nisqually River Delta and increased rearing opportunities for salmonids

Kelley Turner et al., 9:30AM Friday, Room 611

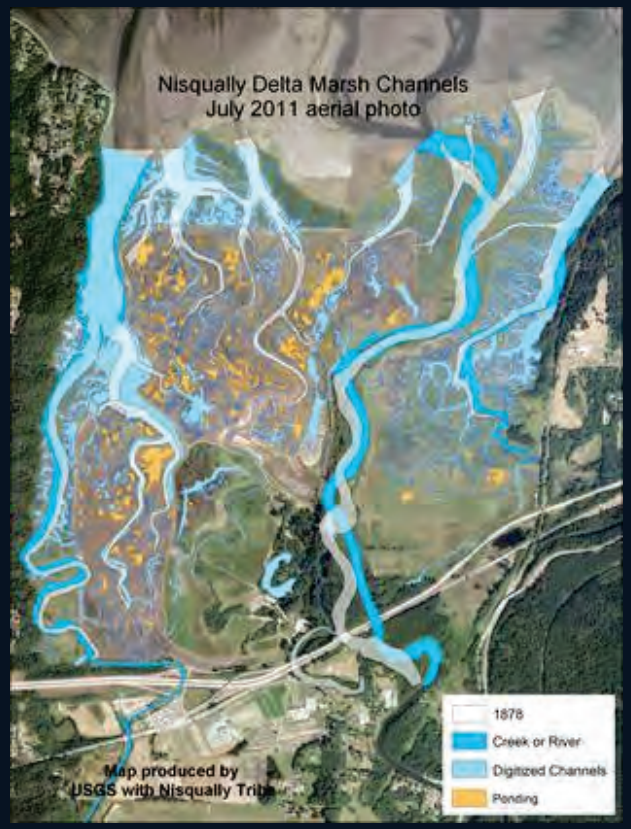
1878

Nisqually Tribe

2011

USGS: Western Ecological Research Center

Historic and Current Overlay



USGS: Western Ecological Research Center

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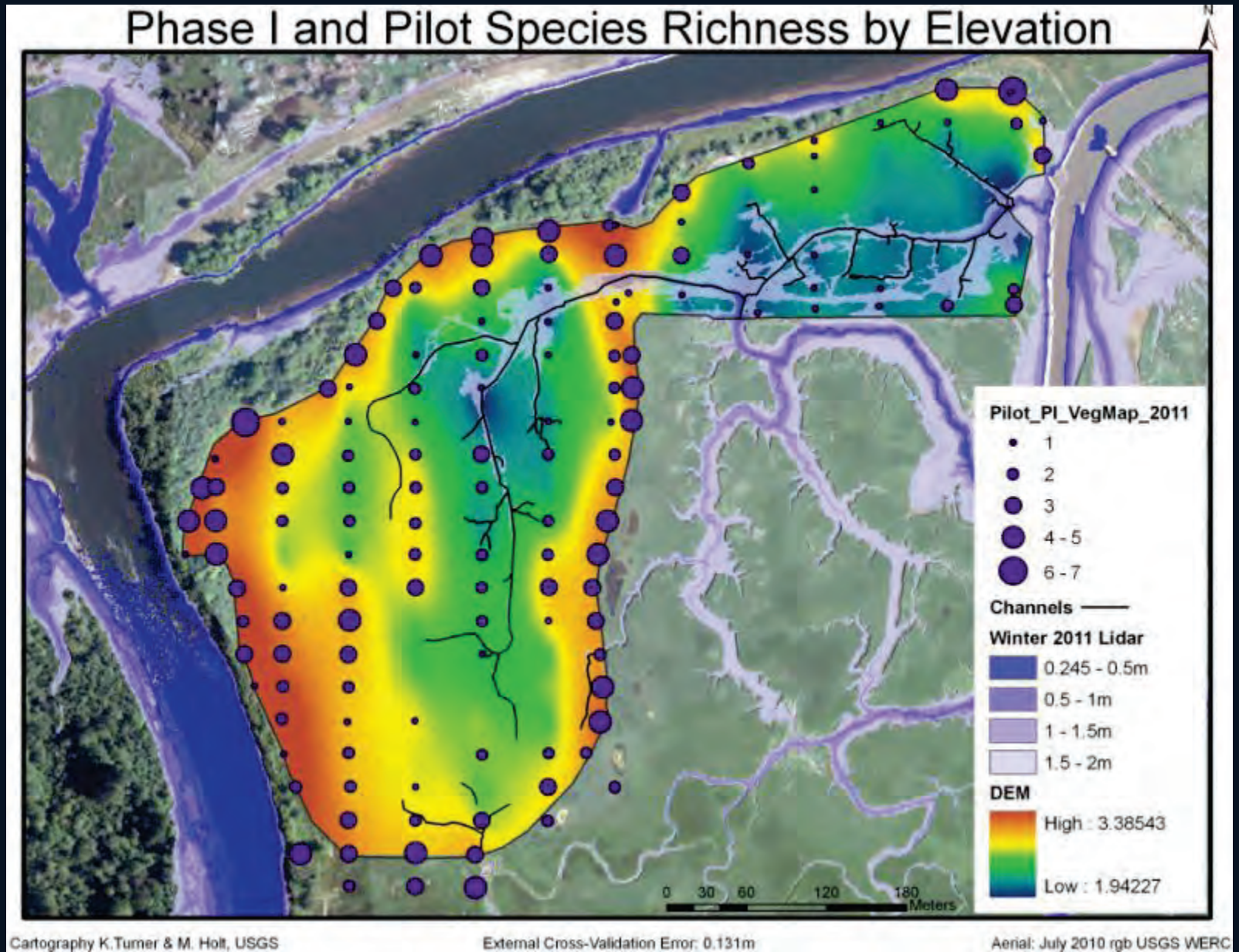
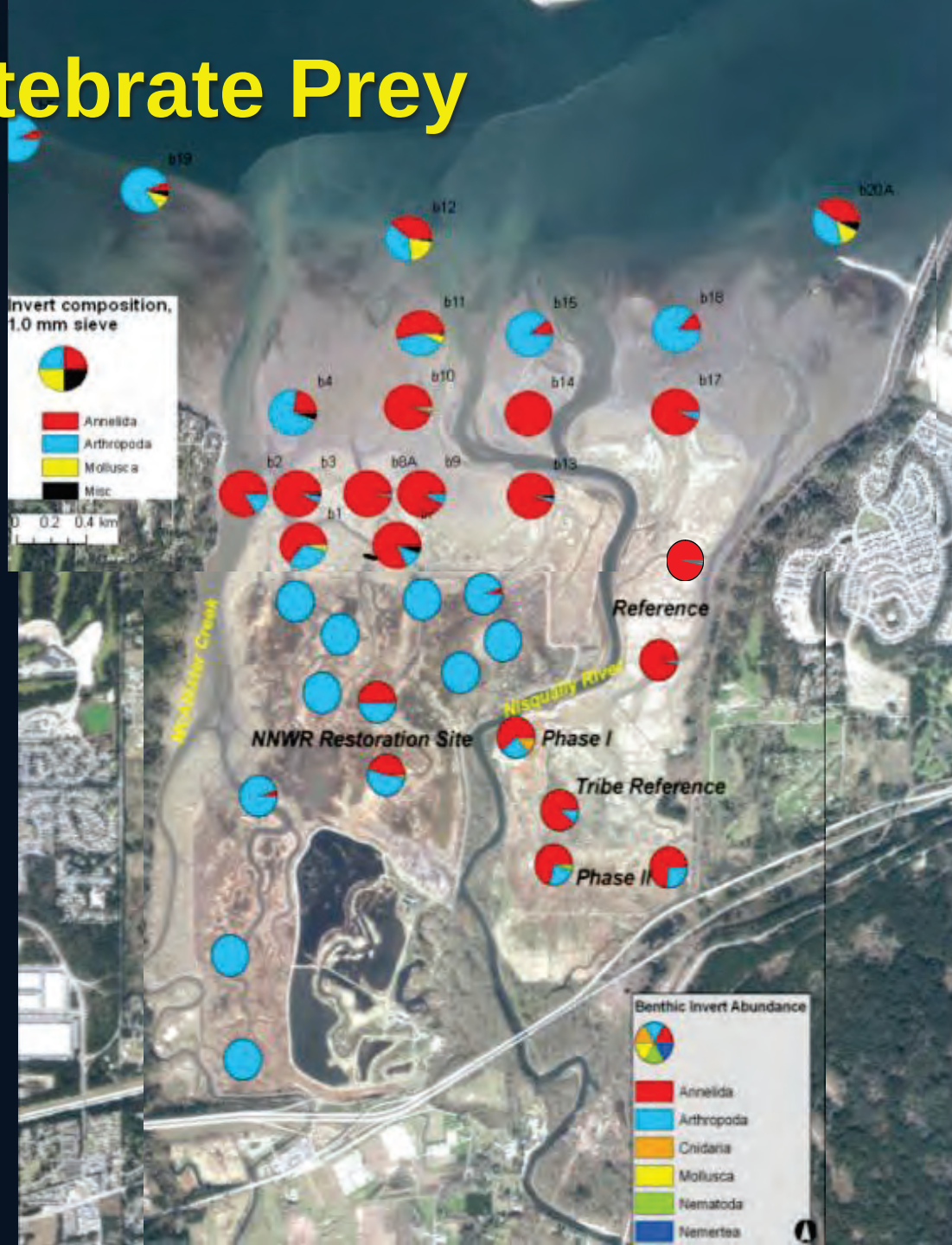
Species Richness by Elevation



Invertebrate Prey

- Invertebrates from fall-out traps, the water column, and benthos were sampled at fish locations for prey availability composition, abundance
- Densities indicated the increased capacity provided by the restoration



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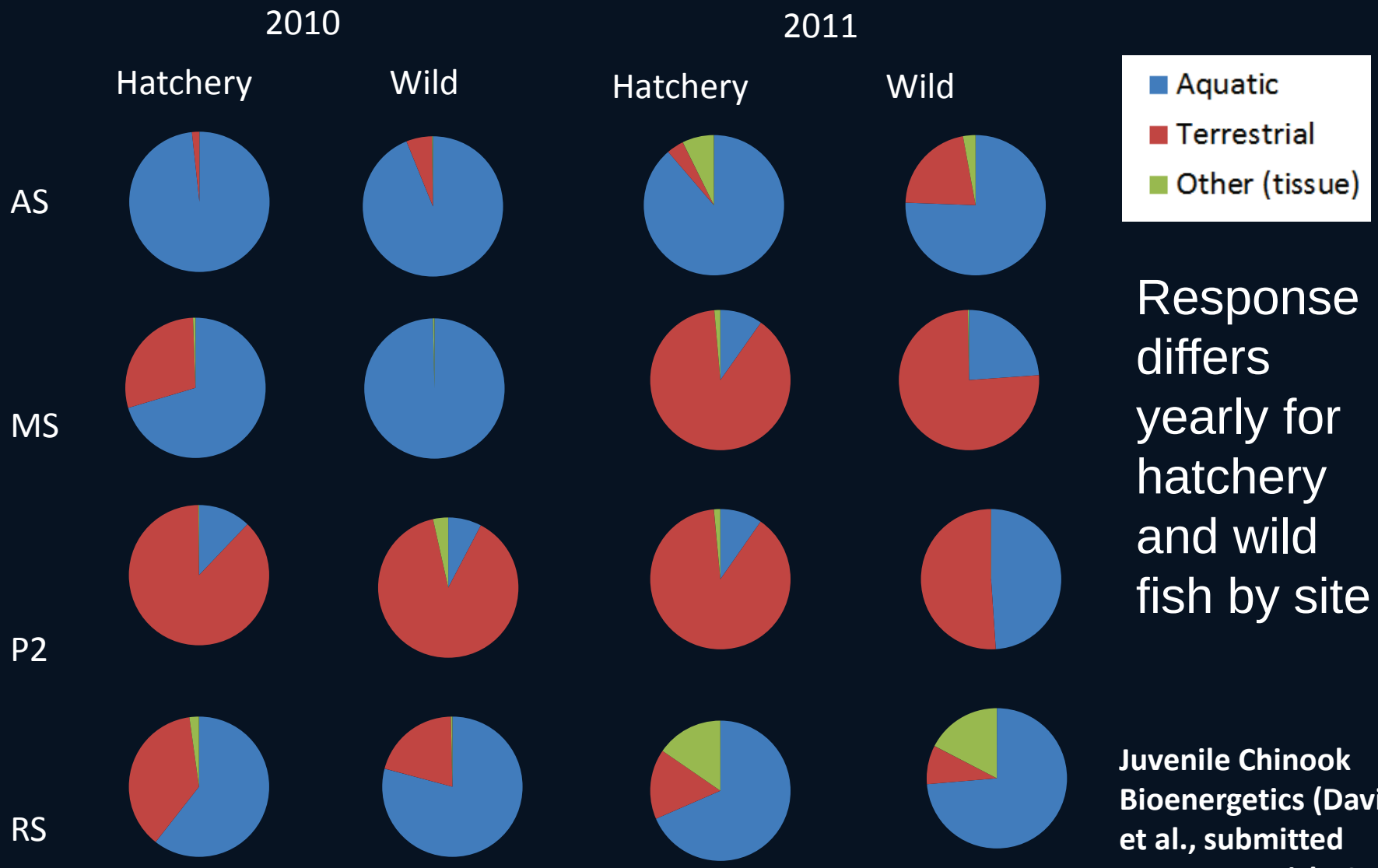
Relating invert availability to juvenile Chinook diet: Index of Relative Importance



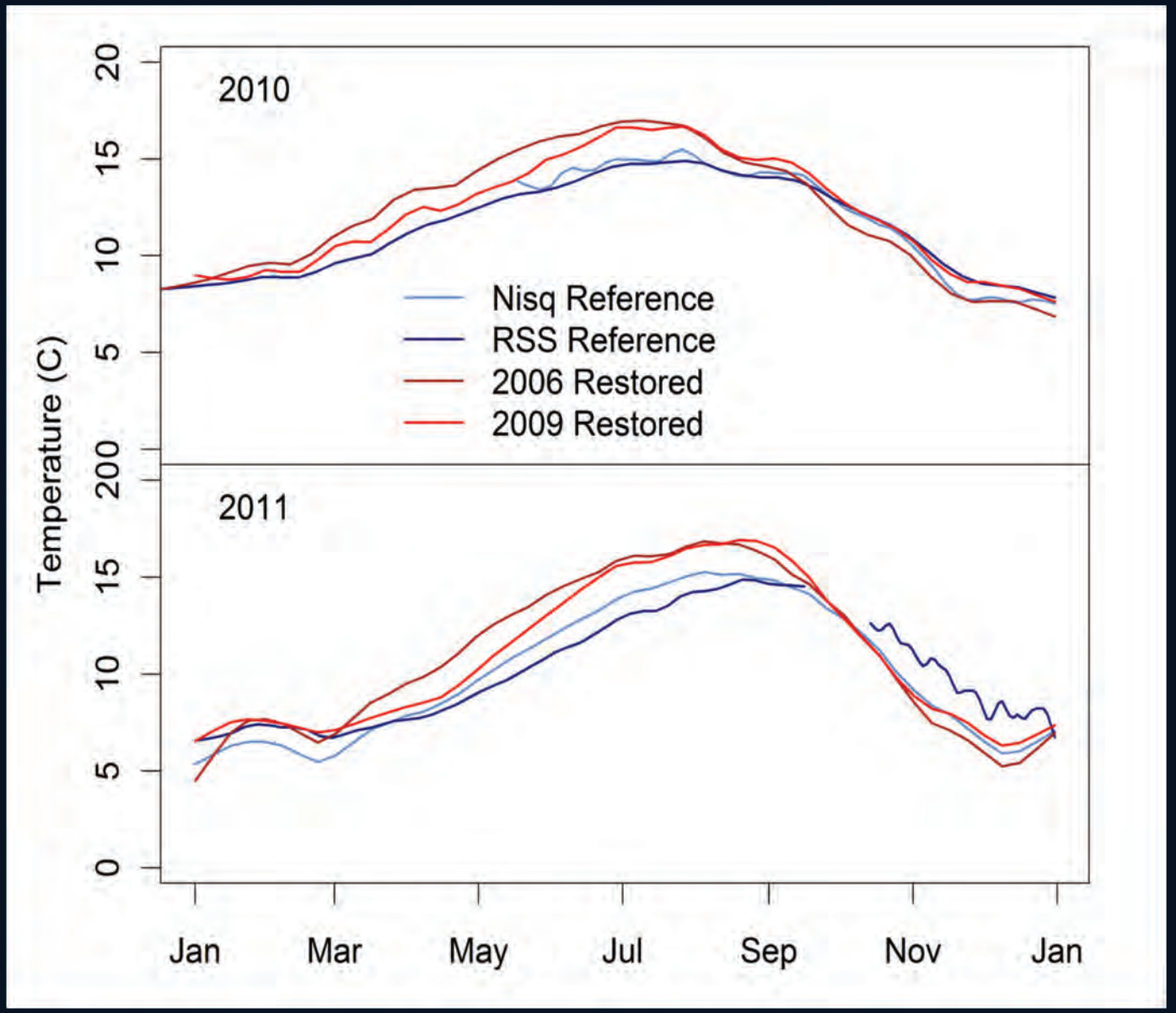
Response differs yearly for hatchery and wild fish by site

Juvenile Chinook Bioenergetics (David et al., submitted Trans. Am. Fish. Soc.)

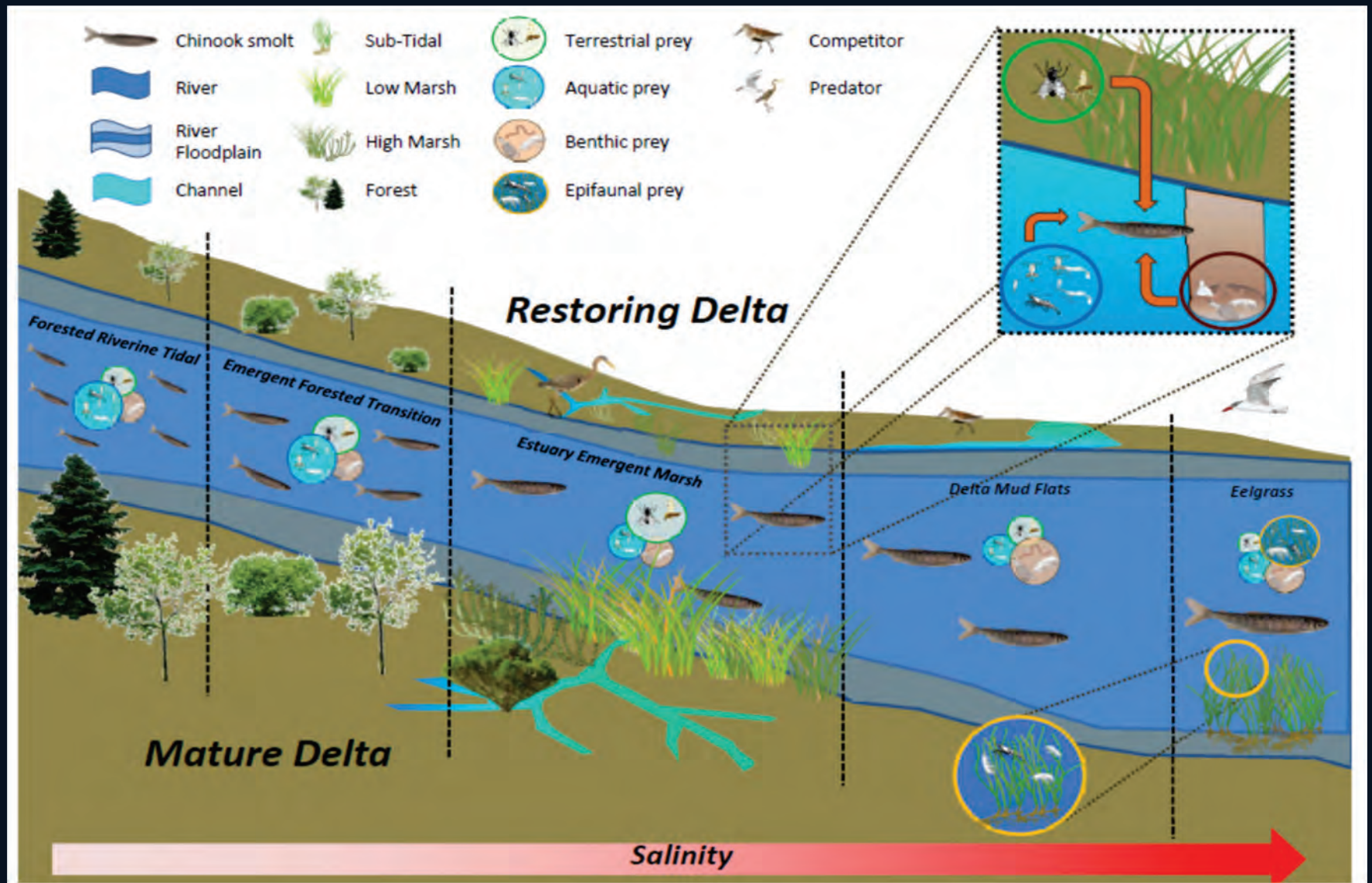
Water temperature is elevated in restored sites

Juvenile Chinook Bioenergetics (David et al., submitted Trans. Am. Fish. Soc.)

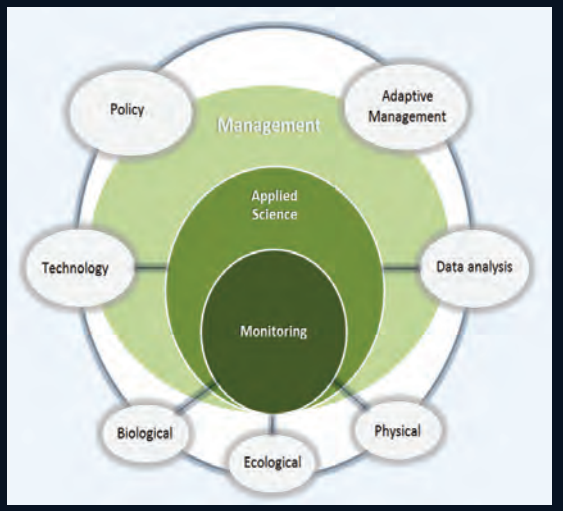
However, temperatures were elevated in unvegetated restored channels that modeling would suggest slows smolt growth



Chinook outmigration and invertebrate prey: restored habitats along a salinity gradient



Lessons Learned



1. Monitoring and applied studies should be integrated from the start with restoration implementation

2. A clear vision of interdisciplinary science should be included in monitoring plans

3. Working towards a common goal of publishing multi-authored results solidifies partnerships and validate results

4. Patience and continued funding over time through joint proposal development is required for best development

Science Partners and Collaborators

- USGS Western Ecological Research Center – M. Davis, C. Freeman, L. Shakeri, K. Thorne, C. Freeman, K. Buffington, K. Powelson, L. Smith, A. Smith, J. Shinn, A. Naljahih, H. Vaska, S. Bishop, J. Felis, K. Gustafson, G. Salwen, W. Chan, A. Smith, TESC Interns (L. Belleveau & H. Allgood), UW Tacoma Intern (H. Minnella), Nicholls State University Intern (J. Bell)
- Nisqually National Wildlife Refuge-- D. Roster, J. Barham, M. Bailey and Refuge Volunteers
- Nisqually Indian Tribe -- C. Ellings, J. Cutler, S. Hodgson, D. Trout
- Nisqually River Foundation -- L. Belleveau, M. Holt, C. Iverson, A. David, J. Hall
- Ducks Unlimited -- D. Golner, S. Liske, P. Schulte, K. Mykut
- EPA, ESRP and Students in Support of Native American Relations (SISNAR)
- USGS Patuxent Wildlife Research Center -- G. Guntenspergen, J. Lynch and J. Olker
- USGS Coastal and Marine Geology – E. Grossman, P. Swarzenski, R. Kayen, G. Gelfenbaum, and D. Finlayson
- USGS Western Fisheries Research Center -- S. Rubin, K. Larsen and A. Lind-Null
- USGS Science Support Program, Northwest Climate Science Center
- USFWS Inventory and Monitoring, Landscape Conservation Cooperative
- Univ. of Washington, Oregon State Univ., UCLA, UC Davis, CSU Moss Landing
- Washington Water Science Center-- R. Dinicola
- Washington Department of Fish and Wildlife – D. Kraege, J. Evenson
- Avian Design -- C. Fox