The CTUIR Freshwater Mussel Project: Using a First Foods Approach to Enhance Conservation

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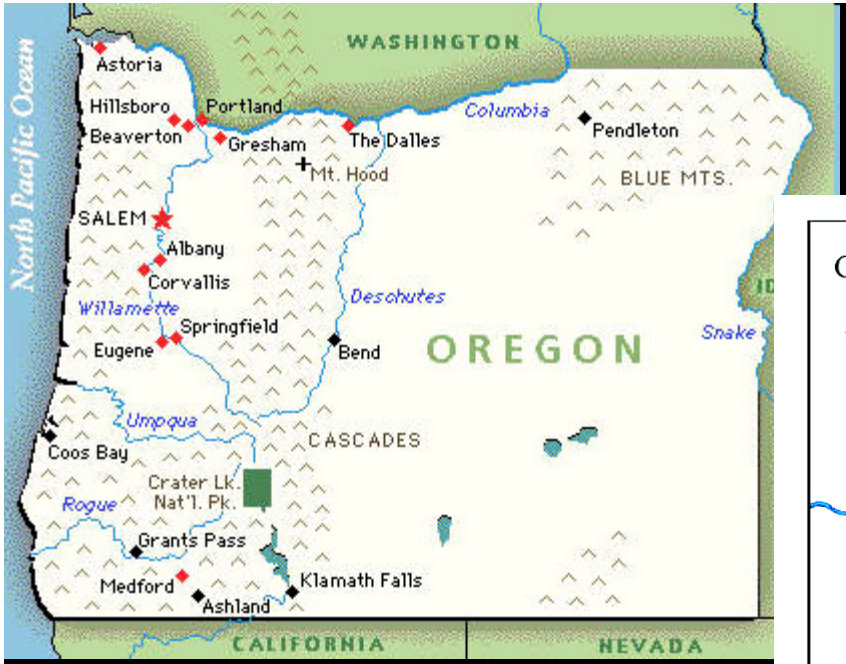
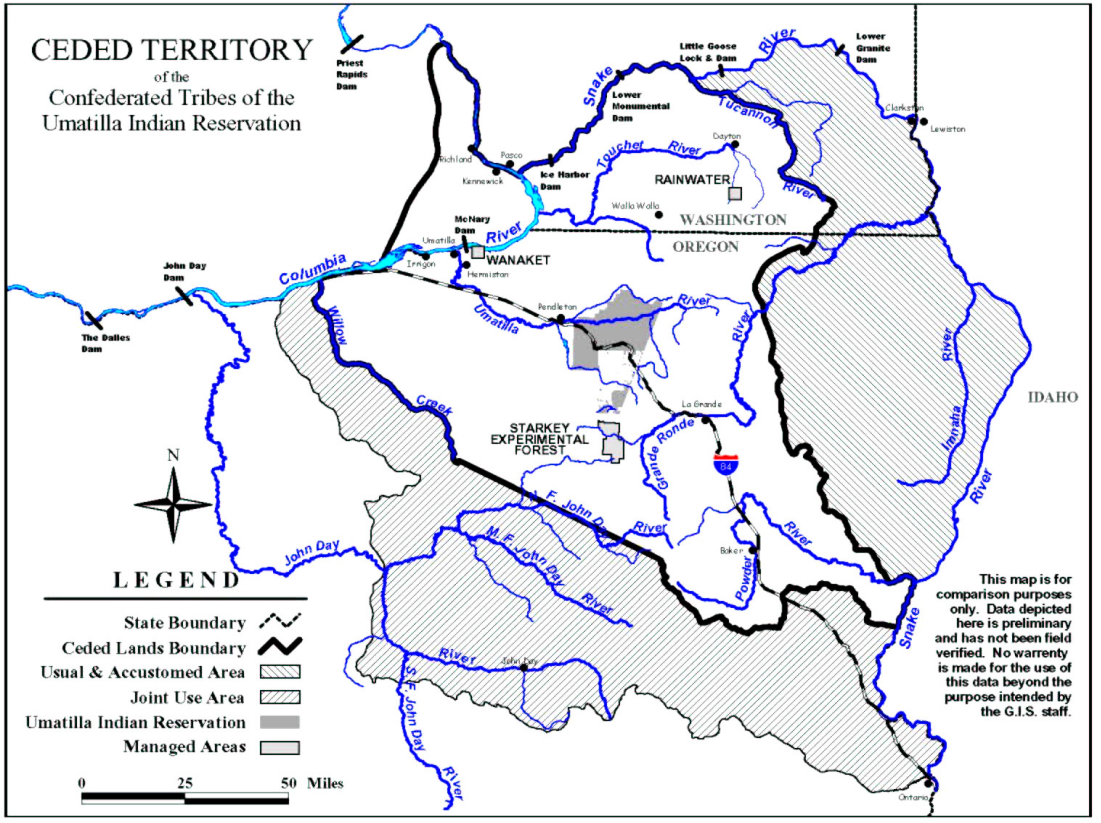
Spiritual Views

"In the traditional mid-Columbia Plateau tribal worldview, animals, plants, water, rocks, etc. are believed to have a shukwat (spirit) and a conscience . This worldview promotes respect for all things in nature…"

-- Close et al. (2002): Fisheries


North Pacific Ocean
WASHINGTON
Astoria
Hillsboro
Portland
Beaverton
Gresham
The Dalles
Columbia
Pendleton
Mt. Hood
BLUE MTS.
SALEM
Albany
Corvallis
Willamette
Springfield
Eugene
Bend
Deschutes
Snake
OREGON
Umpqua
CASCADES
Coos Bay
Crater Lk.
Nat'l. Pk.
Rogue
Grants Pass
Medford
Ashland
Klamath Falls
CALIFORNIA
NEVADA


CEDED TERRITORY
of the
Confederated Tribes of the
Umatilla Indian Reservation
Priest Rapids Dam
Little Goose Lock & Dam
Lower Granite Dam
Lower Monumental Dam
Snake River
Tucannon River
Clarkston
Lewiston
Dayton
Richland
Pasco
Kennewick
Ice Harbor Dam
Touchet River
RAINWATER
Walla Walla
WASHINGTON
OREGON
McNary Dam
Umatilla
Irrigon
WANAKET
Hermiston
Columbia River
John Day Dam
The Dalles Dam
Pendleton
Umatilla River
Willow Creek
La Grande
STARKEY EXPERIMENTAL FOREST
Grande Ronde River
Imnaha River
IDAHO
N
M.F. John Day River
John Day River
Baker
Powder River
Snake River
LEGEND
State Boundary
Ceded Lands Boundary
Usual & Accustomed Area
Joint Use Area
Umatilla Indian Reservation
Managed Areas
0 25 50 Miles
This map is for comparison purposes only. Data depicted here is preliminary and has not been field verified. No warrenty is made for the use of this data beyond the purpose intended by the G.I.S. staff.

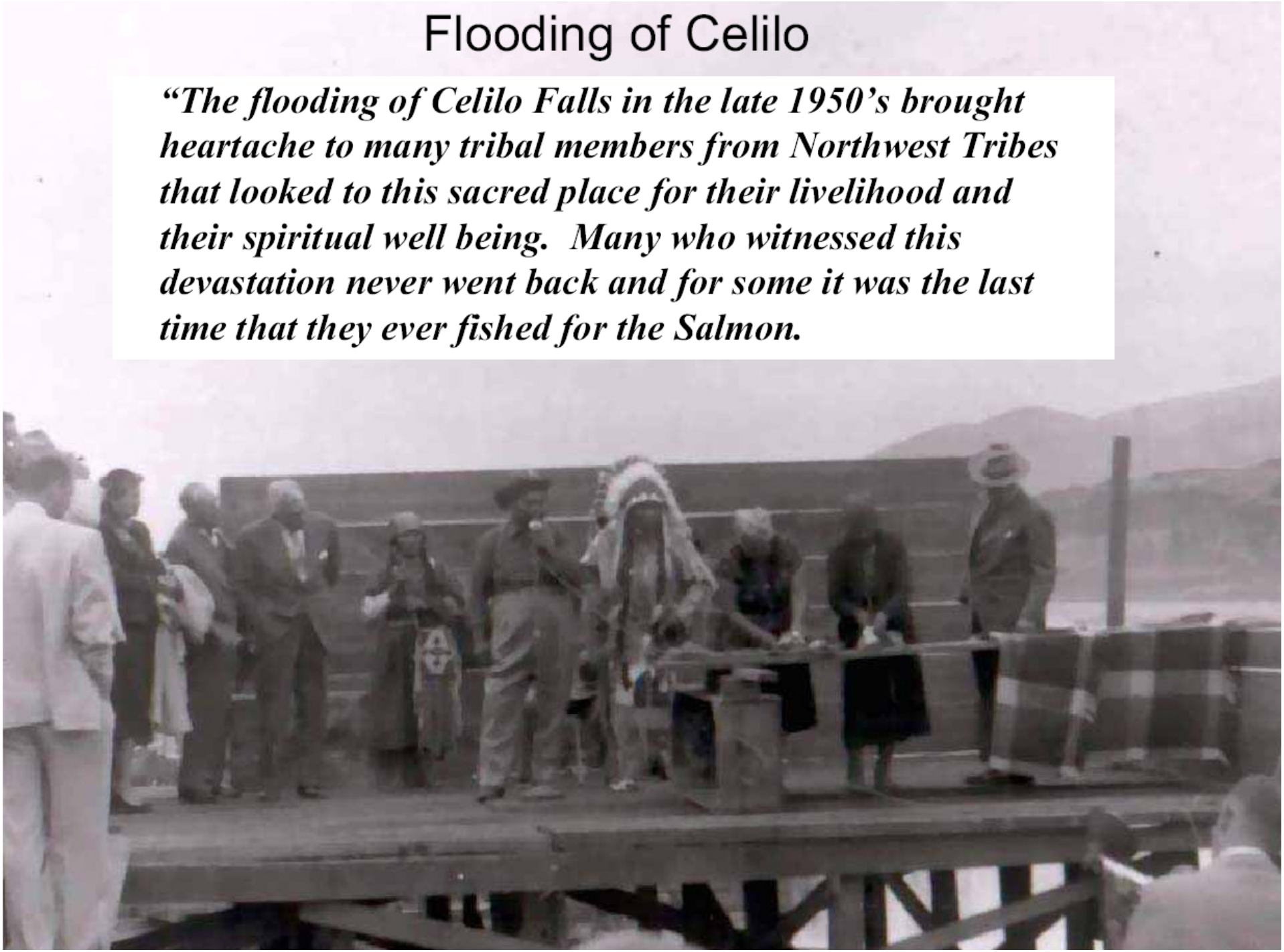

CAYUSE - WALLA WALLA - UMATILLA
CONFEDERATED TRIBES OF THE
UMATILLA INDIAN RESERVATION
Treaty of 1855


"Umatilla Indian Girls" 1964
W.H.J. Moorhouse

In 1957 the once wild river became silent and
salmon fishing was no more.

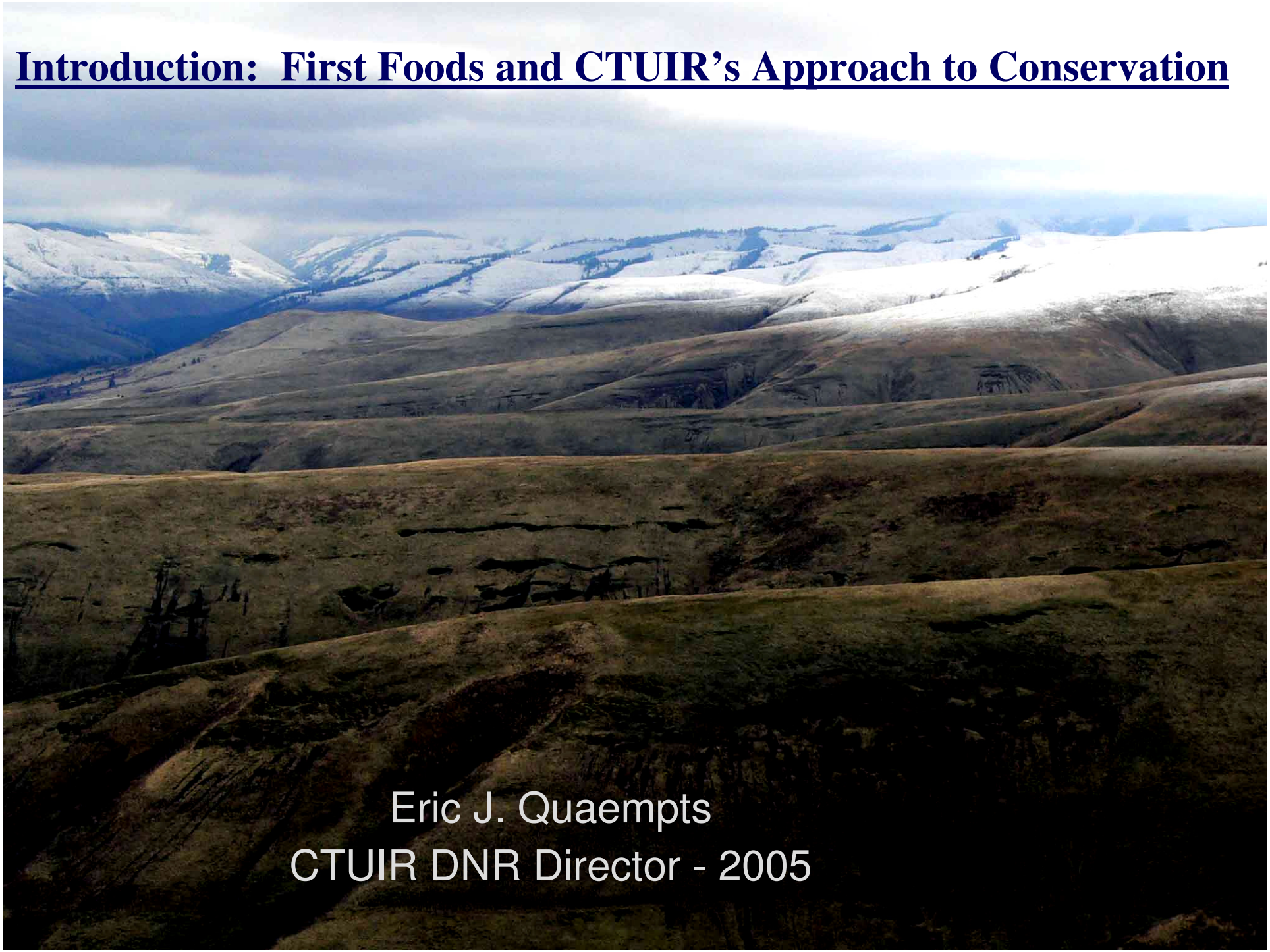
Flooding of Celilo

"The flooding of Celilo Falls in the late 1950's brought heartache to many tribal members from Northwest Tribes that looked to this sacred place for their livelihood and their spiritual well being. Many who witnessed this devastation never went back and for some it was the last time that they ever fished for the Salmon.



It wasn't just the Salmon that became lost, but the mussel beds that once lined the rapids that ran the course of the Columbia also disappeared." **--David Wolf**

Introduction: First Foods and CTUIR's Approach to Conservation



Eric J. Quaempts
CTUIR DNR Director - 2005

Background

Former CTUIR DNR Organizational Units

- Water Resources
- Fish and Wildlife
  - Fish Habitat
- Environmental Planning
- Cultural Resources Protection Program

….fairly traditional approach to Natural Resource Management

But was it?

Culturally relevant and responsive

Transparent to all Tribal members

to address these needs and concerns…

The First Foods Approach:

1) describes the order of foods in a tribal meal as it relates to the landscape; and

2) is expression of the identity and continuity of the Tribes' culture; and

*3) bring attention to species and linkages (ecological processes) that may be largely unrecognized and sometimes devalued outside the reservation.

DNR
Mission Statement

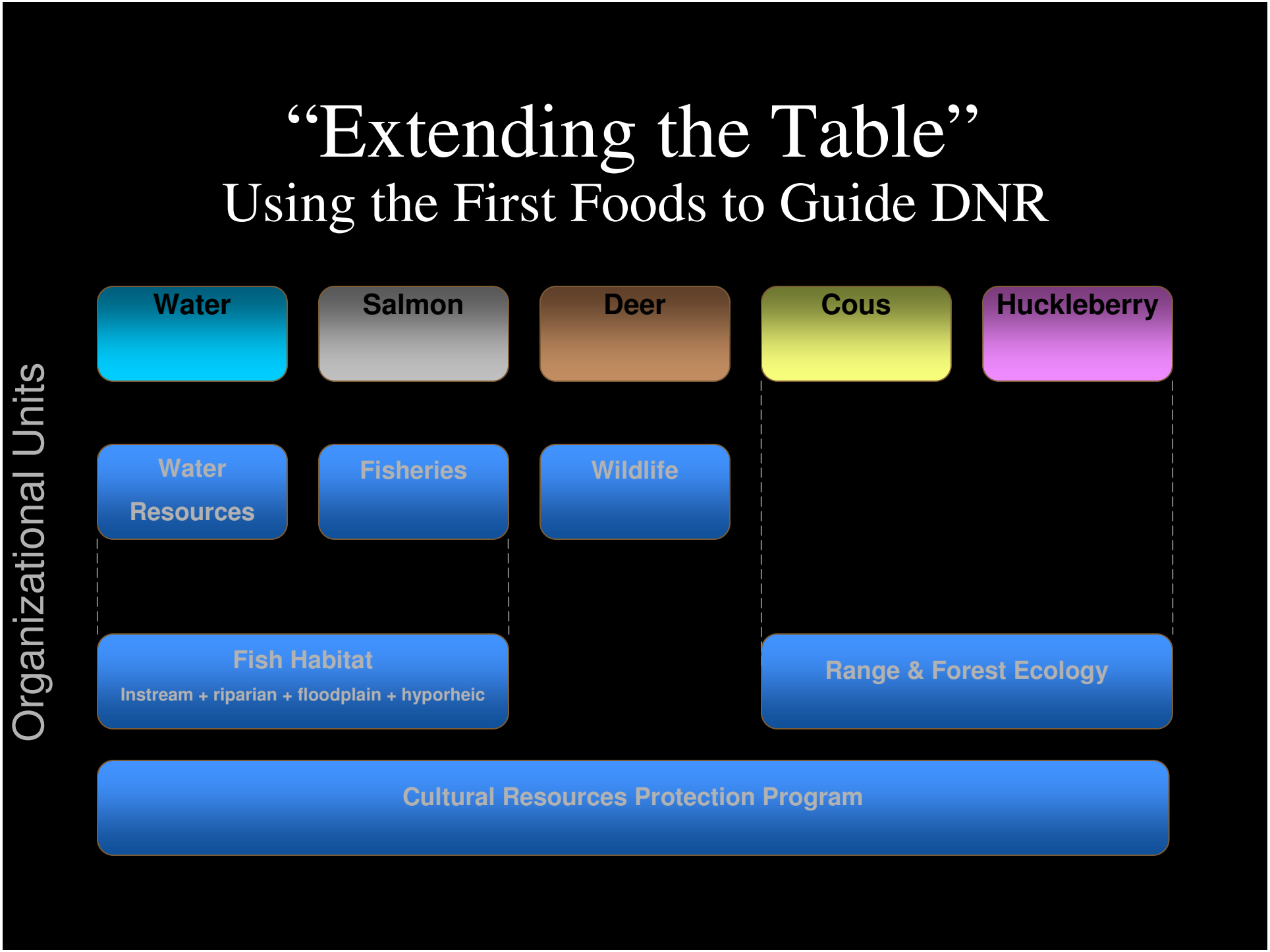
We will accomplish this by utilizing

traditional
ecological
and
cultural knowledge

AND

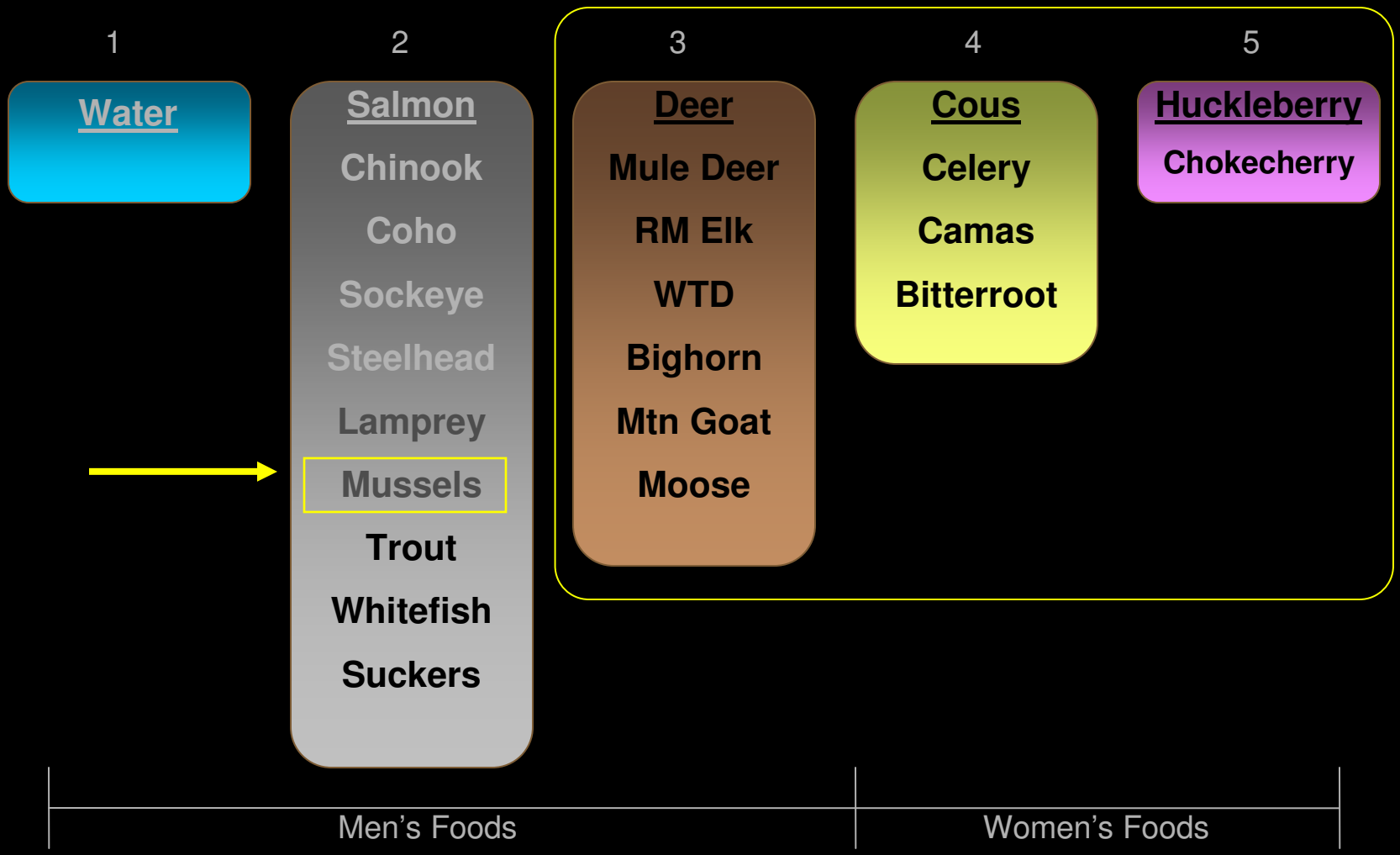
science

"Extending the Table"
Using the First Foods to Guide DNR



"Extending the Table"

Serving Order

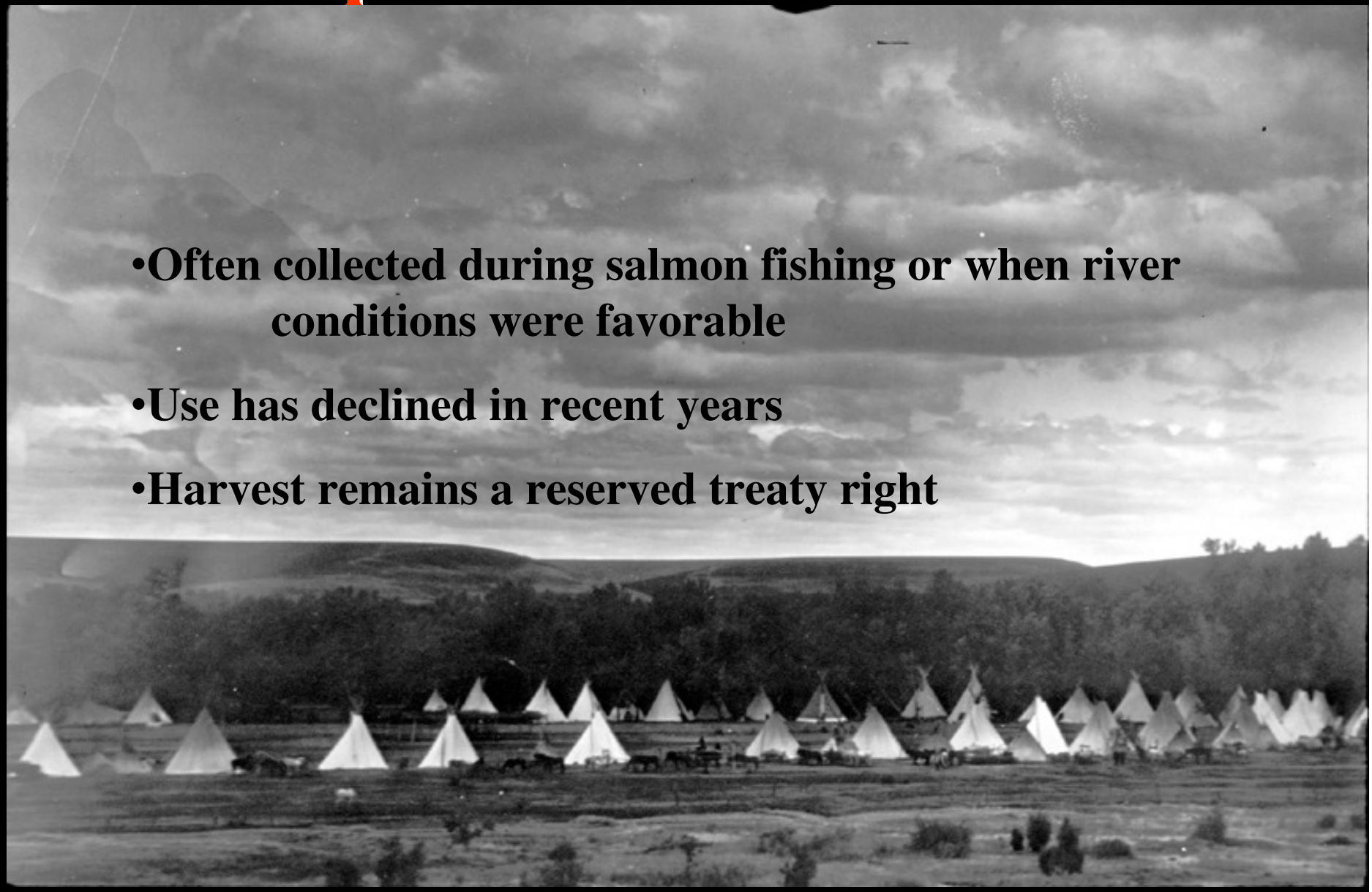


Featured Management Research/Development

Ecological Importance:

1. Bio indicators – long lived sensitive to change
2. Clean water – lungs of the river
3. Provide food for wildlife

Importance to Tribes



- Often collected during salmon fishing or when river conditions were favorable
- Use has declined in recent years
- Harvest remains a reserved treaty right

Why Mussels? Food Resource

Importance to Tribes:

Archeological Record of Harvest > 10,000 yrs.

Shells from Ímatalam, at confluence Columbia and Umatilla rivers

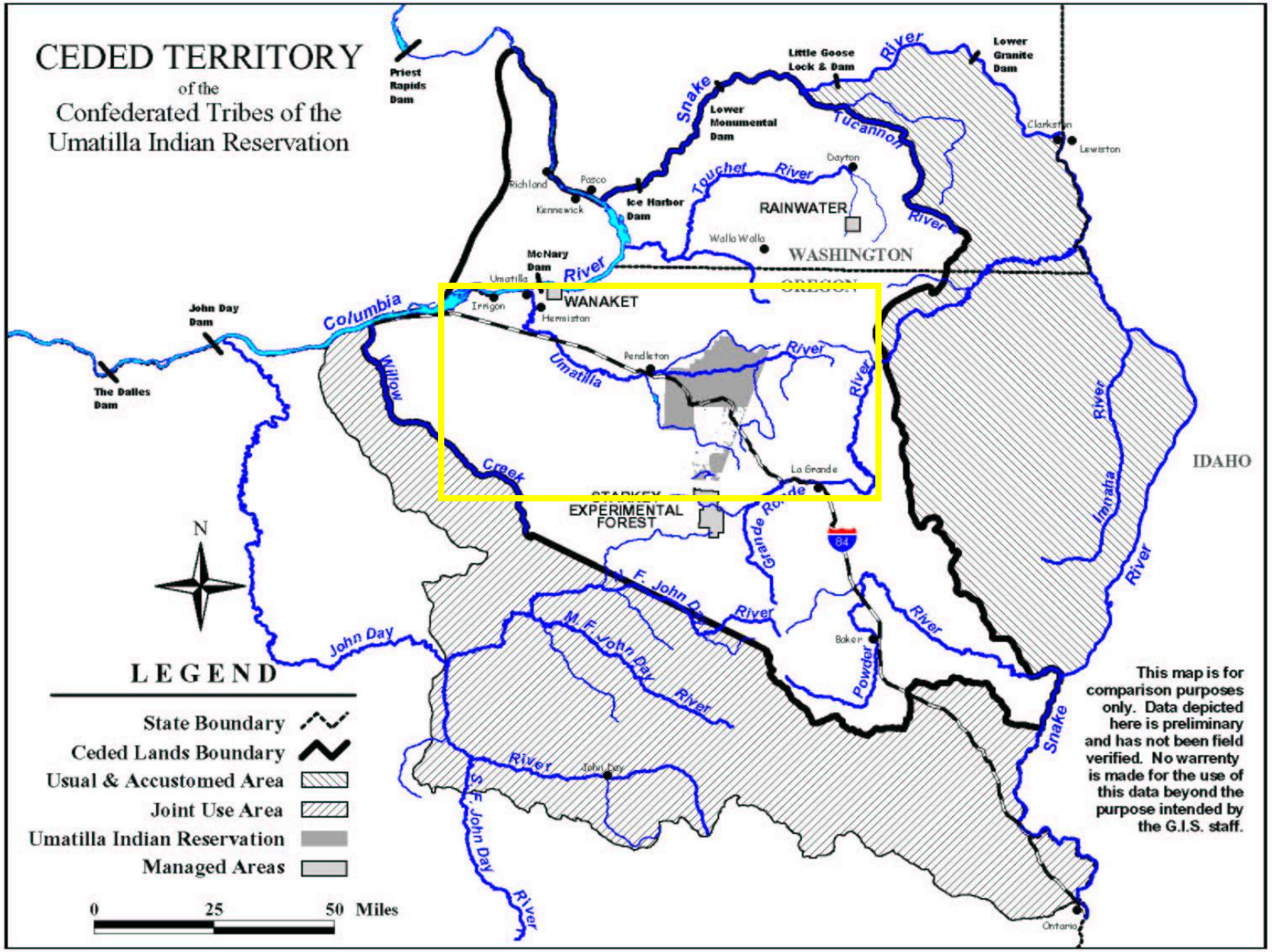
Importance to Tribes: Cultural Values

This rapid I observed as I passed opposite to it to be very bad intercepted with high rock and Small rocky Islands, here I observed banks of Muscle Shells banked up in the river in Several places….

I observed a great number of Lodges on the opposite Side at Some distance below and Several Indians on the opposite bank passing up to where Capt. Lewis was with the Canoes, others I Saw

on a knob nearly opposite to me at which place they delayed but a Short time before they returned to their Lodges ...

----William Clark, October 19, 1805



To protect, restore, and enhance the First Foods

Project Goals:

Restore /enhance mussel populations

1.Determine mussel distribution and status on Tribal lands & identify history distribution.

2.Taxonomic issues and local adaptations that could affect successful reintroduction (genetics).

3.Knowledge of factors controlling distribution and abundance.

4.Host fish information.

5.Relocation trials.

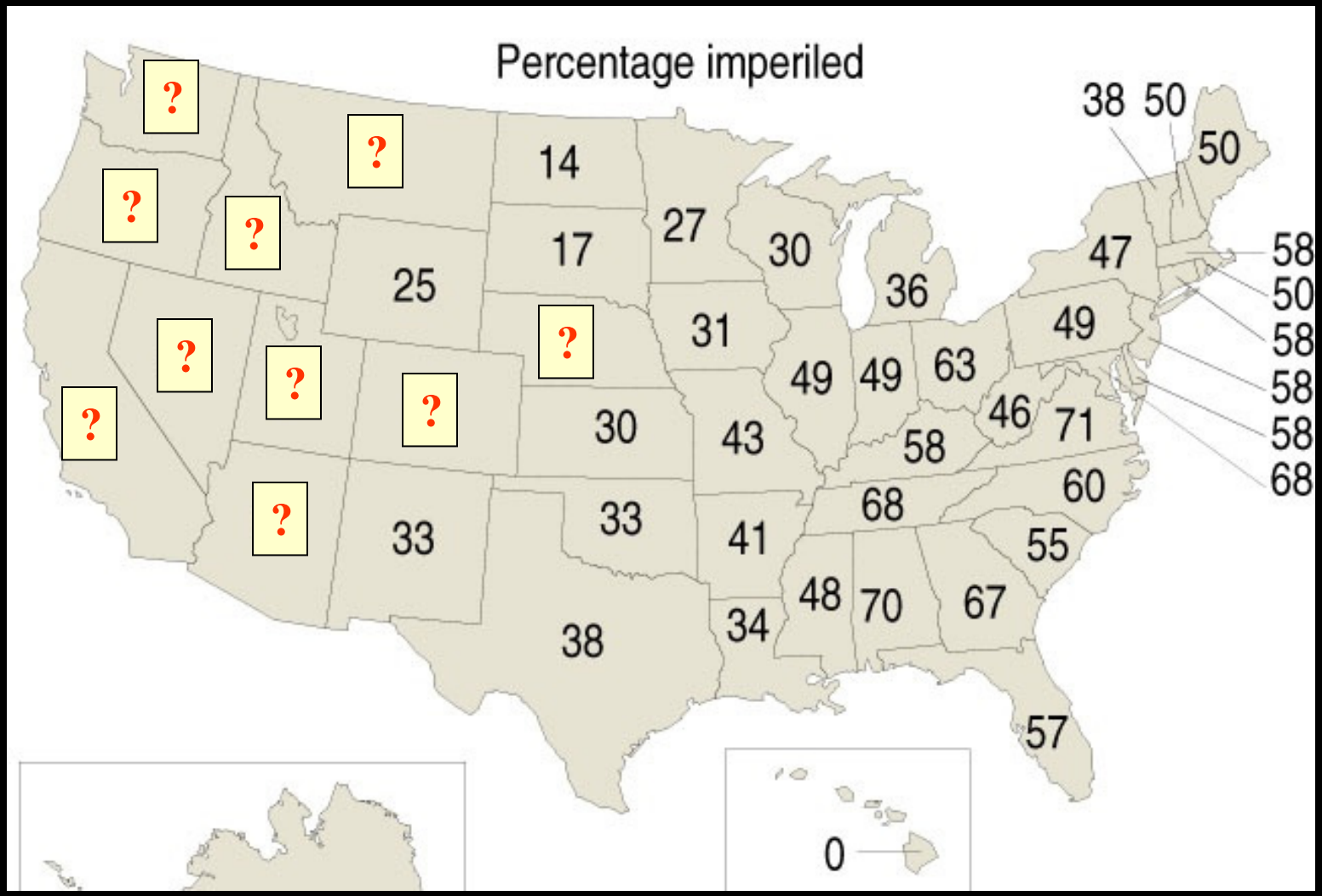
Freshwater mussels in the western US

Margaritifera falcata
Western pearlshell

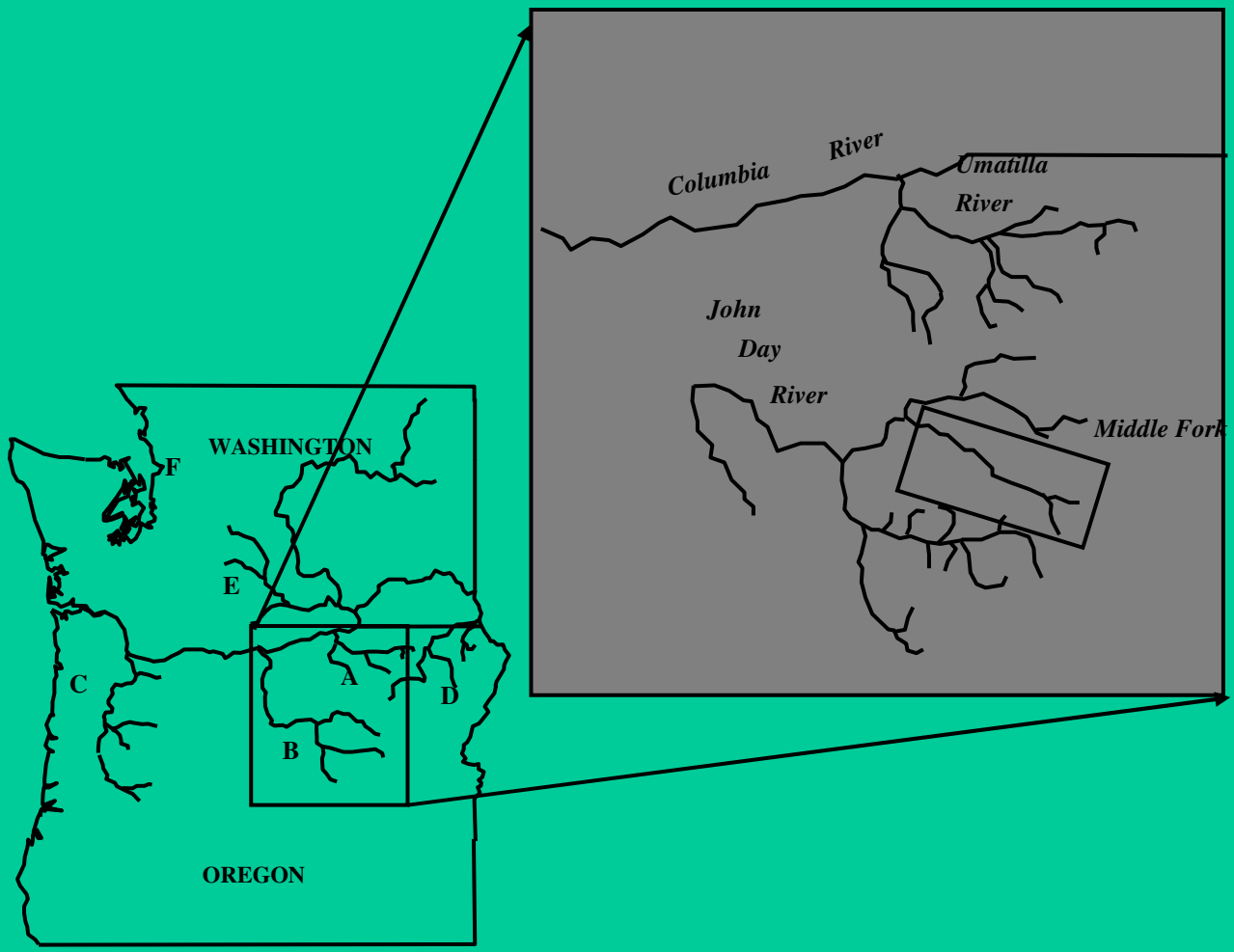
Anodonta spp.
Floaters

Gonidea angulata
Western ridged mussel

Percentage of freshwater mussels at risk by state (Williams & Neves 1995).



Study Areas


Columbia River
Umatilla River
John Day River
Middle Fork
WASHINGTON
F
E
C
A
D
B
OREGON

Where did mussels occur historically?

Museum Searches

Smithsonian Institution

CAS, ANSP, etc….

Tribal Elder Interviews

Results: Historical Data

Museum records are scant.

Tribal elders remember gathering mussels in Umatilla River.

***Margaritifera* shells found in current survey upstream in abandoned river channel (extirpated today?)**

Large shell middens in Umatilla drainage.

“Furthermore, it should be noted that the rapids on the Columbia immediately upstream of the Umatilla was called "muscle shell rapids"
by Lewis and Clark.”

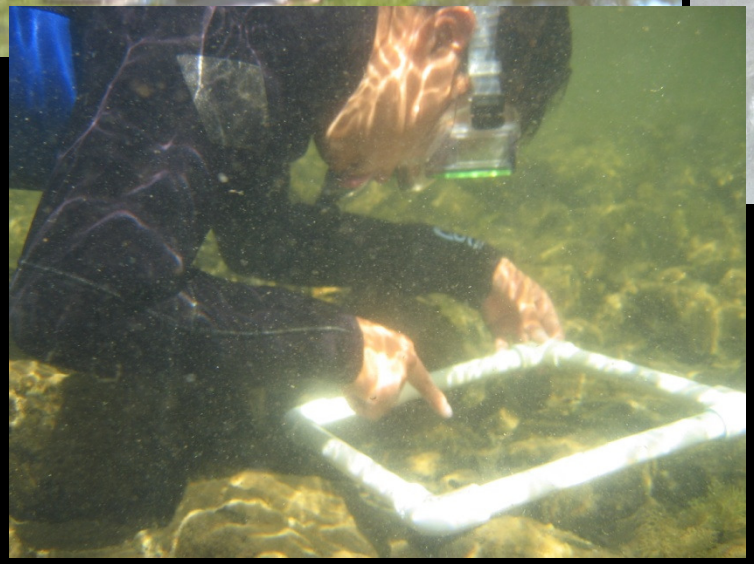
--Teara Farrow, Cultural Resources Protection Program, CTUIR

Umatilla River

Additional Sites: Tributaries

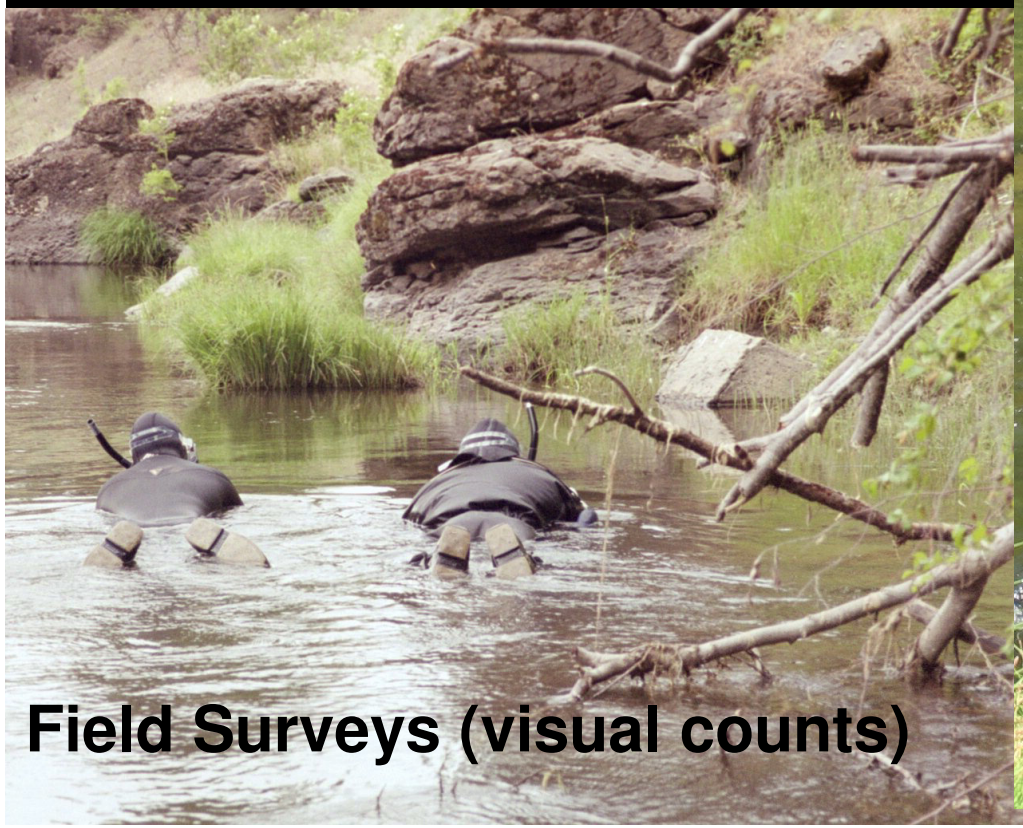
John Day River

Methods: Field Surveys



55 sites Umatilla & tribs.

37 sites Middle Fork & North Fork John Day



Field Surveys (visual counts)

55 Sites in the Umatilla River Drainage

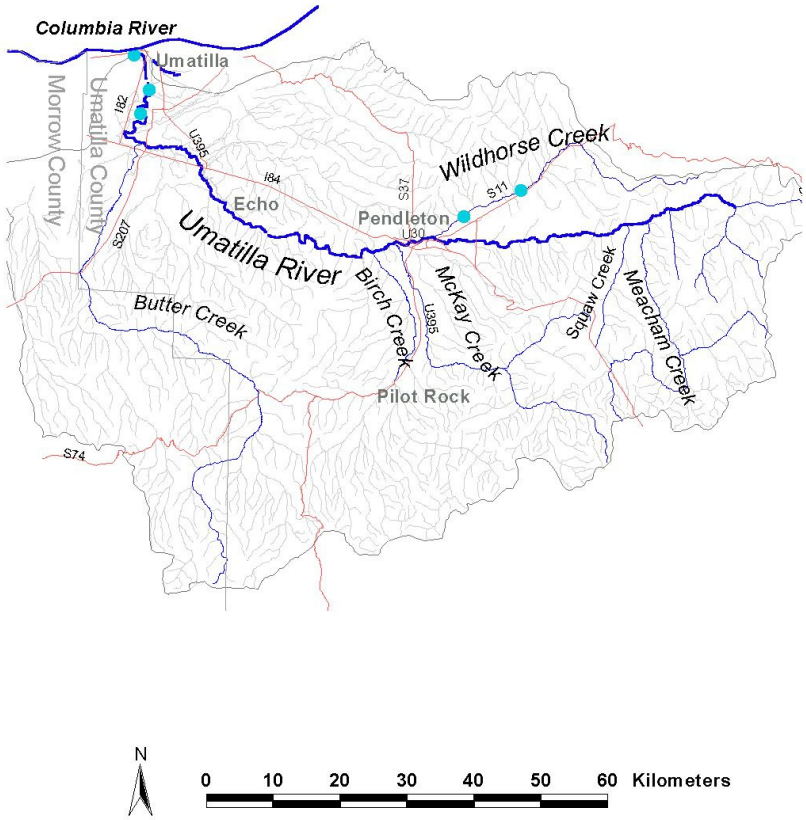
Sites with *Anodonta* present: ~ 7 %

Sites with *Gonidea* present: ~ 7 %

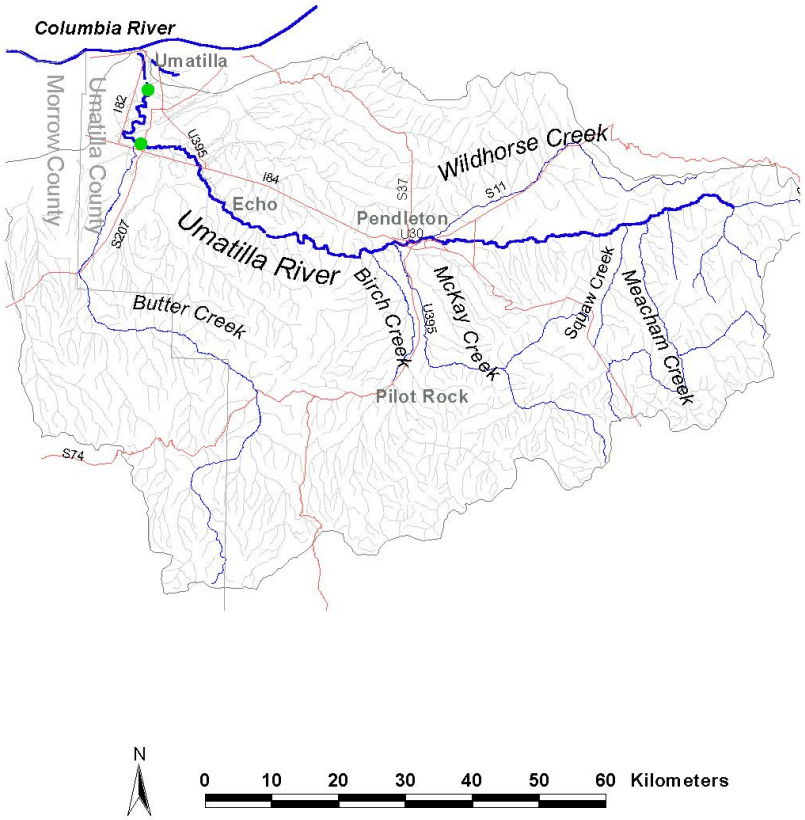
Sites with *Margaritifera* present: 0

Survey Results: Umatilla

Anodonta californiensis



Gonidea angulata



26 sites in the Middle Fork John Day

Sites with *Anodonta* present: ~ 85 %

Sites with *Gonidea* present: ~ 57 %

Sites with *Margaritifera* present: ~ 77 %

13 sites in the North Fork John Day

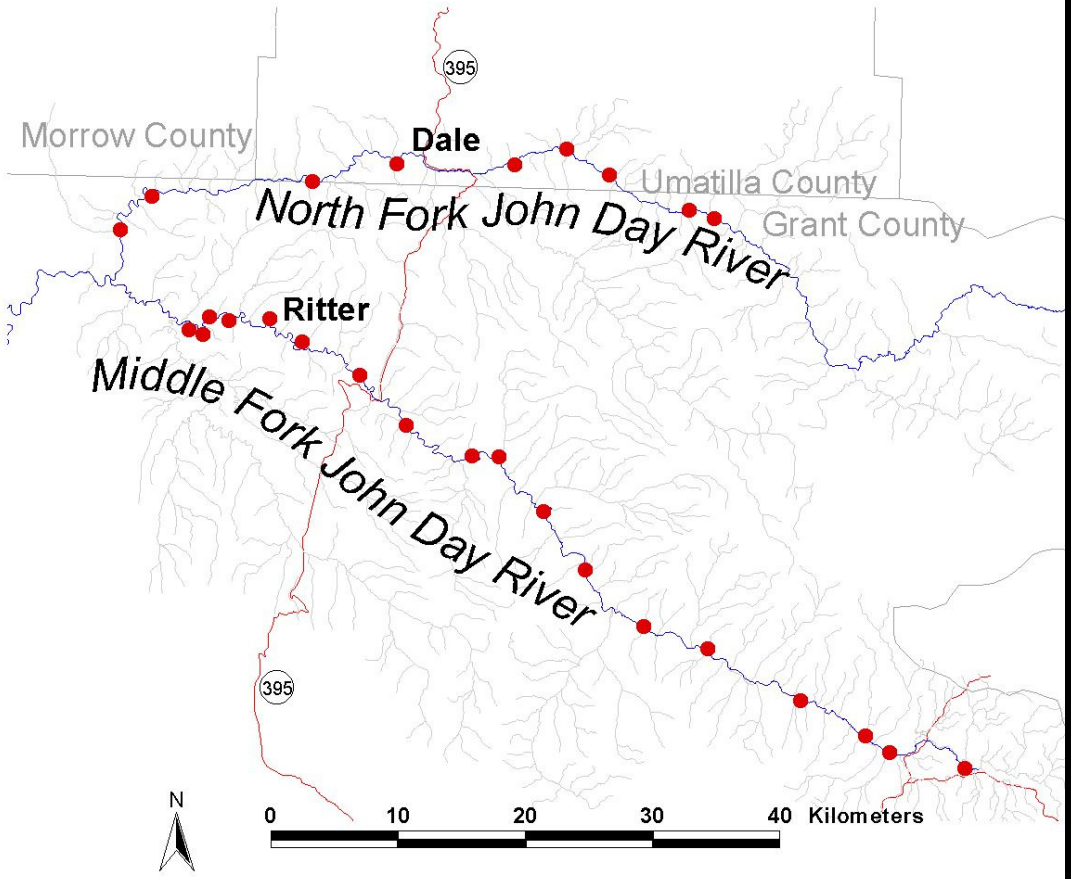
Sites with *Anodonta* present: ~ 46 %

Sites with *Gonidea* present: ~ 15 %

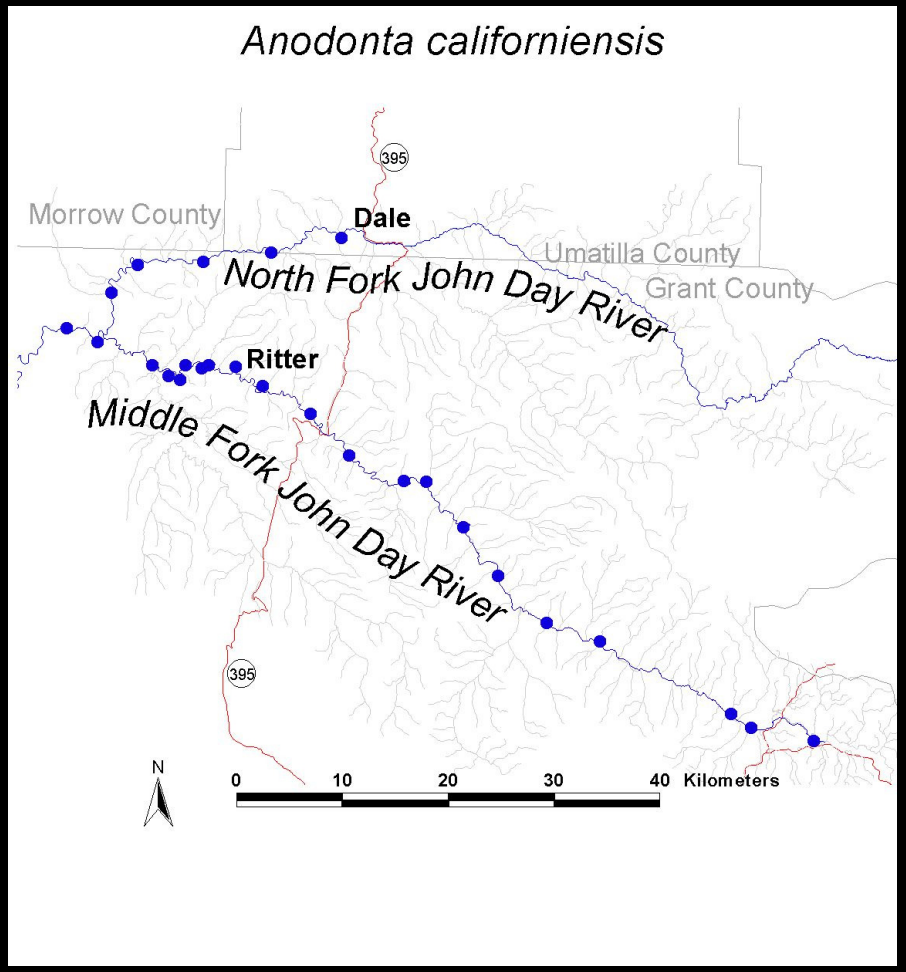
Sites with *Margaritifera* present: ~ 85 %

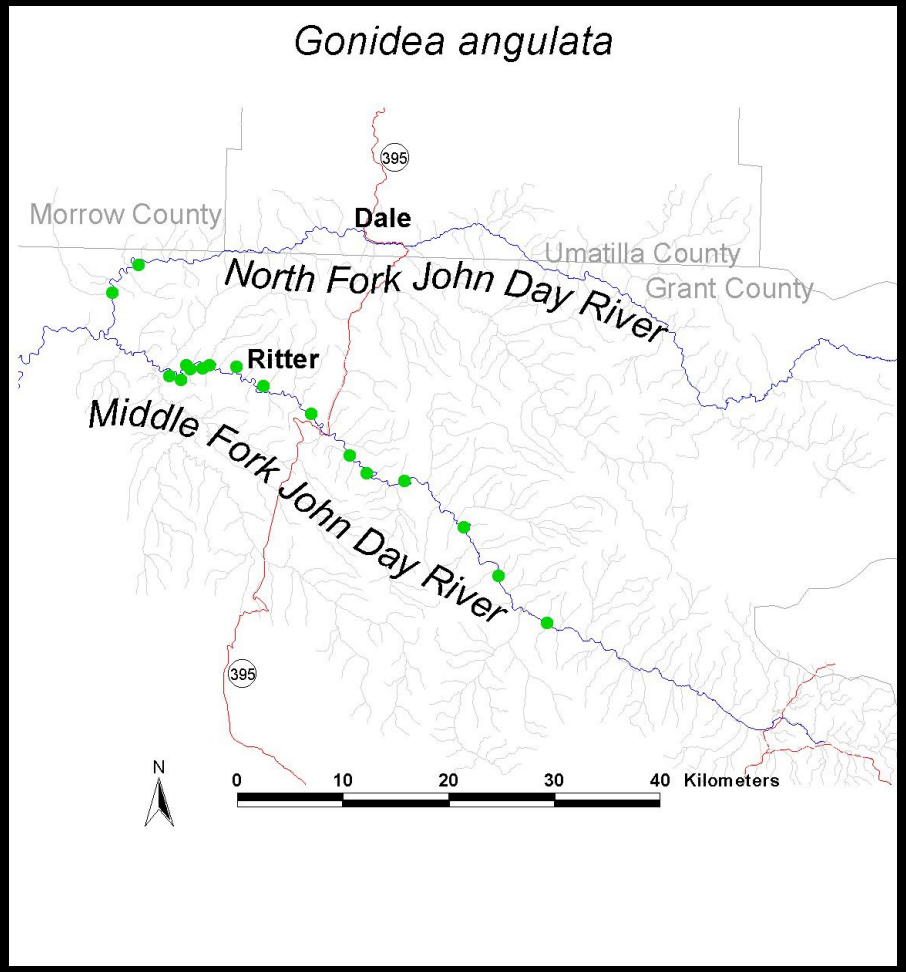
Middle and North Fork John Day rivers

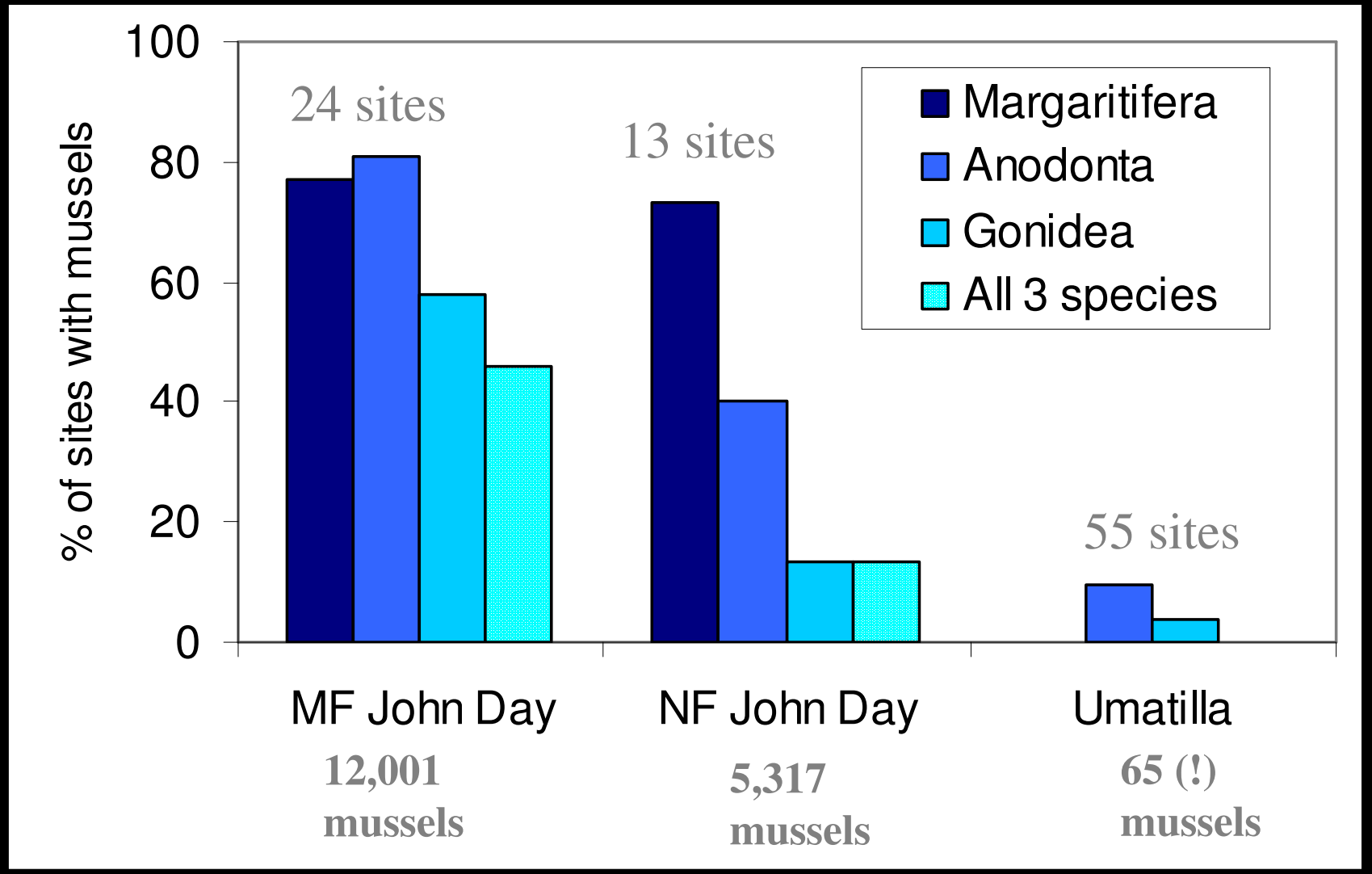
Margaritifera falcata



Middle and North Fork John Day







Why so few in Umatilla drainage?

(and how many other western rivers like this?)

Survey Conclusions:

- **Mussels were common in the Middle Fork and North Fork John Day.**
- **Mussels extirpated from most of main stem Umatilla River, but found in a few tributaries.**

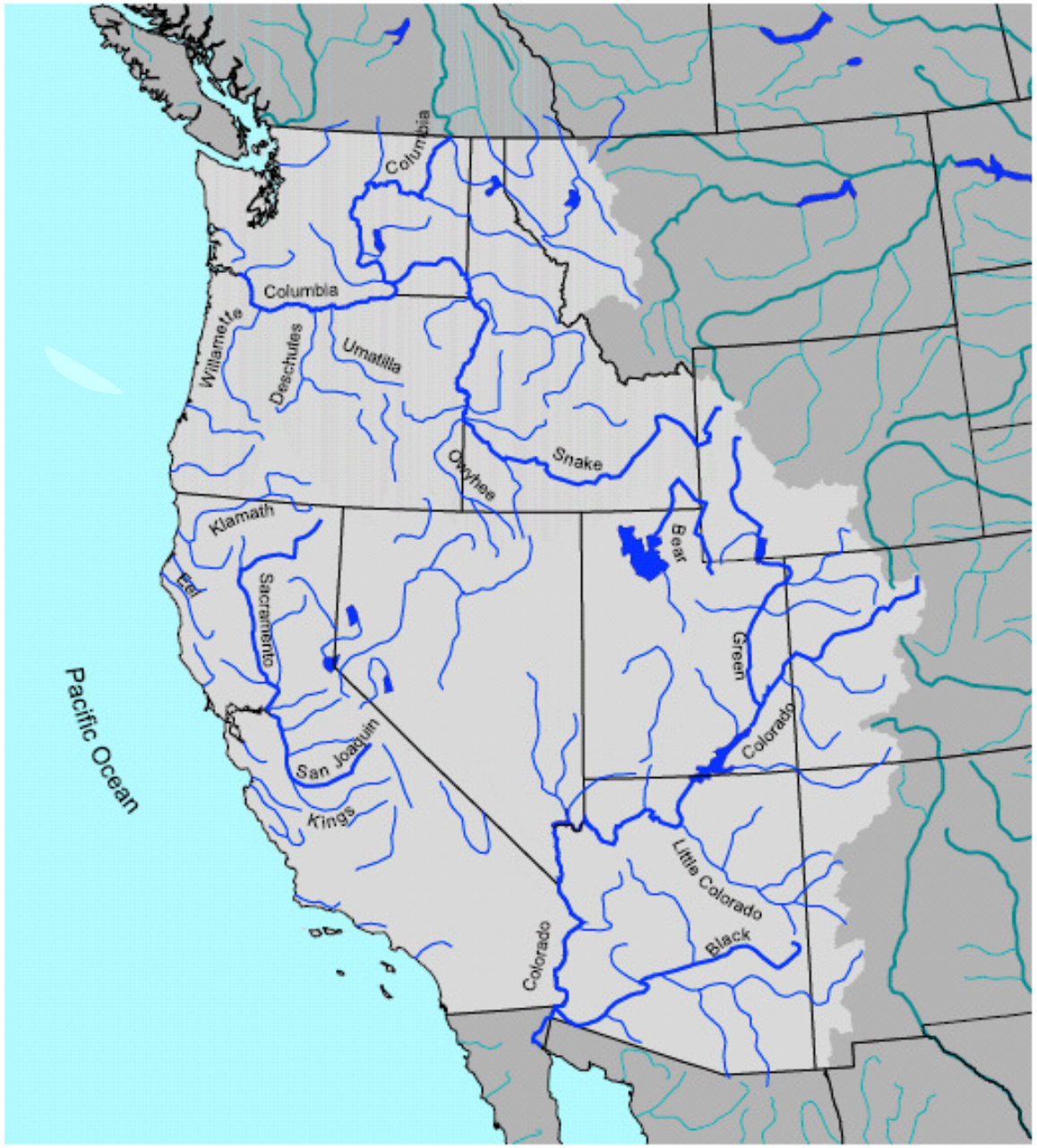
Now what ??? Restore Umatilla…

To Start:

What do we call them?

Why do we call them *that*?

Where are mussels now?



Currently Recognized Western Species of Freshwater Mussels

Anodonta beringiana Middendorff, 1851 (Yukon floater)

Anodonta californiensis I. Lea, 1852 (California floater)

Anodonta dejecta Lewis, 1875 (woebegone floater – extinct?)

Anodonta kennerlyi I. Lea, 1860 (western floater)

Anodonta oregonensis I. Lea, 1838 (Oregon floater)

Anodonta nuttalliana I. Lea, 1838 (winged floater)

Gonidea angulata (I. Lea, 1838) (western ridged mussel)

Margaritifera falcata (Gould, 1850) (western pearlshell)

Conservation Status? All Unknown in Williams et al. (1993)

Five of eight described from areas on or near ceded lands

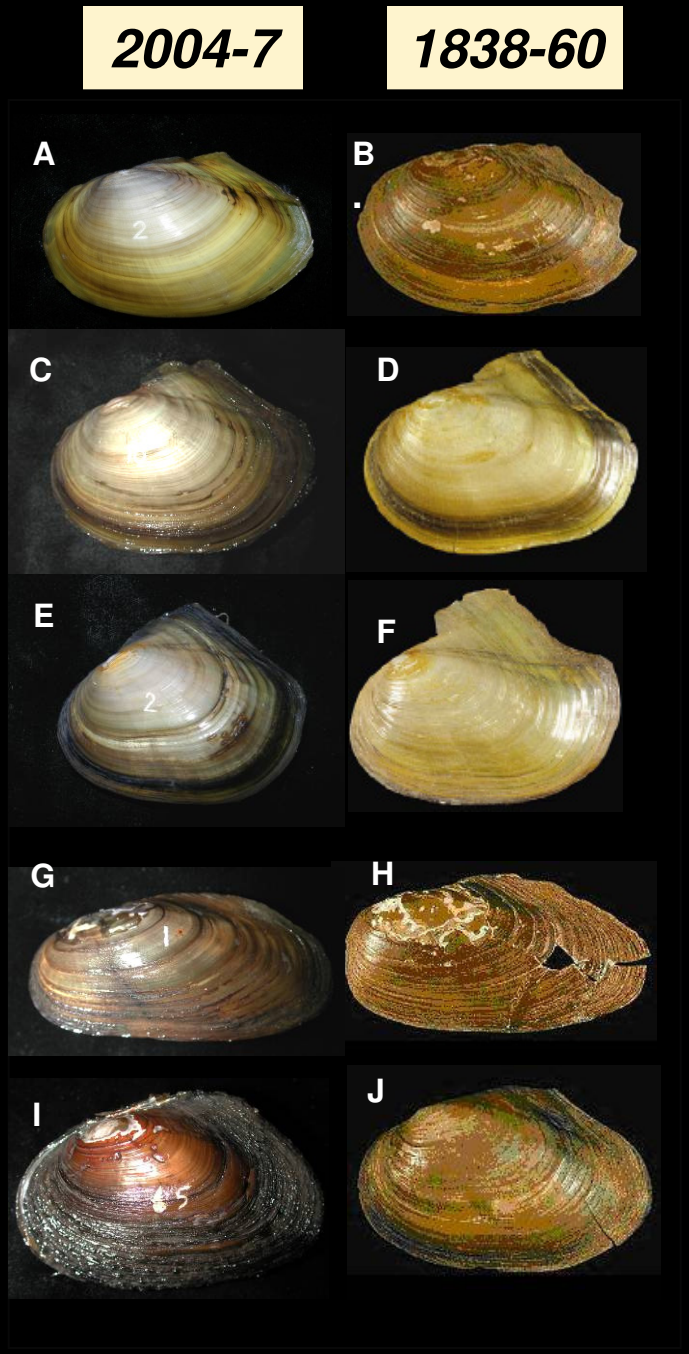
A. oregonensis morph
Will./Col. confluence

A. nuttalliana morph
Will./Col. confluence

A. nuttalliana morph
(wahlametensis?)
Will./Col. confluence

A. kennerlyi morph
Lake Chilliwack BC

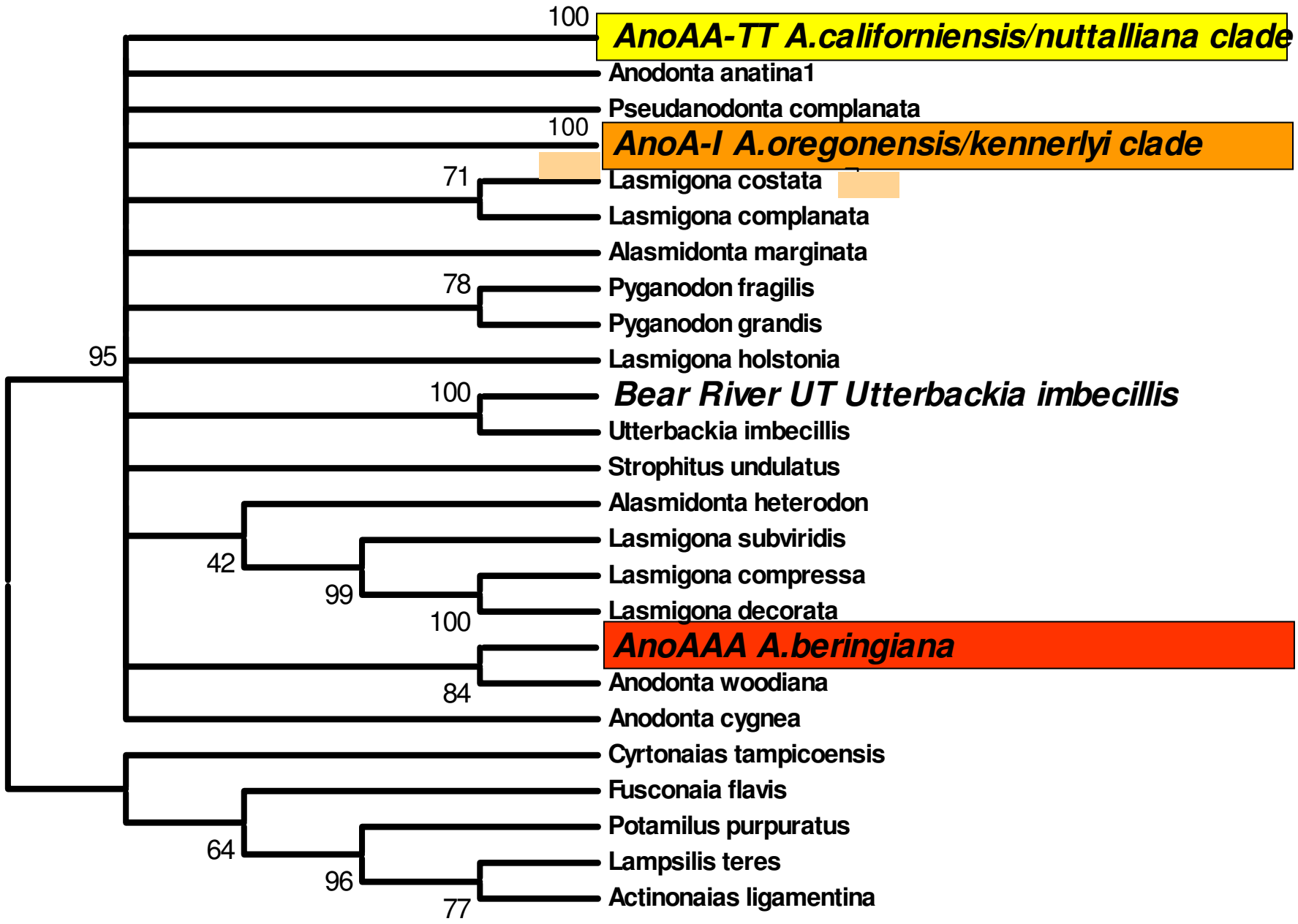
A. californiensis morph
Black River AZ

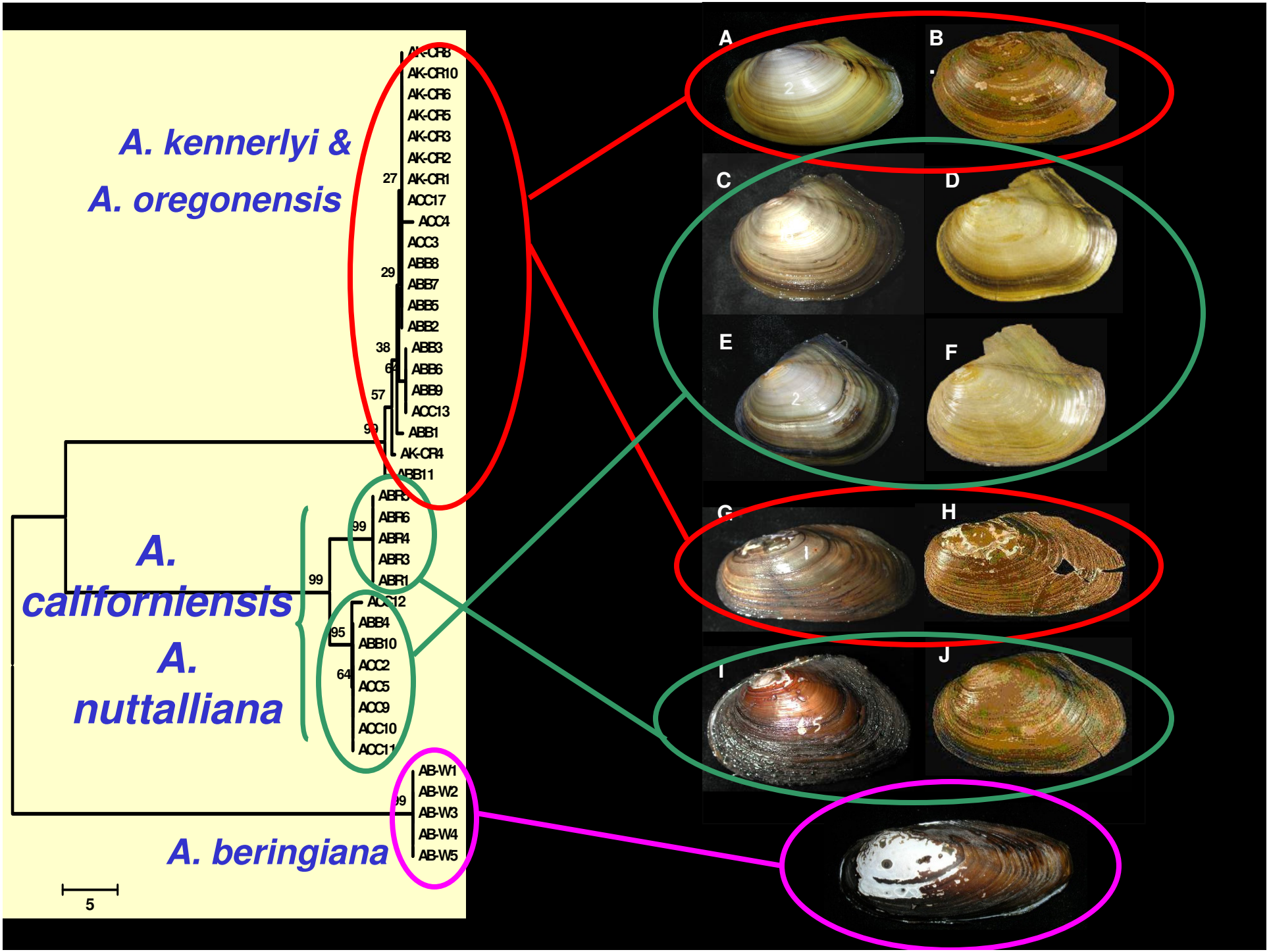


Methods: Genetic Analysis

Vouchers collected, relaxed, and preserved in 95% EtOH

Dr. Karen Mock & Jer Pin Chong


100
AnoAA-TT A.californiensis/nuttalliana clade
Anodonta anatina1
Pseudanodonta complanata
100
AnoA-I A.oregonensis/kennerlyi clade
71
Lasmigona costata
Lasmigona complanata
Alasmidonta marginata
78
Pyganodon fragilis
Pyganodon grandis
95
Lasmigona holstonia
100
Bear River UT Utterbackia imbecillis
Utterbackia imbecillis
Strophitus undulatus
Alasmidonta heterodon
Lasmigona subviridis
42
Lasmigona compressa
99
Lasmigona decorata
100
AnoAAA A.beringiana
Anodonta woodiana
84
Anodonta cygnea
Cyrtonaias tampicoensis
Fusconaia flavis
Potamilus purpuratus
64
Lampsilis teres
96
Actinonaias ligamentina
77


A. kennerlyi &
A. oregonensis
A. californiensis
A. nuttalliana
A. beringiana
AK-CR8
AK-CR10
AK-CR6
AK-CR5
AK-CR3
AK-CR2
AK-CR1
ACC17
ACC4
ACC3
ABB8
ABB7
ABB5
ABB2
ABB3
ABB6
ABB9
ACC13
ABB1
AK-CR4
ABB11
ABR6
ABR4
ABR3
ABR1
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ACC2
ACC5
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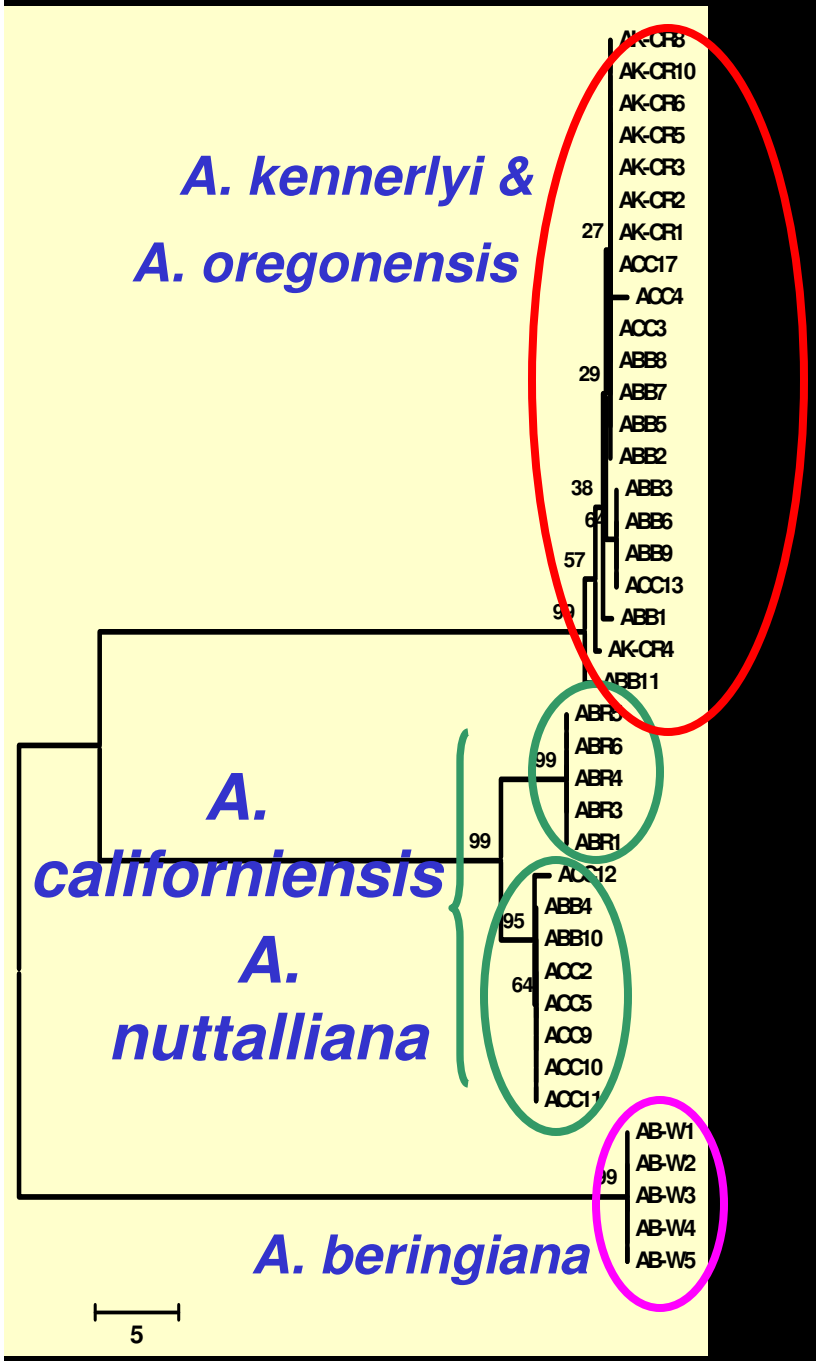


12-14% sequence divergence!

Results of Genetic Study:

Population-level Genetic Diversity Patterns Anodonta californiensis/nuttalliana clade

- **Populations near the Columbia River tend to be the most diverse**
- **Most populations have very low diversity and seem to be experiencing genetic drift.**
- **Some isolated populations are so inbred they are almost identical genetically**
- **Genetic diversity does not seem closely related to perceived population size in the field.**

Results of Genetic Study:

Population-level Genetic Diversity Patterns
Margaritifera falcata

- **Very little genetic diversity!!**

Goal: get mussels back into Umatilla

What we know so far:

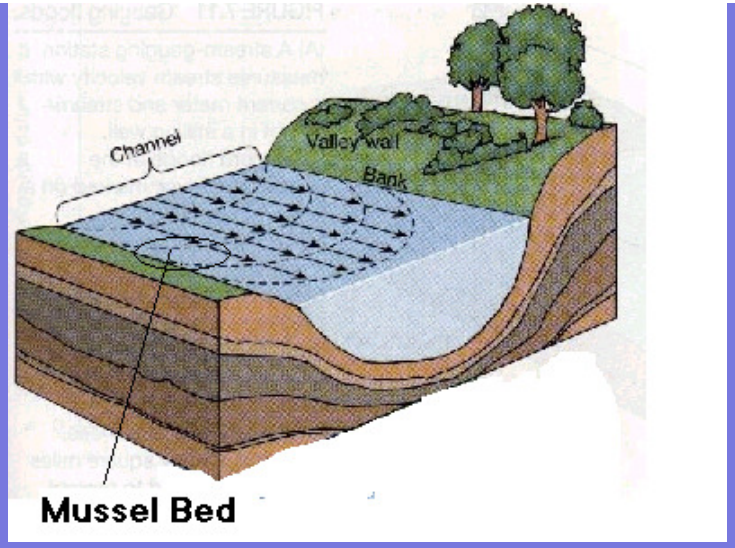
1. *M. falcata* is absent in Umatilla

2. *M. falcata* would be the easiest species to use based on genetics

Meso Scale

- **All three genera positively associated with pools and runs.**

- **Negatively associated with cascades.**

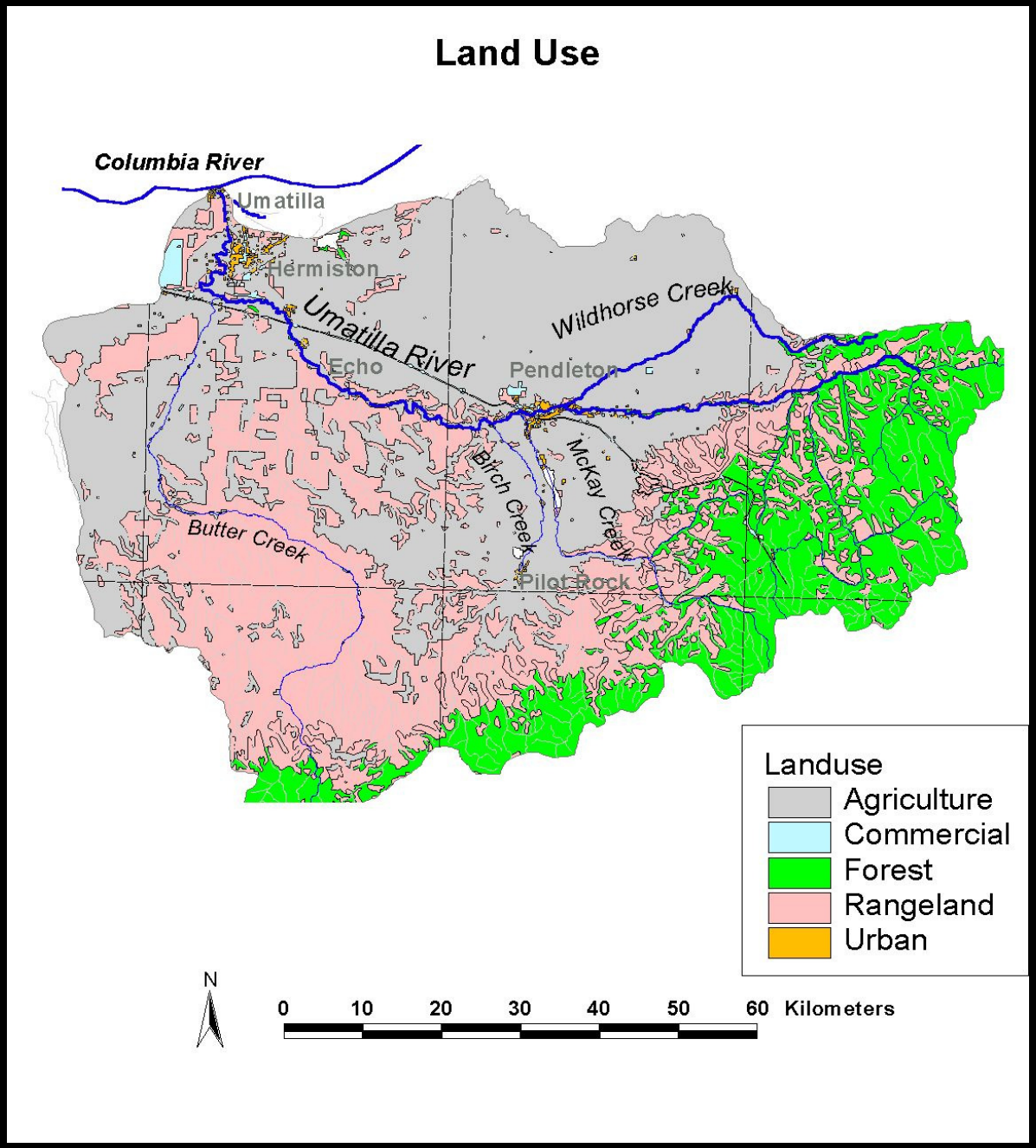


- **Occurred in river stretches with the lowest average channel gradient.**

- ***Margaritifera falcata* occurred in higher slope areas than the other two genera, but not in areas above a 3% gradient.**

- ***Anodonta californiensis* and *Gonidea angulata* were concentrated in areas of the channel where slopes were generally < 1%.**

- **This may explain why *Anodonta californiensis* and *Gonidea angulata* were concentrated in the lower reaches of the channel.**

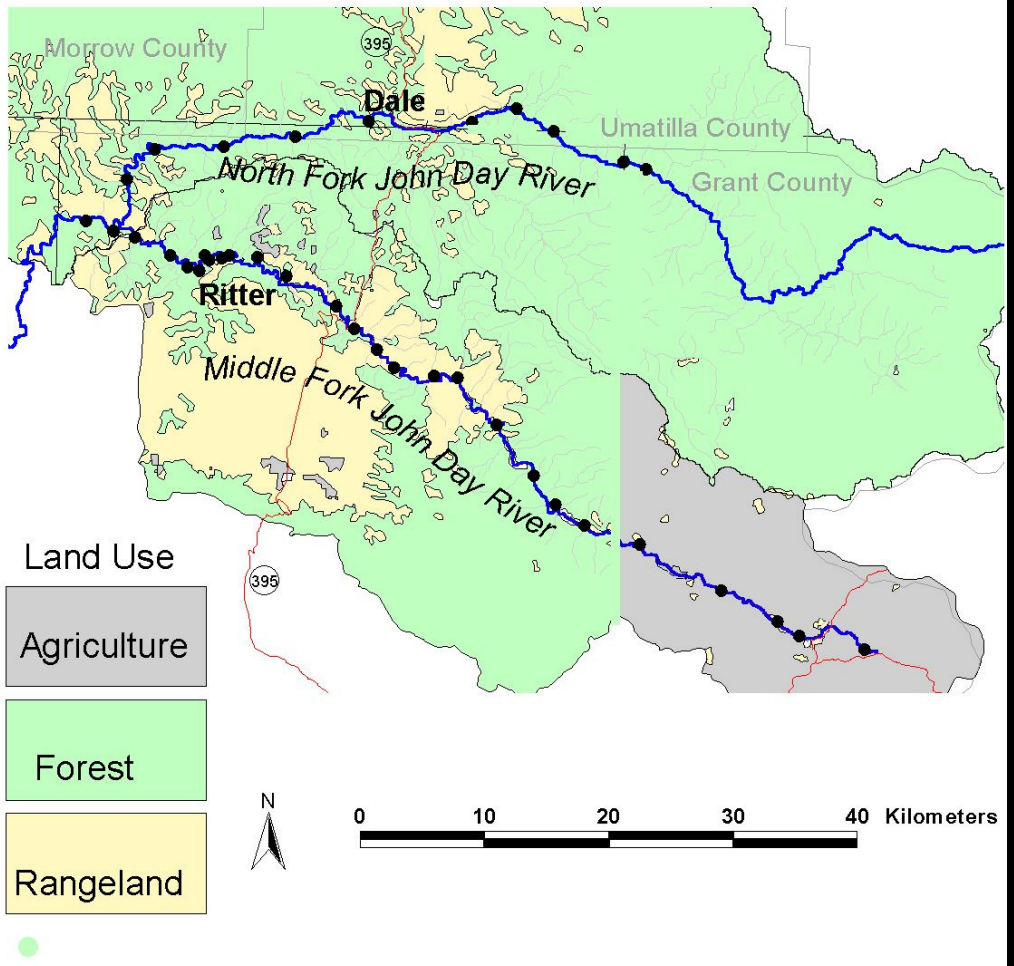


Why?

Land use patterns?

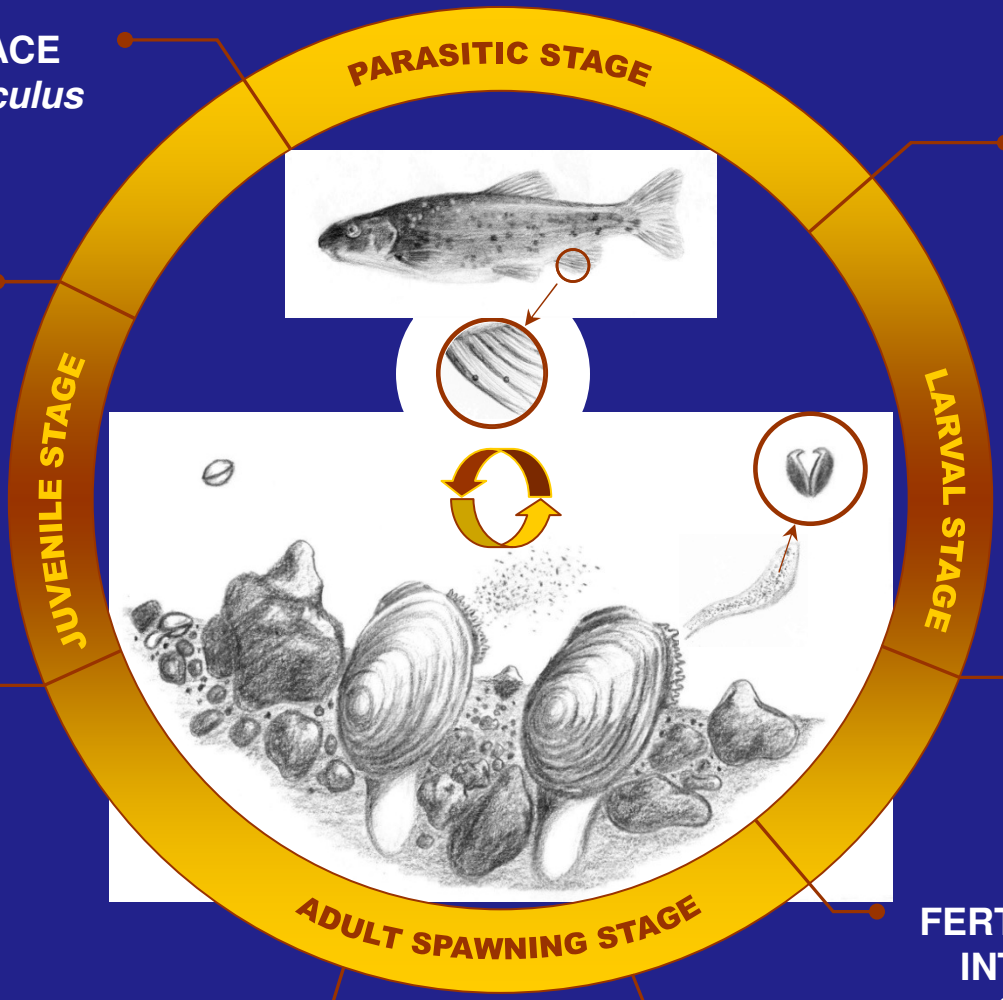
Middle and North Fork John Day rivers

Land Use



Host Fish Studies

LIFE-CYCLE FRESHWATER MUSSEL: Anodonta oregonesis



SPECKLED DACE
Rhinichthys osculus

GLOCHIDIA ATTACH TO FINS OF HOST FISH

TRANSFORMED GLOCHIDIA, NOW A JUVENILE MUSSEL, RELEASE FROM HOST FISH

GLOCHIDIA ARE RELEASED FROM ADULT MUSSEL

THE YOUNG MUSSEL WILL SECURE ITSELF WITHIN THE SUBSTRATE

FERTILIZED EGGS DEVELOP INTO LARVAL MUSSELS CALLED GLOCHIDIA

ADULT MALE

ADULT FEMALE

Illustration by Jeremy Wolf, CTUIR

Methods: Host Fish Study

Field studies

Laboratory studies

Laboratory experiments

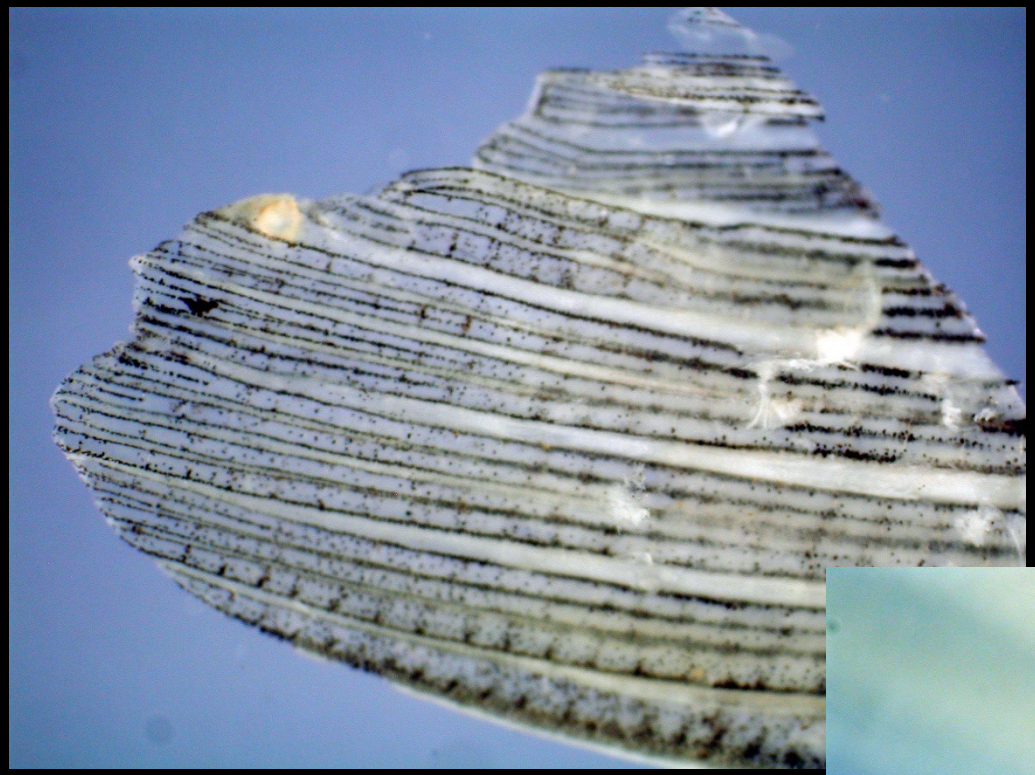
Results: Host Fish (Laboratory)

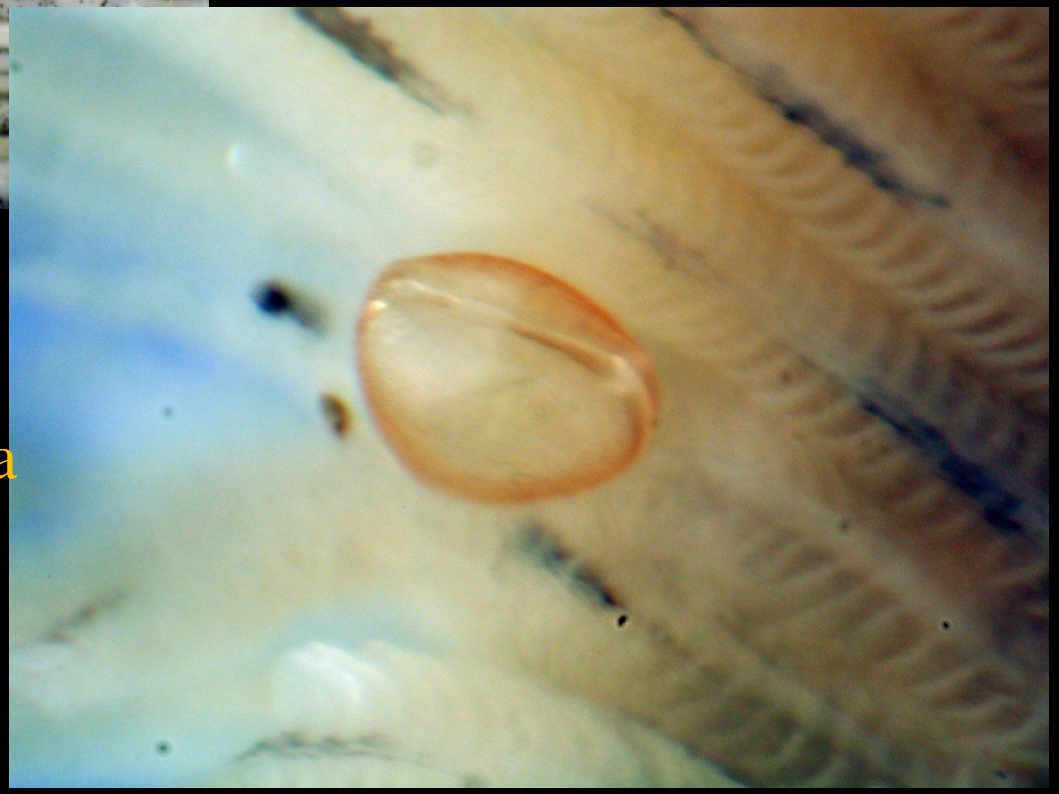
Anodonta californiensis

- Longnose dace
- Speckled dace
- Margined sculpin (marginally only!!)

Gonidia angulata

- Margined sculpin
- Torrent sculpin





Close-up of Anodonta Glochidia
(~ 250-300 microns)

Margaritifera falcata

Results: Host Fish (Field)

Anodonta californiensis

- **Every fish species (8% - 85%)**
- **Speckled dace had highest % fish found with encysted glochidia.**

Gonidea angulata

- 100% torrent sculpin in July had glochidia
- No other fish species had encysted glochidia

Relocation Trials….*in progress*

Dr. Jeanette Howard then Dr. Tamao Kasahara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WATERTIGHT
lifetime guarantee


New threats – "Restoration Projects"
– maybe for salmon….but not for mussels!!
August 10, 2009 restoration site #1

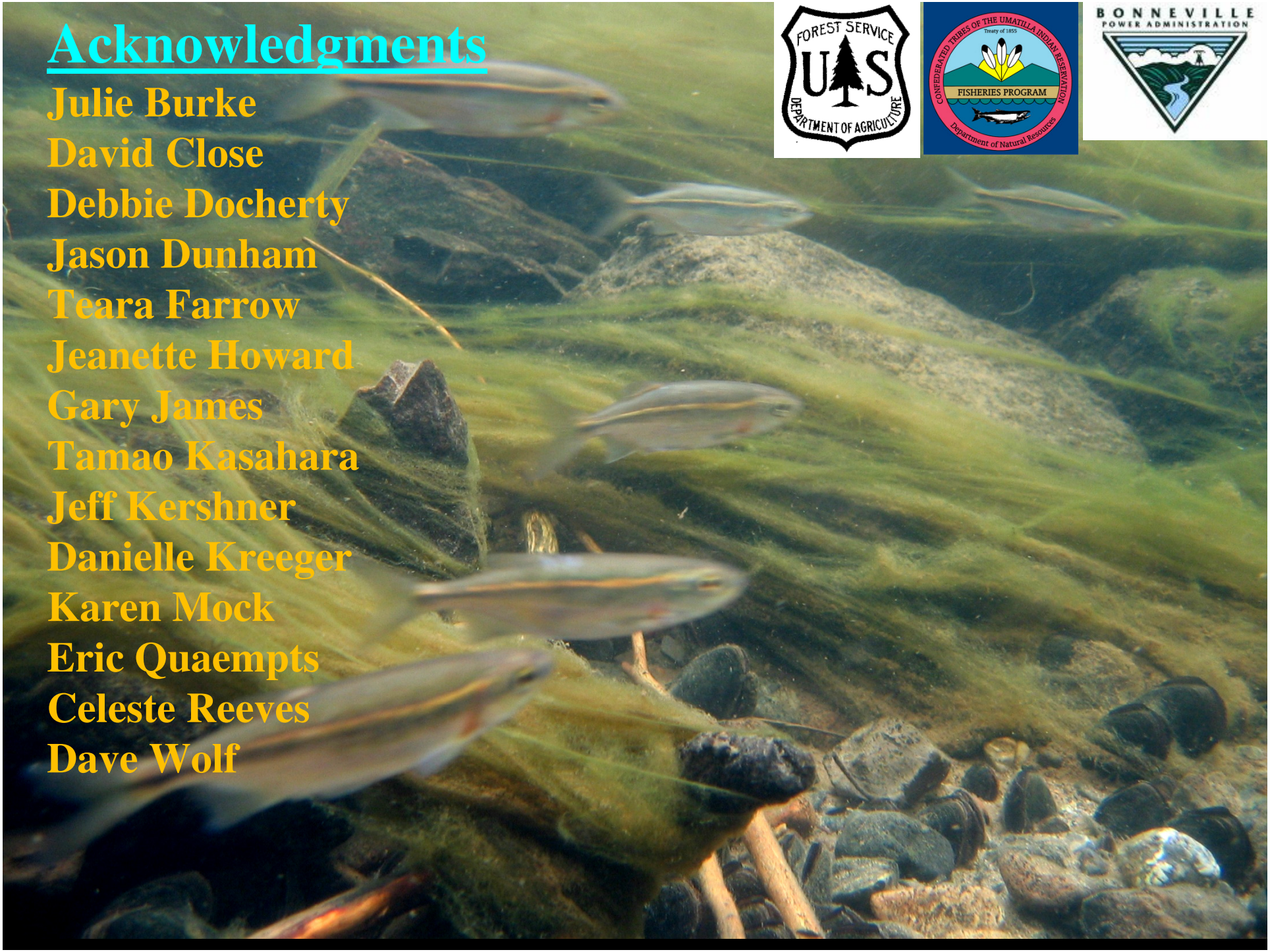
Channel de-watered 100 m above mussel bed where all three western\ genera occurred.

Massive losses to existing beds.

Restoration site #2 August 2010.
5,174 mussels were relocated

Vision Statement

" The Umatilla basin includes a healthy river capable of providing First Foods that sustain the continuity of the Tribe's culture. This vision requires a river that is dynamic, and shaped not only by physical and biological processes, but the interactions and interconnections between those processes."



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Jeff Kershner
Danielle Kreeger
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Eric Quaempts
Celeste Reeves
Dave Wolf