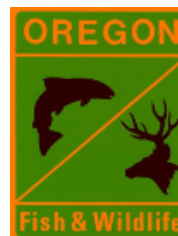


REARING STRATEGIES AFFECT BODY MORPHOLOGY AND CAUDAL FIN QUALITY IN JUVENILE CHINOOK SALMON

KAREN M. COGLIATI
CAMERON S. SHARPE
ROB CHITWOOD
DAVID L.G. NOAKES
CARL B. SCHRECK

*67TH ANNUAL NORTHWEST
FISH CULTURE CONCEPTS*

DECEMBER 6, 2016

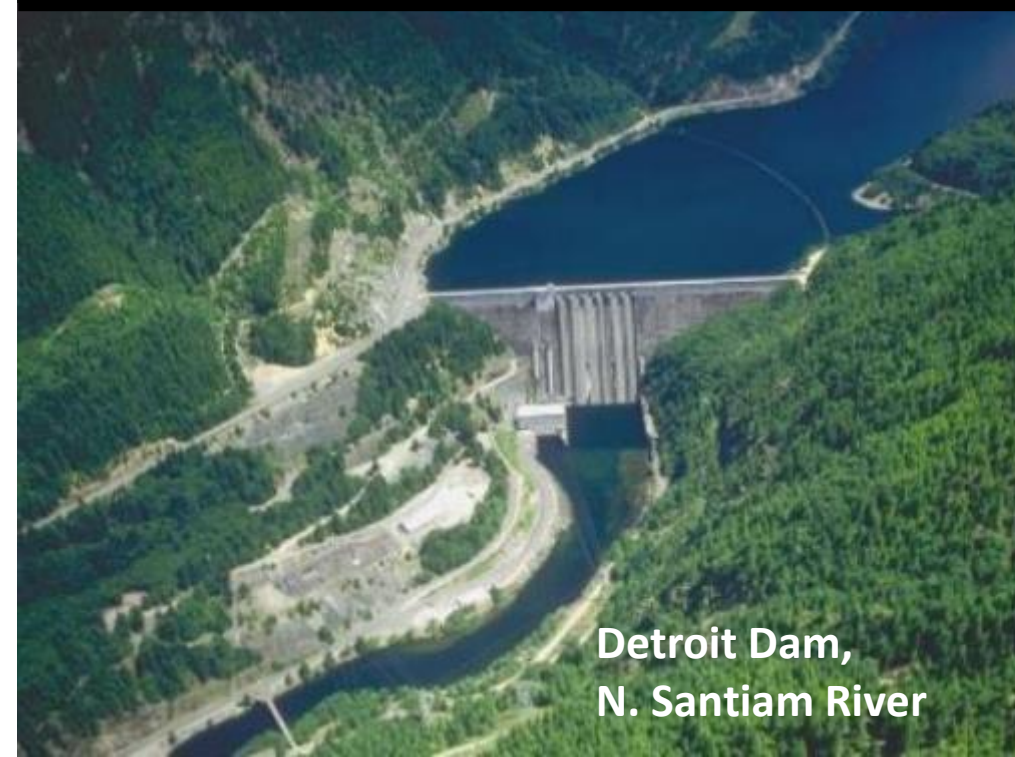


THE COMPLEX ISSUE OF DAMS

- Numerous benefits:
 - Hydroelectricity, flood control, recreation
- But, they change the landscape and environment
- Impair anadromous fish passage
 - Declines in wild fish populations
 - Hatchery fish added to the system



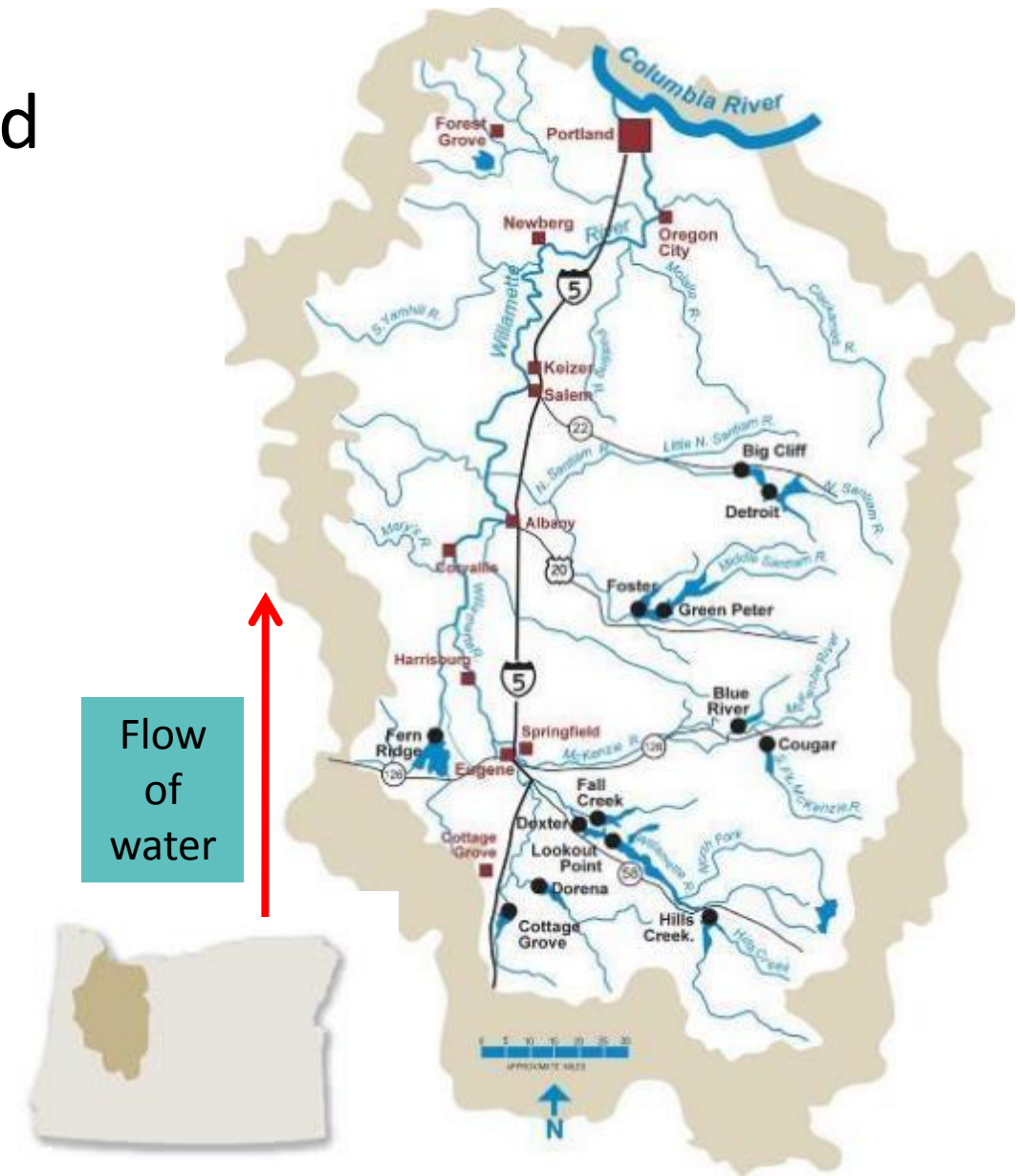
Cougar Dam,
McKenzie River



Detroit Dam,
N. Santiam River

WILLAMETTE VALLEY PROJECT DAMS (OREGON USA)

- Studies evaluating juvenile salmonid movement to and through dams
- Many salmonids ESA listed



HATCHERY AND WILD DIFFERENCES

Chinook Salmon (*Oncorhynchus tshawytscha*)

Hatchery Fish (Marion Forks)
North Santiam
Oregon State University
Life Stage: Smolt
Length: 140mm



Illustration and copyright: Paul Vecsei
Source material: Dr. David Noakes



Chinook Salmon (*Oncorhynchus tshawytscha*)

Wild Fish
Willamette Falls
Oregon State University
Life Stage: Smolt
Length: 151mm



Illustration and copyright: Paul Vecsei
Source material: Dr. David Noakes

Behavior
Morphology
Physiology
Genetics

HATCHERY AND WILD REARING ENVIRONMENT



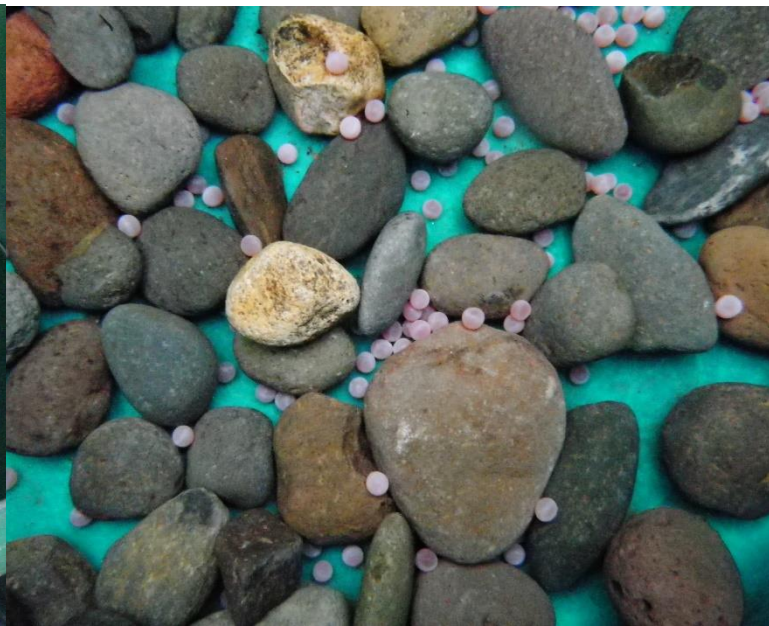


How can we study impacts on wild fish without using wild fish?

Growing interest in creating more wild-like phenotypes

WILD FISH SURROGATE PROJECT

- Produce juvenile salmonids in artificial environments that emulate specific wild fish phenotypes
 - Spring Chinook salmon
 - Winter steelhead trout



Chinook Salmon (*Oncorhynchus tshawytscha*)

Wild Fish Surrogate
Fish Performance and Genetics Lab
Oregon State University
Life Stage: Smolt
Length: 159mm



Illustration and copyright: Paul Vecsei
Source material: Dr. David Noakes

WILD FISH SURROGATE PROJECT

Goal:

Rear and deliver surrogate fish to researchers

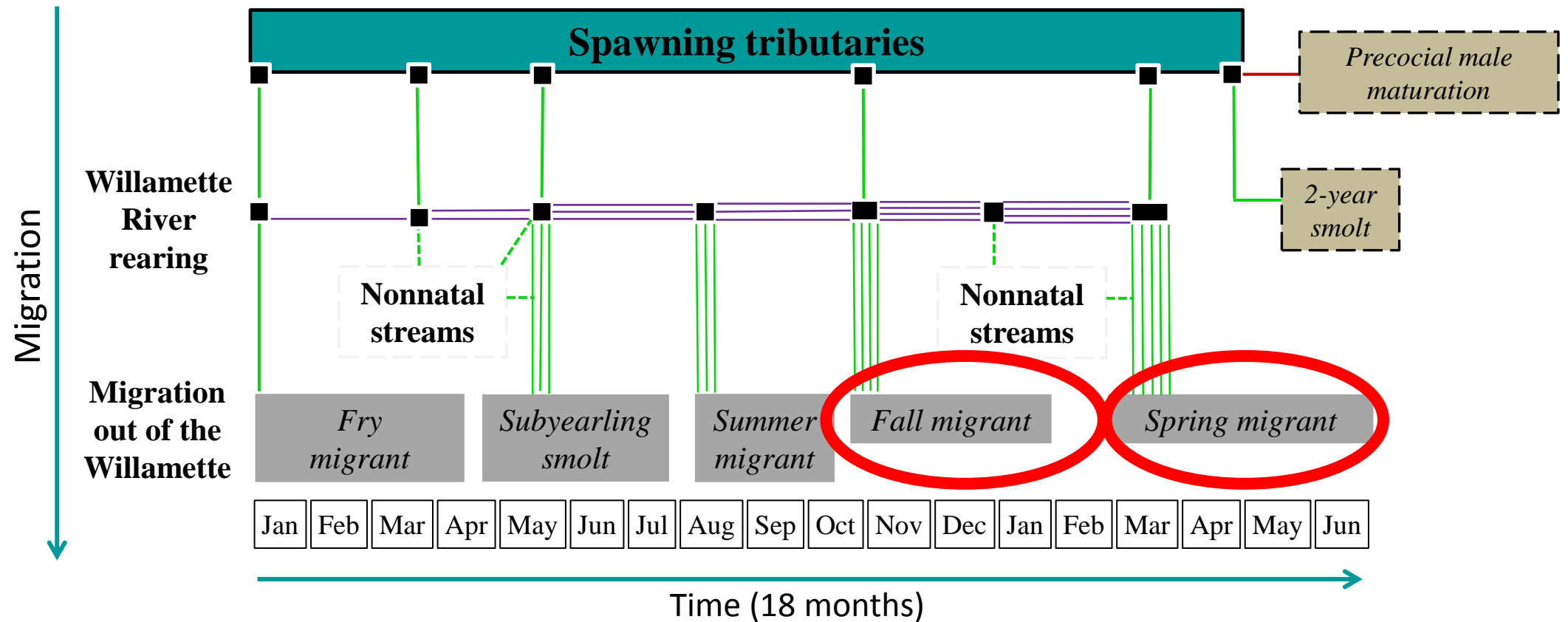
Objectives:

1. Develop rearing protocols that produce more wild-like fish
2. Establish criteria to evaluate the quality and phenotypic accuracy of our surrogates
3. Describe phenotypes of naturally-reared fish to establish target phenotypes
4. Describe phenotypes of hatchery-reared fish to determine the effects of conventional hatchery protocols

ESTABLISHING TARGET PHENOTYPES



JUVENILE CHINOOK SALMON LIFE HISTORIES



ALTERED REARING ENVIRONMENT

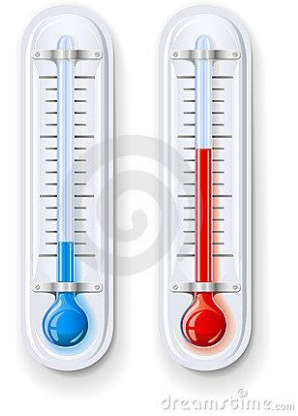
Diet



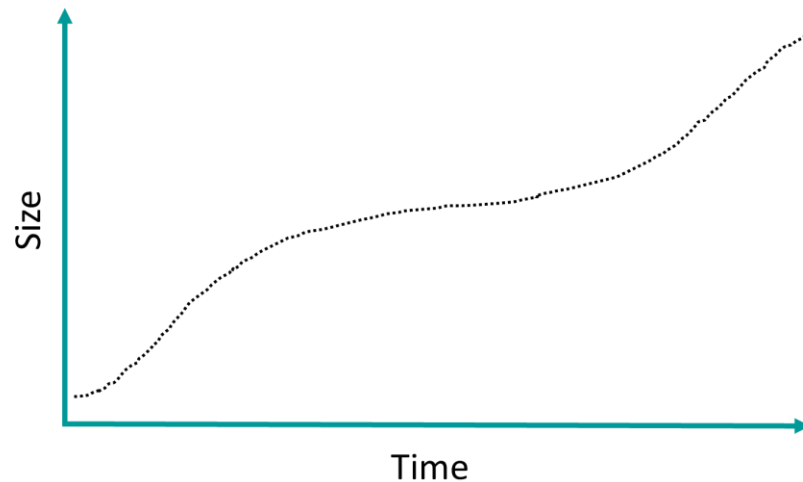
Density



Temperature



Wild-like growth



Tank environment



HOW DO OUR SURROGATES COMPARE?

- Body morphometrics
- Body composition
- Osmoregulation
- Physiology
- Behavior
- Genetic
- Fin quality
- Precocial male maturation

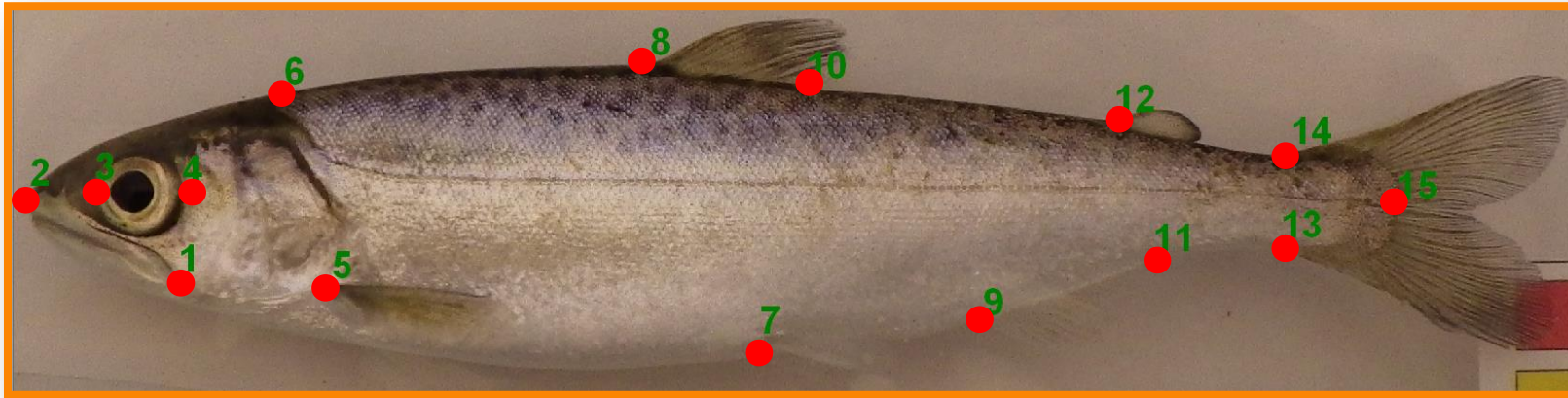
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Wild Fish Surrogate
Fish Performance and Genetics Lab
Oregon State University
Life Stage: Smolt
Length: 159mm



Illustration and copyright: Paul Vecsei
Source material: Dr. David Noakes

- Landmark-based geometric morphometrics



BODY MORPHOMETRICS — SPRING MIGRANTS

Hatchery



Wild



Photos are to scale

BODY MORPHOMETRICS — SPRING MIGRANTS

Hatchery



Wild



Photos are to scale

BODY MORPHOMETRICS — SPRING MIGRANTS

Hatchery



Surrogate



Wild



Photos are to scale

BODY MORPHOMETRICS — SPRING MIGRANTS

Hatchery



Surrogate



Wild



Photos are to scale

BODY MORPHOMETRICS — SPRING MIGRANTS

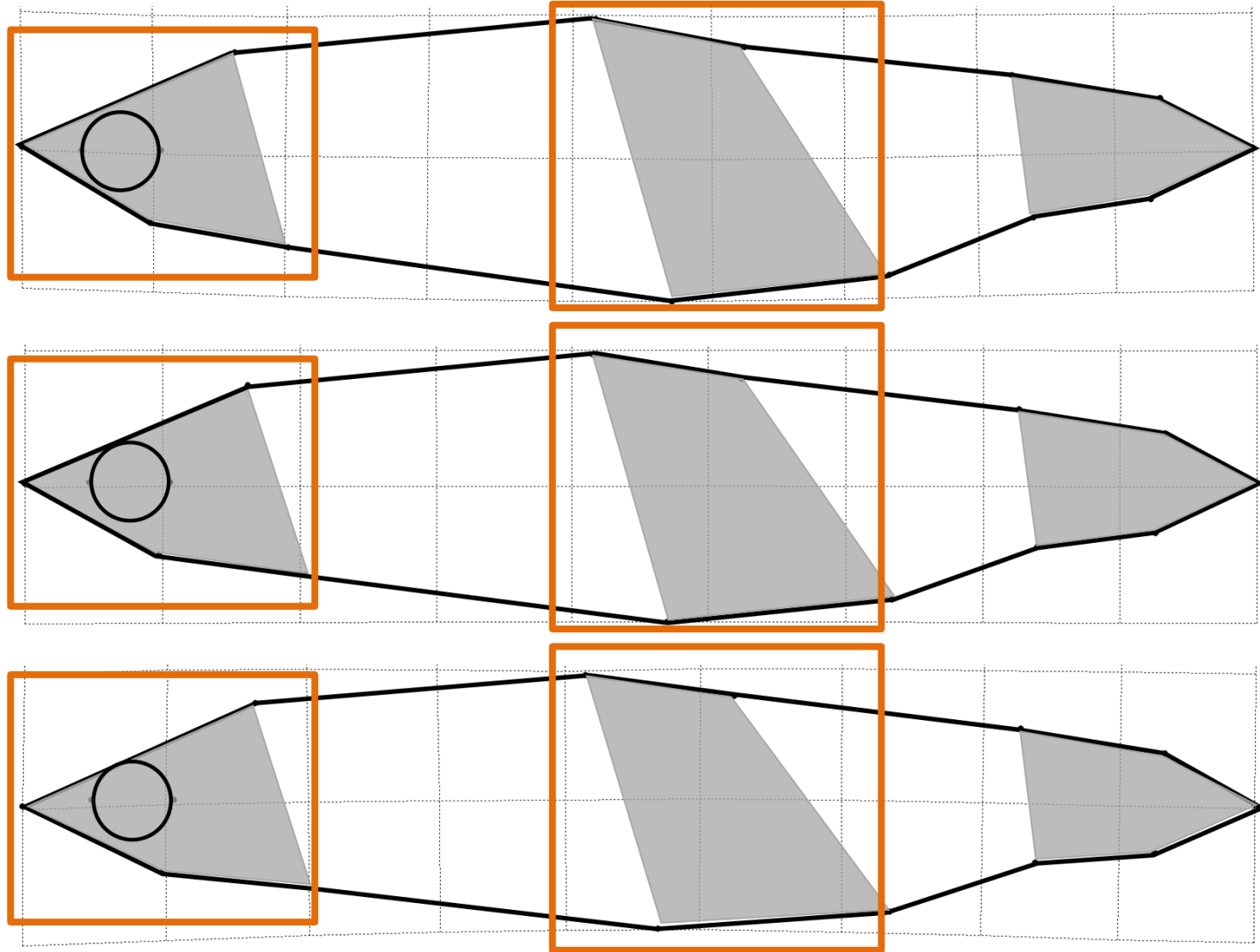
Hatchery



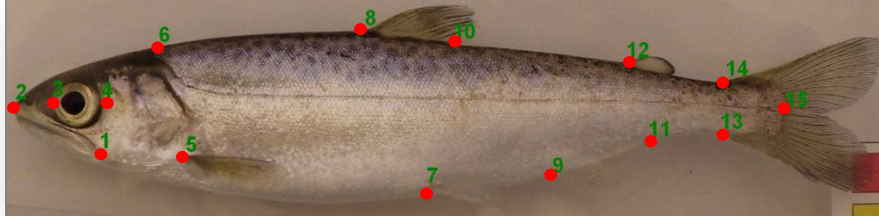
Surrogate



Wild

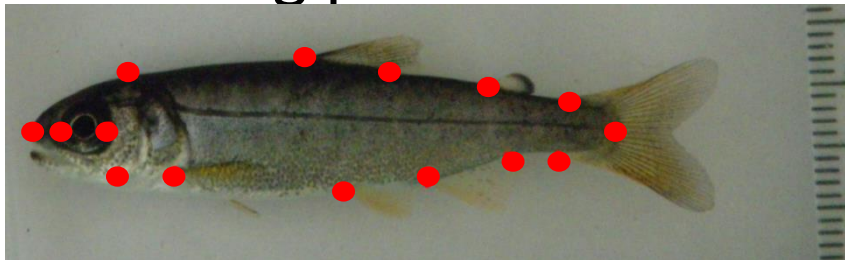


WILD MIGRANT MORPHOLOGY

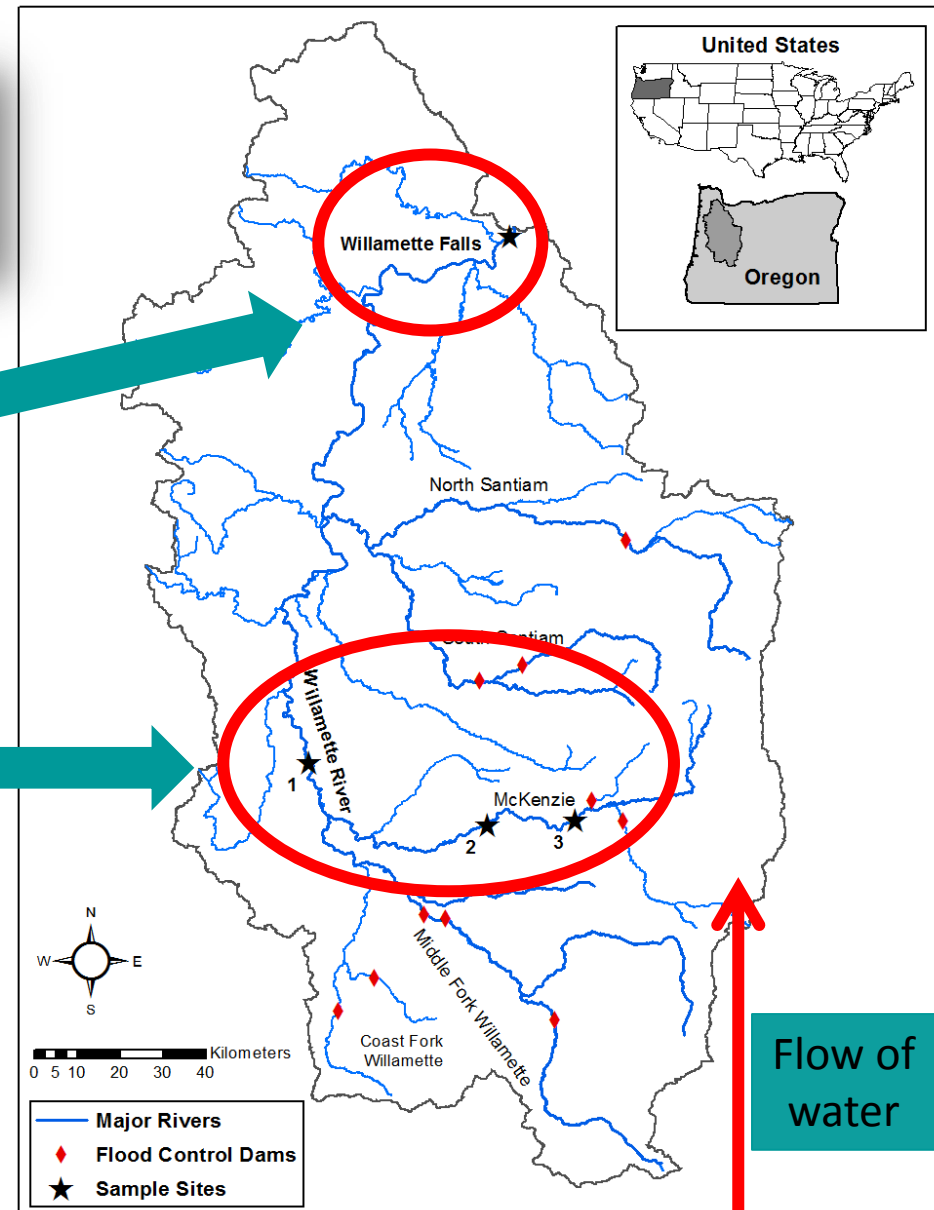


Fall or spring
migrants

Tributary and
mainstem
rearing parr

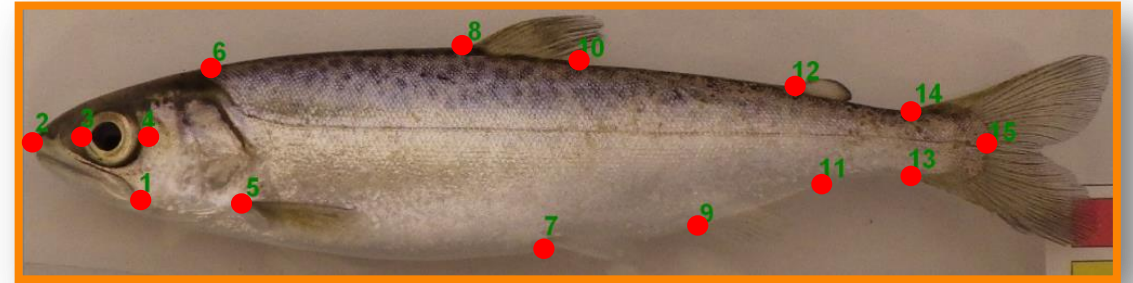


Billman et al. 2014

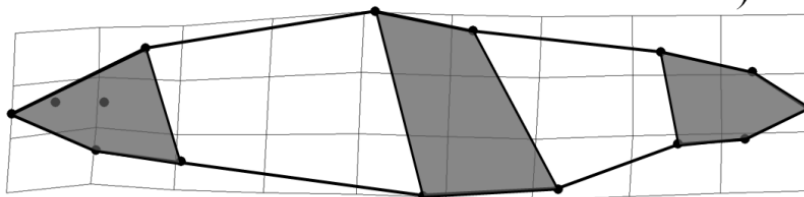


WILD MIGRANT MORPHOLOGY

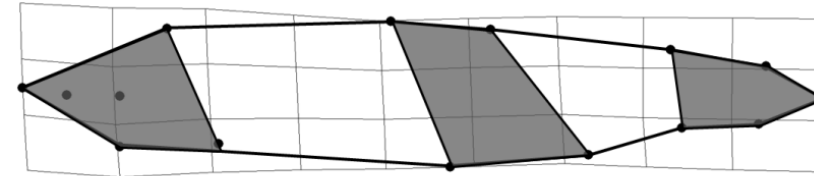
Landmark-based geometric morphometrics



a) Migrants

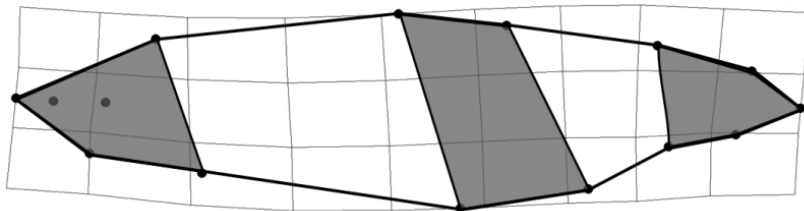


Fall migrant

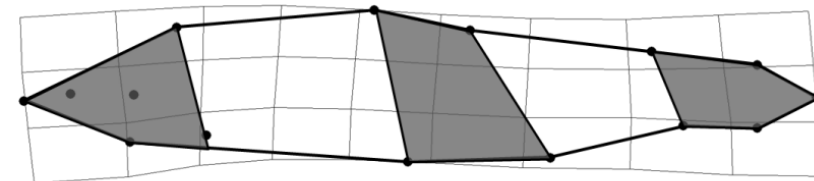


Spring migrant

b) Parr



Downstream



Upstream

EFFECTS OF REARING ENVIRONMENT

Hatchery



Surrogate



OHRC Stream



Wild



CAUDAL FIN QUALITY



Hatchery



Surrogate

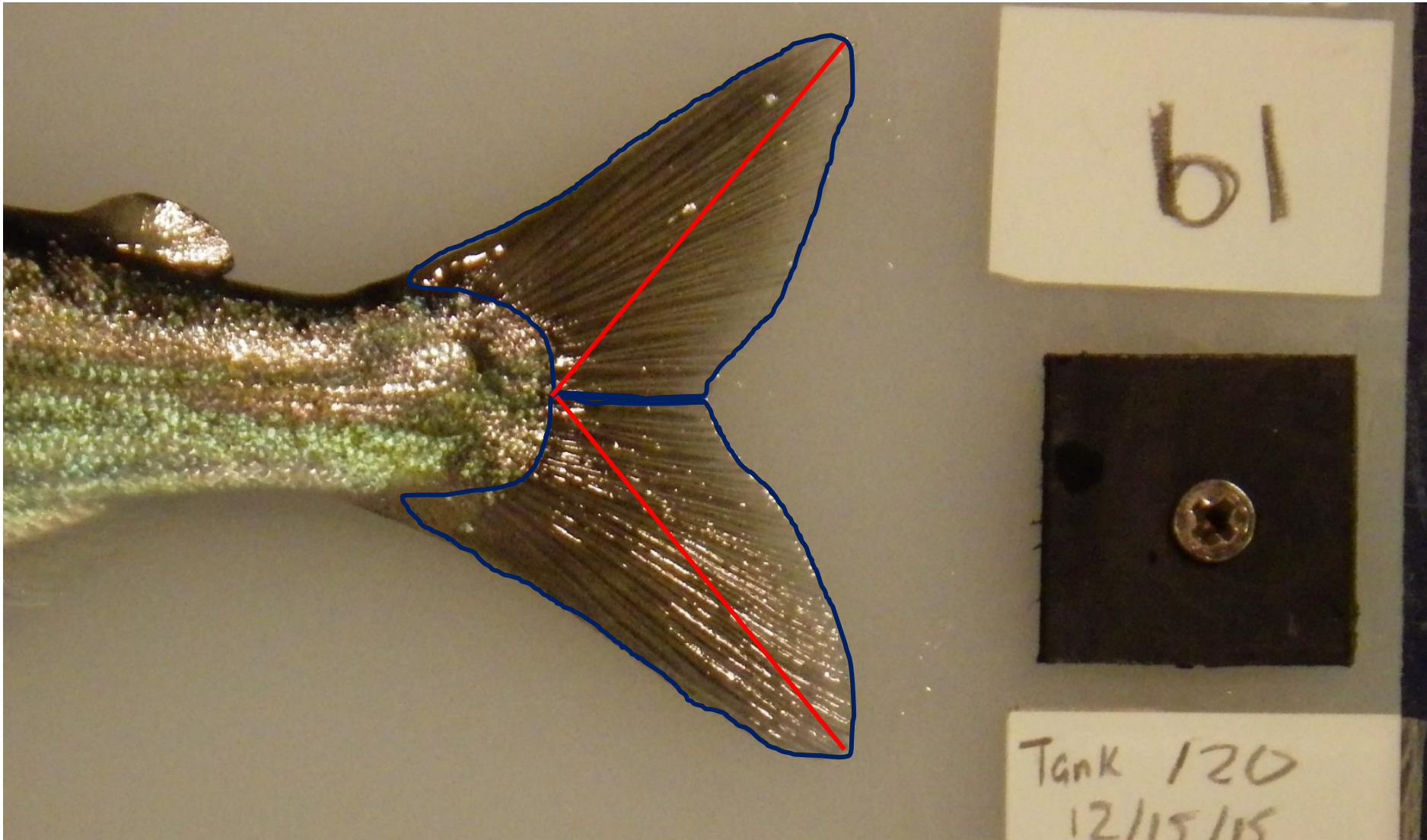


OHRC Stream

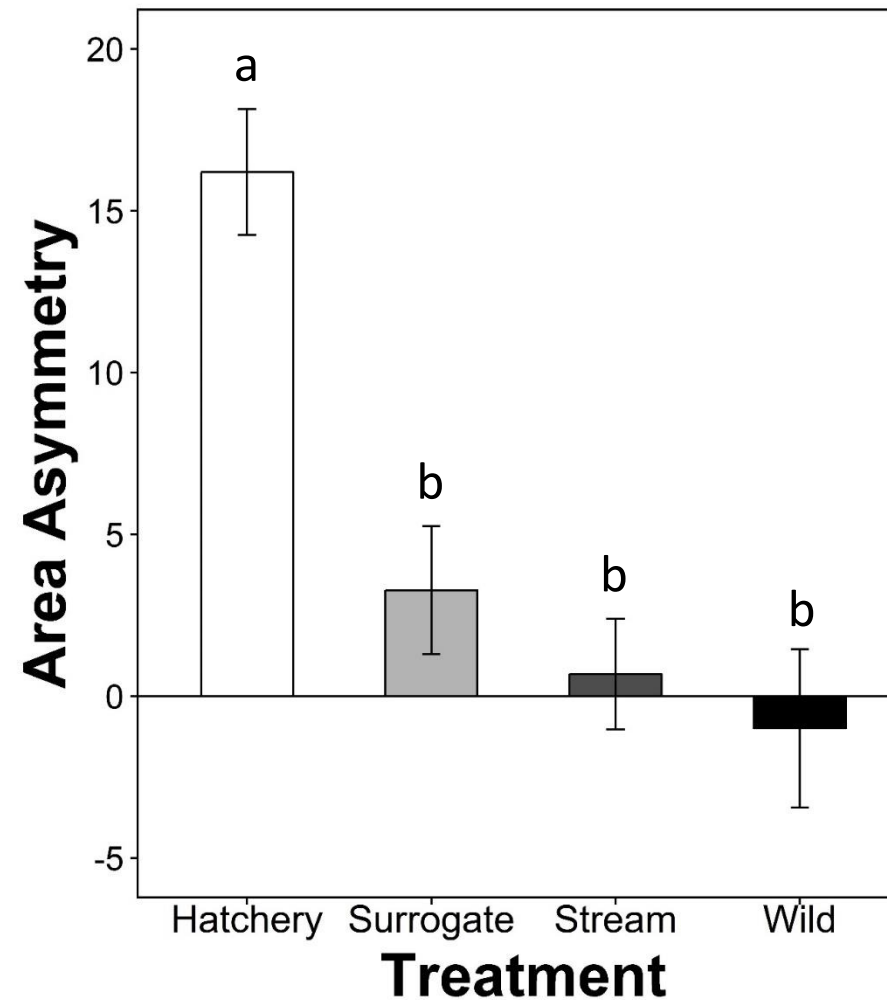
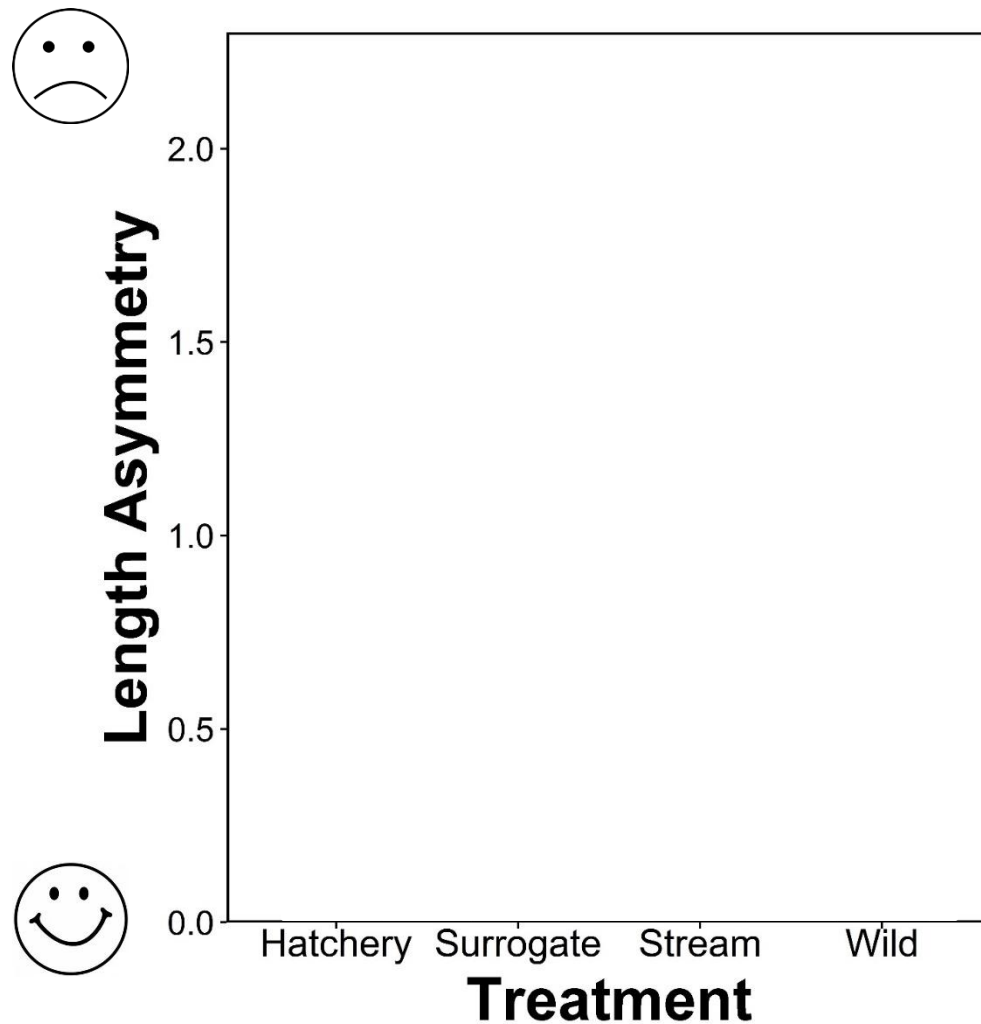


Wild

DIGITIZE IMAGES USING IMAGEJ

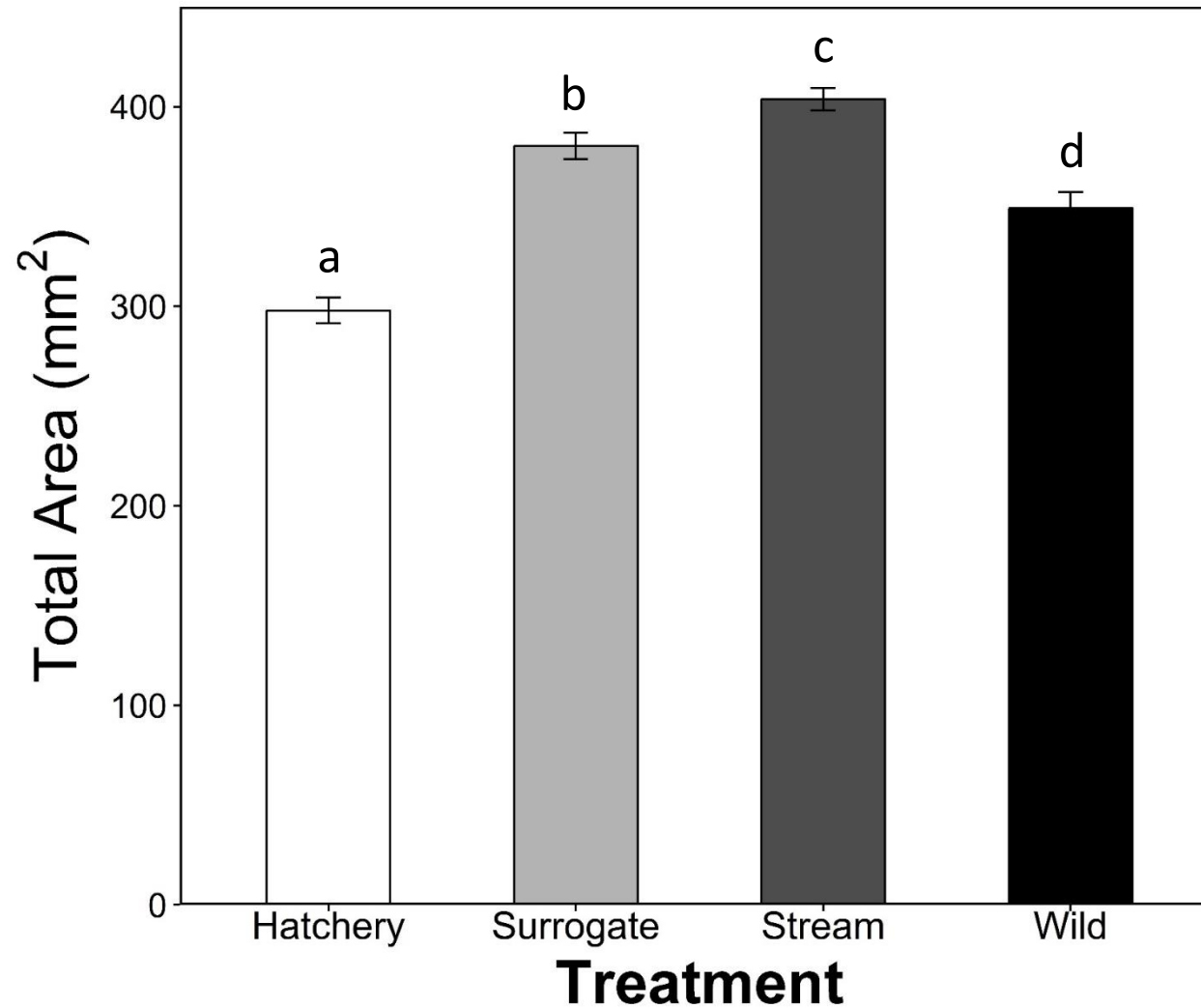


DORSAL – VENTRAL LOBE ASYMMETRIES



Values represent
least square
means, controlling
for body size

CAUDAL FIN QUALITY

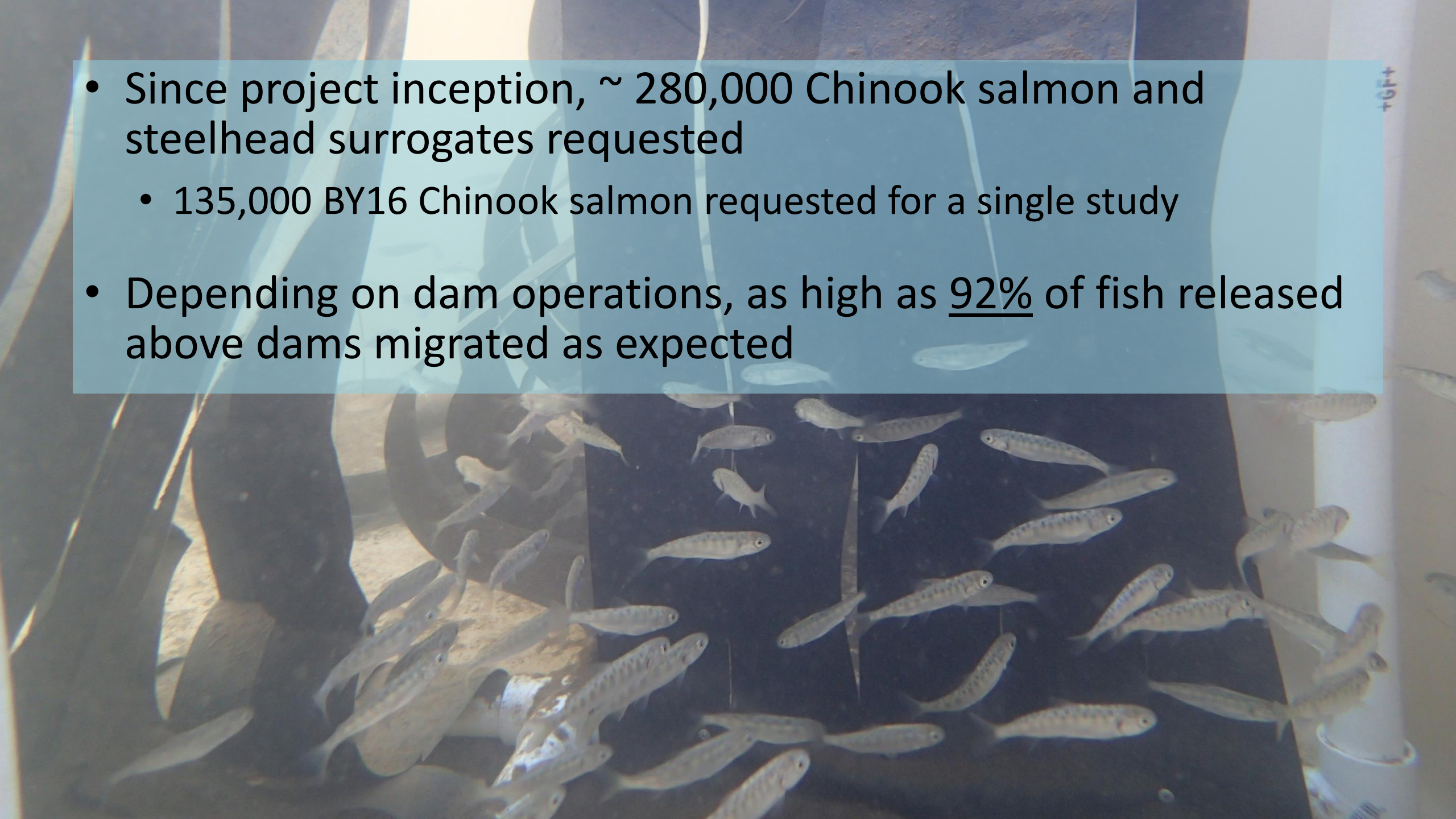


Values represent
least square
means, controlling
for body size

HIGH QUALITY SURROGATES



Photo by Todd Pierce

- 
- The background of the slide is a photograph of a large number of Chinook salmon swimming in a large, clear water tank. The fish are silvery with dark spots and are moving in various directions. The tank's structure, including vertical supports and a curved bottom, is visible. A semi-transparent blue box is overlaid on the upper portion of the image, containing the text.
- Since project inception, ~ 280,000 Chinook salmon and steelhead surrogates requested
 - 135,000 BY16 Chinook salmon requested for a single study
 - Depending on dam operations, as high as 92% of fish released above dams migrated as expected

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Kate Self
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Joyce Mahr
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ODFW staff & hatchery managers

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