The Mill Creek Study: Assessing the effects of large wood placement on a stream ecosystem

Evan Hayduk
MidCoast Watersheds Council
Salmon Recovery Conference, Tacoma, WA
April 9, 2019

Another wood study??!!

- Hundreds of millions of dollars have been spent on thousands of wood placement projects in the Pacific Northwest
- Monitoring studies have generally shown positive effects on stream habitat and local salmonid populations

BUT….

Many critical questions remain:

- How much physical habitat change is needed to produce a measurable change in fish abundance?
- What is the effect of wood placement on fish survival rather than fish abundance?
- What is the long-term impact of wood placement on food resources and fish production?

Roni et al. (2015)

In short, what is the biological return on investment for wood placement projects?

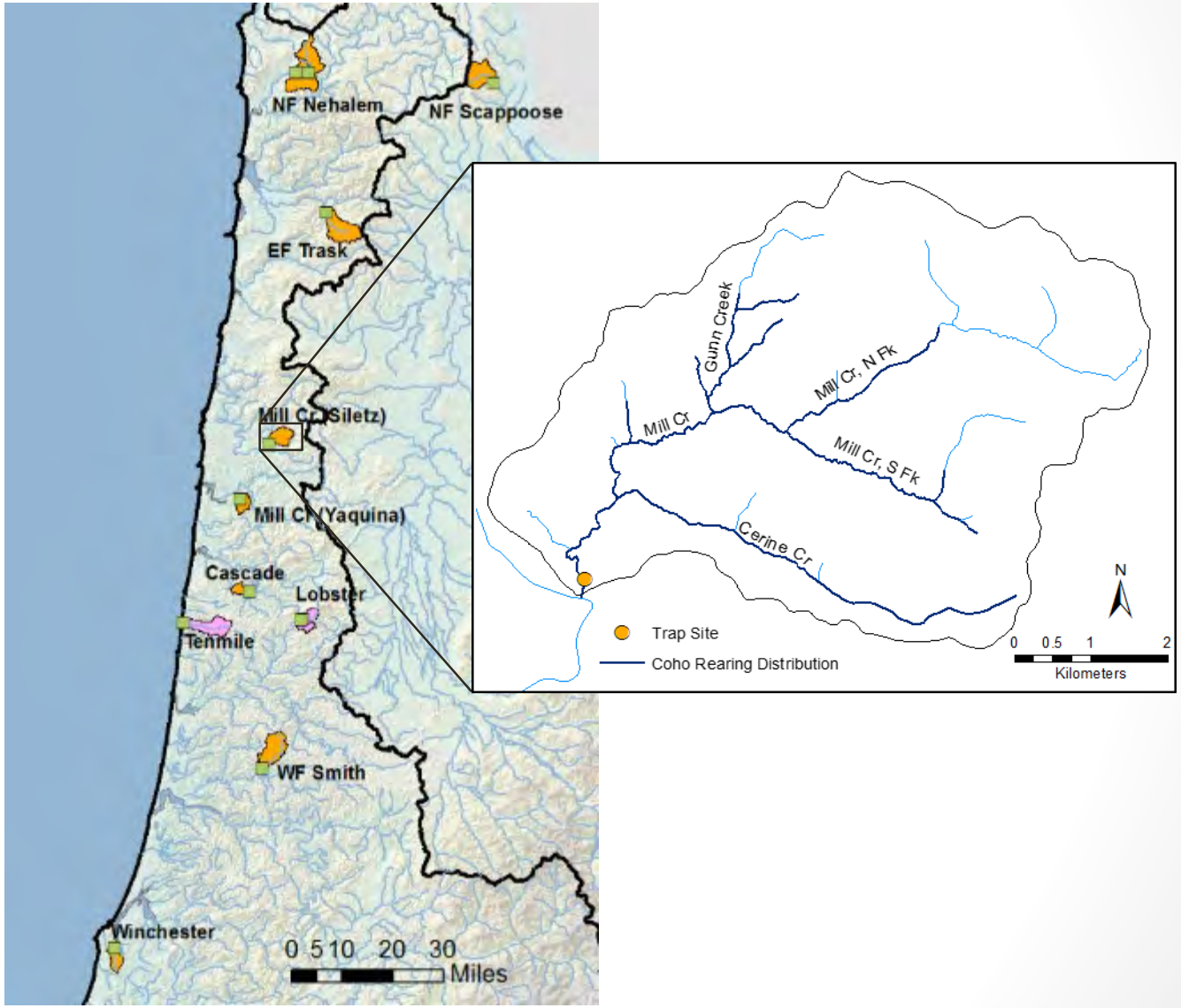
To answer these questions we need:

- Accurate estimates of watershed scale fish production at multiple life stages
- Long-term data due to high variability in fish abundance

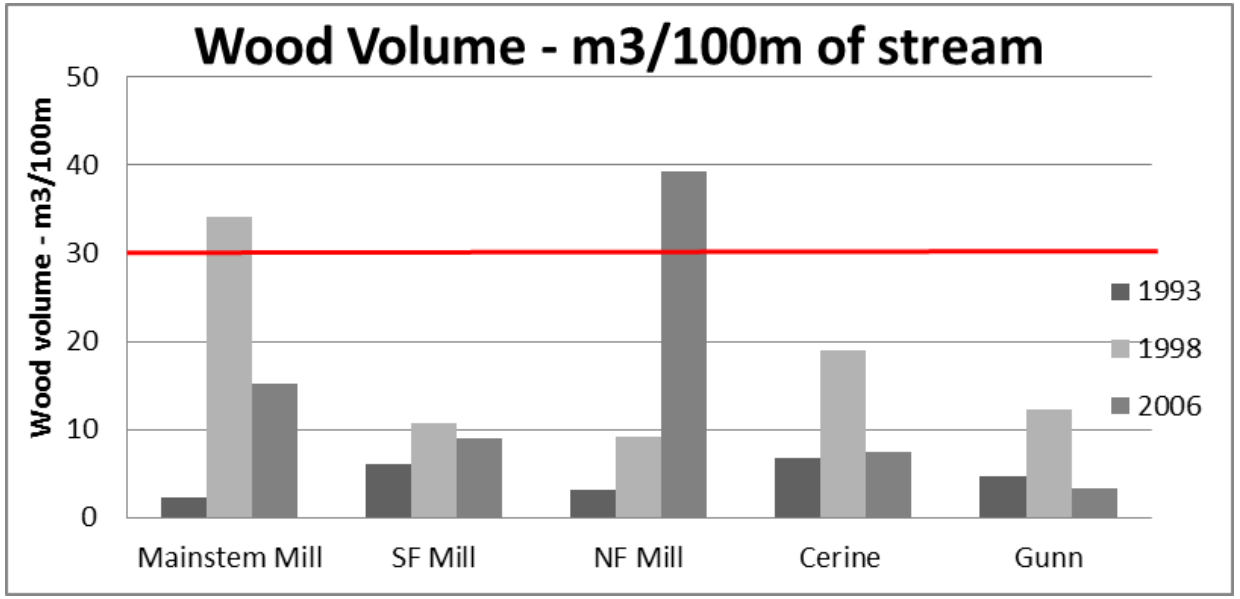
ODFW Salmonid Life Cycle Monitoring Sites

Mill Creek (Siletz River basin)

- 34 km² watershed with 15 miles of anadromous fish habitat
- Partial barrier near mouth allows adult fish to be captured and marked
- Weyerhaeuser and Confederated Tribes of Siletz Indians are major landowners



Restoration Need



Low wood volume and few key pieces relative to ODFW benchmarks

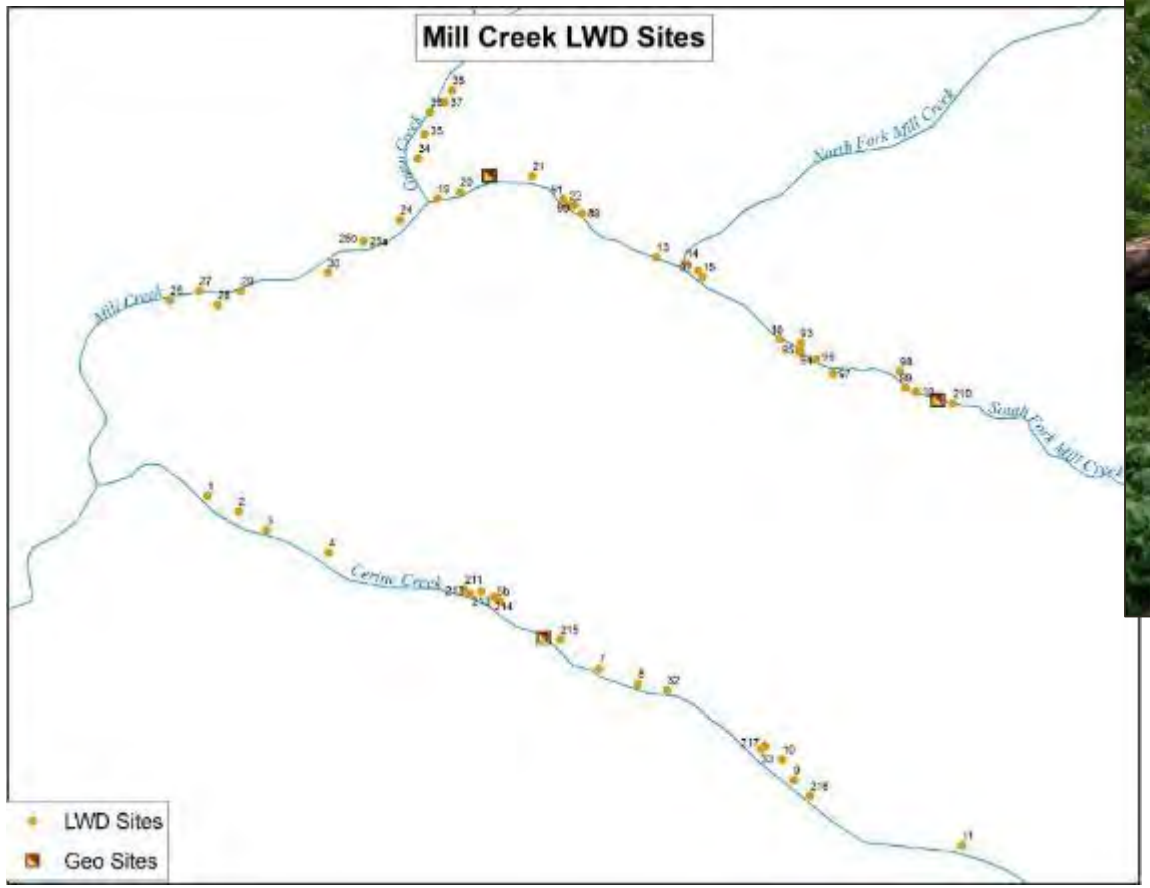
Mill Creek: a unique opportunity to evaluate wood placement effects

- 20 years of data on smolt production and adult returns
- Strong landowner support for project
- Location facilitates ODFW/OSU research partnership
- Only one other wood placement project since monitoring began in 1997 (6 sites in lower NF Mill Creek in 2009)

Wood Placement

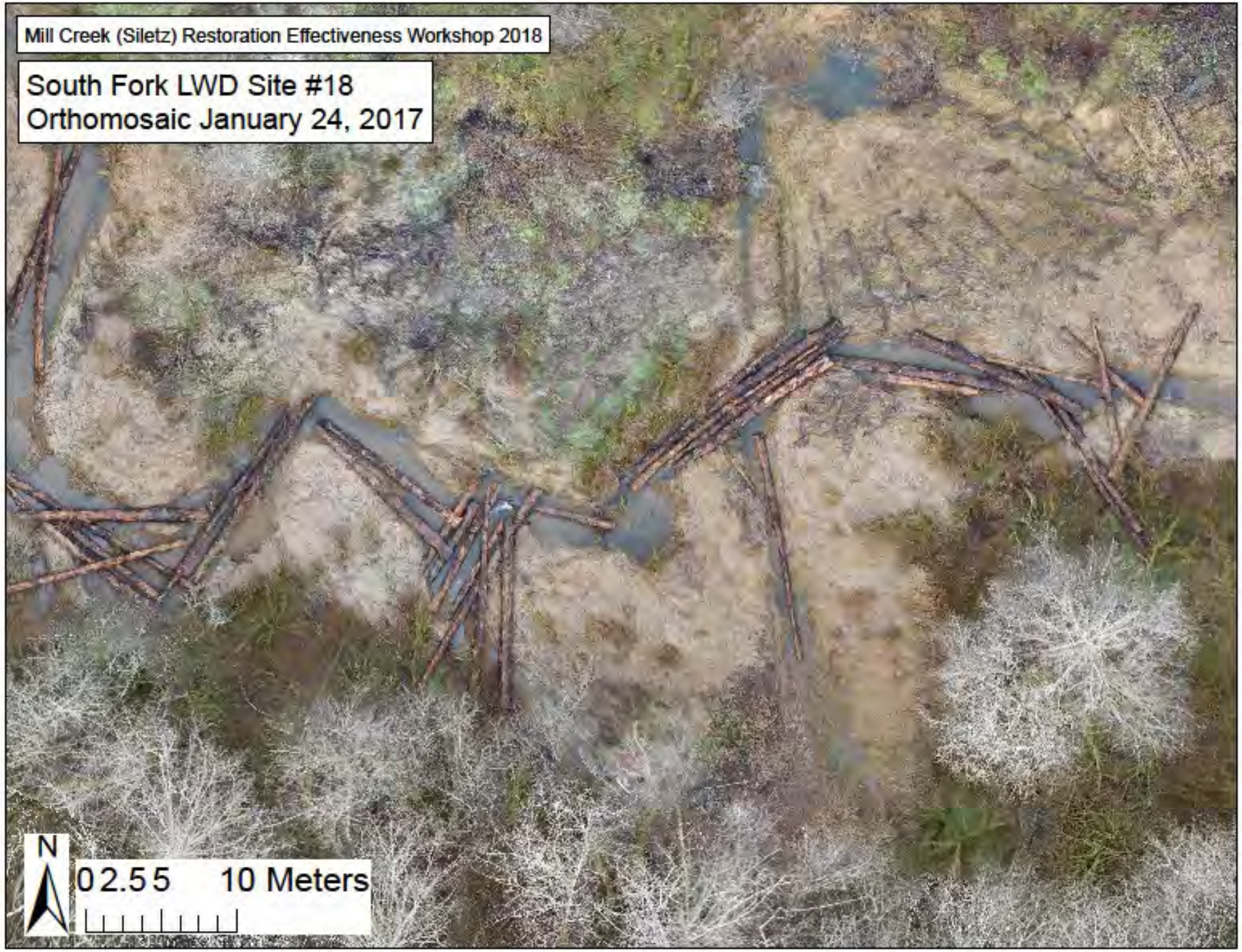
OWEB Grant to place logs in Mill Creek and tributaries (6.8 miles of stream)

37 logs at 3 sites in 2015, 642 logs at 54 sites in 2016



2015 Wood Placement Site in mainstem Mill Creek

Mill Creek (Siletz) Restoration Effectiveness Workshop 2018
South Fork LWD Site #18
Orthomosaic February 8, 2016
N
0 2.5 5 10 Meters


Mill Creek (Siletz) Restoration Effectiveness Workshop 2018
South Fork LWD Site #18
Orthomosaic January 24, 2017
N
0 2.5 5 10 Meters

Effectiveness Monitoring

Five components:

1. Geomorphic response
2. Winter rearing habitat
3. Benthic macroinvertebrate response
4. Overwinter survival of juvenile Coho Salmon
5. Coho Salmon smolt abundance

Outreach with Project Results

1. Geomorphic Response

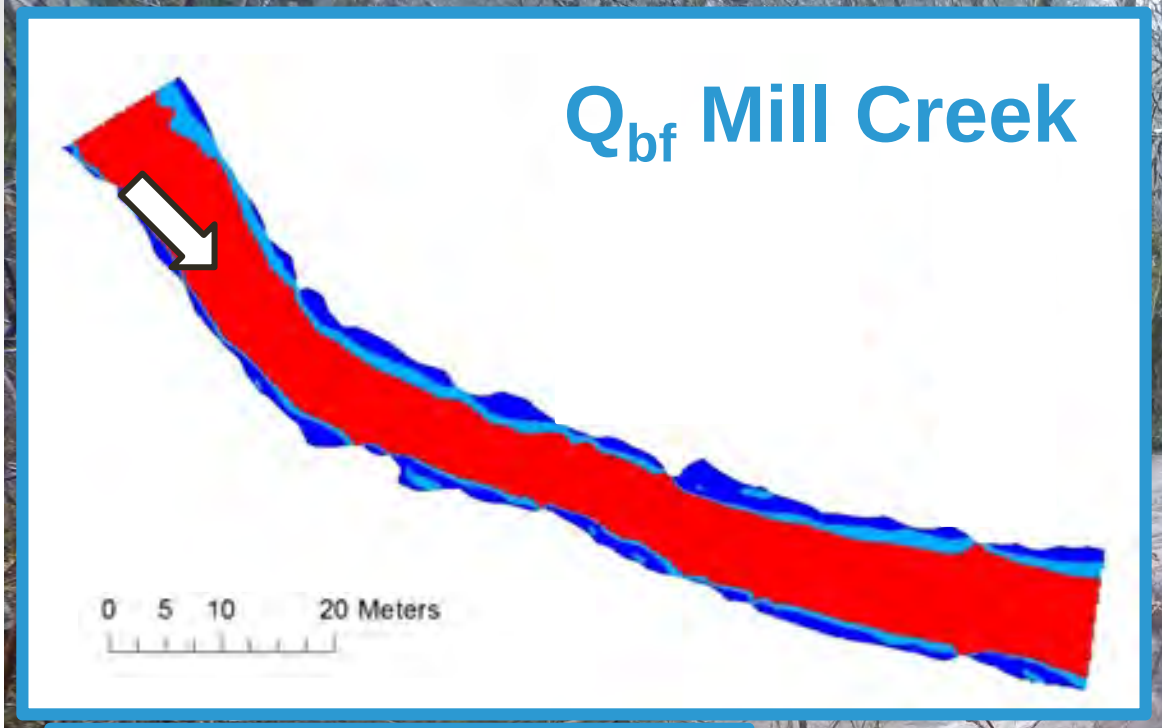
Partners:

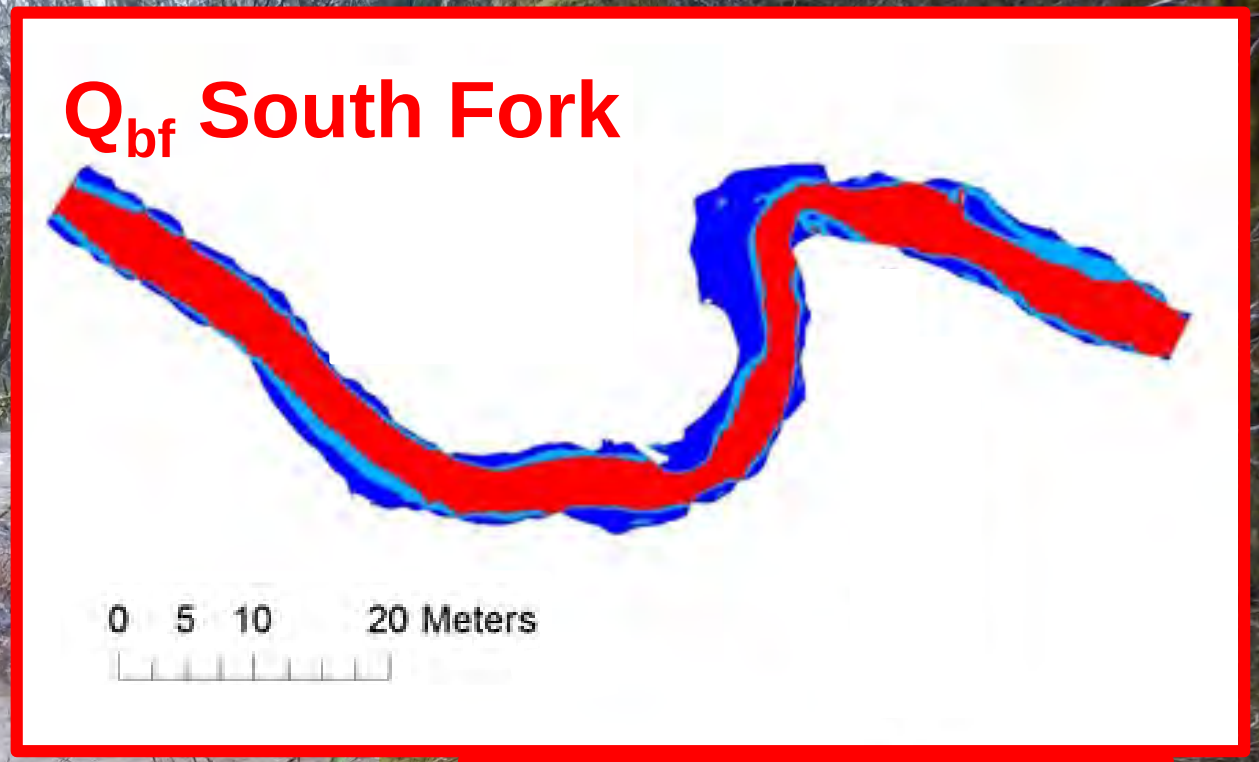
Dr. Catalina Segura

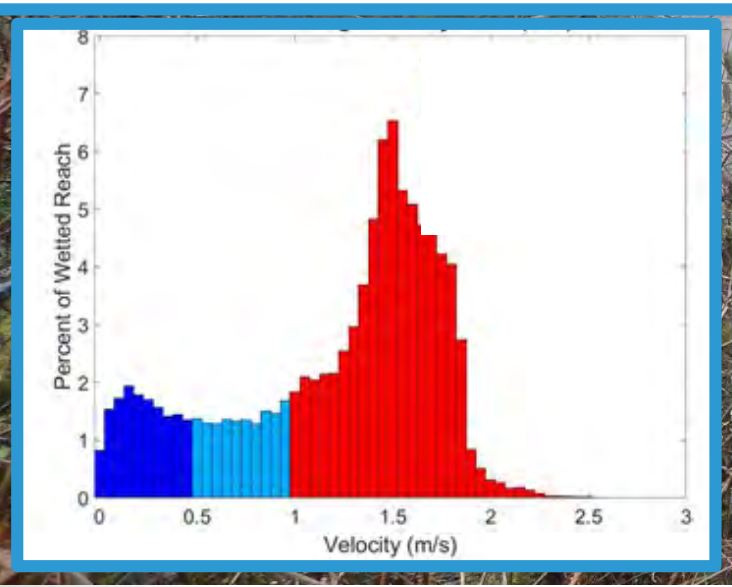
OSU Department of Forest Engineering, Resources, and Management

M.S. students Russell Bair and Amelia Yeager

Model Results velocity



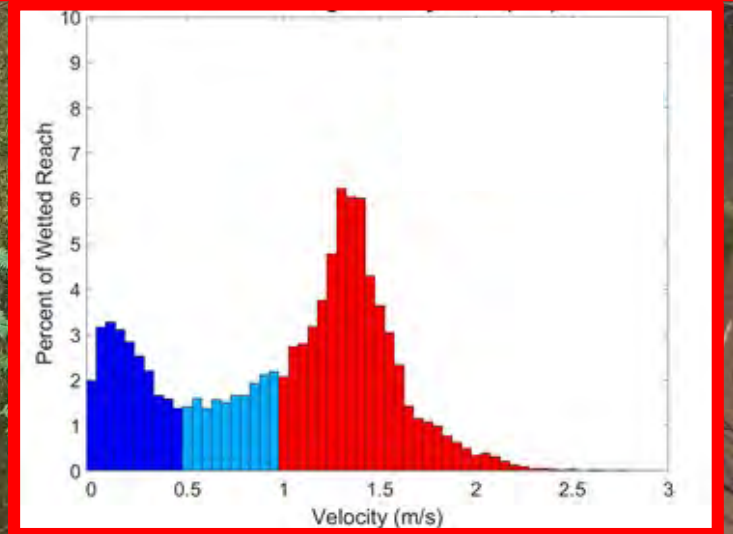




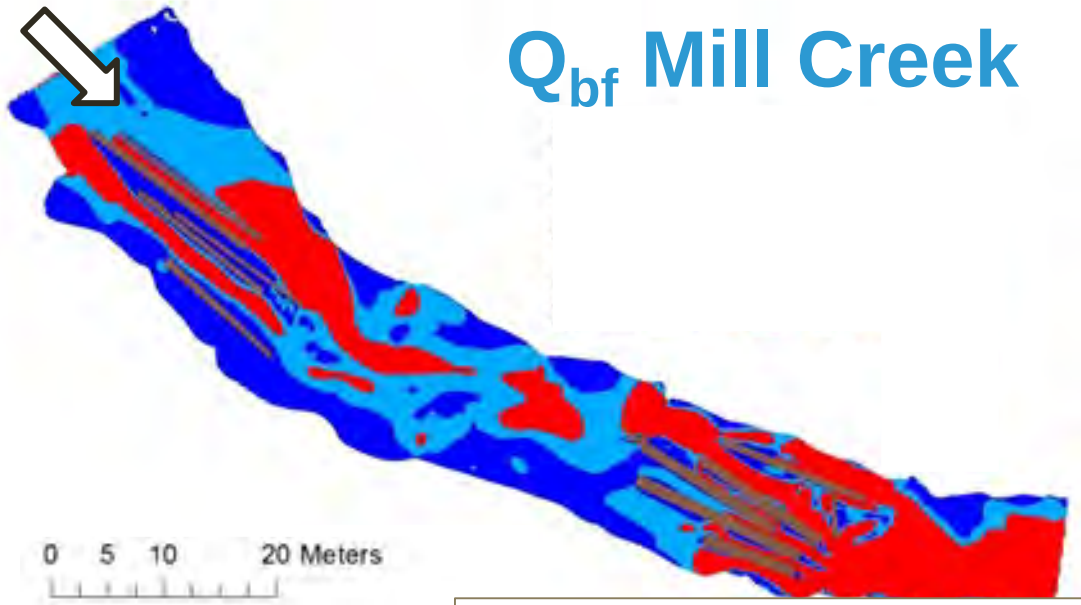
v < 0.5 m/s

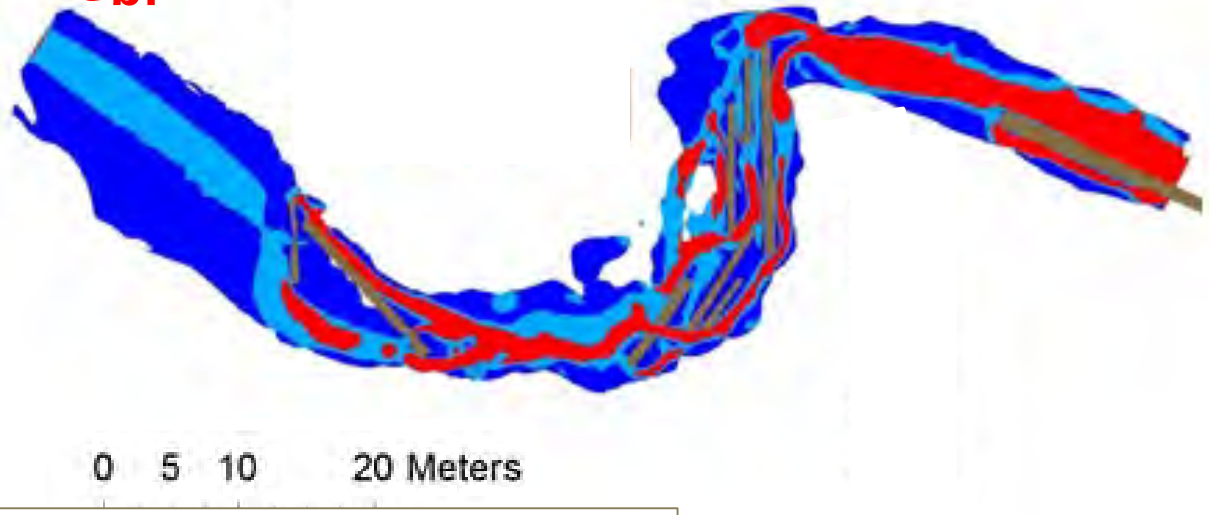
0.5 m/s < v < 1 m/s

v > 1 m/s

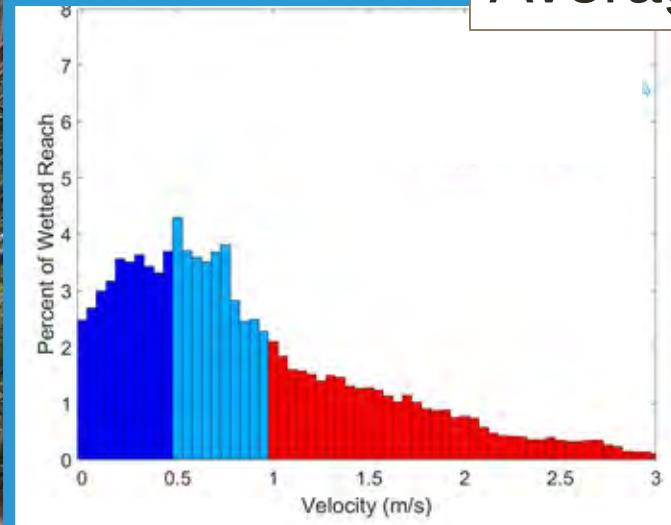


Model Results velocity





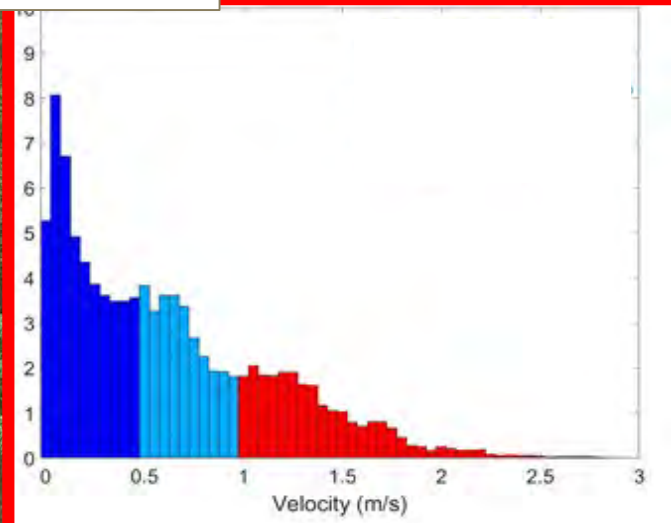
Average increase of 23-36% acceptable area



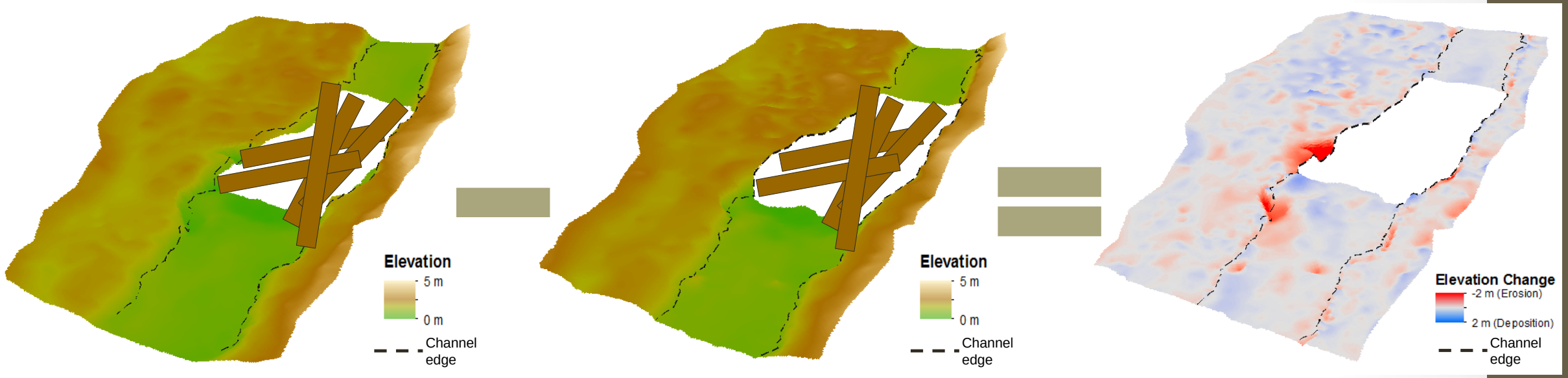
v < 0.5 m/s

0.5 m/s < v < 1 m/s

v > 1 m/s

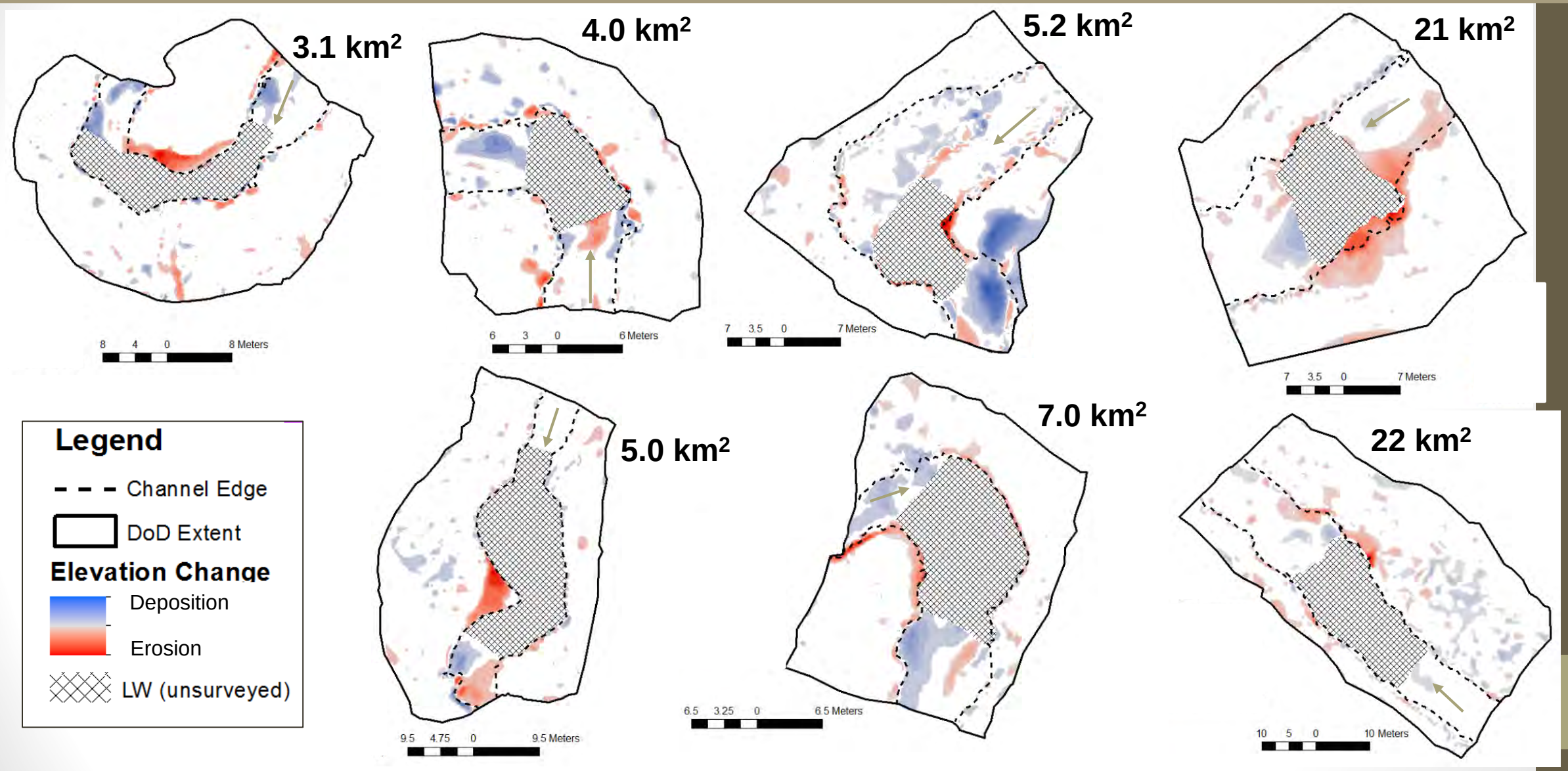


Volumetric Change



ence (DoD)

Volumetric Change



2. Winter Rearing Habitat

Partners

Kara Anlauf-Dunn and Charlie Stein
ODFW Aquatic Inventories Project

Evan Hayduk and Wayne Hoffman
MidCoast Watersheds Council

Lincoln Soil and Water Conservation District

Aquatic Inventories Project
Wadeable Stream Habitat Methods

- Moore et al. Version 25.1, May 2015.

- Describe in primary and secondary channels:
  - Channel dimensions
  - Morphology
  - Habitat unit types
  - Substrate composition
  - Wood
  - Shade
  - Riparian

Study Design

- Surveys typically conducted from February-April to characterize winter habitat conditions

- Three basin surveys encompassing all anadromous fish habitat in Mill Creek
  - One pre-treatment survey in 2015

    Wood Placement in 2015 and 2016
  - First post-treatment survey in 2017
  - Second post-treatment survey in 2022

- Pairwise comparisons of pool habitat, channel complexity, substrate and **habitat capacity** between surveys

- Randomly selected AQI surveys in similar mid-coast streams will serve as controls for these comparisons

3. Benthic macroinvertebrates

Partners:

Shannon Hubler

Oregon Department of Environmental Quality

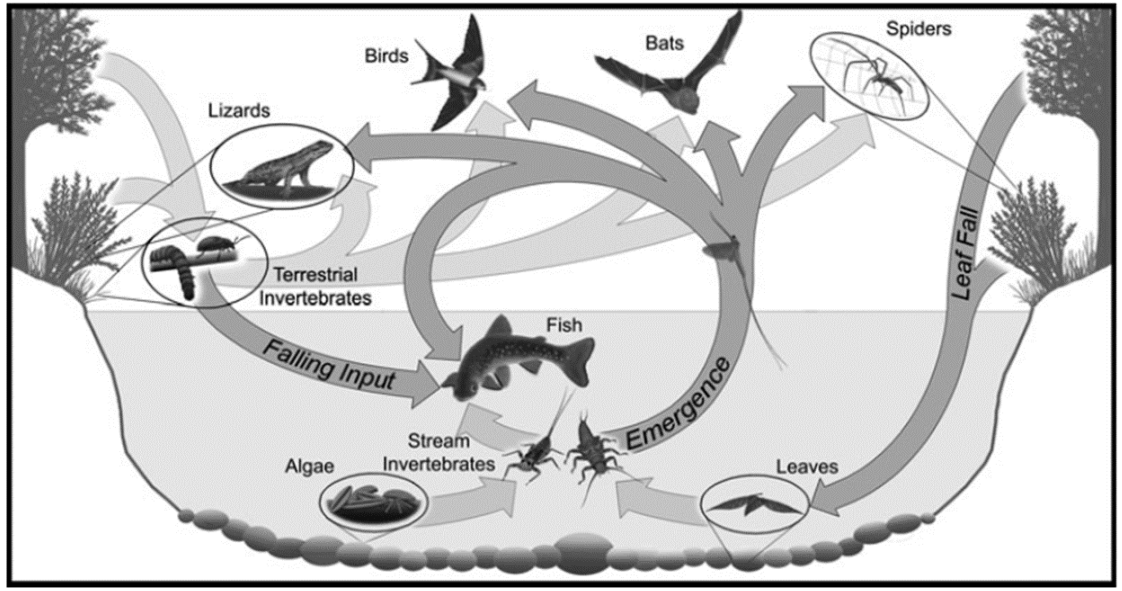
Bill Gerth, Judy Li, and Ivan Arismendi

Oregon State University Department of Fisheries and Wildlife

undergraduate student: TeLa Branstetter

Aquatic macroinvertebrates

- Small aquatic animals without backbones
  includes: aquatic insects, snails, aquatic mites, crayfish, etc.
- Major players in stream biodiversity
- Community composition can be used as an indicator of habitat and water quality
- Important component of stream & riparian food webs



Baxter et al. 2005 Tangled Webs: Reciprocal Flows of Invertebrate Prey Link Stream and Riparian Zones. *Freshwater Biology*

• BACI design to test for macroinvertebrate changes related to wood addition

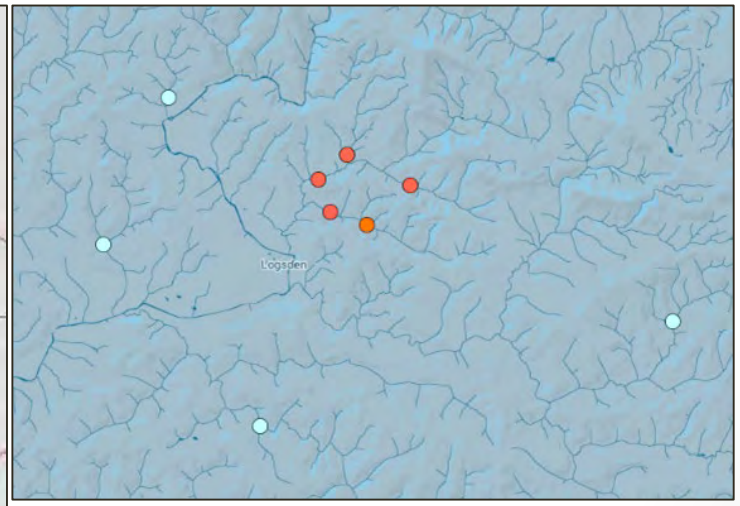
Macroinvertebrate sampling at 5 Mill Creek sites (with wood addition) & 4 control sites (outside Mill Creek watershed, without wood addition)

Samples collected:

- Before & after wood placement (2015 & 2017)

Will also be collected:

- Three, and six years after wood placement (2019 & 2022)



- # Macroinvertebrate sampling

Samples collected in riffle habitat following standard Oregon DEQ sampling protocol

Two types of samples collected at each site:

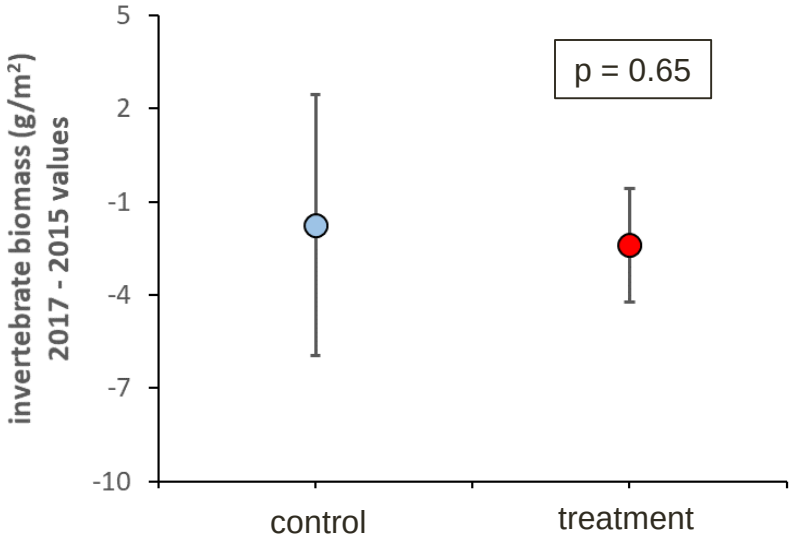
one to measure biomass—frozen in the field on dry ice

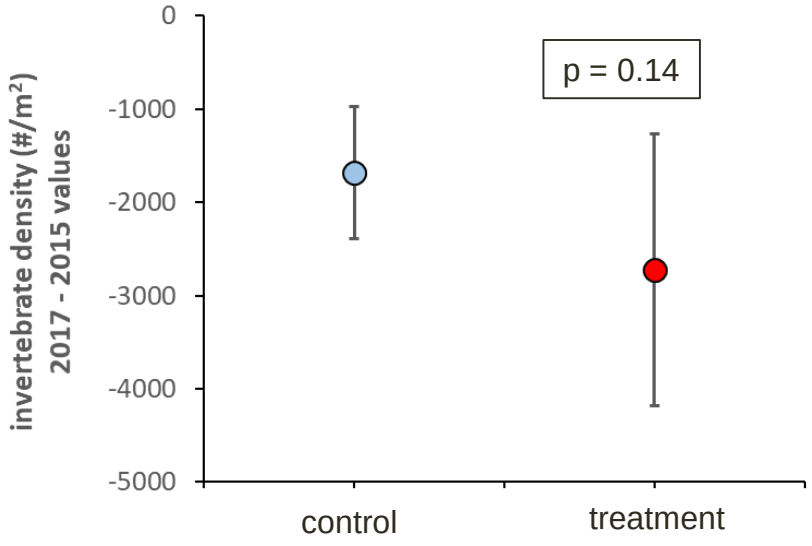
one to assess taxonomic composition—preserved with alcohol

- # Results:

No significant effects of wood placement on invertebrate biomass or density

<u>but</u> overall, biomass and density were higher in 2015 than in 2017





<u>Average biomass</u>

<u>2015</u>: 3.88g AFDM/m^2

<u>2017</u>: 1.77g AFDM/m^2

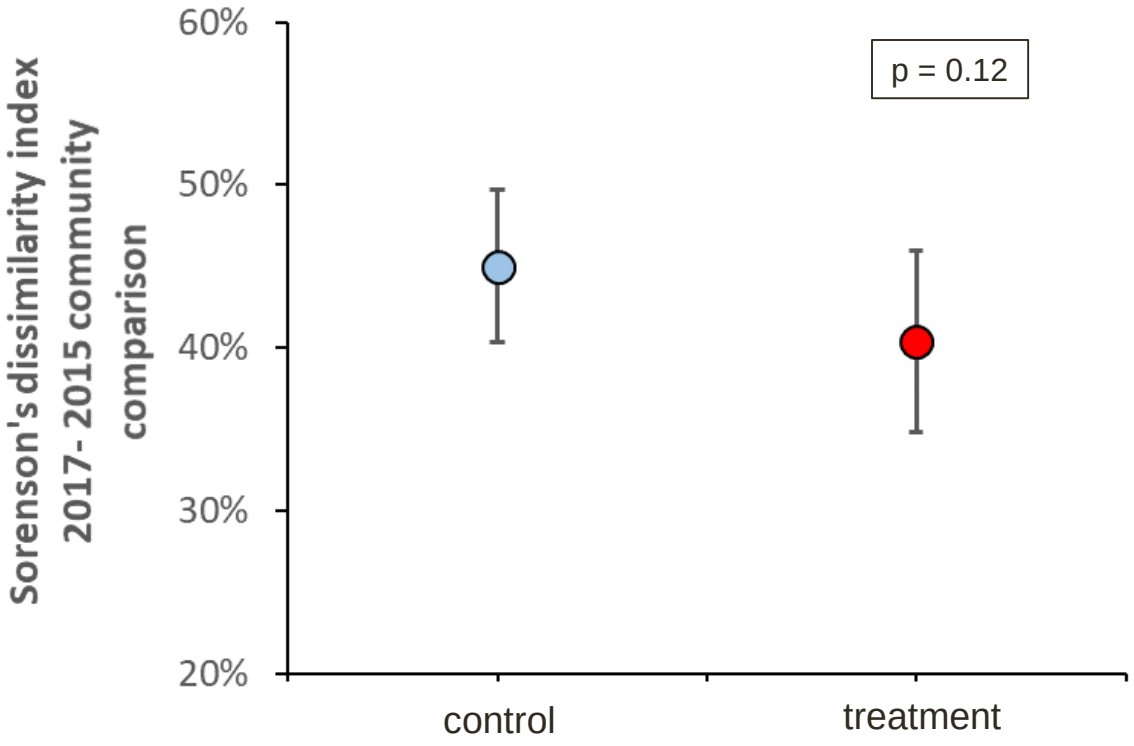
<u>Average density</u>

<u>2015</u>: 4529 invertebrates/m^2

<u>2017</u>: 2268 invertebrates/m^2

- # Results:

No significant effects of wood placement on invertebrate community composition



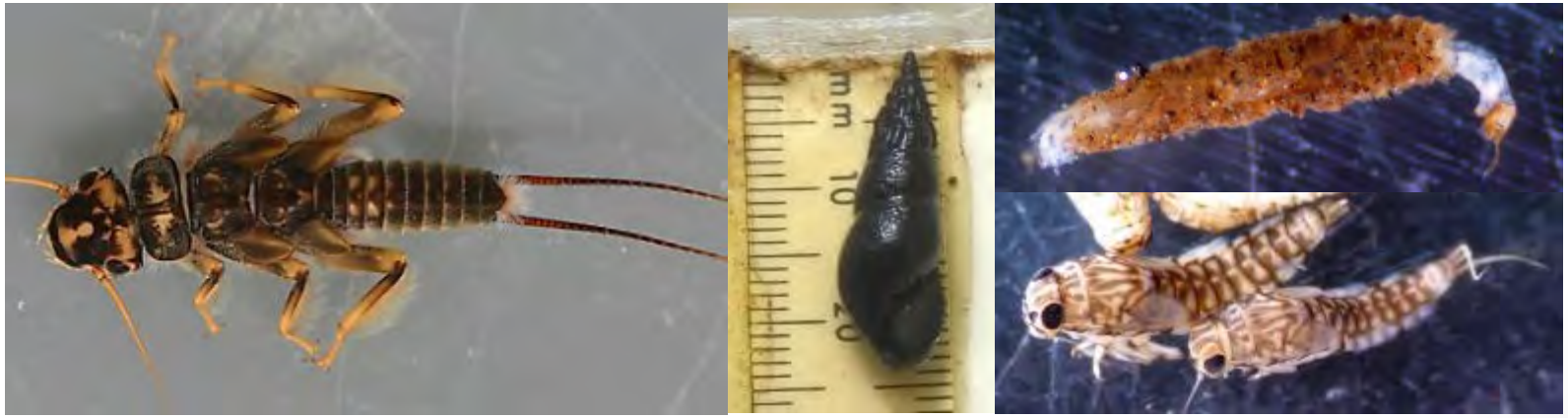
- # Summary

One year after wood addition, no significant effects on invertebrate communities in riffle habitats were detected.

Why?

- Changes to invertebrate communities may take time to develop as wood has more time to interact with streams, changing habitat and food availability—changes may be detected in years 3 & 6.

- Invertebrate changes in pools and on the wood itself may have happened, but not been detected—our sampling was only in riffles so our data would be comparable to other biomonitoring data in OR.



4. Overwinter Survival of Juvenile Coho Salmon

Partners:

Chris Lorion and Erik Suring

ODFW Life Cycle Monitoring Project

Plum Creek and Weyerhaeuser Field Crews

Why overwinter survival?

- Juvenile Coho Salmon in Oregon streams typically spend one year in freshwater before out-migrating as smolts
- Parr overwintering period is typically an important bottleneck
- Examples:

Site	Overwinter Survival
East Fork Lobster Creek (Alsea basin)	11%-51%
Cascade Creek (Alsea basin)	21%
West Fork Smith River (Umpqua basin)	10%
Prairie Creek (Northern California)	36%
Mill Creek (Siletz basin)	20%-36%

Sources: Brakensiek and Hankin 2007; Ebersole et al. 2006; Lorion and Suring 2017; ODFW

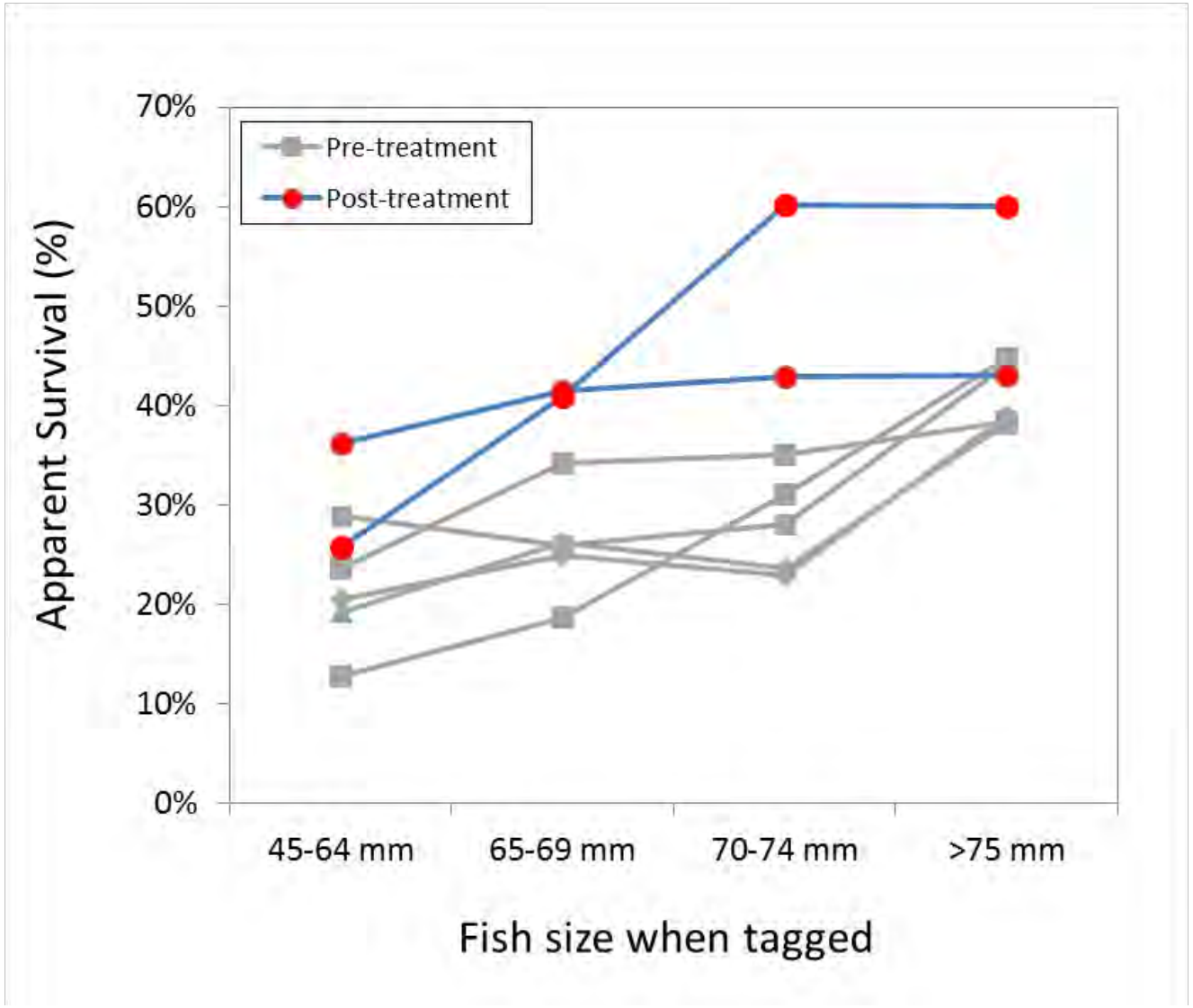
Estimating Overwinter Survival

- Juvenile Coho Salmon are captured in late summer/early fall using seines and backpack electrofishing equipment (1,000-2,000 fish/yr)
- All fish captured are PIT-tagged (≥65mm) or marked with Visible Implant Elastomer (<65 mm)
- Spatially-balanced random sampling design to tag fish throughout the basin (15-20 reaches)

Estimating Overwinter Survival

- “Apparent survival” based on recaptures during spring smolt trapping season (March-June)
- ODFW monitoring site in Lobster Creek (Alsea basin) serving as control in BACI study design
- PIT tag antenna array in lower Mill Creek provides additional out-migrant info

Results


70%
60%
50%
40%
30%
20%
10%
0%
Apparent Survival (%)
Pre-treatment
Post-treatment
45-64 mm
65-69 mm
70-74 mm
>75 mm
Fish size when tagged

Summary

- Overwinter survival has been over 40% in the first 2 years after wood placement after ranging from 20-36% in 5 pre-treatment years
- Increase in survival has been observed across multiple size classes of juvenile Coho Salmon
- Monitoring will continue for the next 4 years, and comparisons with Lobster Creek control site will be used to evaluate how the wood addition affected overwinter survival

5. Coho Salmon Smolt Abundance

Partners:

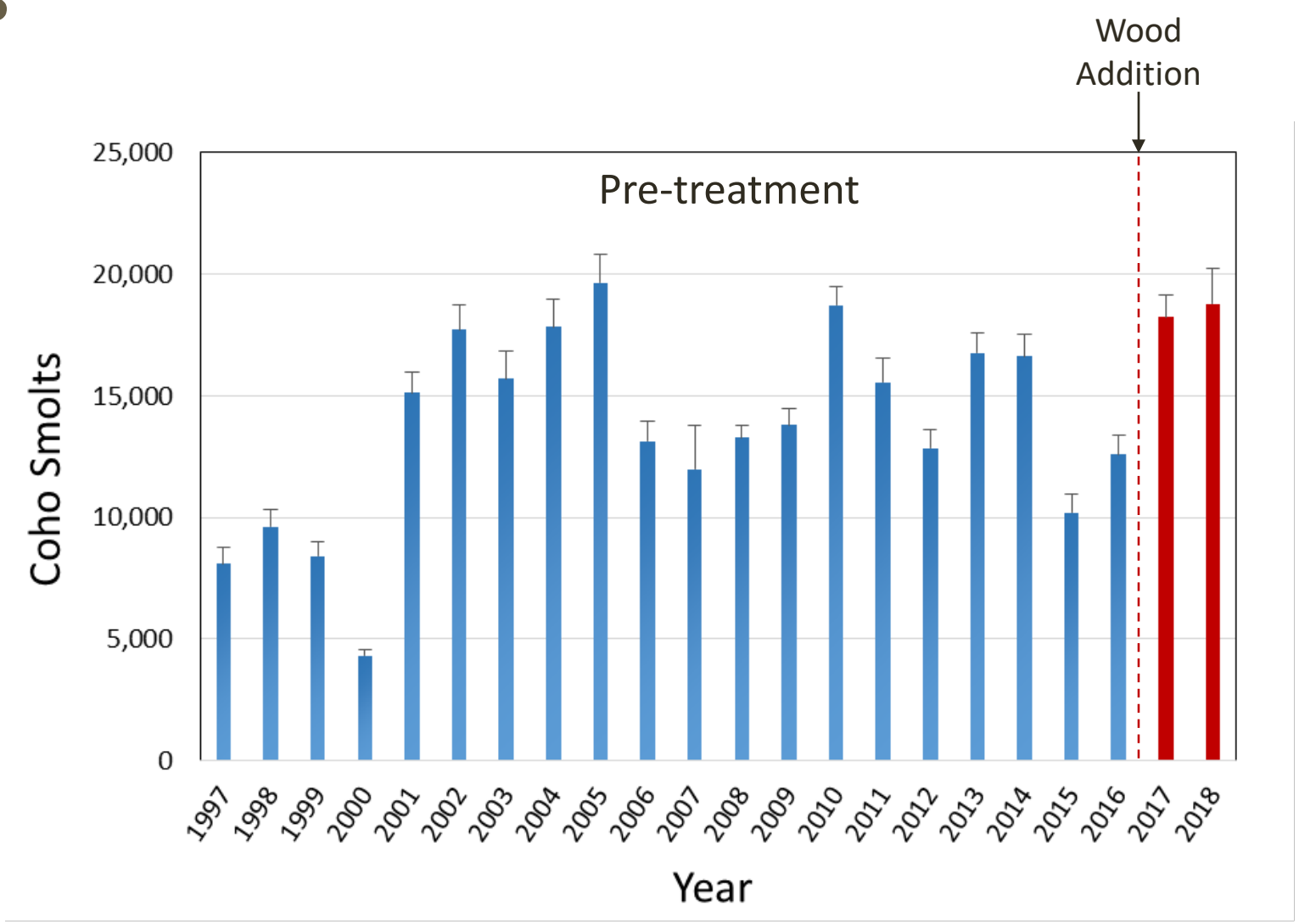
Chris Lorion and Erik Suring

ODFW Life Cycle Monitoring Project

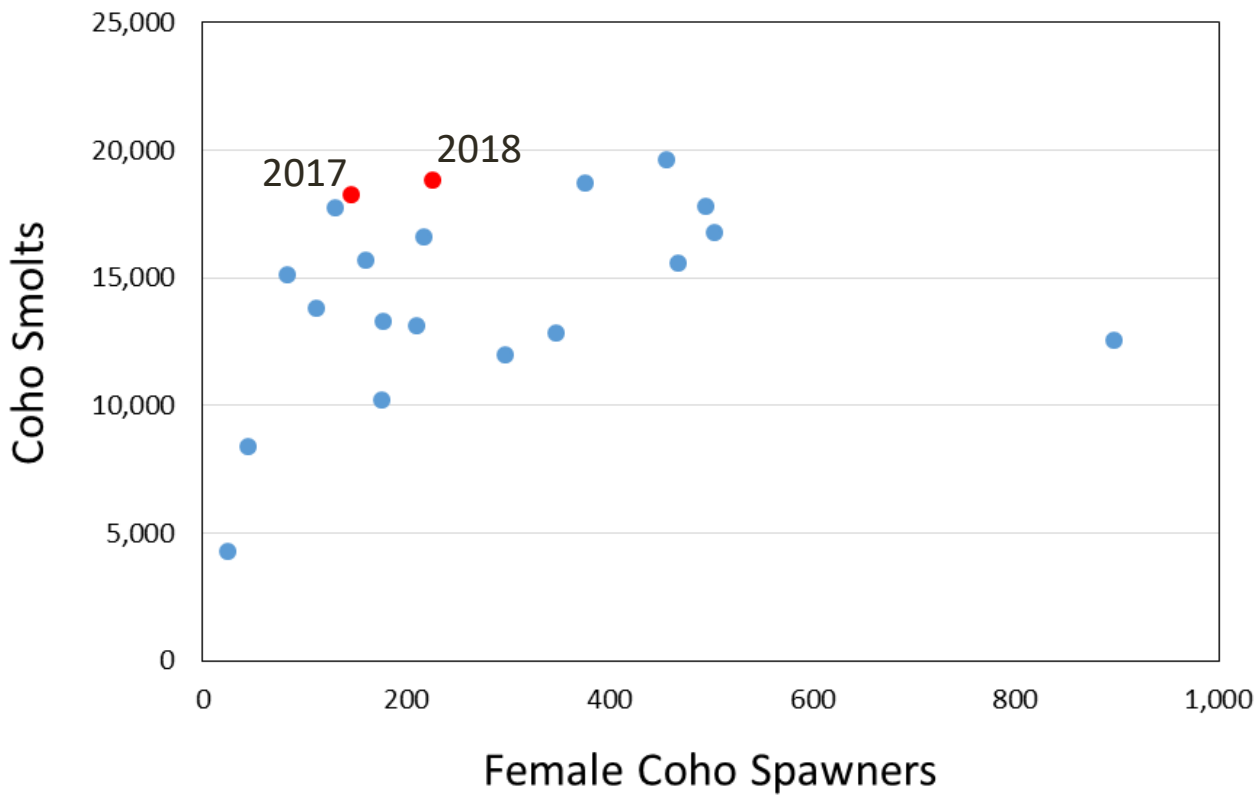
Smolt Abundance

- Rotary screw trap operated annually from March-June since 1997
- Out-migrant estimates are based on mark-recapture methods
- Four other mid-coast smolt monitoring sites serving as controls
- Plan to continue study through 2022 (6 years post-treatment) and hopefully beyond

Results

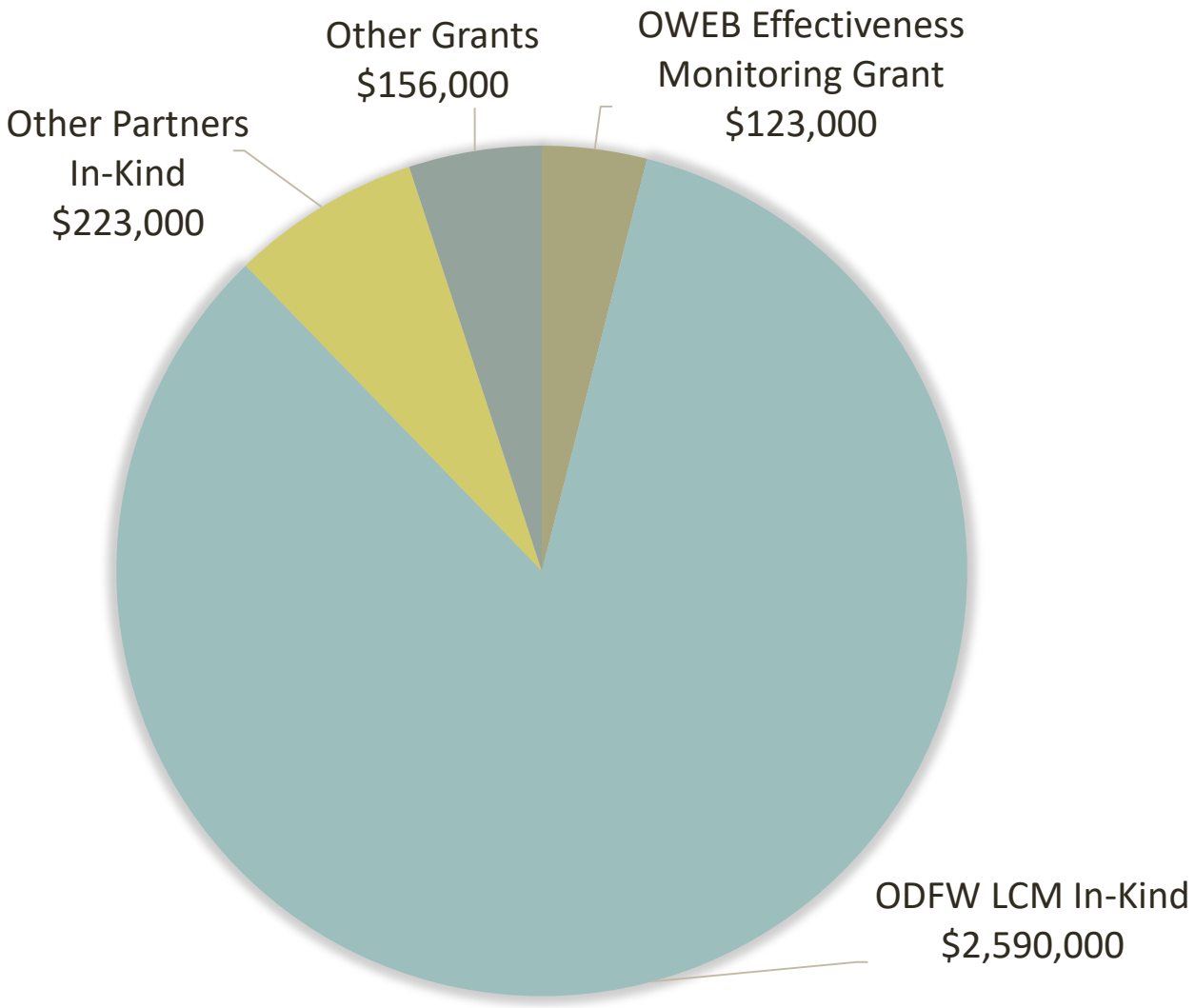

Wood Addition
Pre-treatment
Coho Smolts
25,000
20,000
15,000
10,000
5,000
0
1997
1998
1999
2000
2001
2002
2003
2004
2005
2006
2007
2008
2009
2010
2011
2012
2013
2014
2015
2016
2017
2018
Year

Results



Initial results are encouraging, but additional data collection over the next 4 years and comparisons with control sites will help us evaluate their significance

Thanks

- Stacy Polkowske and Jeff Light
- Oregon Watershed Enhancement Board
- Maryanne Reiter, Weyerhaeuser
- Derek Wilson, Oregon Department of Fish and Wildlife
- All of our monitoring partners!

Mill Creek Effectiveness Monitoring Budget