RECOVERY OF FISH POPULATIONS AND PHYSICAL CHANNEL CHARACTERISTICS IN STREAMS IMPACTED BY CATASTROPHIC DEBRIS FLOWS

JASON WALTER, BRIAN FRANSEN, RENE TAROSKY, TRAVIS SCHILL

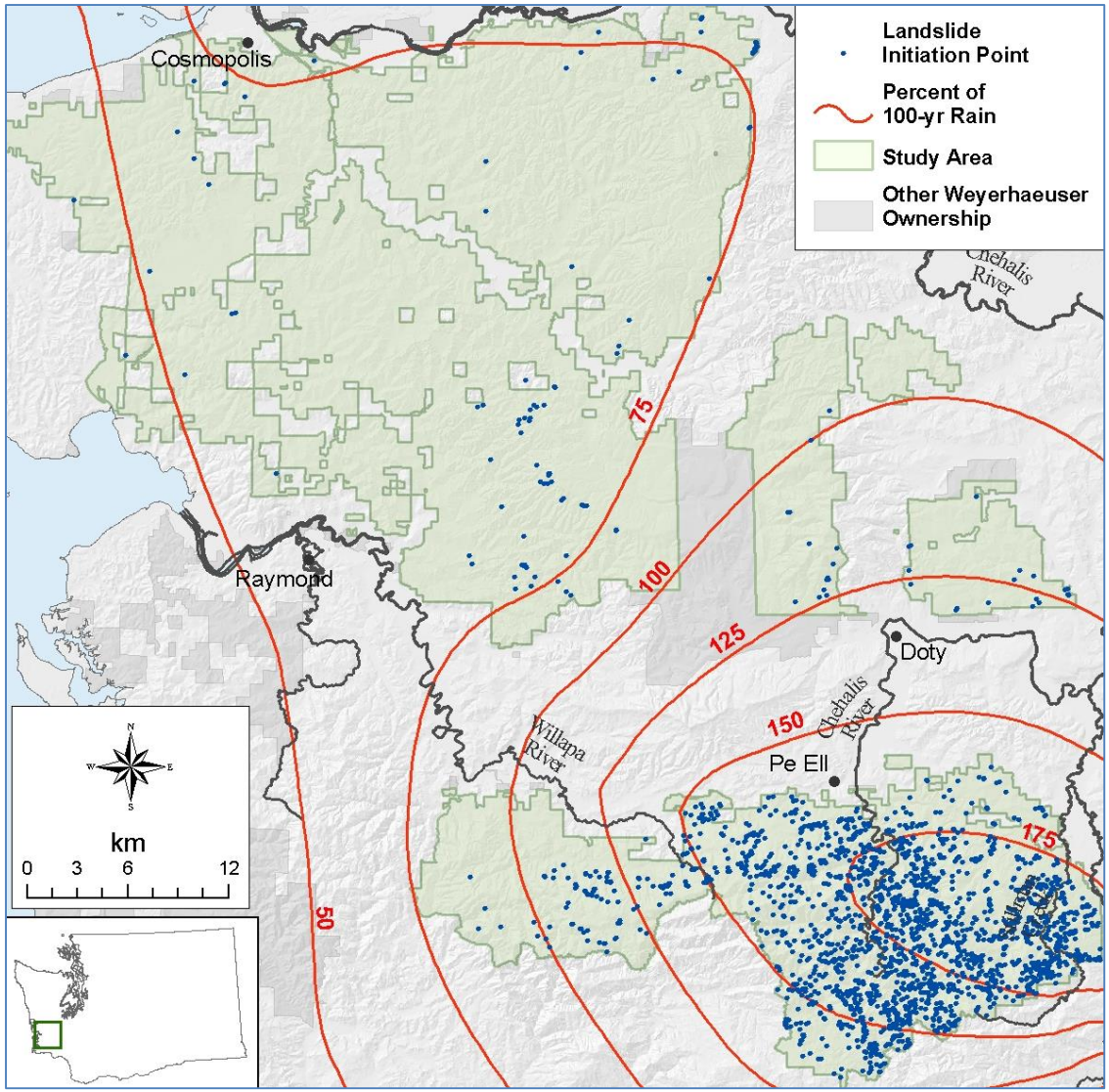
WEYERHAEUSER WESTERN TIMBERLANDS TECHNOLOGY

“The storm was downright weird. Unusual. Freak.”

Fast and Furious
By Tony Lystra
The Daily News
Sunday, December 9, 2007 5:07 AM PST

Photo Credit: (December 04, 2007) Associated Press

STORM INTENSITY



- **24-hour rainfall intensity relative to the 100-year event, with landslides indicated**
- **24-hour max precip. = 14.35”**
- **Total storm precip. = 19.63”**

Turner et al. 2010

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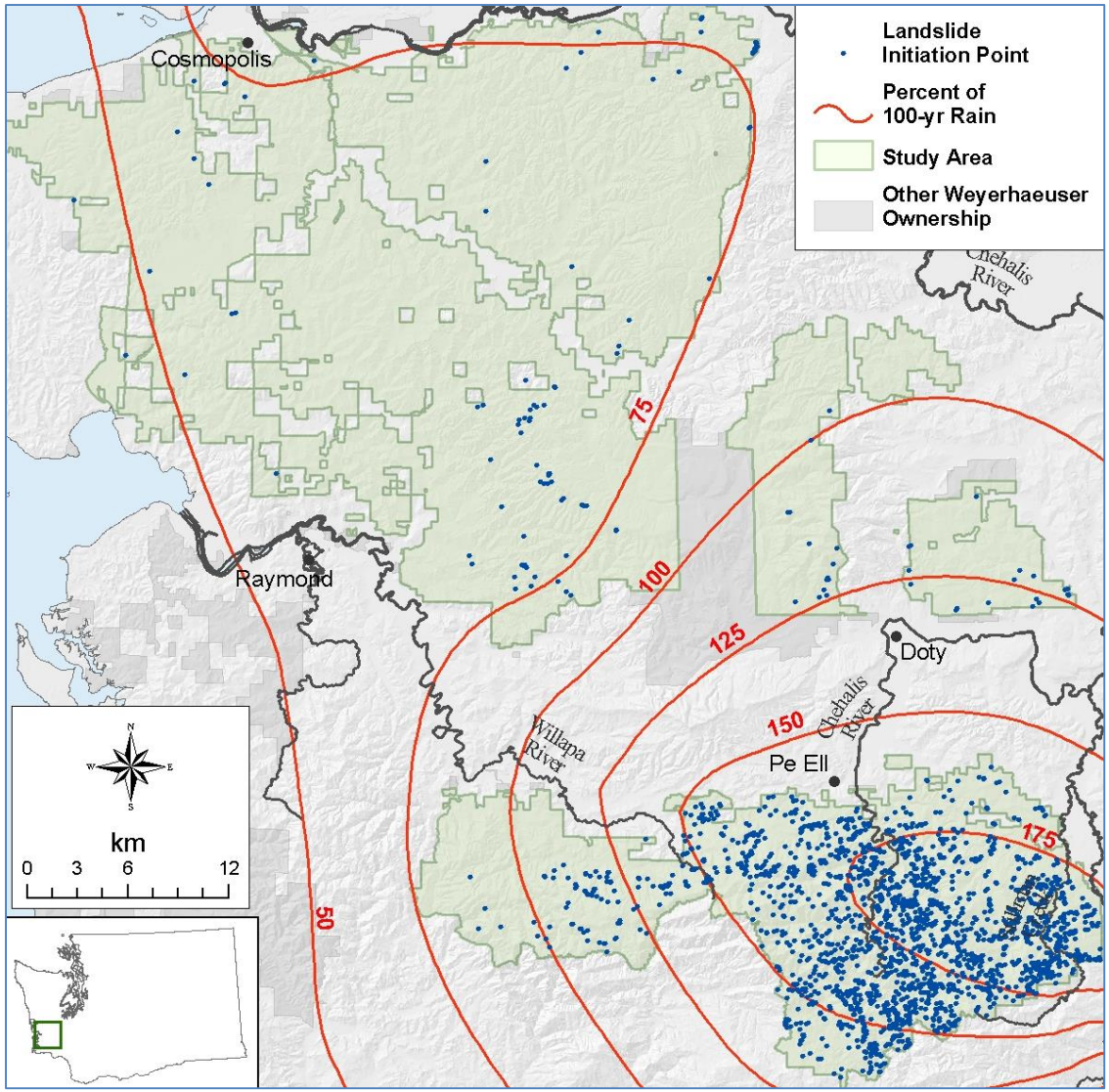

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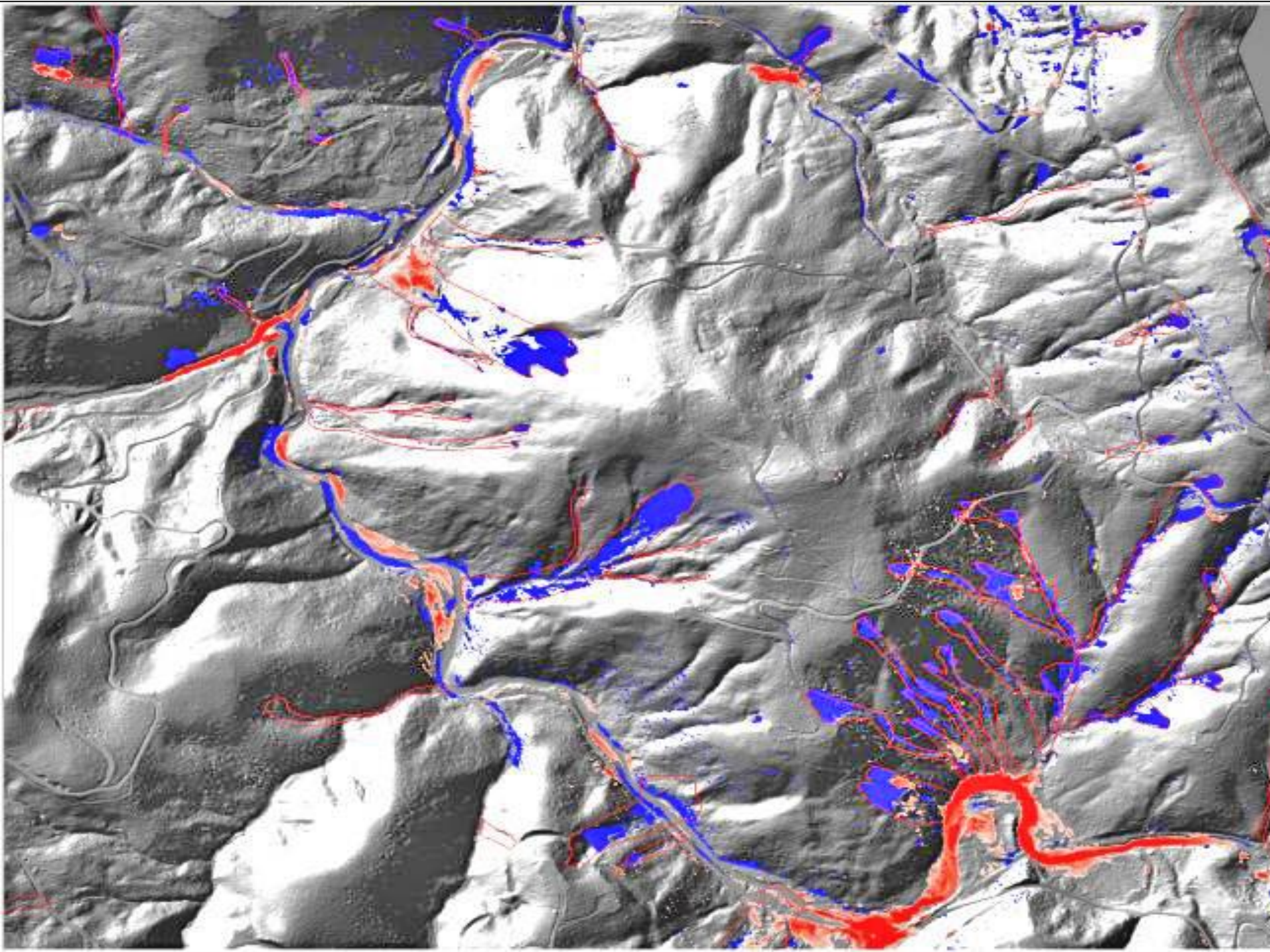


Smith-Root, Inc.
LR-24 ELECTROFISHER
Smith-Root, Inc.

CONTEXT FOR THIS WORK

- **Area most severely impacted by storm one of most studied and well-understood of any within Weyerhaeuser's western ownership**
- **Pre-storm conditions well documented over a period of several decades (HMP, 'Fish Model', water typing)**
- **Most published research on disturbance recovery focused at the individual site scale**
- **Unique opportunity to evaluate and characterize recovery processes across multiple spatial scales over time**

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CONTEXT FOR THIS WORK

"Fish populations may be locally or temporarily extirpated from stream channels due to mass wasting and downstream scouring that can require years before even partial recovery begins."

Washington Forest Practice Board Manual – Section 13

RESEARCH OBJECTIVE

Monitor and evaluate the factors influencing the temporal variability in the recovery of fish populations and habitat in debris-torrented streams.

BUT WHAT IS THIS PROJECT?

- **Assessment of fish recolonization in stream systems where fish were (largely) extirpated by catastrophic debris flows in 2007**

- Characterization of physical stream habitat variables associated with:
  - Rate of fish recolonization
  - Fish population structure in ‘recovering’ systems

- Most extensive study of its kind that we are aware of:
  - 17 basins (2 reference basins not impacted by a debris flow)
  - 29 km of stream

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HOW IS IT DONE?

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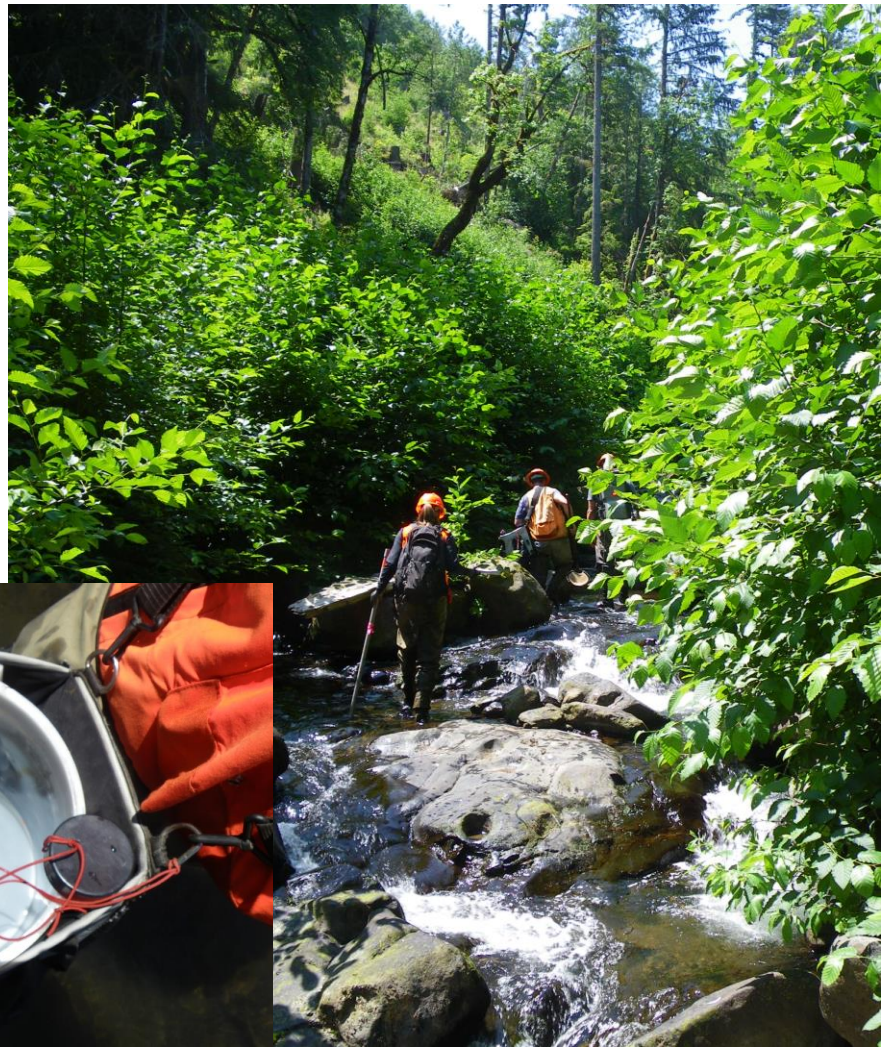
- **Fish abundance data are linearly referenced in GIS. Provide a visual display of trends in recolonization**



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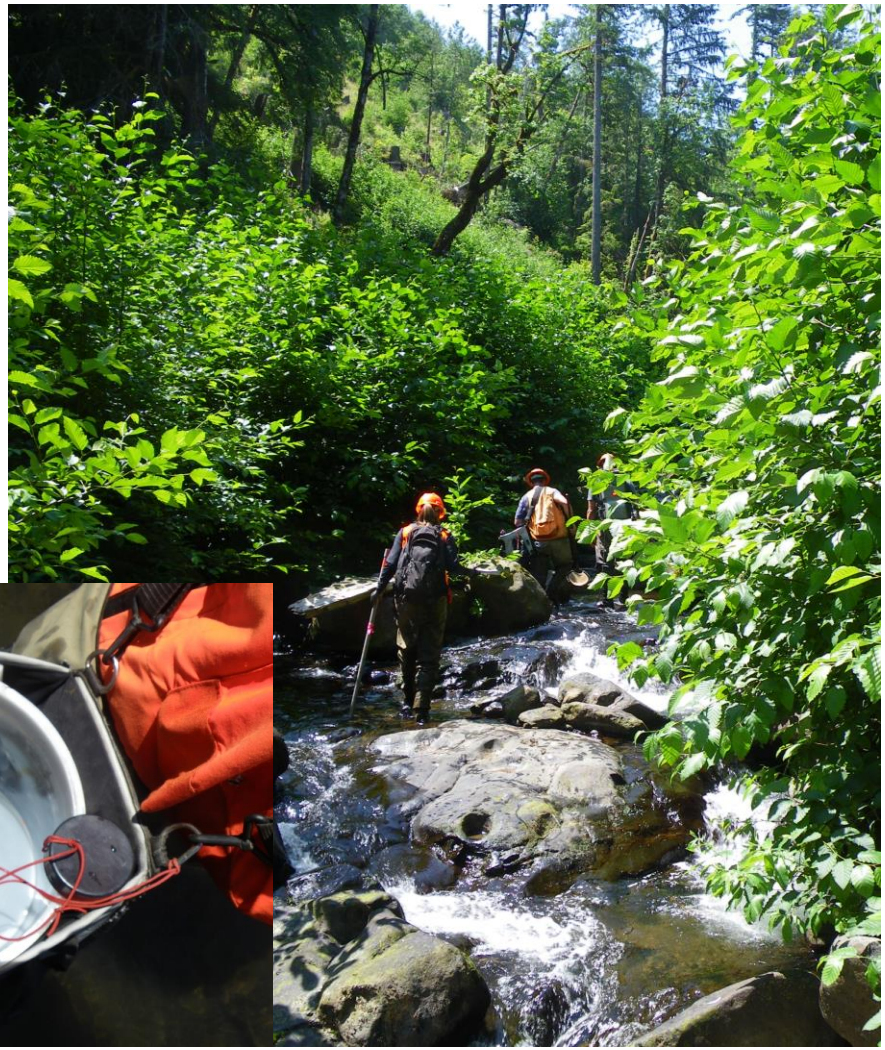
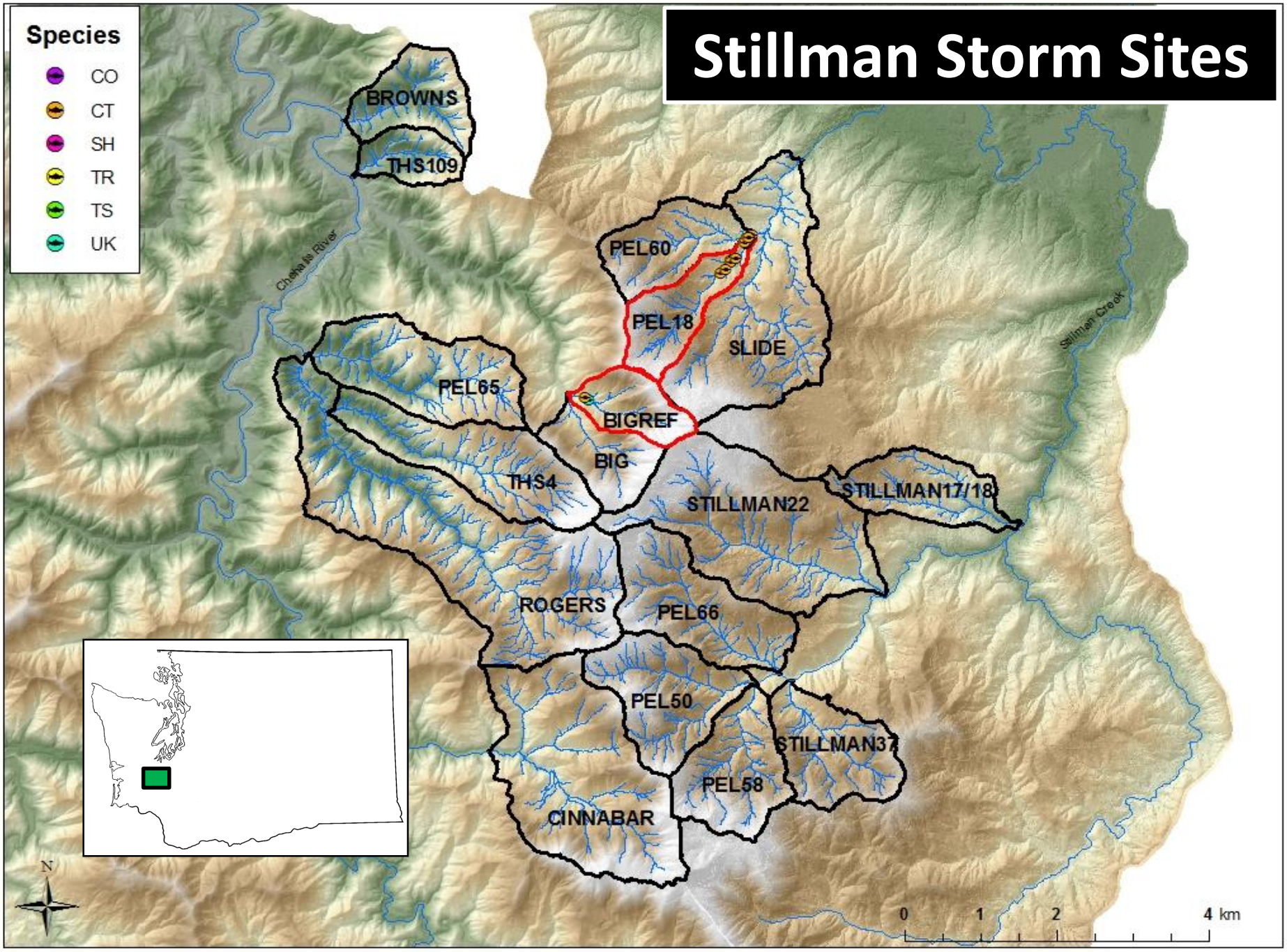


FISH SAMPLING (Torgersen et al. 2004 and Bateman et al. 2005)

- **Spatially continuous, single-pass electrofishing**
- **Upstream**
- **Sampling all habitat units**
- **Enumerate and measure all fish**
- **Habitat survey**

HABITAT SURVEY (Bisson 1982)

- Channel unit type
- Length (m)
- Bankfull and wetted width (m)
- Mean and max depth (cm)
- Gradient (%)
- Substrate
- LWD


Species
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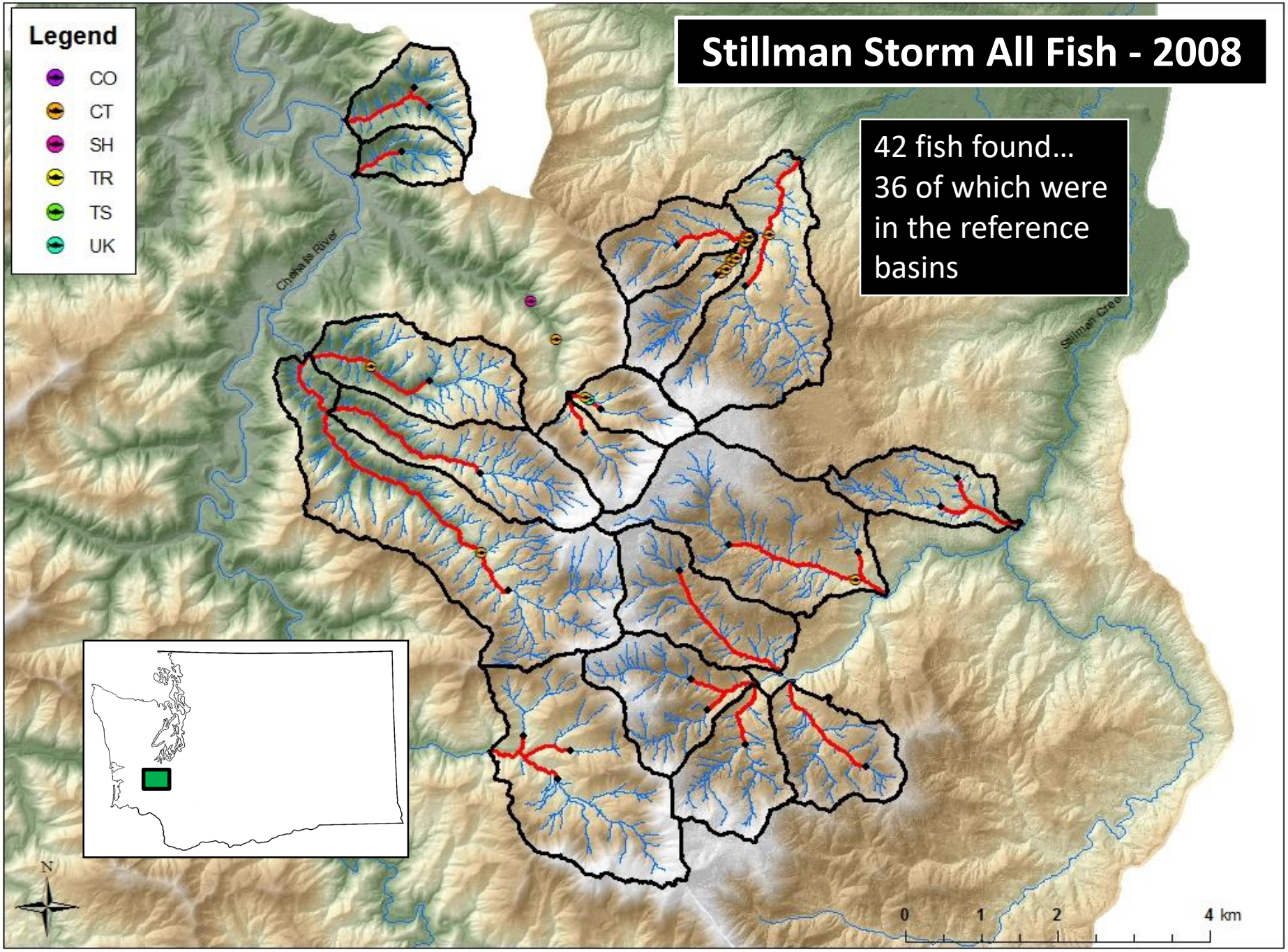
UK
Stillman Storm Sites
BROWNS
THS109
PEL60
PEL18
SLIDE
PEL65
BIGREF
BIG
THS4
STILLMAN22
STILLMAN17/18
ROGERS
PEL66
PEL50
STILLMAN37
PEL58
CINNABAR
Chehalis River
Stillman Creek
N
0
1
2
4 km


Legend
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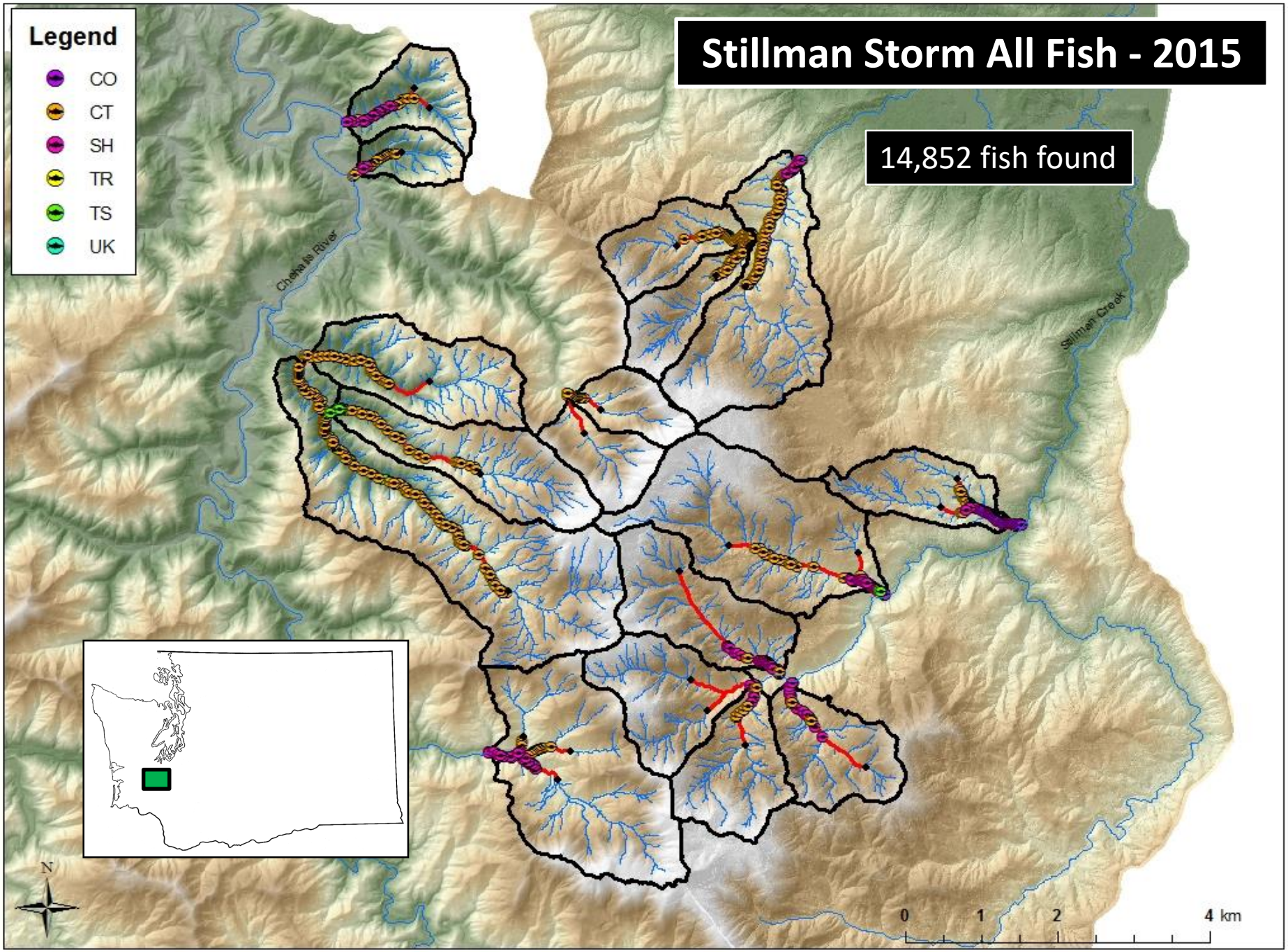
Stillman Storm All Fish - 2008
42 fish found…
36 of which were in the reference basins
Chehalis River
Stillman Creek
N
0
1
2
4 km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Stillman Storm All Fish - 2015
14,852 fish found
Chehalis River
Stillman Creek
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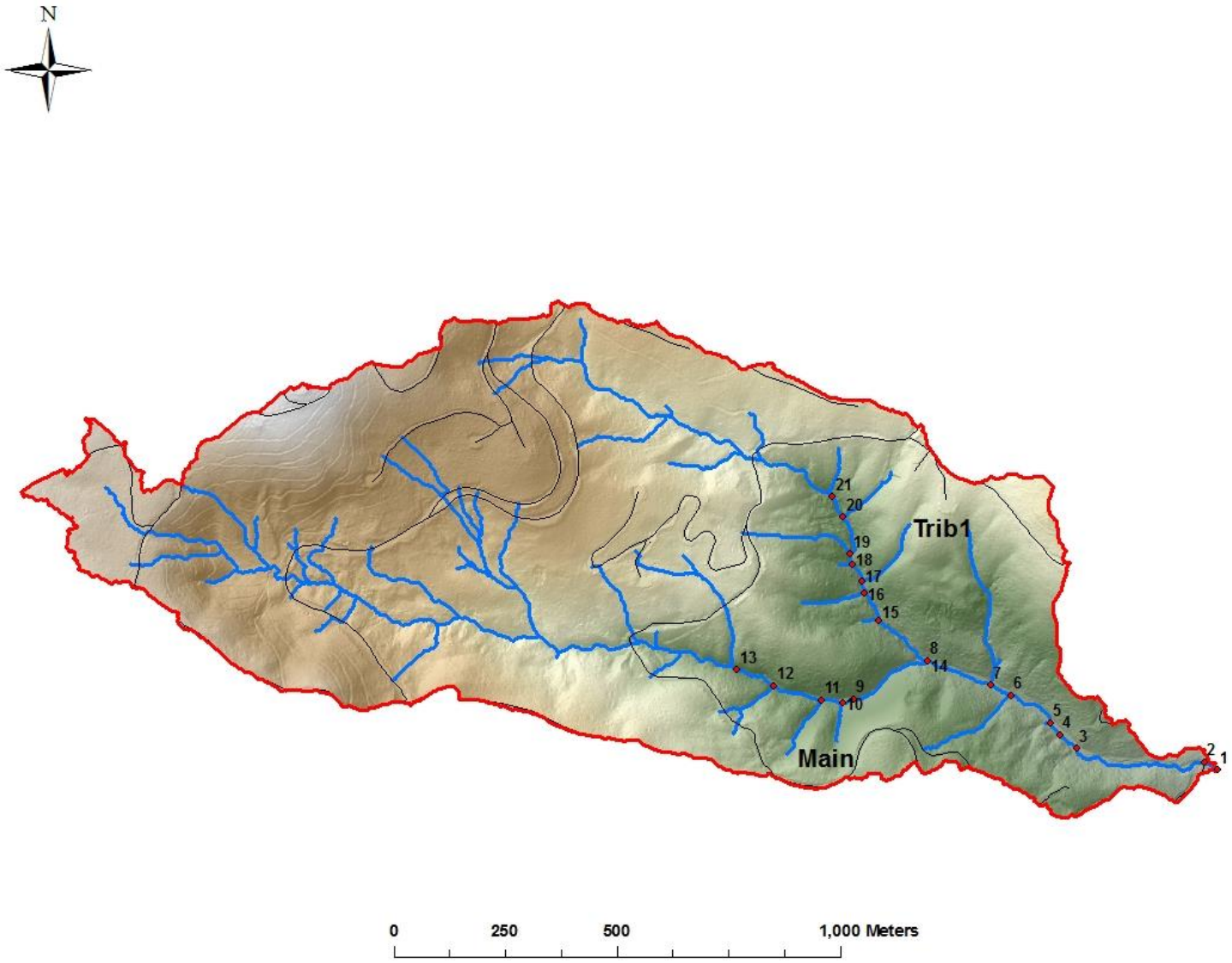
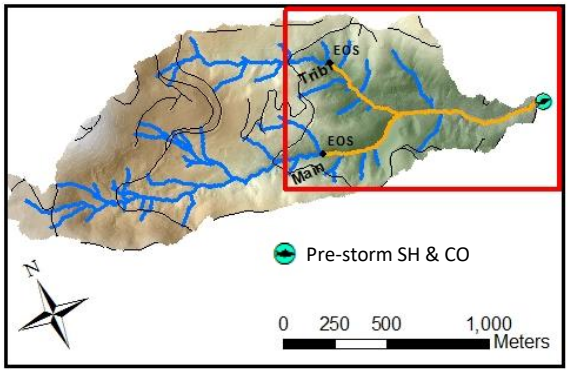
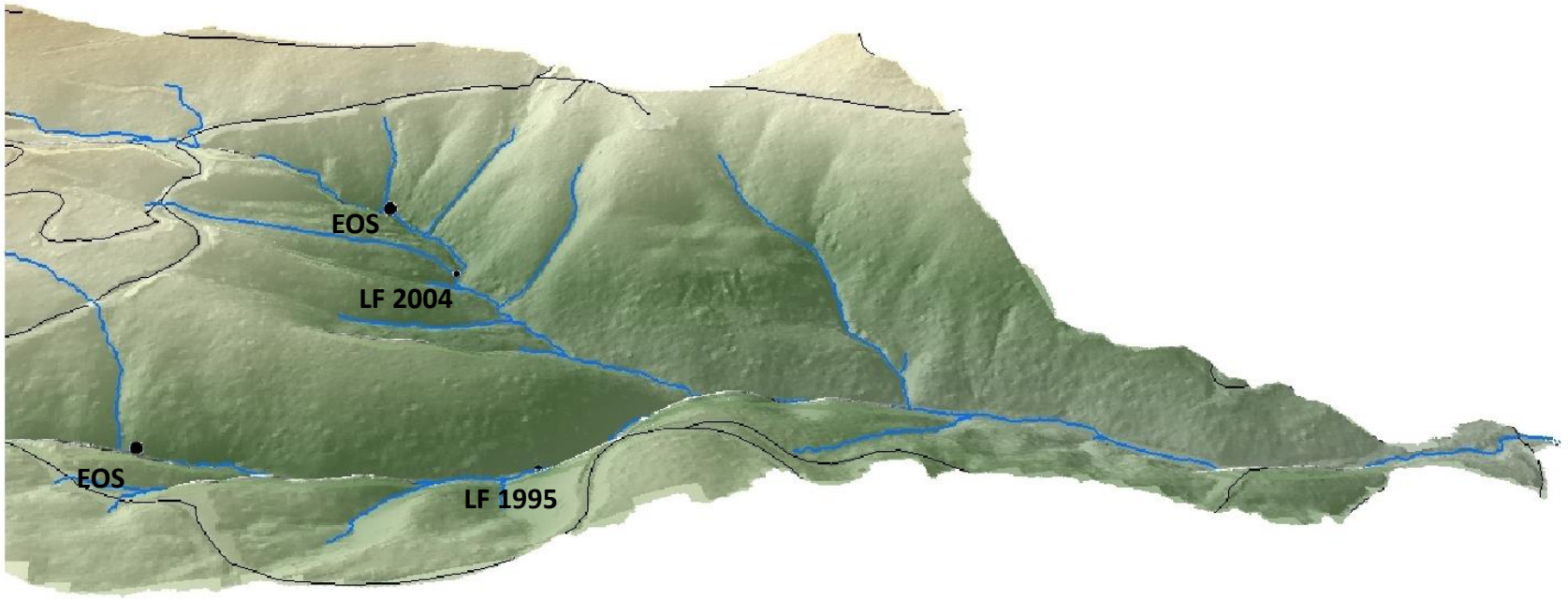
4 km

STILLMAN 17/18

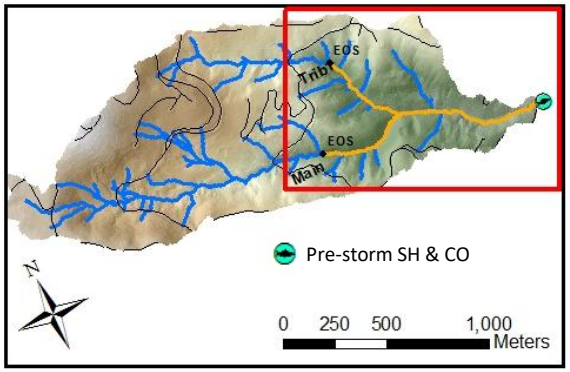


Stillman 17/18 - 2008





Stillman 17/18 - 2009



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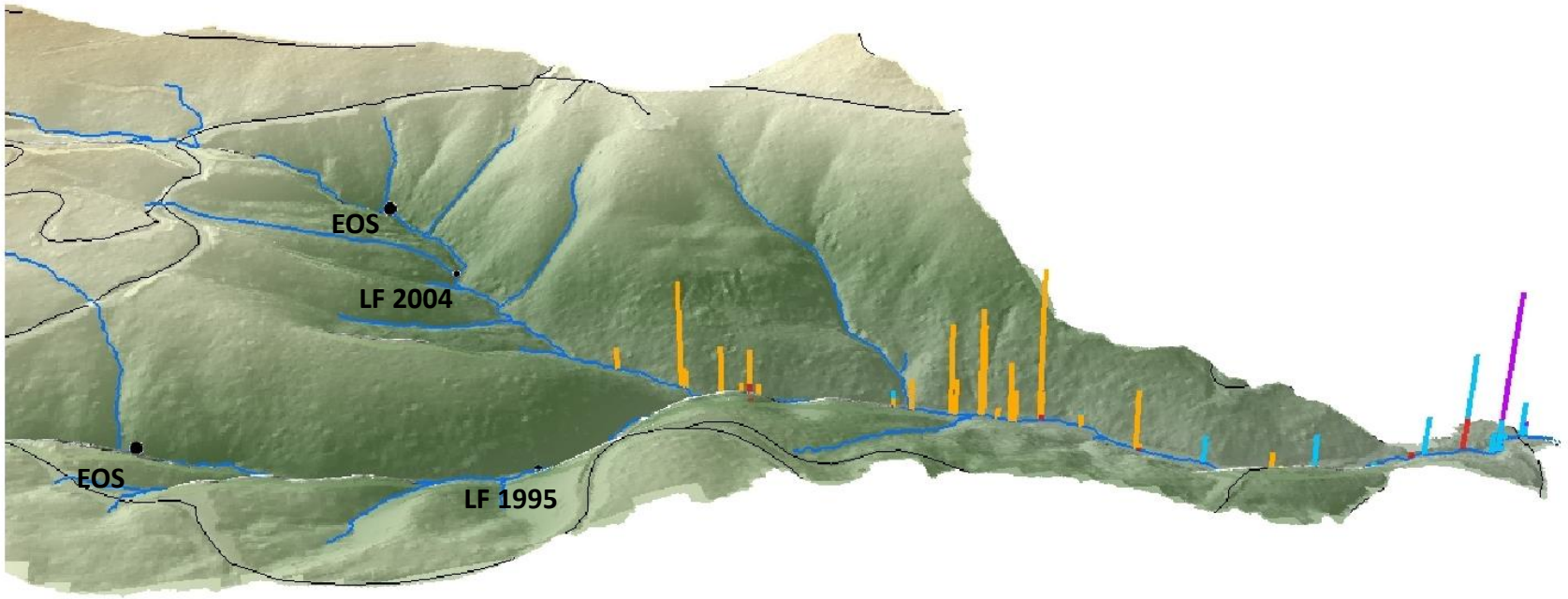
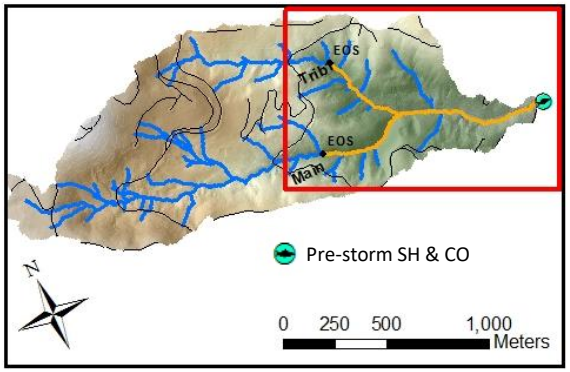


Stillman 17/18 - 2010



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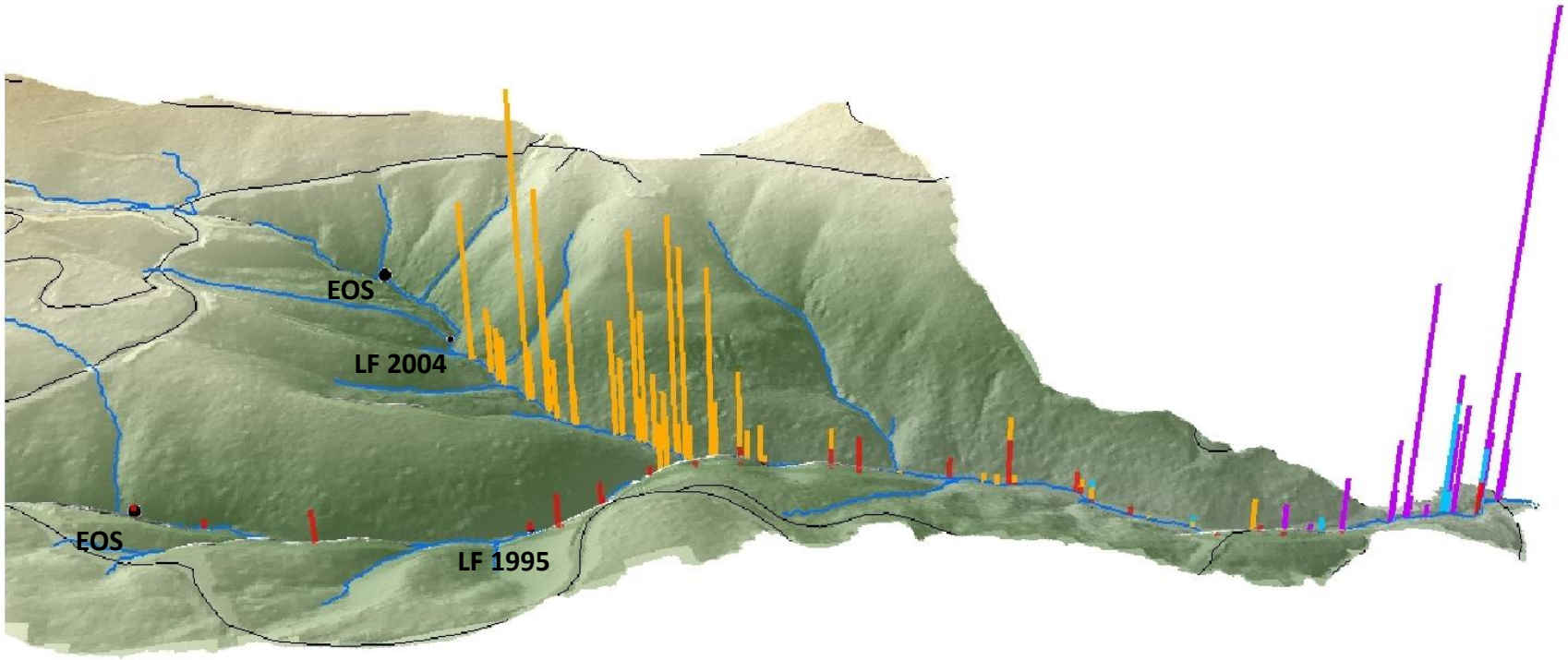
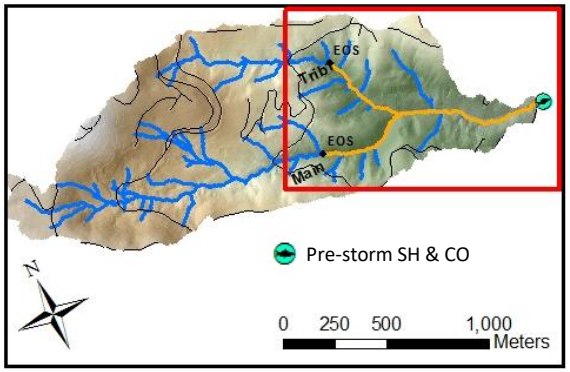


Stillman 17/18 - 2011



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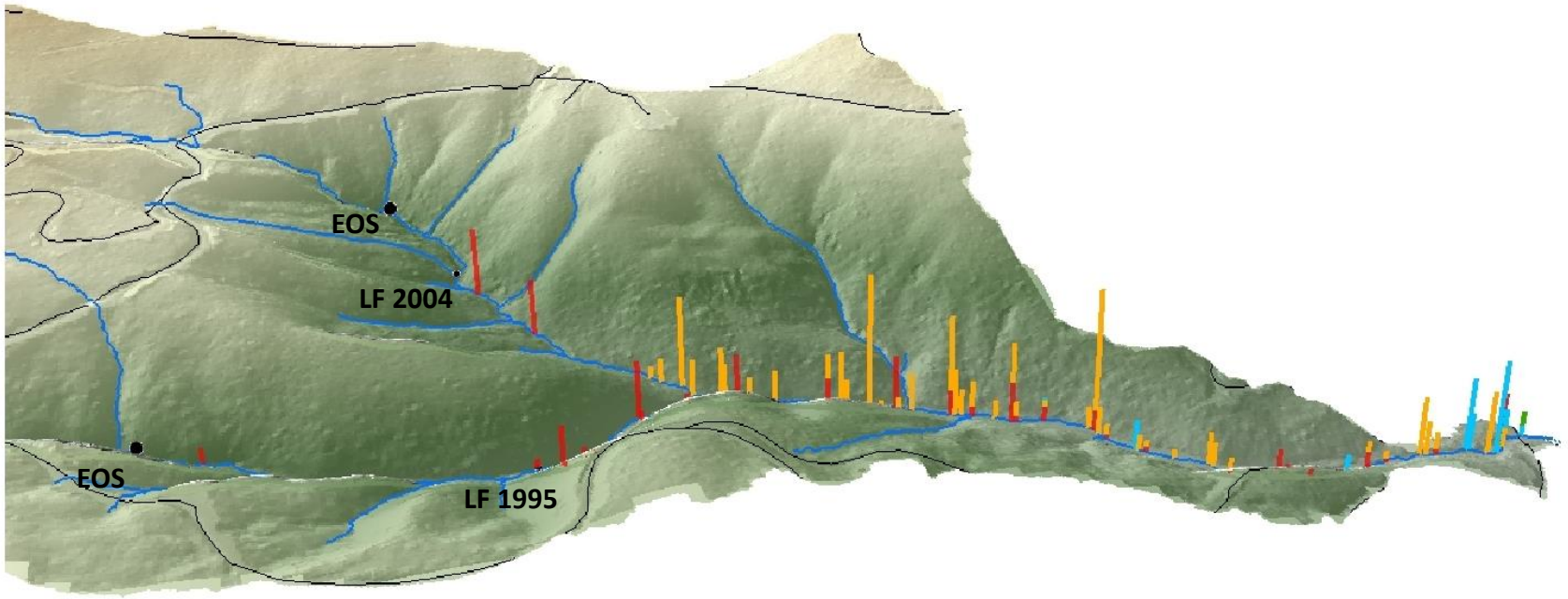
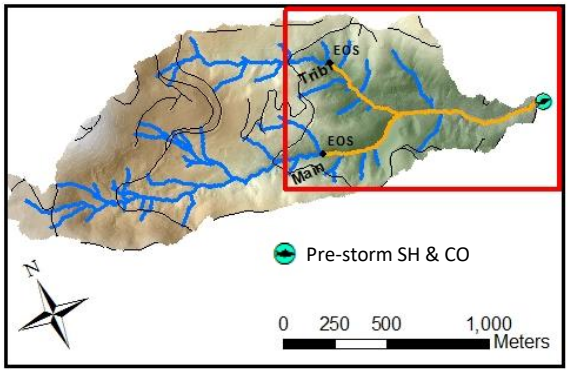
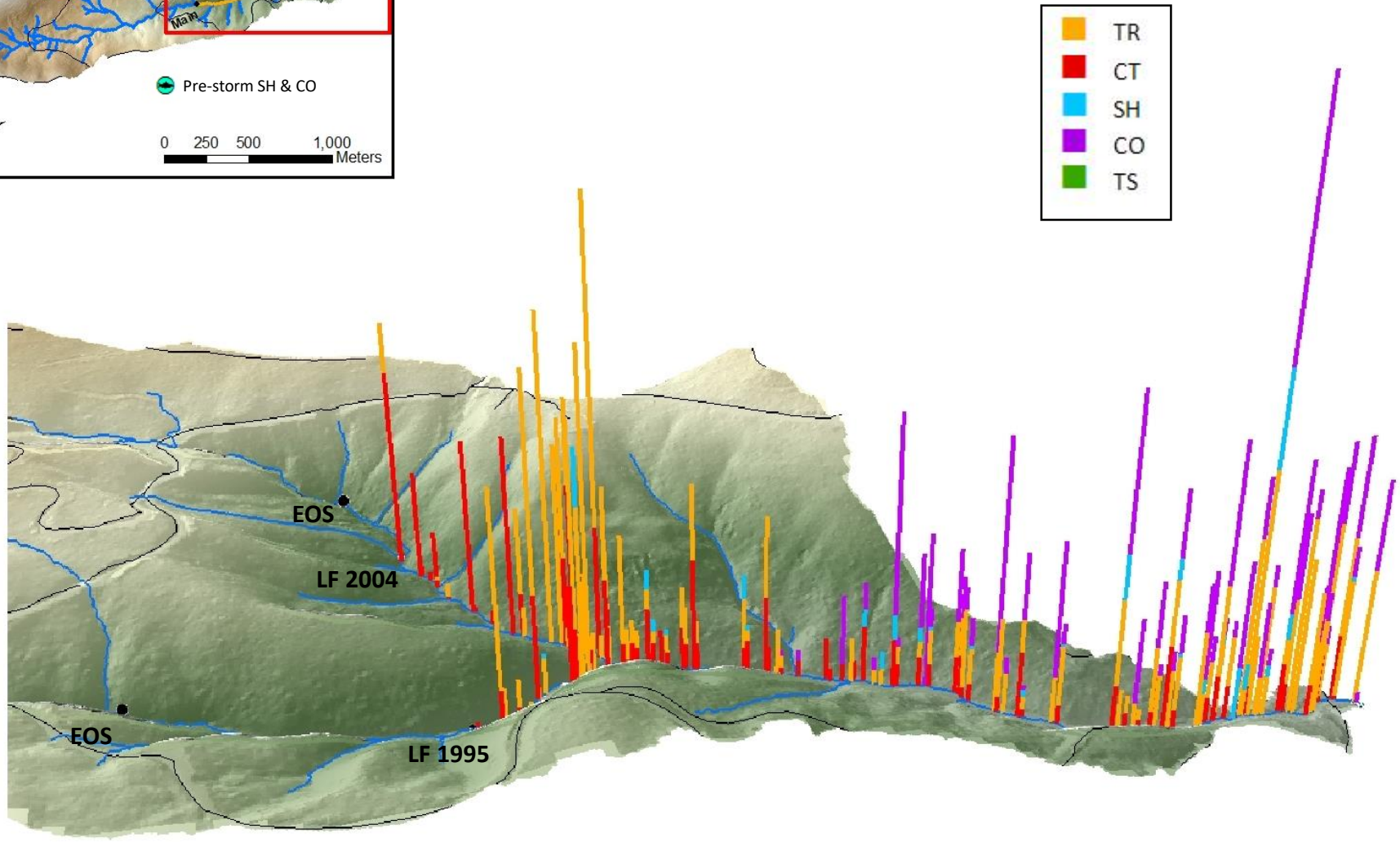
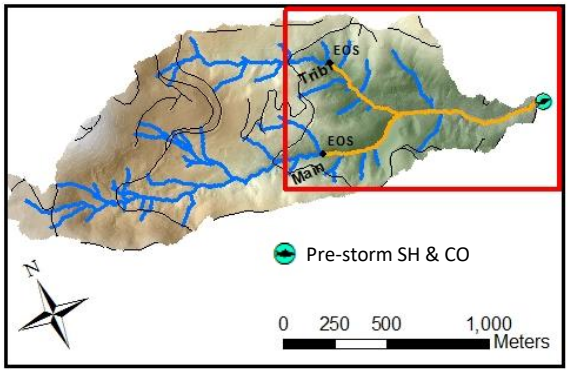


Stillman 17/18 - 2012





Stillman 17/18 - 2013



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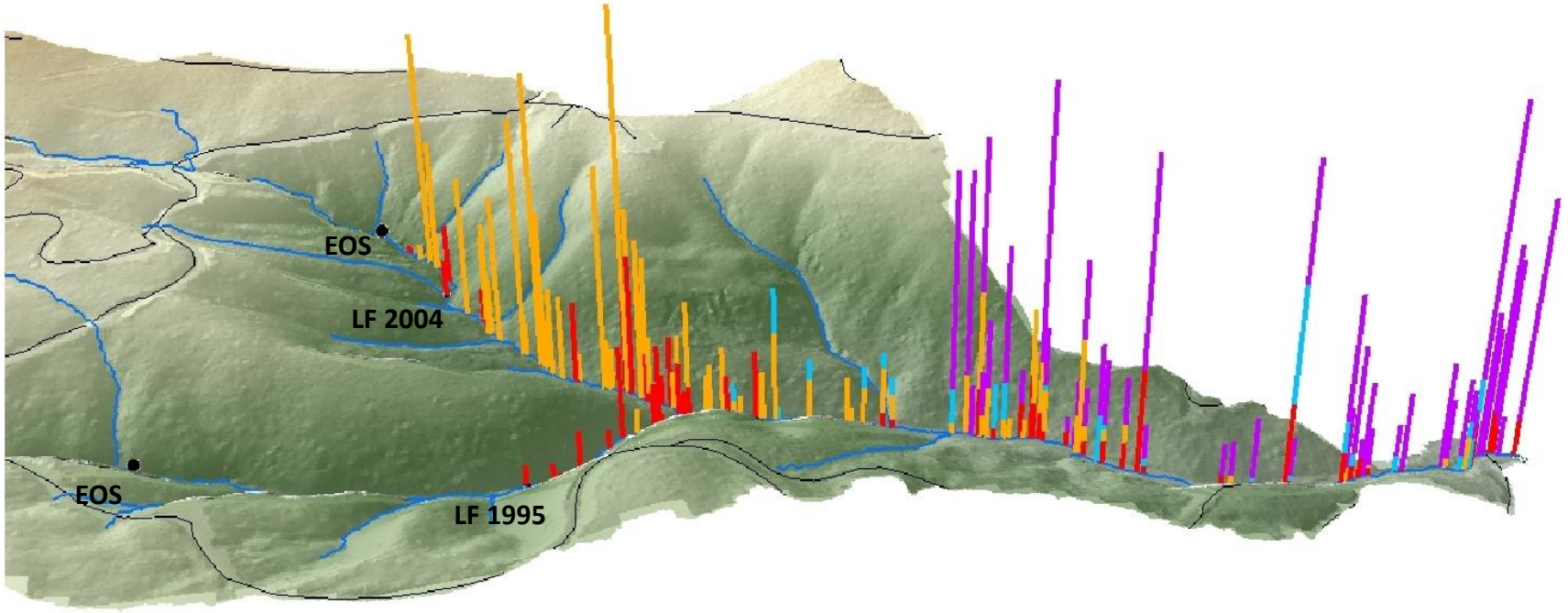
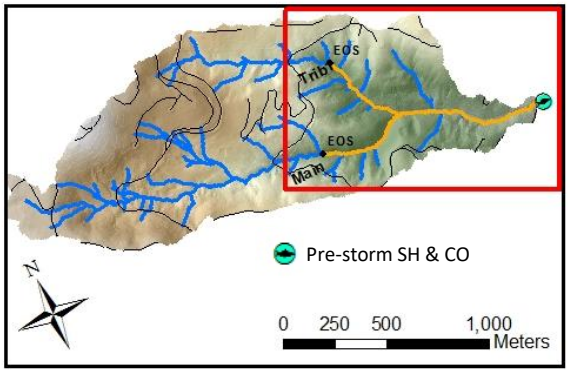
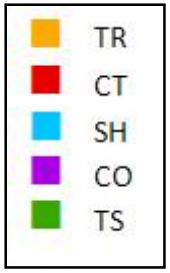
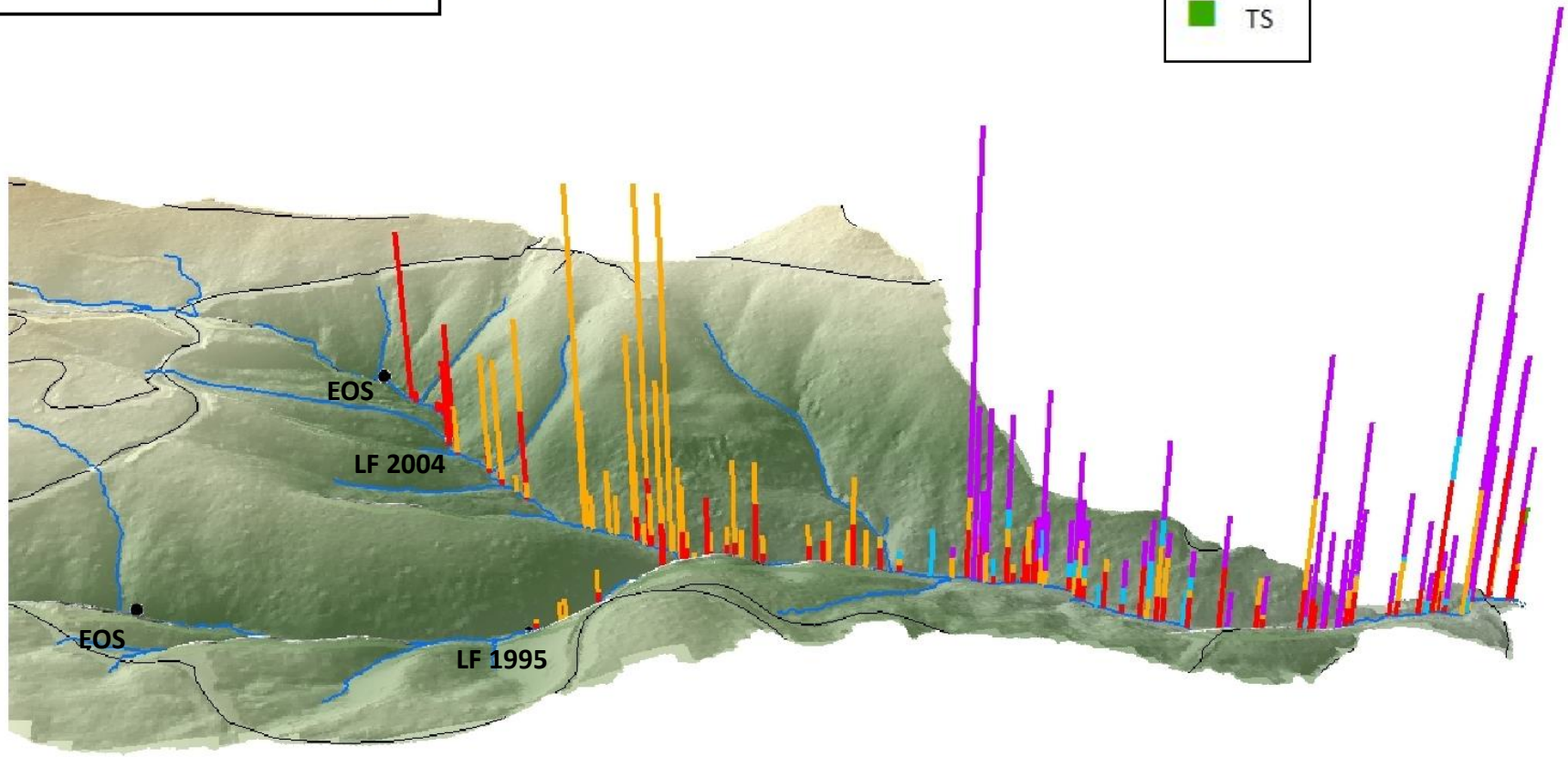


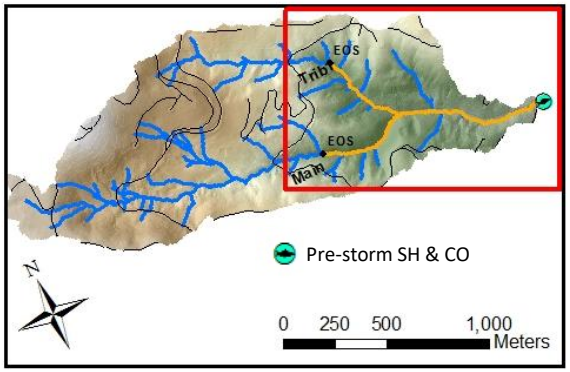
Stillman 17/18 - 2014

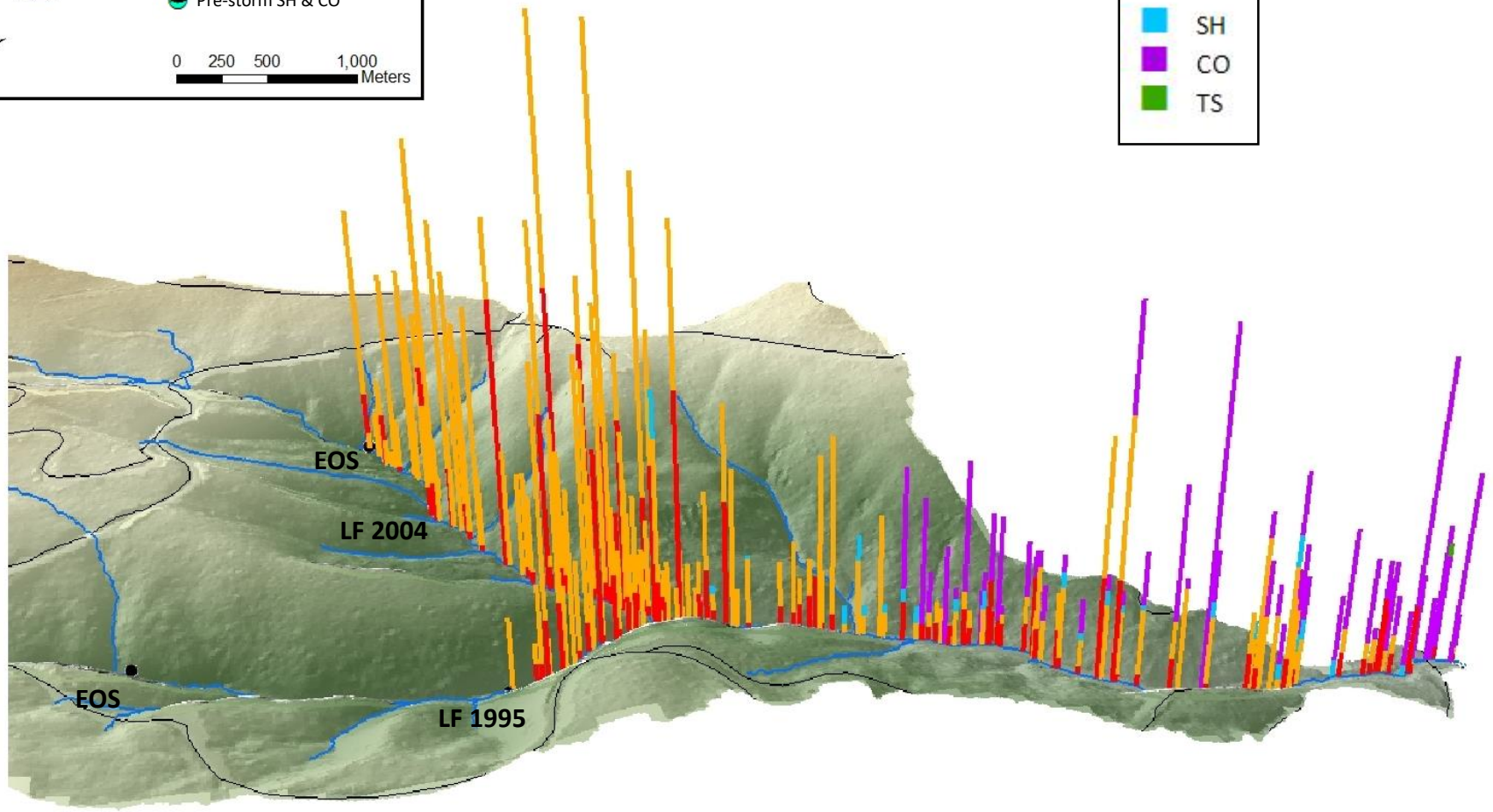




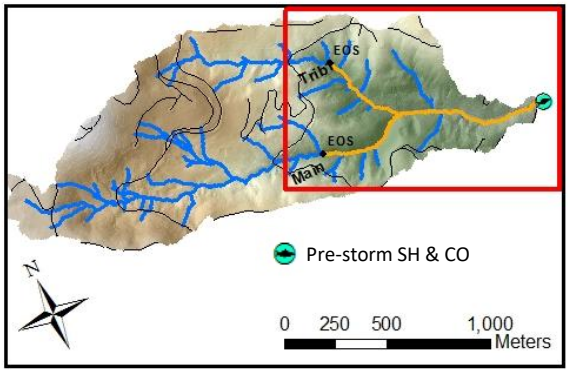


Stillman 17/18 - 2015

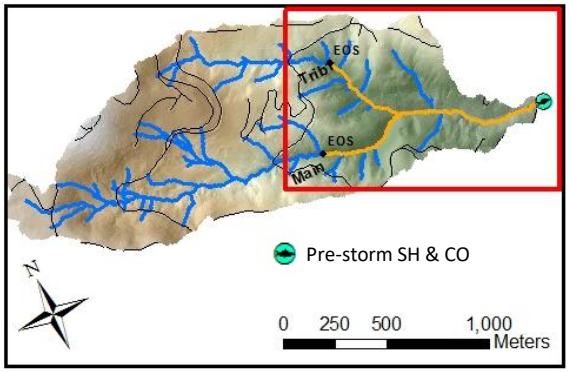


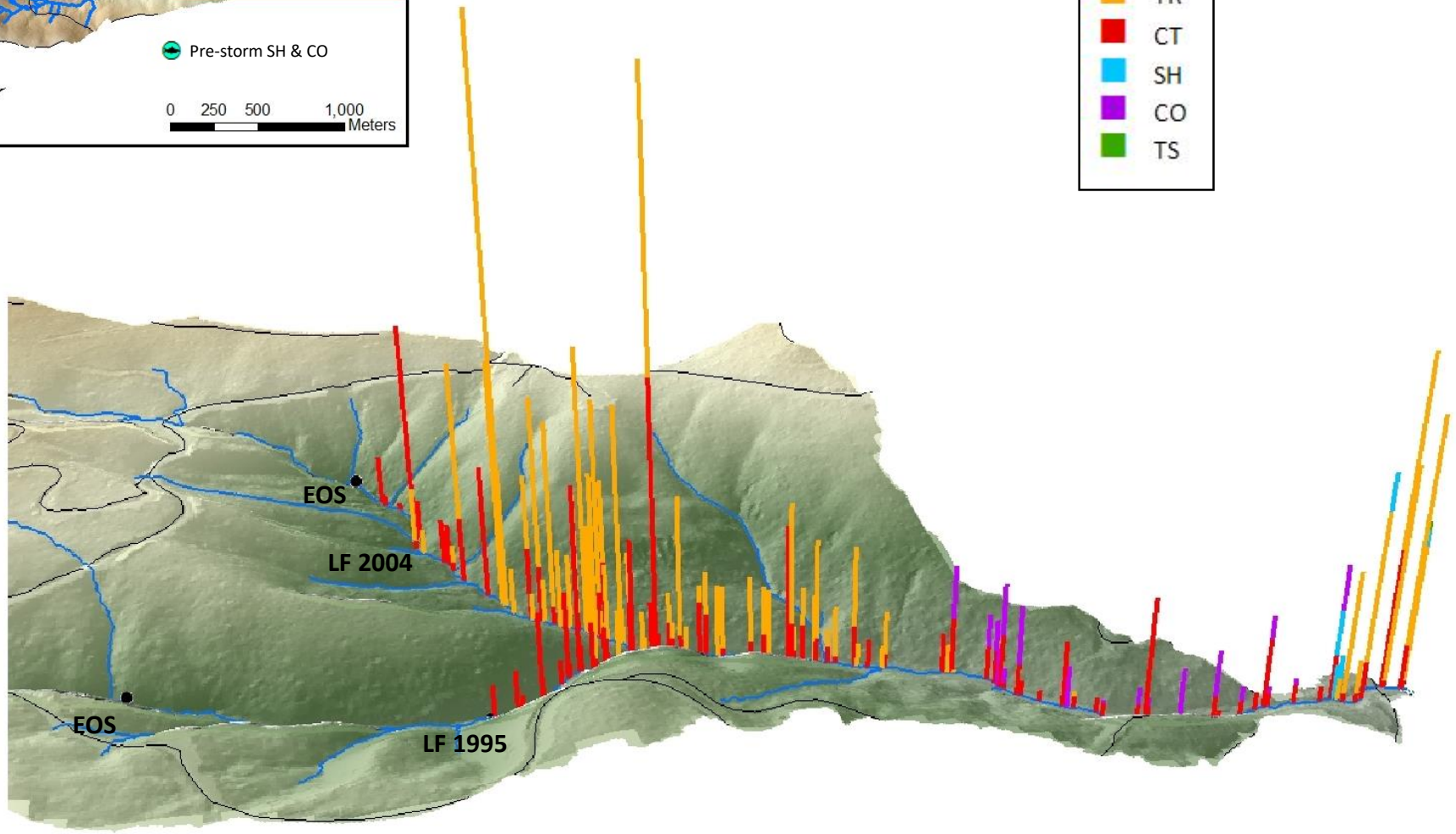


Stillman 17/18 - 2016



Stillman 17/18 - 2017






2008


2010


2012

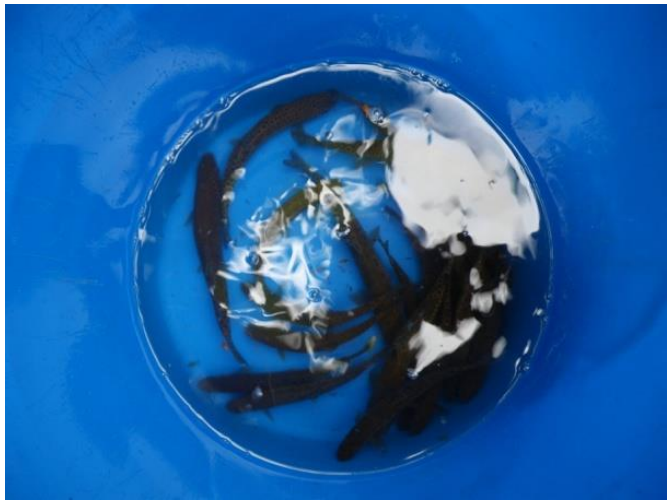

2014


2016

PRELIMINARY FINDINGS

- **Fish returned to all (15) stream systems impacted by catastrophic debris flows by the 2009 sampling period… only 1.5 years after storm**

- **Fish have fully recolonized pre-storm occupied habitats in 10 of 15 streams impacted by debris flows:**
  - **In 6 of these 10 streams within only 4 years post-storm**
  - **In 6 of these 10 streams fish now upstream from pre-storm distribution**



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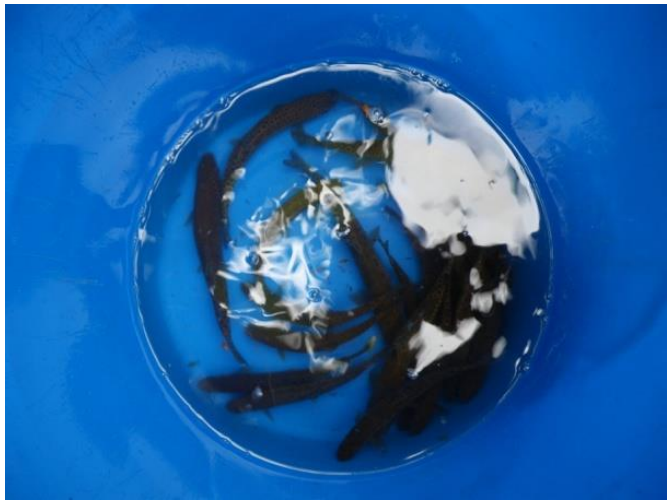

PRELIMINARY FINDINGS

- **Where fish have not recolonized pre-storm occupied habitats, typically some 'feature' associated with stopping point**

- Recolonization rate most significantly influenced by:
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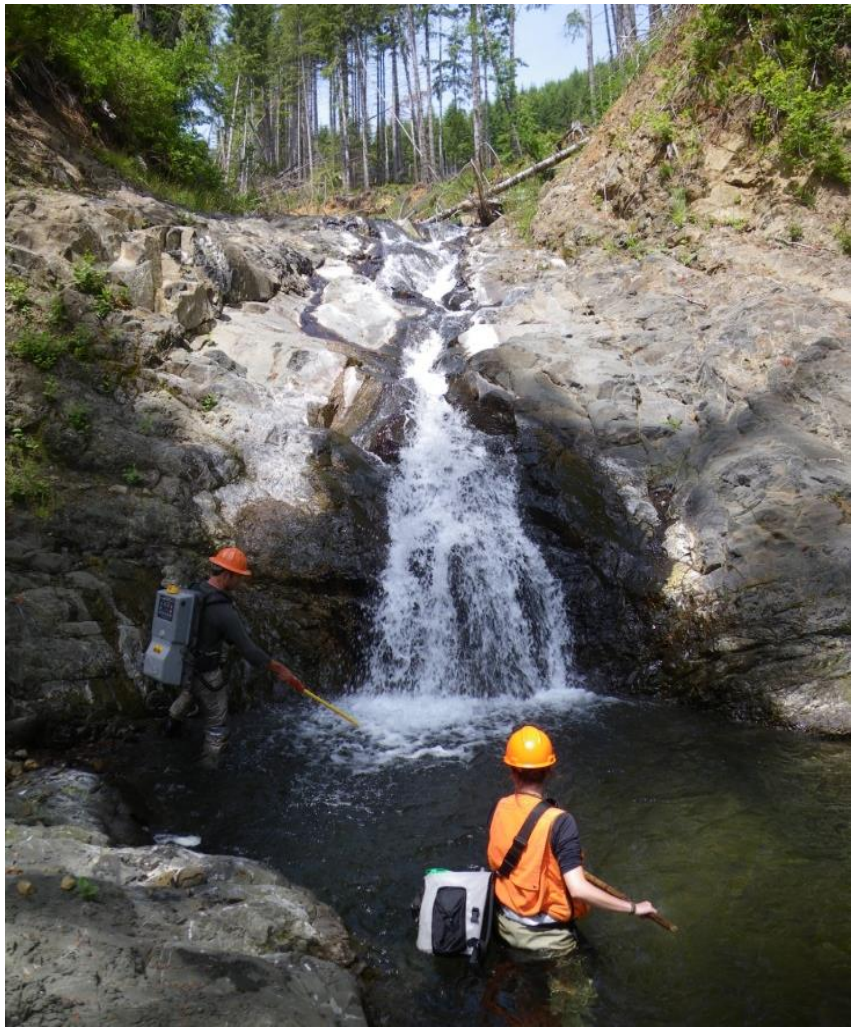
  - Stream gradient
  - Pool availability
  - Substrate



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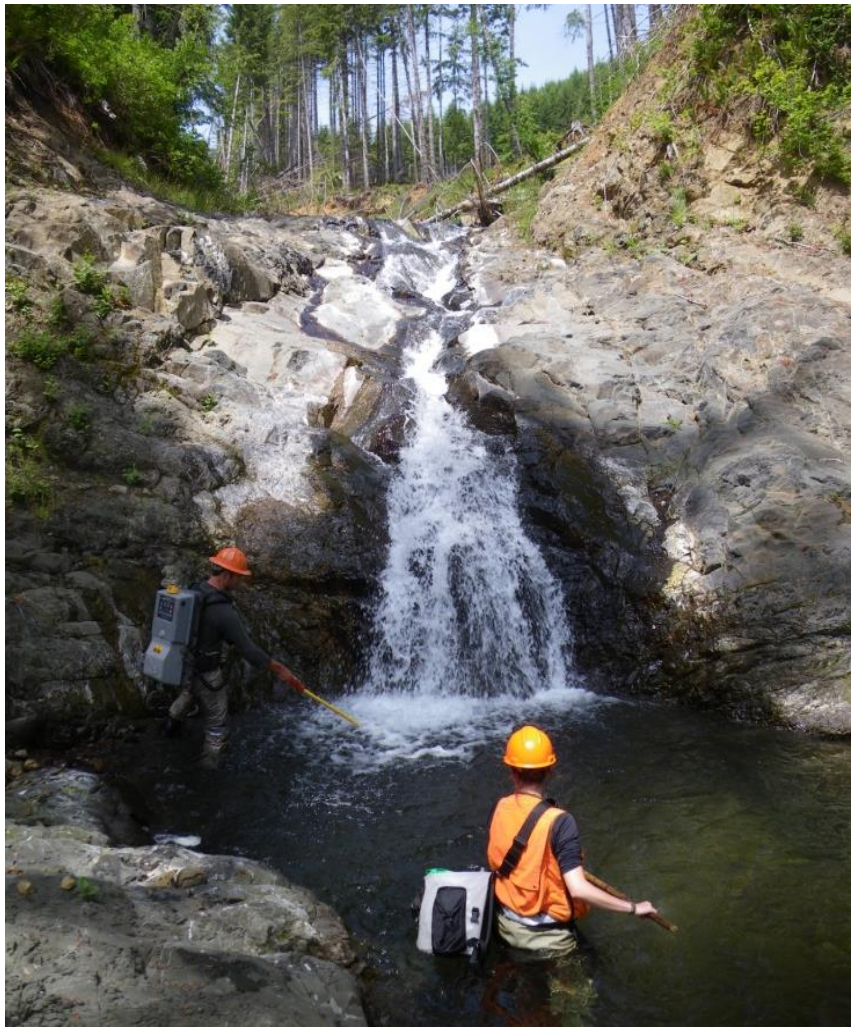

PRELIMINARY FINDINGS

- **Dramatic increase in overall fish abundance (total sampled fish) relative to immediately post-storm findings**
- **Increase in overall abundance driven by change in streams impacted by debris flows… abundance in (2) reference basins relatively static**
- **Cutthroat trout are the uppermost fish in ALL sites, but we have seen expansion in range of anadromous fish, as well**

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- **Complete data analysis in process**
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- **Focus on abundance, Coho ‘signal’ (2011, ‘14, ‘17), etc.**

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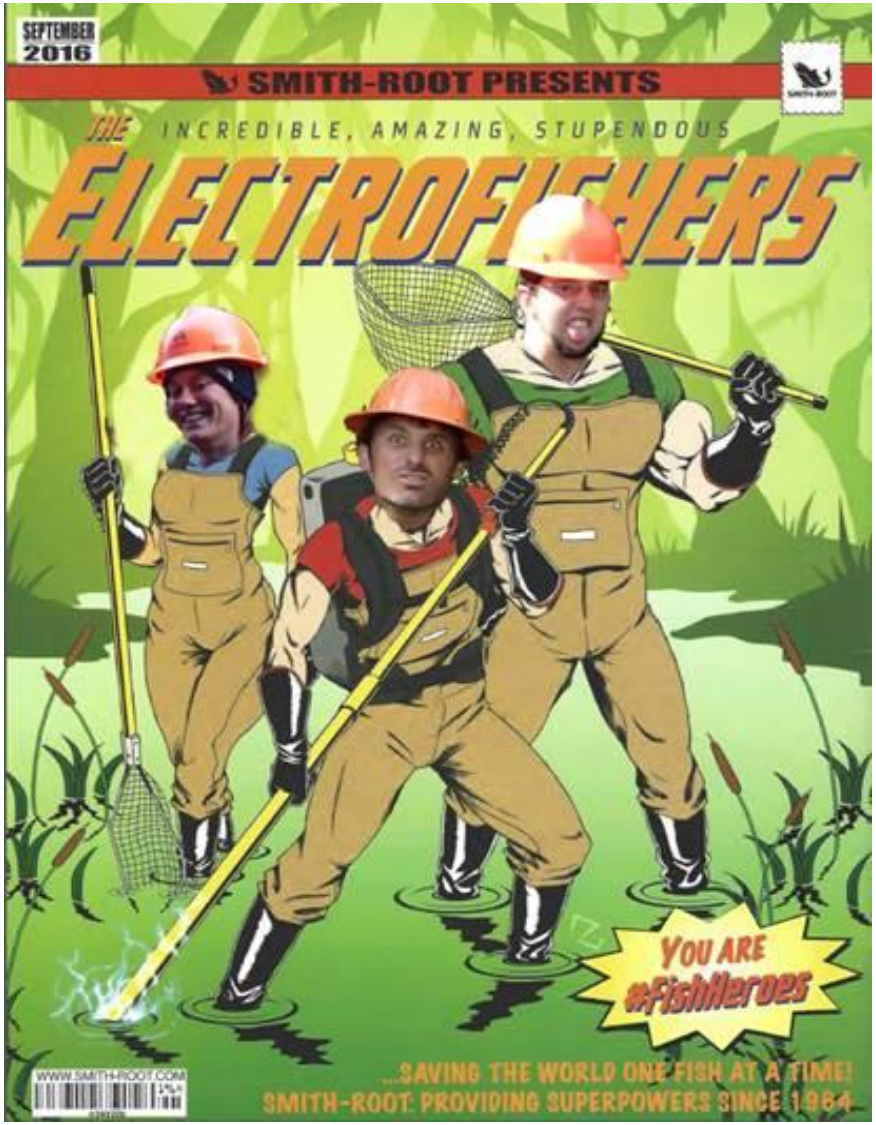
QUESTIONS… COMMENTS?



Pattern detection in stream networks: quantifying spatial variability in fish distribution

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Robert E. Gresswell
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Douglas S. Bateman
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Corvallis, Oregon, 97331, U.S.A.

Abstract

Biological and physical properties of rivers and streams are inherently difficult to sample and visualize at the resolution and extent necessary to detect fine-scale distributional patterns over large areas. Satellite imagery and broad-scale fish survey methods are effective for quantifying spatial variability in biological and physical variables over a range of scales in marine environments but are often too coarse in resolution to address conservation needs in inland fisheries management. We present methods for sampling and analyzing multiscale, spatially continuous patterns of stream fishes and physical habitat in small- to medium-size watersheds (500–1000 hectares). Geospatial tools, including geographic information system (GIS) software such as ArcInfo dynamic segmentation and ArcScene 3D analyst modules, were used to display complex biological and physical datasets. These tools also provided spatial referencing information (e.g. Cartesian and route-measure coordinates) necessary for

Evaluating Single-Pass Catch as a Tool for Identifying Spatial Pattern in Fish Distribution

Article (PDF Available) *in* Journal of Freshwater Ecology 20(2):335-345 · June 2005 *with* 72 Reads
DOI: 10.1080/02705060.2005.9664974

Douglas S. Bateman
15 · Oregon State University

Robert E. Gresswell
30.12 · United States Geological Survey

Christian E. Torgersen

Abstract
We evaluate the efficacy of single-pass electrofishing without blocknets as a tool for collecting spatially continuous fish distribution data in headwater streams. We compare spatial patterns in abundance, sampling effort, and length-frequency distributions from single-pass sampling of coastal cutthroat trout (Oncorhynchus clarki clarki) to data obtained from a more precise multiple-pass removal electrofishing method in two mid-sized (500–1000 ha) forested watersheds in western Oregon. Abundance estimates from single- and multiple-pass removal electrofishing were positively correlated in both watersheds, r = 0.99 and 0.86. There were no significant trends in capture probabilities at the watershed scale (P > 0.05). Moreover, among-sample variation in fish abundance was higher than within-sample error in both streams indicating that increased precision of unit-scale abundance estimates would provide less information on patterns of abundance than increasing the fraction of habitat units sampled. In the two watersheds, respectively, single-pass electrofishing captured 78 and