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

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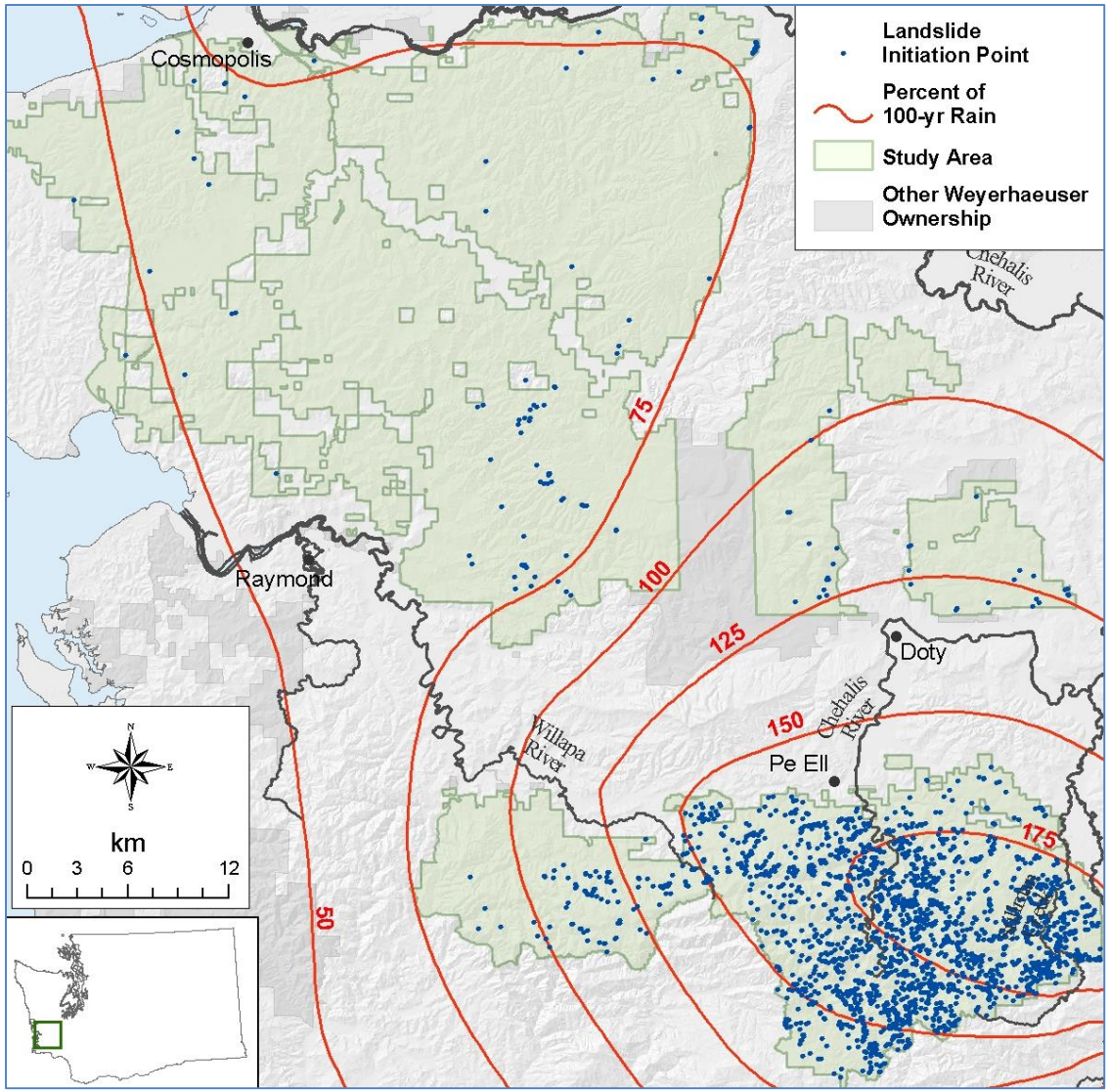
WEYERHAEUSER WESTERN TIMBERLANDS TECHNOLOGY

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

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

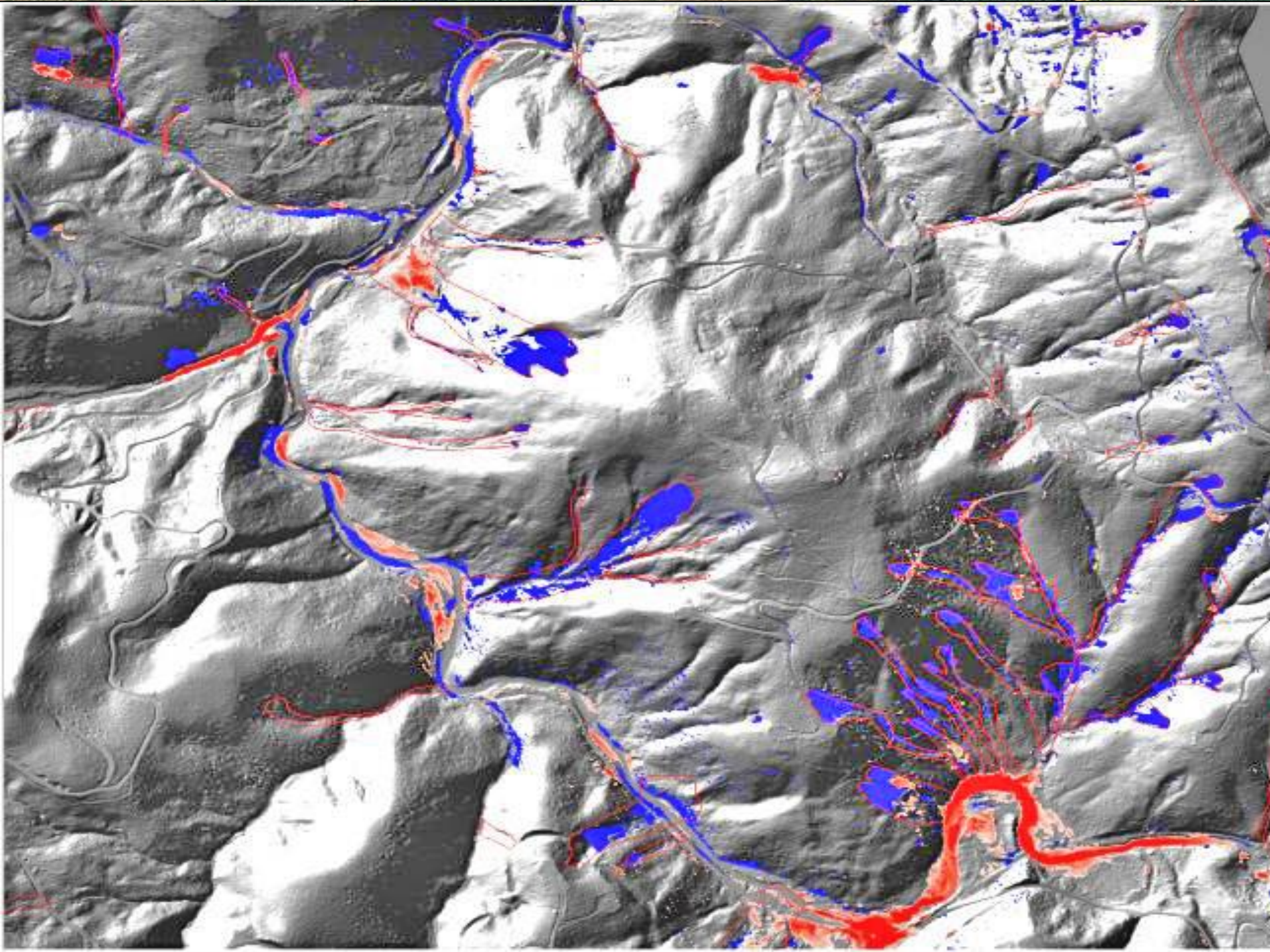
Photo Credit: (December 04, 2007) Associated Press

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




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**

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

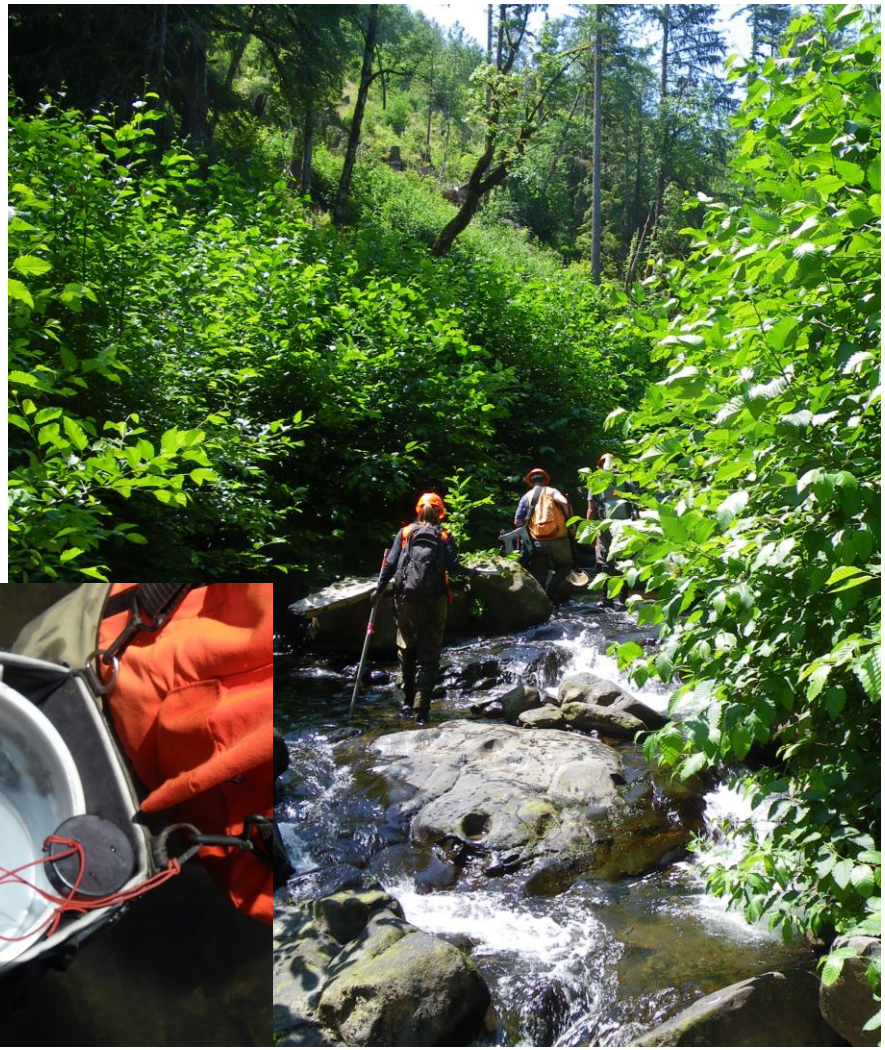
Monitor and evaluate the factors influencing the temporal variability in the recovery of fish populations and habitat in debris-torrented streams.

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

HOW IS IT DONE?

- **Spatially continuous single-pass electrofishing and stream habitat surveys conducted annually *(remember… 29 km)***
- **Fish abundance data are linearly referenced in GIS. Provide a visual display of trends in recolonization**

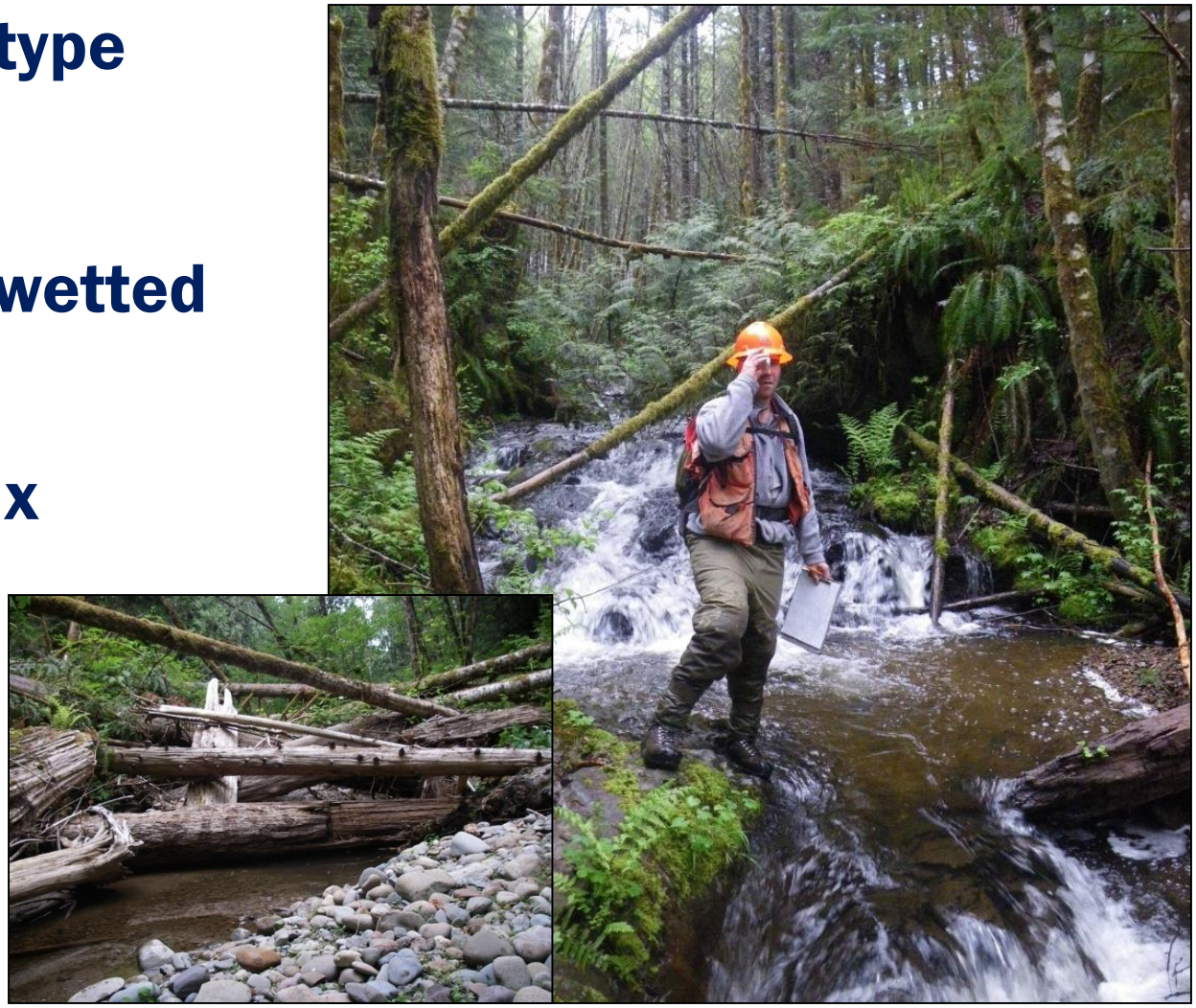


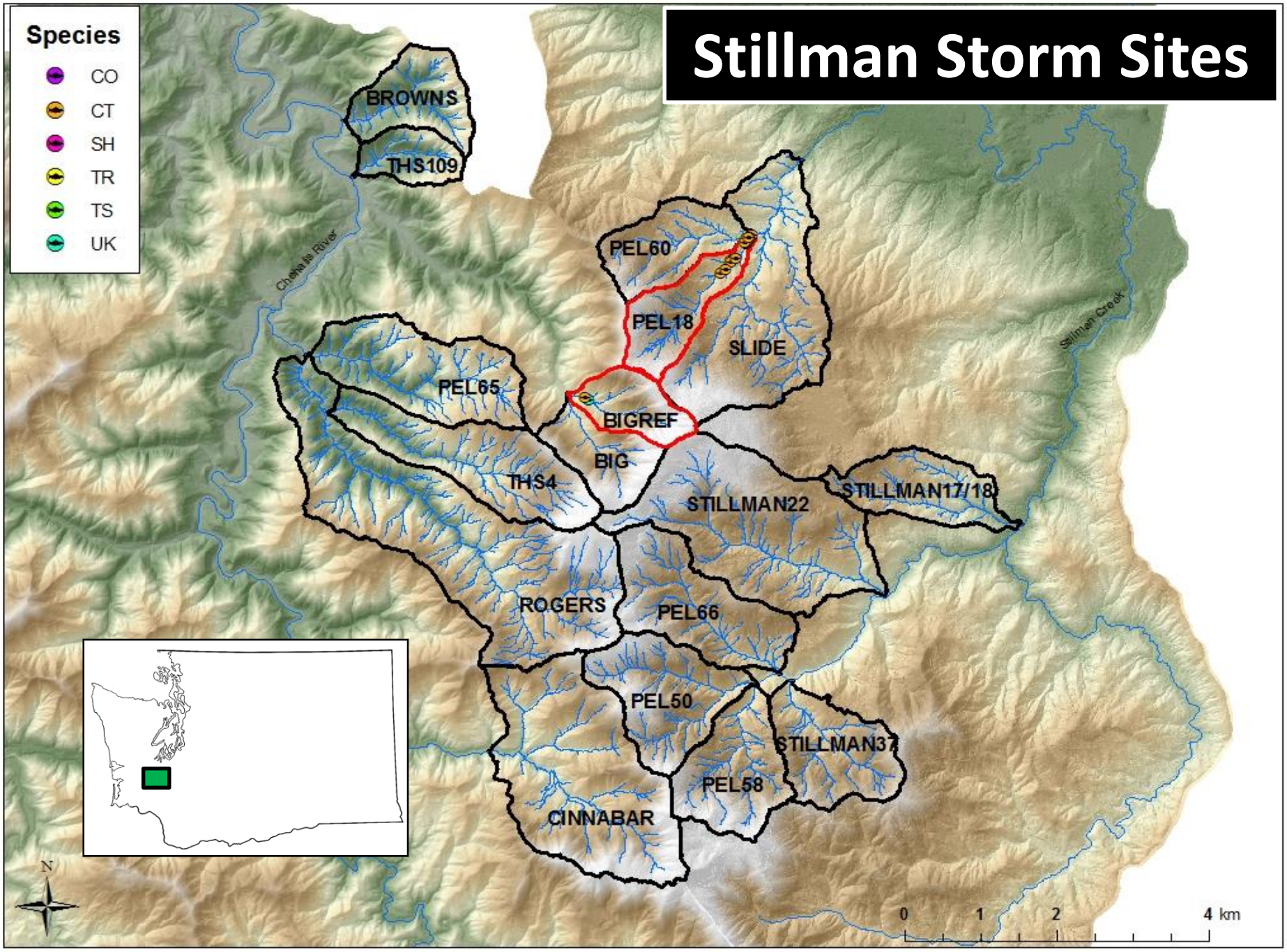
FISH SAMPLING (Torgersen et al. 2004 and Bateman et al. 2005)

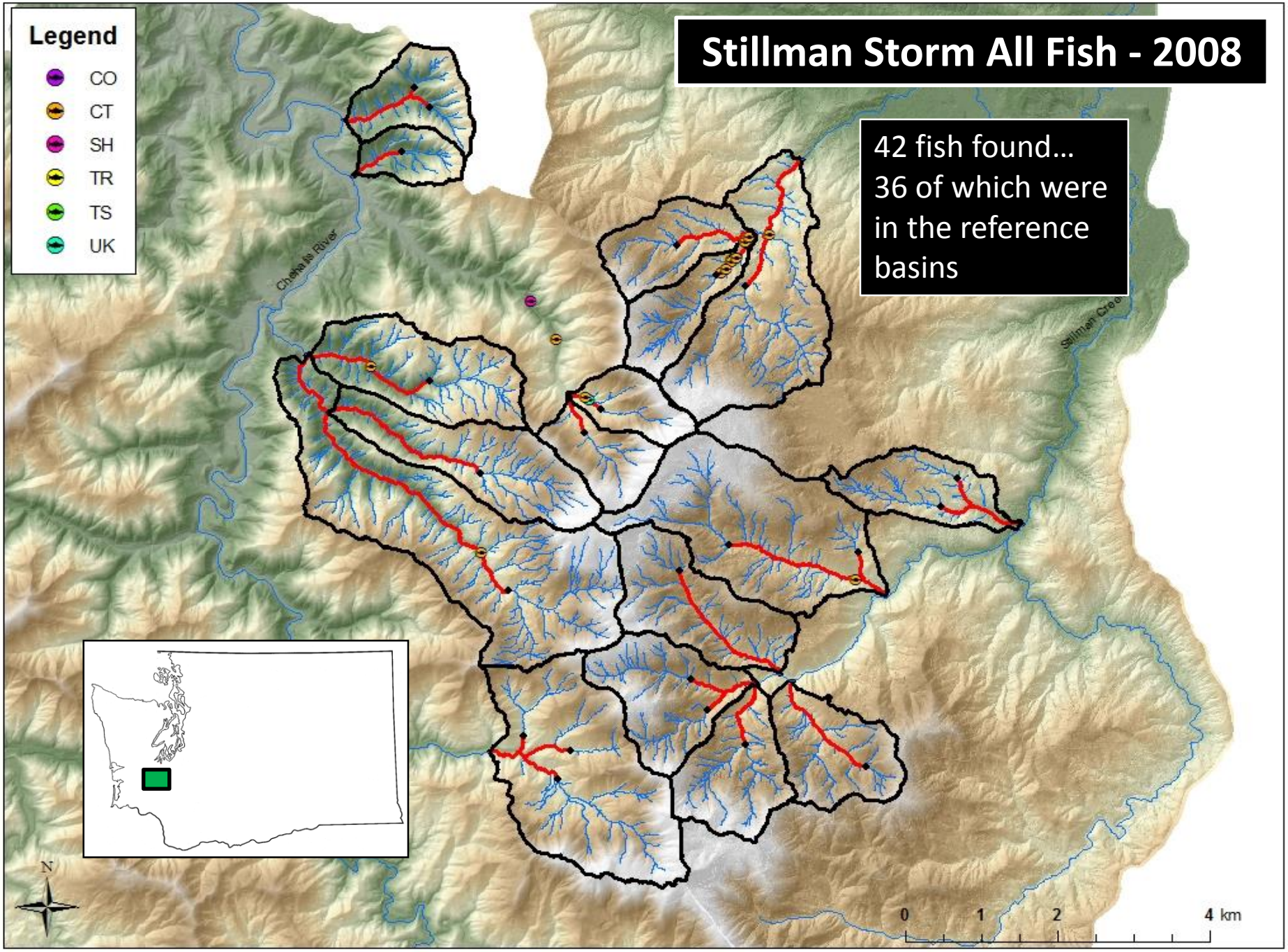
- Spatially continuous, single-pass electrofishing
- Upstream
- Sampling all habitat units
- Enumerate and measure all fish
- Habitat survey

HABITAT SURVEY (Bisson 1982)

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




Species
CO
CT
SH
TR
TS
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


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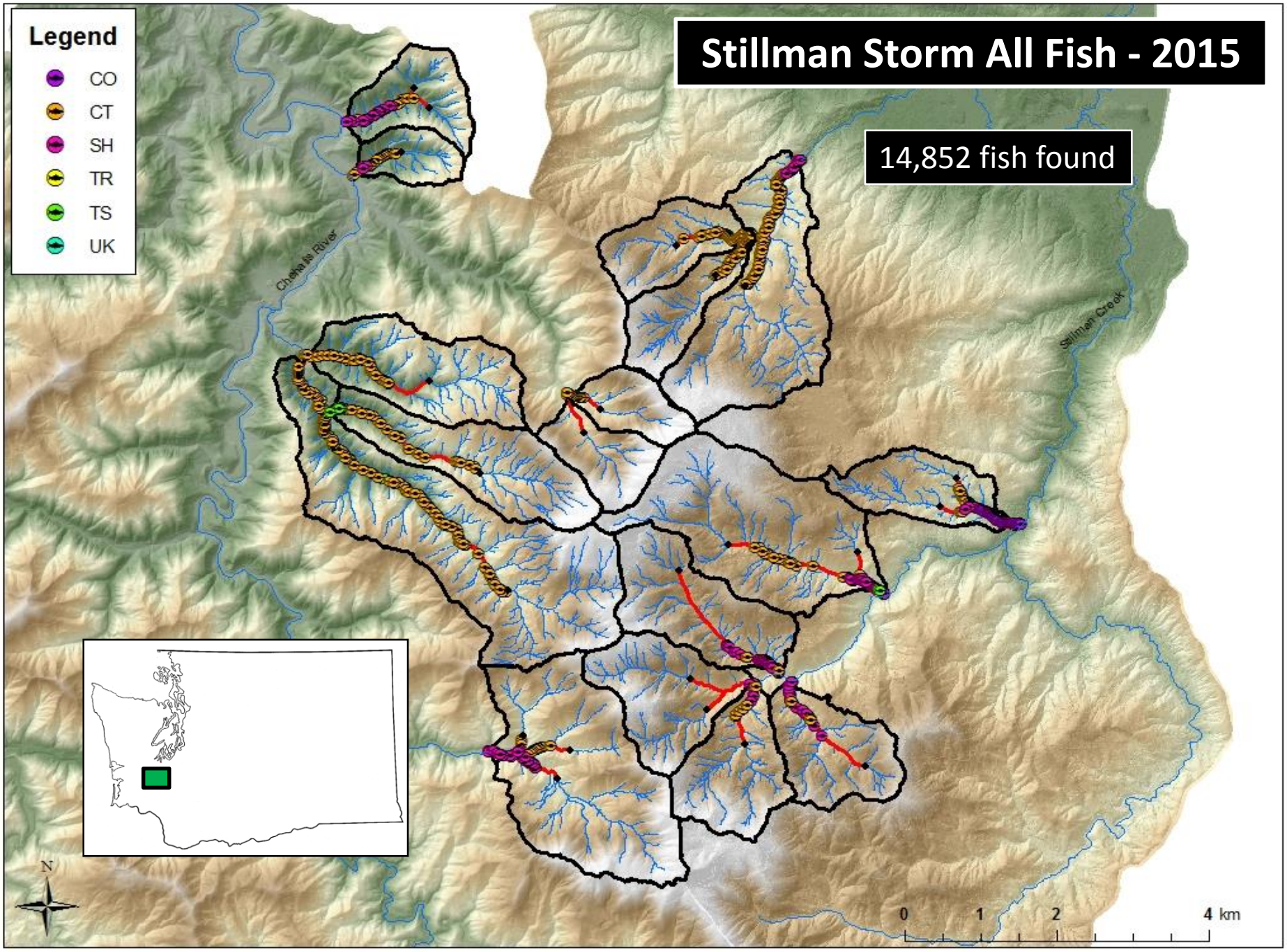
Chehalis River
Stillman Creek
N
0
1
2
4 km


Legend
CO
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UK
Stillman Storm All Fish - 2015
14,852 fish found
Chehalis River
Stillman Creek
N
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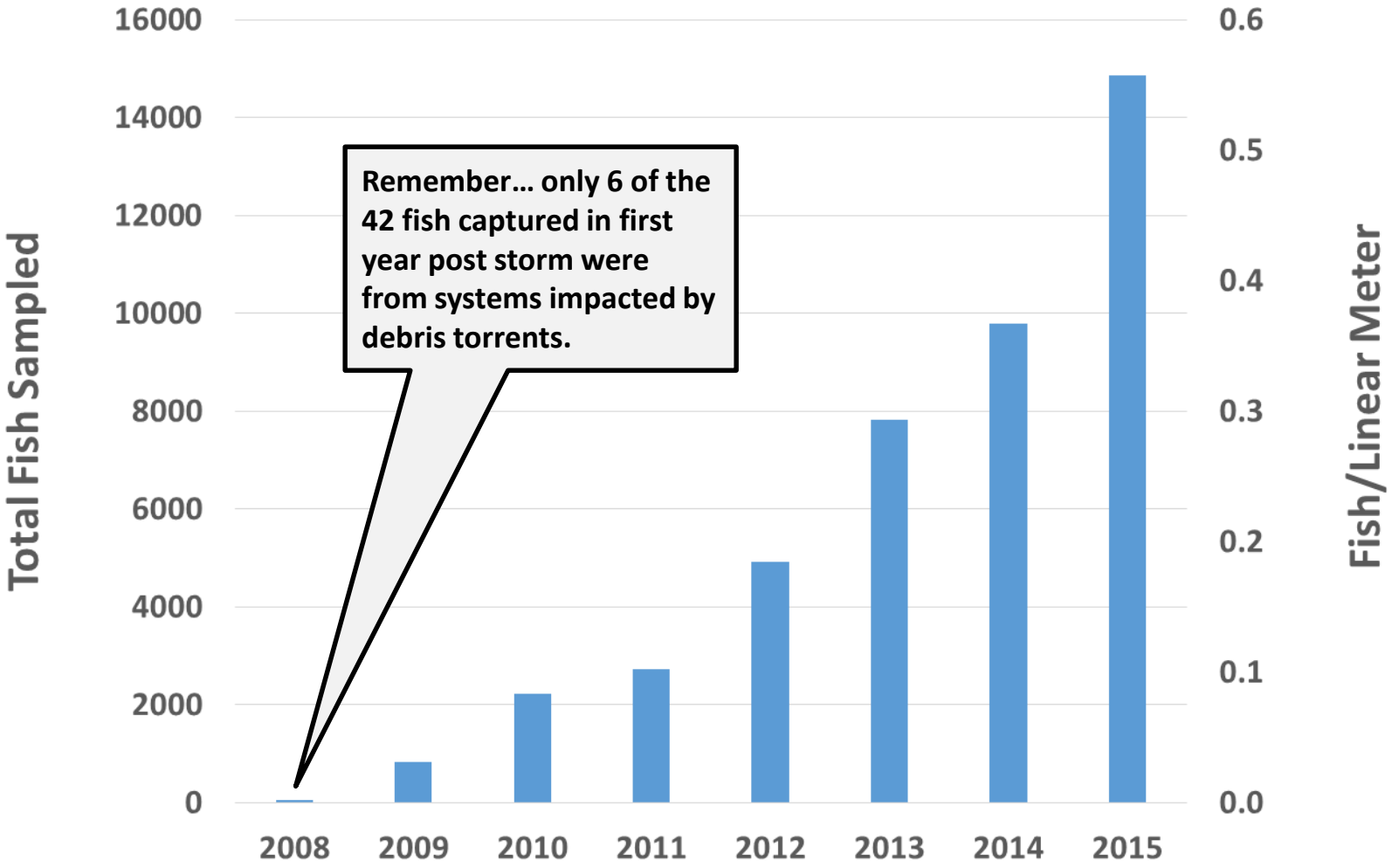
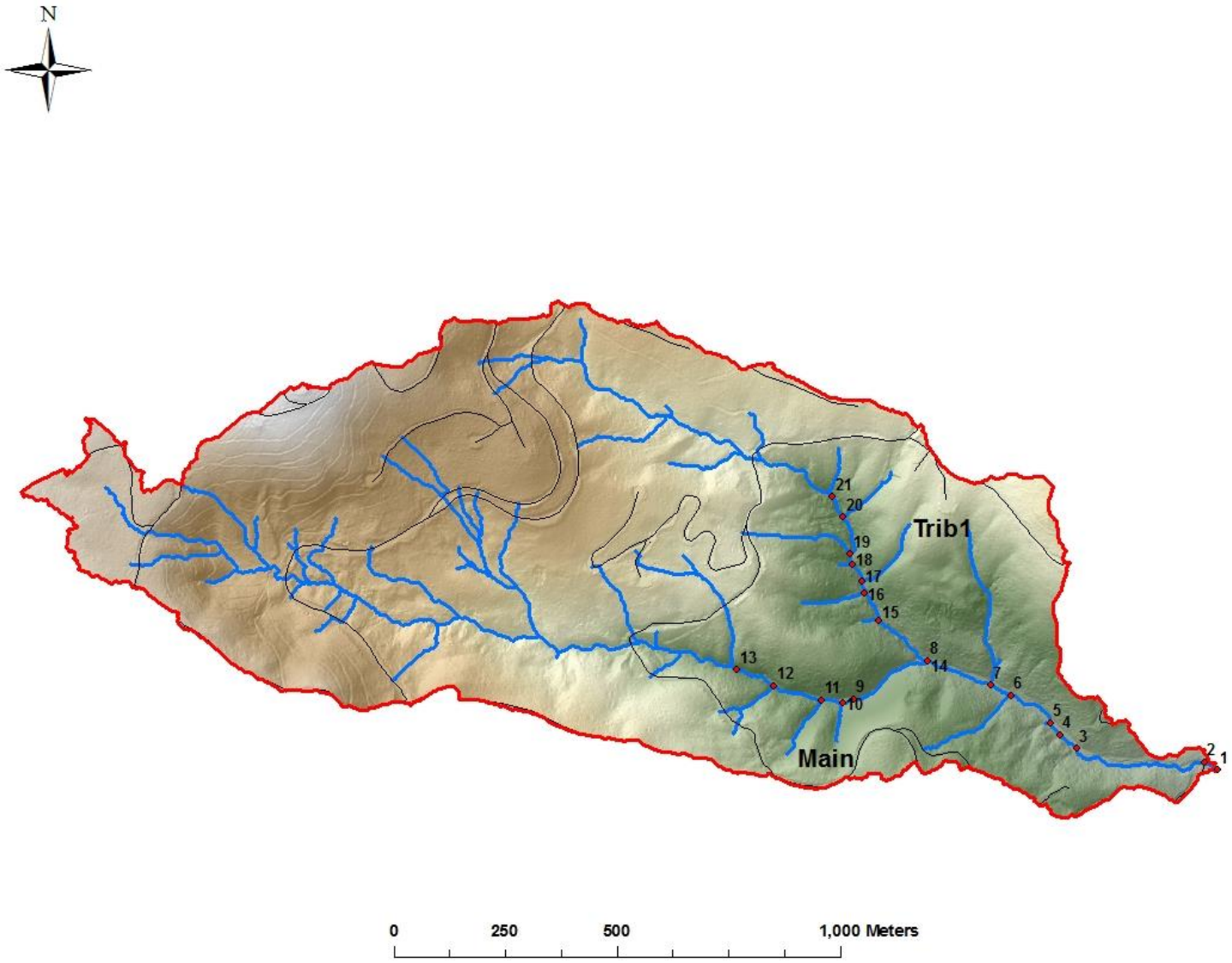
1
2
4 km

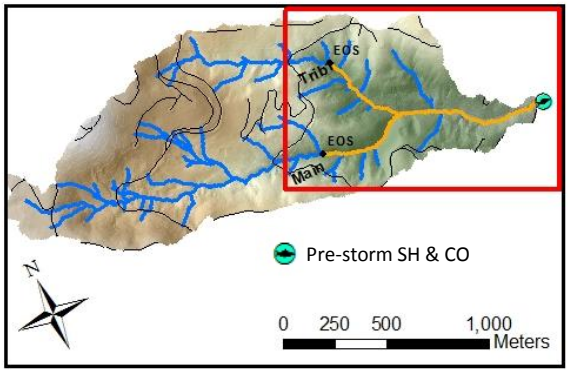
TOTAL FISH SAMPLED BY YEAR

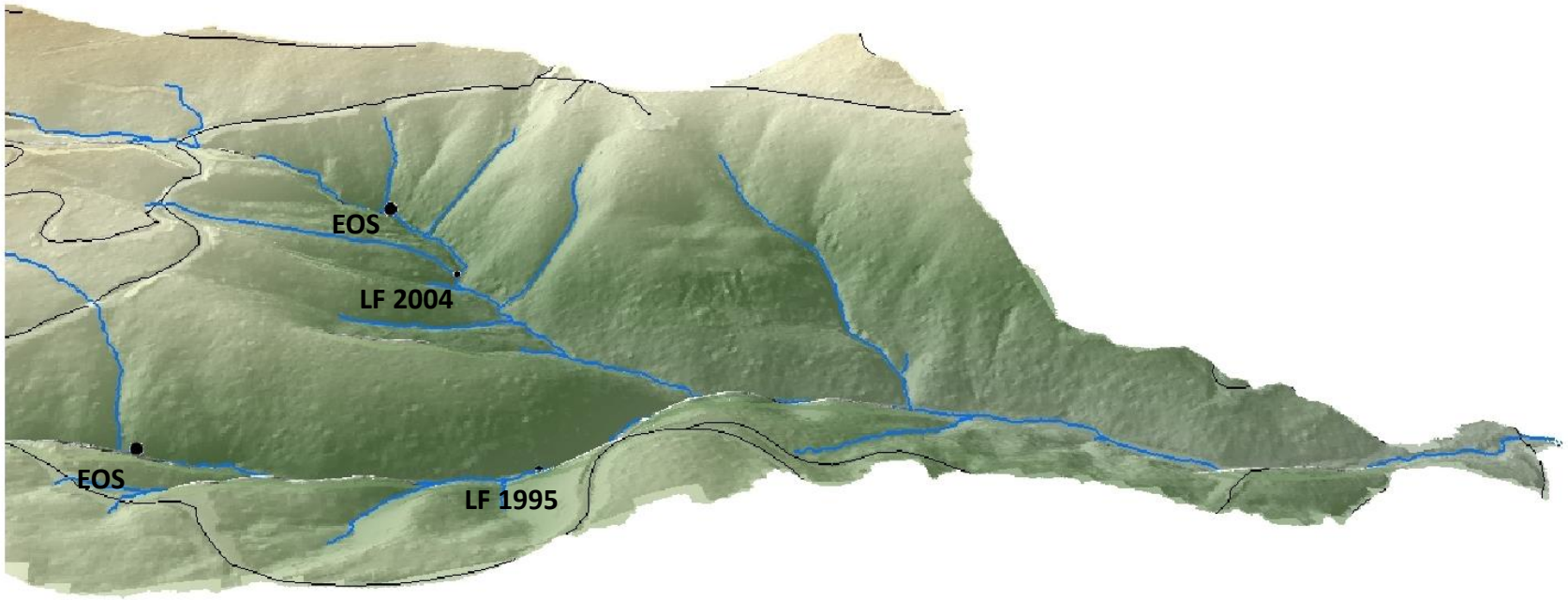


STILLMAN 17/18

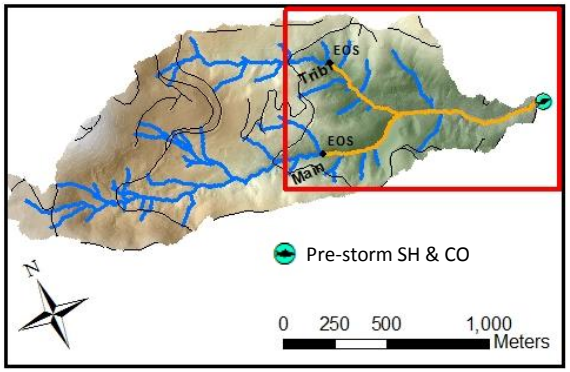


Stillman 17/18 - 2008





Stillman 17/18 - 2009



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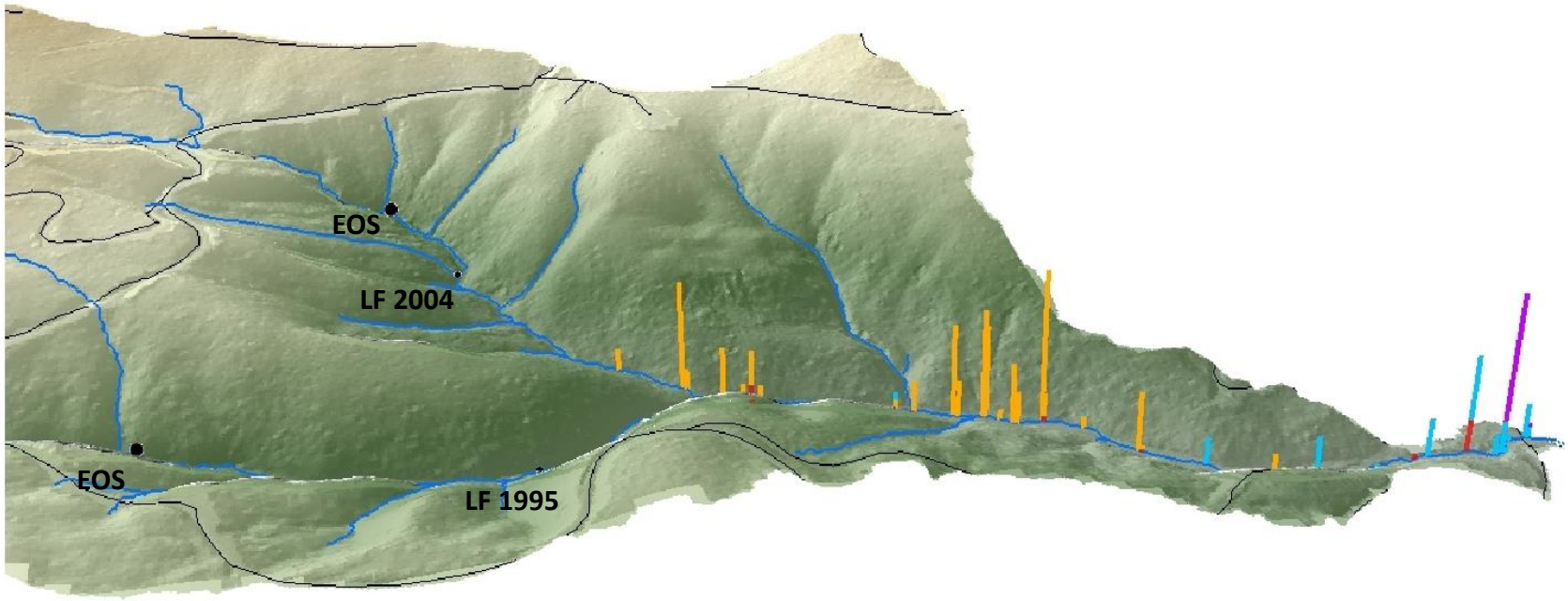
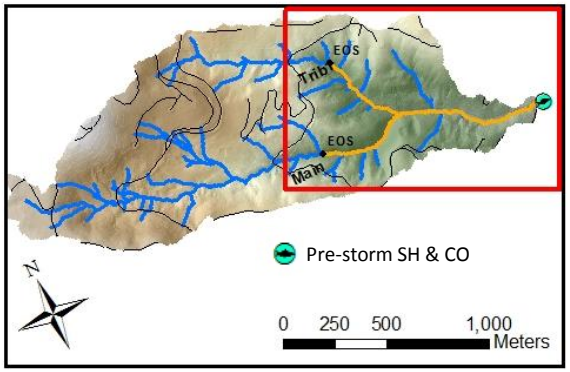


Stillman 17/18 - 2010



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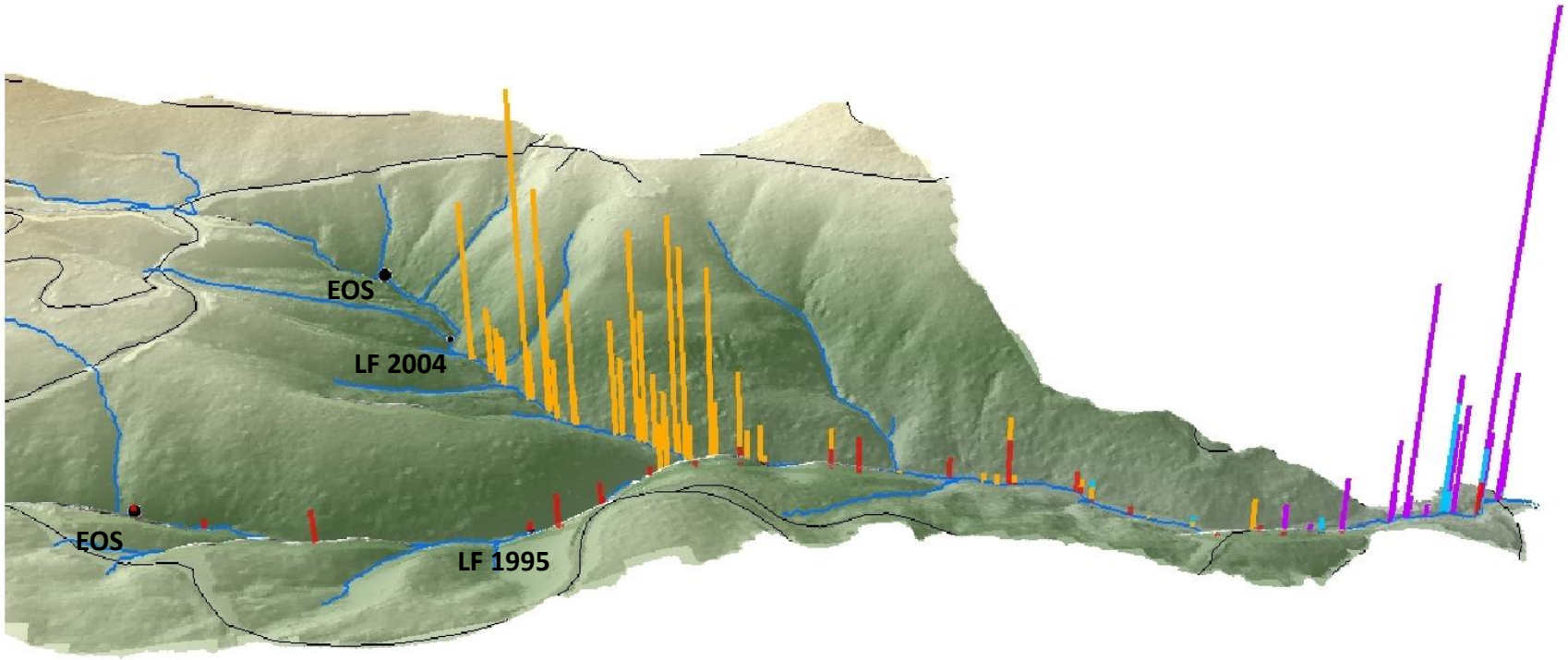
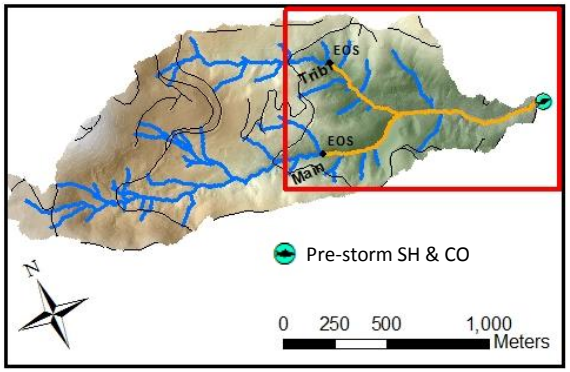


Stillman 17/18 - 2011



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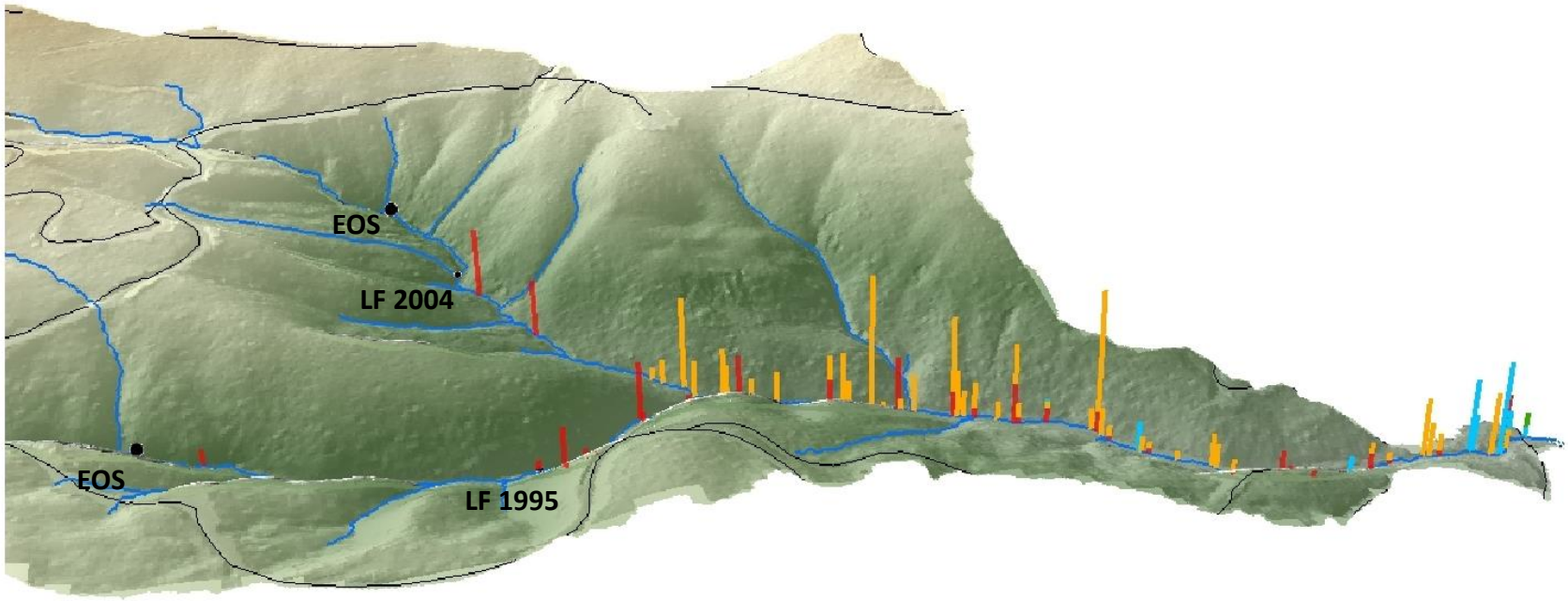
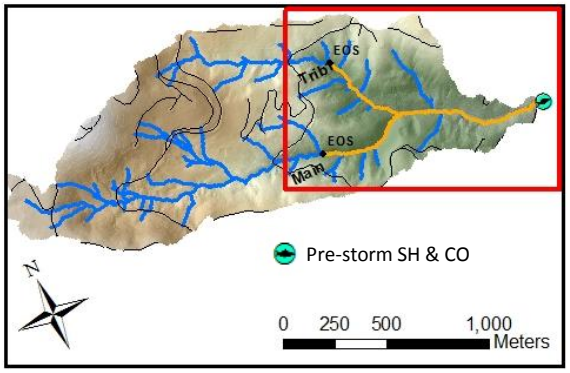
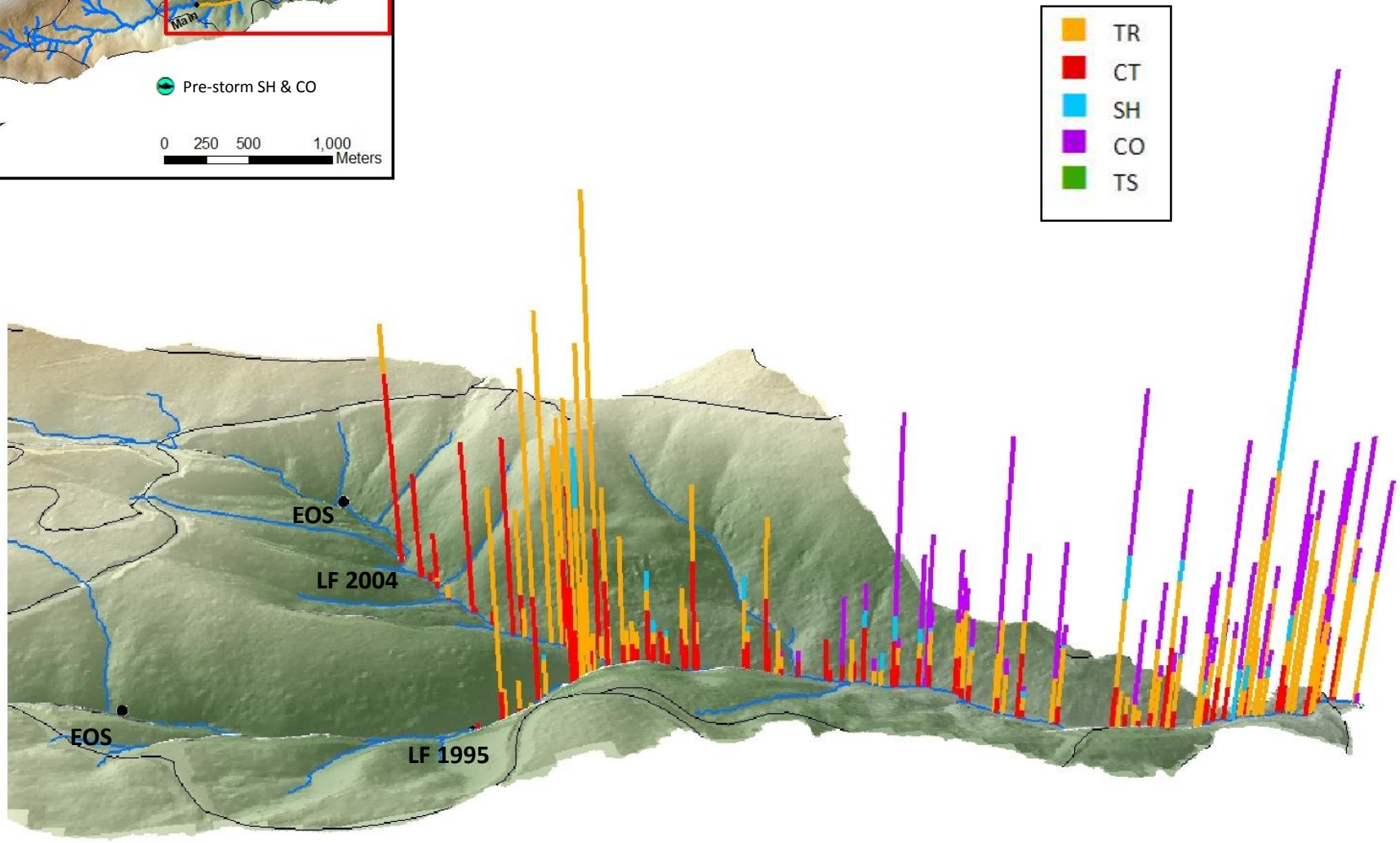
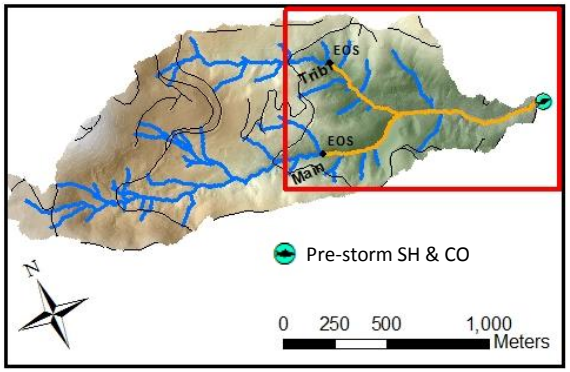


Stillman 17/18 - 2012





Stillman 17/18 - 2013



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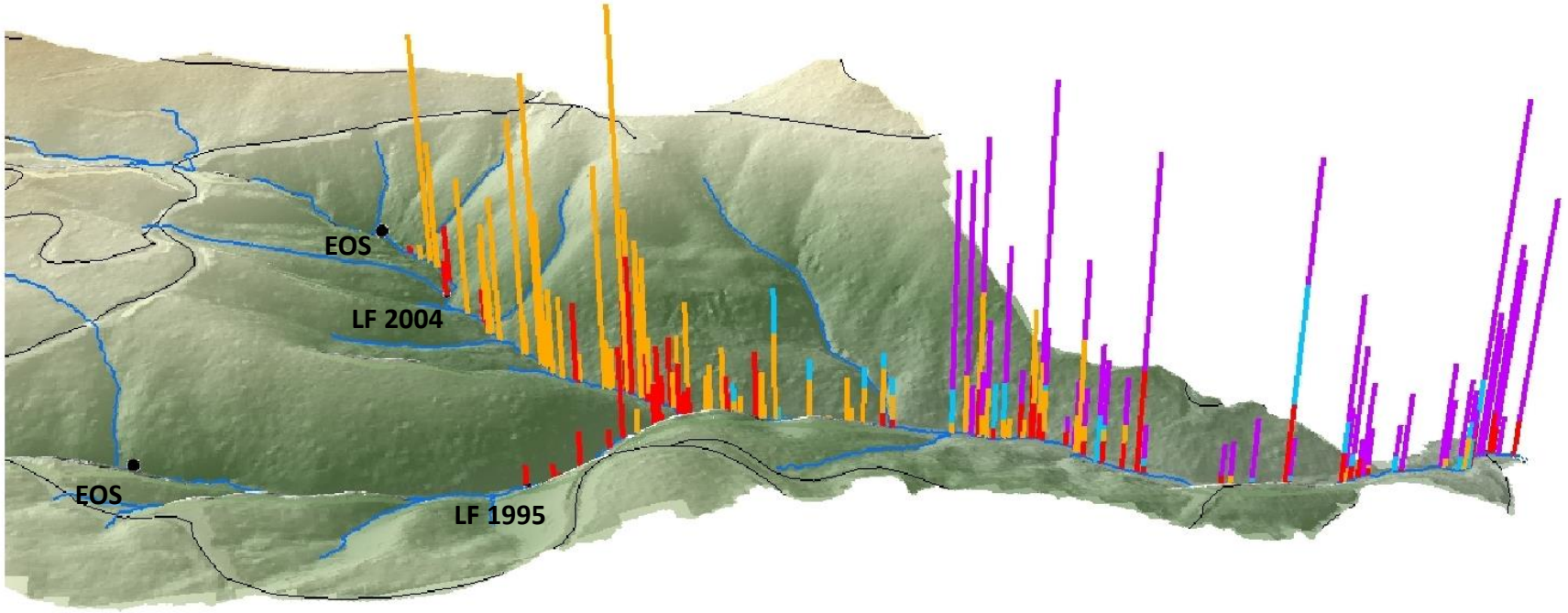
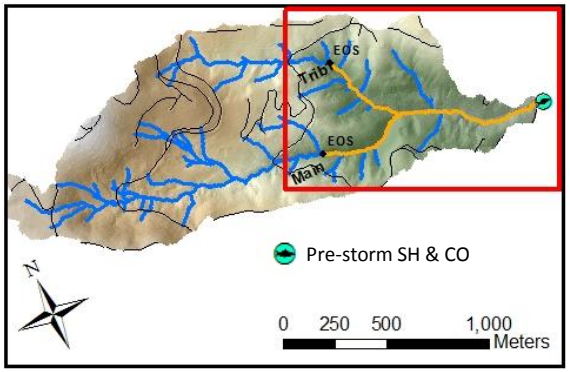
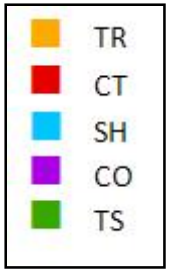
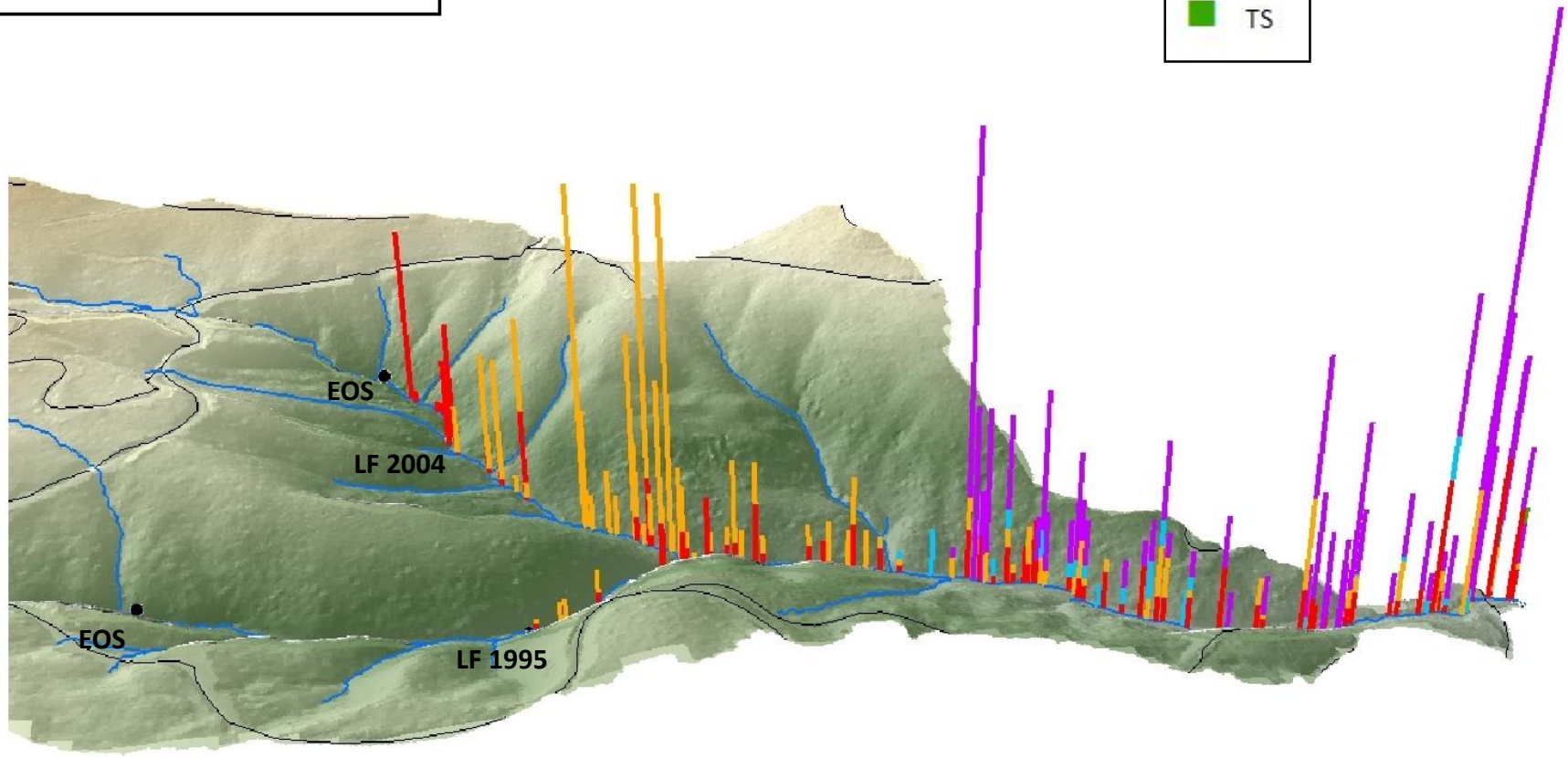


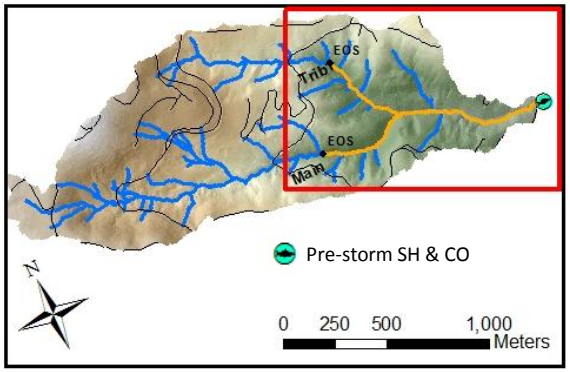
Stillman 17/18 - 2014

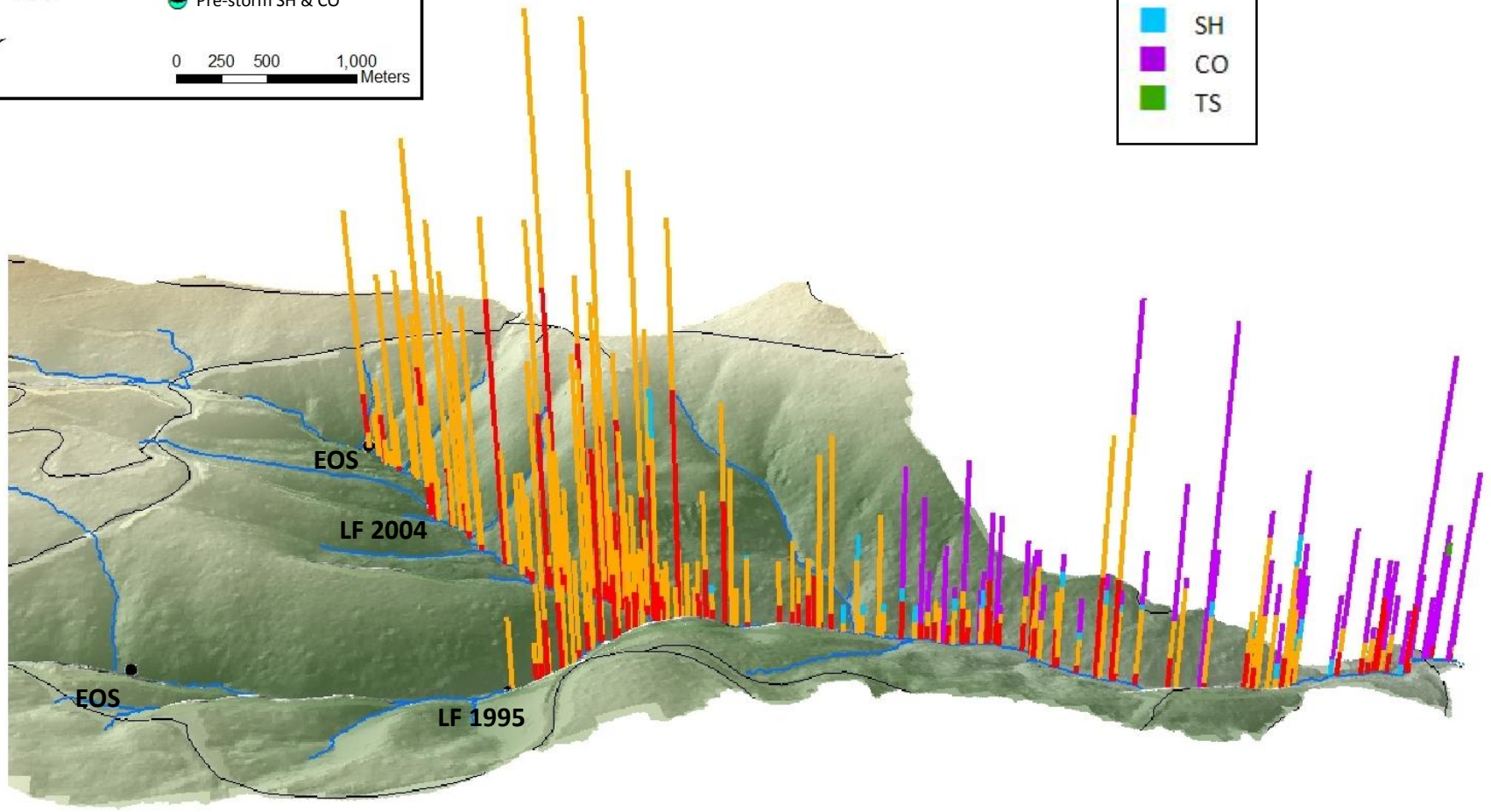




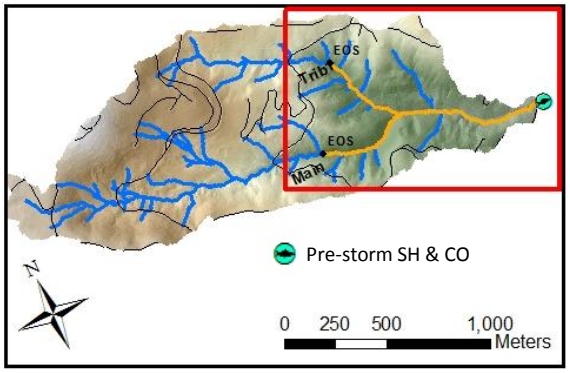


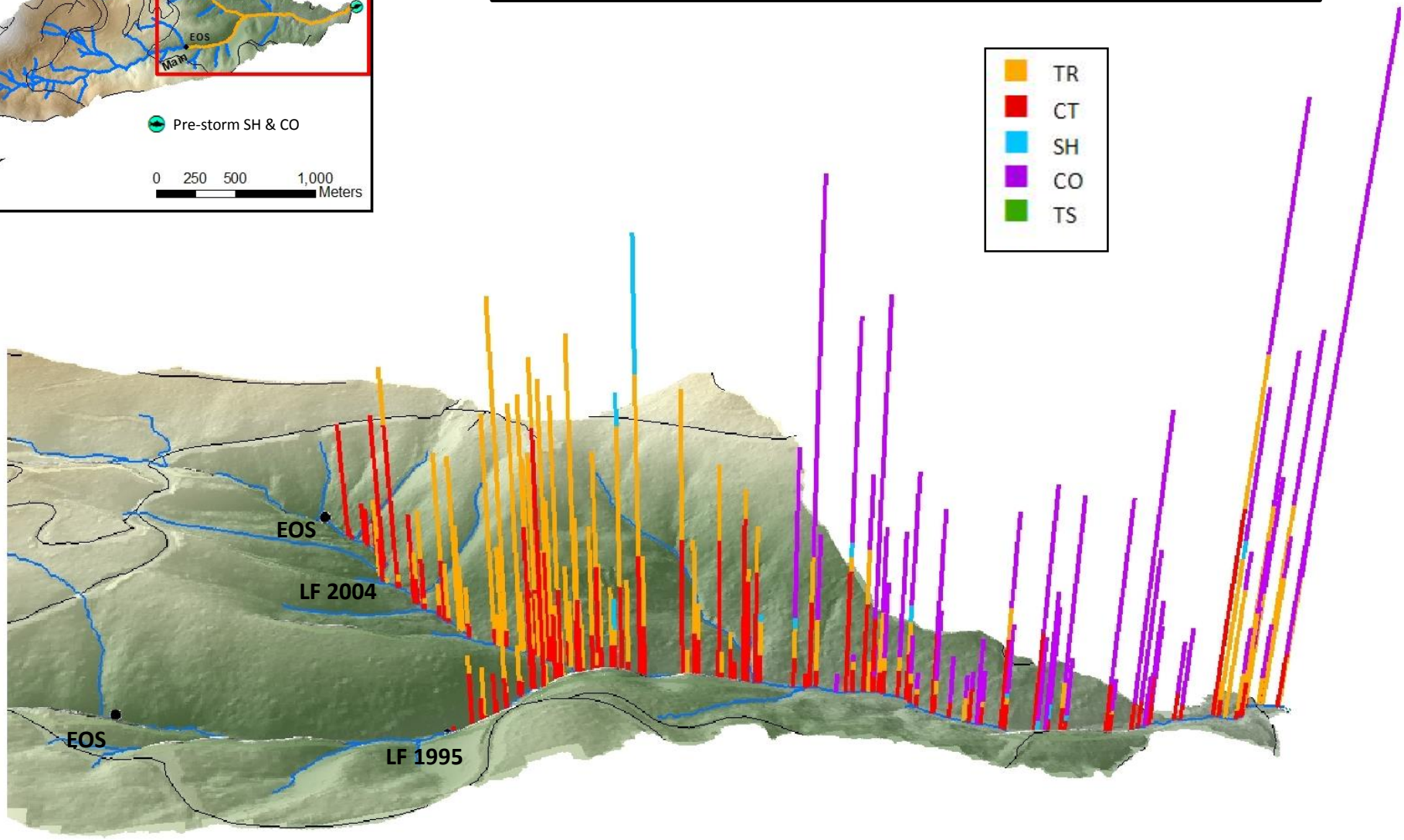
Stillman 17/18 - 2015



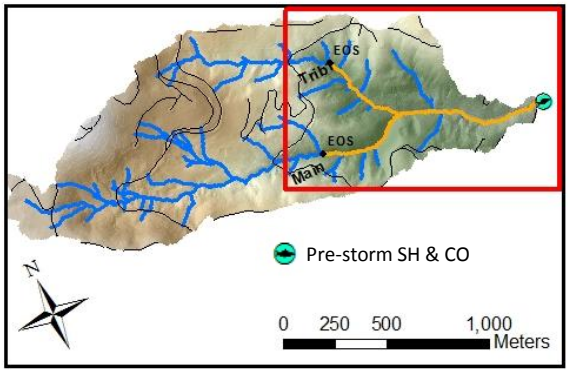


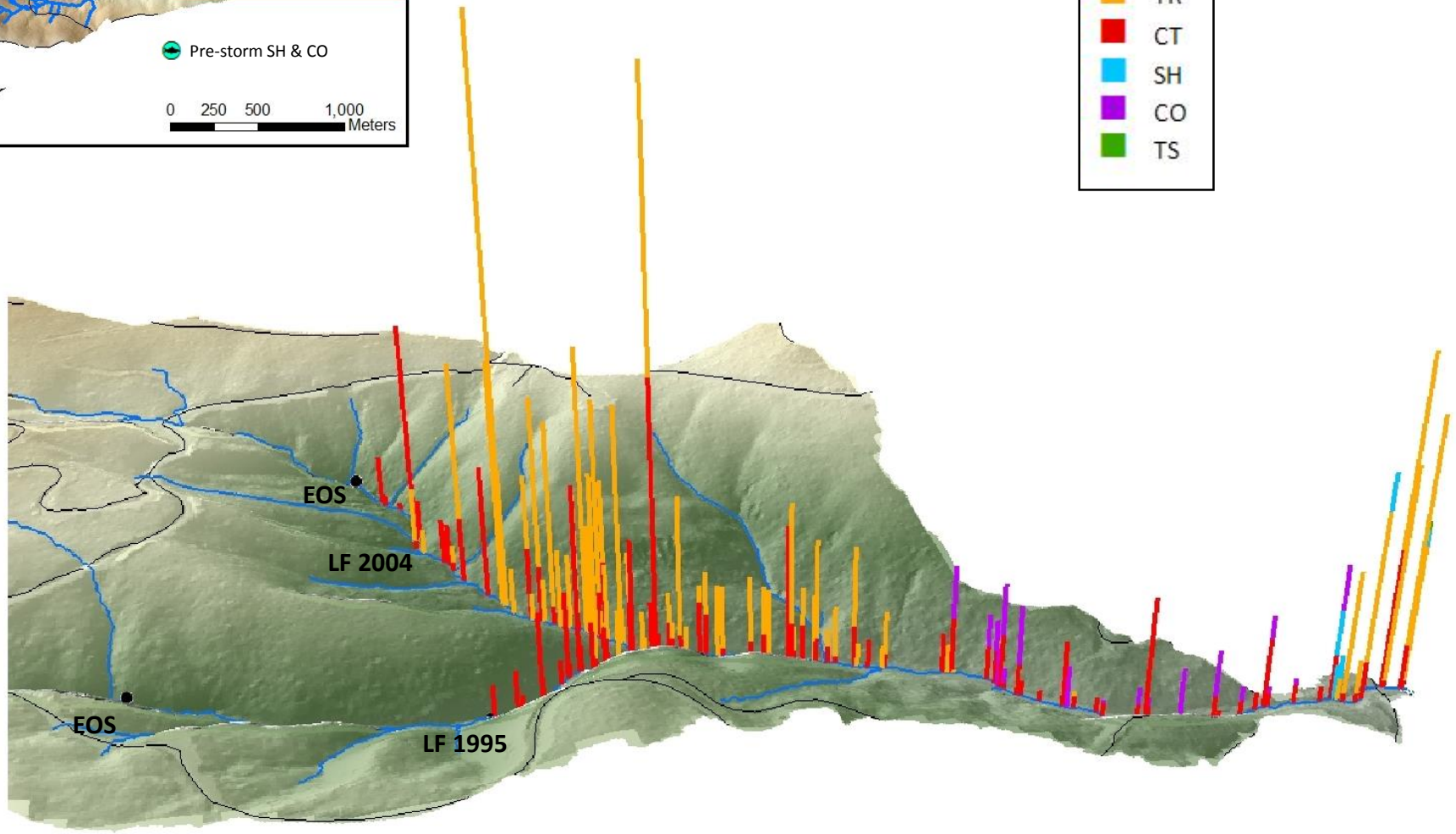
Stillman 17/18 - 2016





Stillman 17/18 - 2017






2008


2010


2012

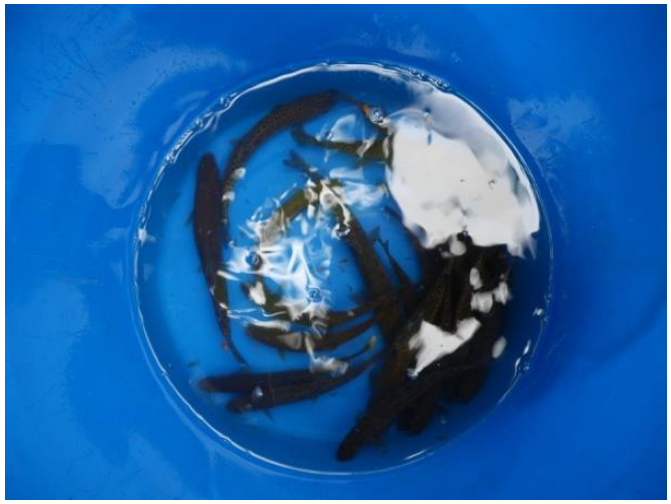

2014


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**

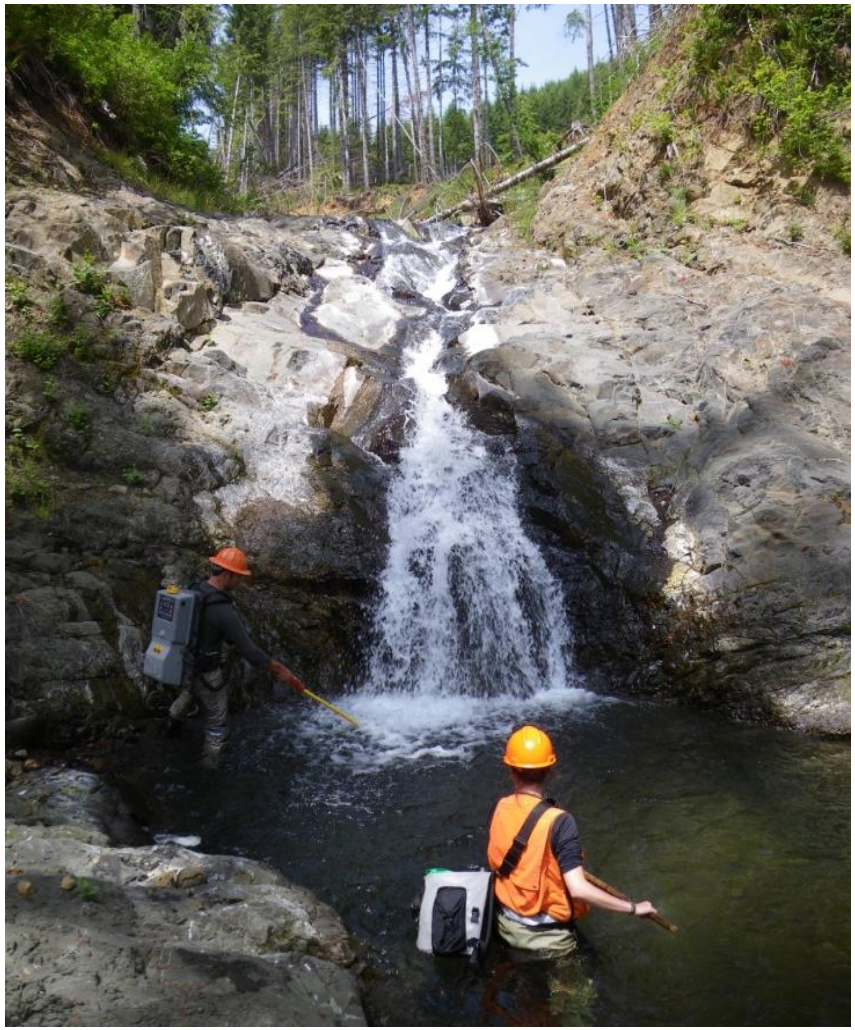
- **Fish have fully recolonized pre-storm occupied habitats in 10 of 15 streams impacted by debris flows:**
  - **In 6 of these 10 streams within only 4 years post-storm**
  - **In 6 of these 10 streams fish now upstream from pre-storm distribution**



PRELIMINARY FINDINGS

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

- **Recolonization rate most significantly influenced by:**
  - **Blockages/barriers**
  - **Stream gradient**
  - **Pool availability**
  - **Substrate**



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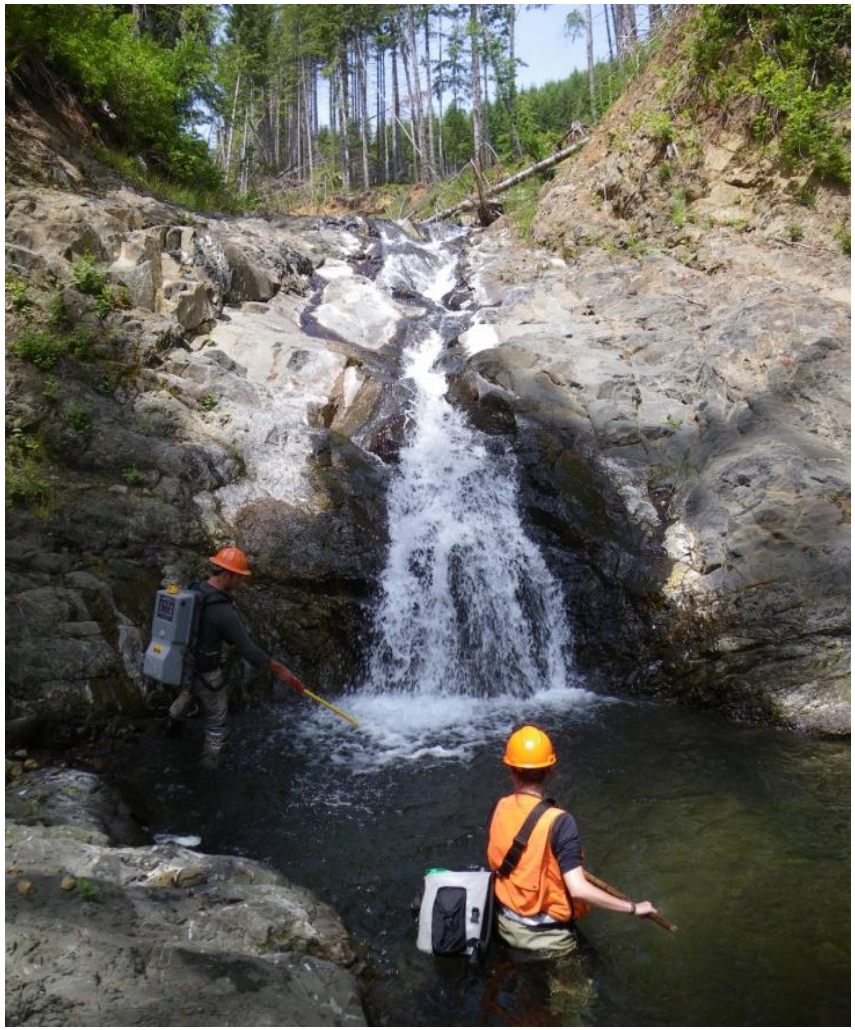
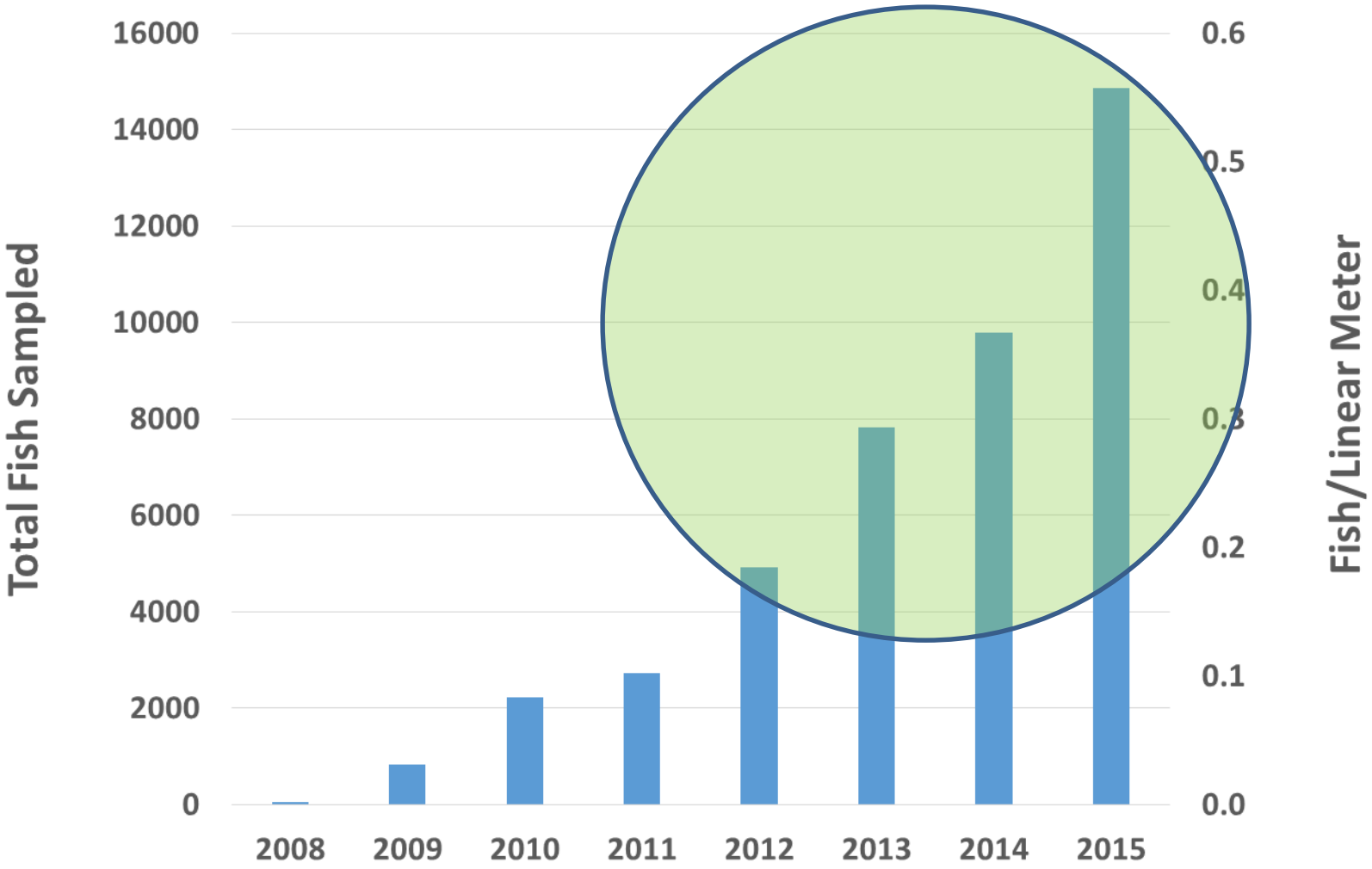


PRELIMINARY FINDINGS

- **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**

PRELIMINARY FINDINGS



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PROJECT STATUS AND FUTURE DIRECTION

- Project is ongoing… 2017 was 10-year post-storm sample
- Complete data analysis in process
- Transition to ‘index reaches’ or truncated sampling where overall fish distribution questions have been answered
- Focus on abundance, Coho ‘signal’ (2011, ‘14, ‘17), etc.

QUESTIONS… COMMENTS?