Skagit Watershed Recovery: Sediment and Landslides

Skagit Watershed Council

March 15, 2023

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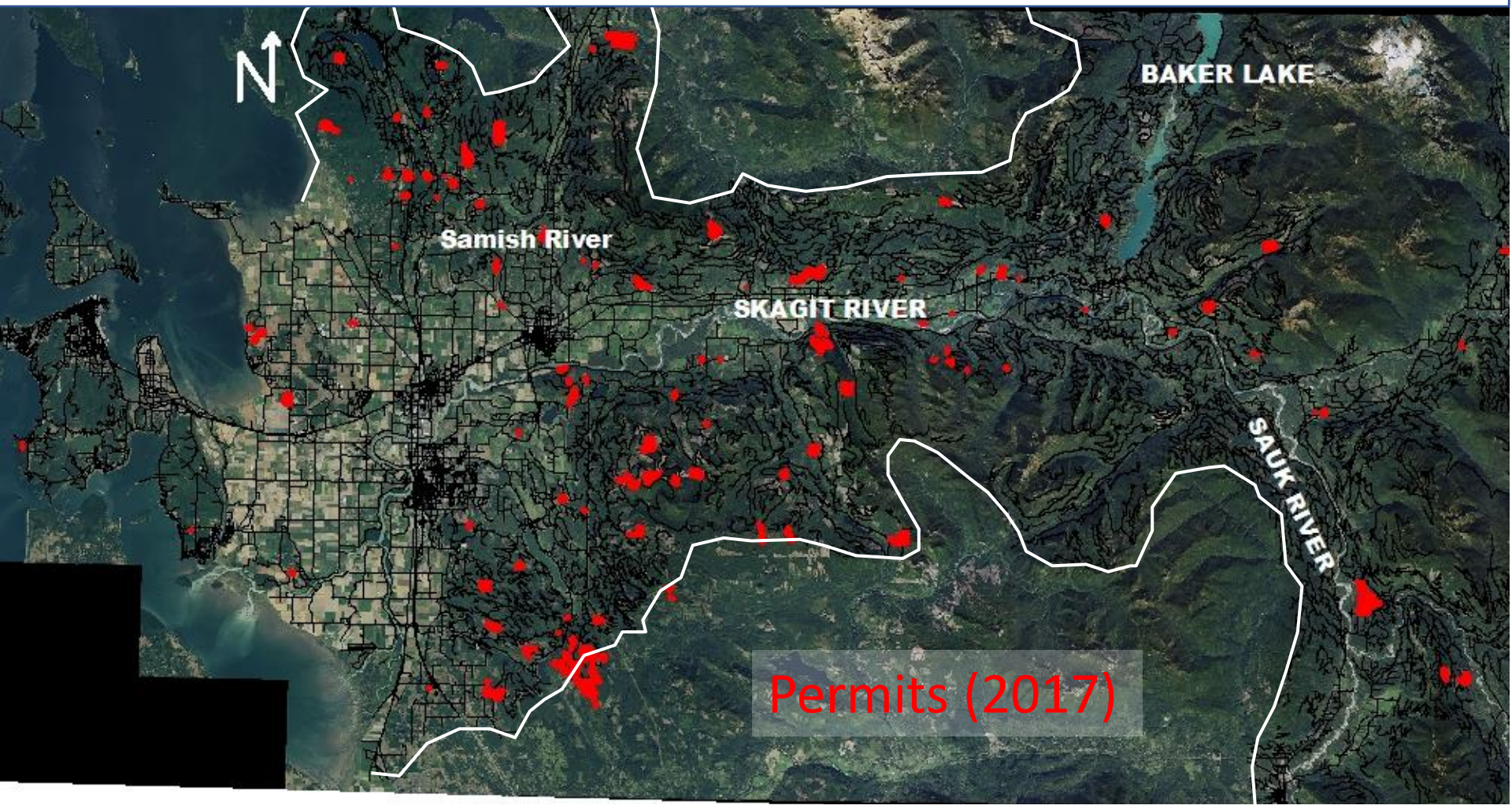
Forest & Fish Program

SKAGIT RIVER SYSTEM COOPERATIVE

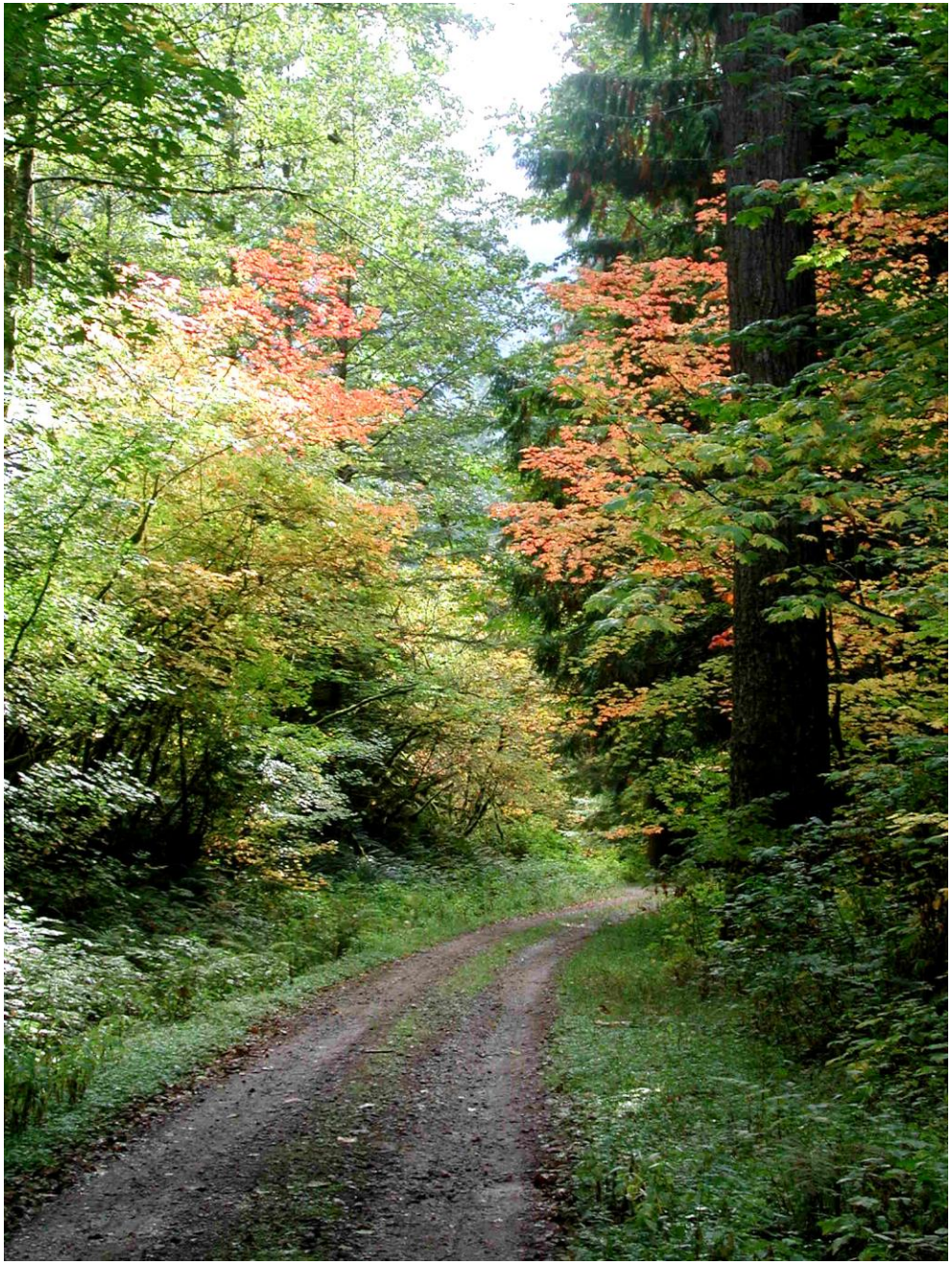
Landslide in old-growth, White Chuck River

SRSC Forest and Fish Program



Where we're headed

- Introduction, Landslides 101 – Curt
- Inventory Study and Results – Gus
- Implications, Recovery – Curt
- Questions and Discussion

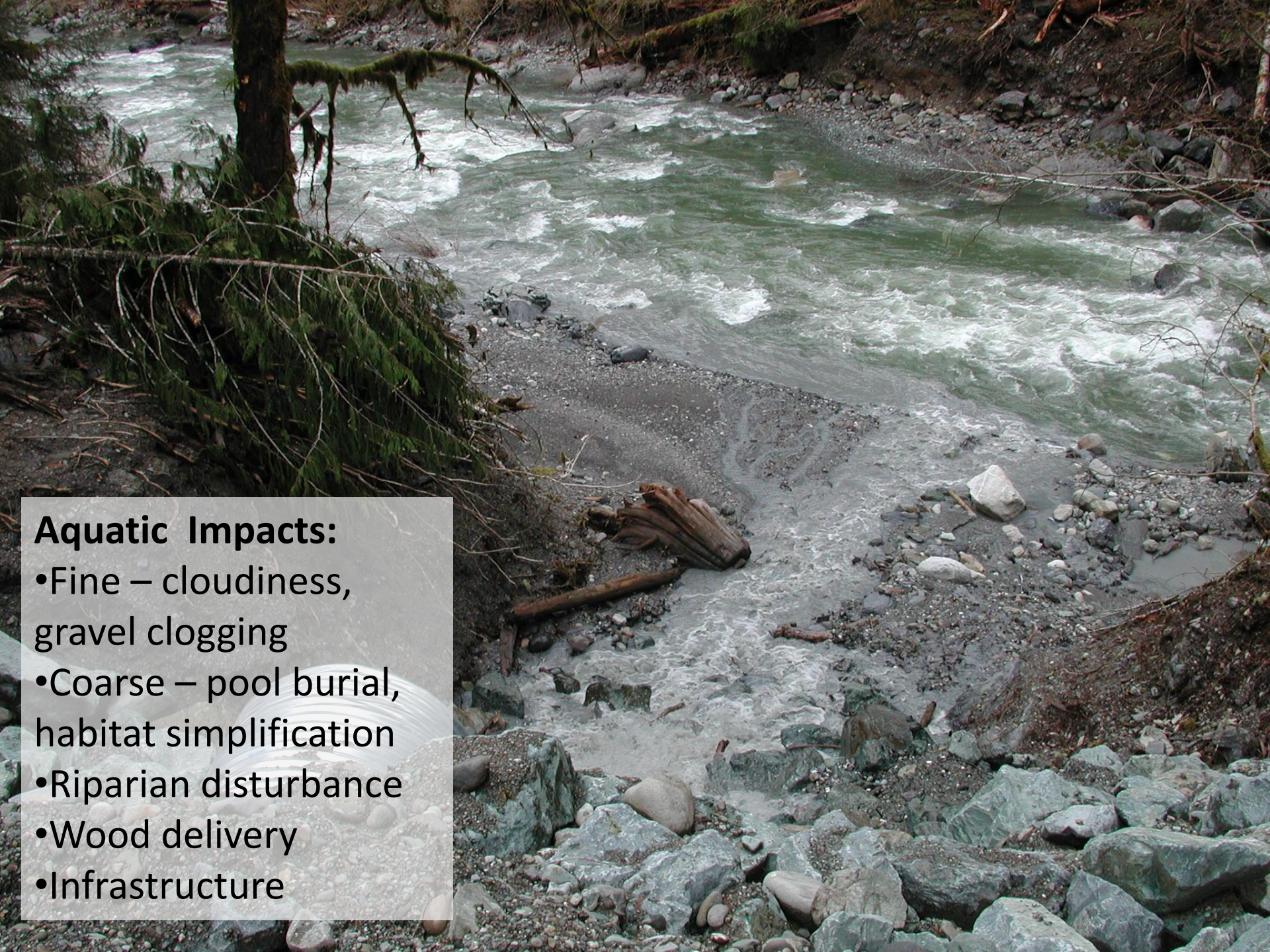


A Sediment-Rich Watershed

- Recent glaciation
- Steep slopes
- Two active volcanoes
- Wet climate

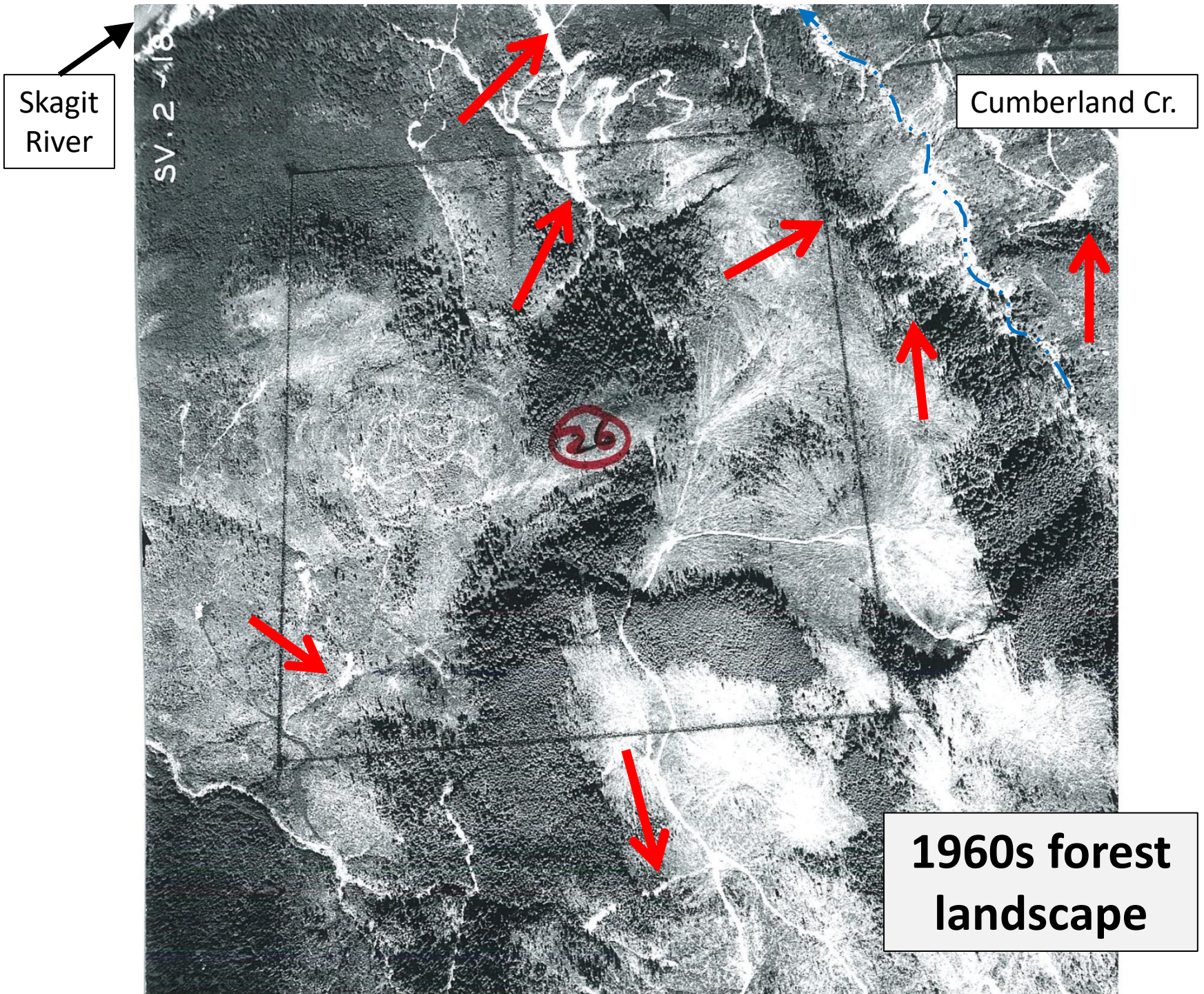
Landslides deliver massive volumes during storms

Impacts irreversible



Aquatic Impacts:

- Fine – cloudiness, gravel clogging
- Coarse – pool burial, habitat simplification
- Riparian disturbance
- Wood delivery
- Infrastructure


Skagit River
Cumberland Cr.
26
1960s forest landscape

Forestry triggers

I. Clearcut logging

- Roots decay, 10-15 years
- More water
- Sensitive locations are predictable

II. Logging roads

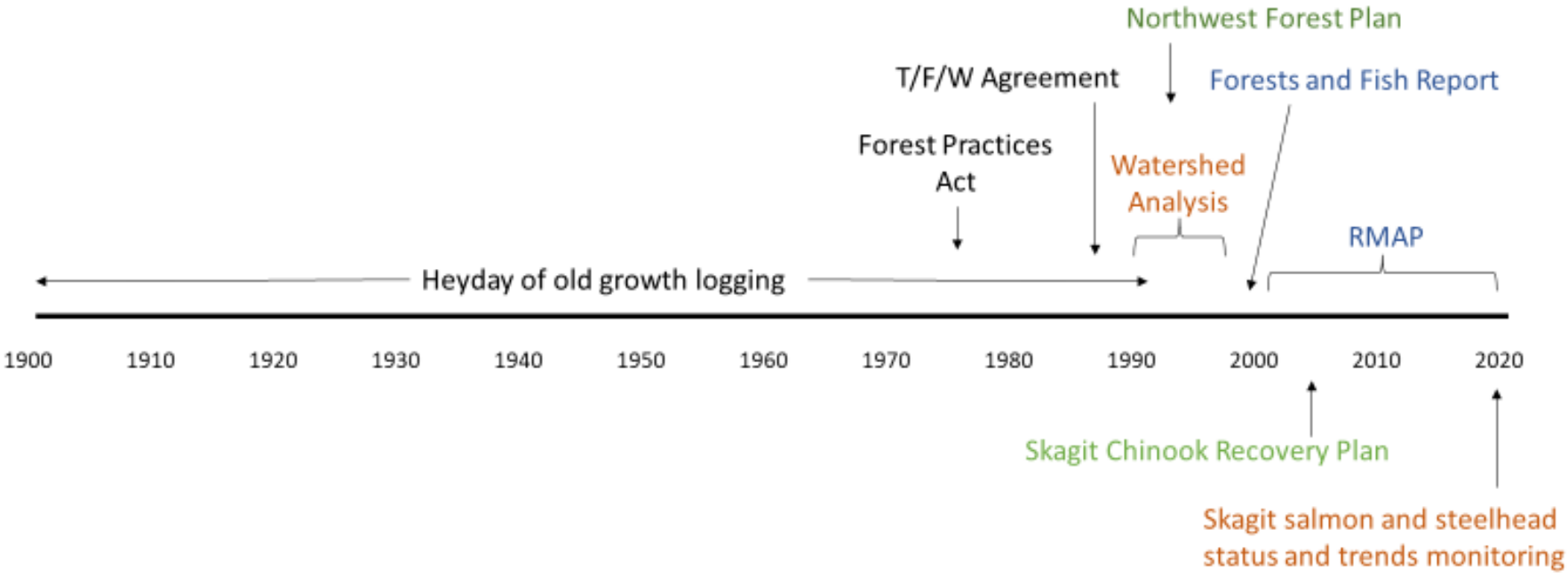
Construction has same impacts as clearcut, plus:

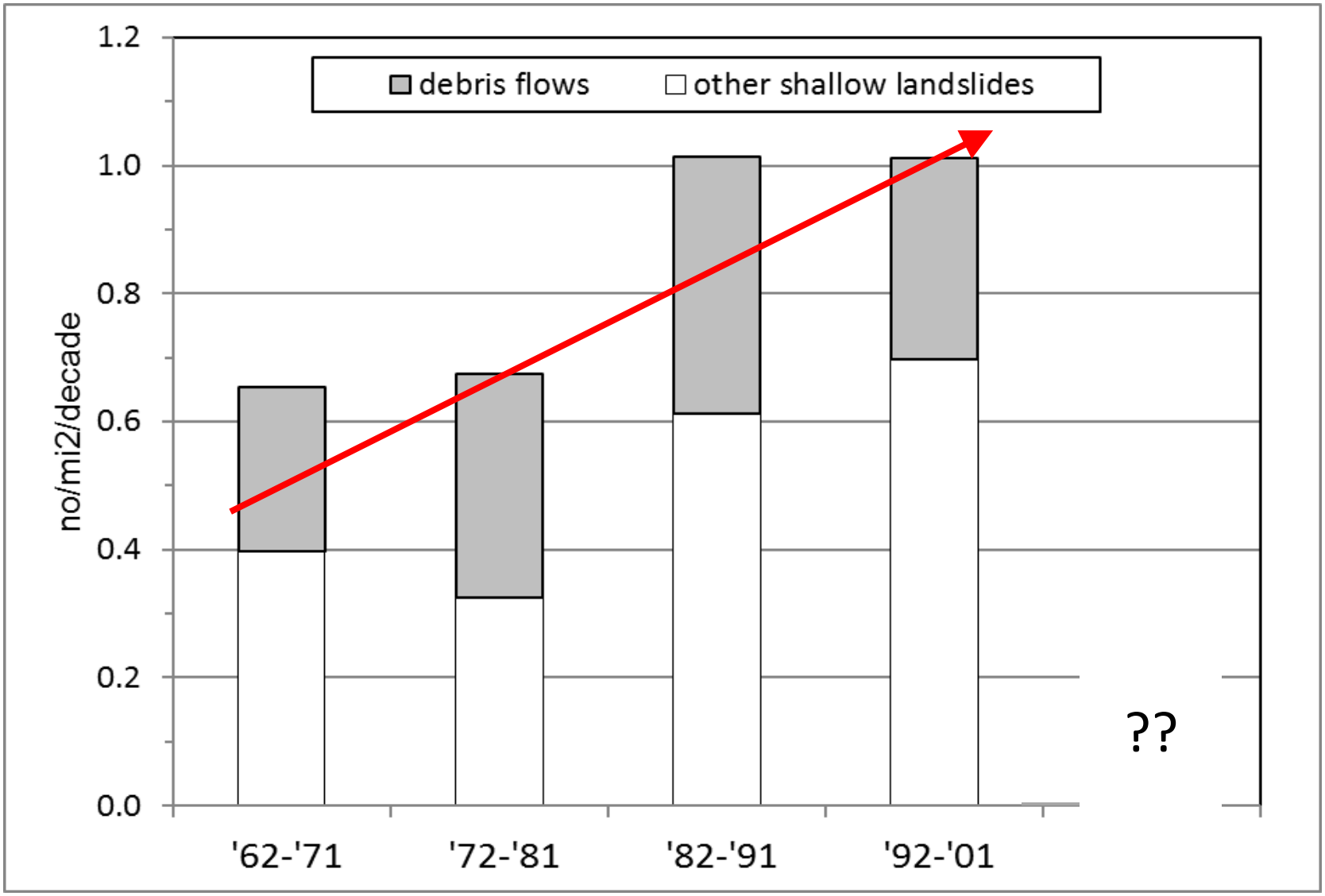
- Redirection of water
- Displacement of soil
- Roads can be repaired or deconstructed

Yet….

the forest
never
sleeps…

A brief history of logging, regulation, and restoration planning in the Skagit watershed




debris flows
other shallow landslides
no/mi2/decade
1.2
1.0
0.8
0.6
0.4
0.2
0.0
'62-'71
'72-'81
'82-'91
'92-'01
??

Skagit Watershed Recovery Strategy – 2000
Process Restoration

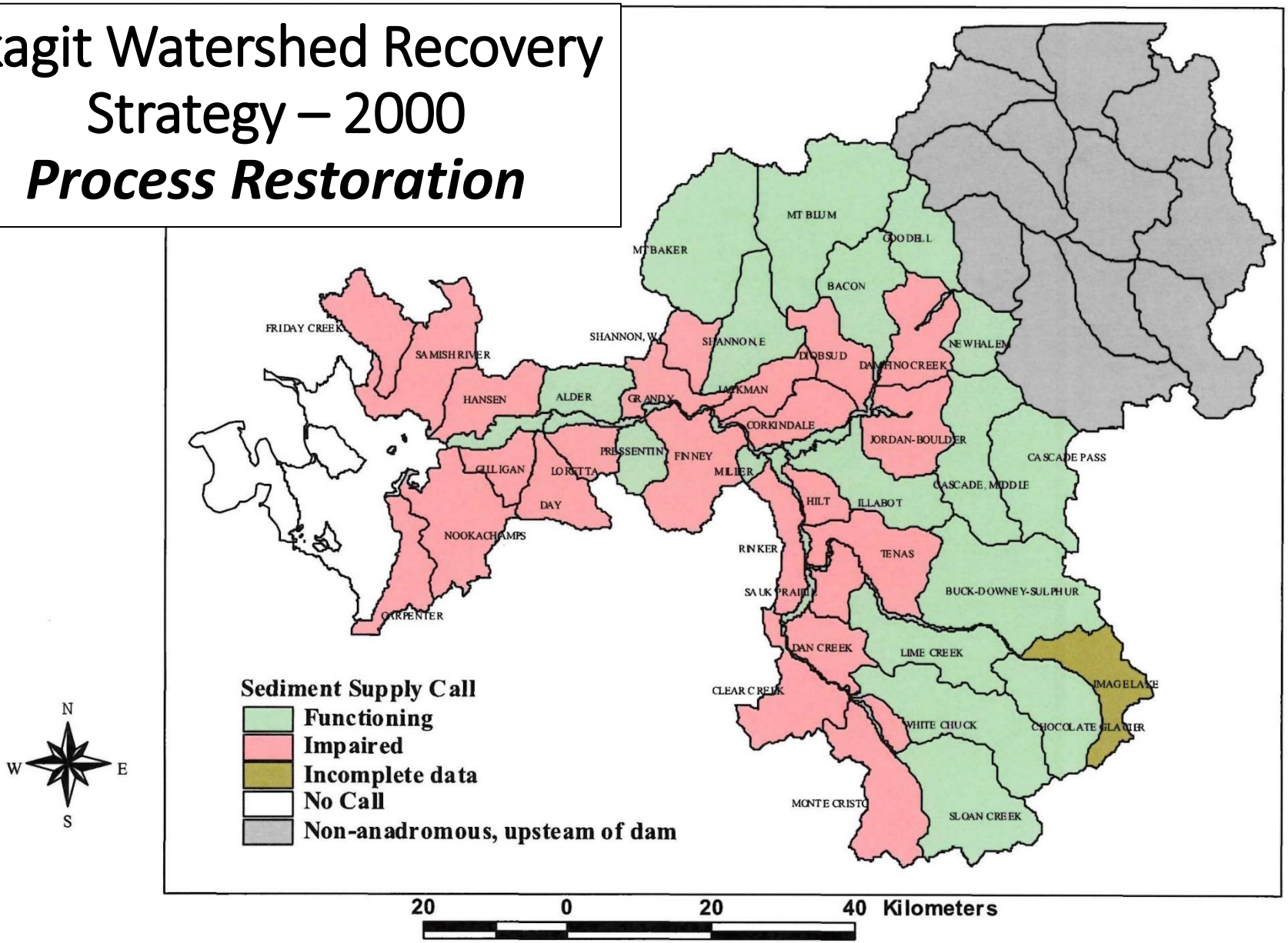


Figure 2-8. Map of WAUs where sediment supply is likely impaired or function.

Sediment Reduction Projects

- Forest Service (4)
- SRSC (3)
- Skagit CD (2)
- Skagit County (1)

Chinook Plan 2005

- Forests & Fish regulations (state/private)
- Slope buffers and road work
- RMAP completion by 2021

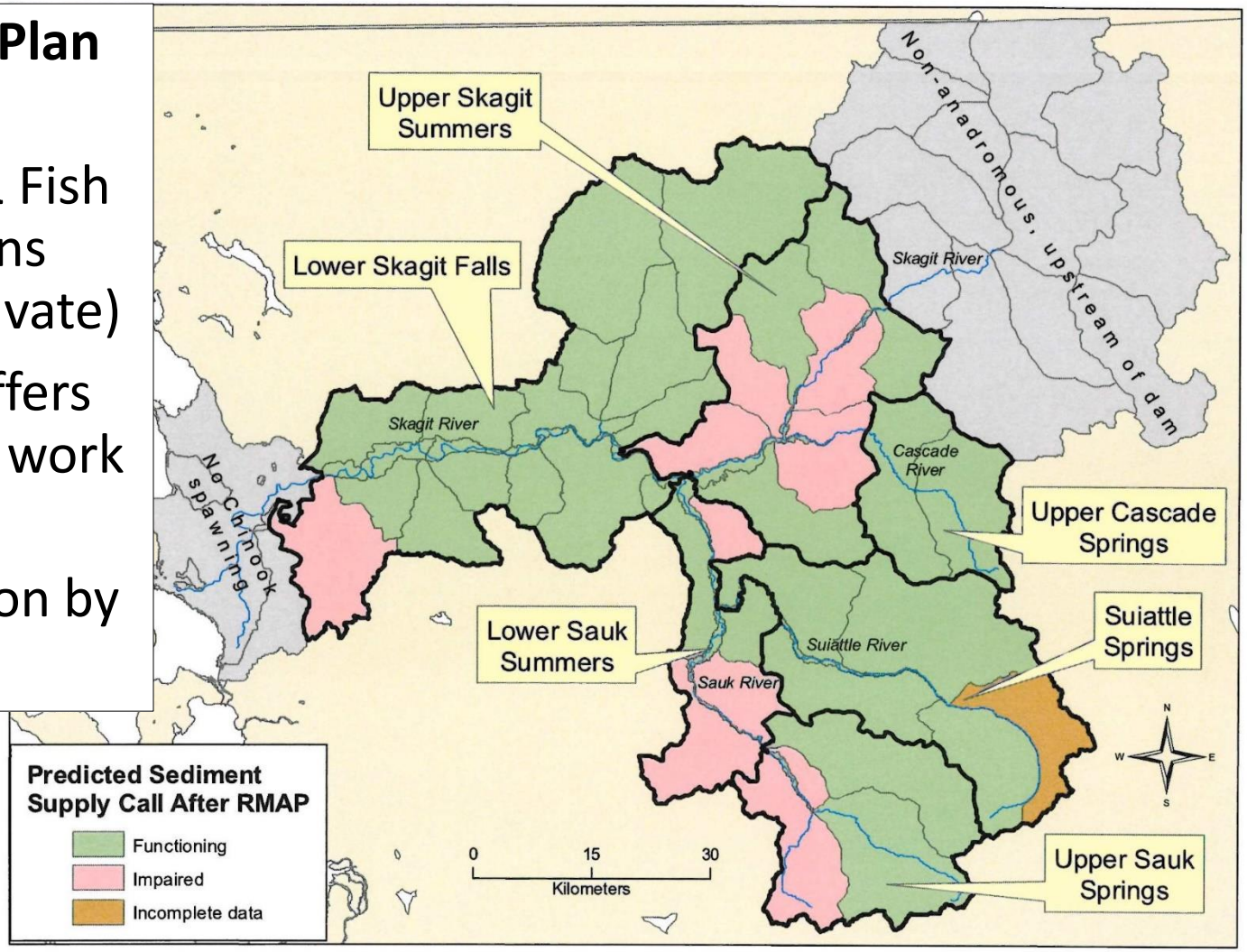


Figure 9.2. *Predicted sediment supply call after RMAP.* Sediment supply call under predicted conditions with RMAP implementation and selected projects on federal lands.

Conceptual Model - Ch 9. Restoration of Spawning Habitat

Strategy:
- Retain forest on unstable slopes
- RMAP for S&P lands
- Decommission risky federal roads

Biotic Objectives:
- increased egg>fry survival
- Improved rearing & refuge

Action: Treat Roads - upgrade or decommission

Action: Buffer sensitive features

Intermediate Result: Roads stabilized

Intermediate Result: Landslides reduced

Intermediate Result: Channel habitat improved

SRSC Landslide Monitoring

Other habitat influences

2023 – are we seeing expected changes?

SRSC Habitat Status and Trends Monitoring

- Freshwater Indicator – Landslides
- Index for Egg-to-Fry Survival

Landslide Inventory Project - Gus

Skagit Landslide Inventory Project

Monitoring questions:

- Are there temporal patterns in landslide abundance?

related to…

Skagit Landslide Inventory Project

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related to…

- Regional climate or storm events?

Skagit Landslide Inventory Project

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- Timber harvest rate?

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Monitoring questions:

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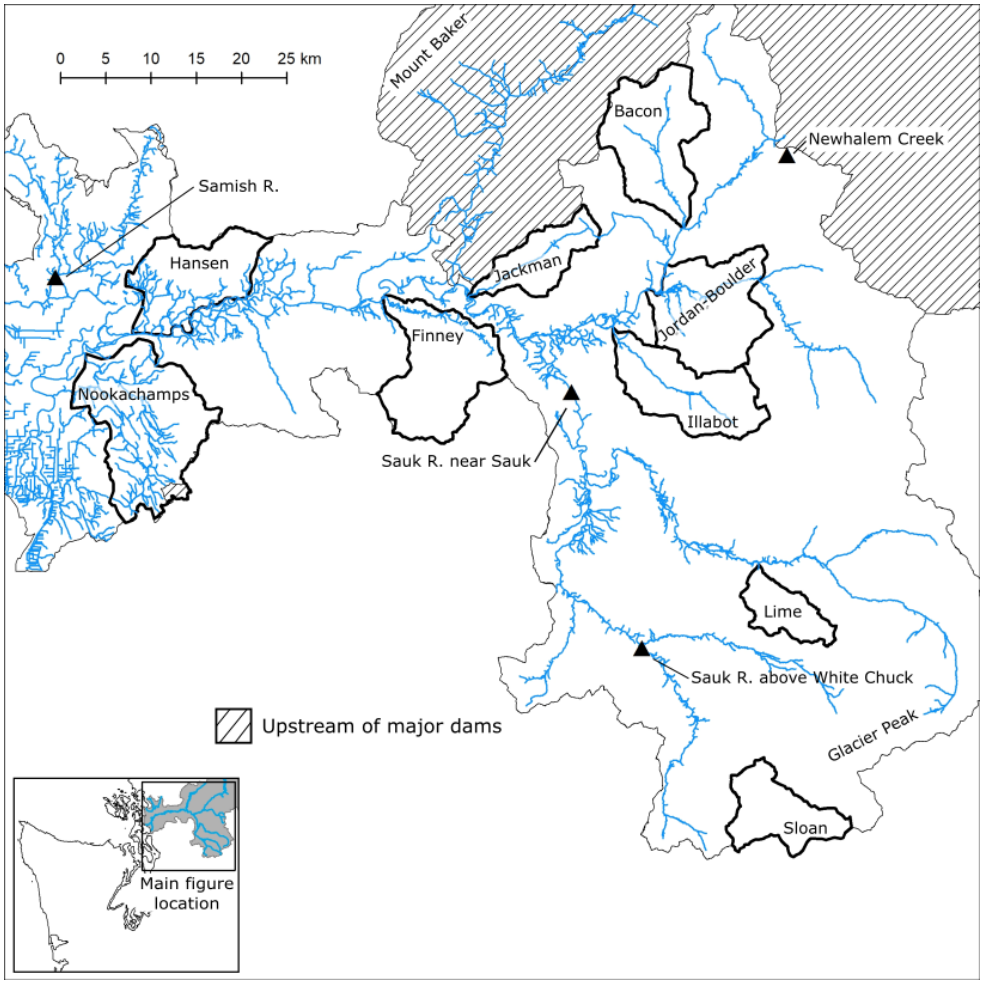
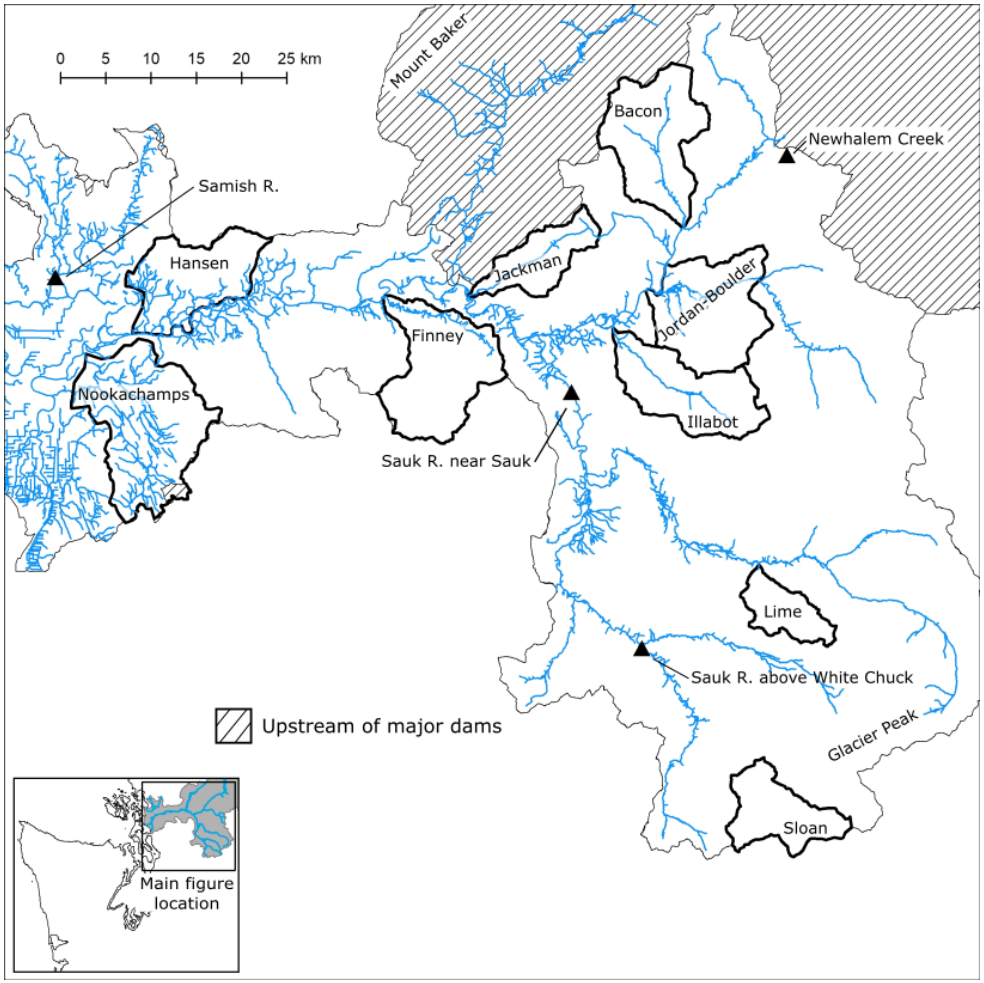
related to…

- Regional climate or storm events?
- Timber harvest rate?
- Forestry practices?

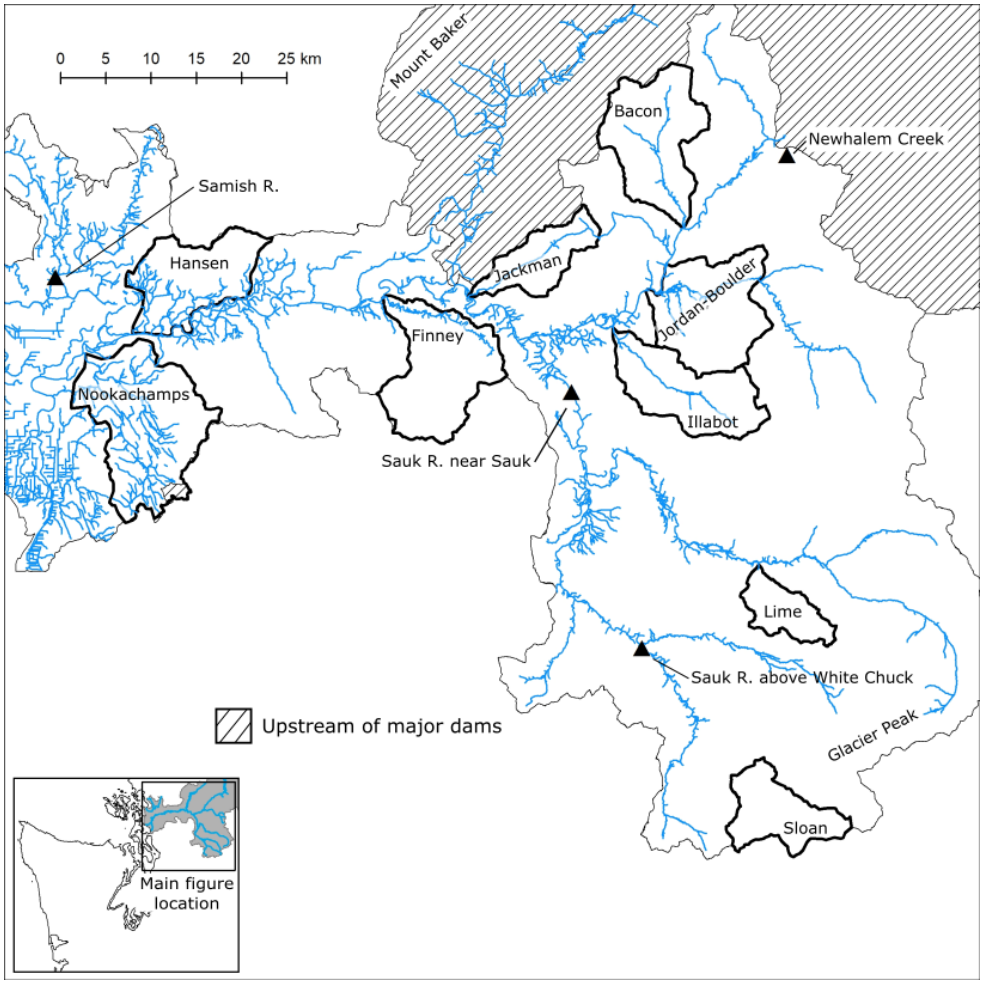


Skagit River study area



Skagit River study area

- Nine inventory basins.



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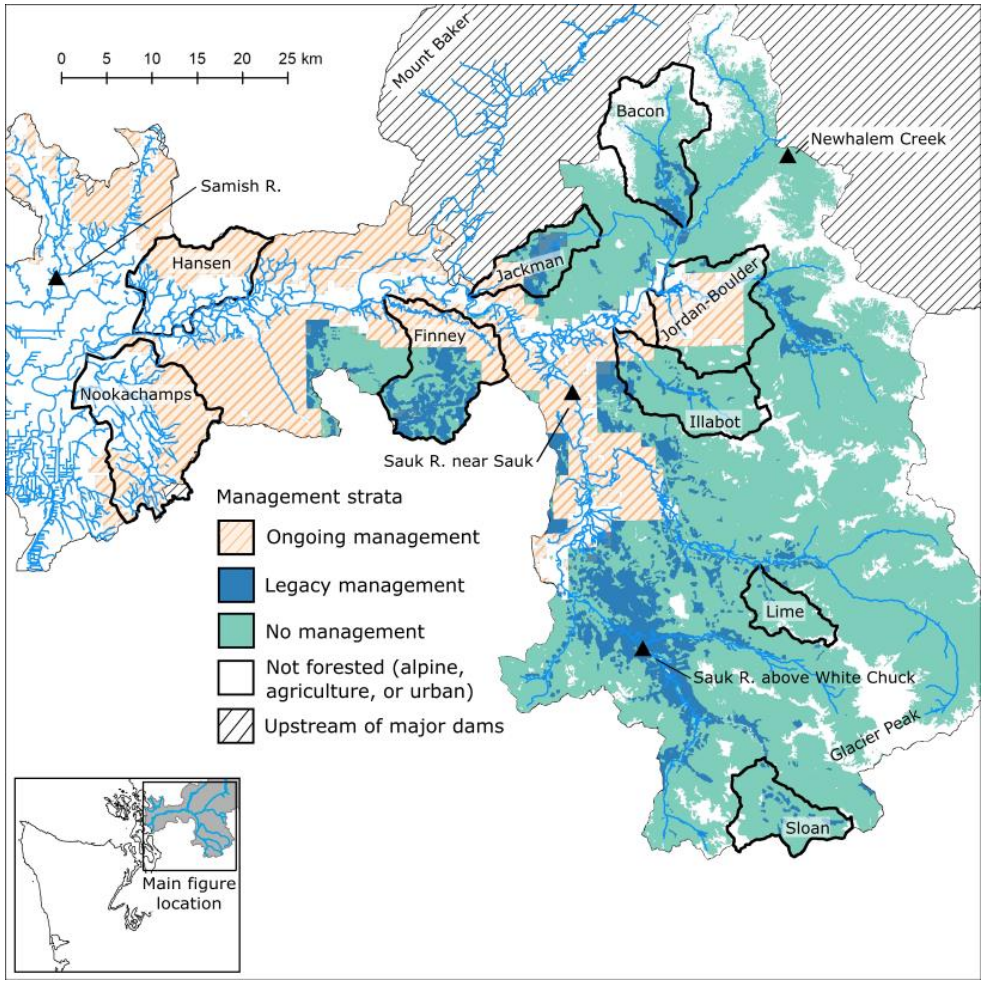
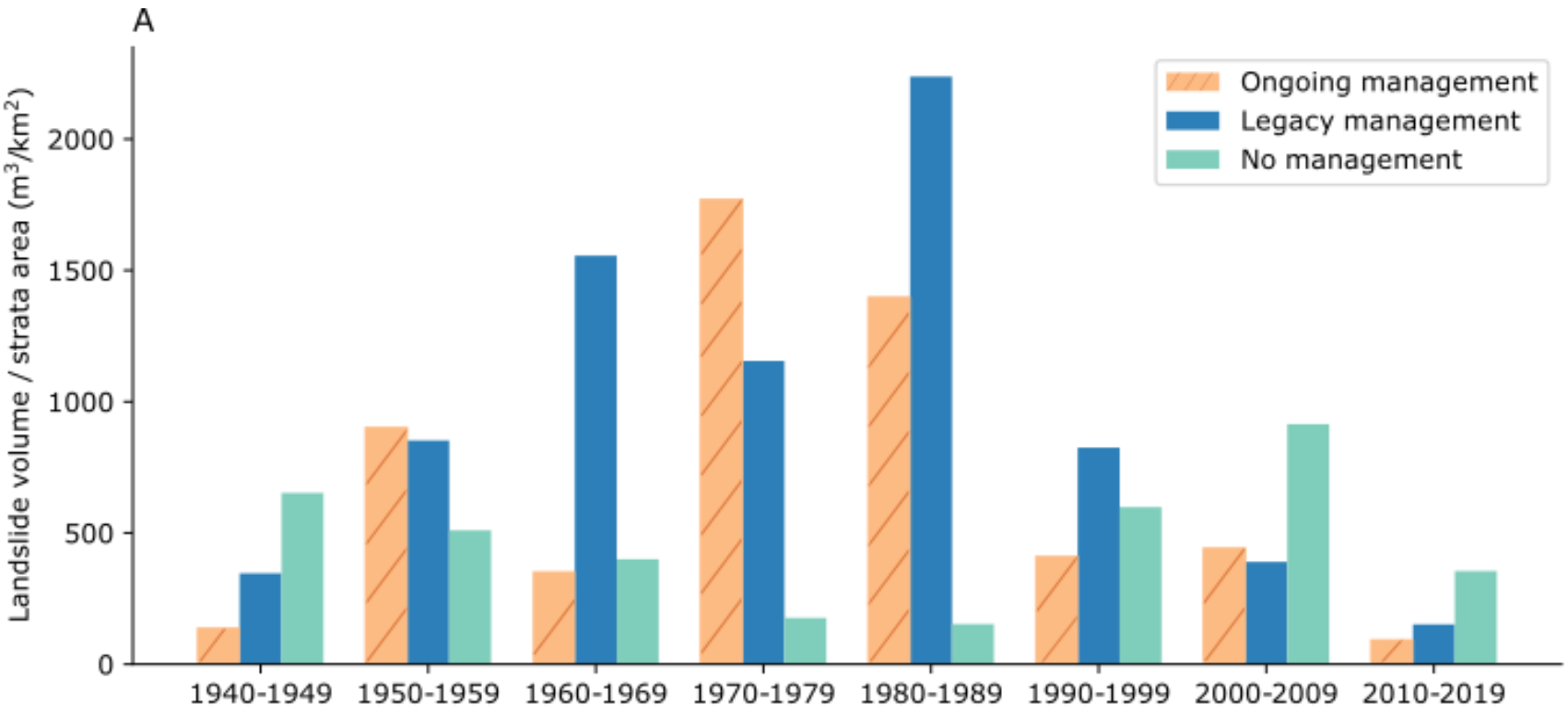


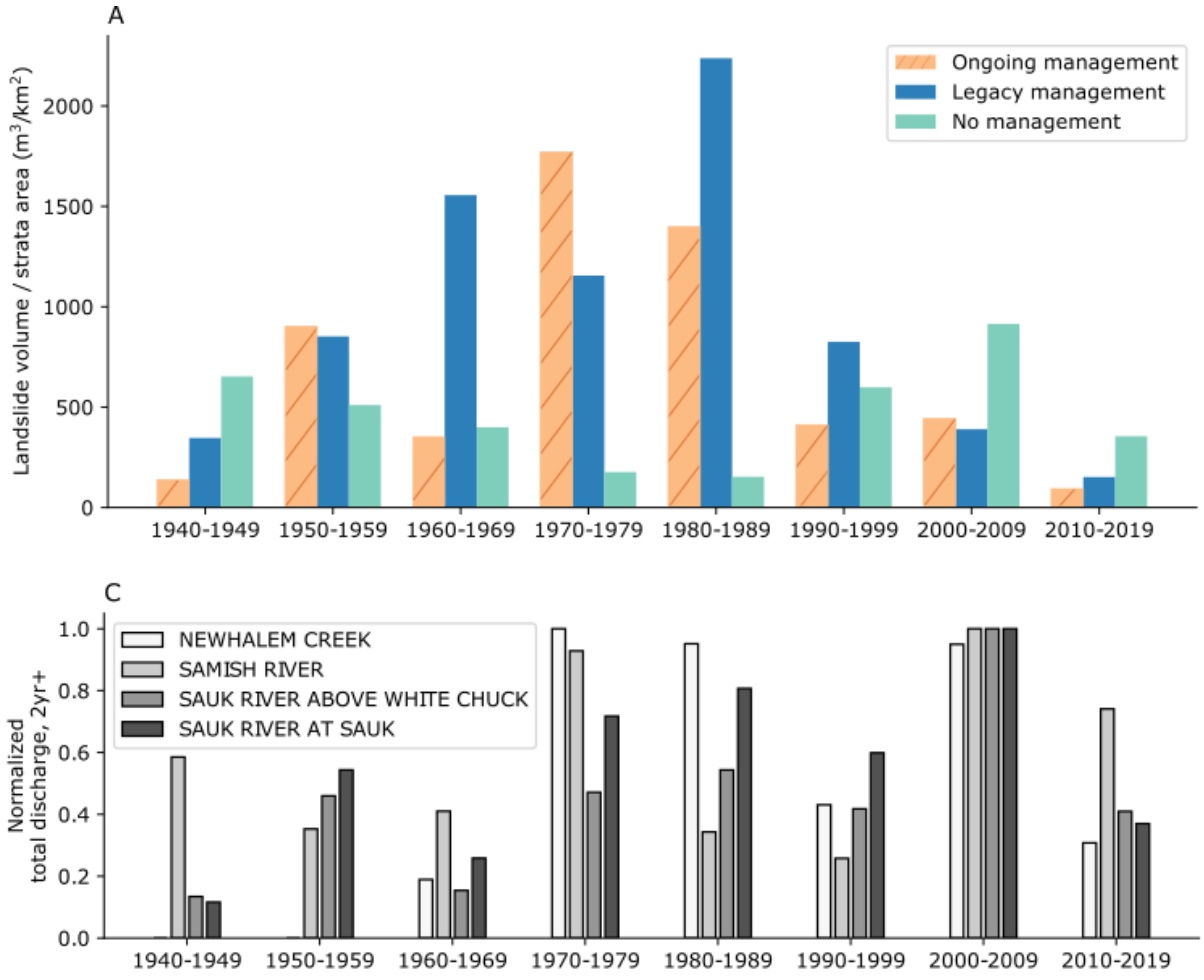
Skagit River study area

- Nine inventory basins.
- Landslide inventories: 1940-2019.
- Management history regimes:
  - Ongoing management
  - Legacy management
  - No management

Are there temporal patterns in landslide abundance?


A
Landslide volume / strata area (m³/km²)
0
500
1000
1500
2000
Ongoing management
Legacy management
No management
1940-1949
1950-1959
1960-1969
1970-1979
1980-1989
1990-1999
2000-2009
2010-2019

Do temporal patterns correspond to climate or storms?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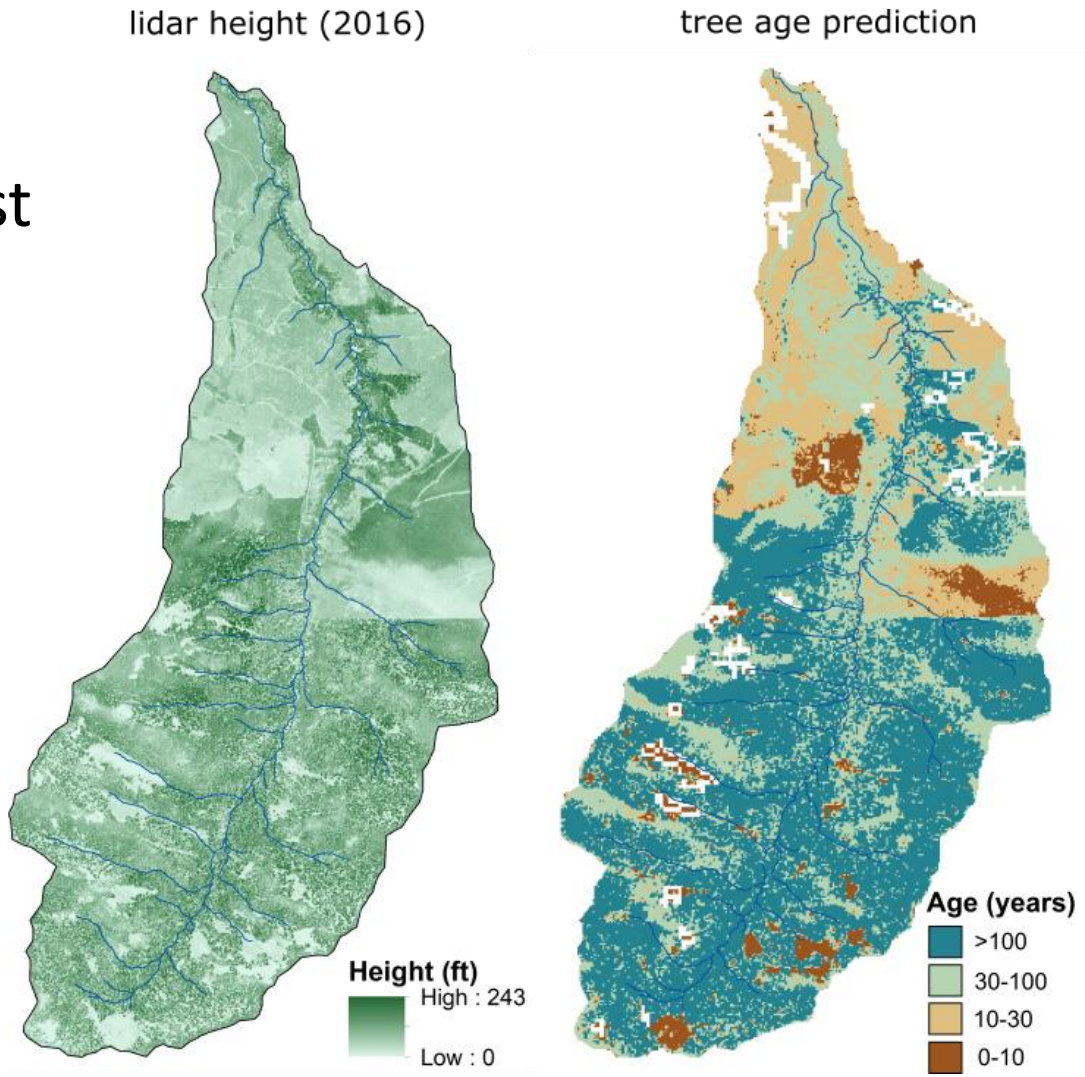
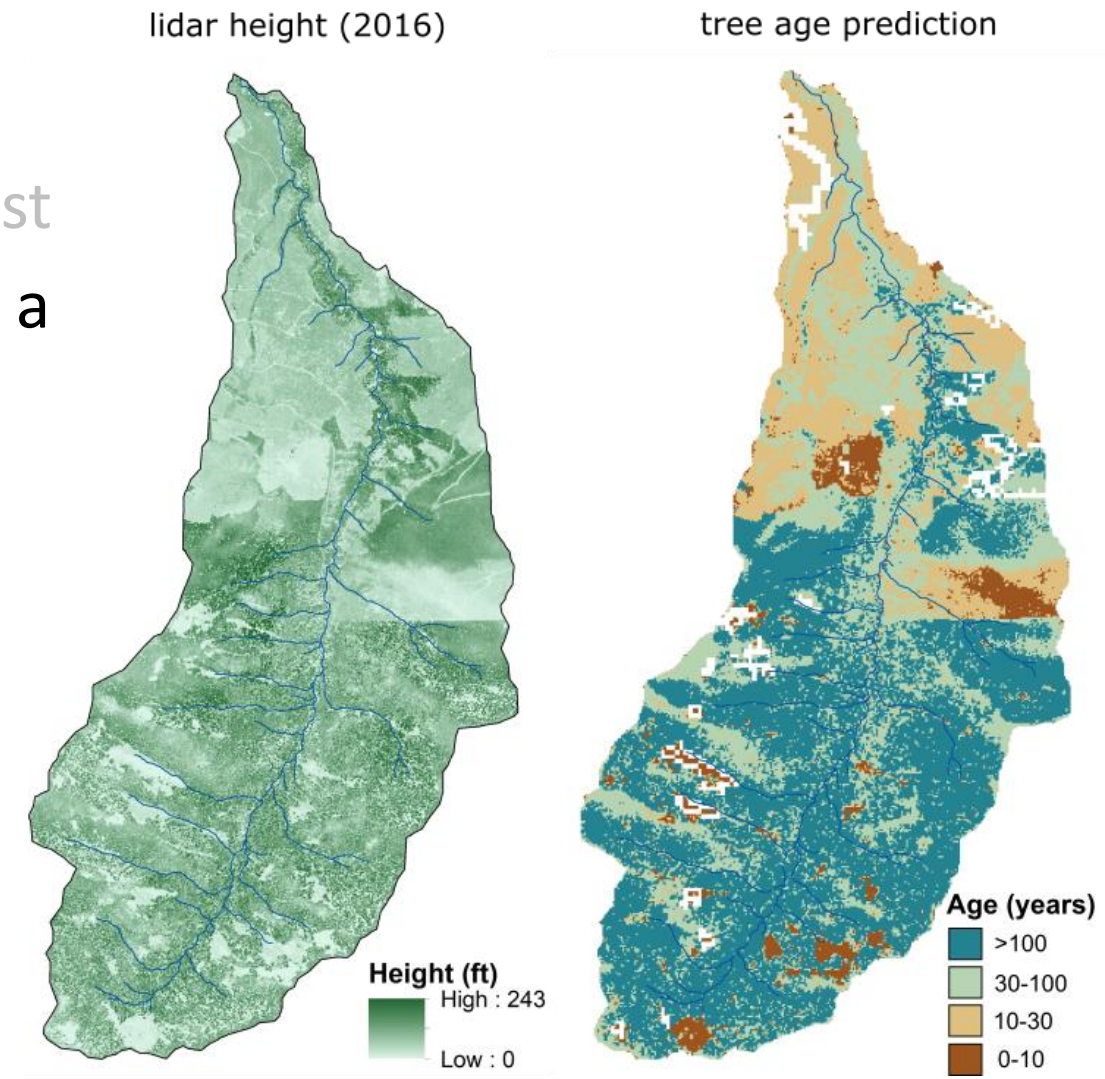
No management
1940-1949
1950-1959
1960-1969
1970-1979
1980-1989
1990-1999
2000-2009
2010-2019
C
Normalized total discharge, 2yr+
0.0
0.2
0.4
0.6
0.8
1.0
NEWHALEM CREEK
SAMISH RIVER
SAUK RIVER ABOVE WHITE CHUCK
SAUK RIVER AT SAUK
1940-1949
1950-1959
1960-1969
1970-1979
1980-1989
1990-1999
2000-2009
2010-2019

Do temporal patterns correspond to timber harvest rate?

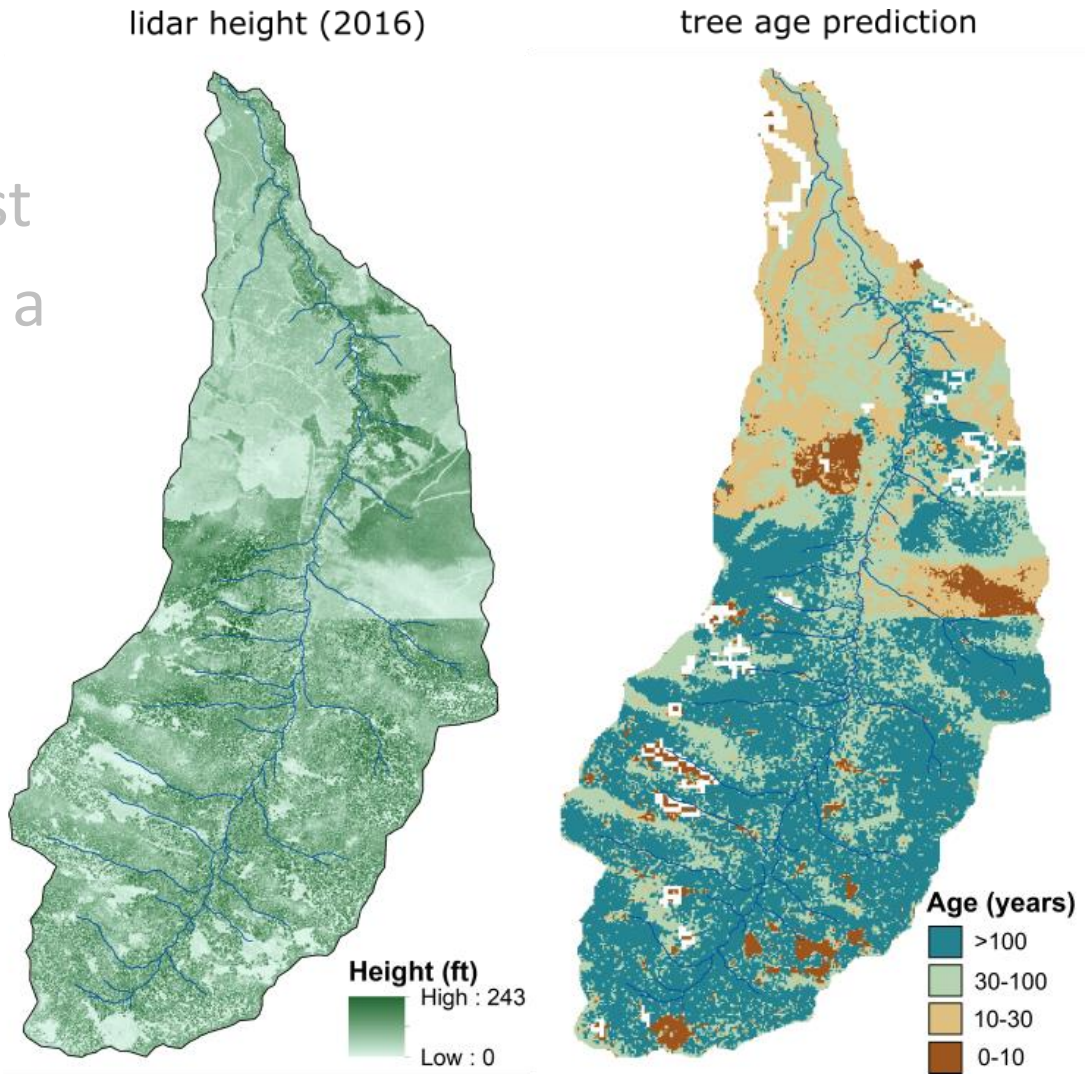
- Tree age = time of harvest



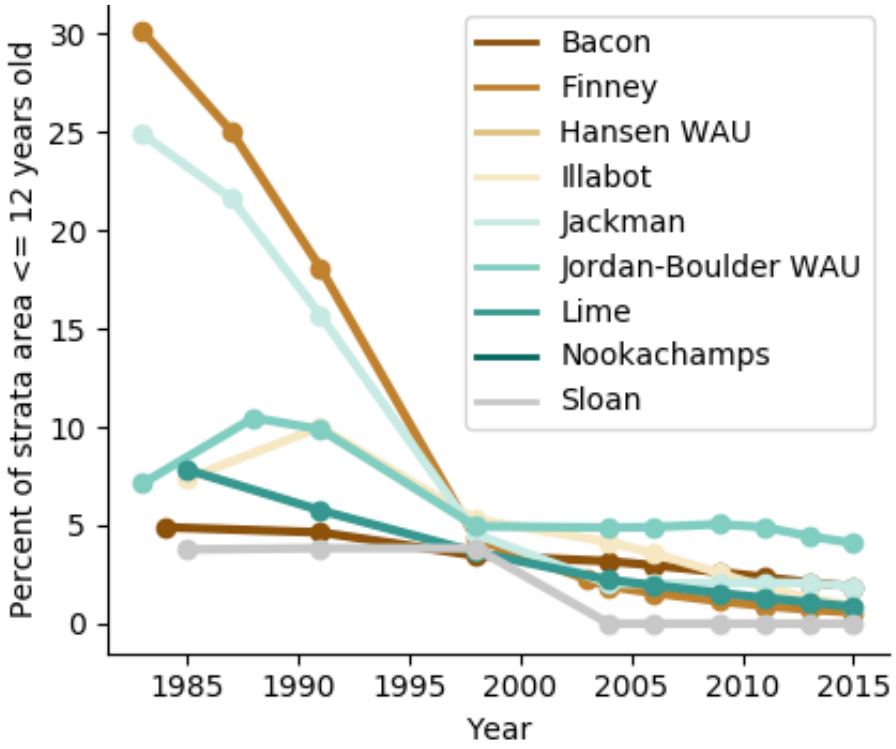
- Tree age = time of harvest
- Stand age model: age as a function of height

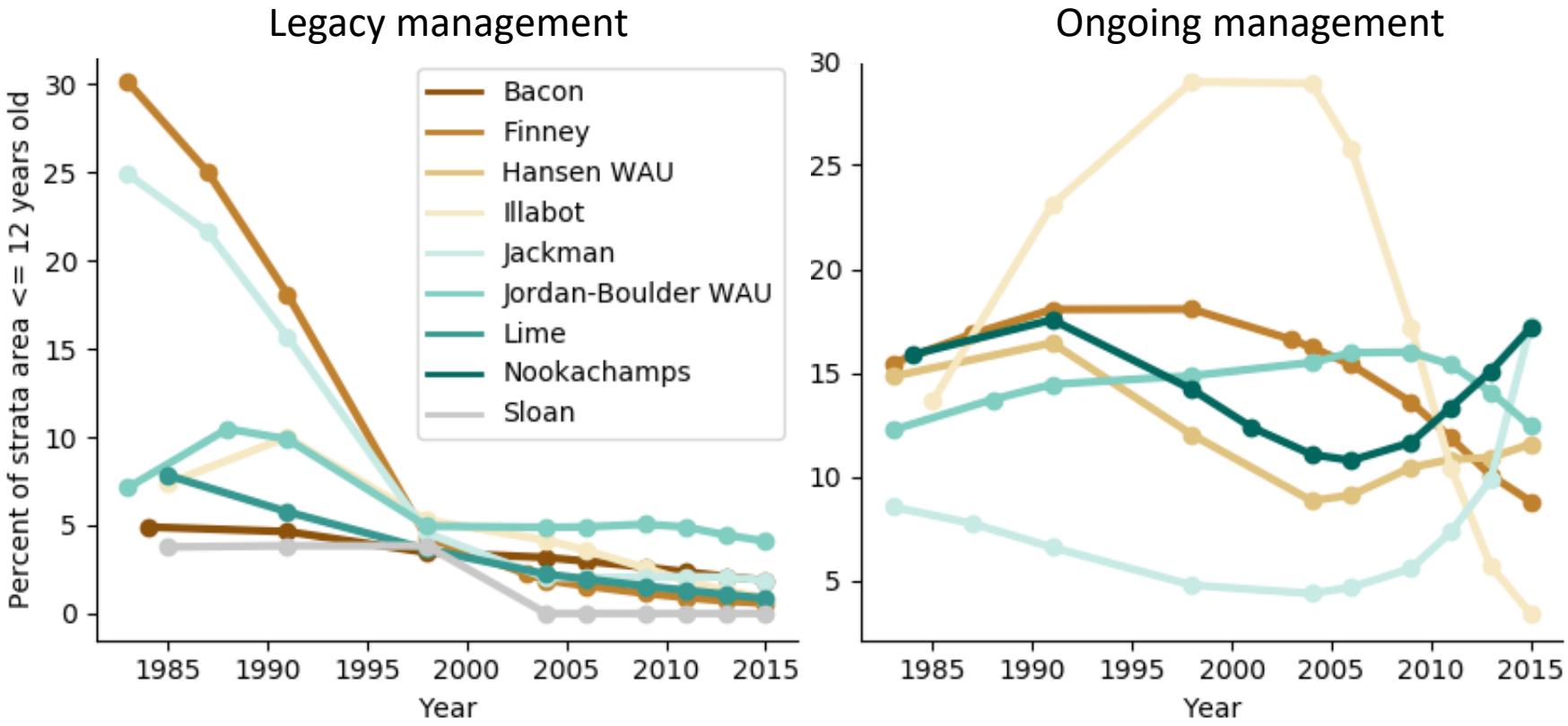


- Tree age = time of harvest
- Stand age model: age as a function of height
- lidar heights -> maps of forest age



Legacy management

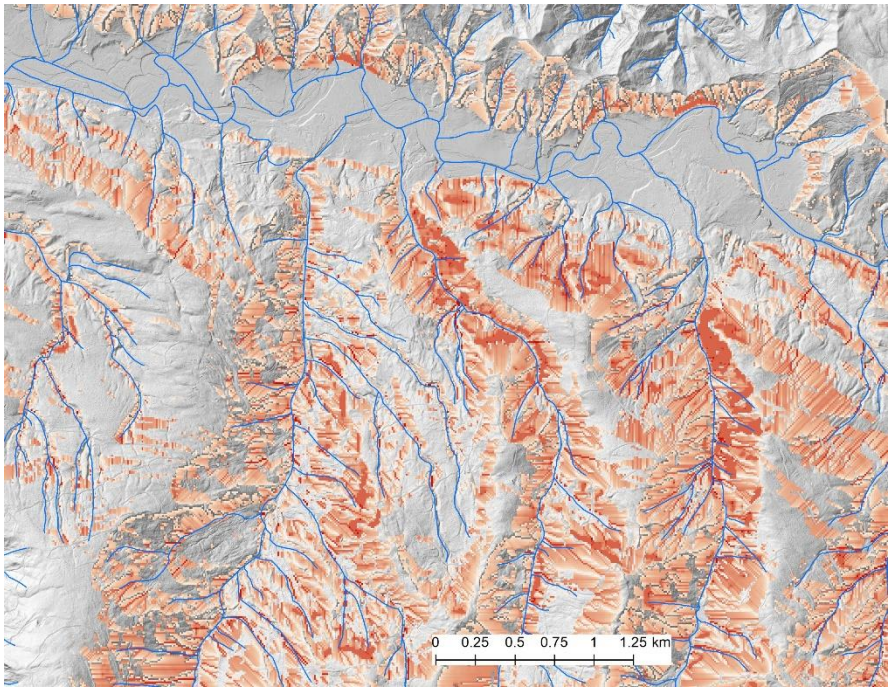



Legacy management
Ongoing management
Percent of strata area <= 12 years old
Year
Bacon
Finney
Hansen WAU
Illabot
Jackman
Jordan-Boulder WAU
Lime
Nookachamps
Sloan
0
5
10
15
20
25
30
1985
1990
1995
2000
2005
2010
2015

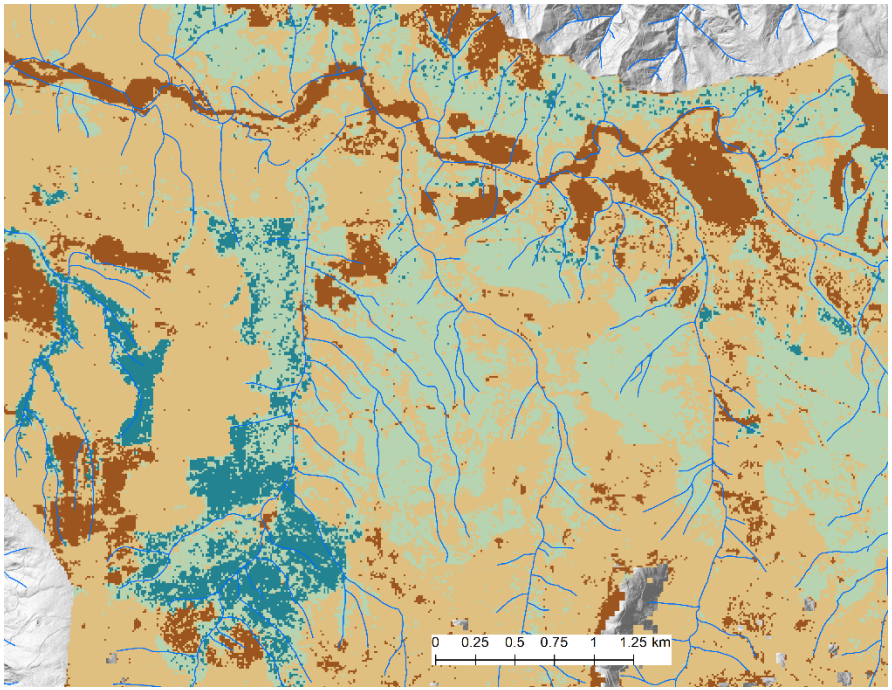
Do temporal patterns correspond to changes in forestry practices?

Verifying hazard avoidance: overlay of topography and stand age

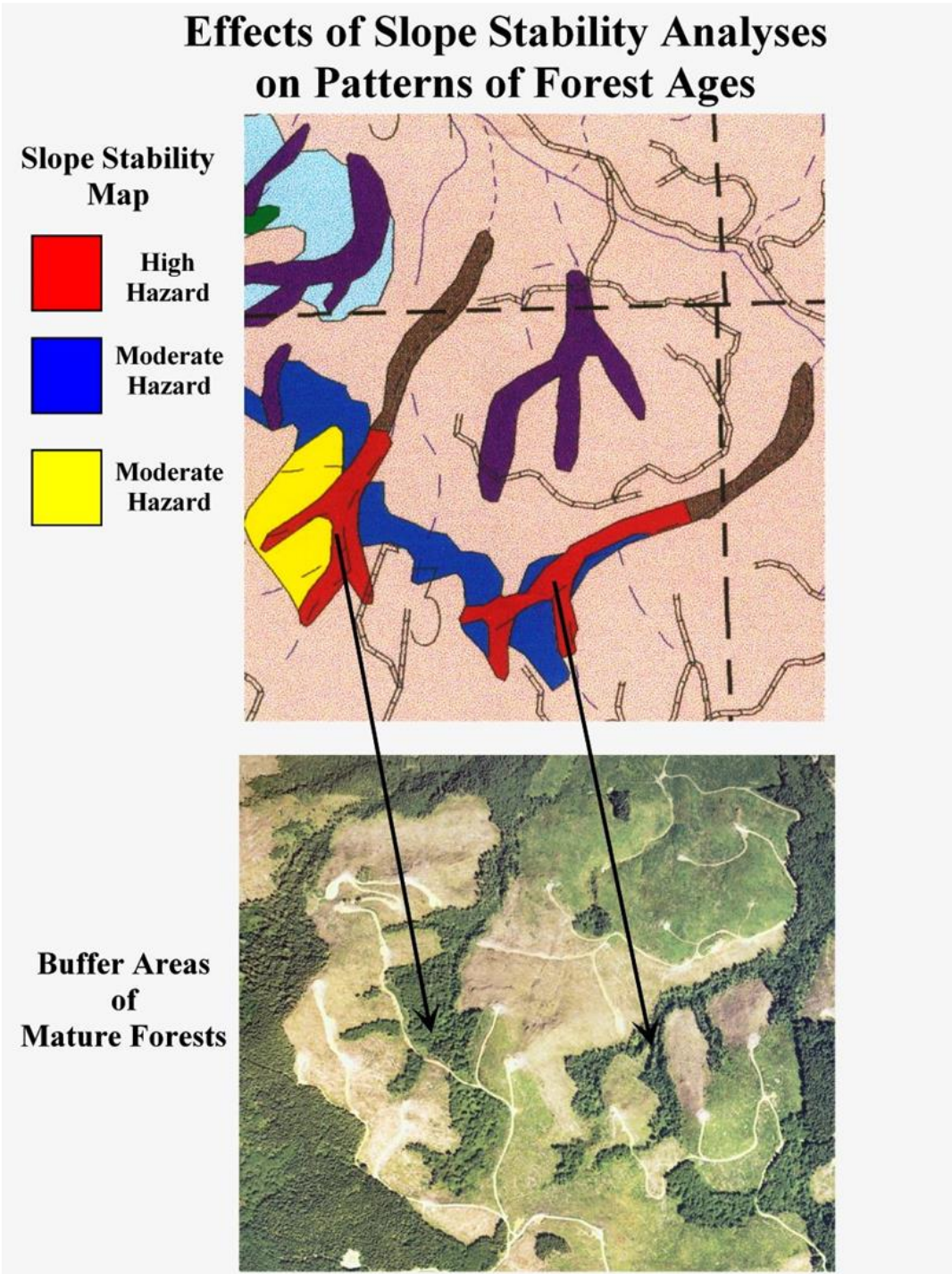
Unstable landforms



Stand age

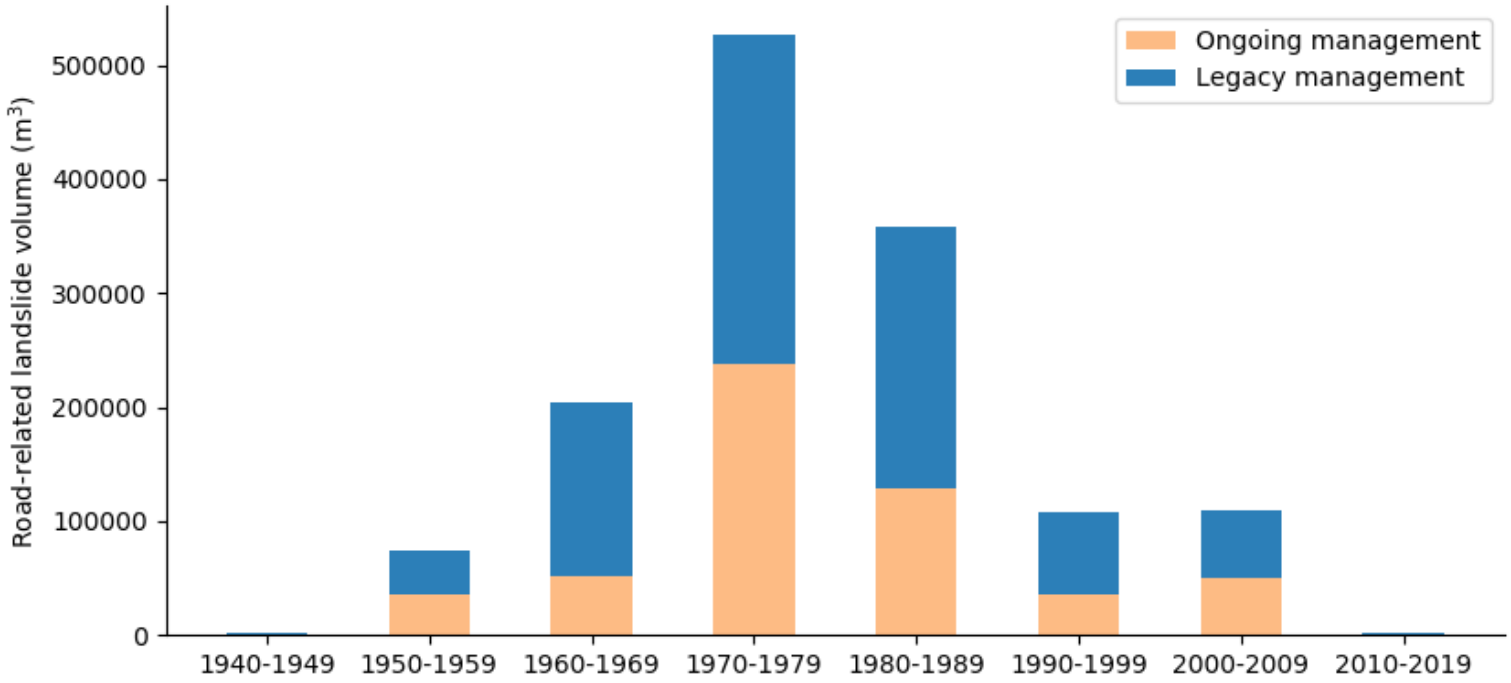


Landform buffers demonstrate hazard avoidance



Graphic: Lee Benda

Timeseries of forest road landsliding



Uncertainty

- Smallest and deep-seated landslides were not included due to detection challenges.
  - Mitigation addresses all types of landslides, so no reason to think excluded landslides are responding differently than landslides we included.
- Random process?...highly unlikely
- Soil evacuation legacy?...also highly unlikely

In summary…

- Are there temporal patterns of landslide abundance: Yes!

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- Related to climate? NM Yes, managed forests Mixed.

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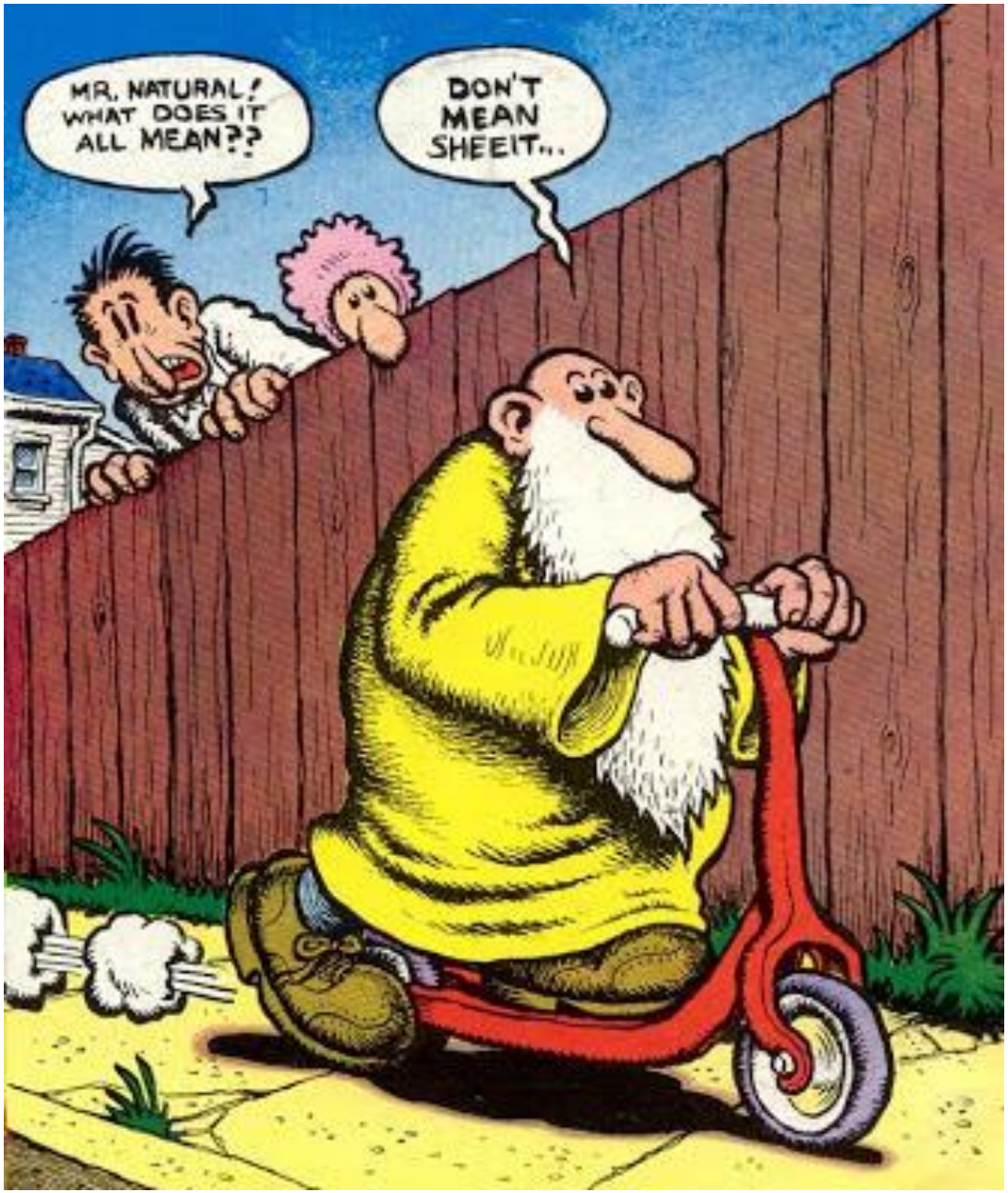
In summary…

- Are there temporal patterns of landslide abundance: Yes!
- Related to climate? NM Yes, managed forests Mixed.
- Related to logging rate? LM Yes, OM No.
- Related to forestry practices? Yes!

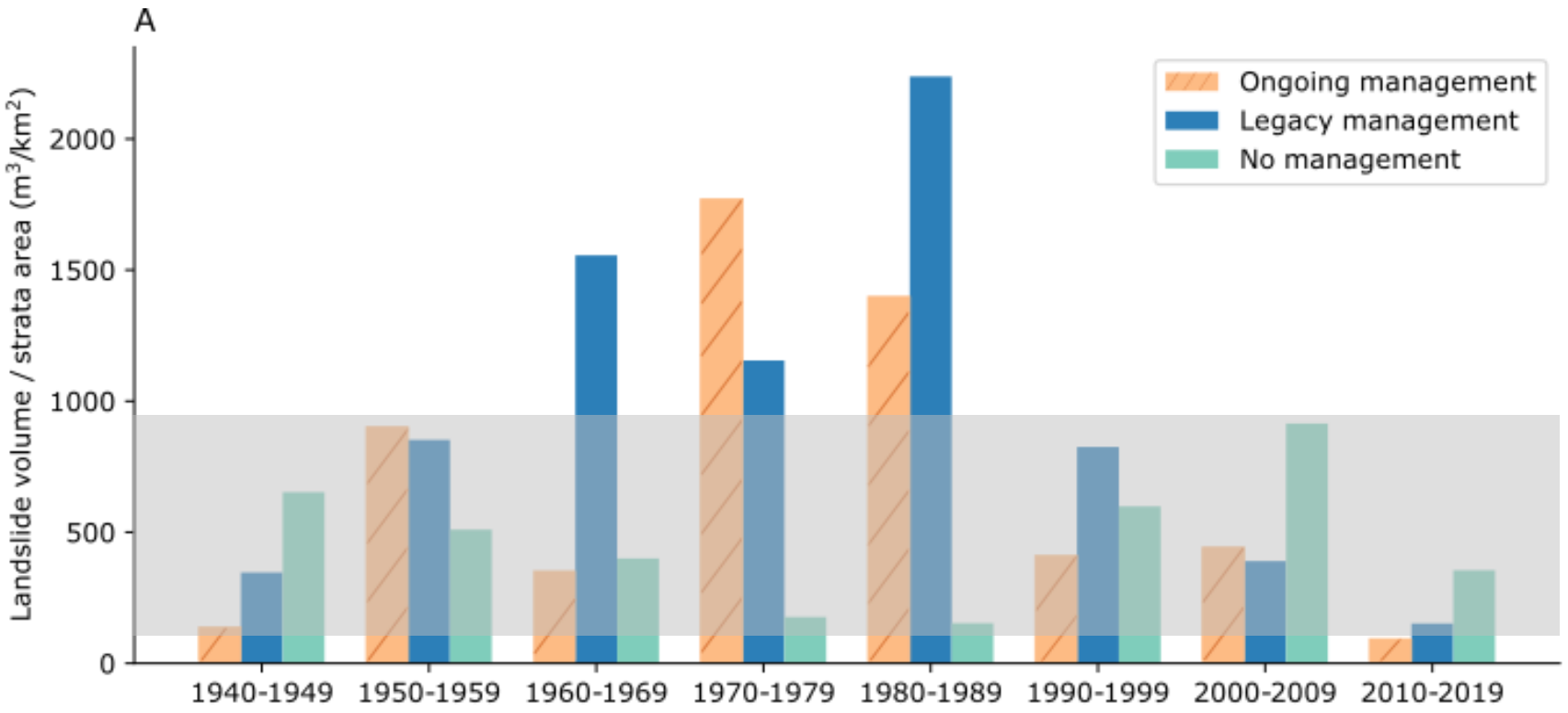
So, what does it all mean…?!

A watershed success story?



Cartoon: R. Crumb

Range of natural variability



Federal Forests
(LM – blue)

Shift from timber emphasis (‘90s)

- By mid 2000s, stabilization recovered

Road network downsized

- Main roads repaired
- Decommissioning (risk based)
- Revegetation

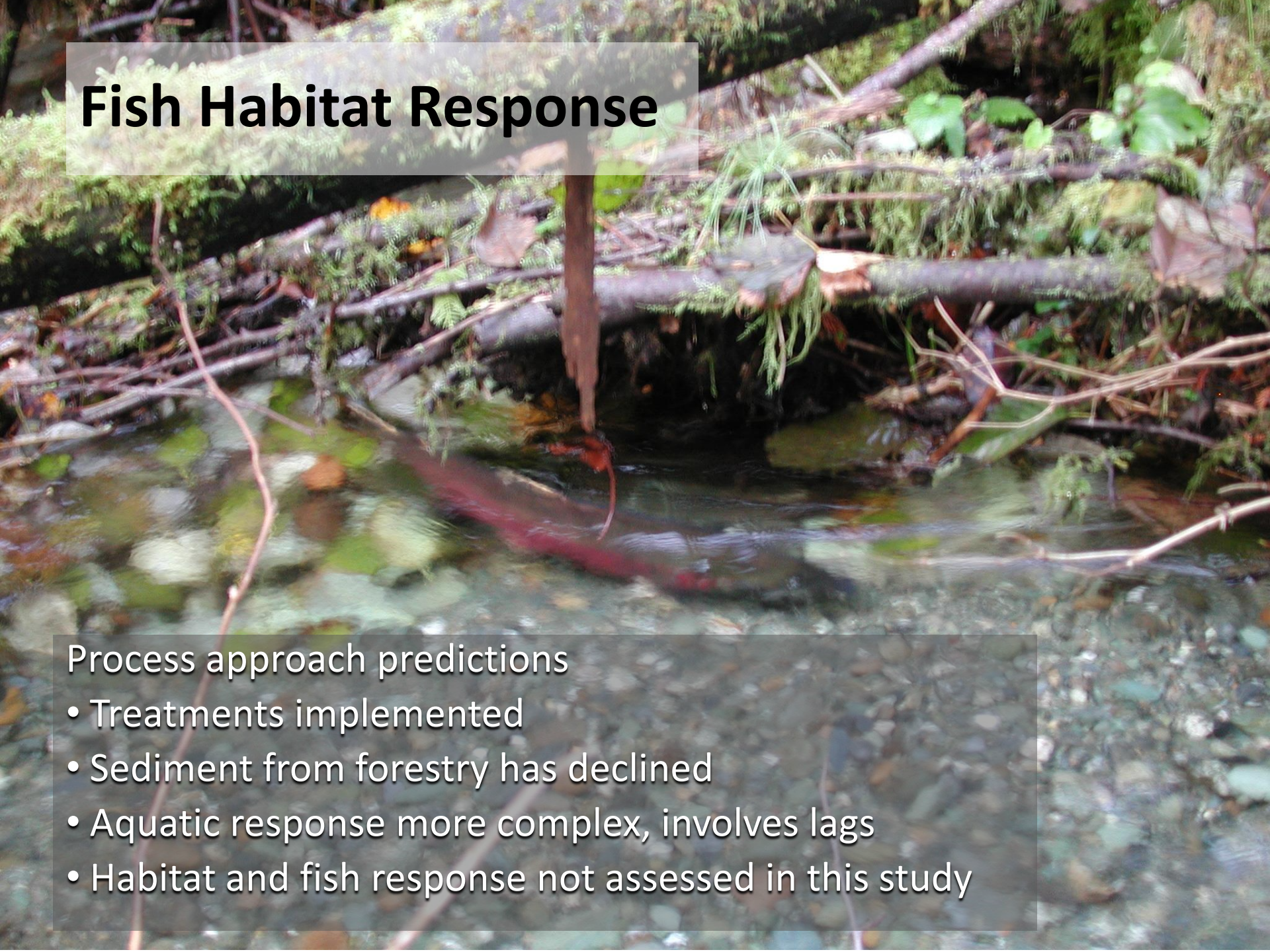
Private & State Forests
(OM orange)

Ongoing harvest with slope and stream buffers

Road network treated:

- Most roads upgraded
- Abandonment

Fish Habitat Response



Process approach predictions

- Treatments implemented
- Sediment from forestry has declined
- Aquatic response more complex, involves lags
- Habitat and fish response not assessed in this study

Forests will continue to change

- Return of big fires, burned buffers?
- Climate change: Stronger storms, increased tree growth?
- Shorter timber rotations?
- Revived harvest on federal lands?

Thanks!

LANDSLIDE DATA
UW: Kari Paulson, Dave Parks
Watershed Analysts: Noel Wolff, Carol Coho, Lee Benda
DNR Geology: Bill Lingley, Pat Pringle, Matt Brunengo, Karl Wegman, Laura Vaugeois

REVIEWS
Eric Beamer, Greg Hood, Drew Coe, Greg Stewart