



THE SALMON FAMILY TREE

RAY TROLL 2003

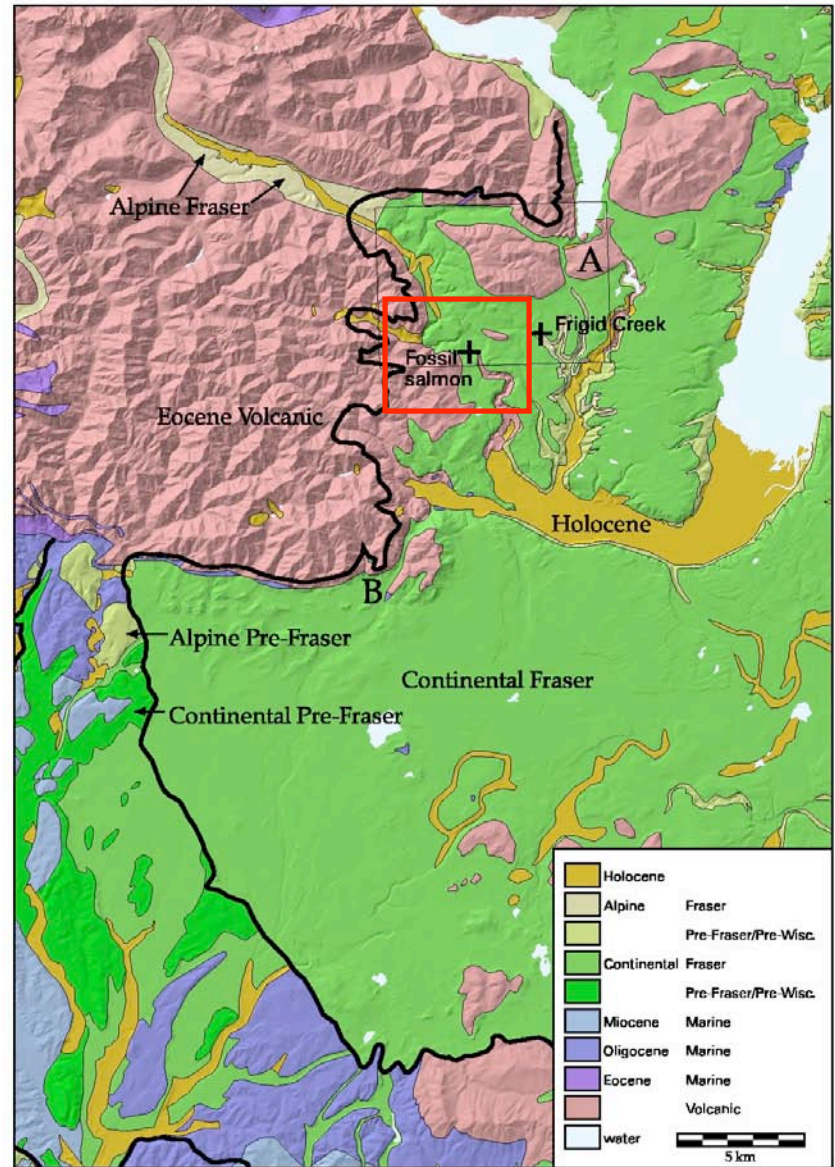
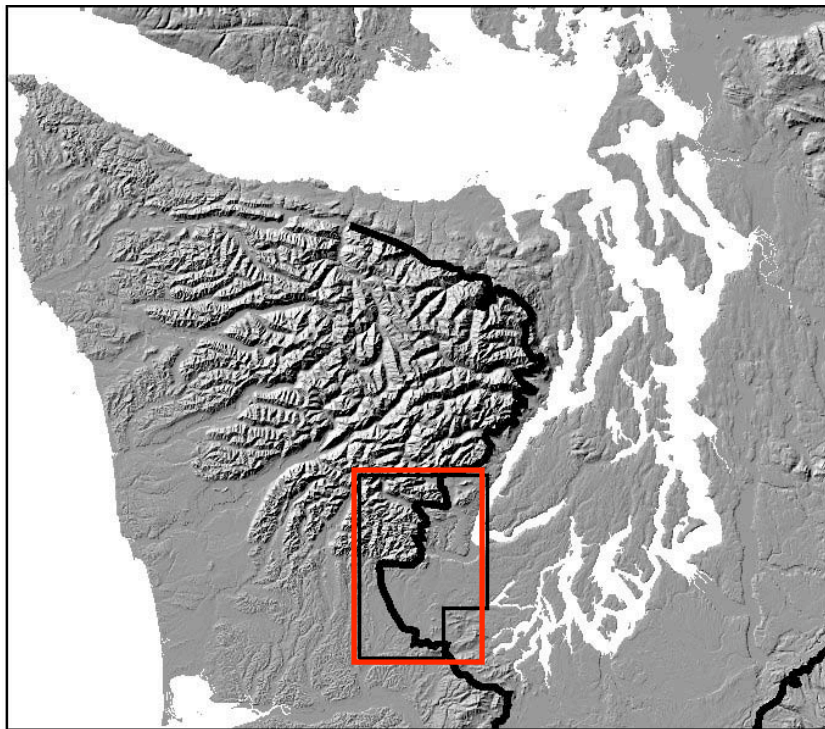
Classical Hypothesis for Pacific Salmon Evolution and Diversification

- Isolation during glacial advances
- **Problem:** Fossil salmon pre-date Pleistocene glaciations!

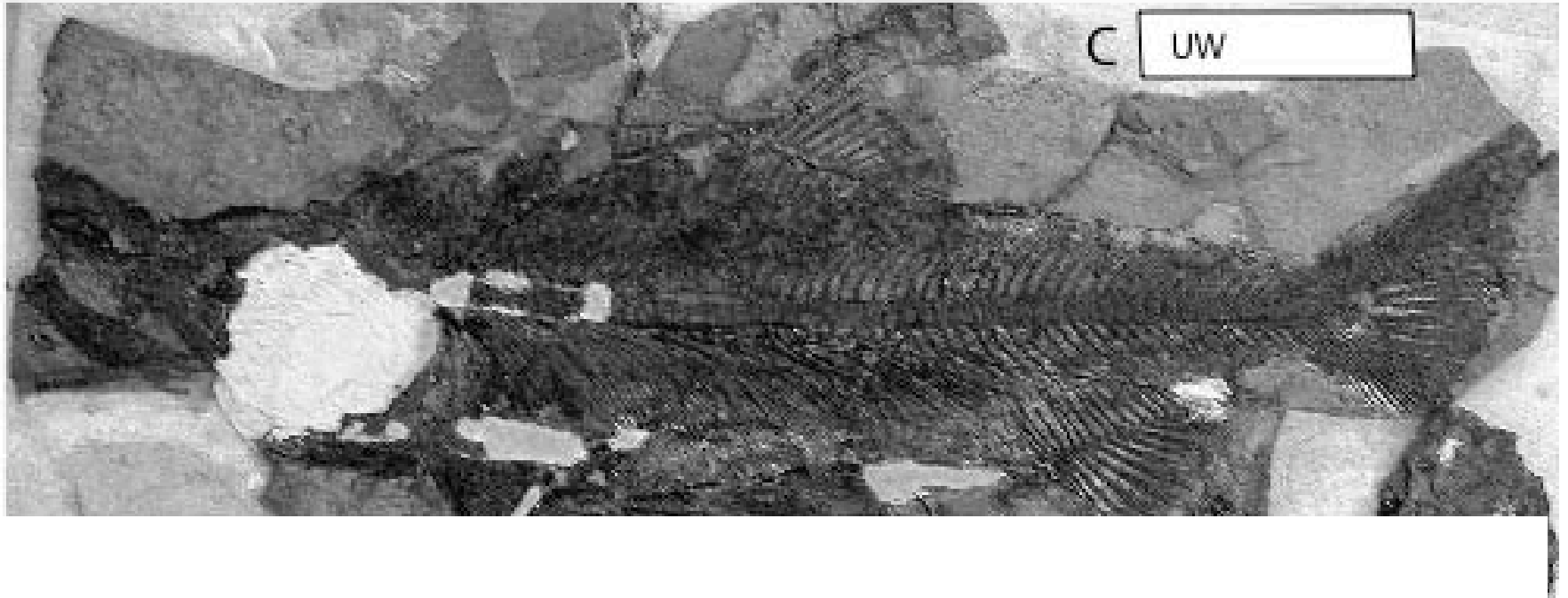
Evolution of the Pacific Salmon

- Pacific salmon evolved between 20 million and 6 million years ago (Miocene).
- Radiation of Pacific salmon into distinct species coincides with uplift of Pacific Rim topography.

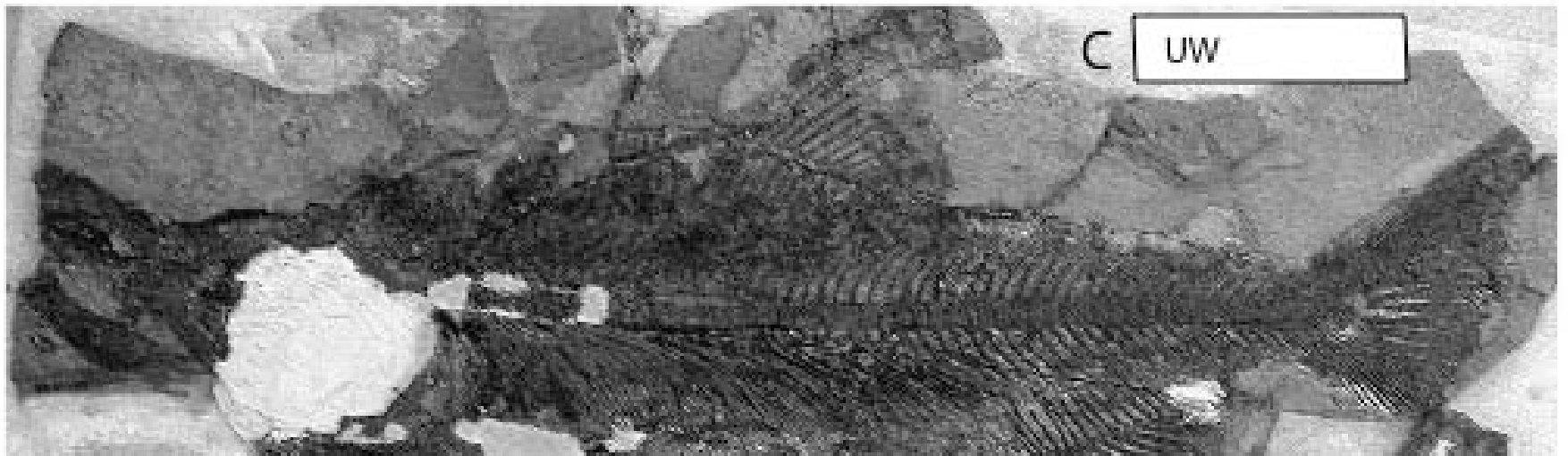
The Skokomish River fossil salmon locality is just upstream of the gorge of the South Fork at the edge of the Puget Lowland.



Skokomish River, Sockeye Salmon



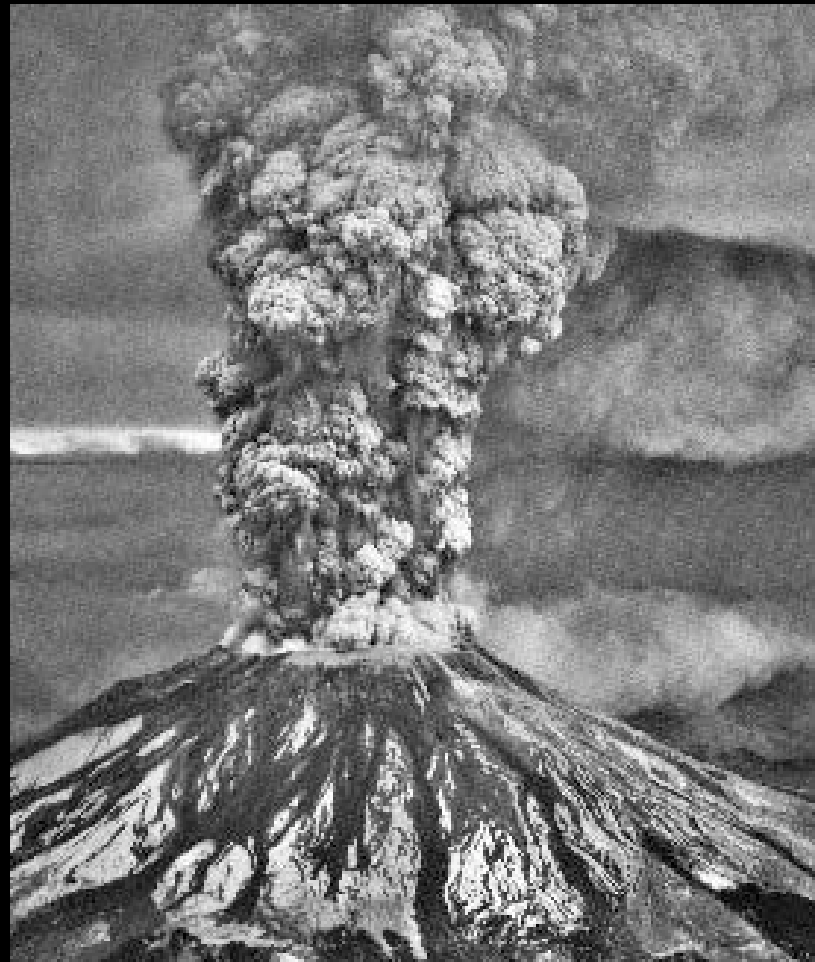
4 year old, spawning population



Major life history traits
established by 1 million years ago

Salmon and Natural Disturbances

For millions of years salmon thrived in a landscape shaped by floods, volcanic eruptions, and natural disturbances.



Archaeological excavations along the Columbia River confirm extensive salmon fishing for >9300 years...

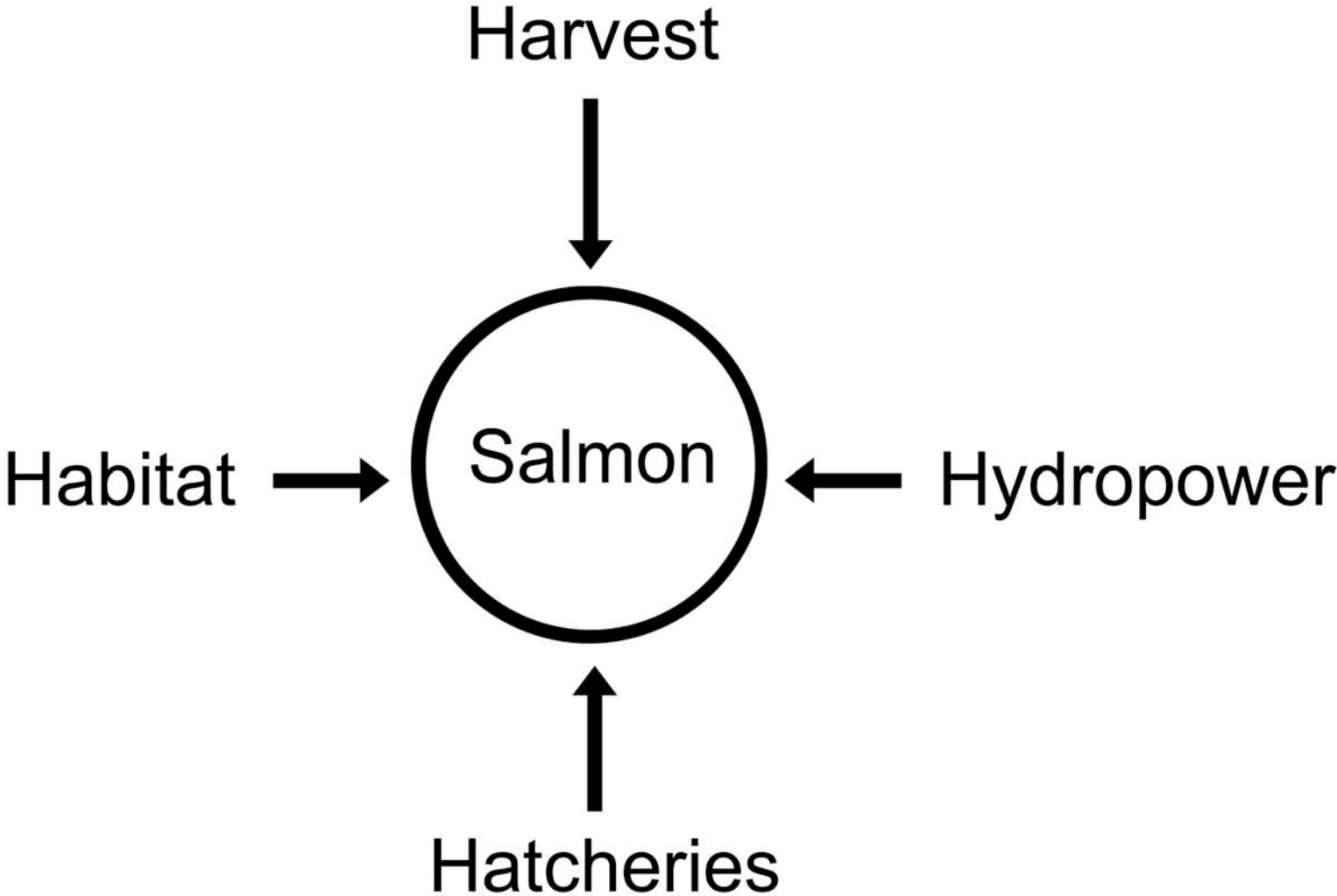


Butler and O'Connor,
Quaternary Research, v.
62, p 1-8, 2004

Status of Salmon Populations Today

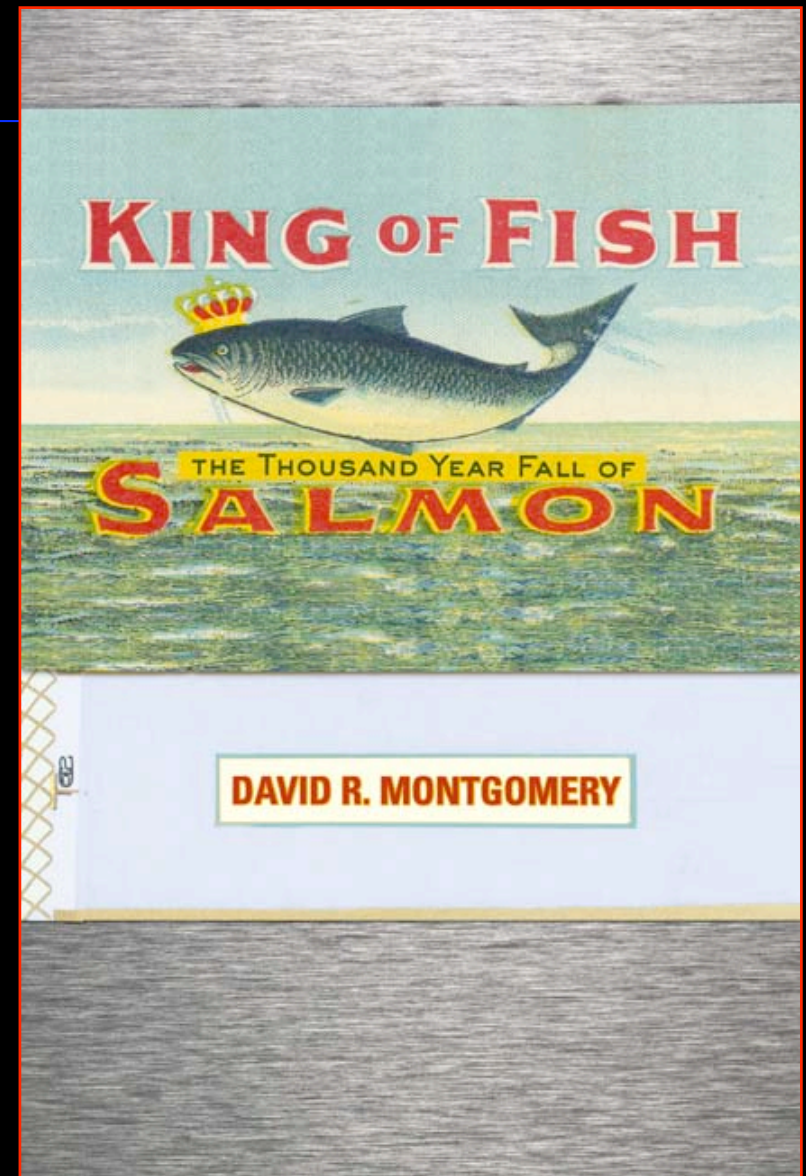
<u>Region</u>	<u>Percent of Historical Run Size</u>
• Alaska	106
• British Columbia	36
• Puget Sound	8
• Washington	<2
• Columbia Basin	<2
• Oregon	7
• California	5
• California, Oregon, Washington, Idaho	5

Gresh, T., J. Lichatowich and P. Schoonmaker (2000) An estimation of historic and current levels of salmon production in the Northeast Pacific ecosystem: Evidence of a nutrient deficit in the freshwater systems of the Pacific Northwest. *Fisheries*, 25(1): 15-21.



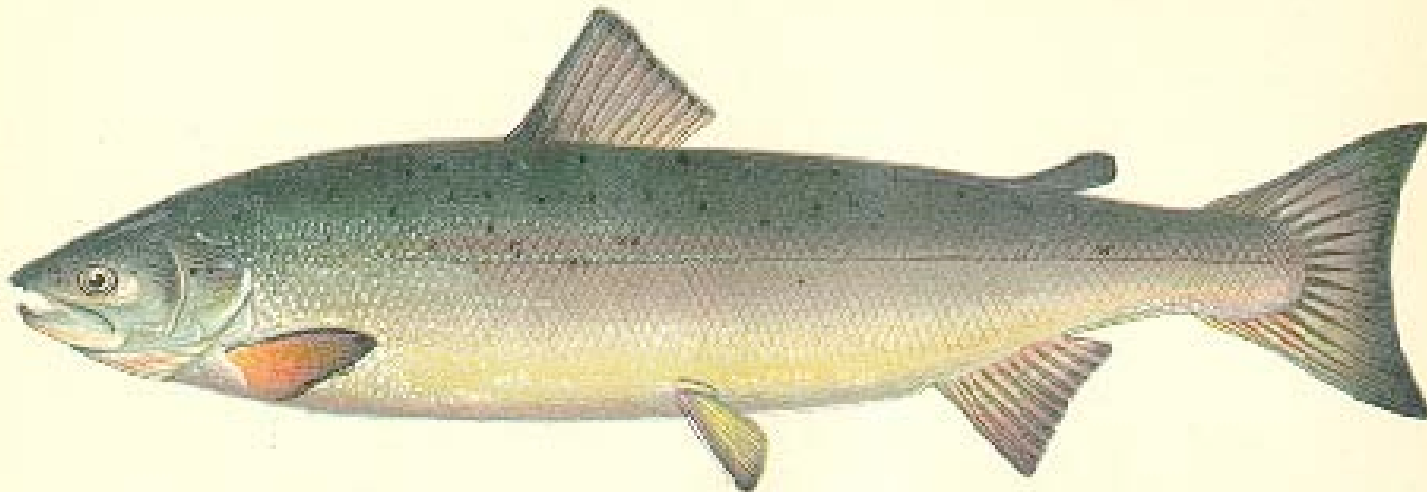
History, The 5th H

Strikingly similar pattern of changes to river systems and salmon crises in Great Britain, New England, and now the Pacific Northwest.



Harvest

The earliest recorded salmon-fishing legislation was an edict issued by King Malcolm II of Scotland in 1030 that established a closed season for taking "old salmon".



THE ATLANTIC SALMON

Habitat

A statute dating from the reign of Richard the Lion-hearted declared that rivers must be kept free of obstructions so as to permit a well-fed three-year-old pig, standing sideways in the stream, not to touch either side.

Hydro (dams)

An Act passed in the reign of King Robert the First, in 1318, forbade the erection of fixtures of any size or dimensions that would prevent the progress of salmon up and down a river.

George I Tries to Save the Salmon

In 1714 George I enacted a law to prevent blocking salmon from their spawning grounds in seventeen English rivers.

By 1868, all seventeen rivers protected by George I were either blocked or poisoned by pollution.
[habitat and hydro]

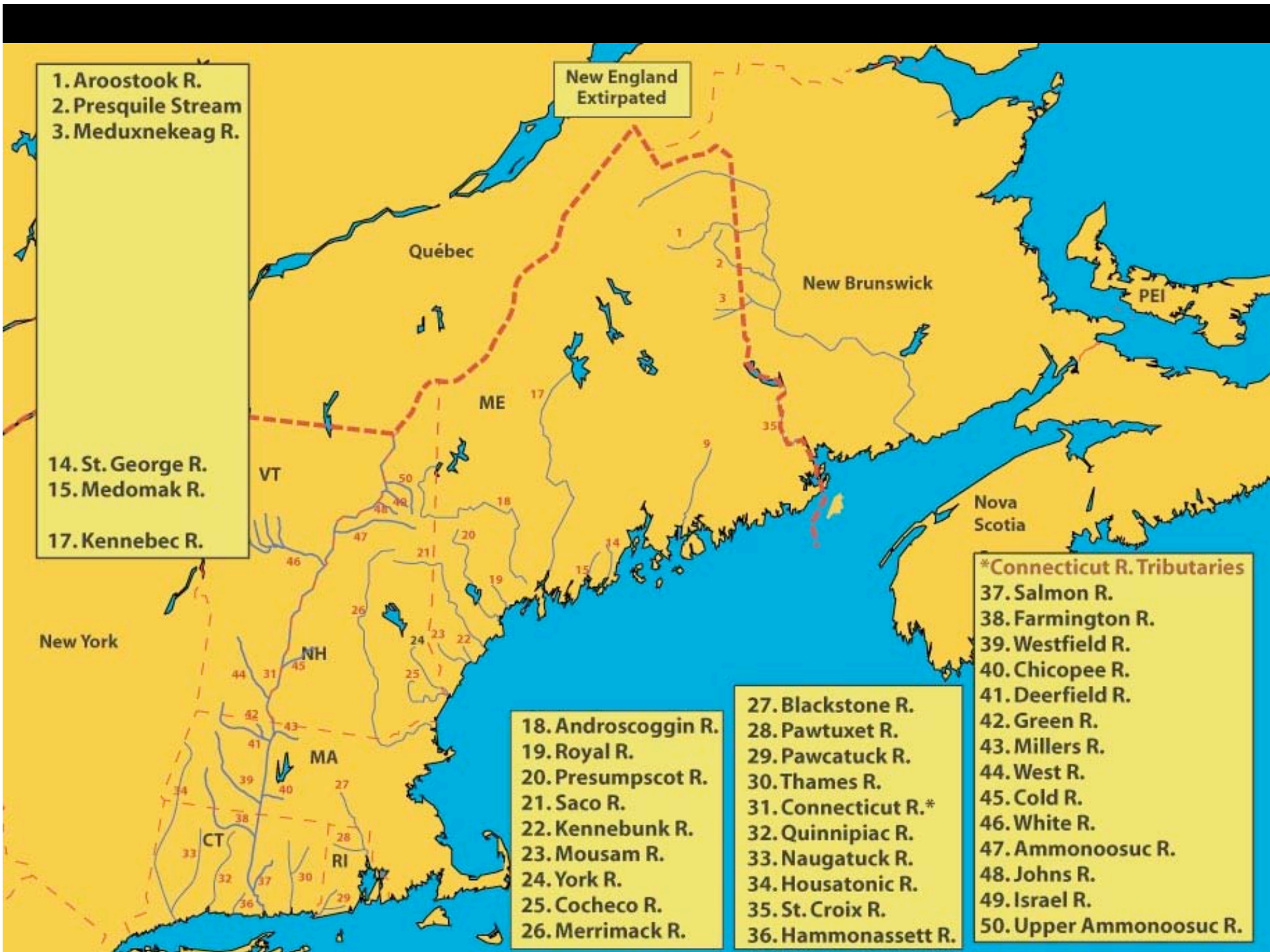
Alexander Fraser proposed steps to increase the number of salmon in Scottish rivers (1833):

- (1) don't block the ability of salmon to migrate up or down stream [hydro];
- (2) limit fishing intensity so as to not take the majority of the spawners [harvest];
- (3) prevent habitat degradation that could damage the fishery [habitat].

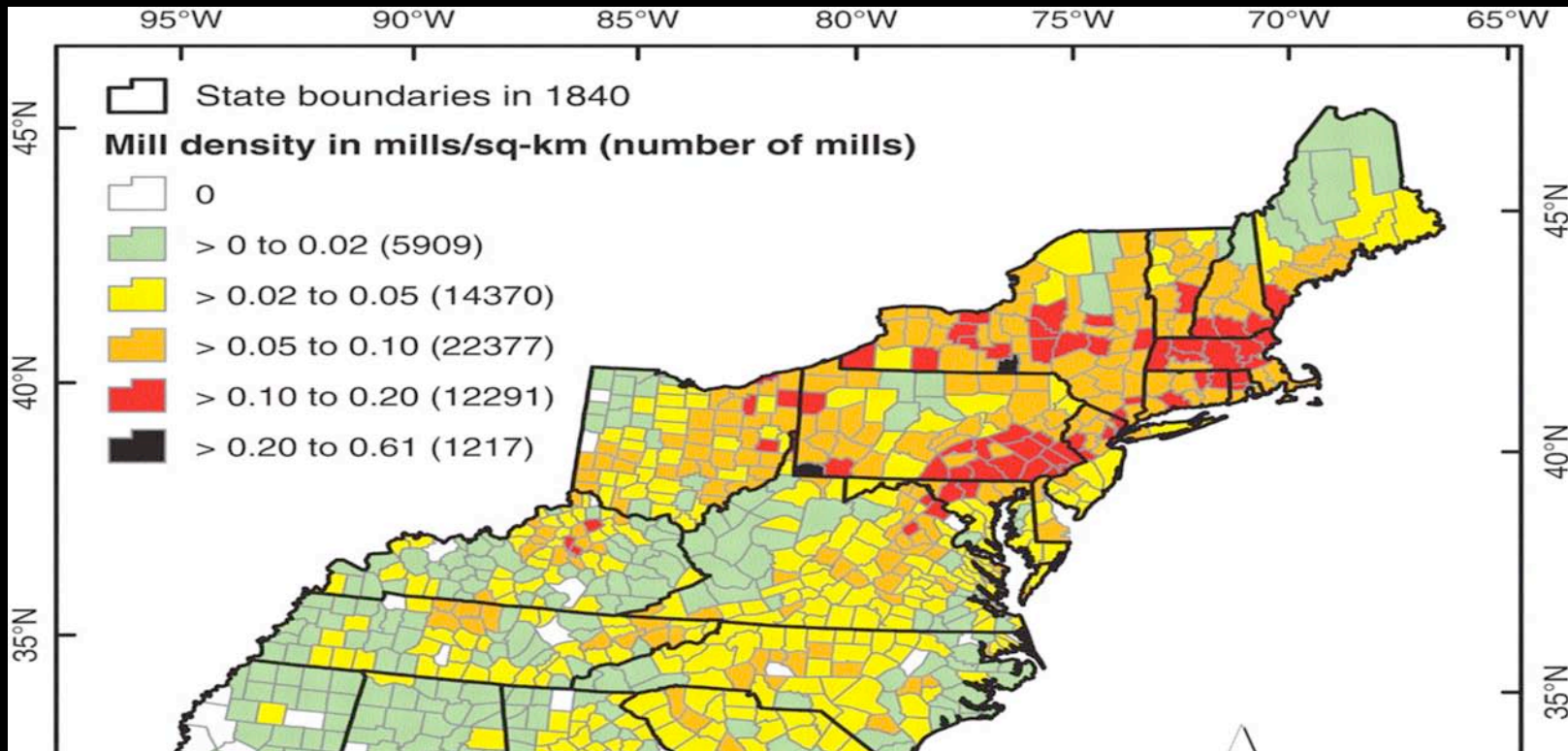
New World Salmon

"If the Pigeons plagued us by their abundance, the Salmon gave us even more trouble. So large a quantity of them enters into this river that at night one is unable to sleep, so great is the noise they make in falling upon the water after having thrown or darted themselves in to the air."

— N. Denys (1672 , p. 199).



The proliferation of small dams gradually blocked salmon from New England's rivers.



First laws outlawing salmon-blocking dams date from 1709.

Between 1820 and 1880 over one hundred and fifty fishery laws relating to salmon were passed by the state of Maine.

Enforcement, provided for at the local level, was virtually nonexistent.

Key factors in British and New England salmon declines

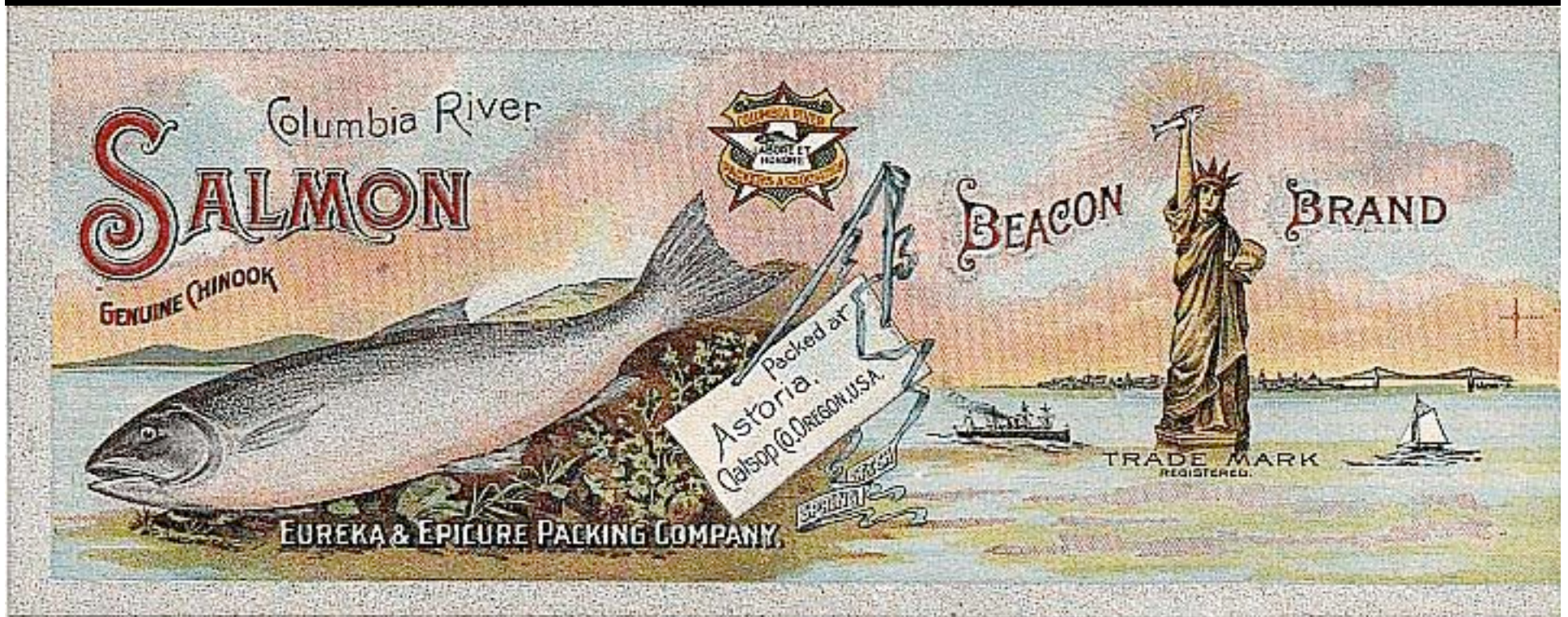
Local control and lax enforcement

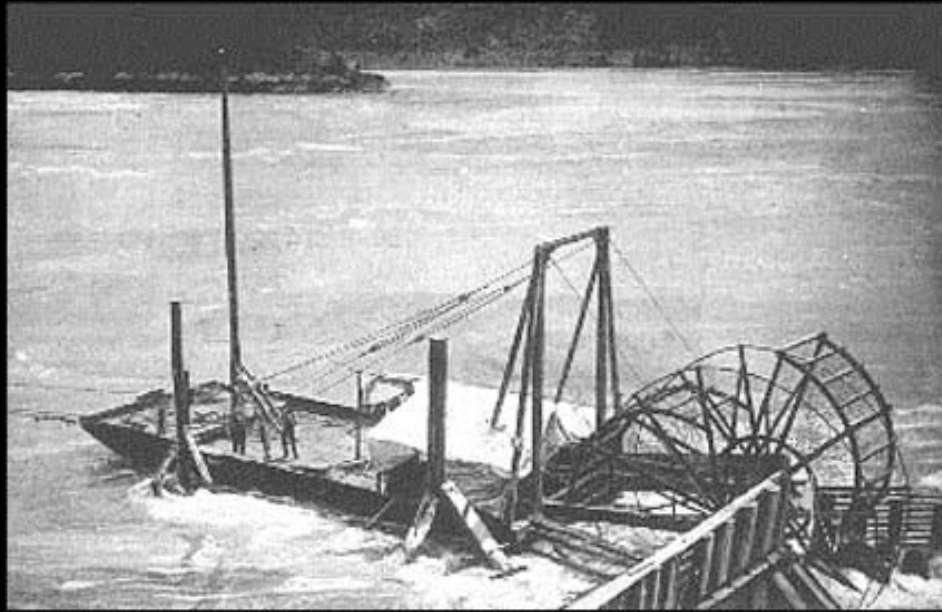
Gradual accumulation of many individual habitat impacts

Over-reliance on hatcheries at the expense of habitat

Lack of long-term planning and understanding of habitat-fish

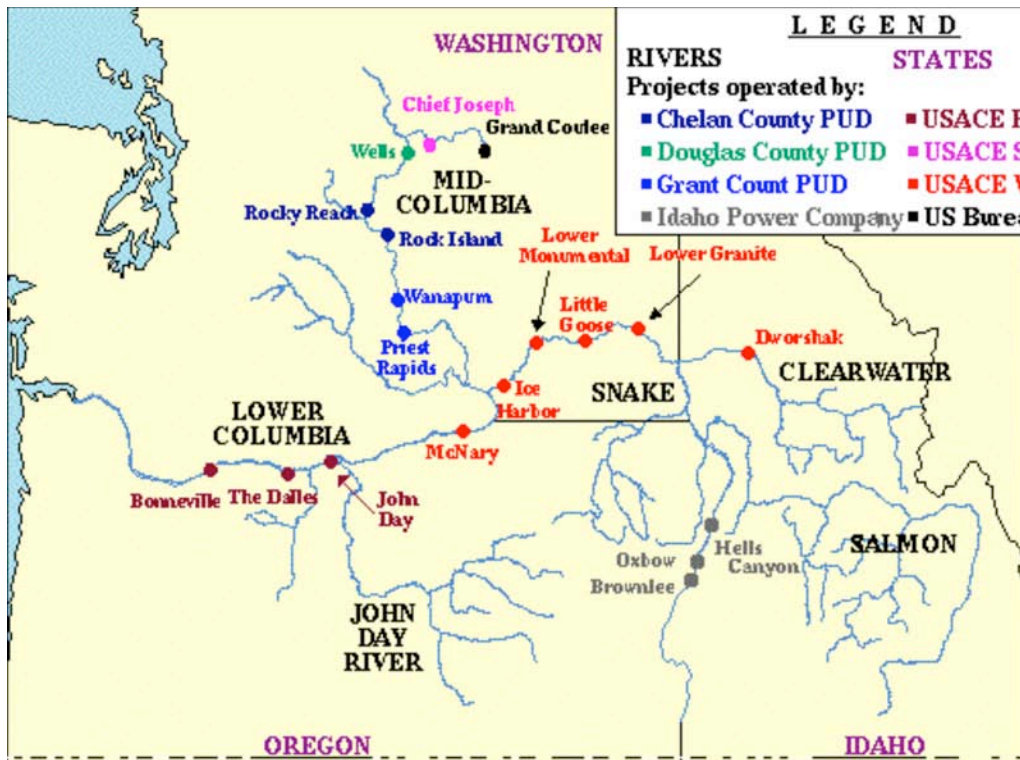
Have we learned any of these lessons?
Are we really doing anything any
different in the Pacific Northwest?



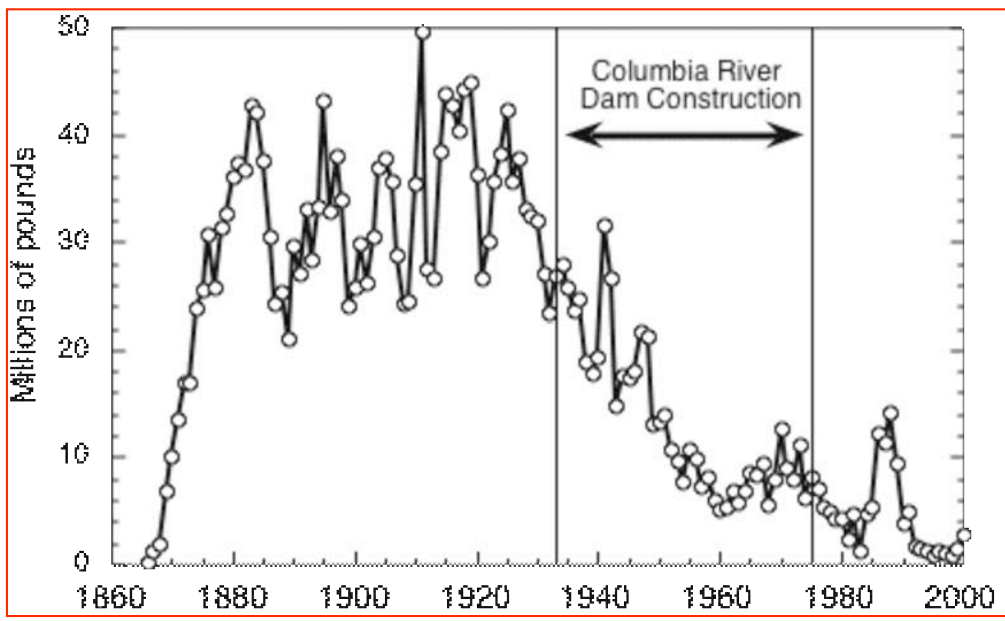


Harvest

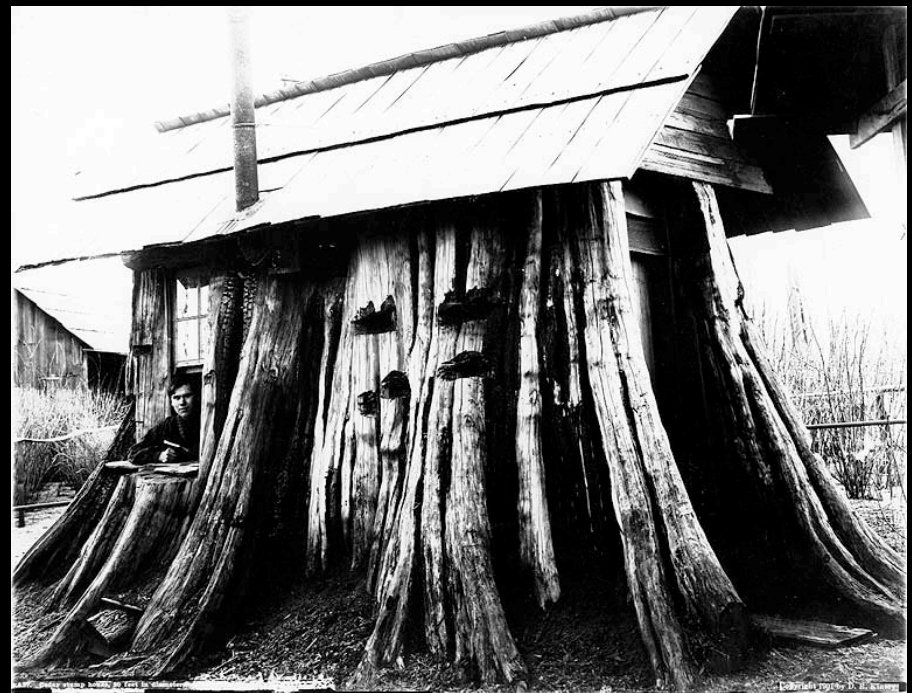




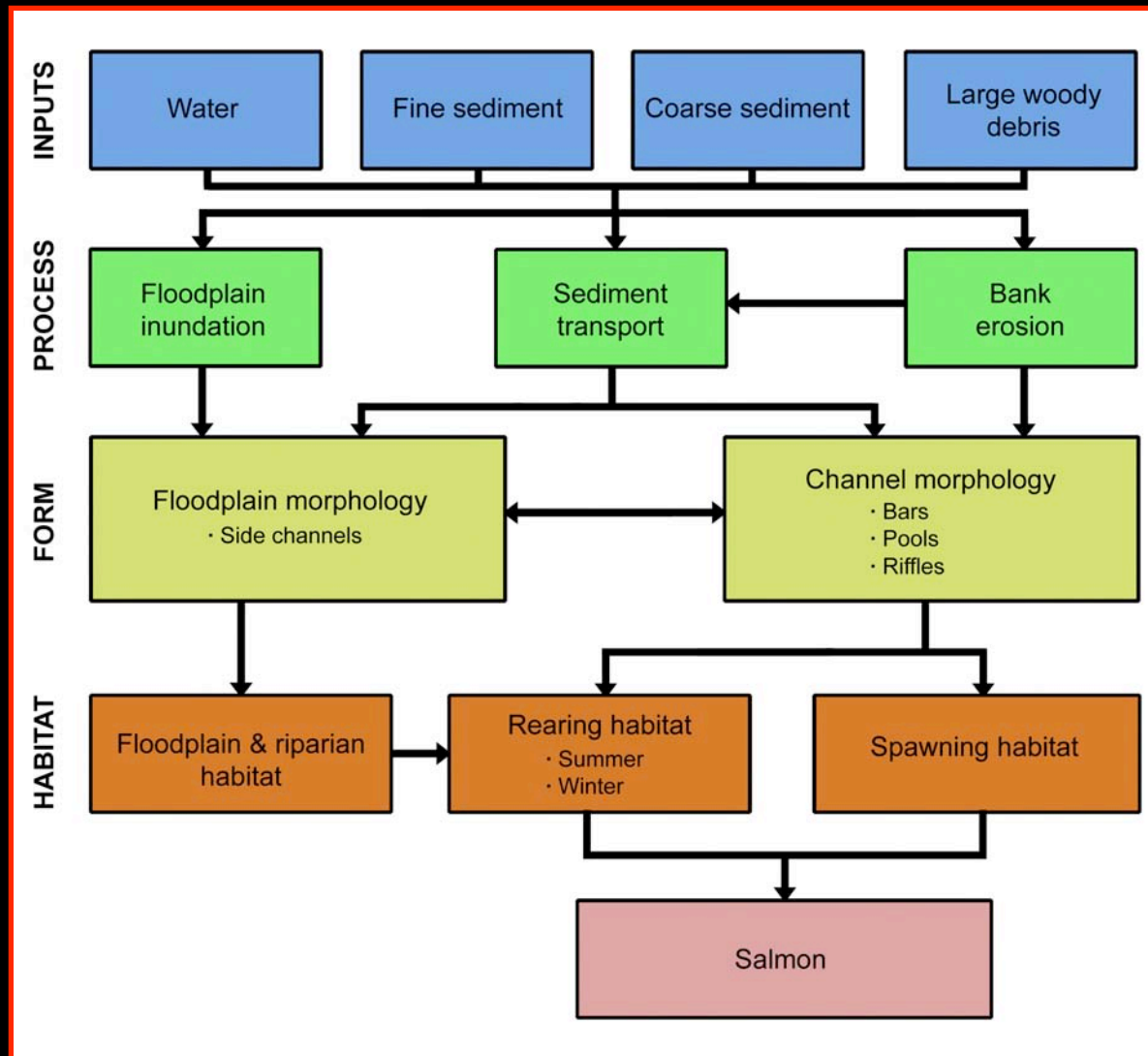
Hydro



Habitat



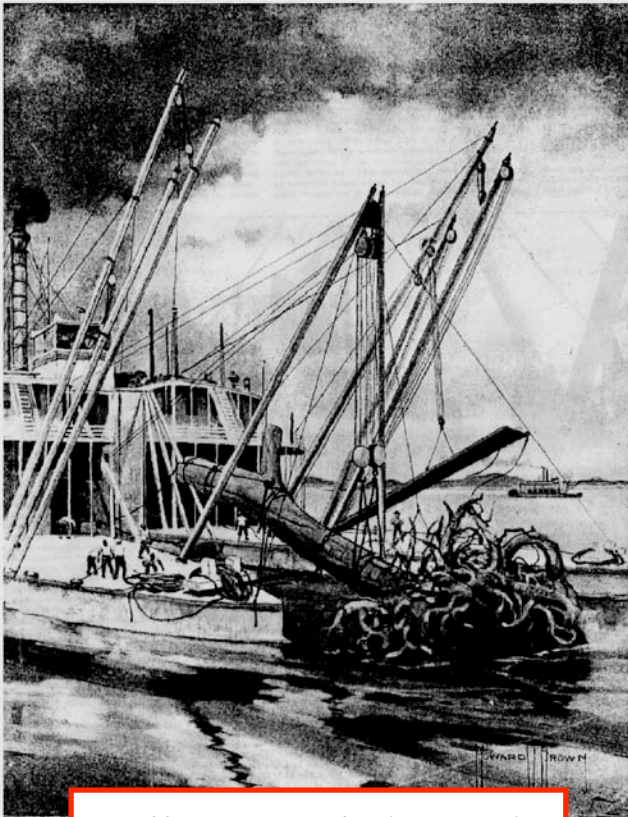
The supply and transport of water, sediment, and wood interact to structure salmon habitat.



Army Corps of Engineers aggressively "de-snagged" American Rivers

SCIENTIFIC AMERICAN

A Weekly Review of Progress in
INDUSTRY • SCIENCE • INVENTION • MECHANICS

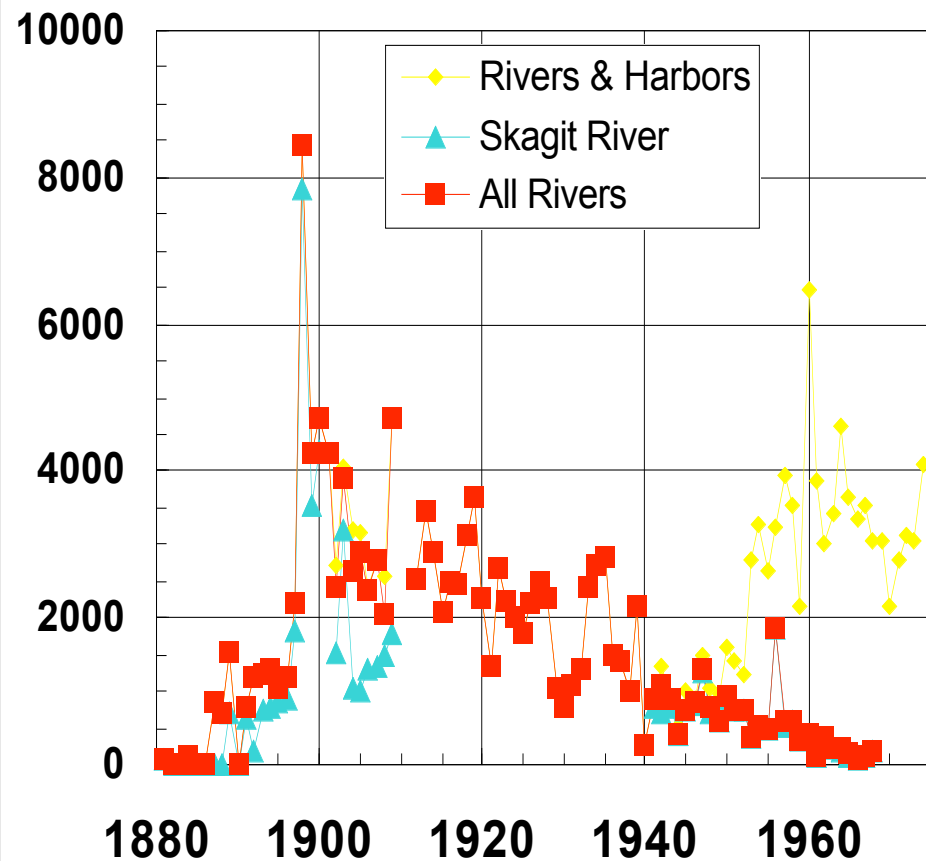


Collins et al. (2002)

Vol. CXXV, No. 4
July 23, 1921

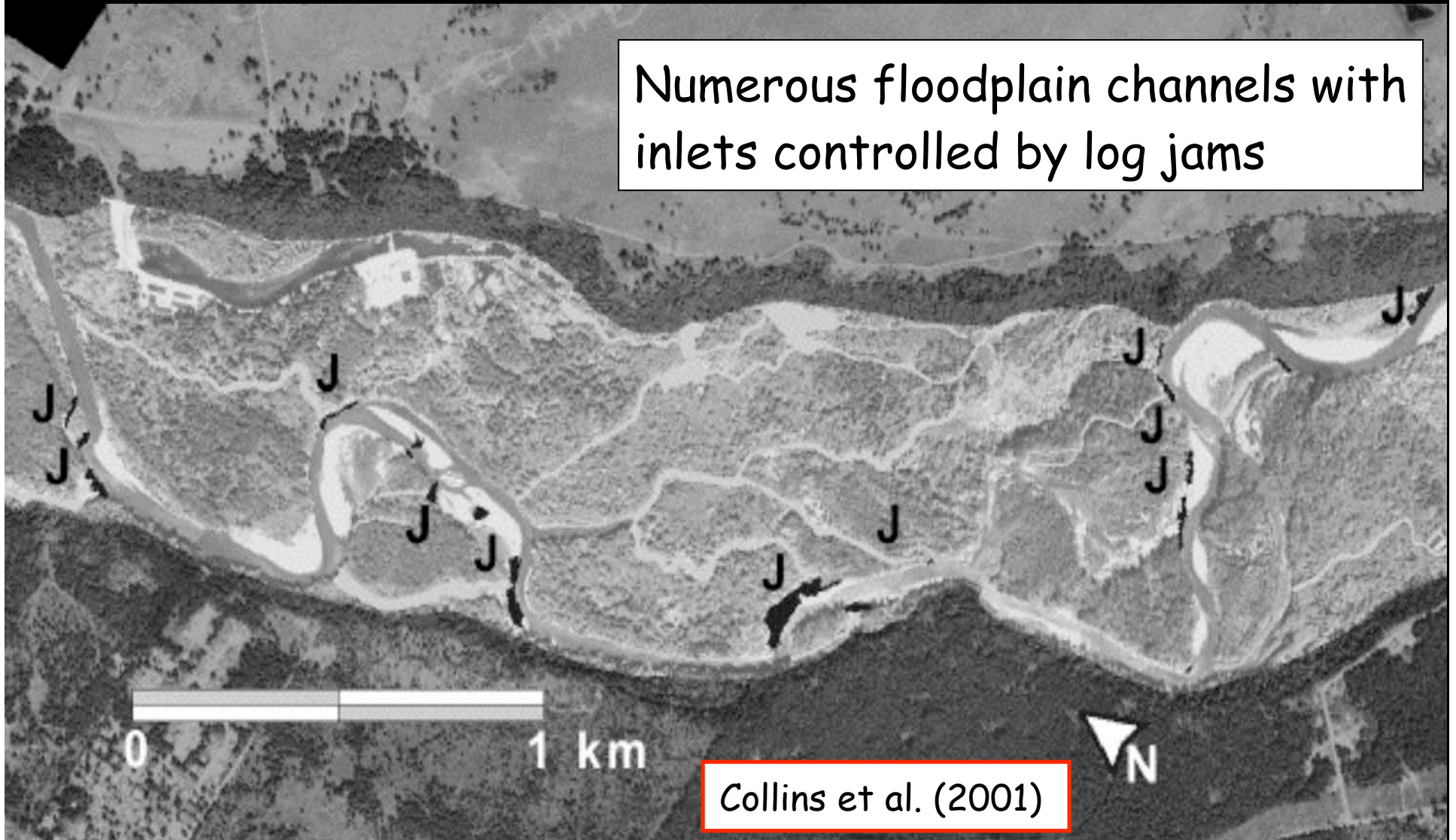
Mapp & Co., New York, N.Y.

Price 15 Cents
20 cents in Canada



Nisqually River Floodplain

Numerous floodplain channels with inlets controlled by log jams



Collins et al. (2001)

Big Trees Influenced Big Rivers



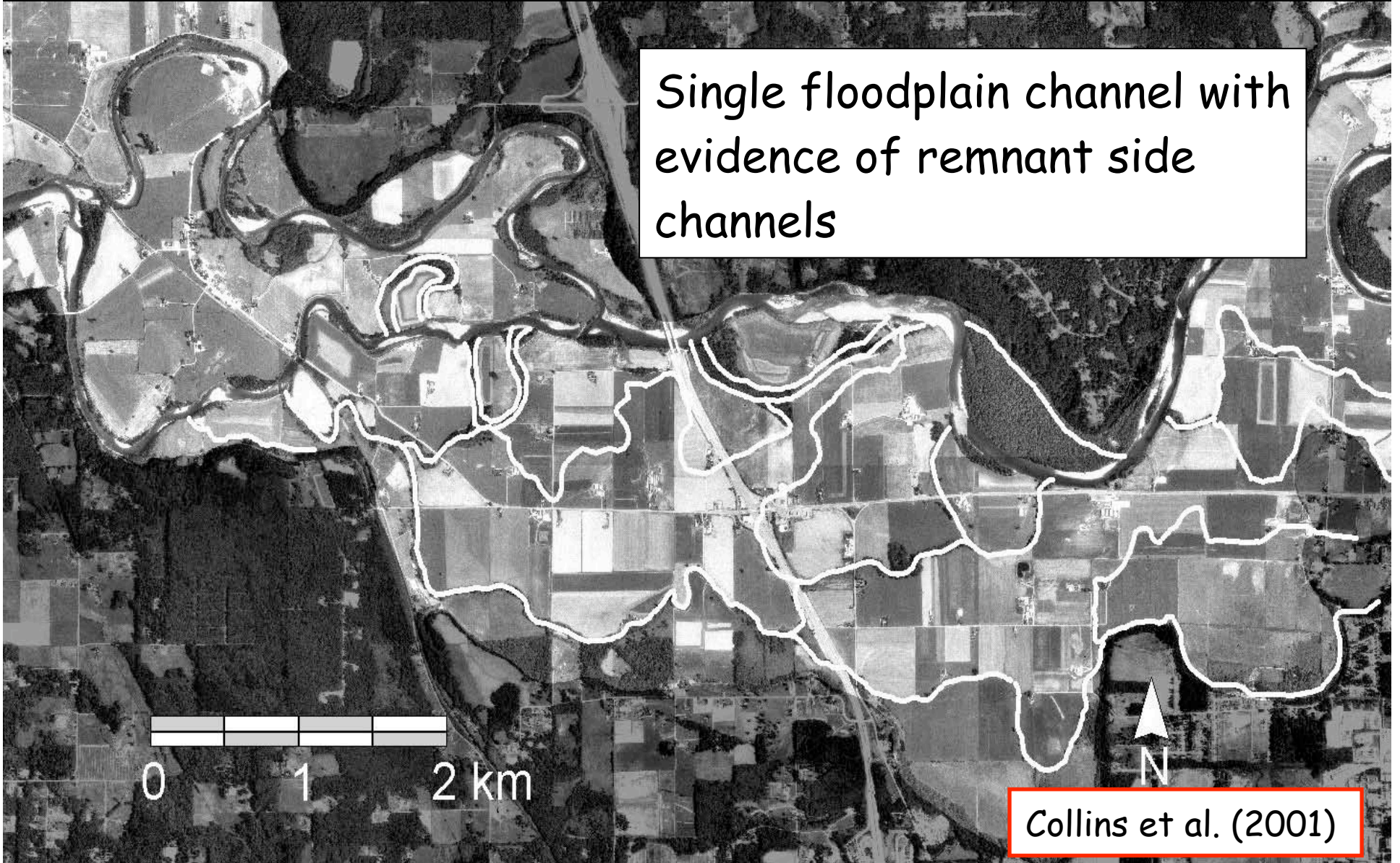
Stillaguamish River, Washington

Single floodplain channel with evidence of remnant side channels

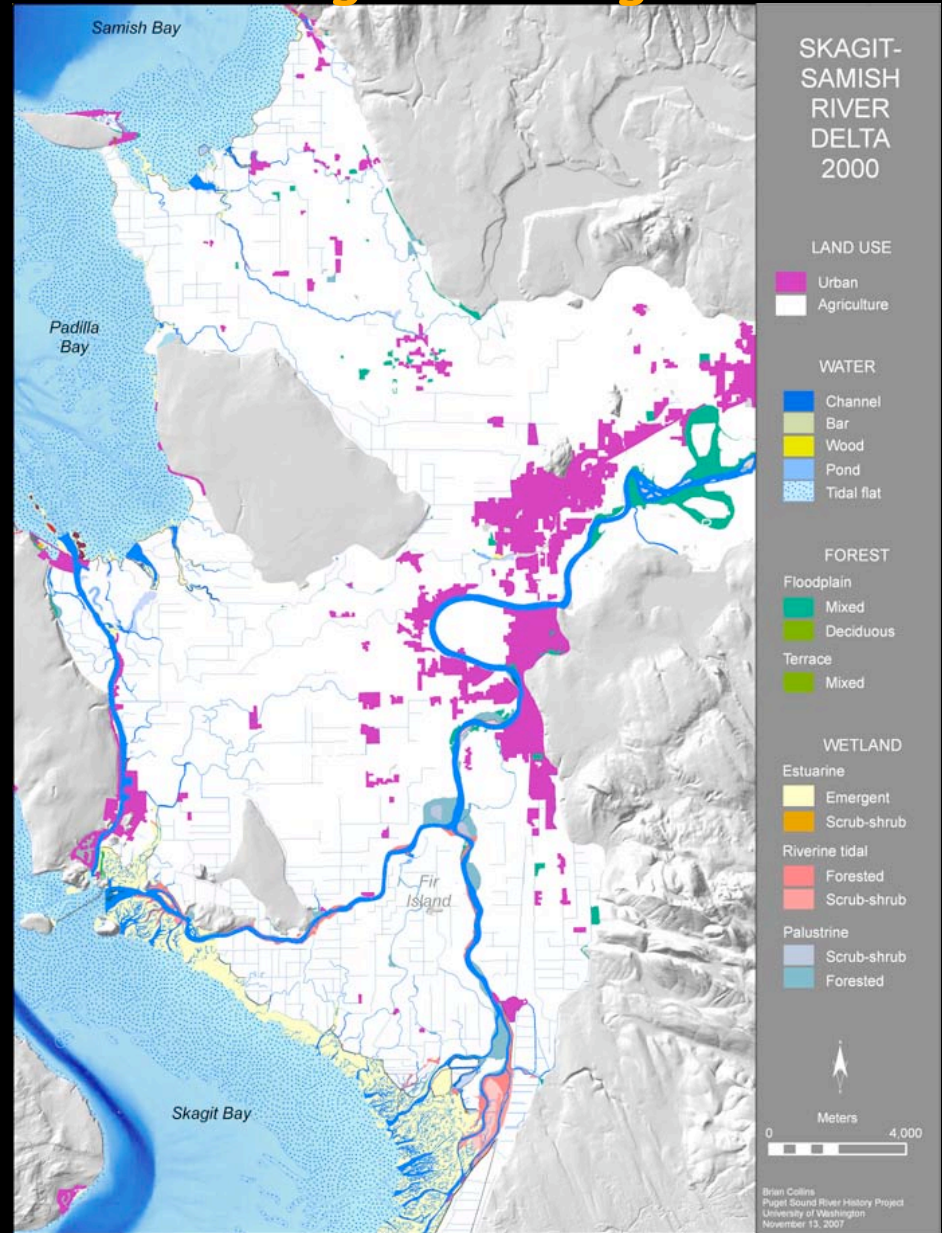
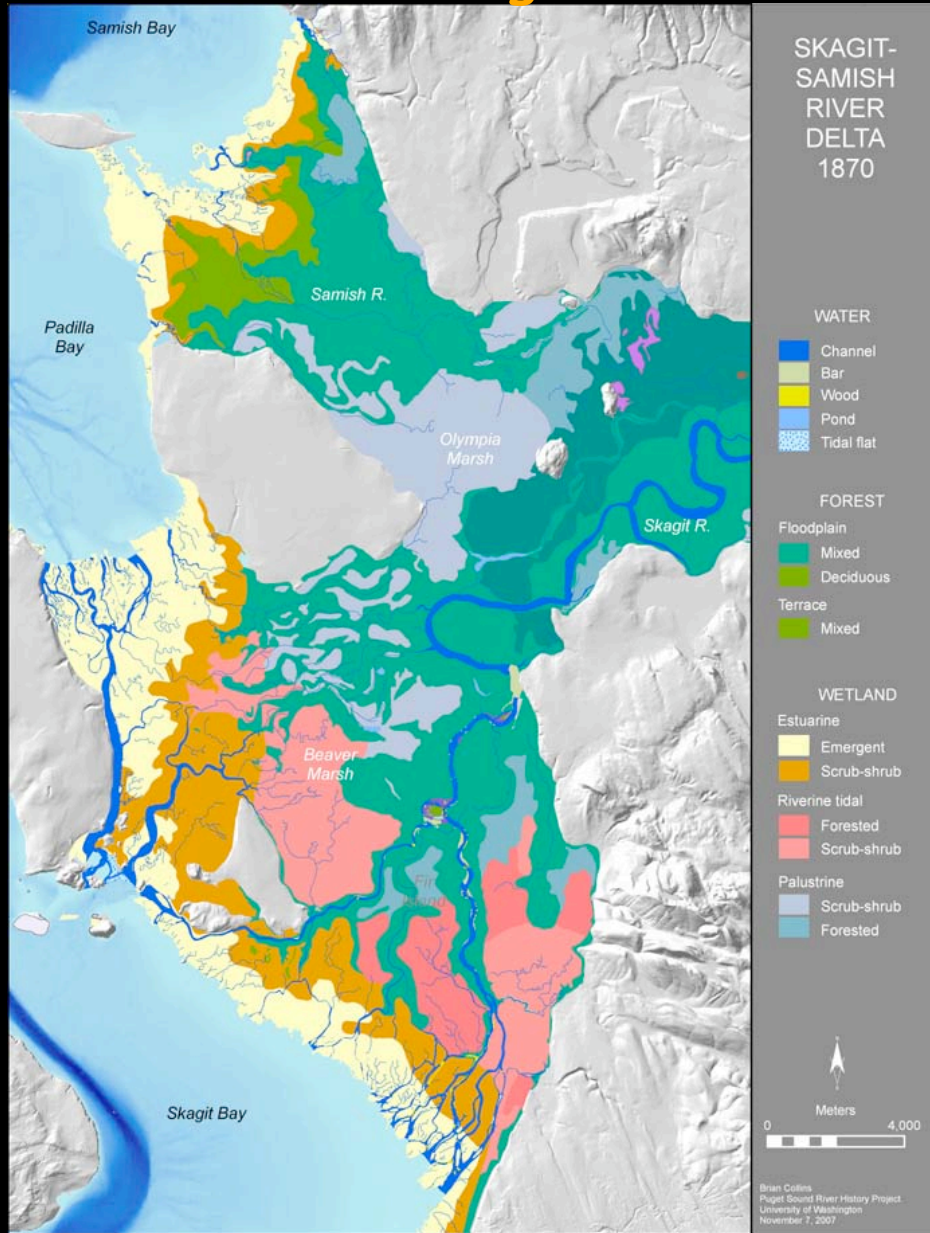
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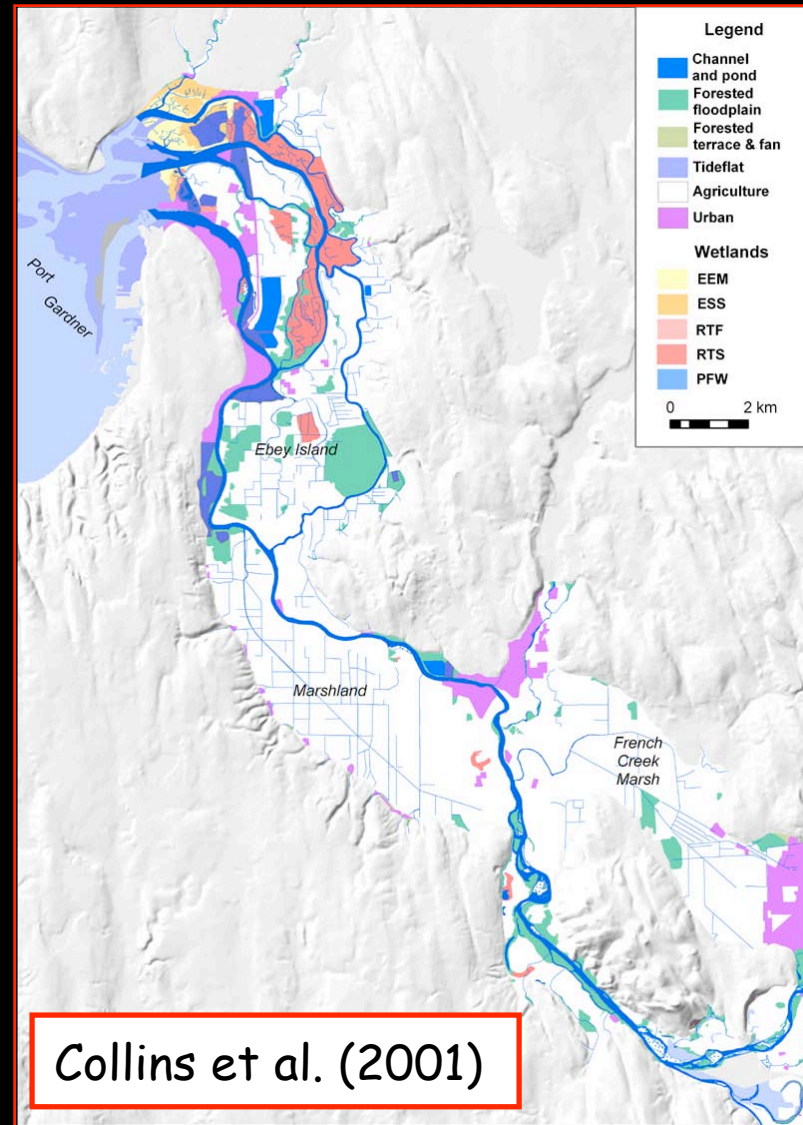
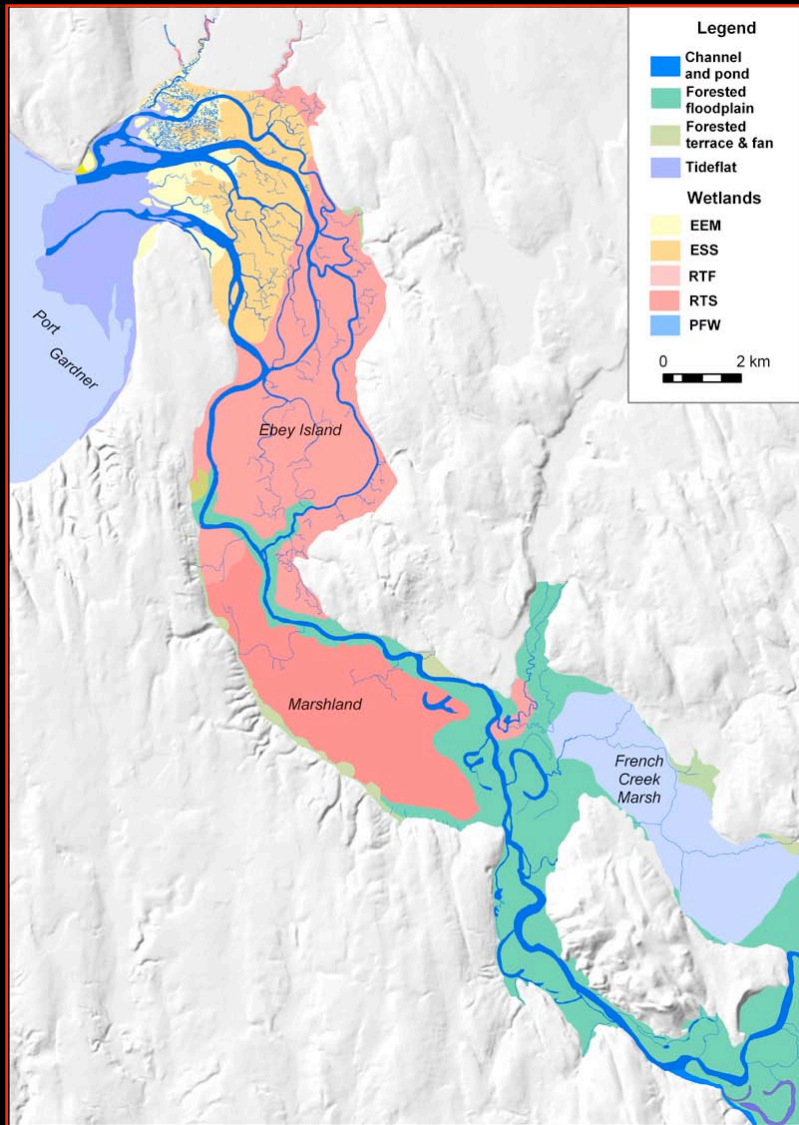
Collins et al. (2001)



Historical changes in salmon habitat along the Skagit River



Huge losses of side channels and valley bottom wetlands along most major Puget Sound rivers, yet the story for each river is unique.



Estimating historical aquatic habitat in wetlands: Historical wetland habitats, Skagit River estuary

Seasonal water depths from GLO field notes help describe historical wetland habitat

23.57 A rough guess was made
4:00 Put a post for Quarter Sea Cr. down a chain stake
and built a mound according to instructions ✓
4:5:00 A rough mound here. Put a flag across a corner
from the point of intersection with the right bank, one each
100 yds to a point from which the flag bears
S 27 W, making the dist 176 the across to

Descriptions of wetlands in
Skagit Flats:

from the point of intersection with the left bank, one each 100 yds
to a point from which the flag bears S 1-32° E, which gives the distance across
to the point where the flag bears S 27 W

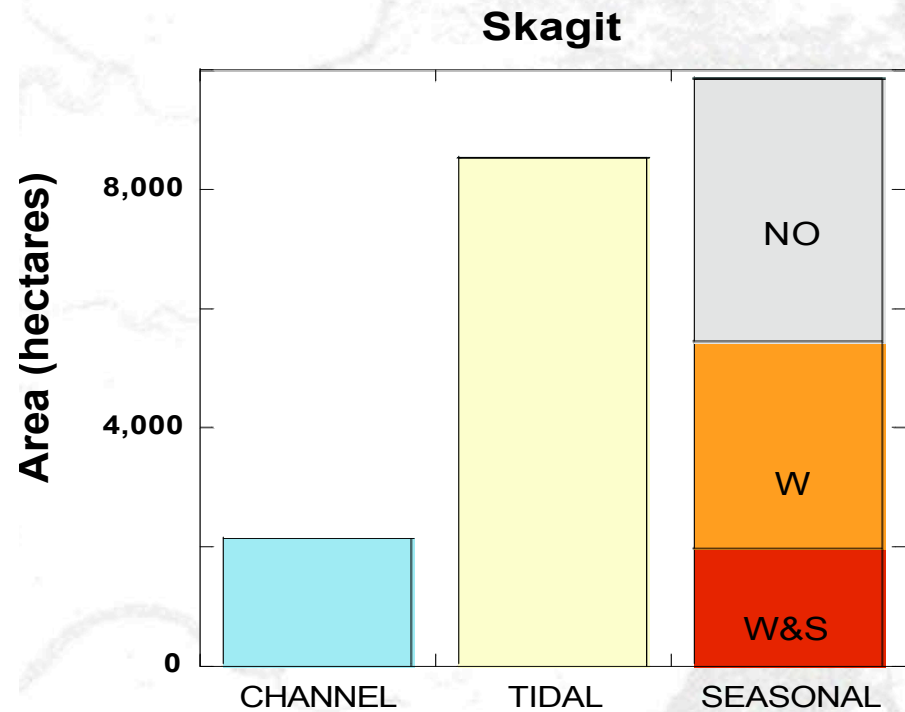
“The water was 2 _ feet deep and appeared to be deeper farther northward, we therefore consider it unfit for cultivation and impracticable to now survey it” --November 2, 1866

11:57 from the point of intersection with the left bank, one each 100 yds
to a point from which the flag bears S 68 W, making the distance across
to the right bank of the slough

27:35 A rough mound here. Put a flag across a corner from the point of intersection with the left bank, one each 100 yds
to a point from which the flag bears S 68 W, making the distance across
to the right bank of the slough

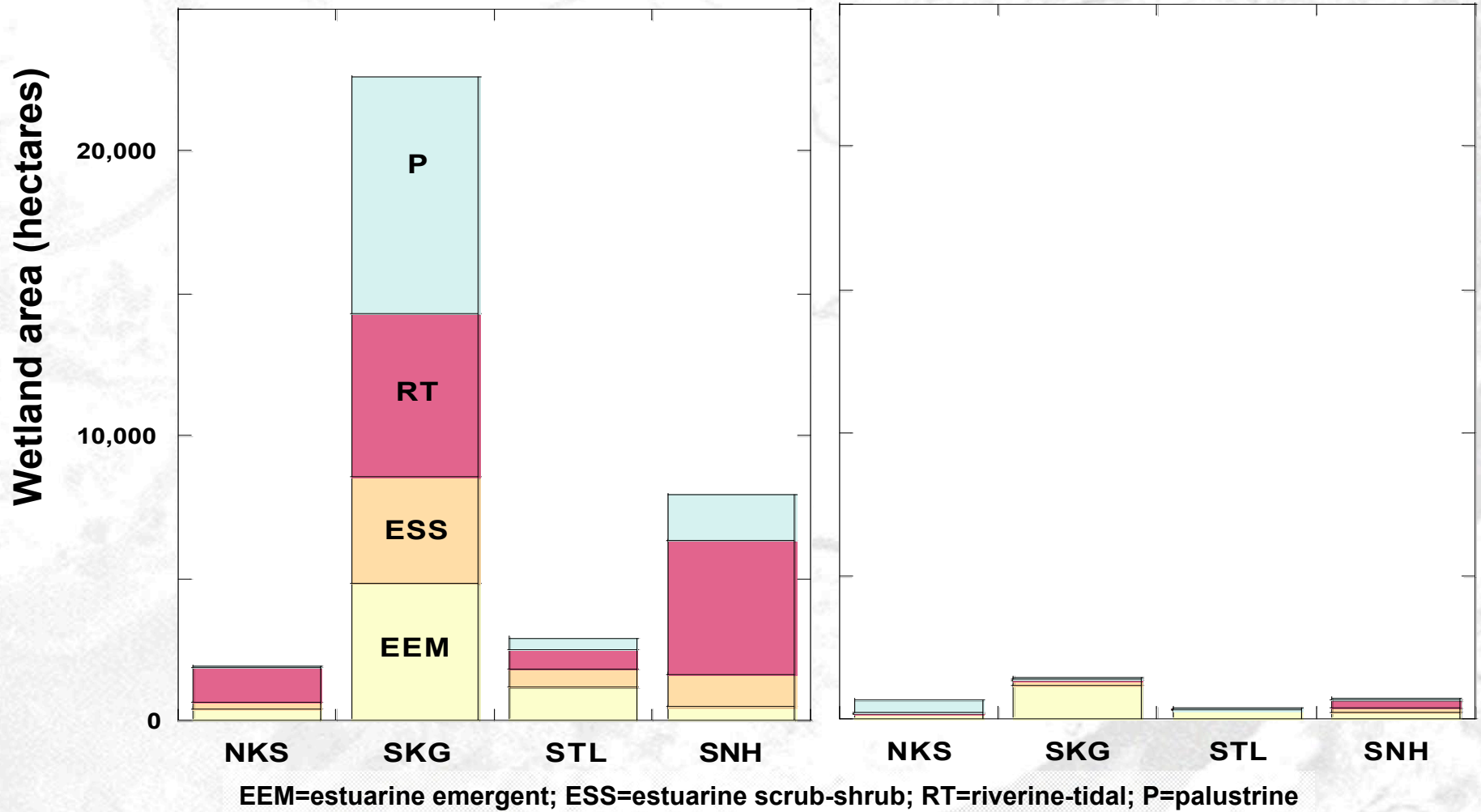
“Through marsh Covered with Hard Hack Willow and scattering firs. Standing water from 6 in to two feet deep” --August 30, 1872

4:0:50 Put a post for Quarter Sea Cr. down a chain stake and built a mound according to instructions
4:10:10 The corner stake here S 6. 7 1/2 E.
From this point, go 100 yds. Put up the monument by sides here or there if it deep.



Seasonal inundation (> 1 ft for most of season):
W: winter W&S: winter & summer

Change to wetland area in four North Sound estuaries/deltas



Provide some refuge for the salmon, and provide it quickly, before complications arise which may make it impracticable, or at least very difficult. ... If we procrastinate and put off our rescuing mission too long, it may be too late to do any good. After the rivers are ruined and the salmon gone they cannot be reclaimed ... all the power of the United States cannot restore salmon to the rivers after the work of destruction has been completed.

— Livingston Stone (1892)

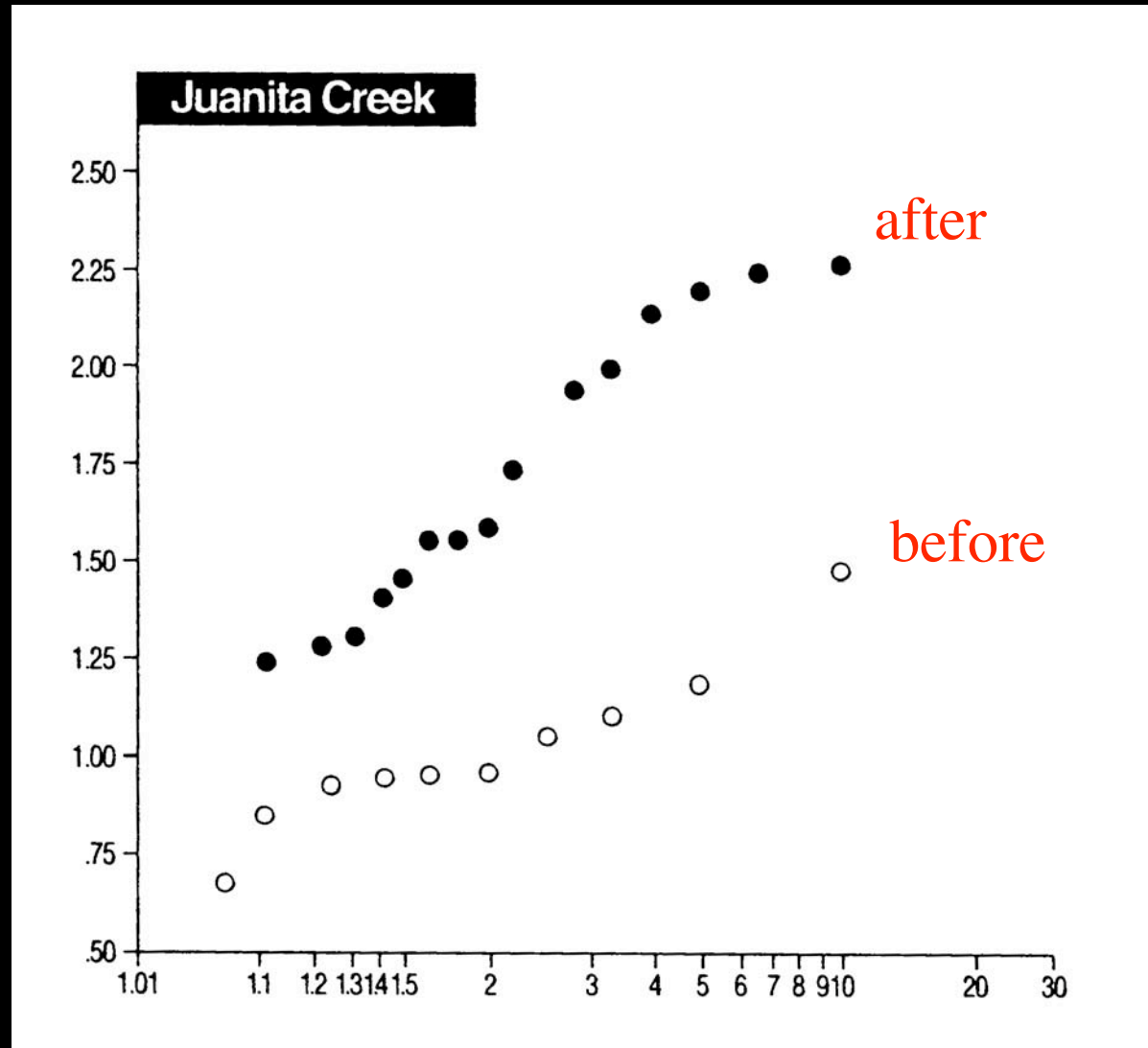
One of the few strategies that might work over the long run would be to create a network of Salmon Sanctuaries by restoring forested river corridors along river floodplains.



Urbanization changes the way that water moves across and off the land, resulting in increased high flows, and often turning the pre-urbanization 10 year flood into a post-urbanization annual flood.



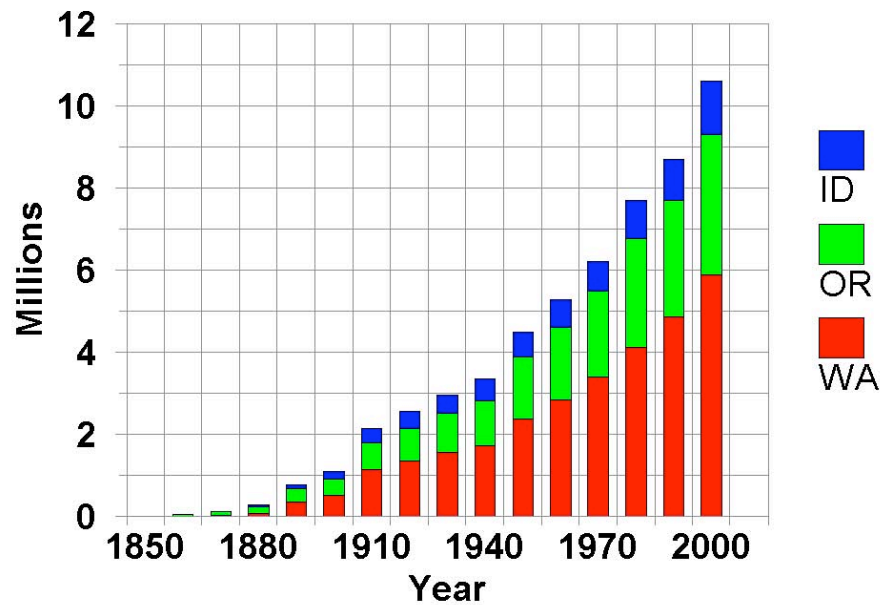
Discharge
(cfs)



Recurrence interval

Moscip and Montgomery, JAWRA, 1997

WA, OR, ID Population, 1850-2000



Puget Sound Partnership recommendations essentially ignore the adverse impacts likely to occur due to future development.



The Seattle Times / Harley Soltes via AP

On October 26, 2006, fourteen "so-called" experts sent a letter to the Puget Sound Partnership expressing concern over failure to adequately address management of stormwater runoff from future development.

Doug Beyerlein
Susan Bolton
Derek Booth
Tom Holz
Thom Hooper
Richard Horner
James Karr
DeeAnne Kirkpatrick
John Lombard
Chris May
Gary Minton
David Montgomery
David Somers
Cleve Steward

"The strategies listed are not likely to be sufficient to achieve ecosystem goals..."

Puget Sound Partnership, Page 43,
Appendix A, report of scientific
working group.

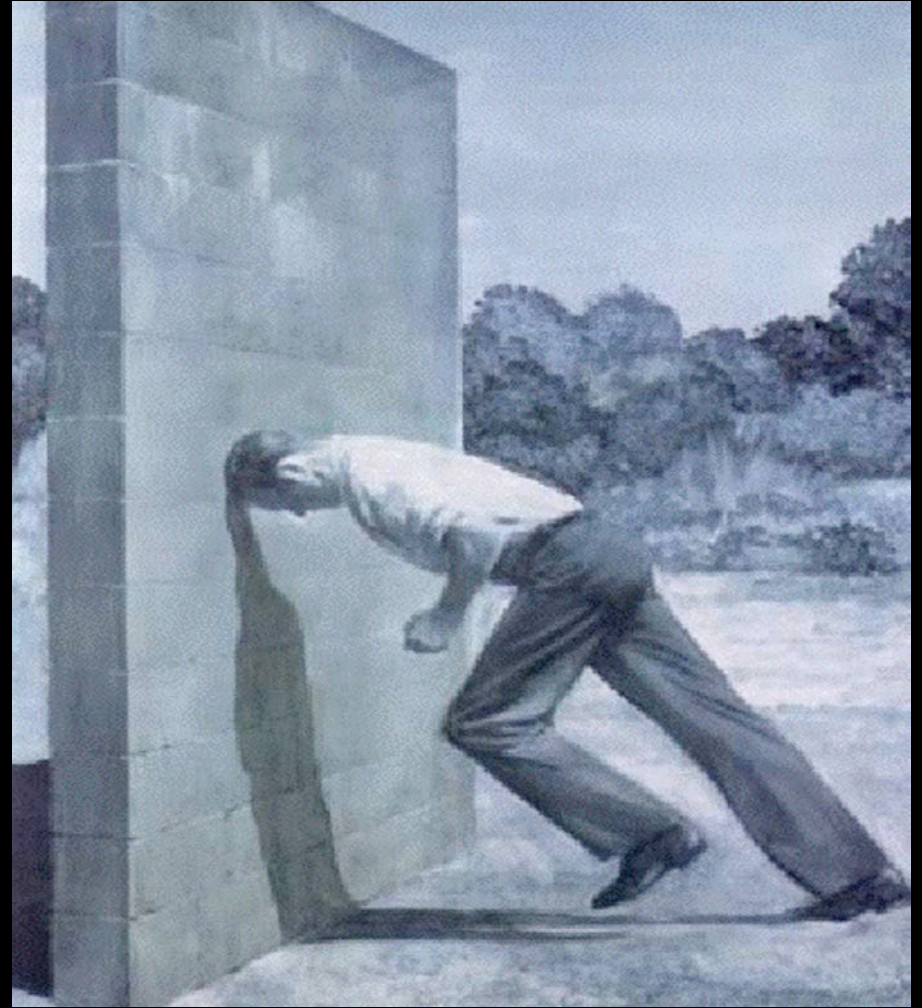


NPDES permits only require adherence to the state stormwater manual, which itself states:

"Land development as practiced today is incompatible with the achievement of sustainable ecosystems."



When a key industry group threatened to pull out of the Partnership, the effort to re-examine stormwater runoff recommendations apparently was abandoned, despite the acknowledged failure to adequately address impacts from



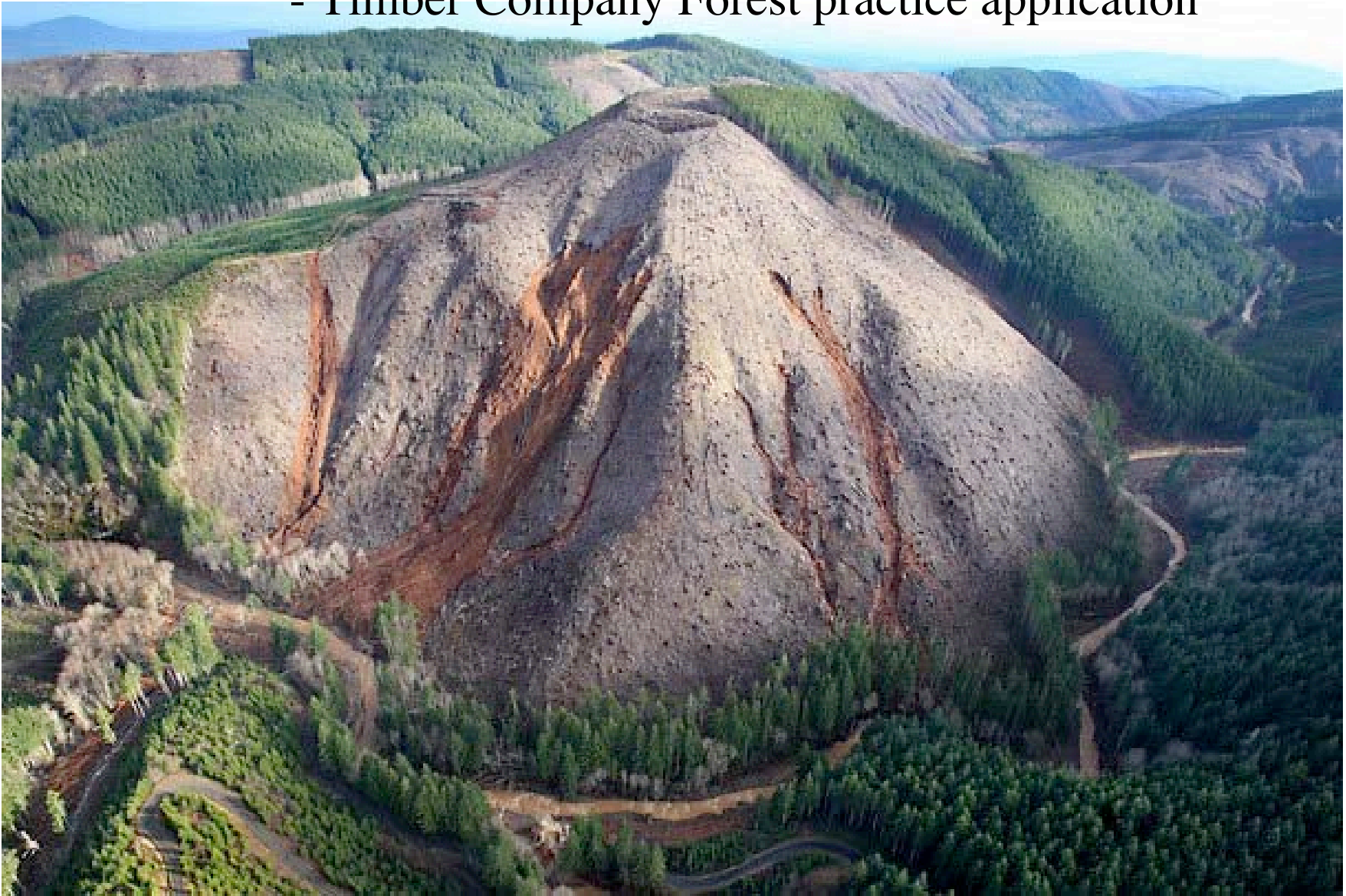
“Forest practices had no effect on landsliding”
- WA State DNR



Stillman Creek, Washington

Photo: Seattle Times

Site was inspected and found to have “no potentially unstable slopes.”
- Timber Company Forest practice application



Stillman Creek, Washington

Photo: Seattle Times

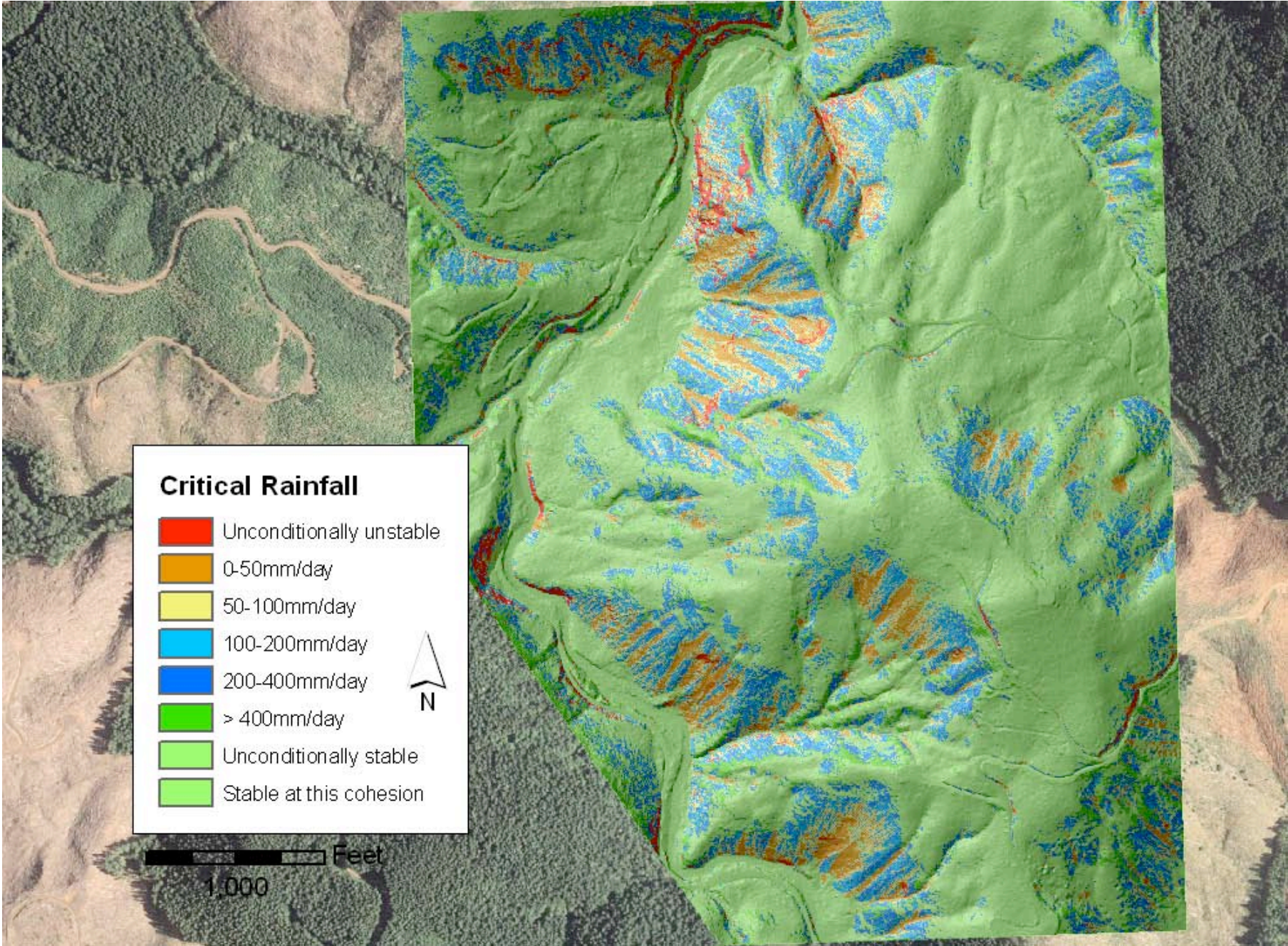
“Who could have predicted it?”

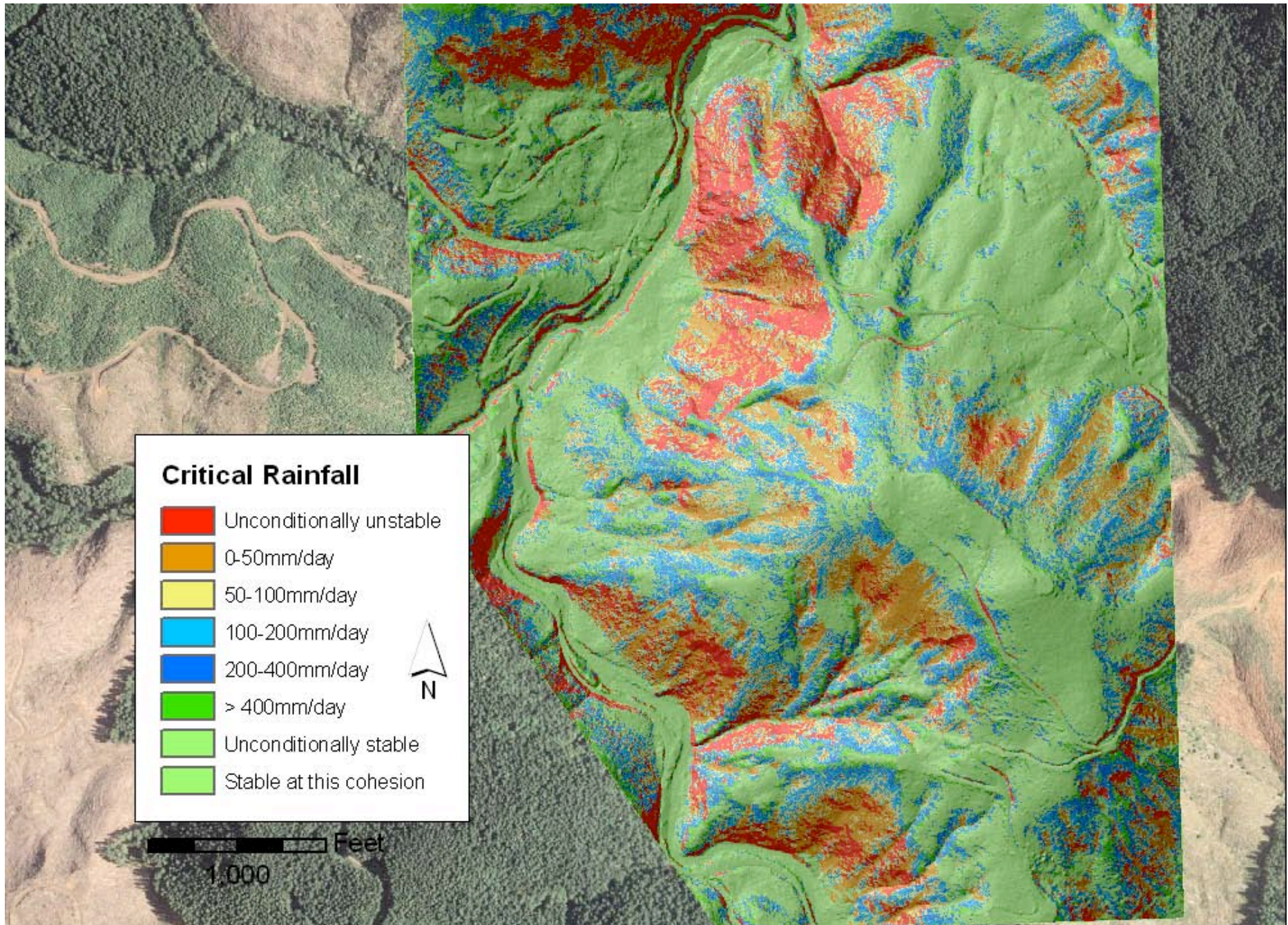
- WA State DNR



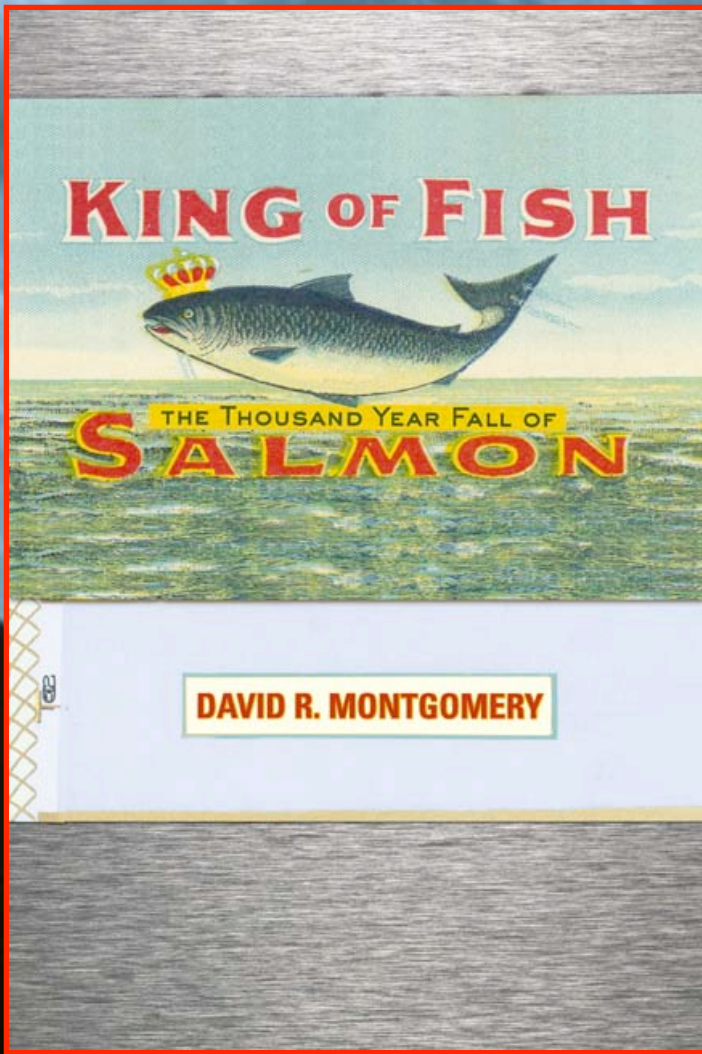
Stillman Creek, Washington

Photo: Seattle Times





History



Process

