



Smokey the Beaver: Beaver Wetlands as Fire-Resistant Natural Infrastructure

Emily Fairfax

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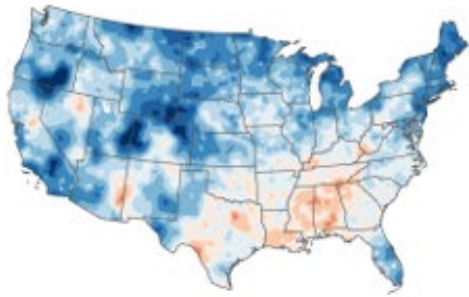


Climate is changing, and our “normal” isn’t what it used to be.

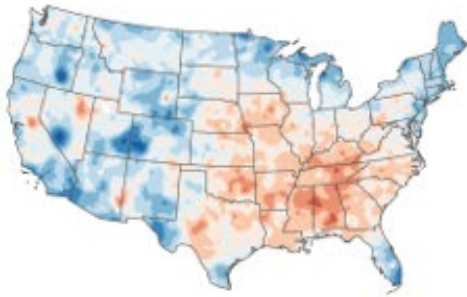
We're feeling the impacts of climate change today, with more on the horizon.

U.S. ANNUAL TEMPERATURE COMPARED TO 20th-CENTURY AVERAGE

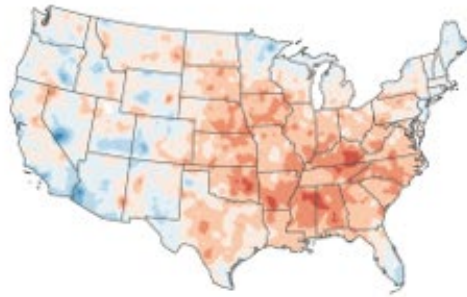
1901-1930



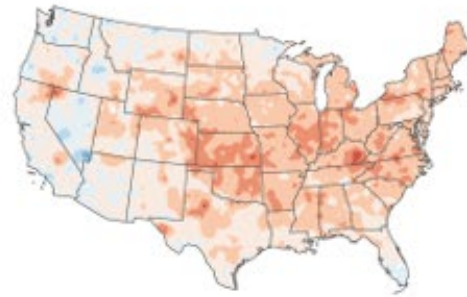
1911-1940



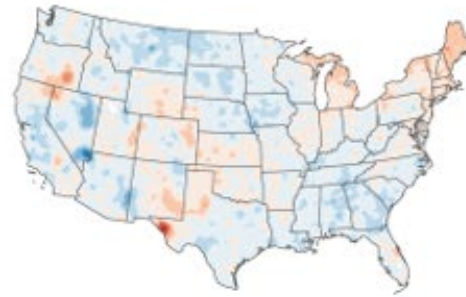
1921-1950



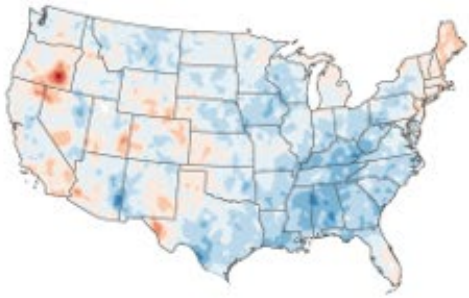
1931-1960



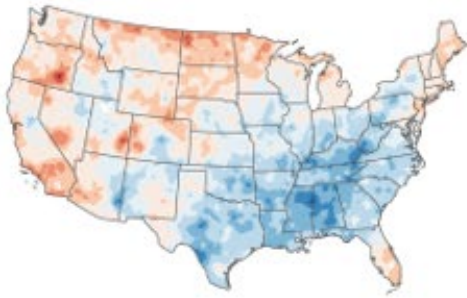
1941-1970



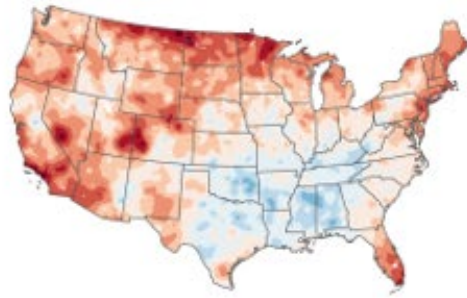
1951-1980



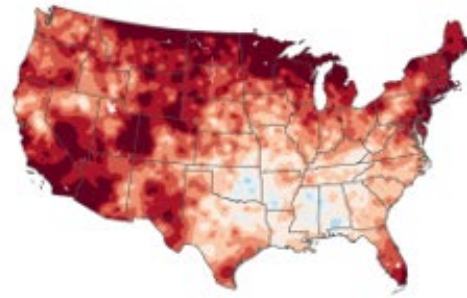
1961-1990



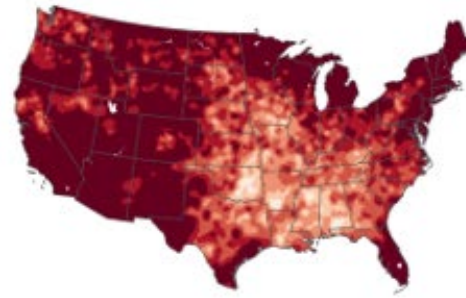
1971-2000



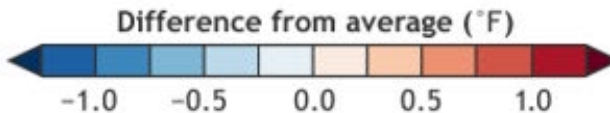
1981-2010



1991-2020



30-yr running average
correlation to 1901-20



NOAA Climate.gov
Data: NCEI

We need to build more climate resilient landscapes.





So how about nature's engineers?





Beavers and Wildfire?



Photo and Drawing by Emily Fairfax (Sept 2021)

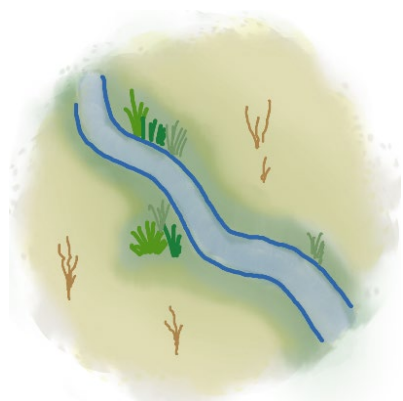


Photo and Drawing by Emily Fairfax (Sept 2021)

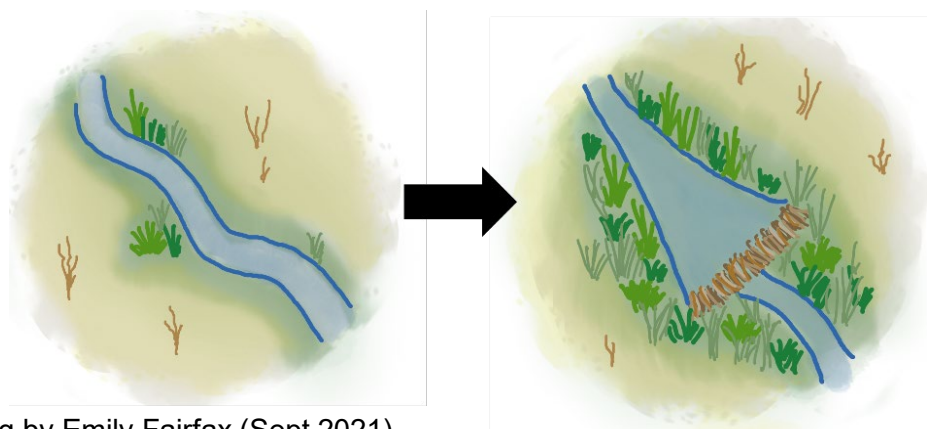


Photo and Drawing by Emily Fairfax (Sept 2021)

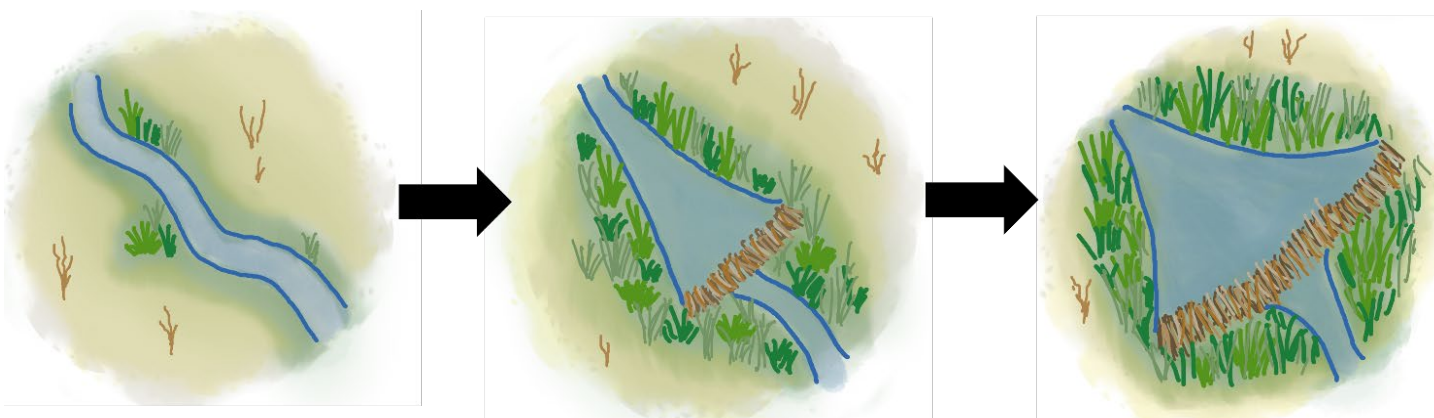


Photo and Drawing by Emily Fairfax (Sept 2021)

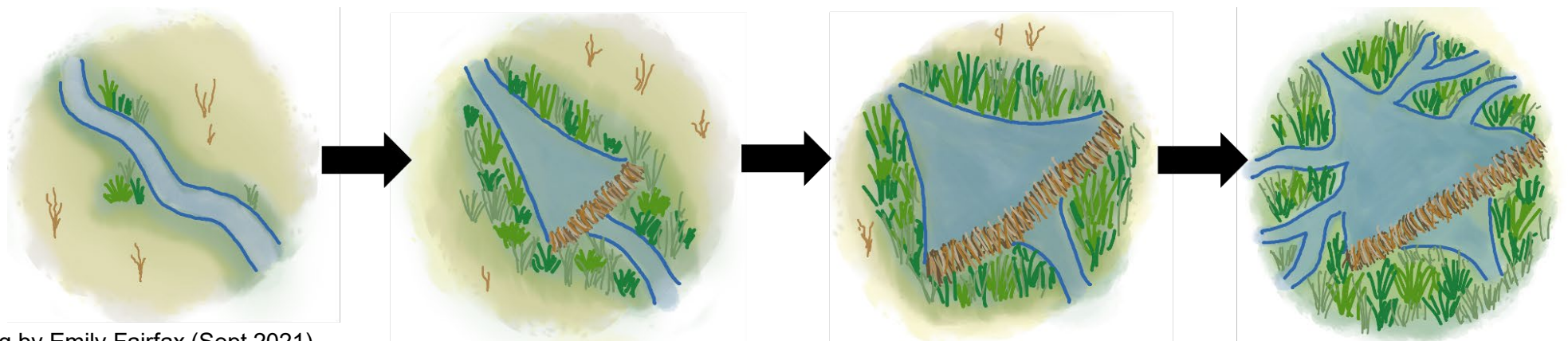


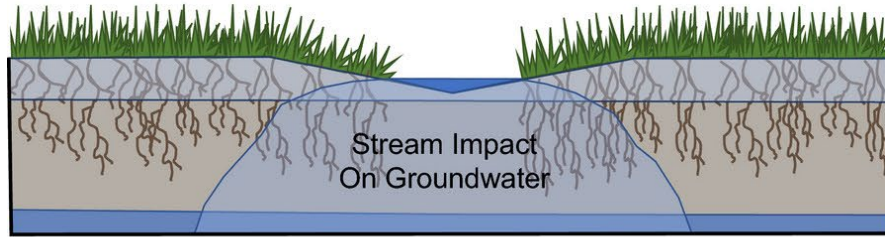
Photo and Drawing by Emily Fairfax (Sept 2021)



State of the Science

Beaver ponds provide reliable, consistent habitat.

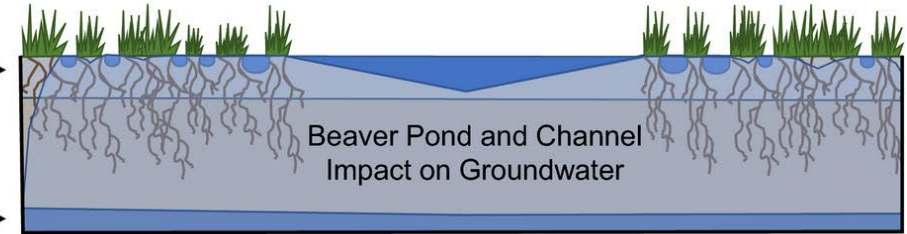
Stream without Beavers



← Infiltrating Precipitation →

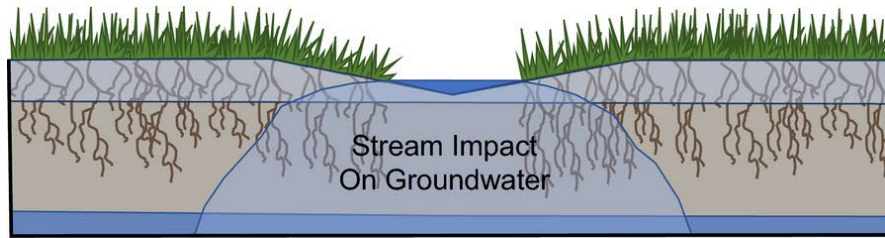
← Deep Water Table →

Stream with Beavers



Beaver ponds provide reliable, consistent habitat.

Stream without Beavers

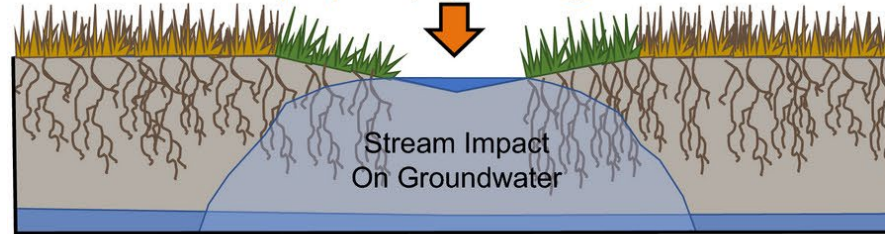


← Infiltrating Precipitation →

← Deep Water Table →

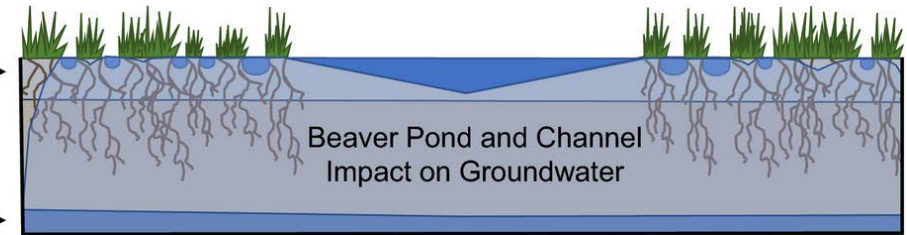
Drought Conditions

less precipitation, veg relies on groundwater



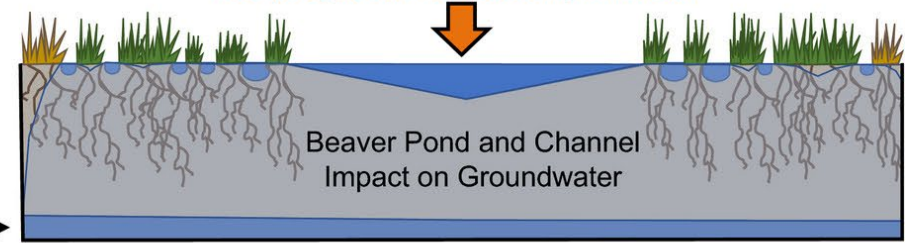
← Deep Water Table →

Stream with Beavers



Drought Conditions

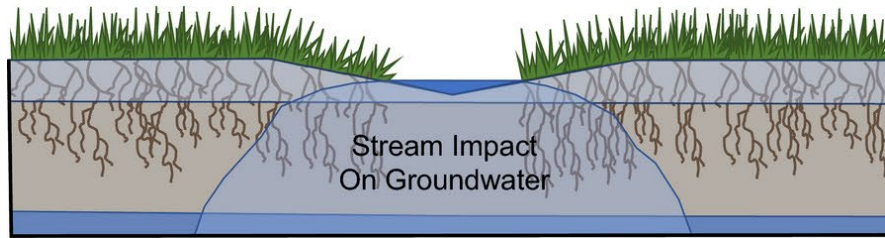
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Stream without Beavers

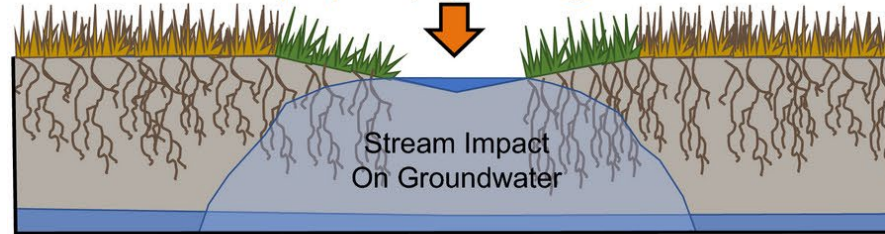


Infiltrating
Precipitation

Deep
Water Table

Drought Conditions

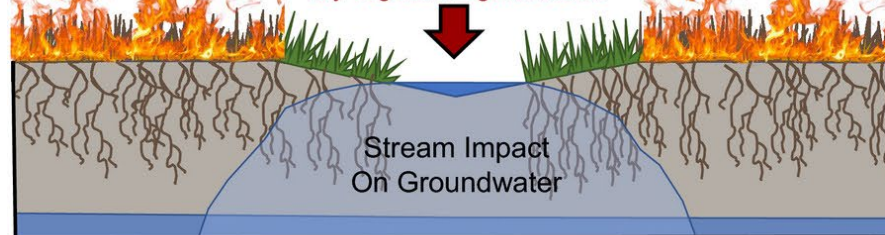
less precipitation, veg relies on groundwater



Deep
Water Table

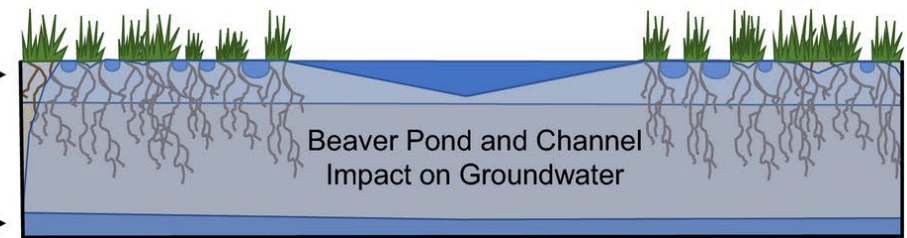
Fire Conditions

dry vegetation ignites/burns



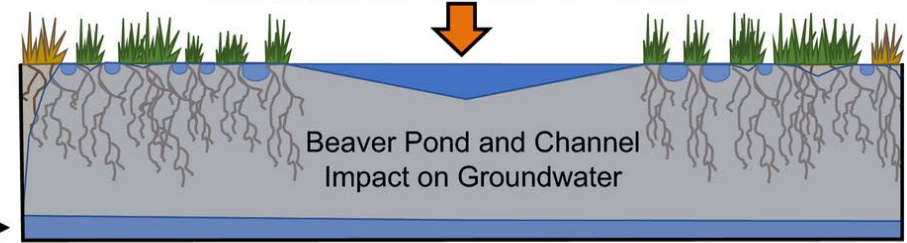
Deep
Water Table

Stream with Beavers



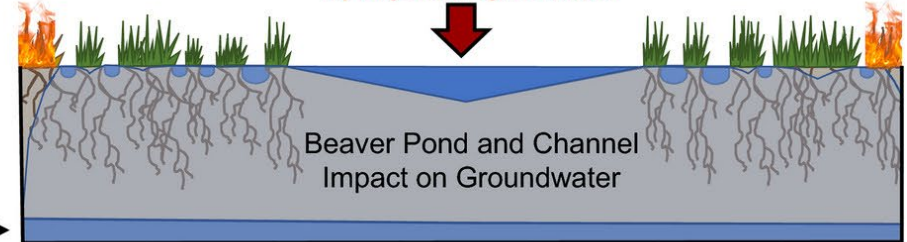
Drought Conditions

less precipitation, veg relies on groundwater



Fire Conditions

dry vegetation ignites/burns



Deep
Water Table

Water doesn't burn. Beaver complexes are wet.

Without Beavers



With Beavers



Photos by **Dr. Joe Wheaton (Utah State University)** of the 2018 Sharps Fire in Idaho. Licensed under [CC-BY-4.0](https://creativecommons.org/licenses/by/4.0/)

Water doesn't burn. Beaver complexes are wet.

Without Beavers



With Beavers



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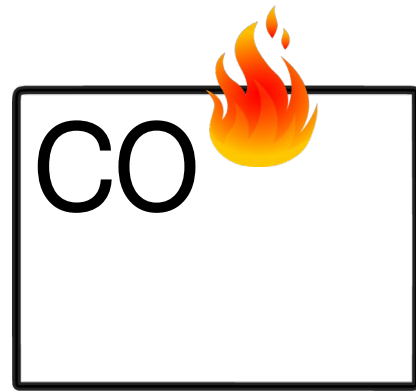
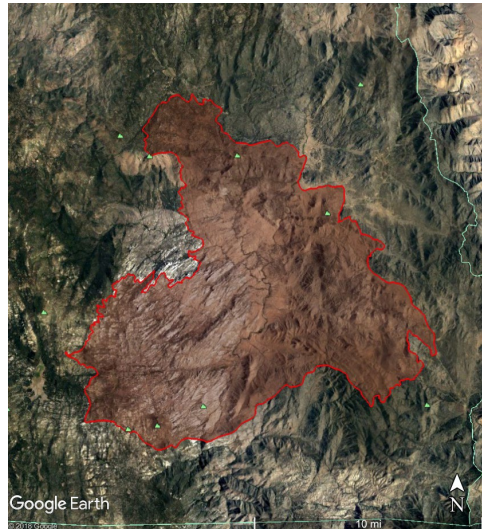


Photo by Charlie Erdman of the 2021 Bootleg Fire in Oregon.

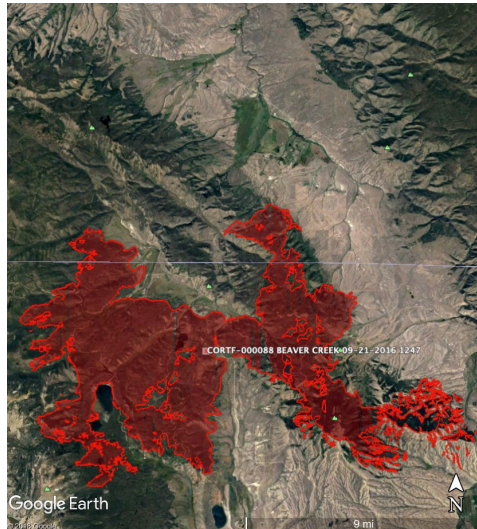
Does it happen everywhere? Or was it an anomaly?



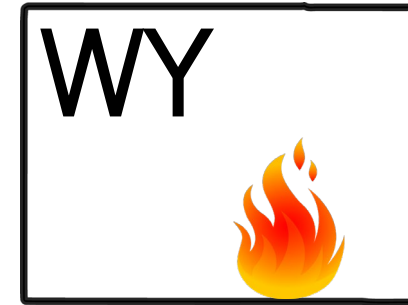
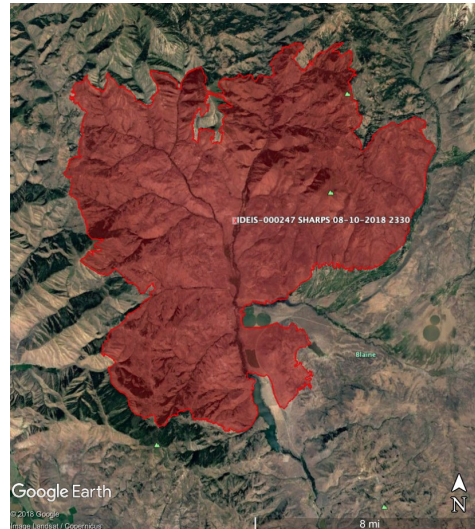
79,000 acres



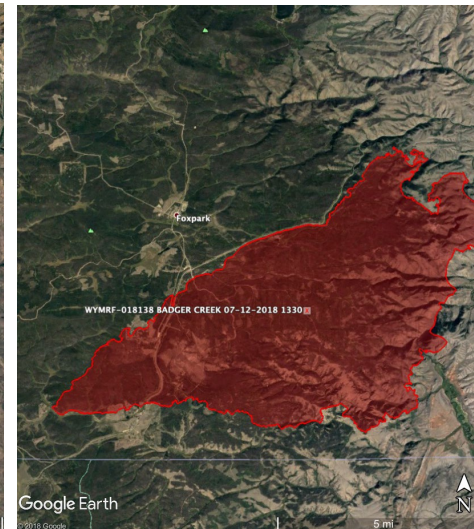
38,000 acres



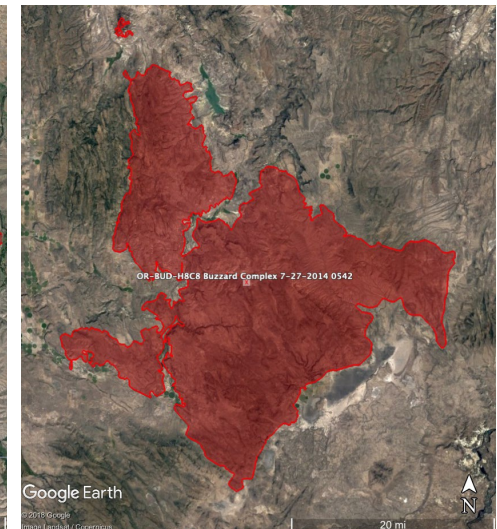
65,000 acres



21,000 acres



395,000 acres



Consistently. Repeatedly. Reliably.

Smokey the Beaver: beaver-dammed riparian corridors stay green during wildfire throughout the western United States


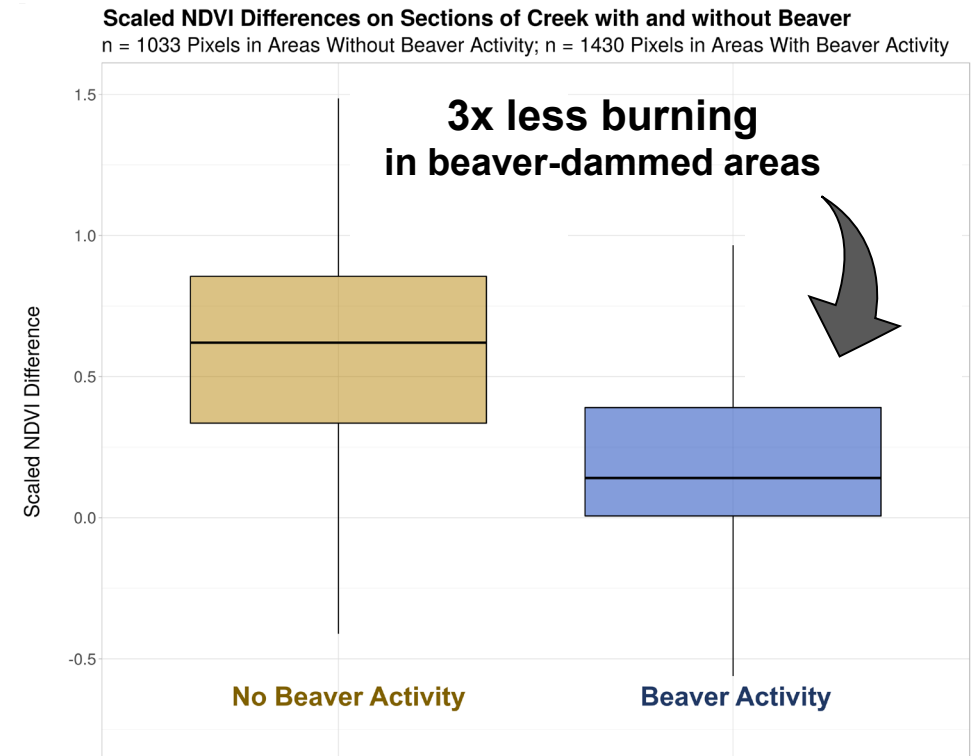
EMILY FAIRFAX ^{1,3} AND ANDREW WHITTLE²



Photo by Manter Fire BAER Team (2000)





What makes megafires different?

Megafire: a fire with a burn area larger than 100,000 acres

Many megafires exhibit extreme, often self-sustaining fire behaviors such as:

- **Creating Pyrocumulus Clouds** (ember and ash spewing clouds)
- **Creating Pyrocumulonimbus Clouds** (the “fire-breathing dragons of clouds”)
- **Explosive Spread Rates** (e.g. ~100,000 acres in < 24hrs)
- **Larger Moderate-Severe Burn Areas** (faster-growing fires tend to be more destructive)

Megafires moved into the Rocky Mountains in 2020

Mullen Fire

Sept 17, 2020 – Oct 28, 2020

176,878 acres

926 satellite-visible beaver dams

Cameron Peak Fire

Aug 13, 2020 – Dec 2, 2020

208,913 acres

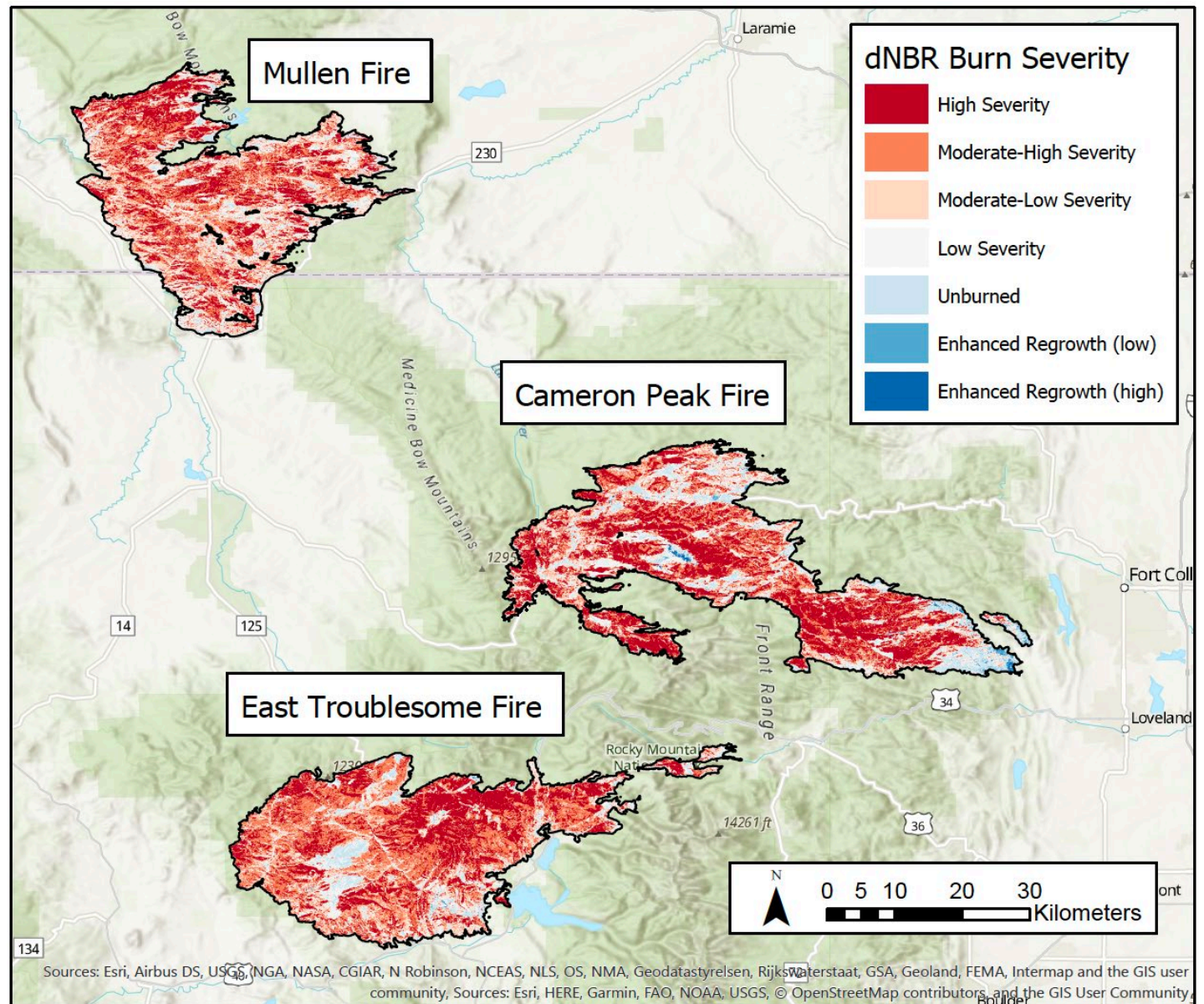
99 satellite-visible beaver dams

East Troublesome Fire

Oct 14, 2020 – Nov 30, 2020

193,812 acres

512 satellite-visible beaver dams



The difference in burn severity was significant

Non-River Areas

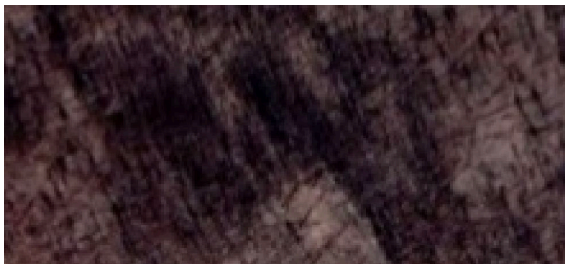
41% High Severity

19% Moderate Severity

19% Low Severity

21% Unburned

60% / 40%



River Without Beavers

23% High Severity

18% Moderate Severity

27% Low Severity

32% Unburned

40% / 60%



Beaver-Dammed Areas

3% High Severity

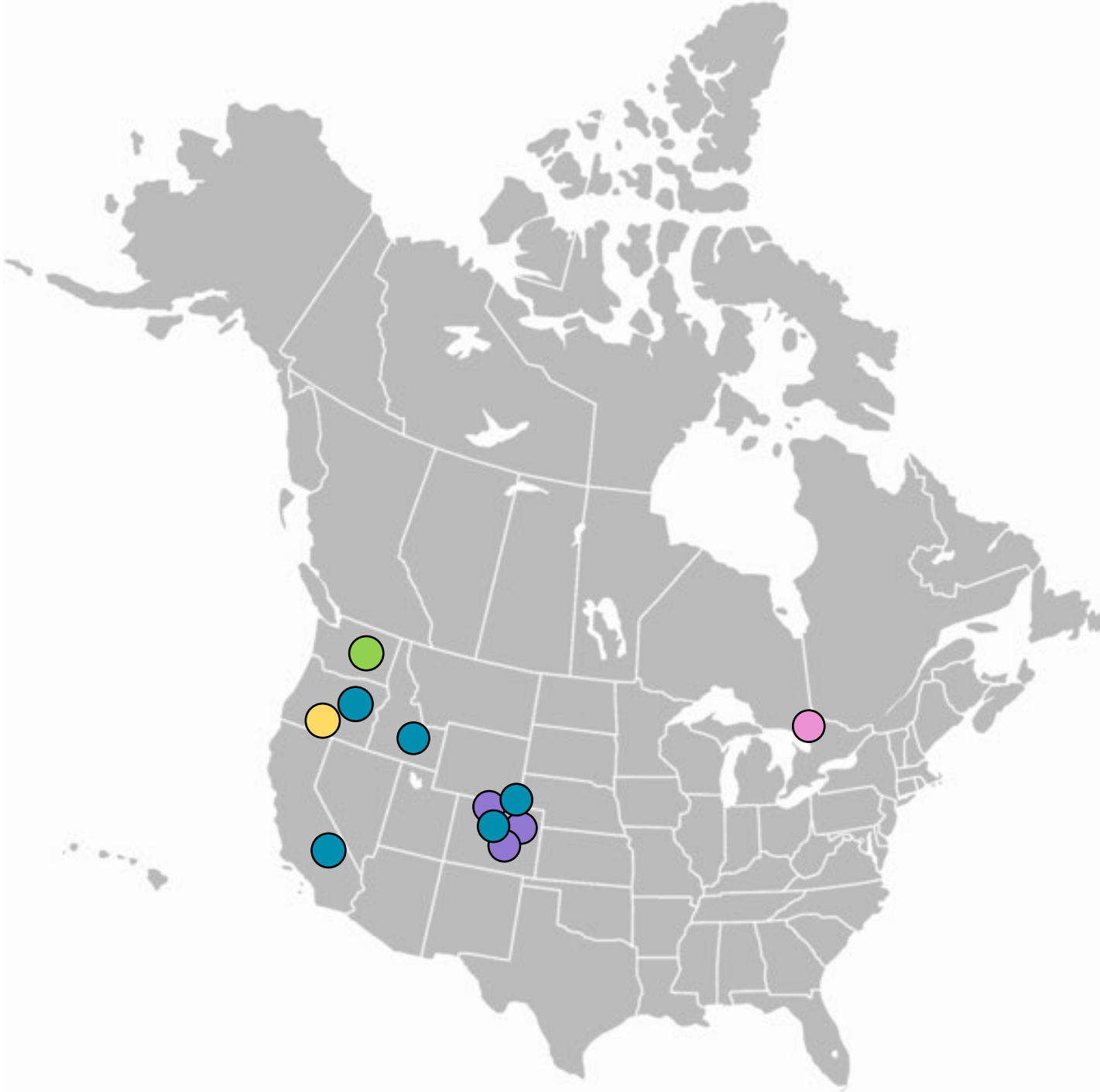
8% Moderate Severity

32% Low Severity

57% Unburned

11% / 89%





-  **Fairfax & Whittle** (2020). Smokey the Beaver: beaver dammed riparian corridors stay green during wildfire throughout the western US.
-  **Fairfax et al** (*in press*). Impacts of beaver dams on riverscape burn severity during megafires in the Rocky Mountain region, western United States.
-  **Markle et al** (2022). Wetland Successional State Affects Fire Severity in a Boreal Shield Landscape.
-  **Whipple** (2019). Riparian Resilience in the Face of Interacting Disturbances.
and
Weirich (2021). Beaver moderated fire resistance in the North Cascades and potential for climate change adaptation.
-  **Trout Unlimited**. Photographs and personal account from field crew.



**Cutting Trees,
Establishing Wetlands**

**Water Storage: Ponding and
Water Table Elevation**



Fairfax & Whittle (2020). Smokey the Beaver: beaver dammed riparian corridors stay green during wildfire throughout the western US.



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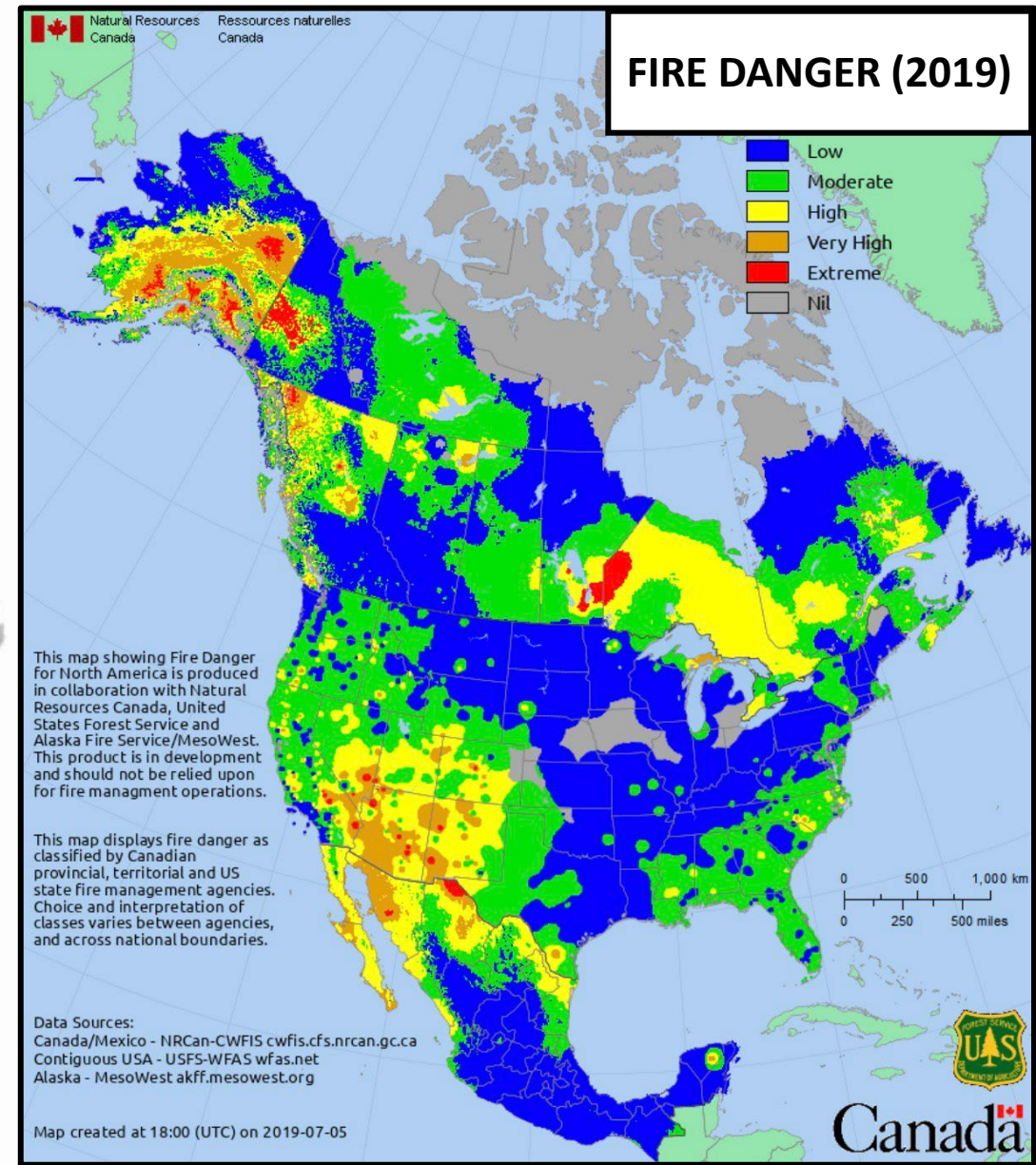
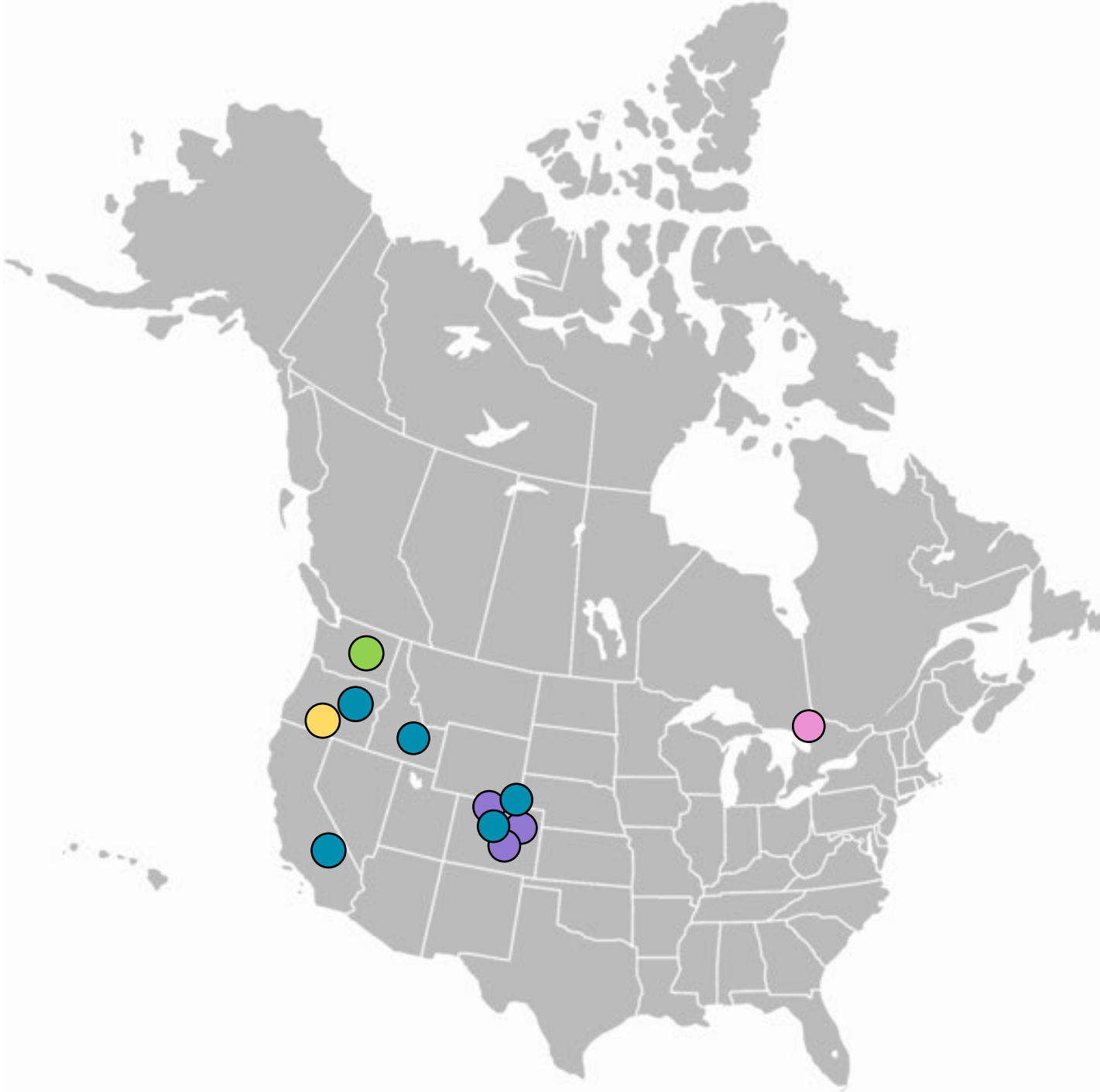


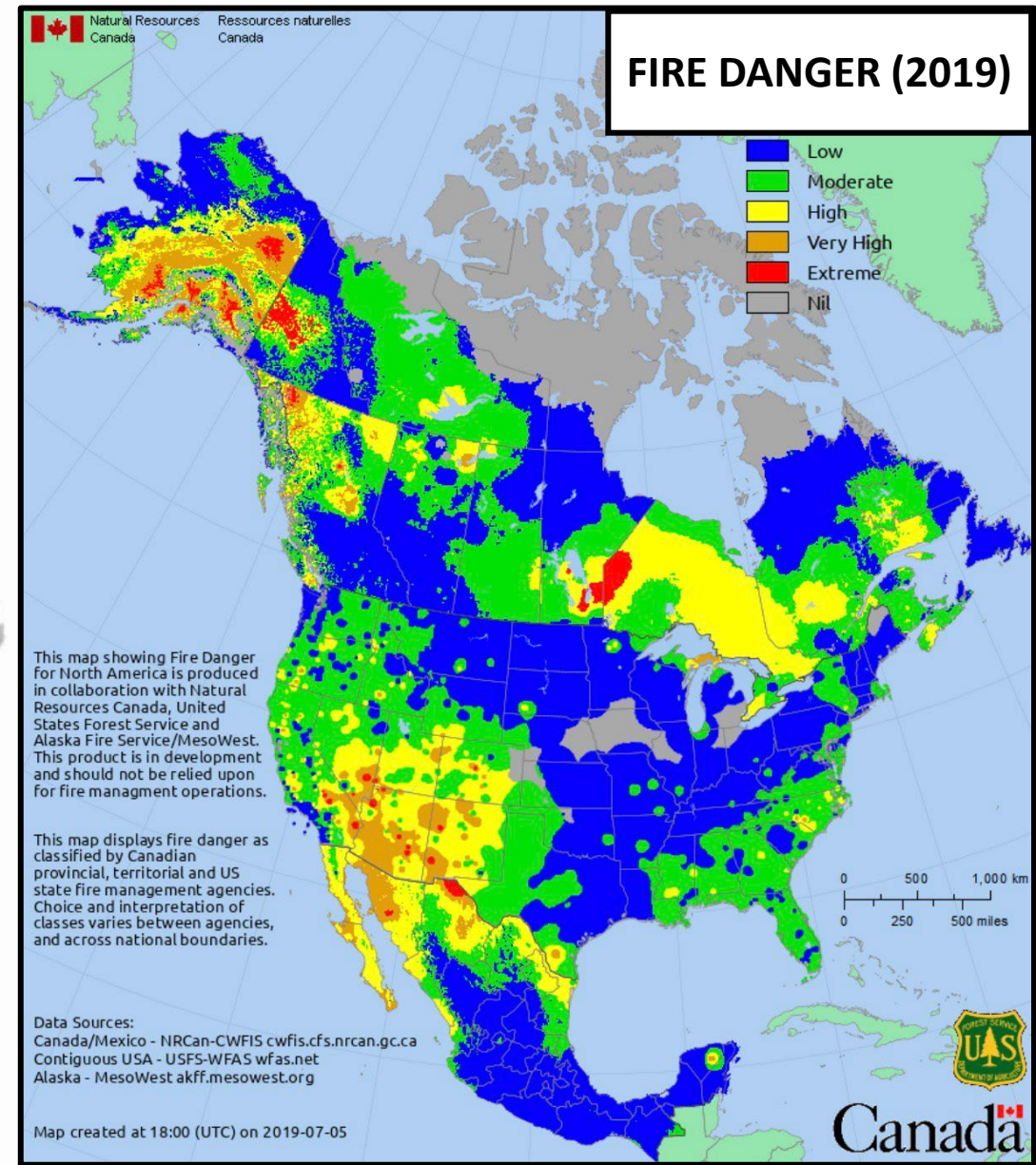
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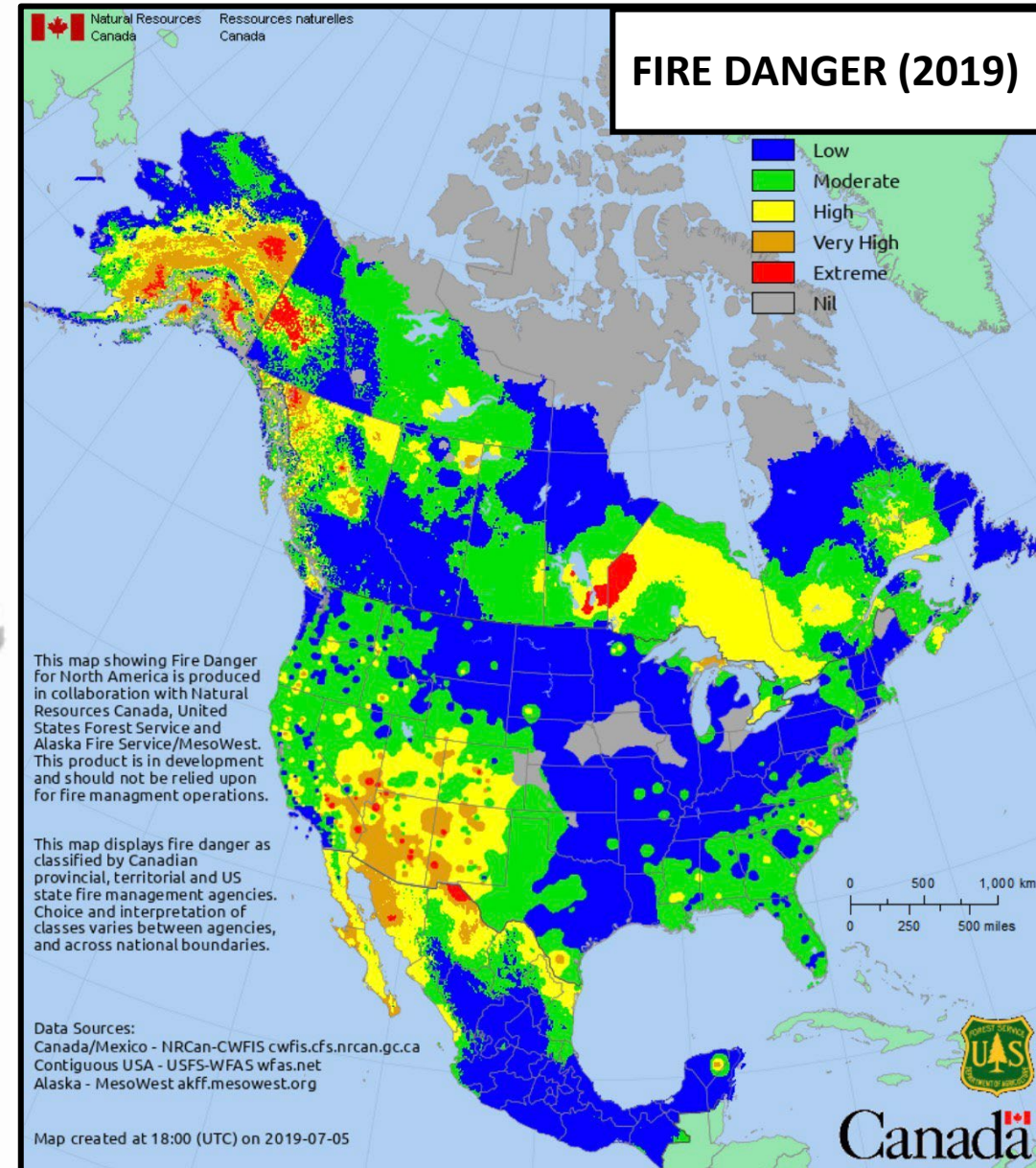
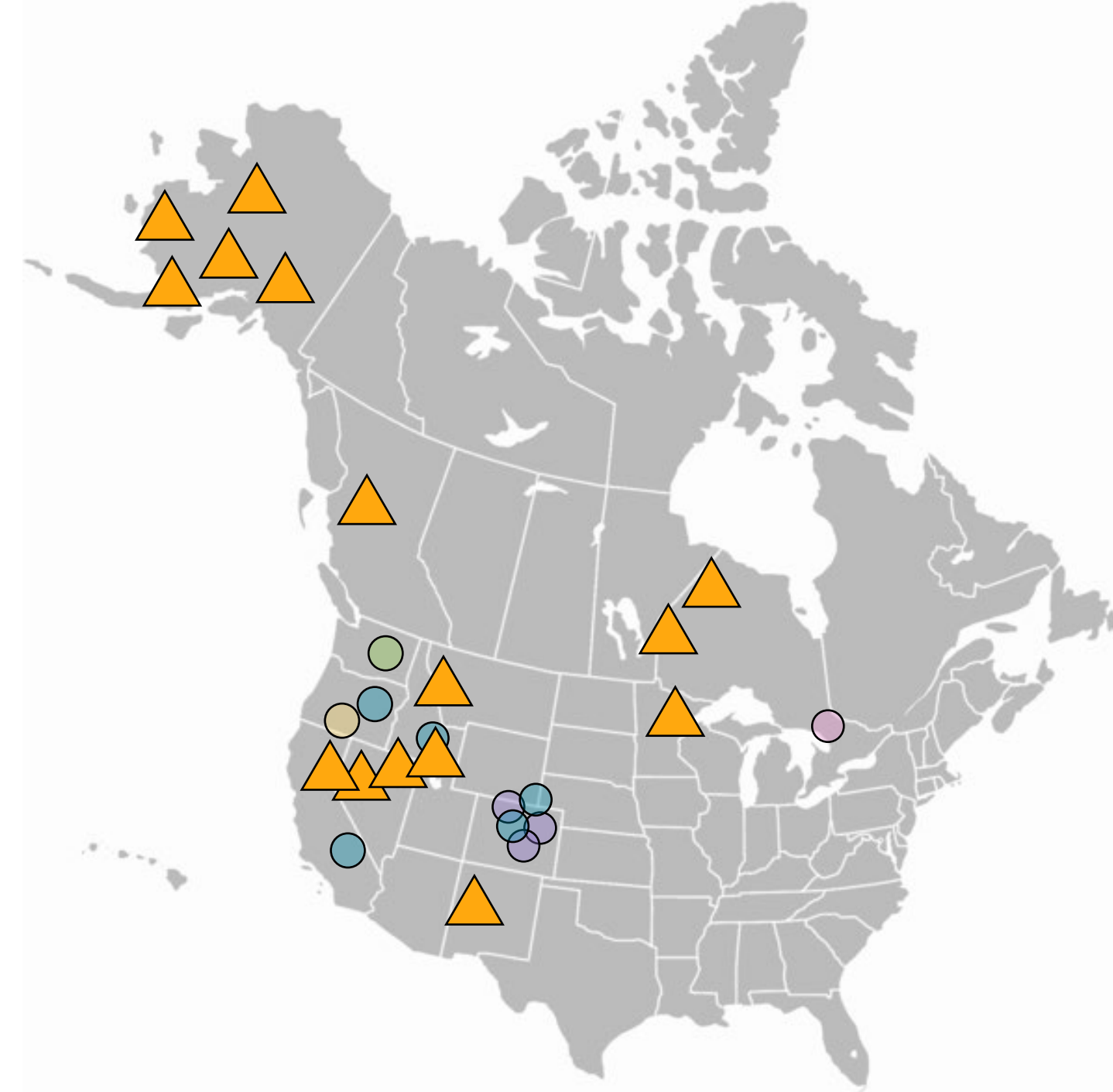
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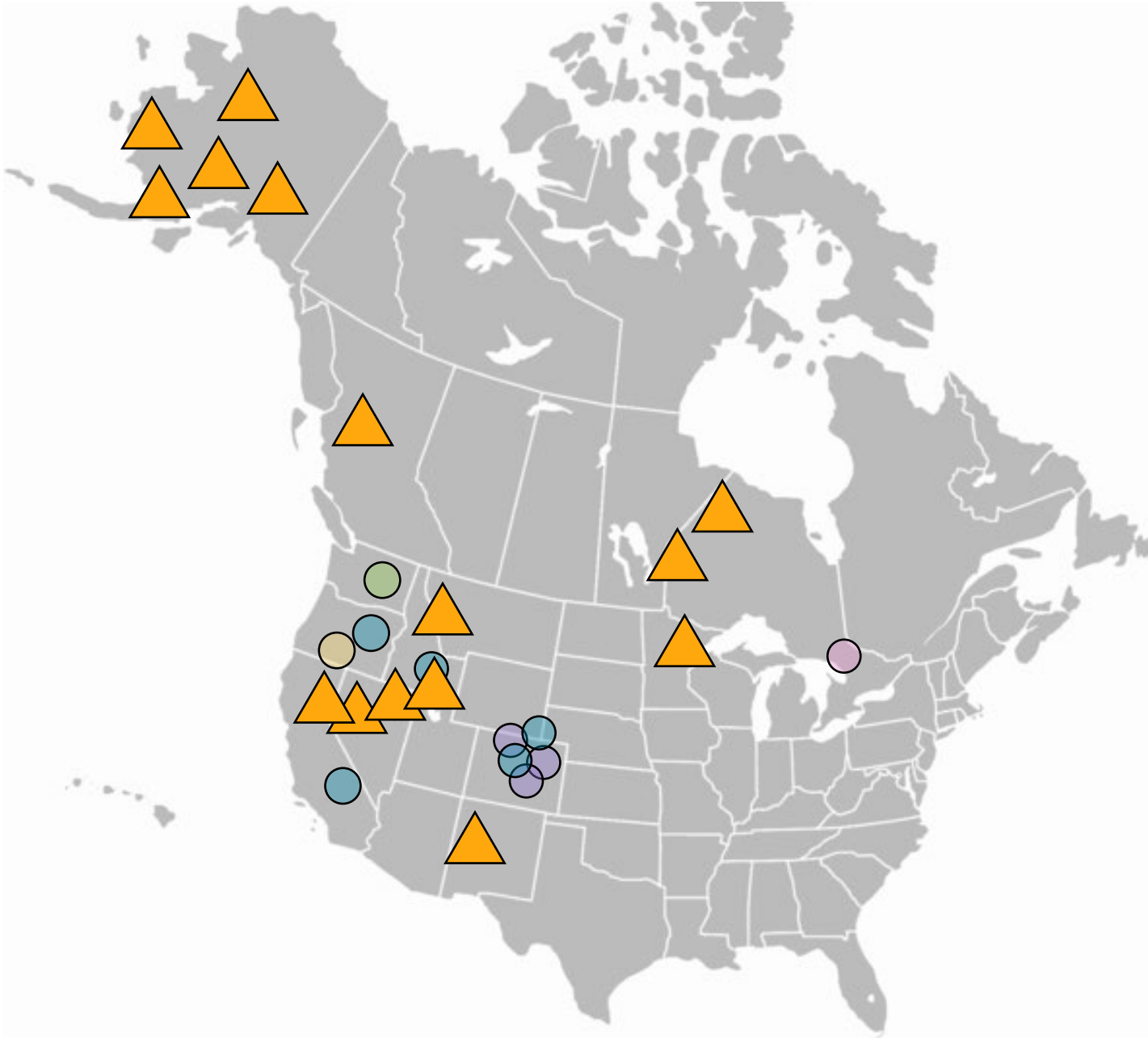
Trout Unlimited. Photographs and personal account from field crew.







15 Wildfires, 2.1 Million Acres, 2647 Beaver Dams (so far...)



- Map all dams that are visible and ponding water within the ~5-10 years before the fire.
- Note which dams were partially/fully drained right before the fire, and when they were last full
- Does fire resistance vary by region?
- Does beaver activity / ponding status matter?



Small Patch Vegetation Mosaics
Very Long-Term Landscape Effect,
Mild Fire Suppression

**Longer to Form, More Durable.
Weaker Fire Suppression Effect**

Valley Bottom Fuel Thinning
Long-Term Landscape Effect,
Moderate Fire Suppression

Floodplain Soil Water Storage
Medium-Term Landscape Effect,
Strong Fire Suppression

Pond + Canal Surface Water Storage
Short-Term Landscape Effect,
Very Strong Fire Suppression

**Shorter to Form, Less Durable.
Stronger Fire Suppression Effect**





Questions?

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