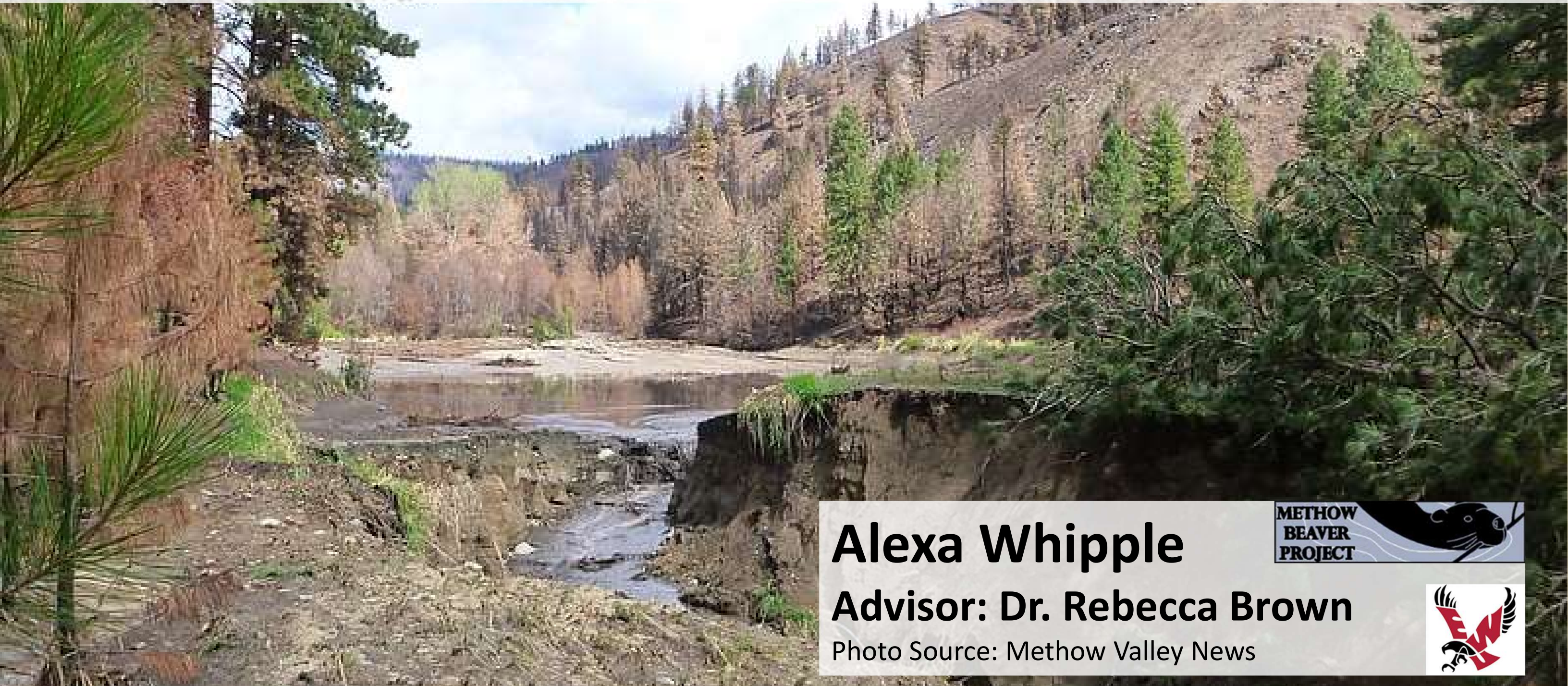


Riparian Resilience in the Face of Interacting Disturbances



Alexa Whipple

Advisor: Dr. Rebecca Brown

Photo Source: Methow Valley News



Riparian Resilience in the Face of Interacting Disturbances



Wildfire

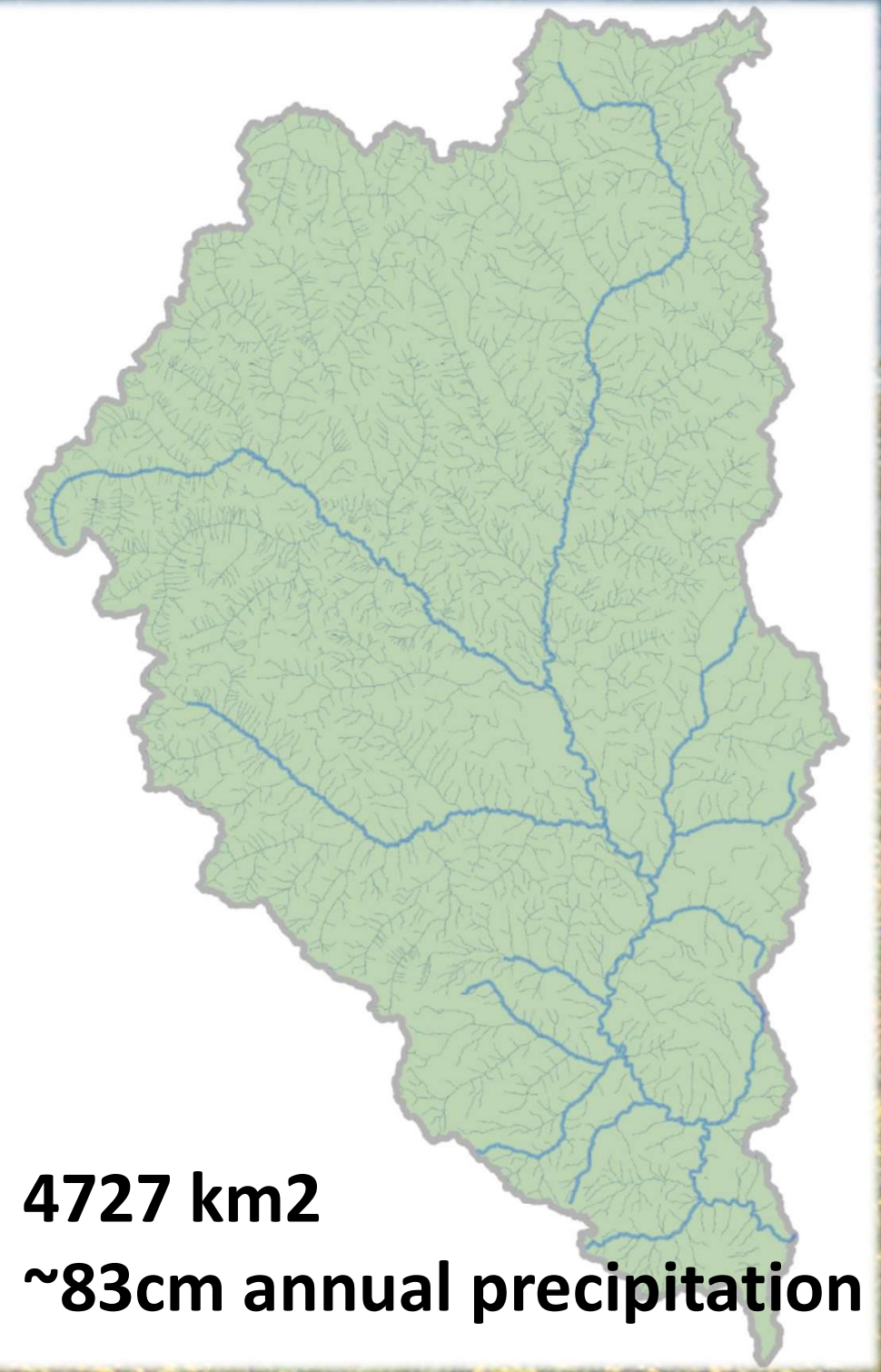


Erosion



Beaver

Methow River Watershed



Wildfire

2014 Carlton Complex

Historic Fire Patterns

- Frequent
- Smaller scale
- Low severity

Recent Fire Patterns

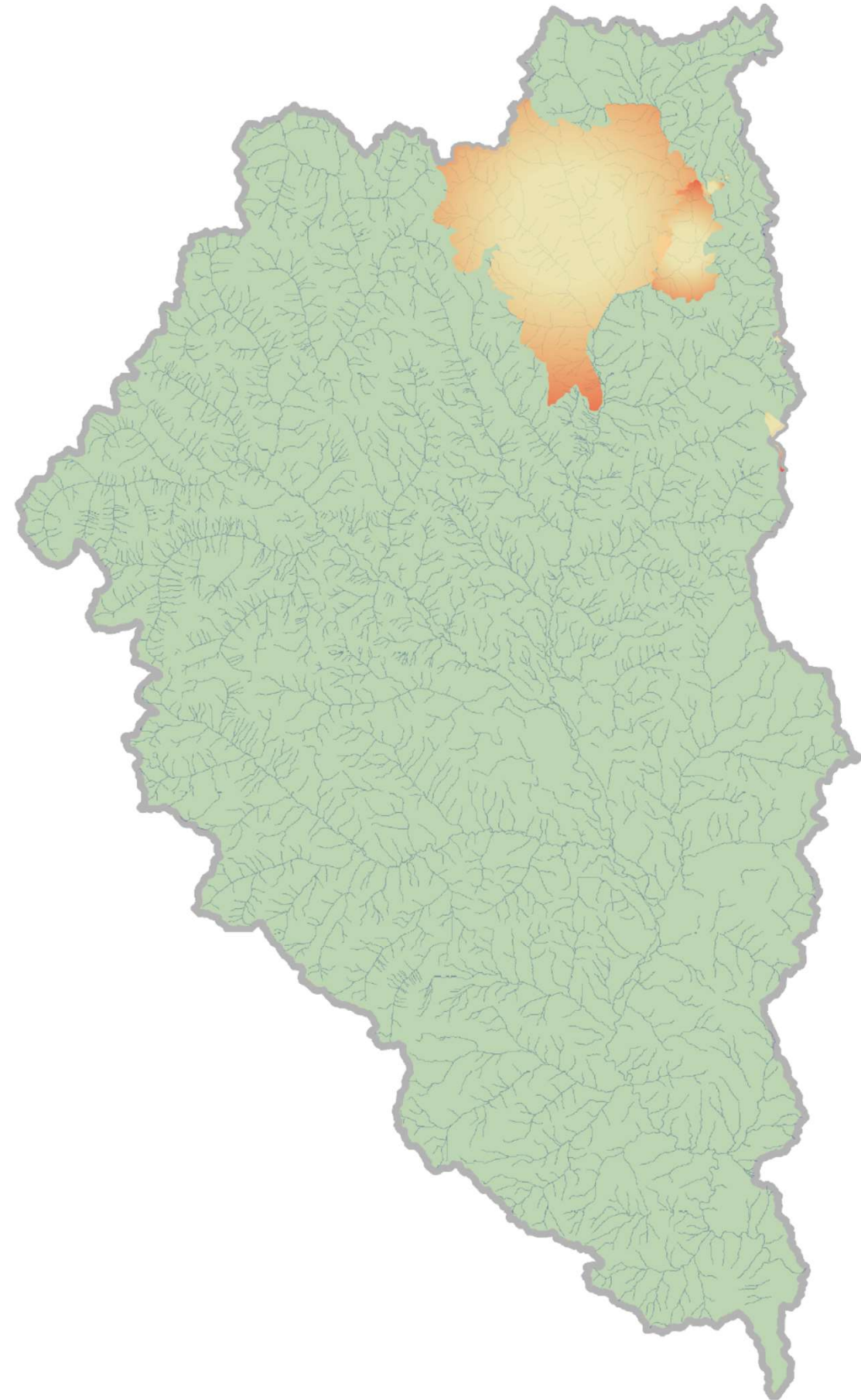
- Frequent-suppressed
- Larger scale
- Higher severity

O'Connor et al 2014



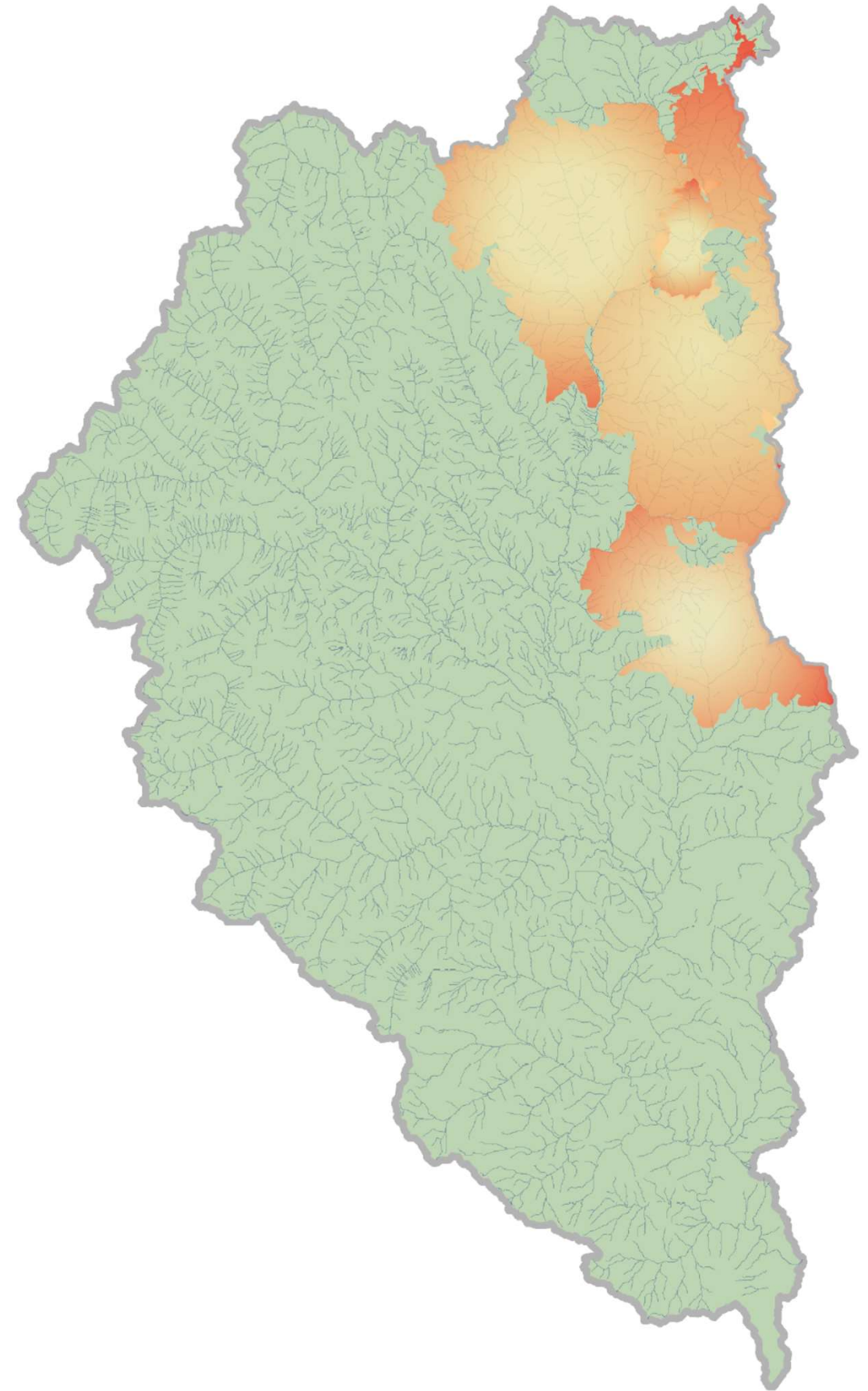
Methow River Watershed ~20 year fire history tableau

2000-2003



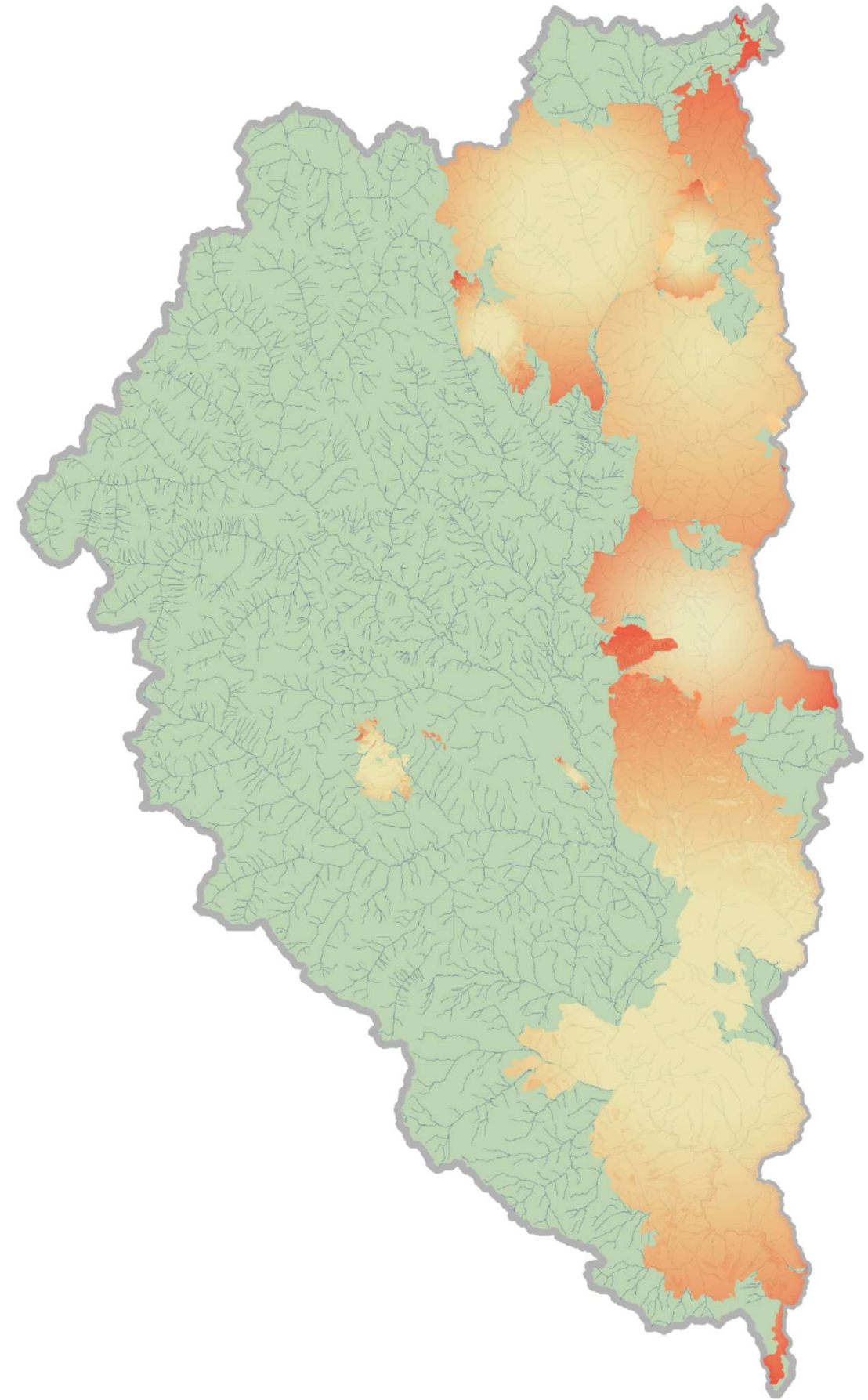
Methow River Watershed ~20 year fire history tableau

2006



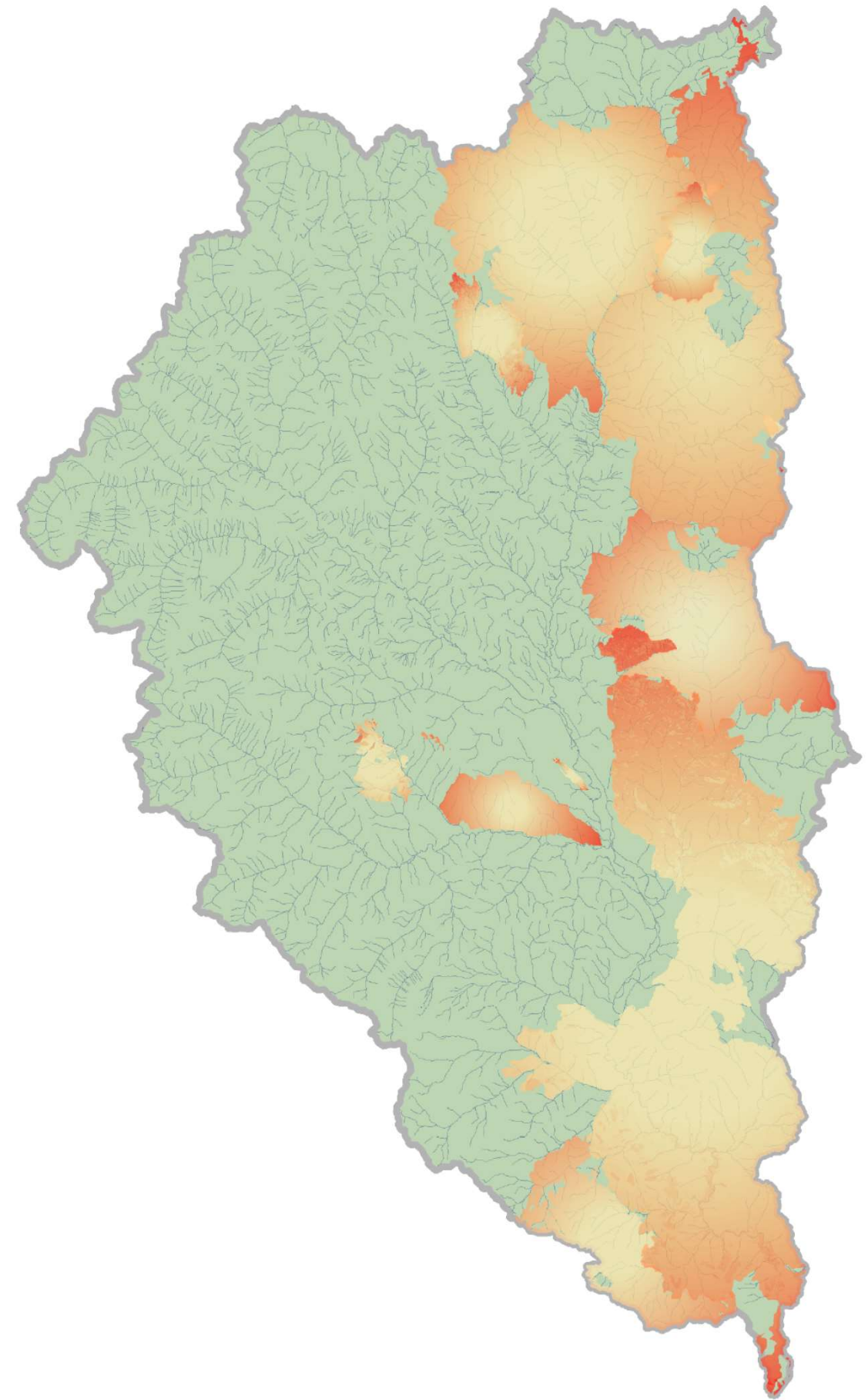
Methow River Watershed ~20 year fire history tableau

2014



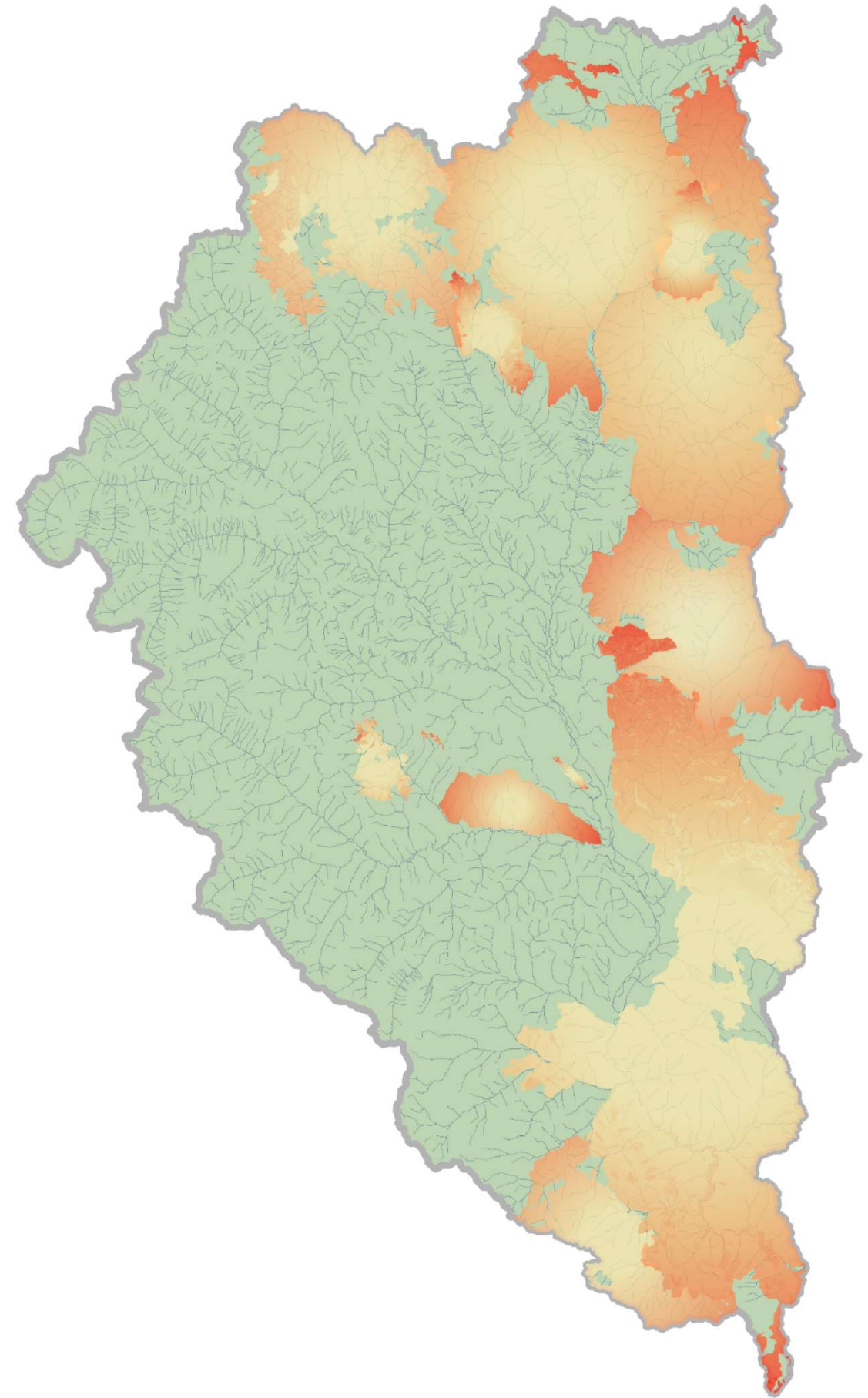
Methow River Watershed ~20 year fire history tableau

2015



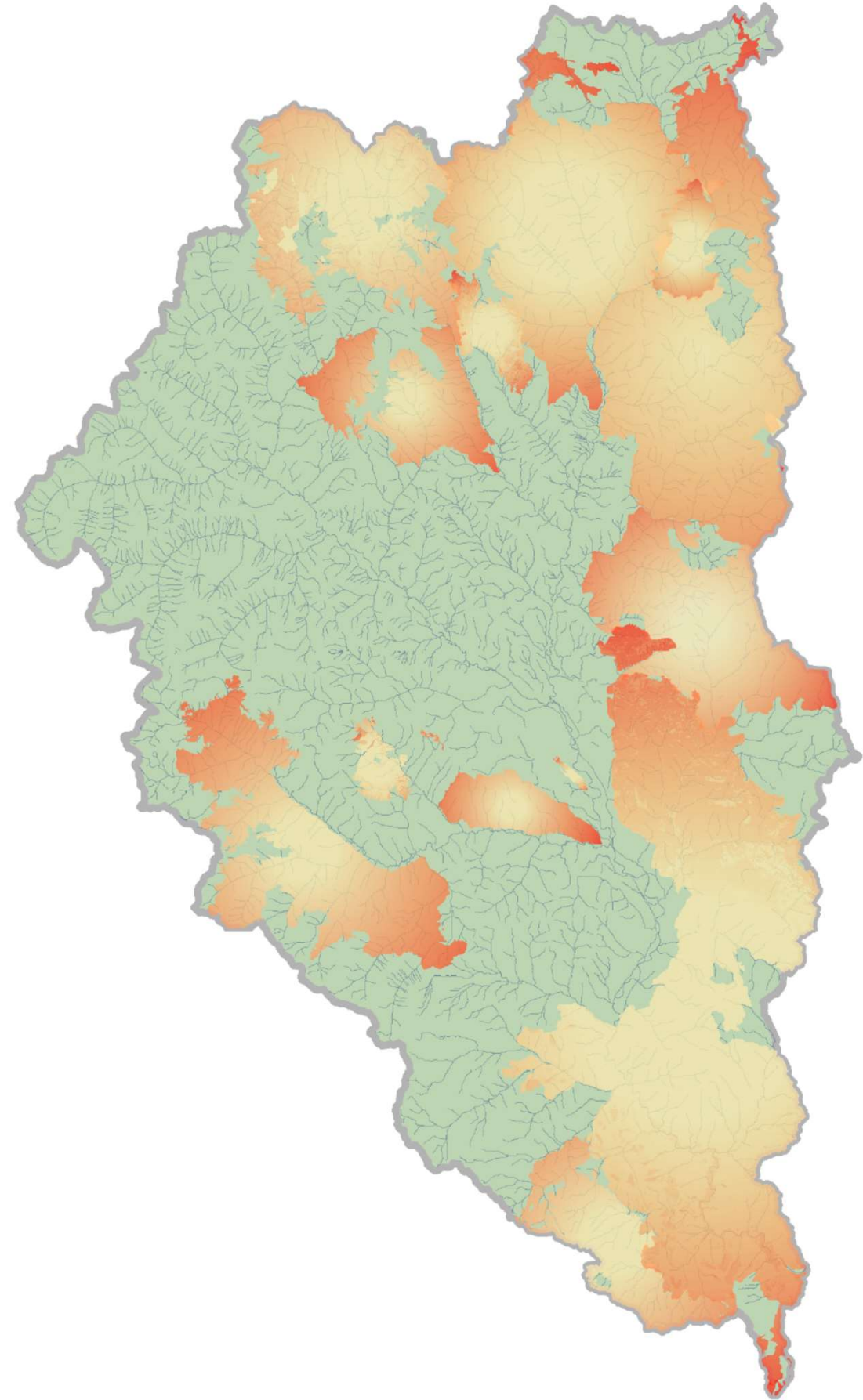
Methow River Watershed ~20 year fire history tableau

2017



Methow River Watershed ~20 year fire history tableau

2018



Increasing wildfire scale & burn severity
= severe erosion & channel incision



Source: Cannon et al 2010

Incising events after Wildfire

- ↓ Flood control
- ↓ Water storage
- ↓ Stream complexity
- ↓ Habitat/Biodiversity
- ↓ Water table
- ↓ Floodplain connectivity

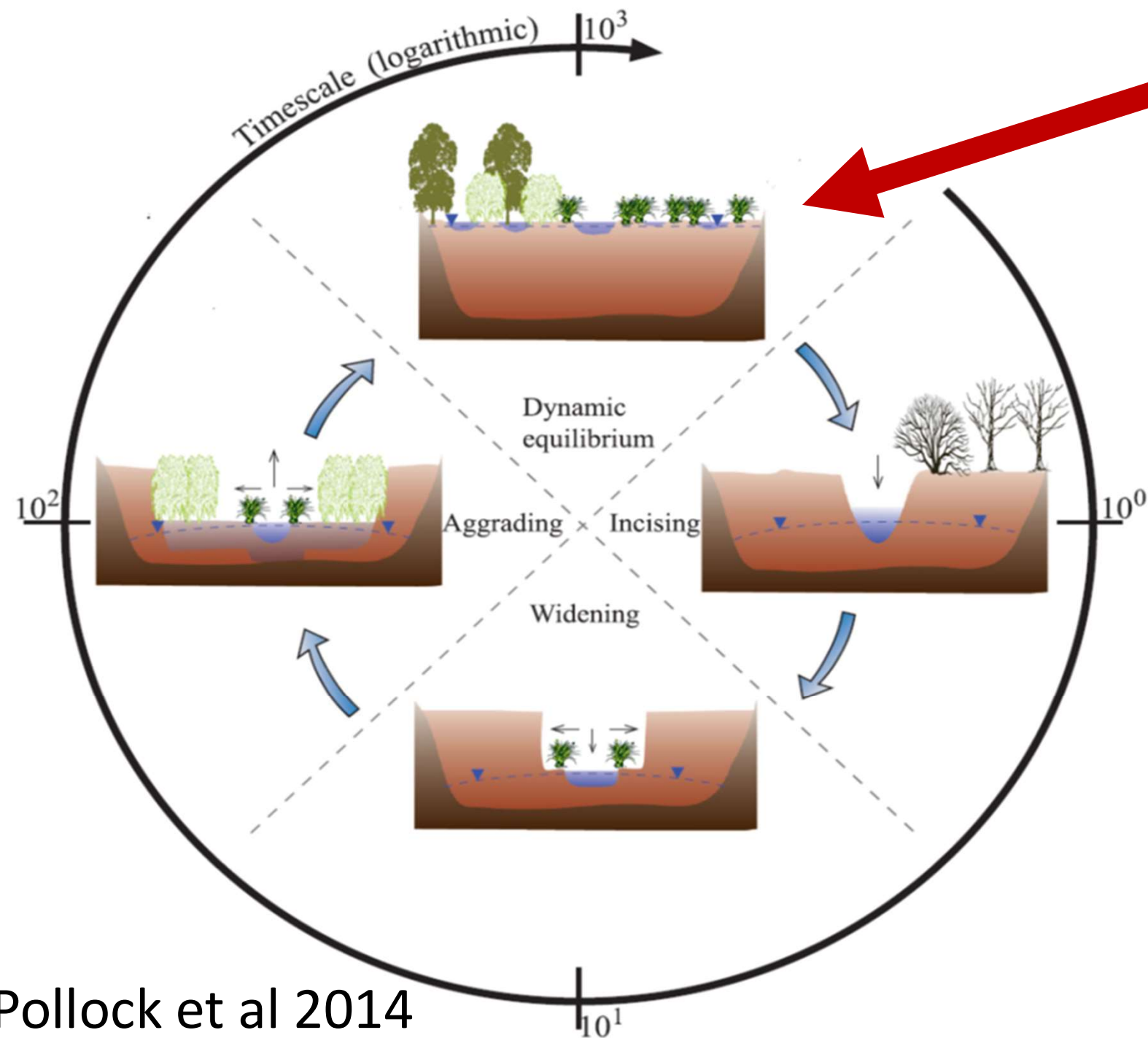


Incising event post-Wildfire

- ↓ Flood control
- ↓ Water storage
- ↓ Stream complexity
- ↓ Habitat/Biodiversity
- ↓ Water table
- ↓ Floodplain connectivity



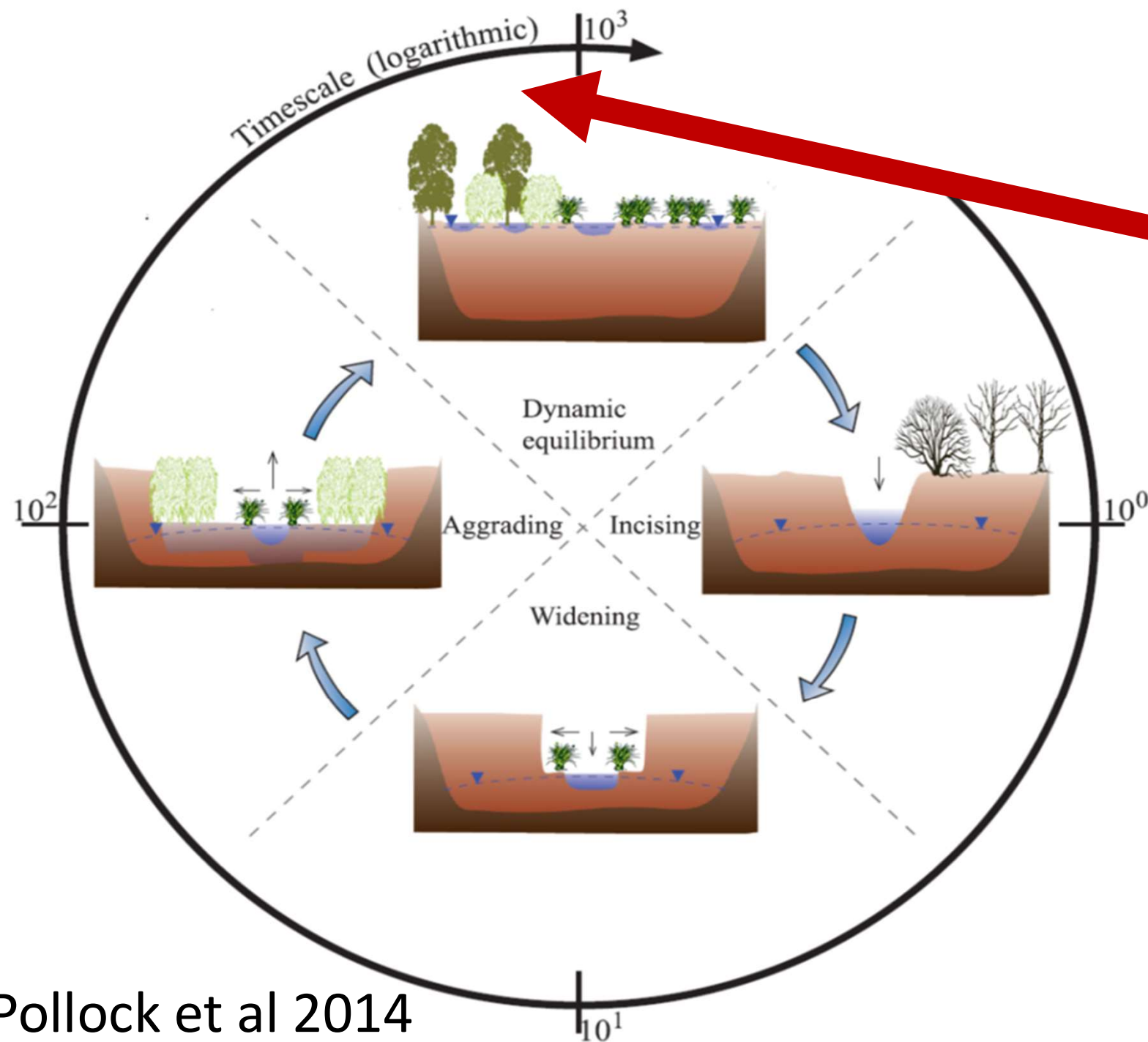
Time?



Return to original
dynamic **disequilibrium**?

Pollock et al 2014
Cluer & Thorne 2013

Time?

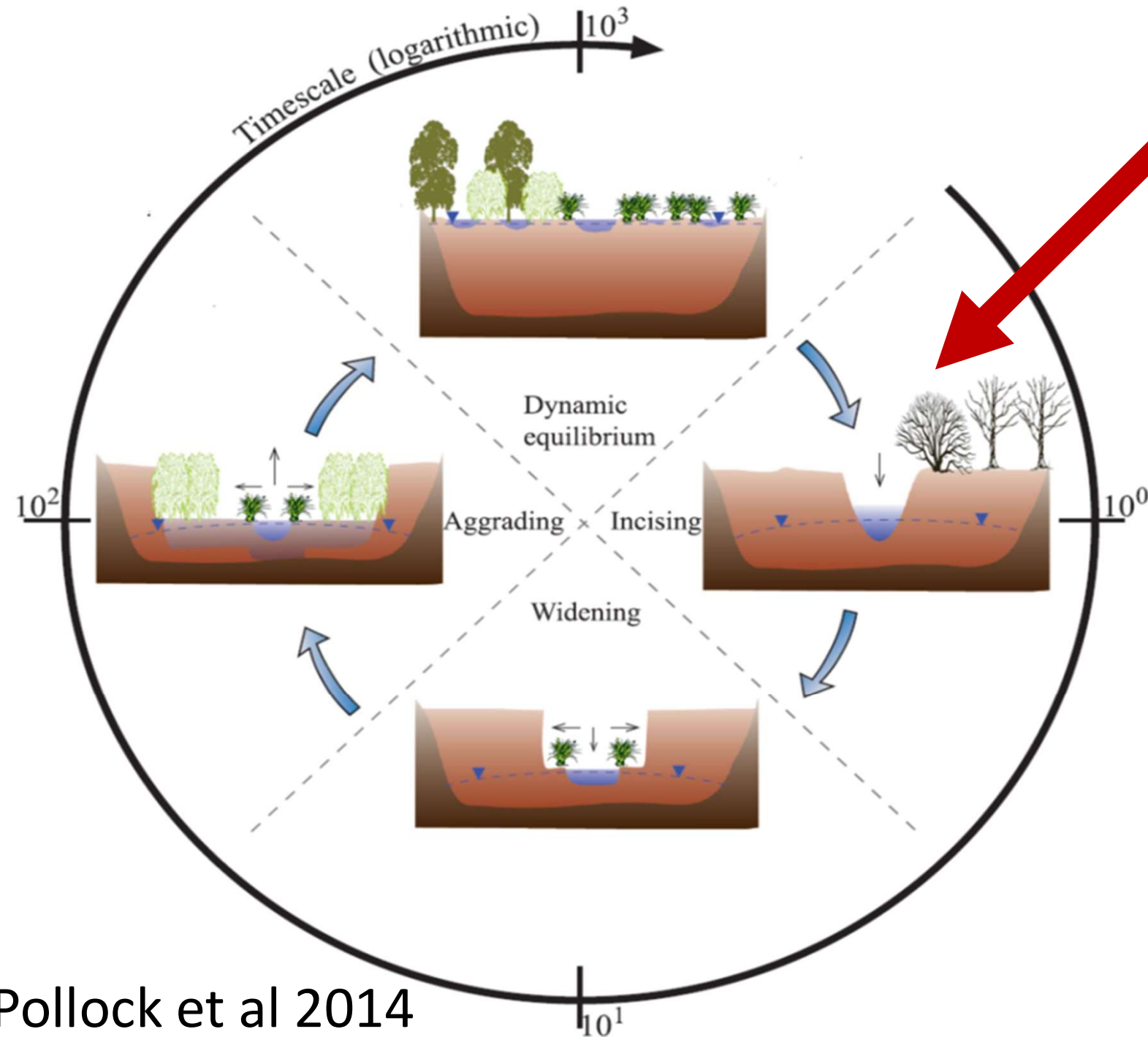


Return to original
dynamic disequilibrium

- Logarithmic timescale
100's-1000's of years

Pollock et al 2014
Cluer & Thorne 2013

Time?



Incised stable state

a. pre-incision

b. degrading

c. degrading & limited widening

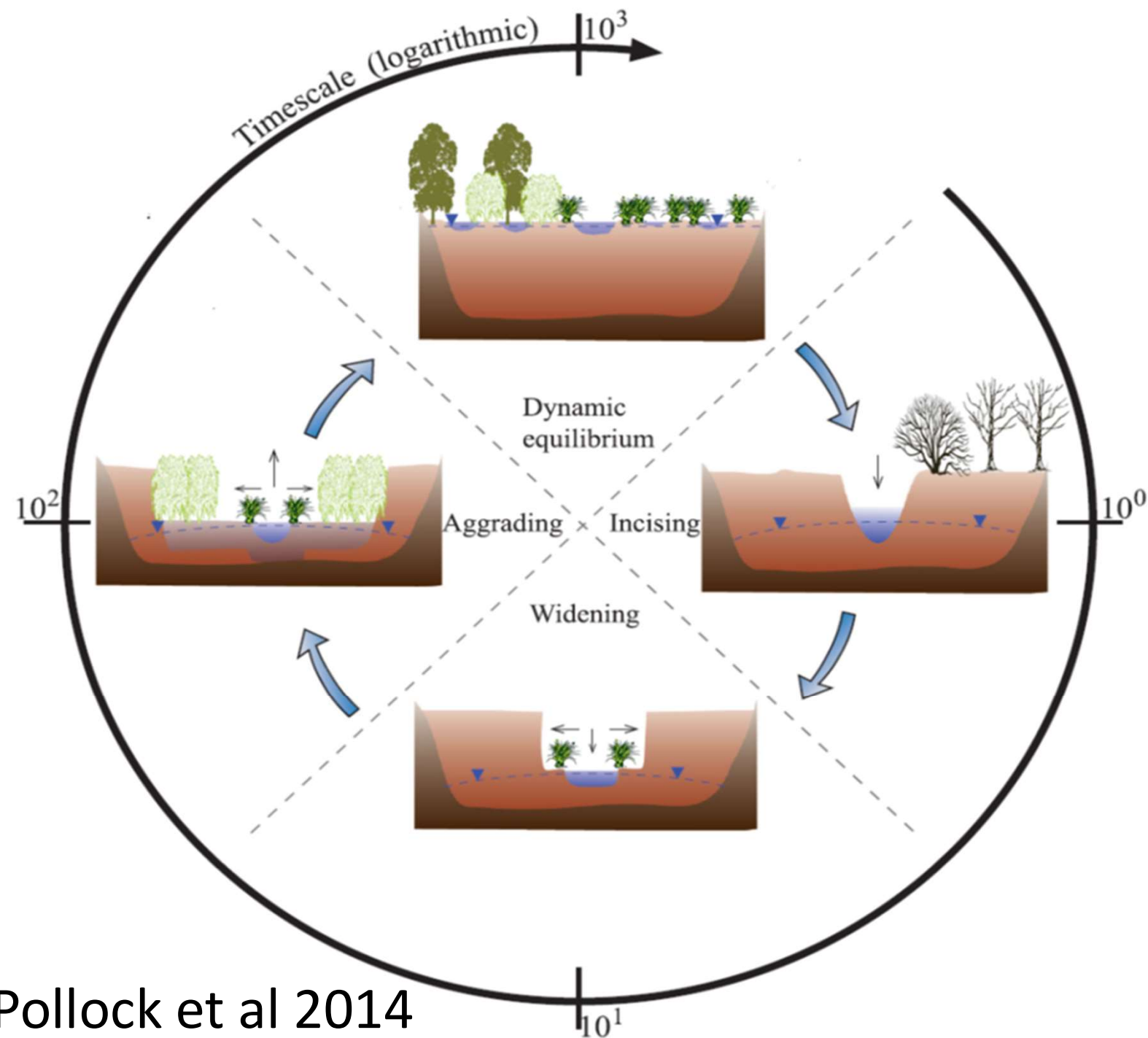
d. aggrading/quasi equilibrium

Beechie et al 2007

Pollock et al 2014

Cluer & Thorne 2013

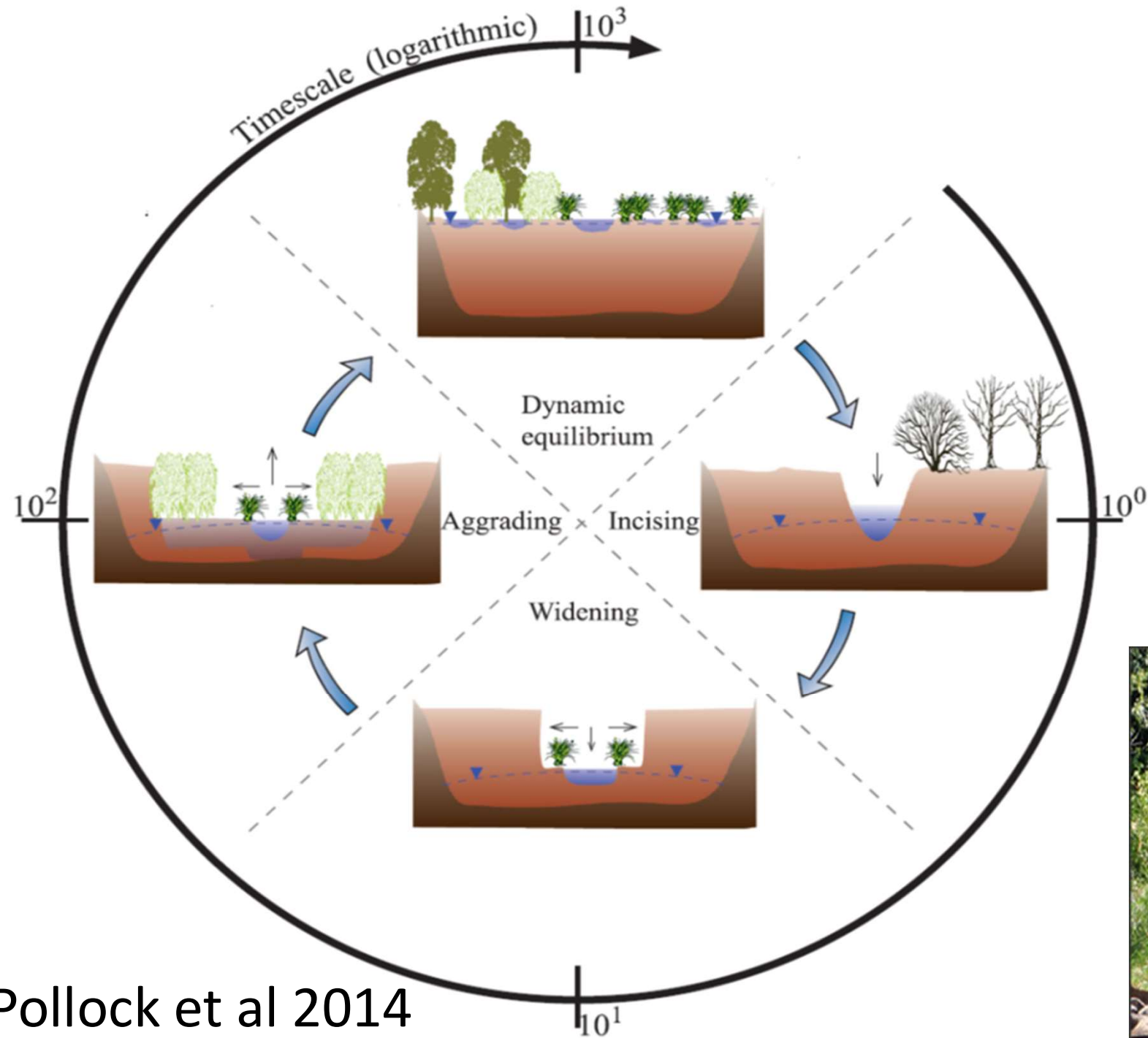
Time?



Pollock et al 2014
Cluer & Thorne 2013



Time?



Pollock et al 2014
Cluer & Thorne 2013

River engineering?



Repurposing?





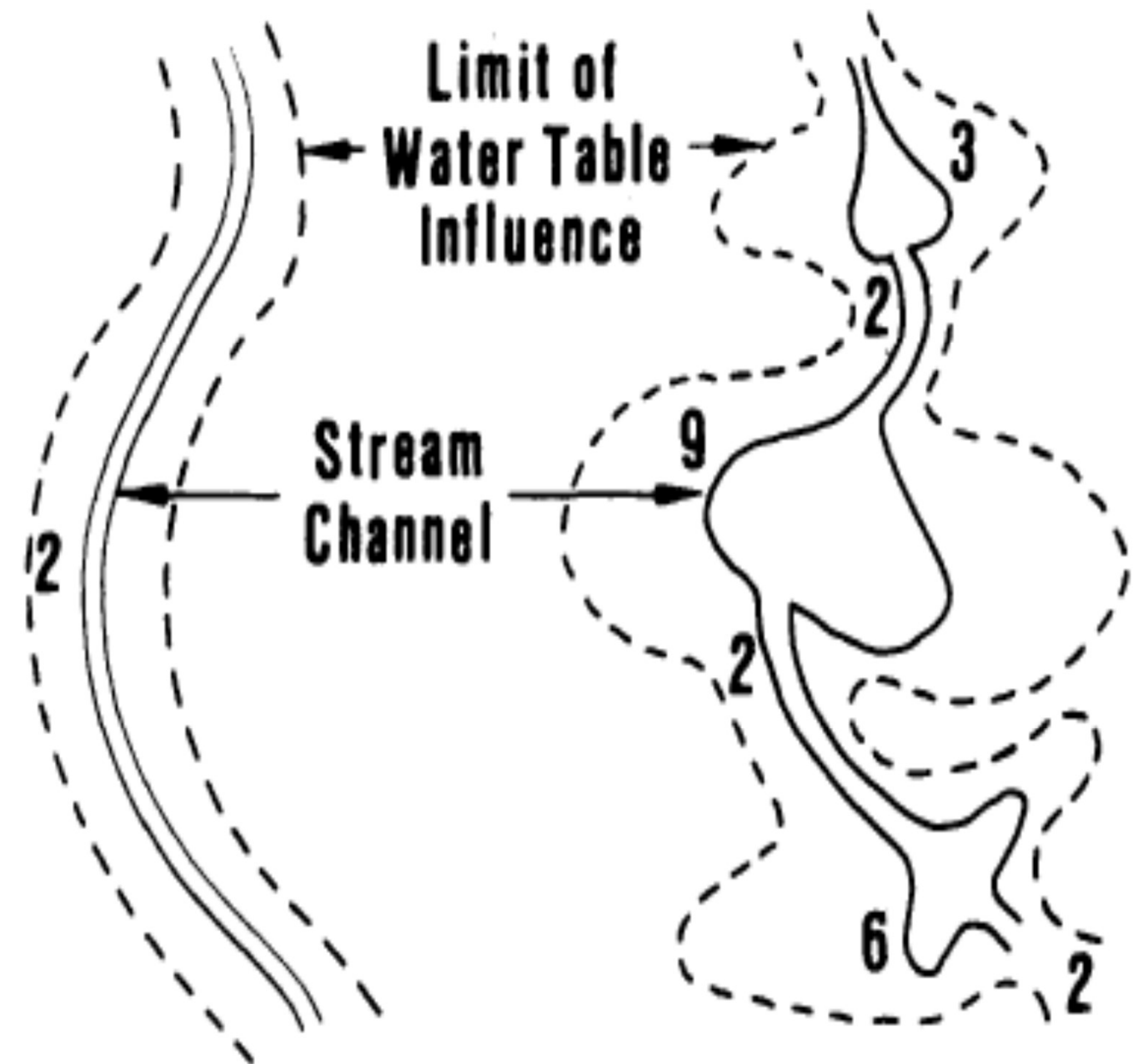
Chase Dekker via Shutterstock

Beaver dam building activity:

- ↑ Flood attenuation
- ↑ Water storage
- ↑ Stream complexity
- ↑ Habitat/Biodiversity
- ↑ Water table
- ↑ Floodplain connectivity

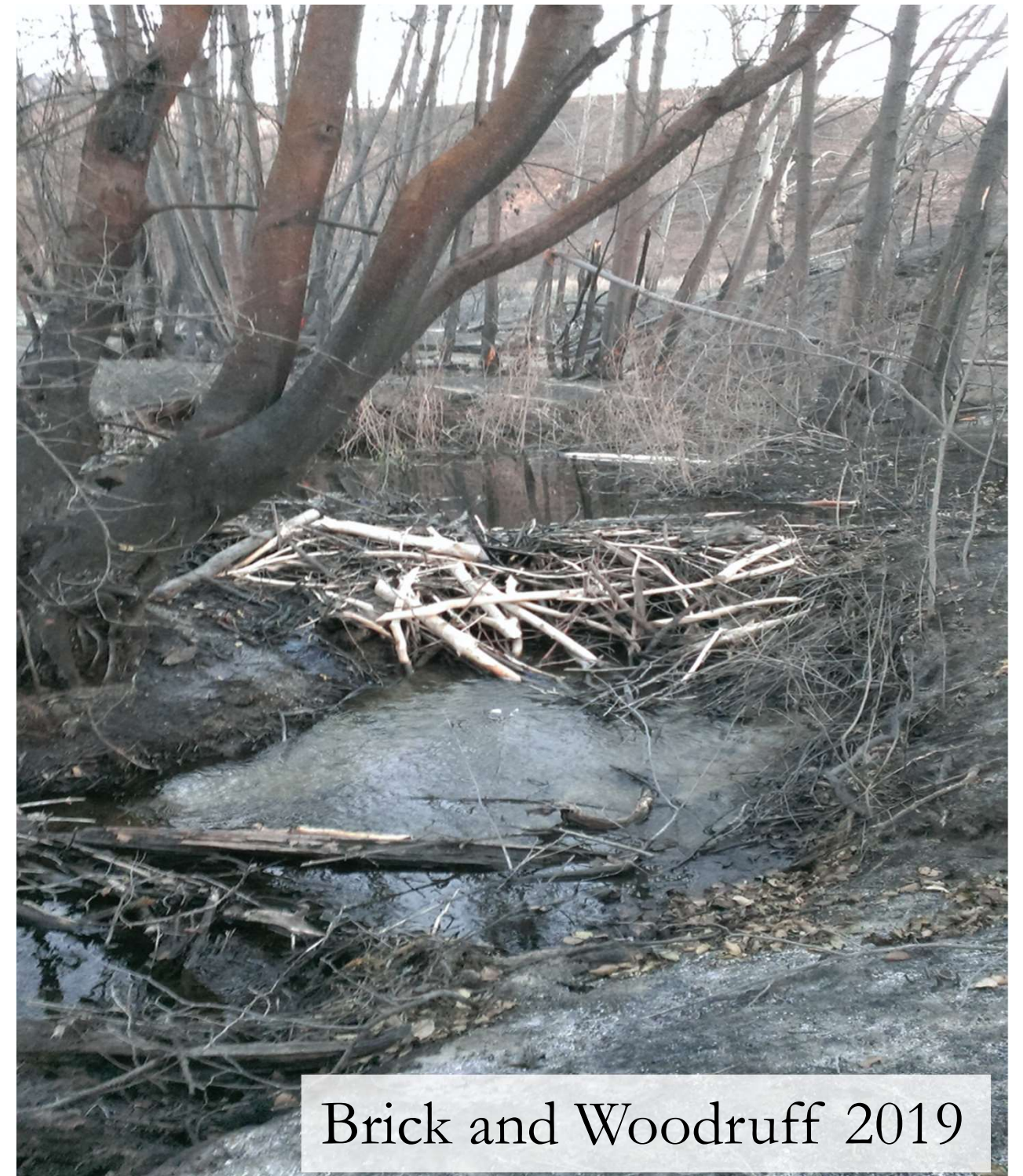
No Beavers

Beavers






Naiman et al 1988

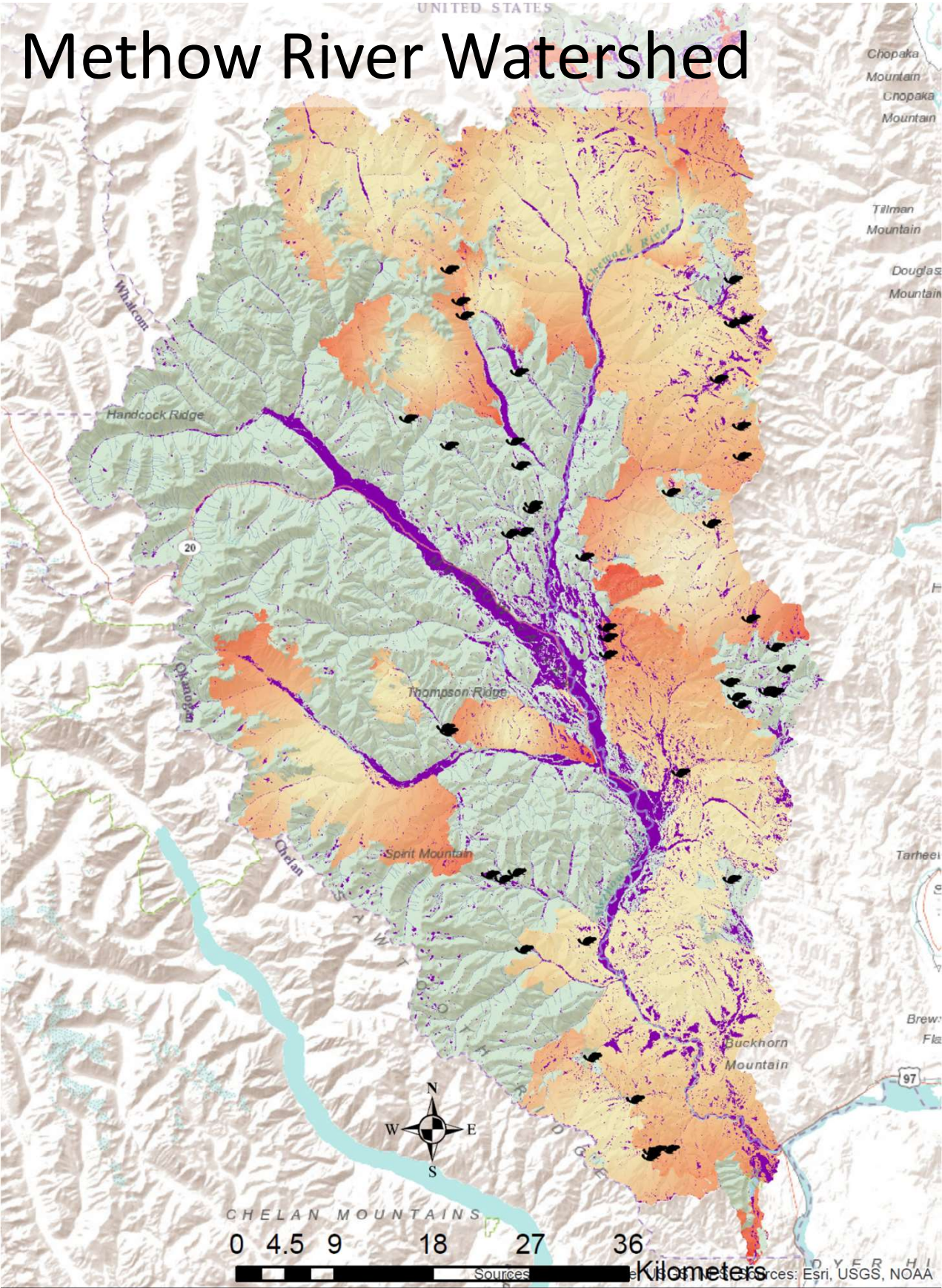
Can beaver activity increase
the resilience of burned &
degraded riparian systems?



Study Design

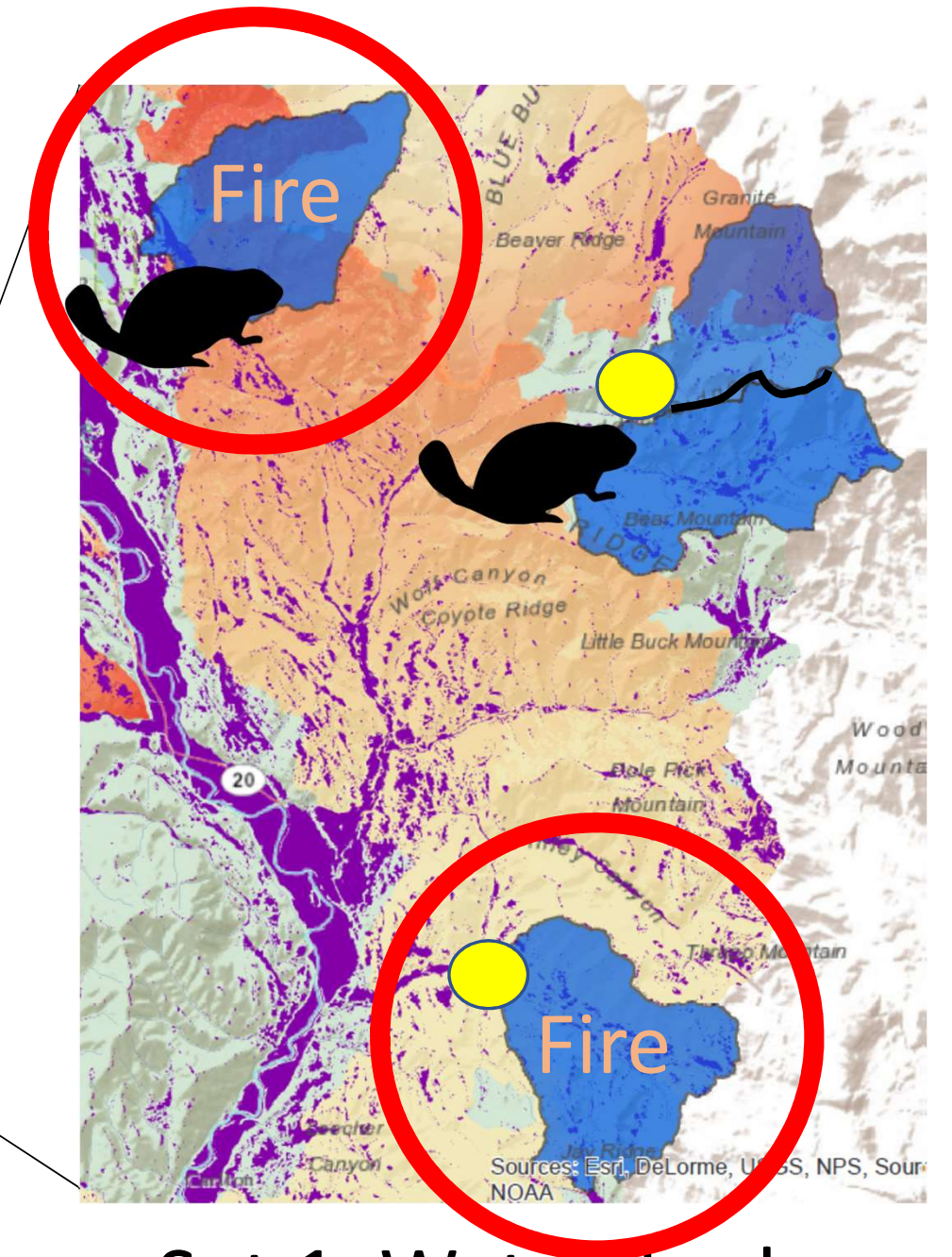
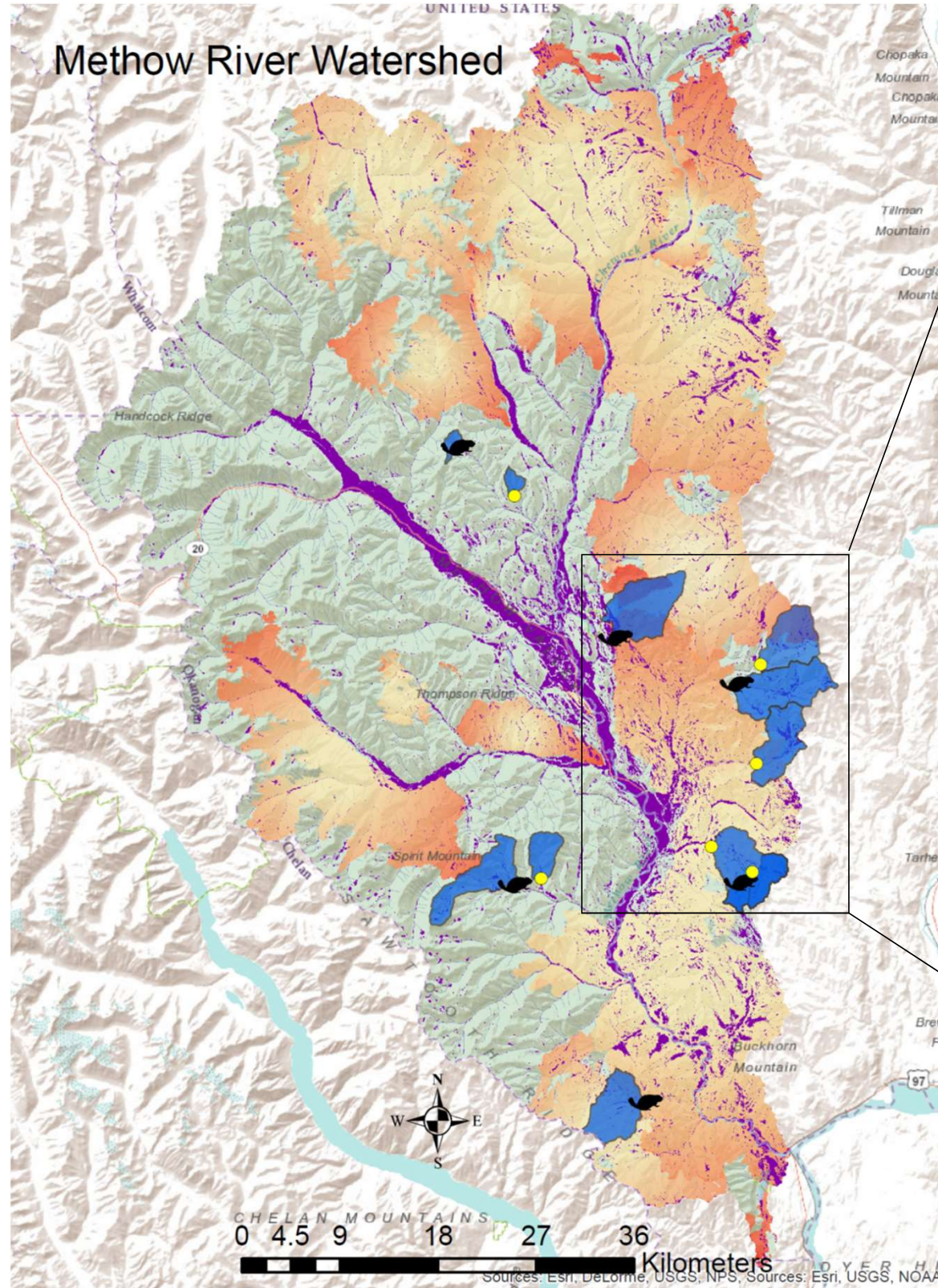
3 Sets	Beaver	No Beaver
Fire	1 , 1	1 , 0
No Fire	0 , 1	0 , 0

-  = <10% slope of stream
-  = Fires over last 20 years
-  = beaver location



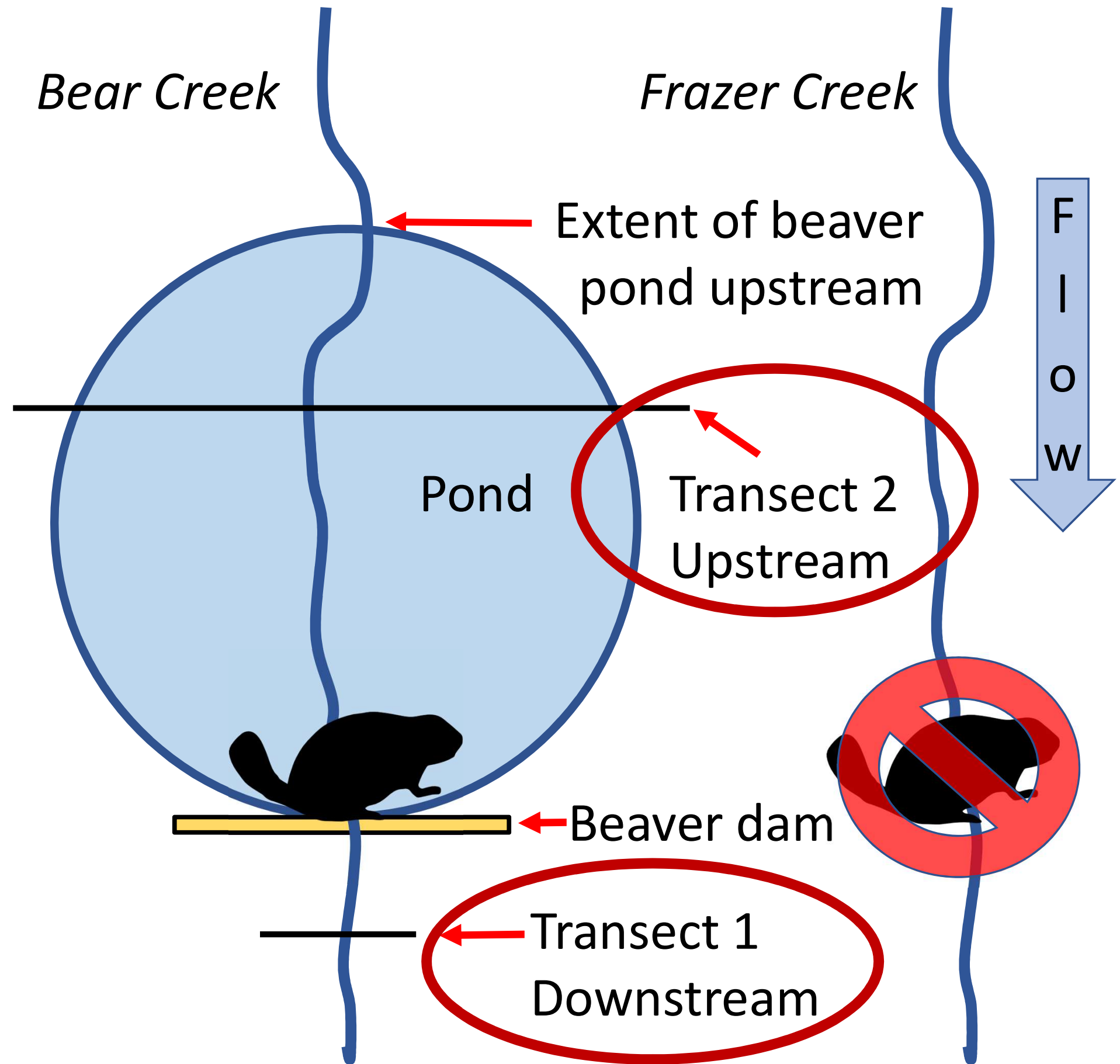
Study Site Locations

-  = Fires over last 20 years
-  = <10% slope of stream
-  = study site watersheds
-  = beaver study site
-  = non beaver study site

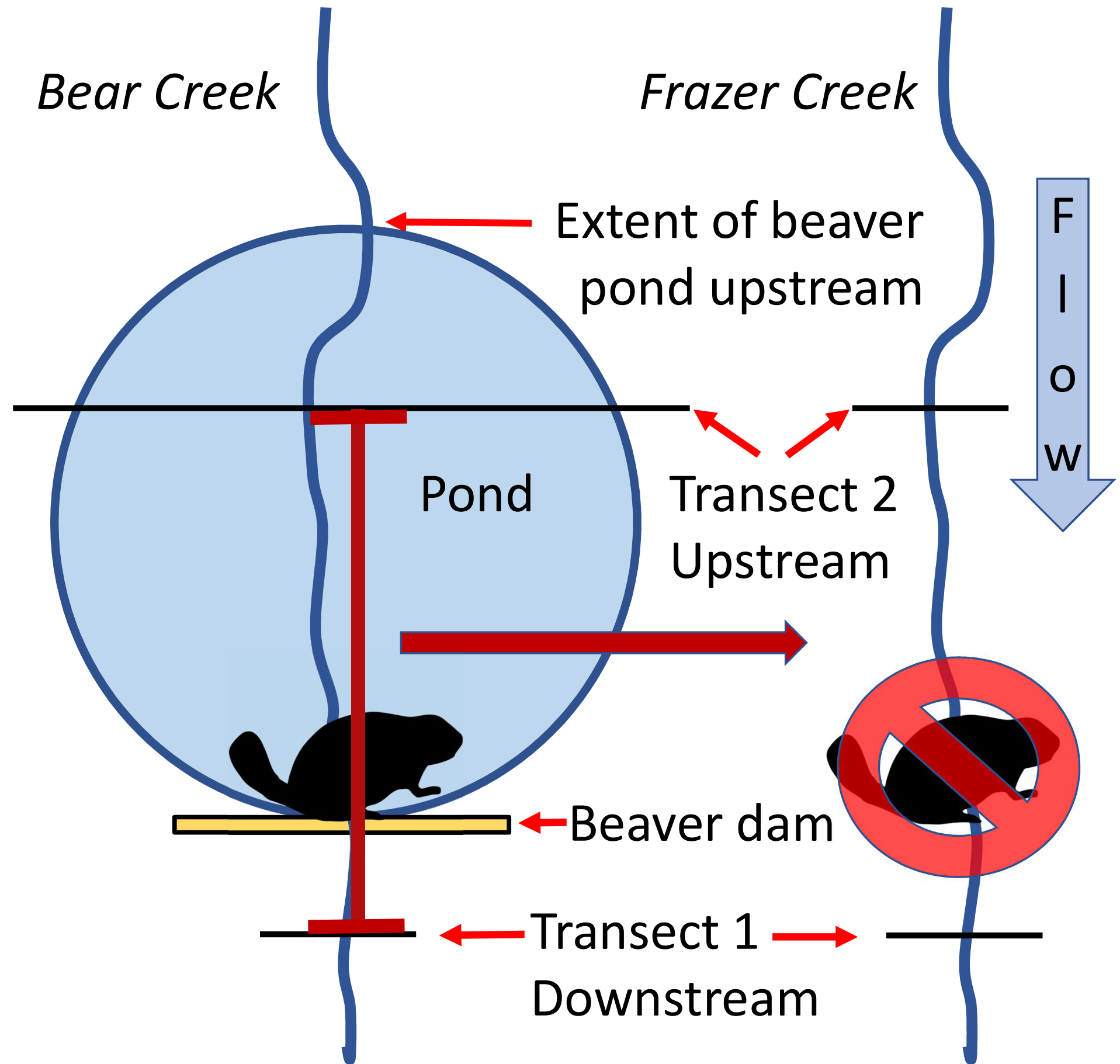


Set 1 Watersheds
21-31 km²

Methods



Methods



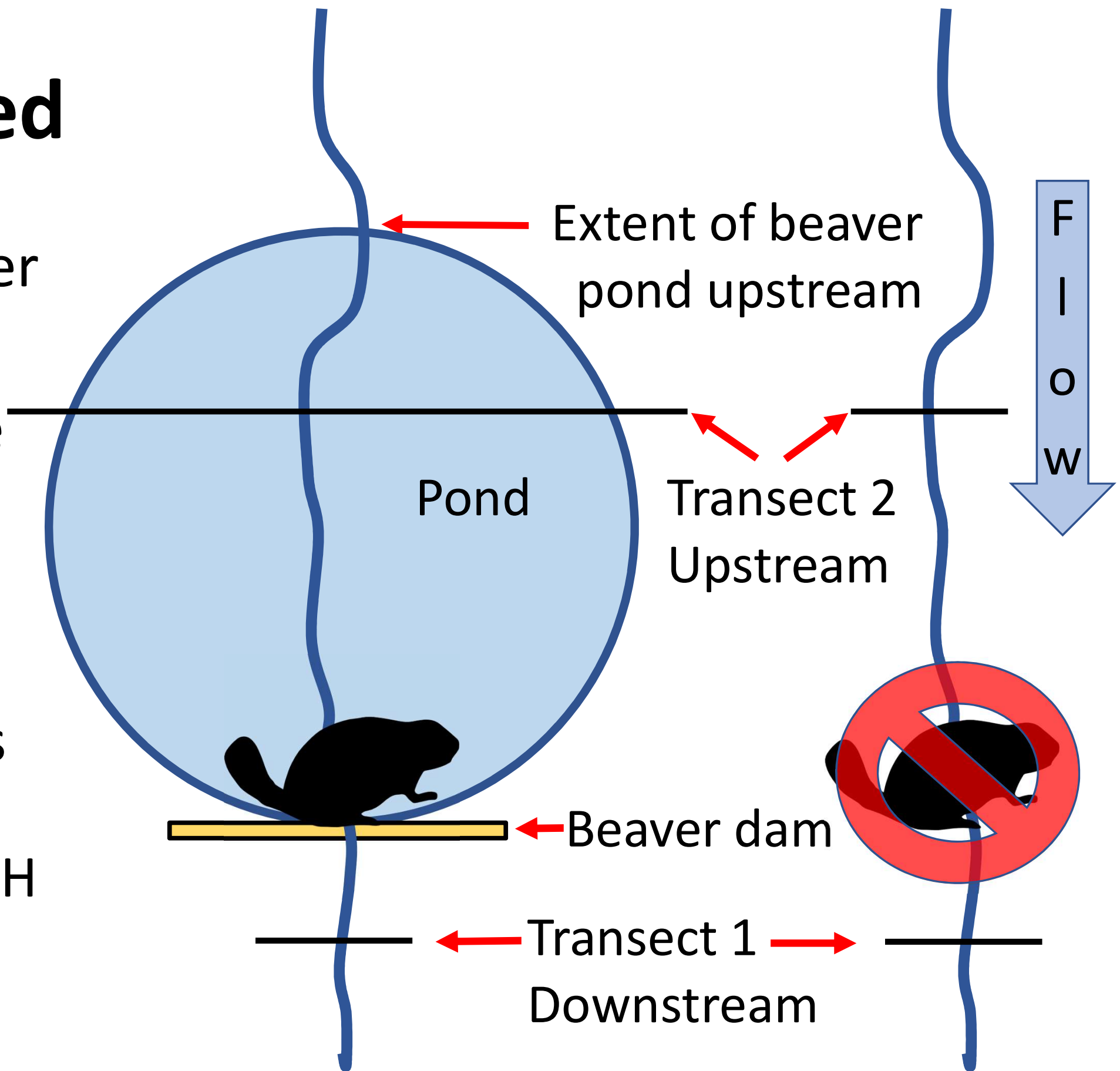
Variables Measured

Vegetation species
composition, ground cover

Stream channel substrate

Channel cross sections

Water quality parameters
Temperature,
% dissolved oxygen, pH
Total Phosphate



Variables Measured

Vegetation species composition
and ground cover

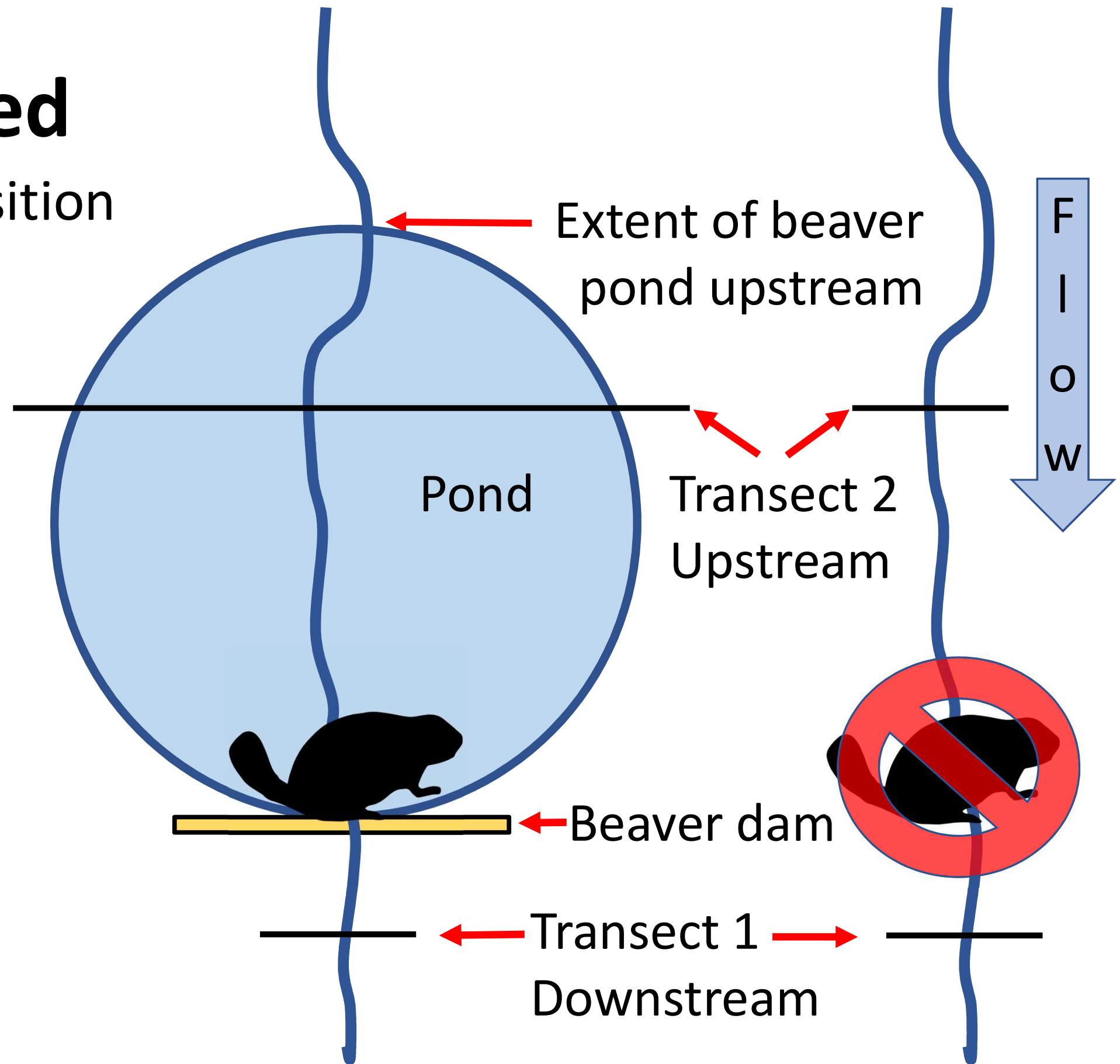
Stream channel substrate

Channel cross sections

Water quality parameters

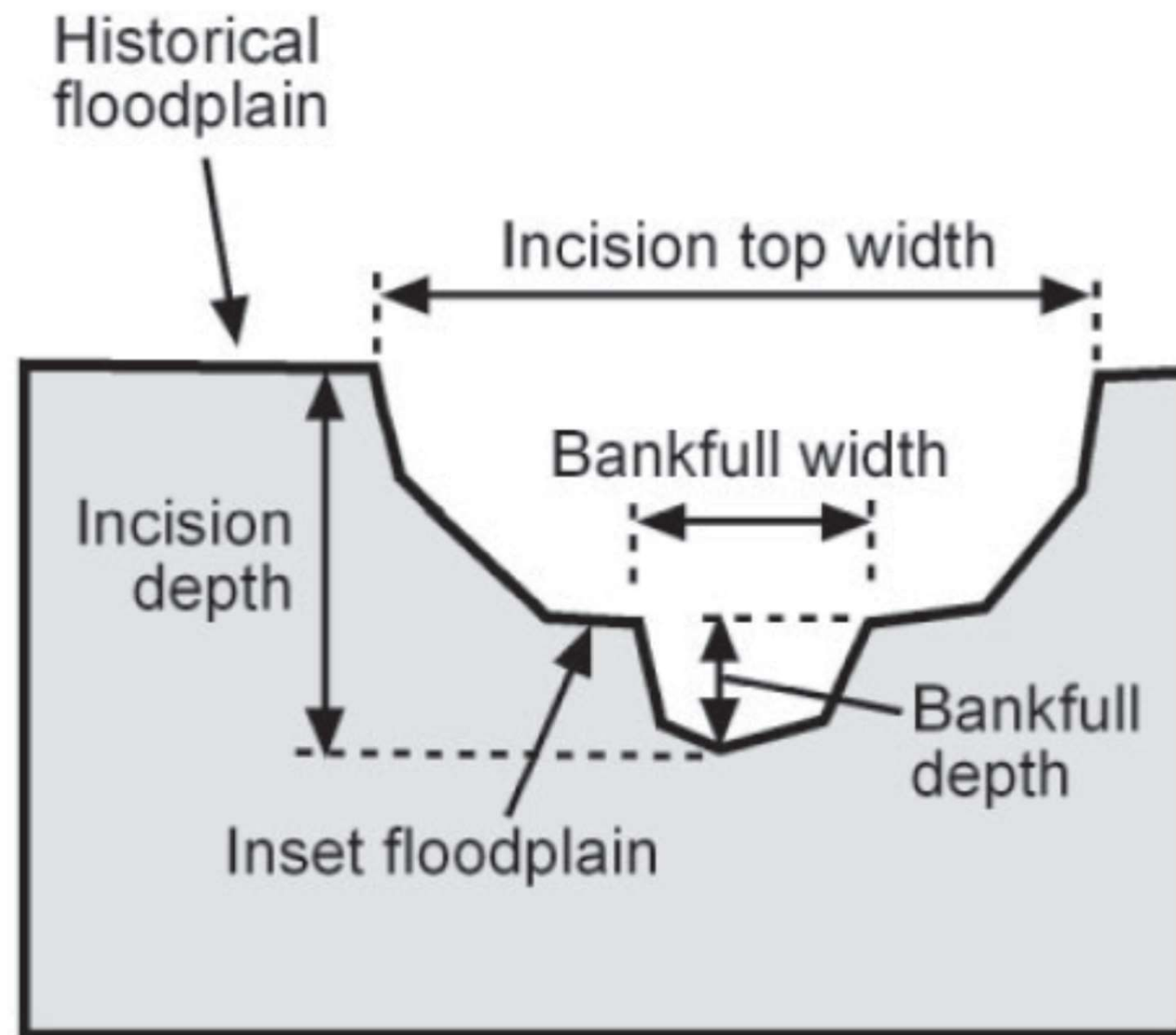
Temperature,
% dissolved oxygen,
pH

Total Phosphate



Channel Cross Sections

Bankfull elevation



Beechie et al 2007

Bankfull Width/Depth Ratio

channel form & stability

erosion & deposition
processes

stream evolution potential

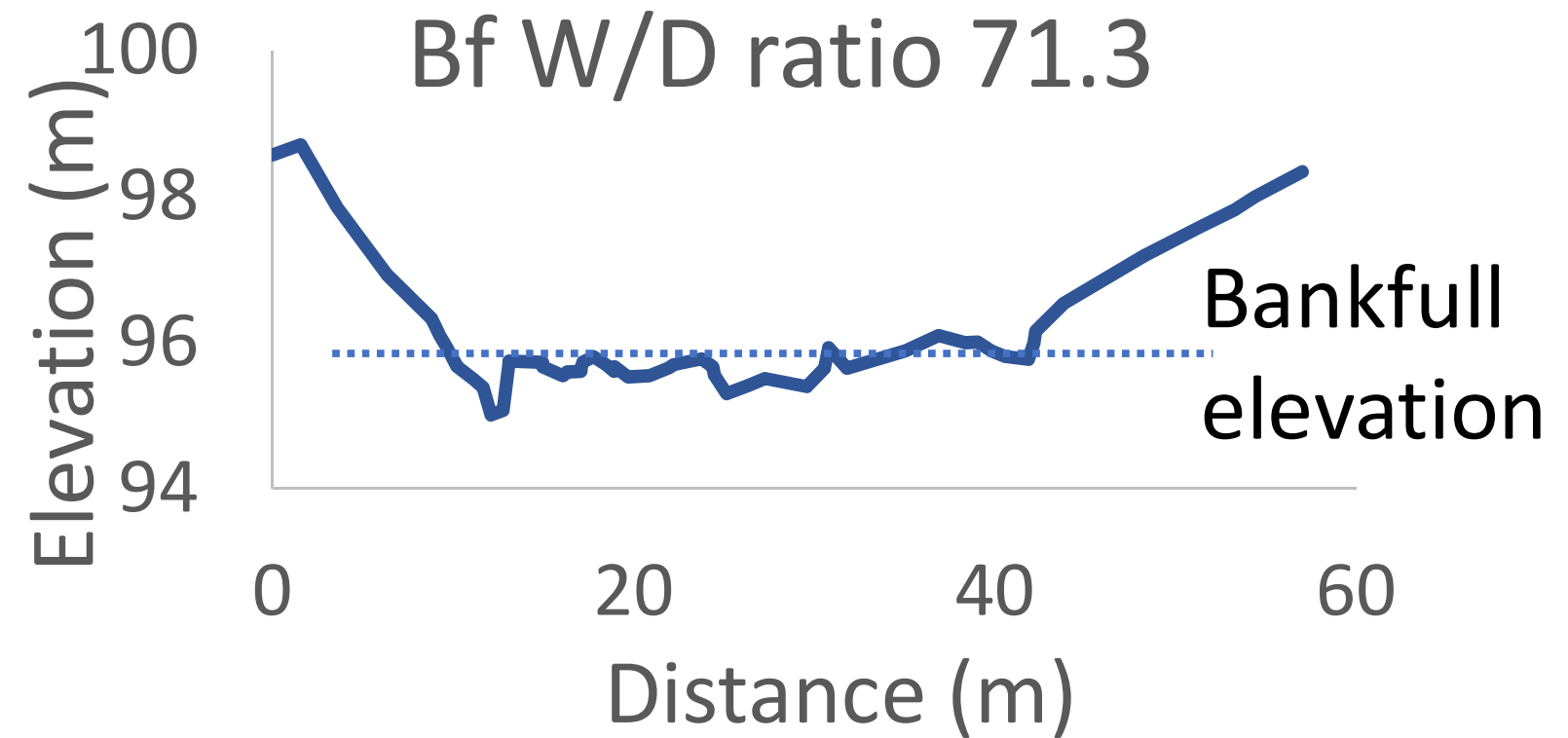
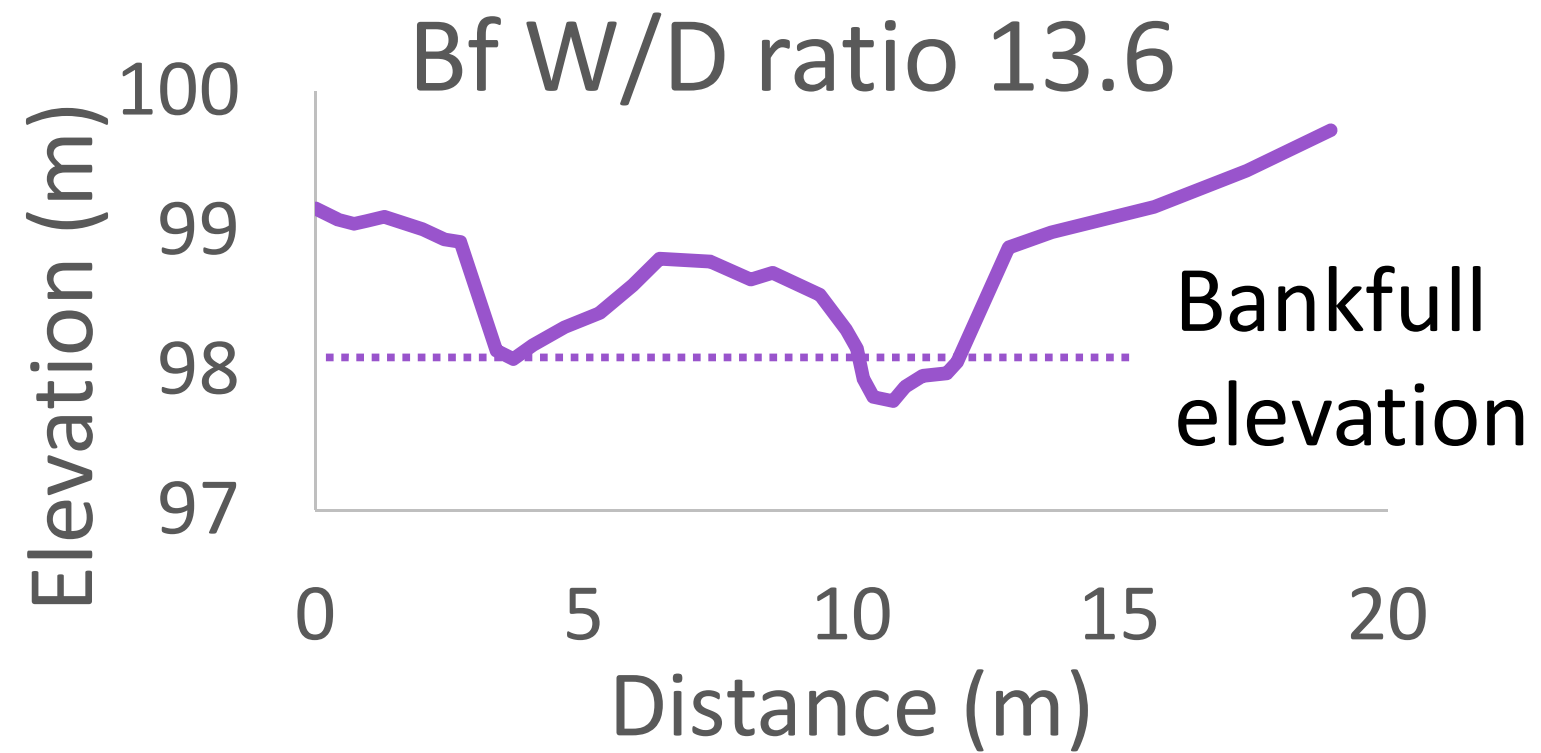


Connection w/ floodplain

No Beaver/No Fire



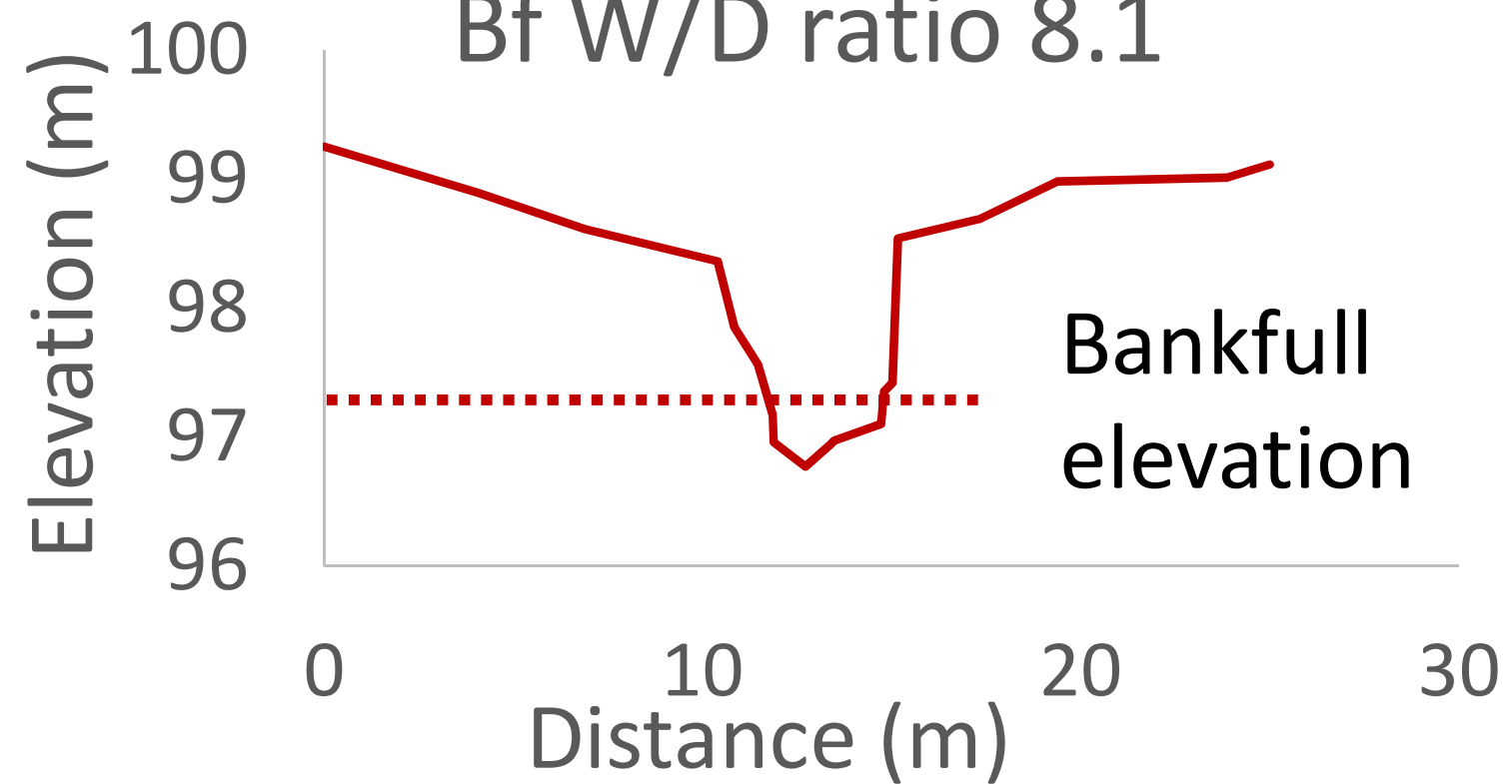
Beaver/No Fire



No Beaver/Fire 2014



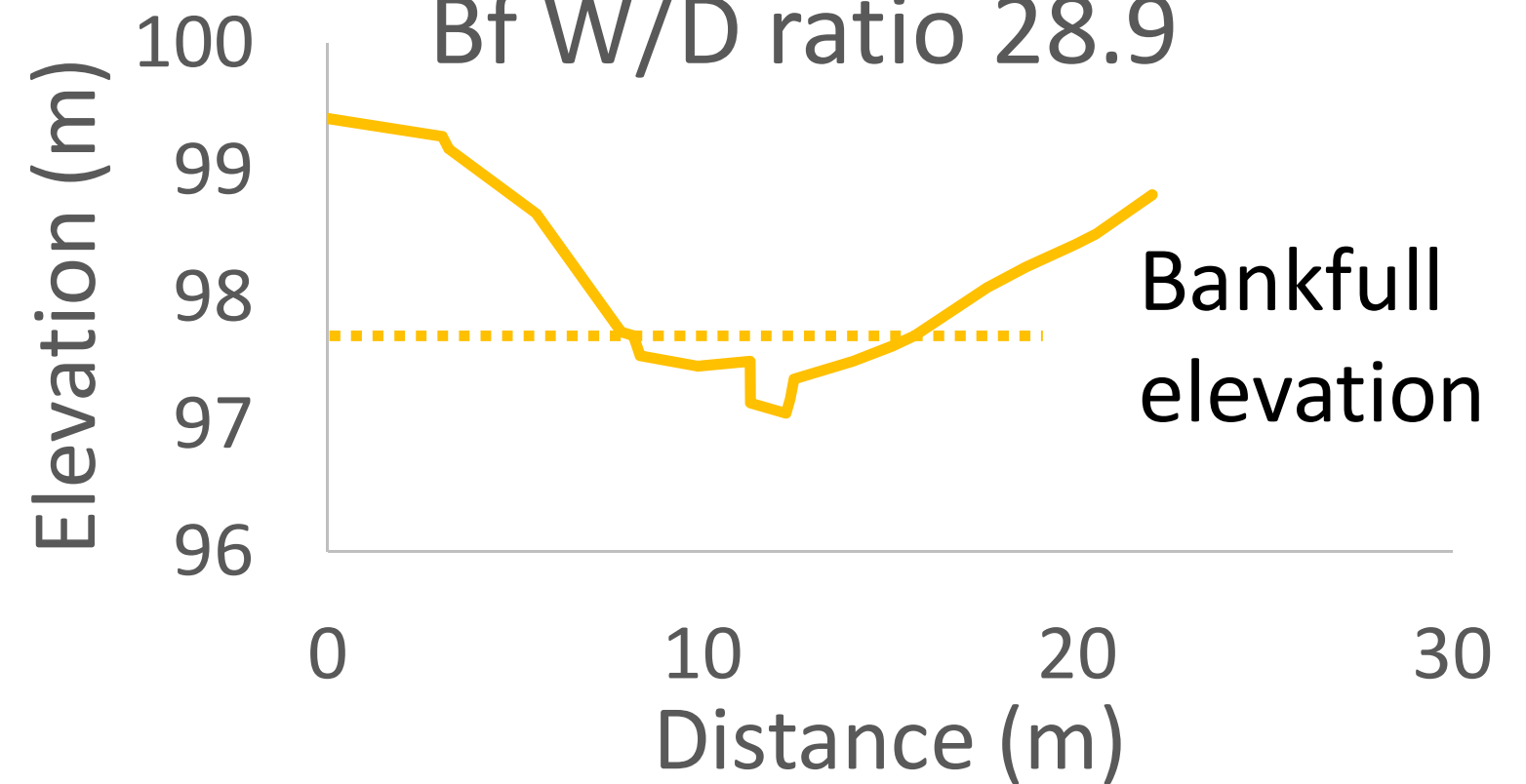
Bf W/D ratio 8.1



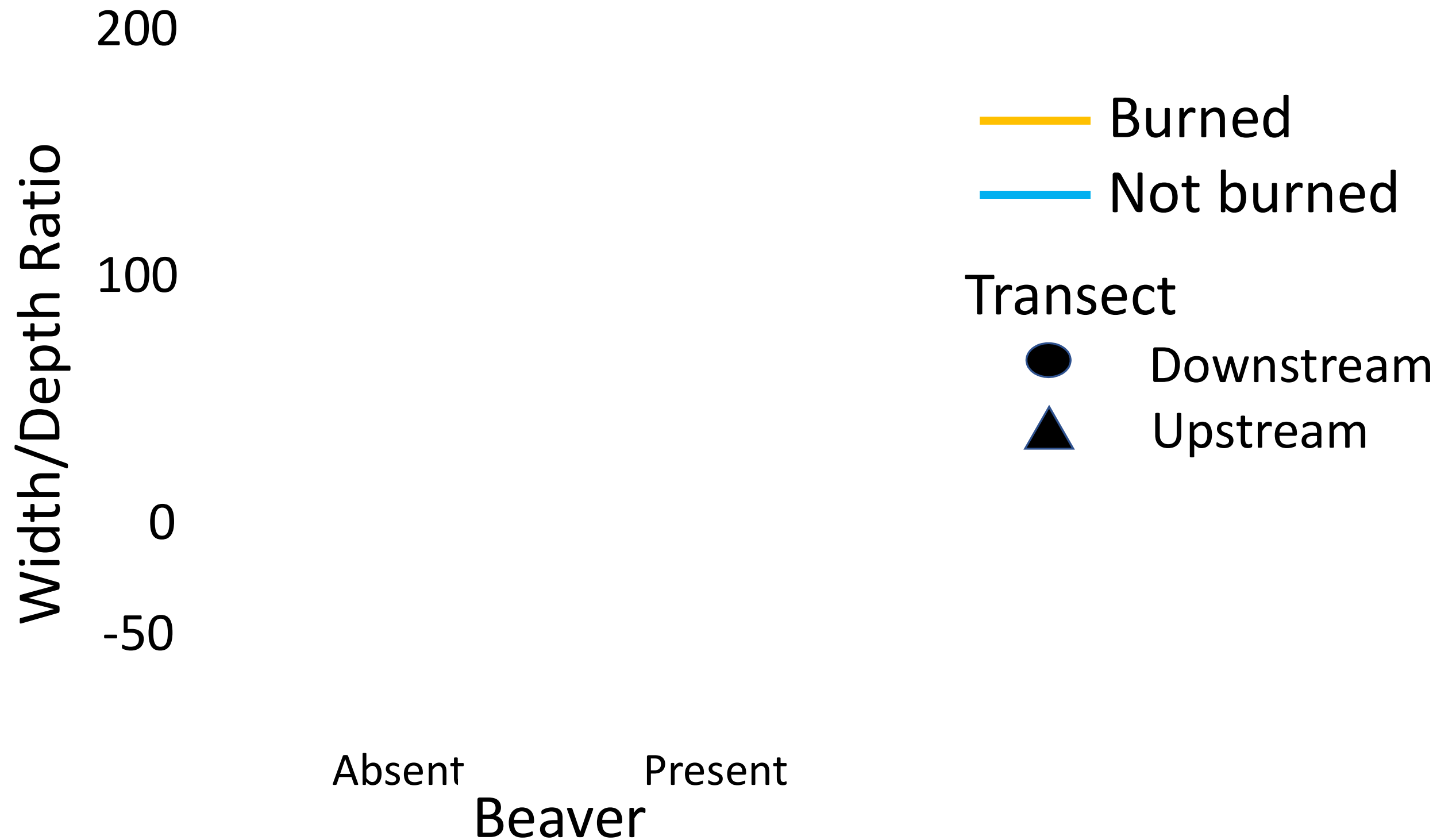
Beaver/Fire 2014



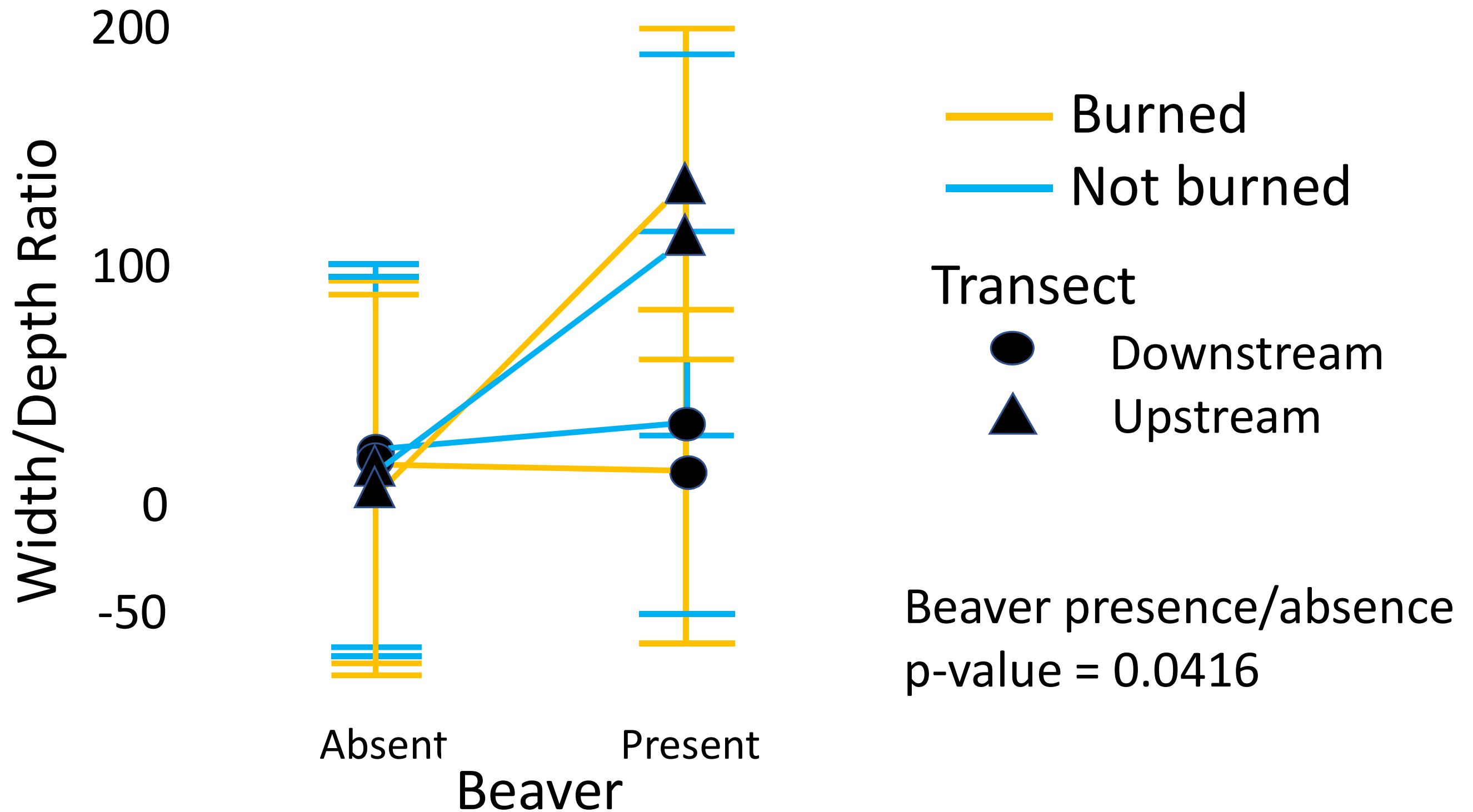
Bf W/D ratio 28.9



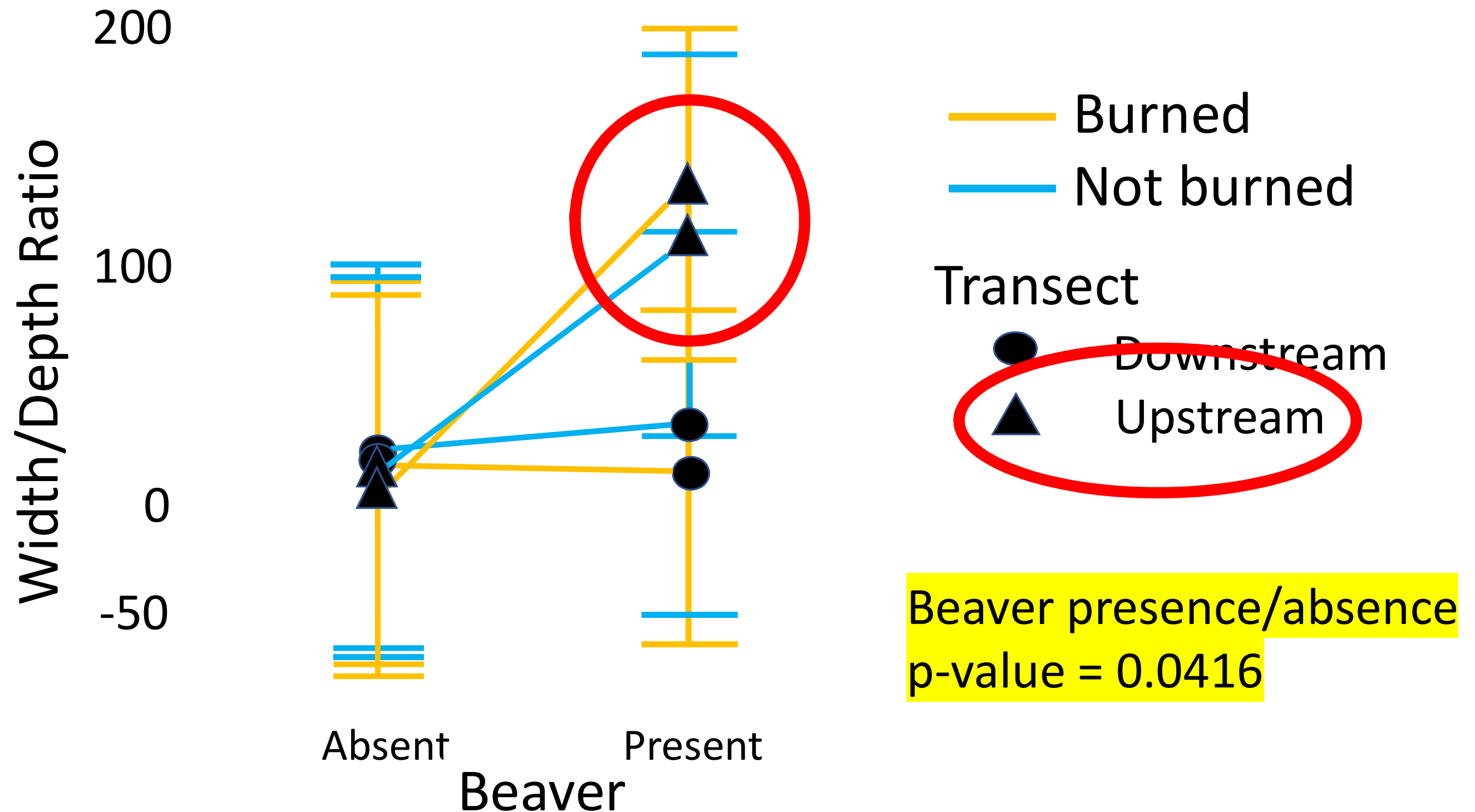
Do beavers increase Width/Depth ratios in burned watersheds?



Do beavers increase Width/Depth ratios in burned watersheds?



Do beavers increase Width/Depth ratios in burned watersheds?



Phosphate and water quality after wildfire

Limiting nutrient

Concentrations increasing 5-10 years after fire (Rust et al 2018)

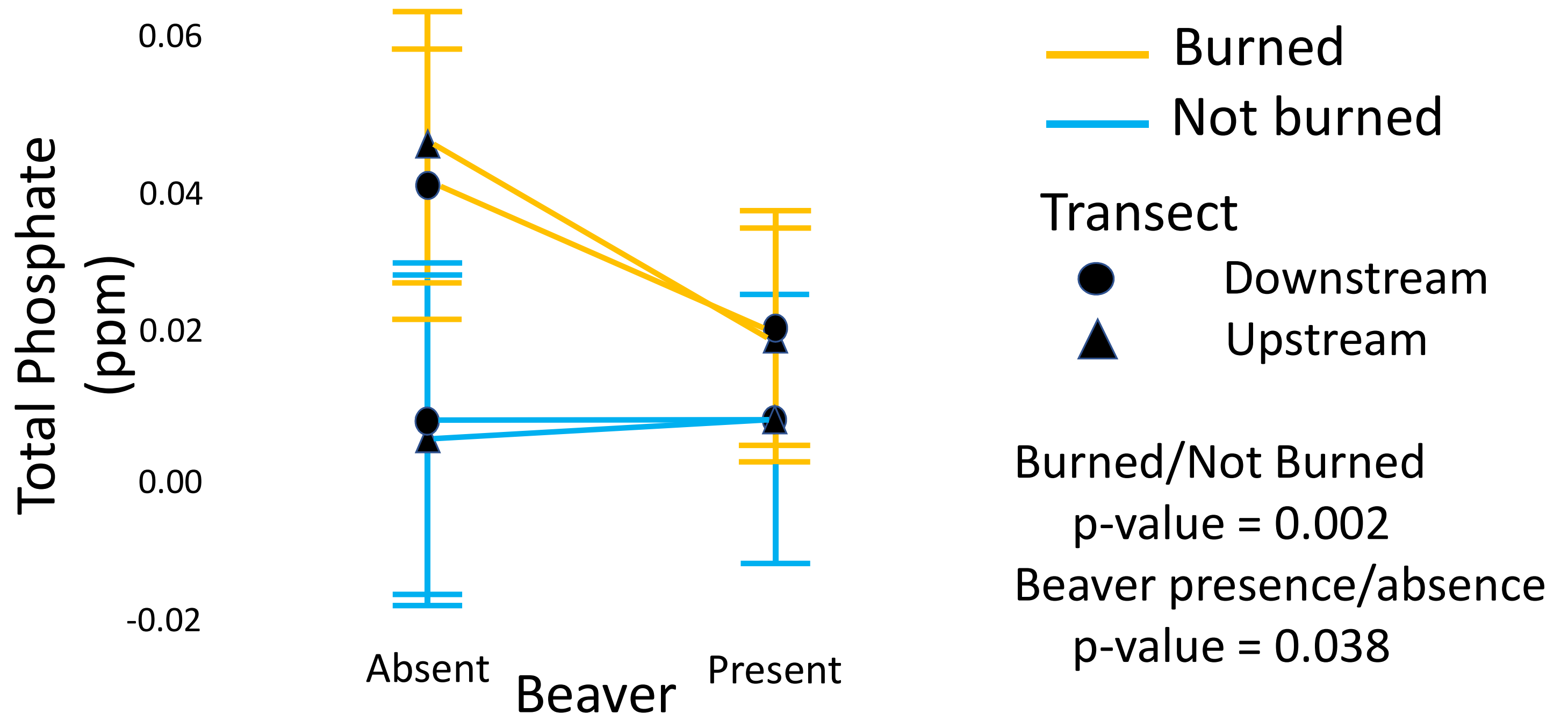
Contributes to eutrophication

Total Phosphorus Analysis

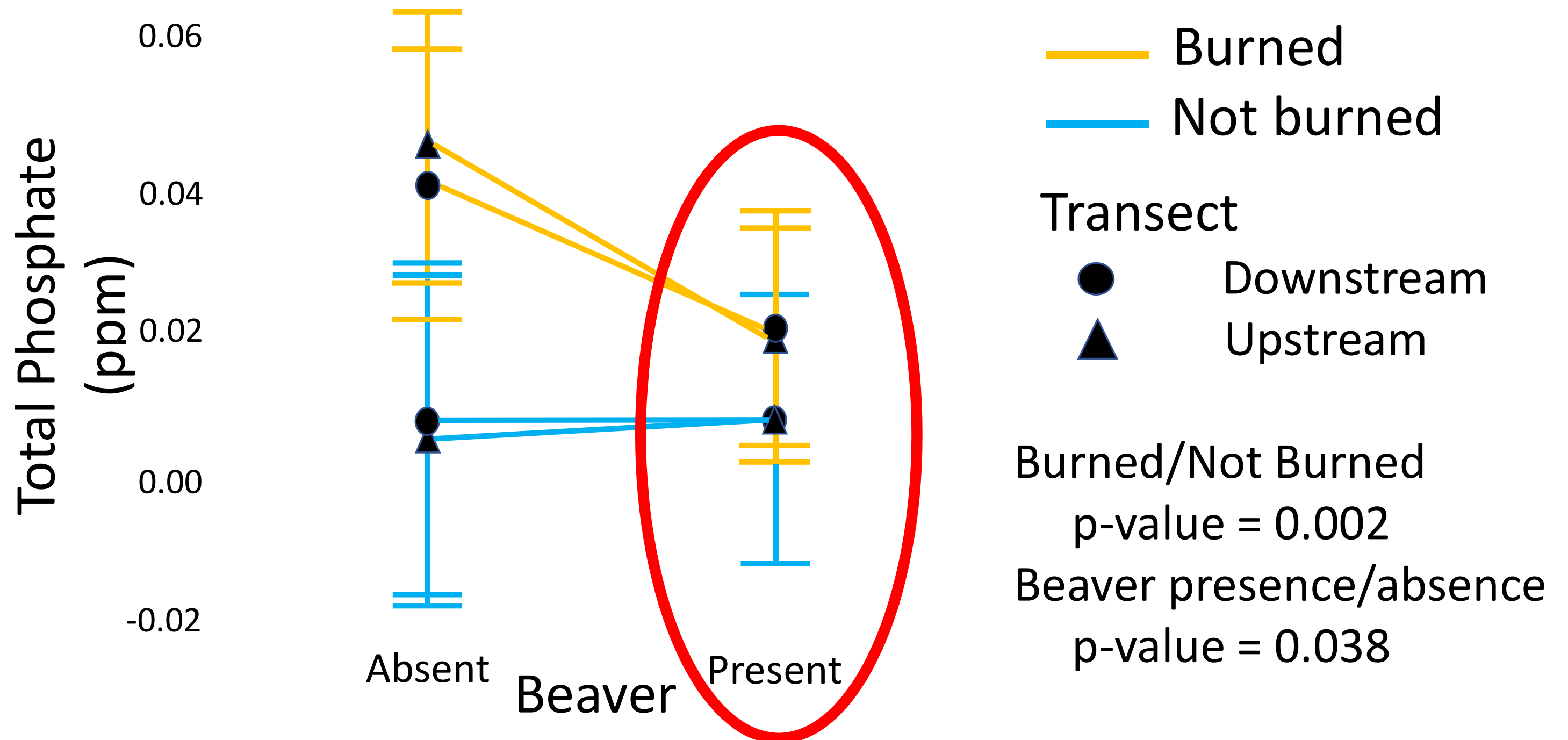
- Filtered and digested samples
- Molybdate/Ascorbic Acid “Blue” method



Do beavers effect concentration of Total Phosphate in burned watersheds?



Do beavers effect concentration of Total Phosphate in burned watersheds?



Do beavers increase riparian resilience after Wildfire?

↑ Width/Depth ratios
in burned channels

↓ Phosphate after fire

Next Steps:

Vegetation species
composition

Water quality analyses





Acknowledgements

- My dear family!
- Rebecca Brown, Margaret O'Connell, Lauren Stachowiak, Stacy Warren - EWU
- Sue Niezgoda - Gonzaga U.
- Torre Stockard & Julie Nelson, Methow Beaver Project
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- My Research Crew – Cole Sherwood, Carissa Simpson, Willy Duguay, Joe Weirich, Jess Rolland



Questions?

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Brozef Shtetz