Geomorphic Influences on River Corridor Resilience to Wildfire Disturbances

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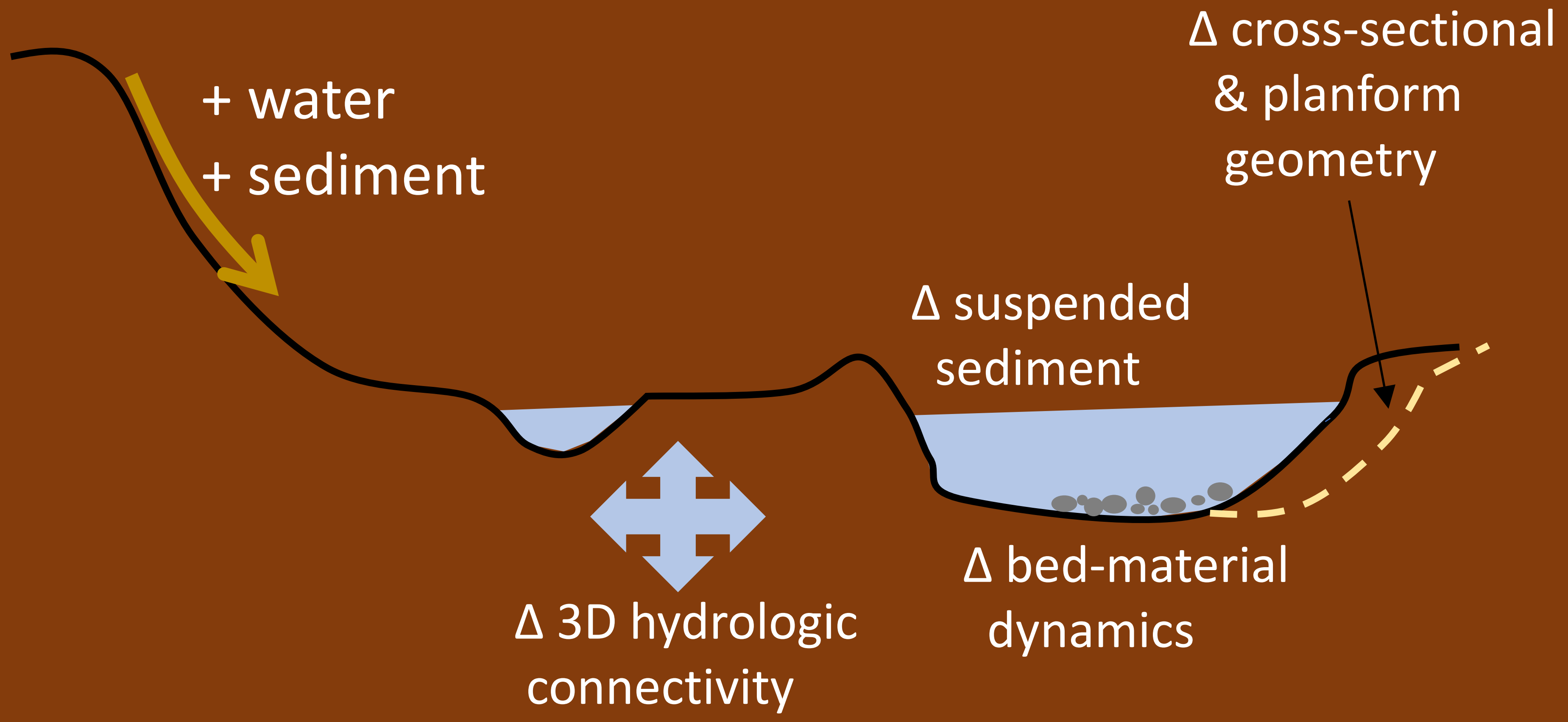
Wildfire Disturbance Cascade



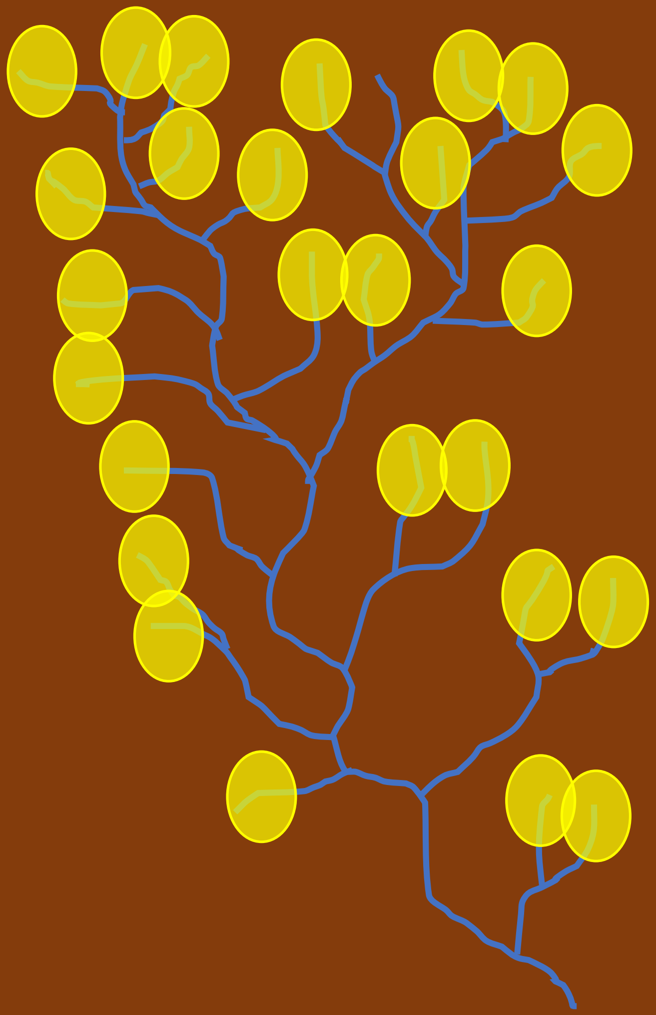
Resilience

ability to recover to pre-disturbance conditions

continuum dependent on time & space scales, rather than binary

system (e.g., river network or river corridor) includes individual components with different levels of resilience

Disturbance cascade within a reach & transmission downstream within a river network



Resilience at the network-scale is fostered by attenuating inputs at the reach-scale

cumulative importance of headwaters

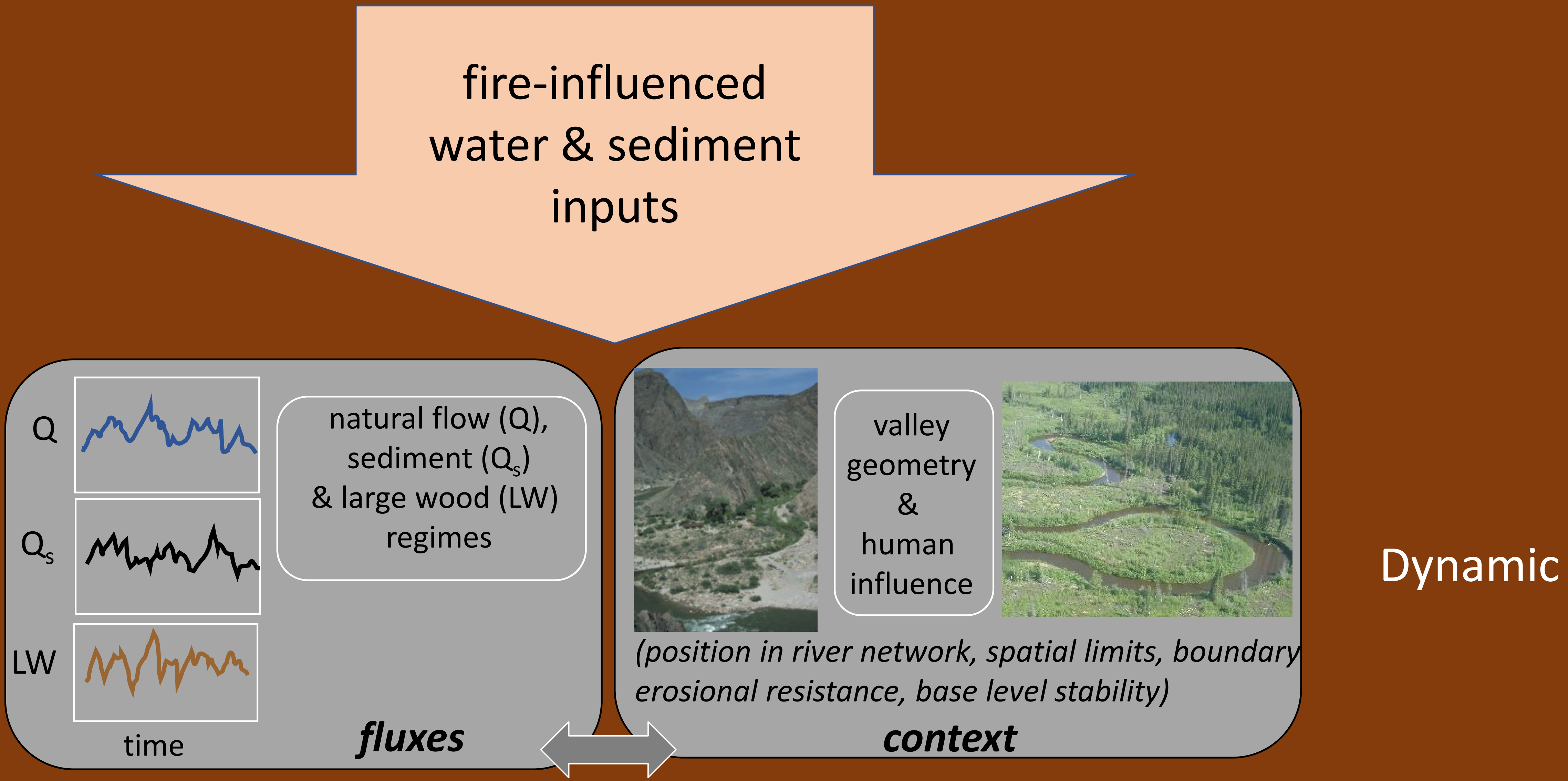
What characteristics of a river corridor influence the disturbance cascade at the reach-scale?

- configuration & stability of river corridor
  - valley floor lateral confinement & gradient
  - flow regime
  - sediment regime
  - vegetation & large wood regime
  - biota

Pre-existing

- post-fire water & sediment inputs (magnitude, frequency, duration, timing)

Disturbance


fire-influenced water & sediment inputs
Q
Q_s
LW
time
natural flow (Q), sediment (Q_s) & large wood (LW) regimes
fluxes
valley geometry & human influence
(position in river network, spatial limits, boundary erosional resistance, base level stability)
context
Dynamic

Configuration & stability influence resilience

and

the details of inputs following disturbance
govern how the river corridor might be altered

Example: Little Beaver Creek, Colorado

drainage area 40 km^2

old-growth montane forest

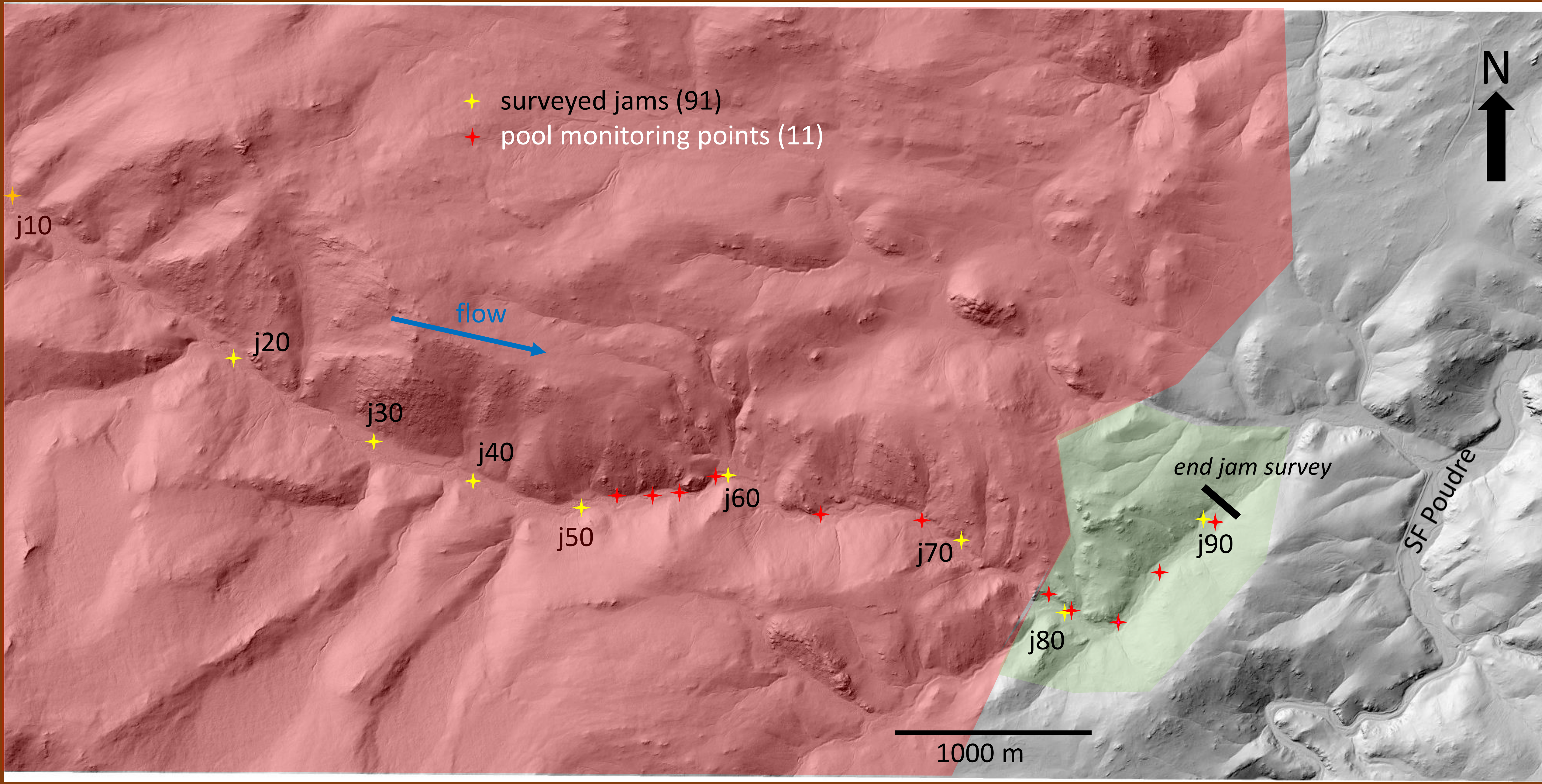
abundant large wood & history of beaver activity

avg S 0.025 m/m; cobble-boulder substrate; pool-riffle to wood-forced steps

floodplain width 15 to 50 m

single-thread to anastomosing planform

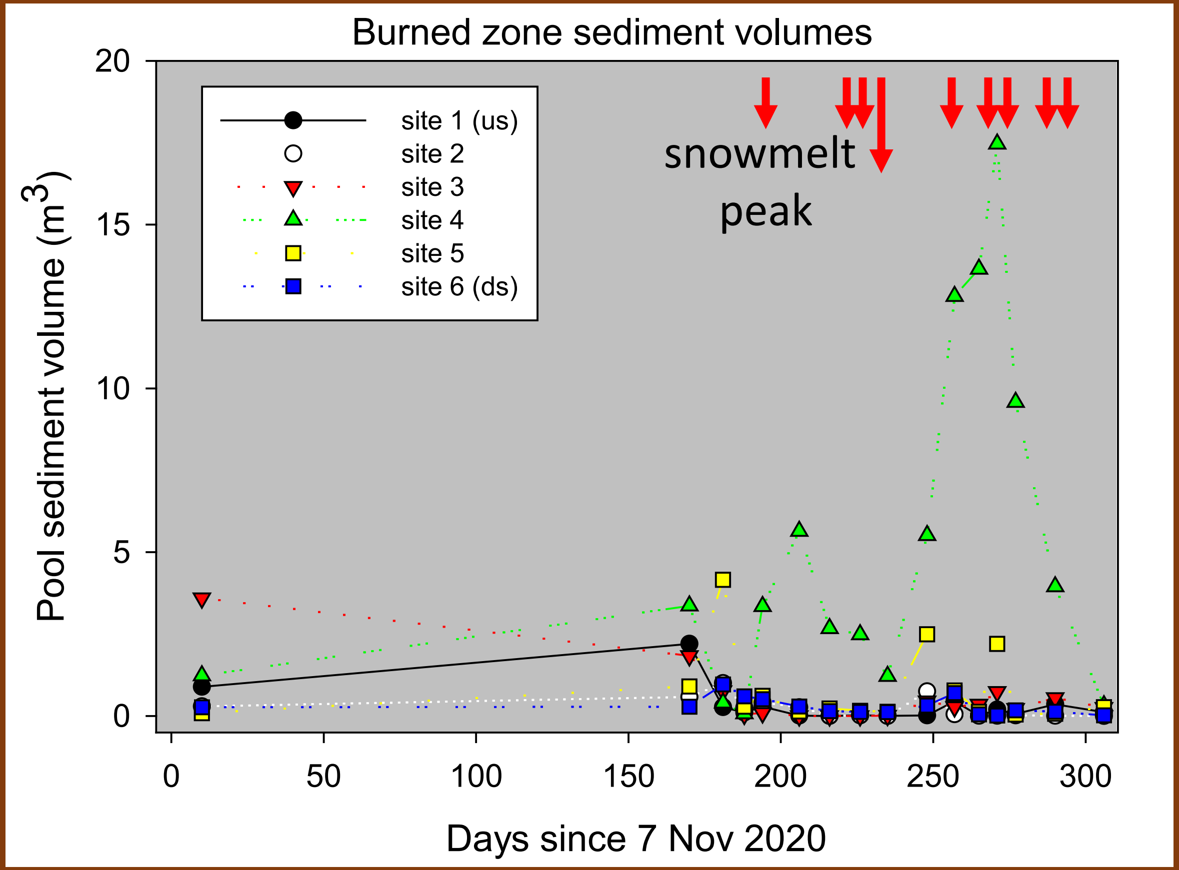
snowmelt peak flow with summer convective storms

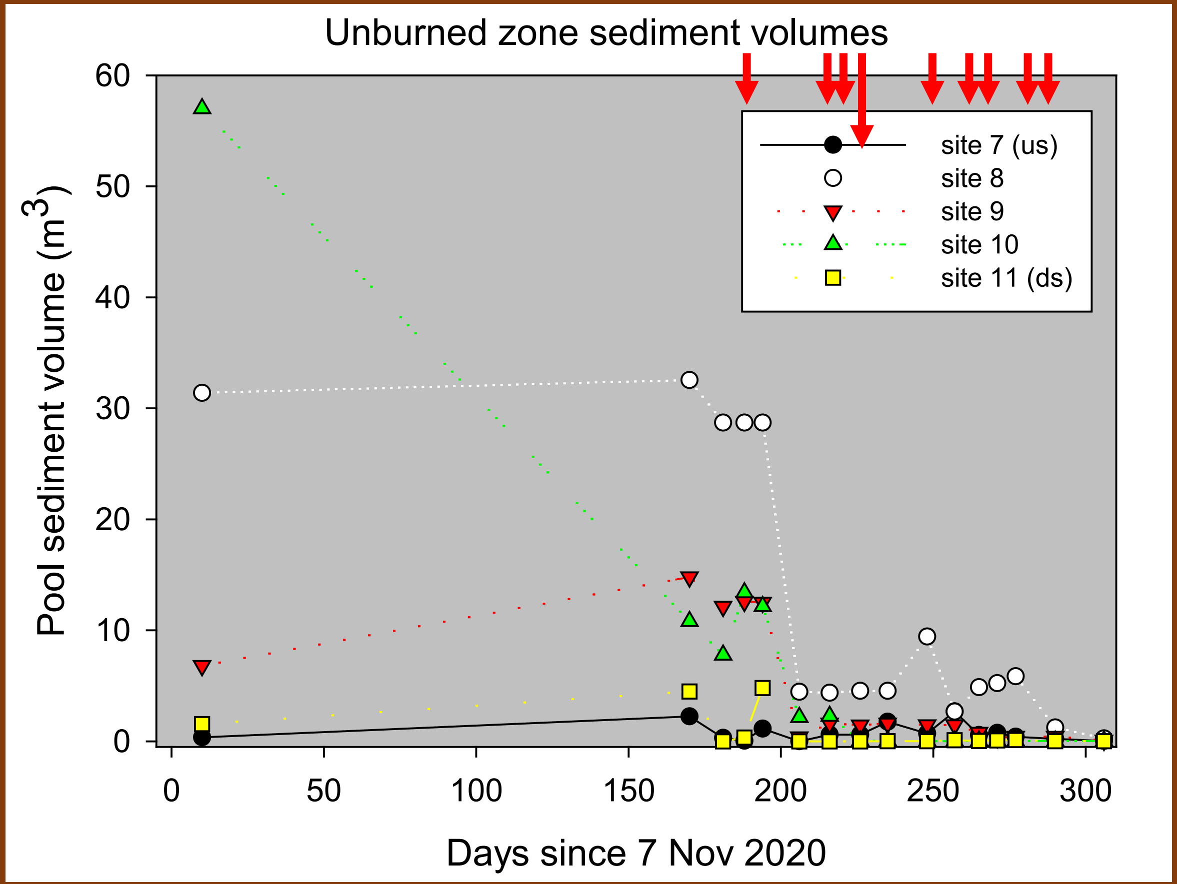


red area burned, green did not


7 November 2020

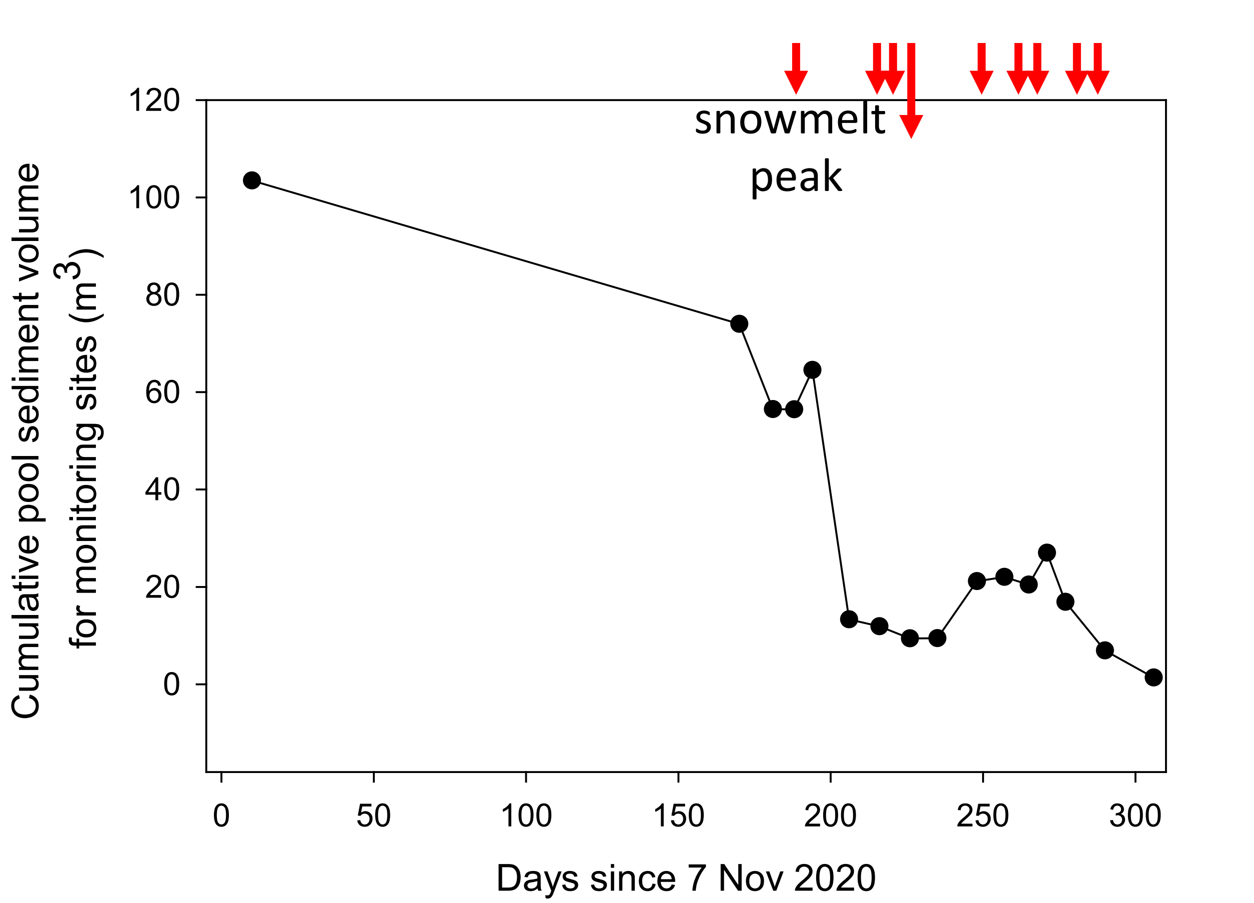
Temporal changes not consistent between sites





Differences in volume of sediment stored in logjam backwaters more strongly influenced by size & stability of logjam than by discharge or sediment supply

Cumulative sediment storage at 11 monitoring sites declines with time



Largely as a result of jams breaking up & losing storage capacity

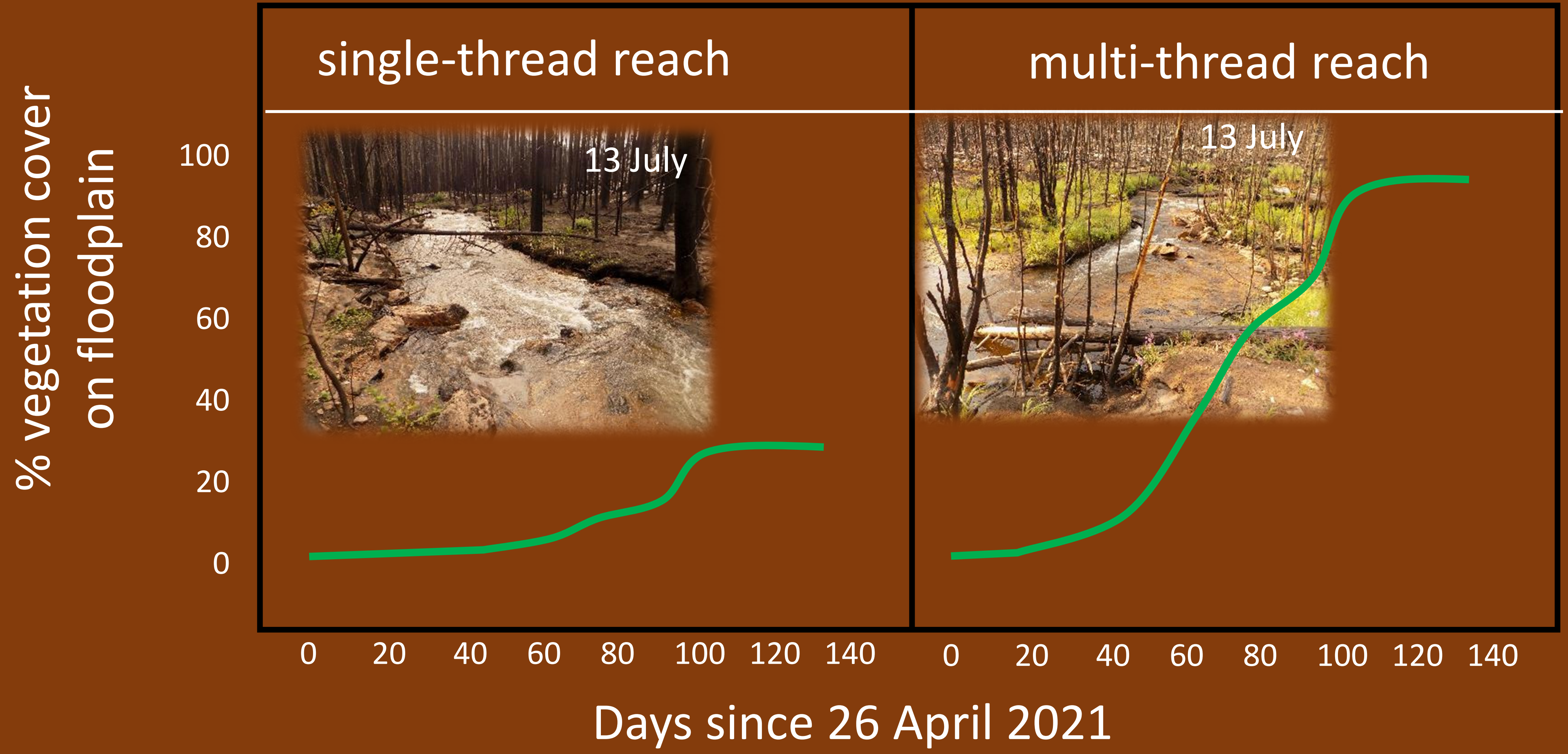
26 April

9 September

Logjams & relict beaver dams that are now vegetated berms foster formation of secondary channels & channel-floodplain-hyporheic connectivity

Portions of the river corridor with greater spatial heterogeneity & connectivity more effectively attenuate downstream fluxes of water and sediment & facilitate vegetation regrowth on the floodplain, thus enhancing downstream resilience to the wildfire disturbance

Reach-scale response for floodplain vegetation during first year following fire



Within a reach, spatial heterogeneity promotes in-channel & floodplain deposition & floodplain re-vegetation (single-thread, steeper channel reaches tend to quickly pass water & sediment downstream & have more bank erosion)

At the network scale, the presence of more heterogeneous, retentive reaches presumably reduces the effects of the disturbance cascade to downstream portions of the network

Valley segments with less lateral confinement & greater spatial heterogeneity most effectively attenuate downstream fluxes of post-fire water & sediment inputs –

storage in backwaters, secondary channels, on floodplain

Management & restoration that foster spatial heterogeneity within selected reaches can enhance resilience to wildfire disturbance cascade

Reach-scale valley geometry (10^2 m^2)

wide, low gradient reaches

old beaver-dam berm traps wood → channel-spanning logjam

SPATIAL HETEROGENEITY → RESILIENCE

logjam backwater stores sediment & jam promotes overbank flow, secondary channels, & hyporheic exchange flow

higher water table & sediment deposition promote floodplain re-vegetation

beaver return & build new dams

Go to www.menti.com and use the code 8302 0921

What is your primary reason for trying to understand or foster resilience after wildfire?

- attenuating downstream water & sediment fluxes
- protecting river biota
- maintaining water quality
- all of the above
- other