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## Forest resilience to fire in the western US: a test case for using satellite metrics to assess spatial and temporal patterns of forest recovery

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Johnson, Marie, "Forest resilience to fire in the western US: a test case for using satellite metrics to assess spatial and temporal patterns of forest recovery" (2021). *UM Graduate Student Research Conference (GradCon)*. 9.

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# Forest Resilience to Wildfire in the West



Marie Johnson

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Global Climate & Ecology Lab

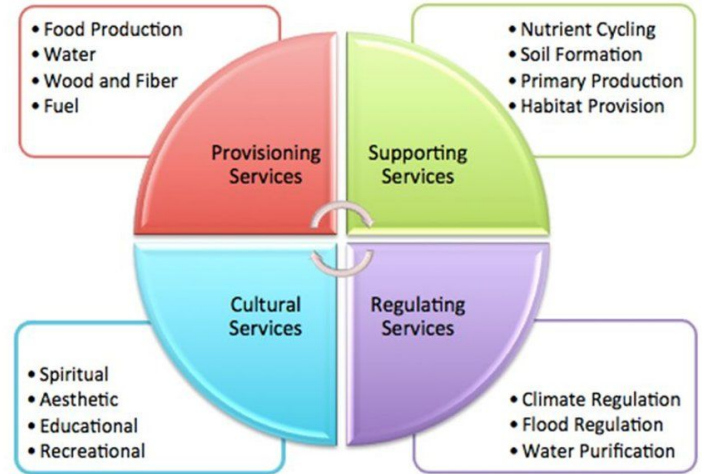
Advisor: Dr. Ashley Ballantyne

# Why should we care about forest loss?



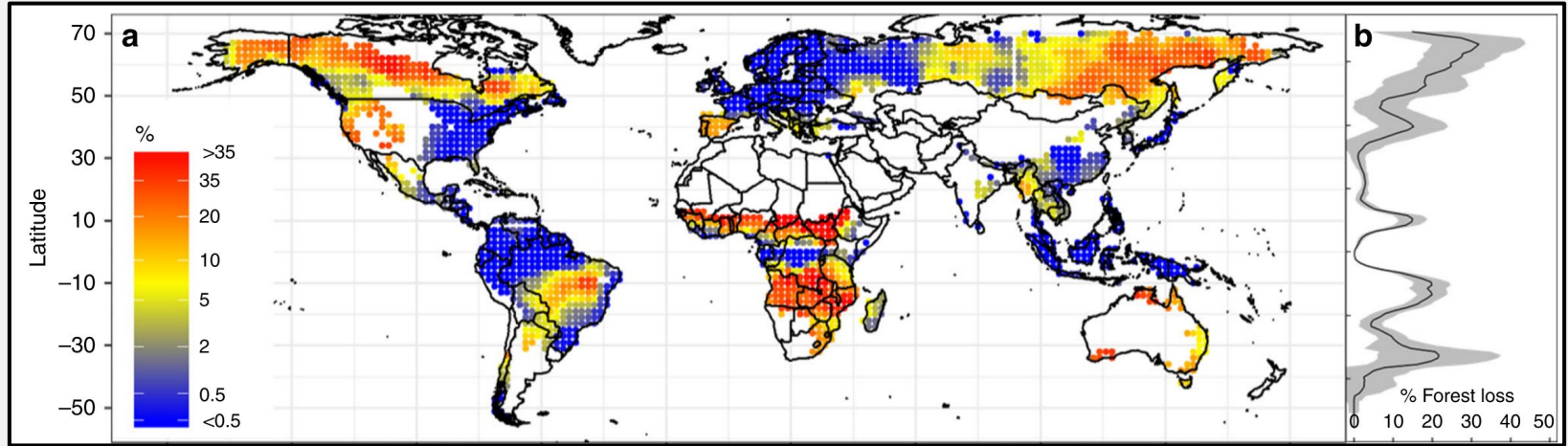
Gallatin National Forest (*American Rivers*)

## Forests provide ecosystem services



(*Millenium Ecosystem Assessment, 2005*)

# Why should we care about wildfire and forest recovery?



Percent forest loss due to wildfire 2003-2014 (Liu et al. 2019)

- 15% fire-induced forest loss globally
- Western US and forested ecosystems



# Yellowstone National Park Fires



1988



2018

*Photos by Larry Mayer, Billings Gazette*

# Forest Disturbances

*A discrete event that disrupts energy and material flows within an ecosystem*



Insects



Drought



Natural disaster



Wildfire

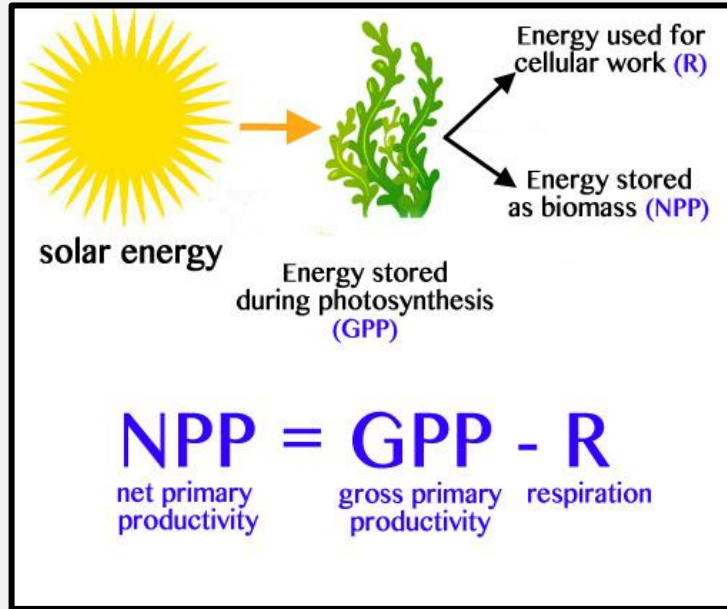


# Resilience: It isn't all about the trees!

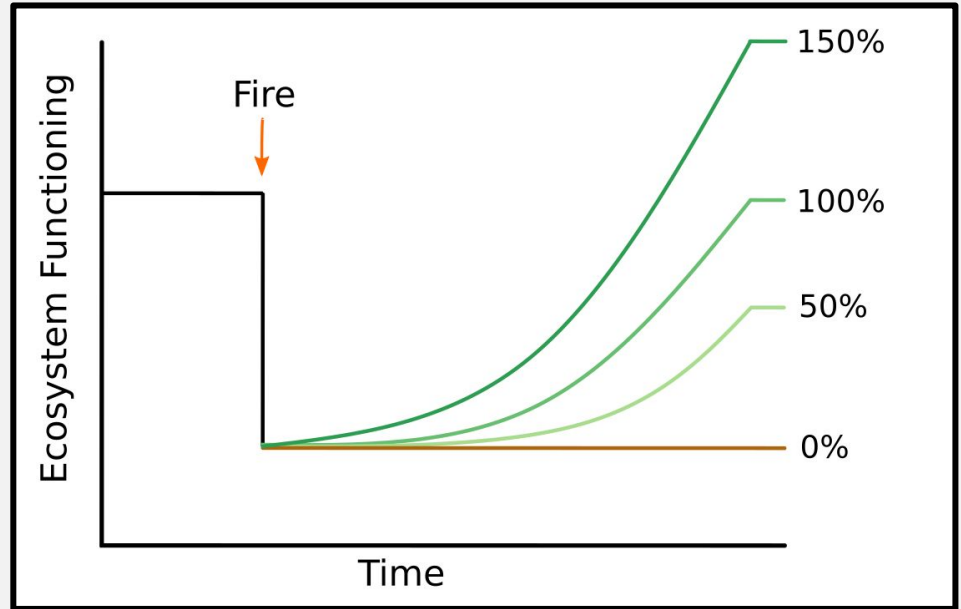
*The capacity of a forest to withstand a disturbance while maintaining its 'identity' in terms of function, composition, and structure*

Resilience Property		Definition	Examples
Resilience	Function	Processes within an ecosystem and their interactions	Photosynthesis Nutrient cycles
	Structure	Physical characteristics of size and distribution	Tree height, density, canopy cover
	Composition	Makeup of vegetation	Species abundance Vegetation types

# Ecosystem Function: Net Primary Production



Plant structural biomass - stems, leaves, roots *Krempels 2010*



Conceptual diagram recovery following fire

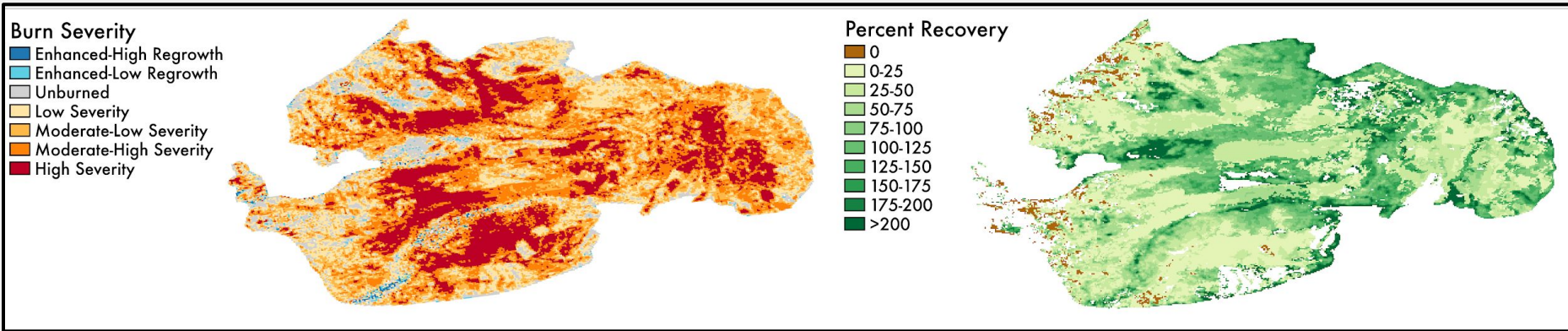


# The Crazy Horse Fire



- Burn 2003
- Mission Wilderness and Flathead National Forest
- ~11,000 acres

# Recovery of Net Primary Production at Crazy Horse

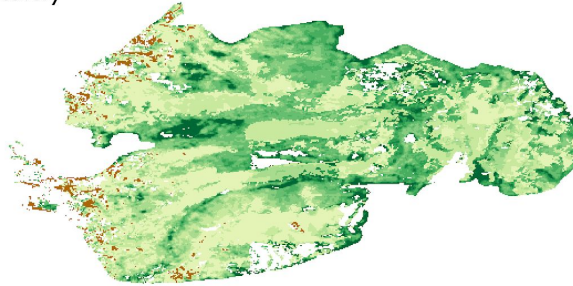
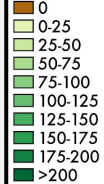


Crazy Horse Fire 2003

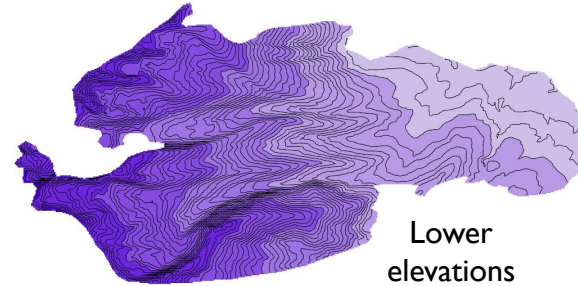
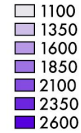
NPP recovery in 2018

# What explains recovery?

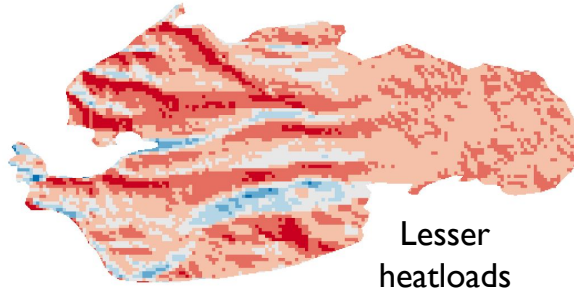
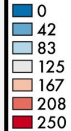
Percent Recovery



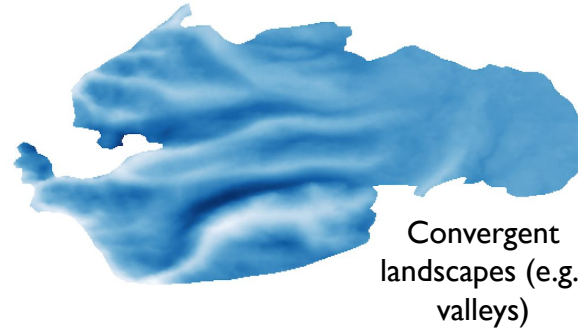
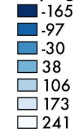
Elevation



Continuous Heat-Insolation Load Index



Topographic Position Index



Topographic predictors of recovery

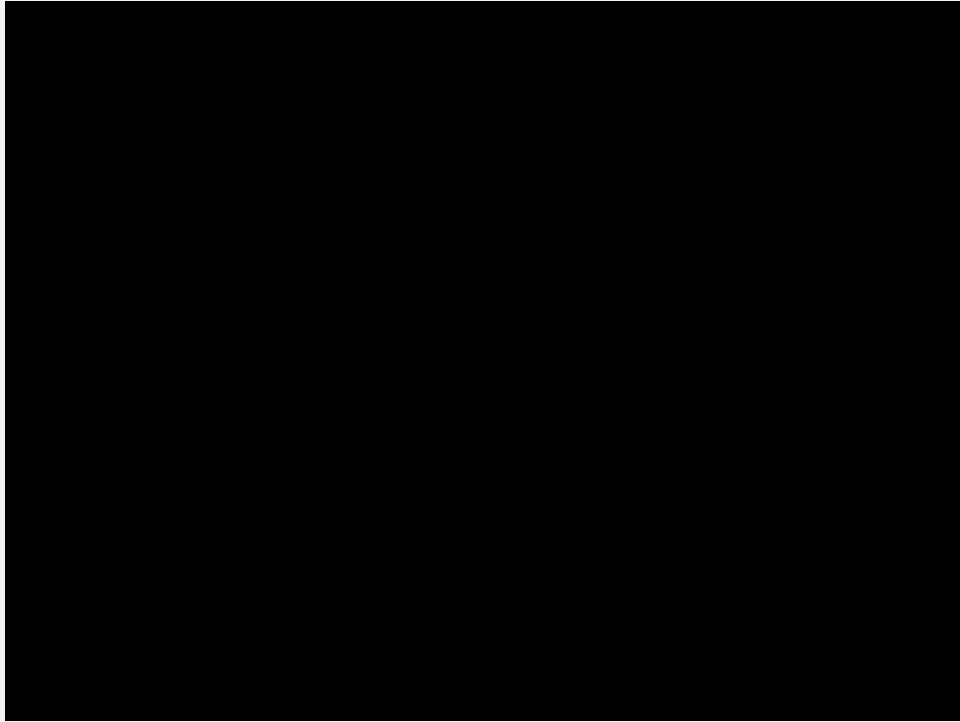


## How does recovery compare on the ground?



The Crazy Horse Fire 16 years later (2019)

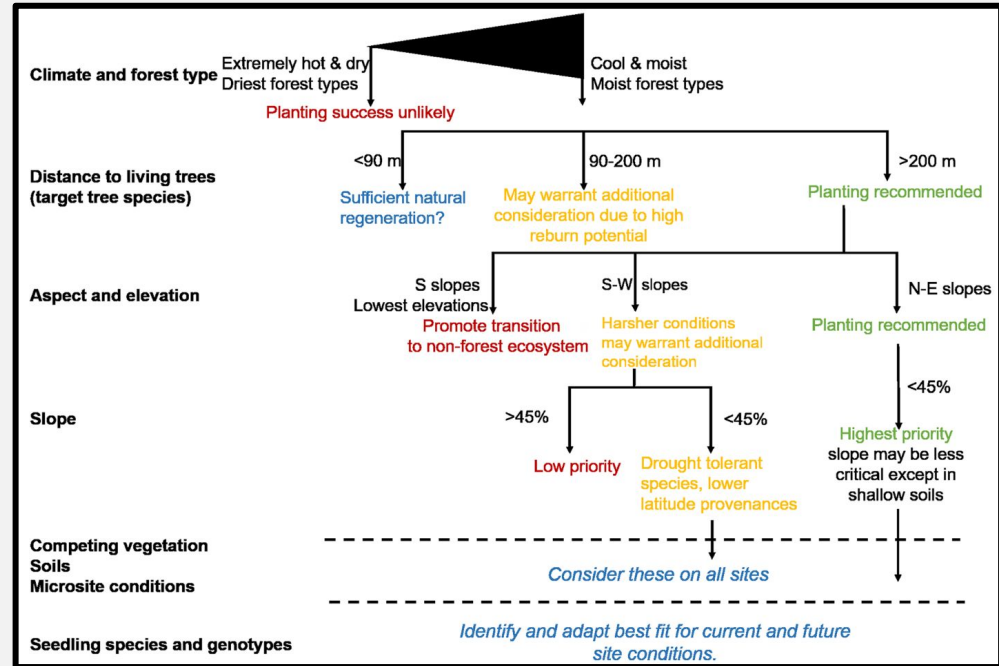
## How does recovery compare on the ground?



Percent recovery estimated at 30% for this location

# How do we manage forests for their continued existence?

- Structure & Composition
- Decision support trees



Stevens-Rumann et al. 2019



Thanks for listening!