



# Ecosystem Resiliency Measures in the Gardiner Basin

Clayton B. Marlow

Montana State University



# 2015 - Project Goal and Objectives



- Goals

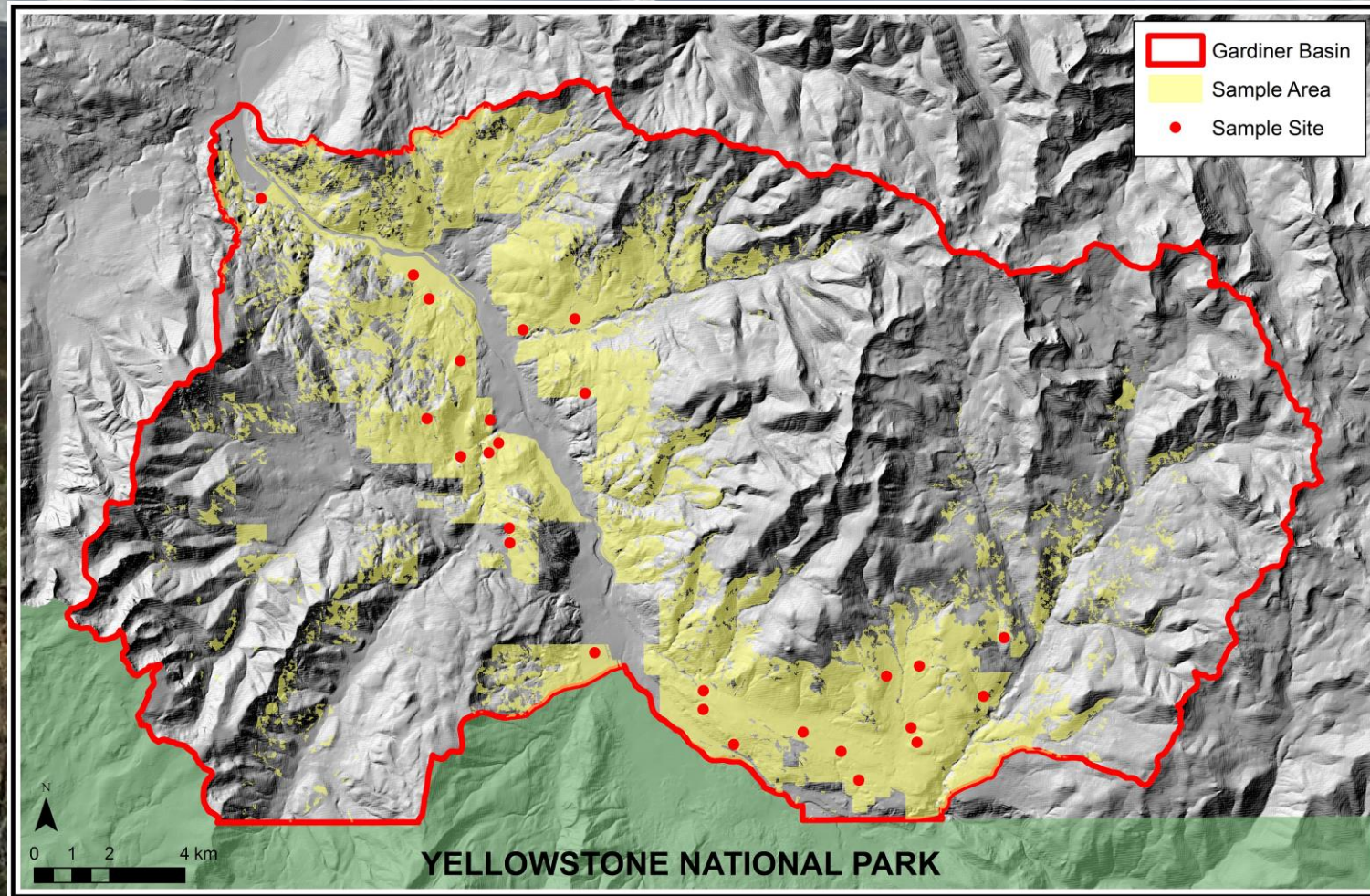
- Develop ecological baseline for Forest Service lands north of YNP
- Becomes basis for monitoring grassland communities as dominant grazer shifts from elk to bison

- The Purpose of Monitoring

- Accomplishment of management goals or revise existing strategies
- Historically most monitoring addressed response of vegetation to grazing pressure



# 2015 Field Survey





# Ecosystem Measurements

## Soils



## Vegetation





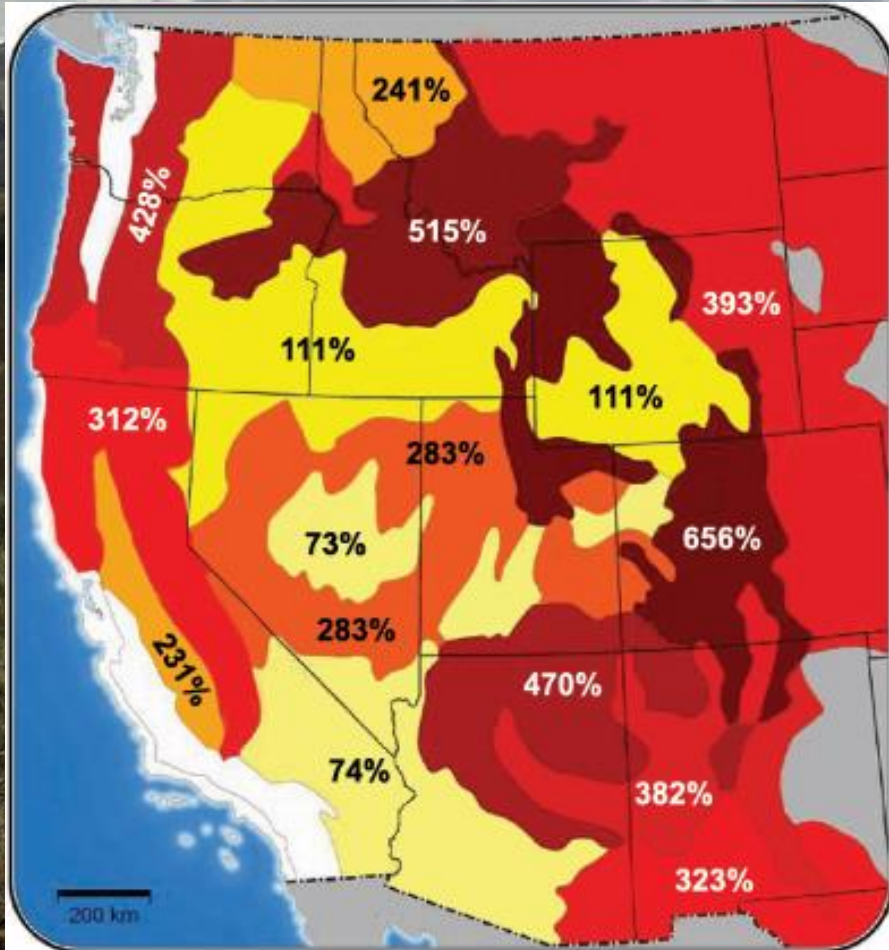
# Ecosystem Resiliency



capacity to recover following disturbance



# Increasingly important under changing climate

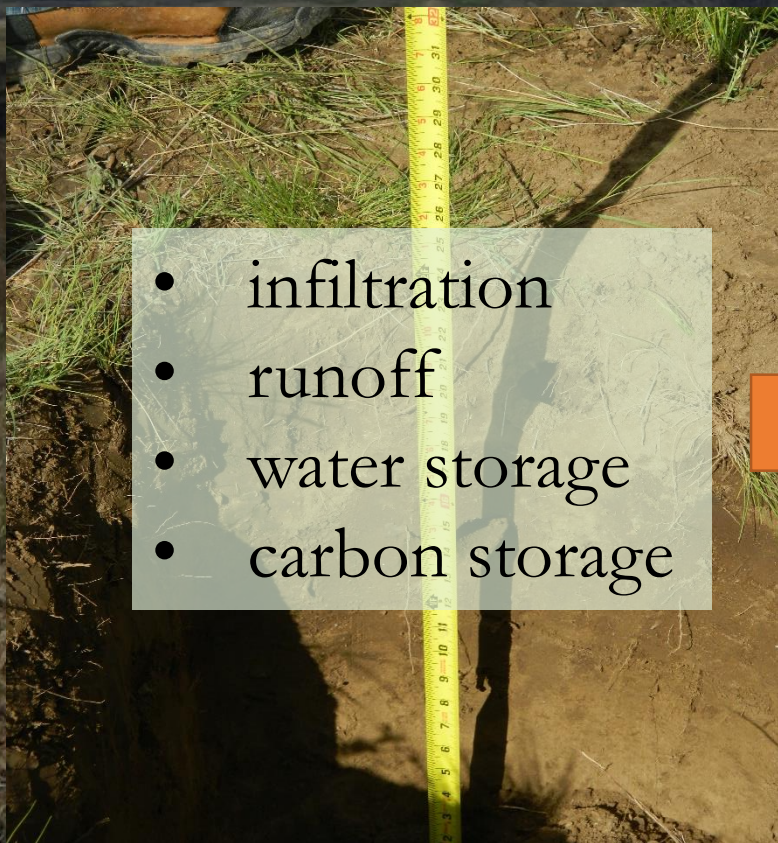


- Can current systems recover in face of projected increase in occurrence and severity of wildfire??
  - Likely if critical processes remain intact
- Basis for system resiliency
  - Soil health
  - Watershed condition

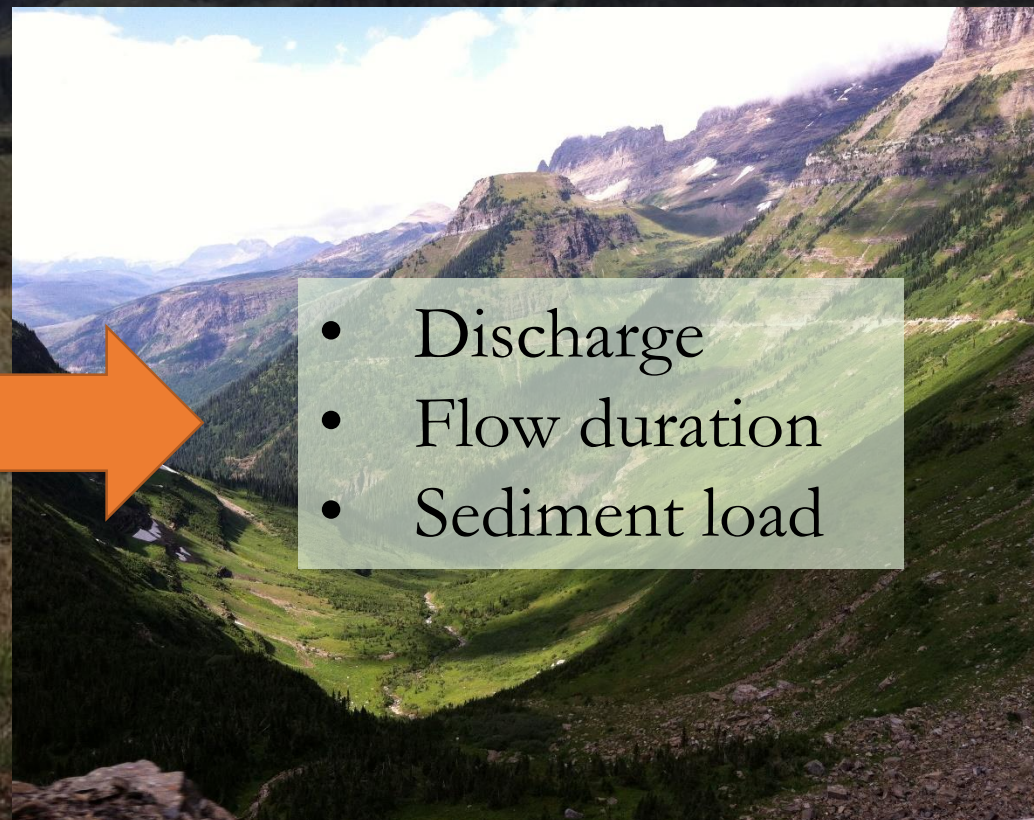


# Critical Processes

## Soil Health



## Watershed



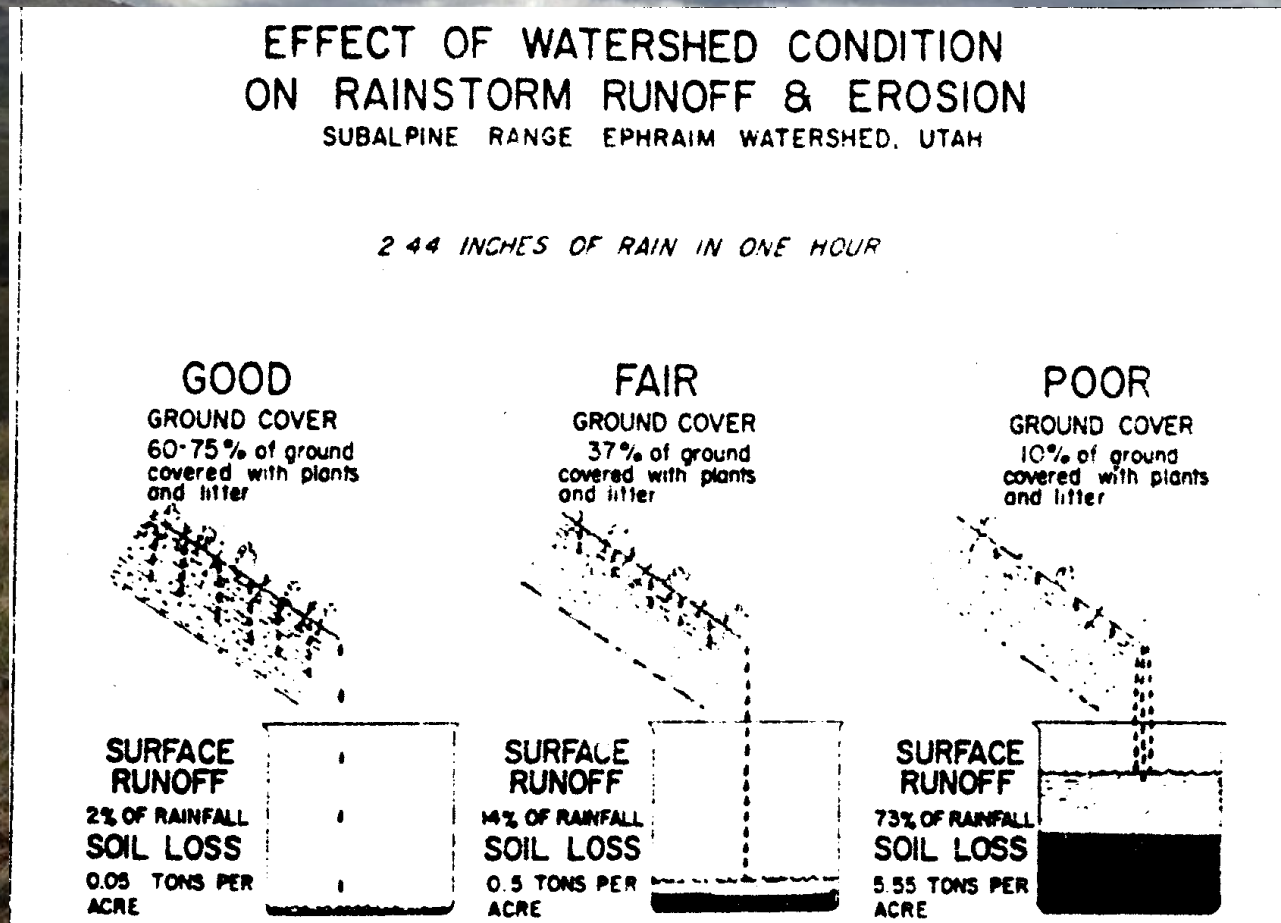


# Vegetation Community Composition

- Contributes to ecosystem resiliency through:
  - Building and maintaining soils
    - Addition of organic matter (roots and litter) makes soils more stable
    - Stable soil aggregates increase water infiltration
  - Control of infiltration rates and therefore runoff
    - Vegetation cover limits soil crusting (maintains infiltration)
    - High infiltration rates = less runoff
    - Lower runoff = less sediment delivery to streams and rivers



# Vegetation cover is link between soil health and watershed condition





# Watershed Condition in the Gardiner Basin



<b>Geology</b>	<b>4-15%</b>	<b>15-35%</b>	<b>35-60%</b>
unconsol	34	45	73
bedrock	32	46	33

## Likely Erosion Rate

<b>Low</b>	<b>Mod</b>	<b>high</b>
25	63	90



# Dominant Species (NE Aspect)

Species	4-15%		15-35%		35-60%	
Sagebrush	8	15	0	6		10
Idaho fescue	<1	4	0	1		5
Junegrass	2	2	4	3		0.5
Indian Ricegrass	<1	0	<1	0		<1
Sandberg bluegrass	2.5	3	3	3		<1
Bluebunch wheatgrass	2	5	5	5		6
Needleandthread	2	6	1	2		<1



# What does grassland composition say about Gardiner Basin resiliency?

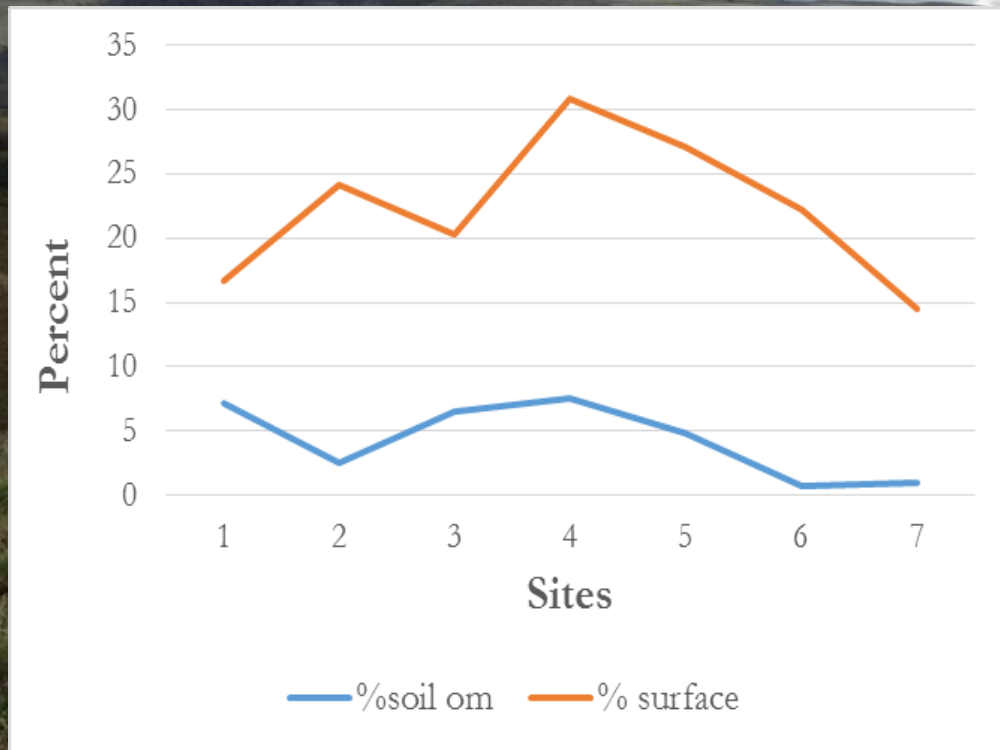
- Slope, aspect and geology strongly affect plant community dominants
- Sagebrush more common on 15%+ slopes
- Idaho Fescue most abundant on NE aspects
- Bluebunch wheatgrass most abundant on 15 – 35% slopes
- Needleandthread grass most abundant on 4 – 15% slopes

Reference	Percent	4 – 15%		15 – 35%		35 – 60%	
Sagebrush	18	28	34	2**	29	46	21
Other woodies	2	2	2	0.2	7	0	2
Climax grasses	45	32	36	57*	27	46*	36
Perennial grasses	12	23*	15	33*	20*	8	17
Forbs	23	14	13	8	17	0	24



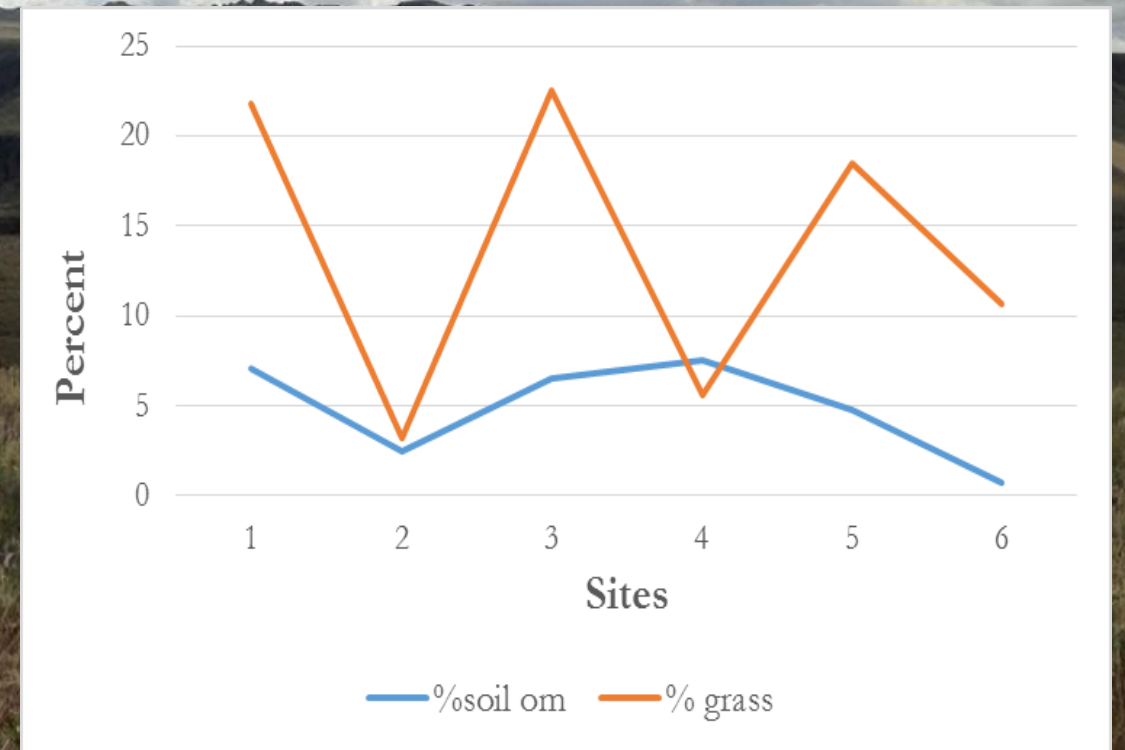
# 4 – 15% Slopes

## Residual (Litter)



$P = 0.40$ , Adj  $R_{sq} = -0.03$

## Perennial Grass Cover

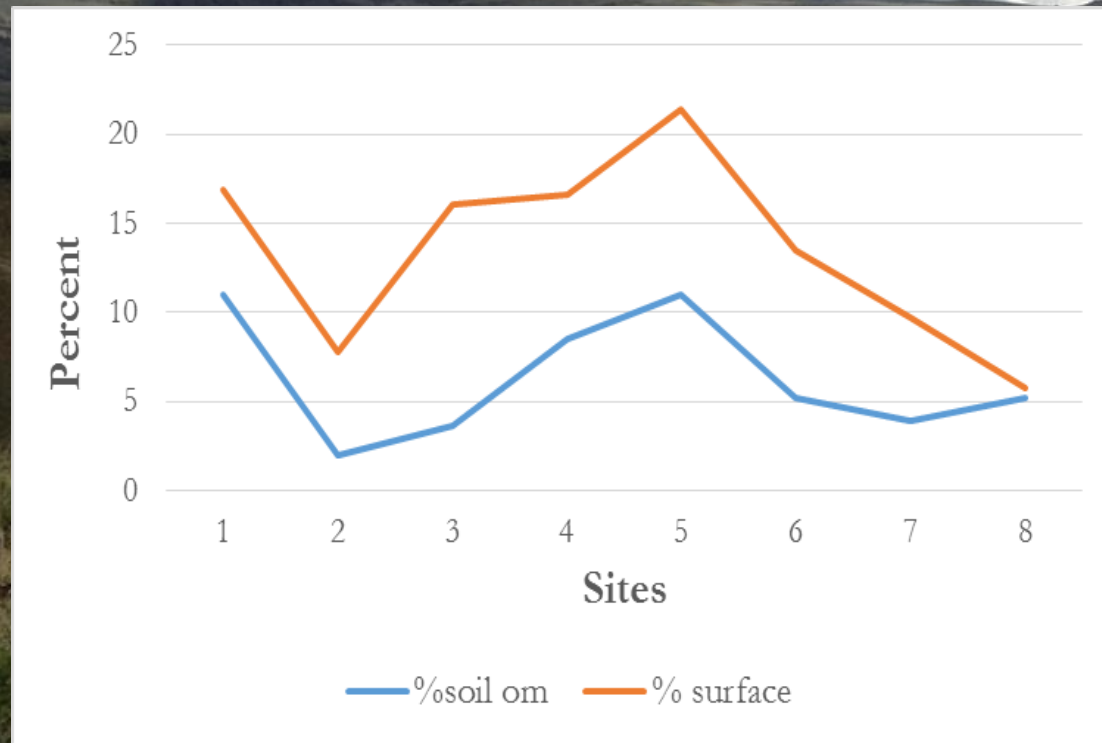


$P = 0.18$ , Adj  $R_{sq} = 0.18$



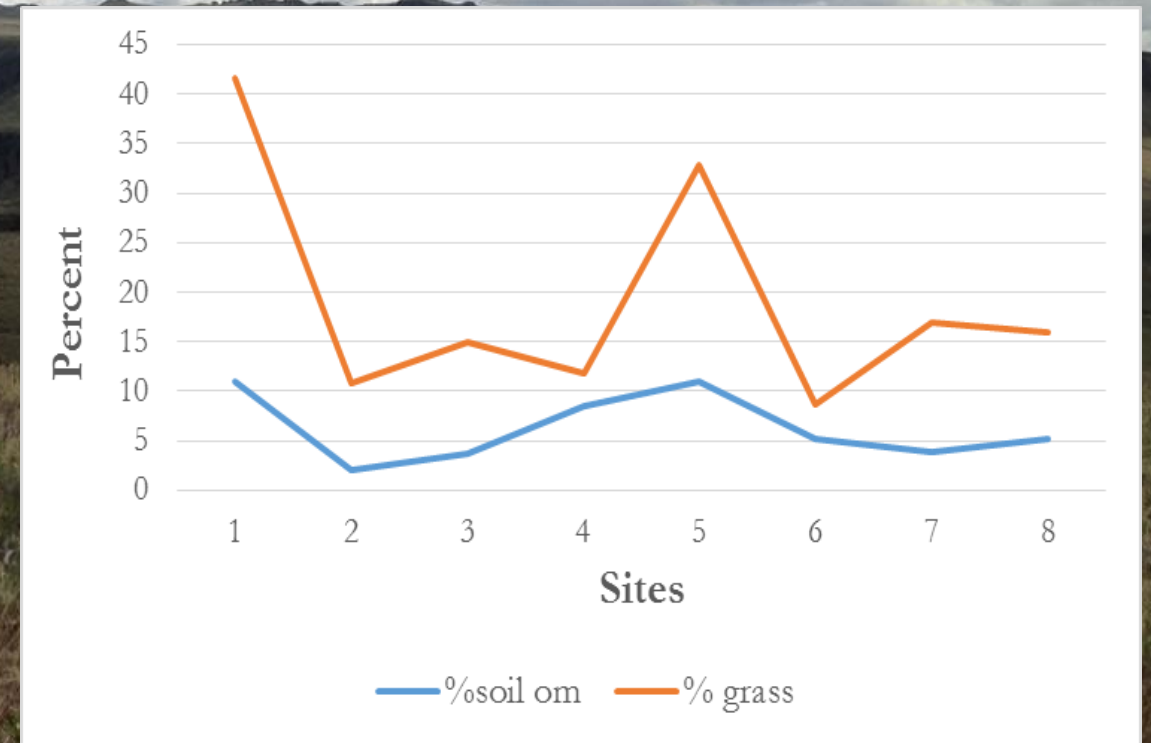
# 15 – 35% Slope

## Residual (Litter)



$P = 0.03$ , Adj Rsqu = 0.48

## Perennial Grass Cover

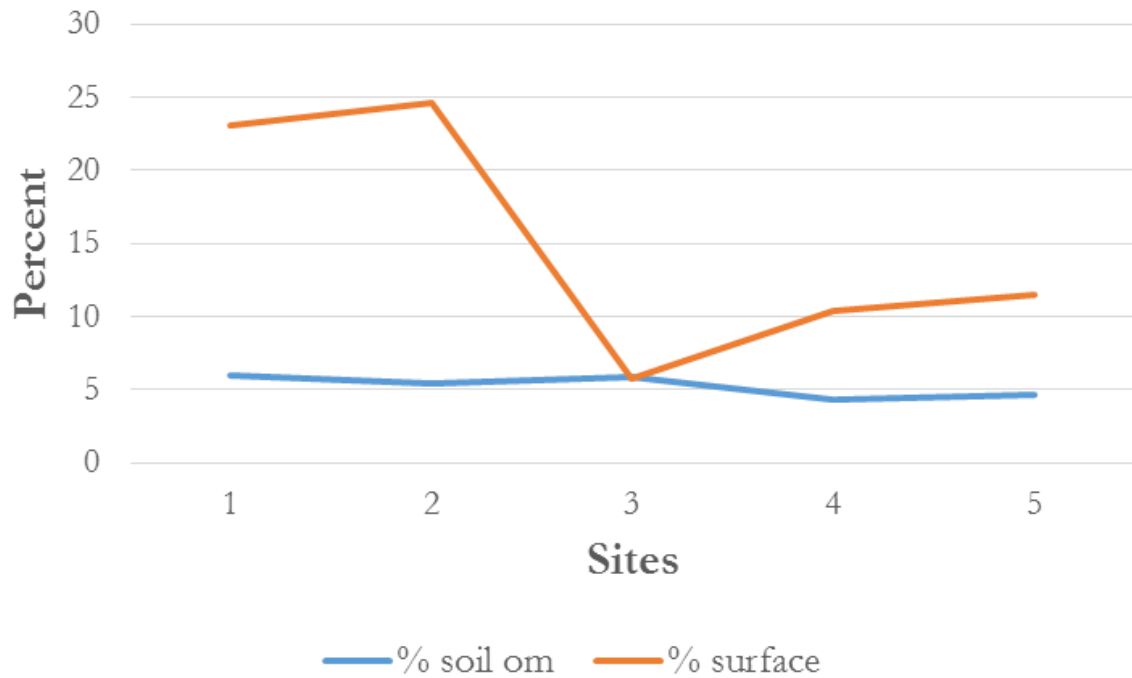


$P = 0.02$ ; Adj Rsqu = 0.55



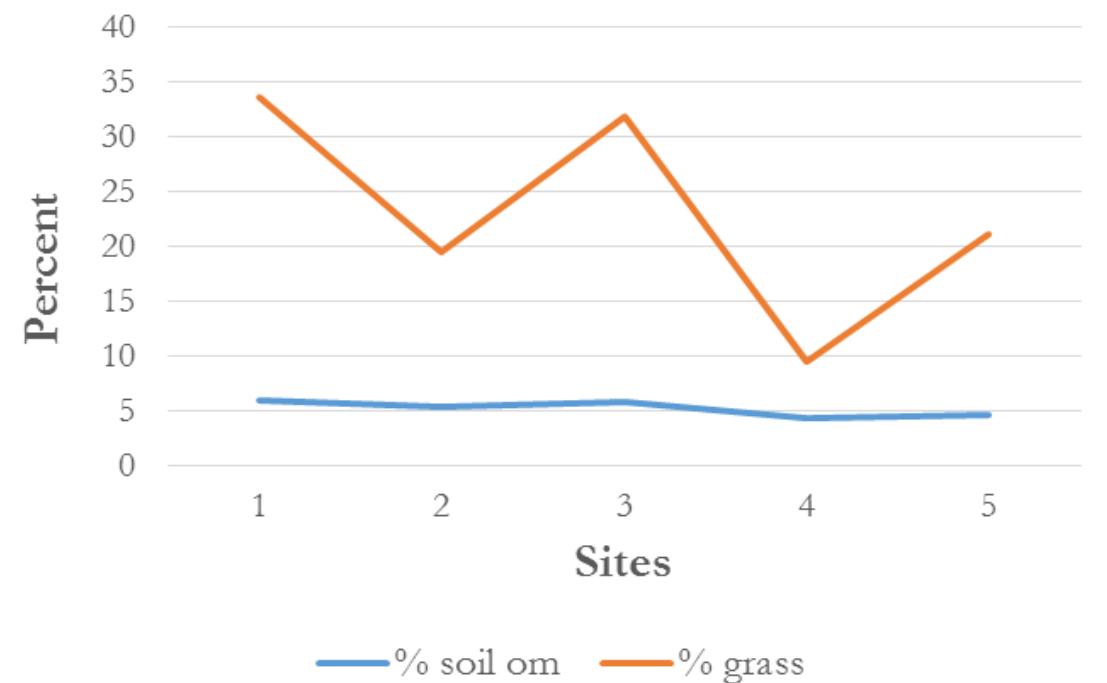
# 35 – 60% Slope

## Residual (Litter)



$P = 0.60$ , Adj Rsqu = -0.2

## Perennial Grass Cover

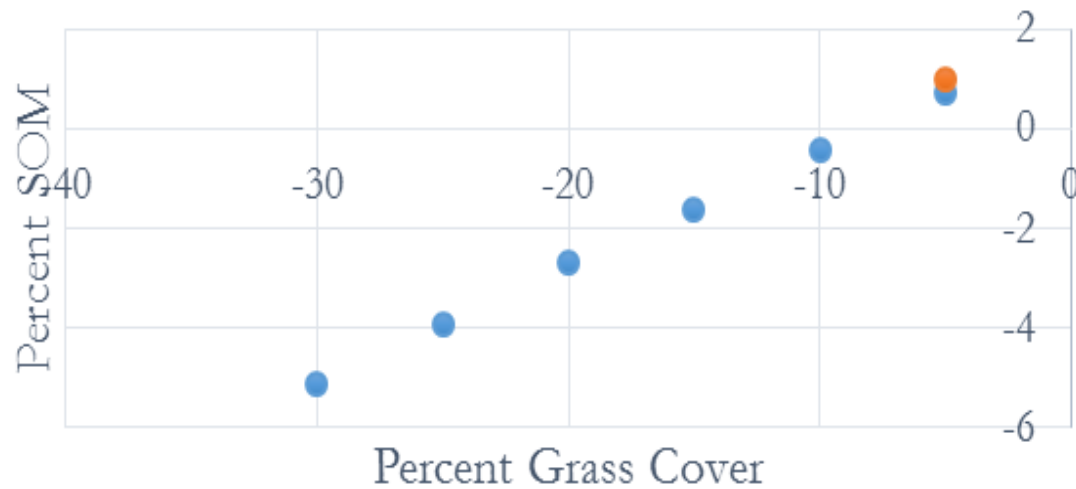


$P = 0.02$ , Adj Rsqu = 0.78

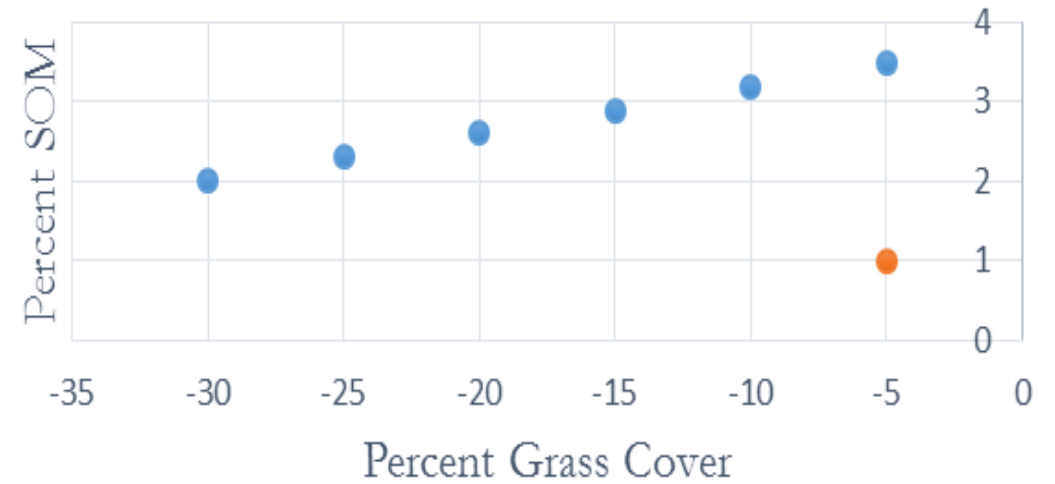


# Simple Model Outcomes

Grass - 15 to 35% slope



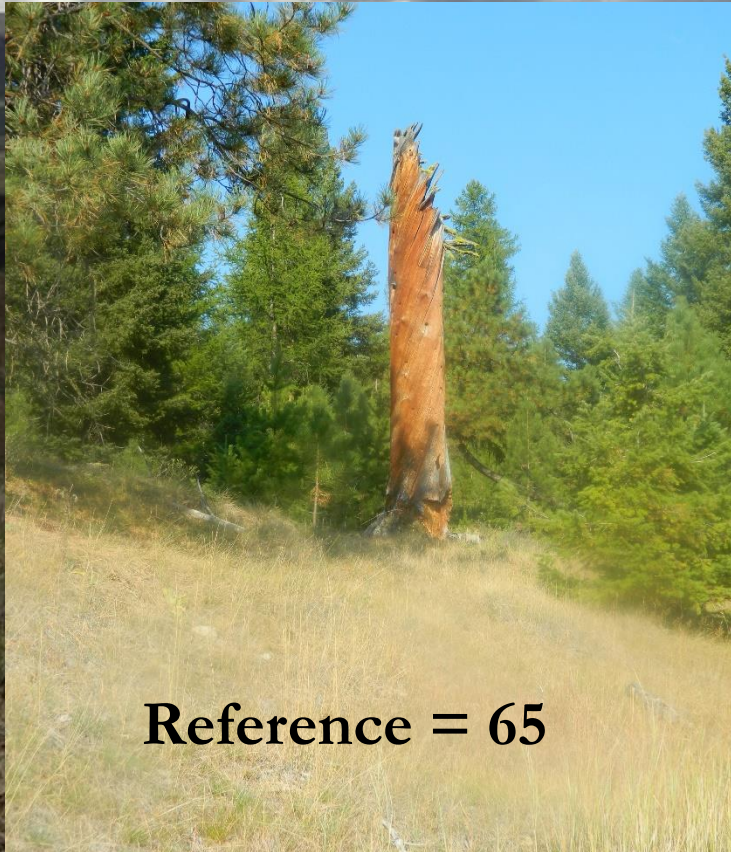
Grass - 35 to 60% slope



Depending on slope there is a 0.3 to 1.2% loss of SOM with each 5% reduction in grass cover



# Another Measure of Resiliency



**Reference = 65**

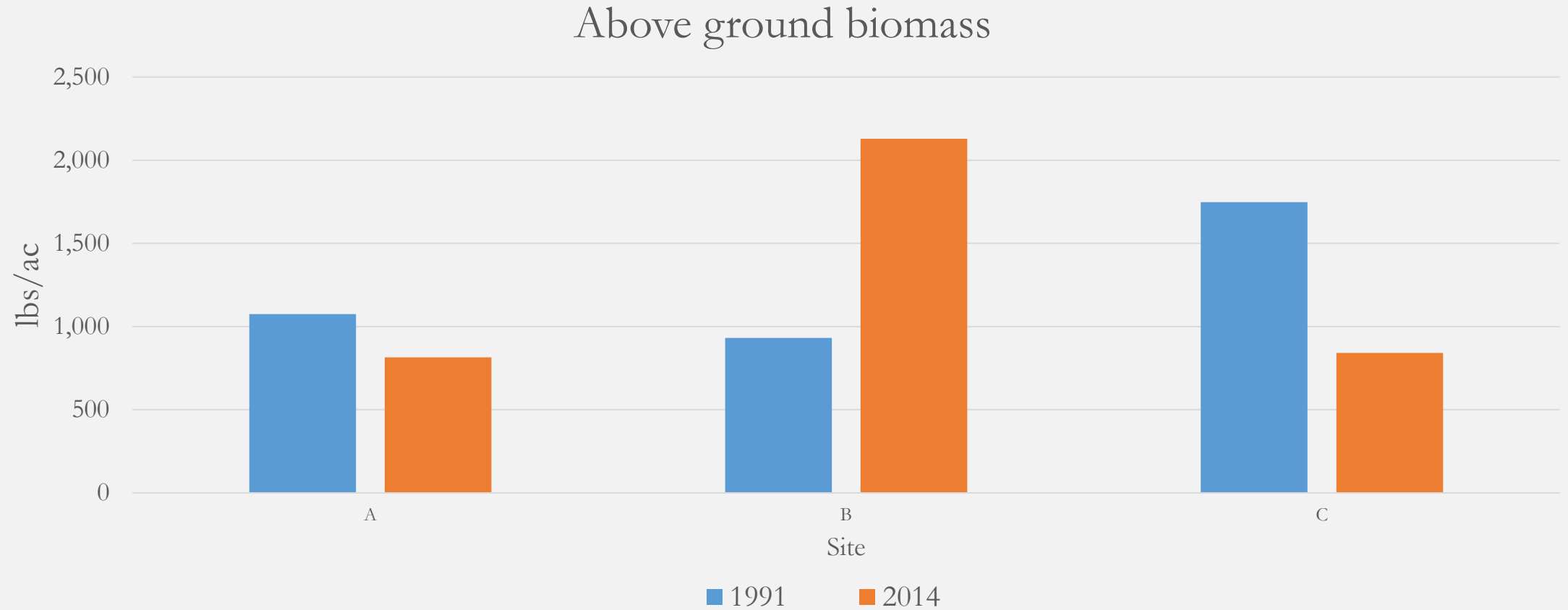
- **Species Richness**

- Higher number suggests greater likelihood of recover following disturbance

<b>slope</b>	<b>4-15%</b>	<b>15-35%</b>	<b>35-60%</b>
uncon	10 (8-12)	7 (6-8)	7
bedrock	11 (7-13)	11 (7-19)	13 (7-19)



# Supportive Evidence





# Monitoring Ecosystem Resiliency

- 2015 Soil and Vegetation Baseline
  - Vegetation cover limits erosion and runoff
    - cover currently 35 – 70% (approaching threshold)
    - Long term monitoring indicates substantial decline in cover
  - Soil health tied to perennial grass cover
    - As cover declines soil health declines
  - Species richness (forb component) very low (low resiliency)
- Sample adequacy
  - 28 sites (9 – 64)



# Questions??

