Fire, invasive plants, and rangeland change

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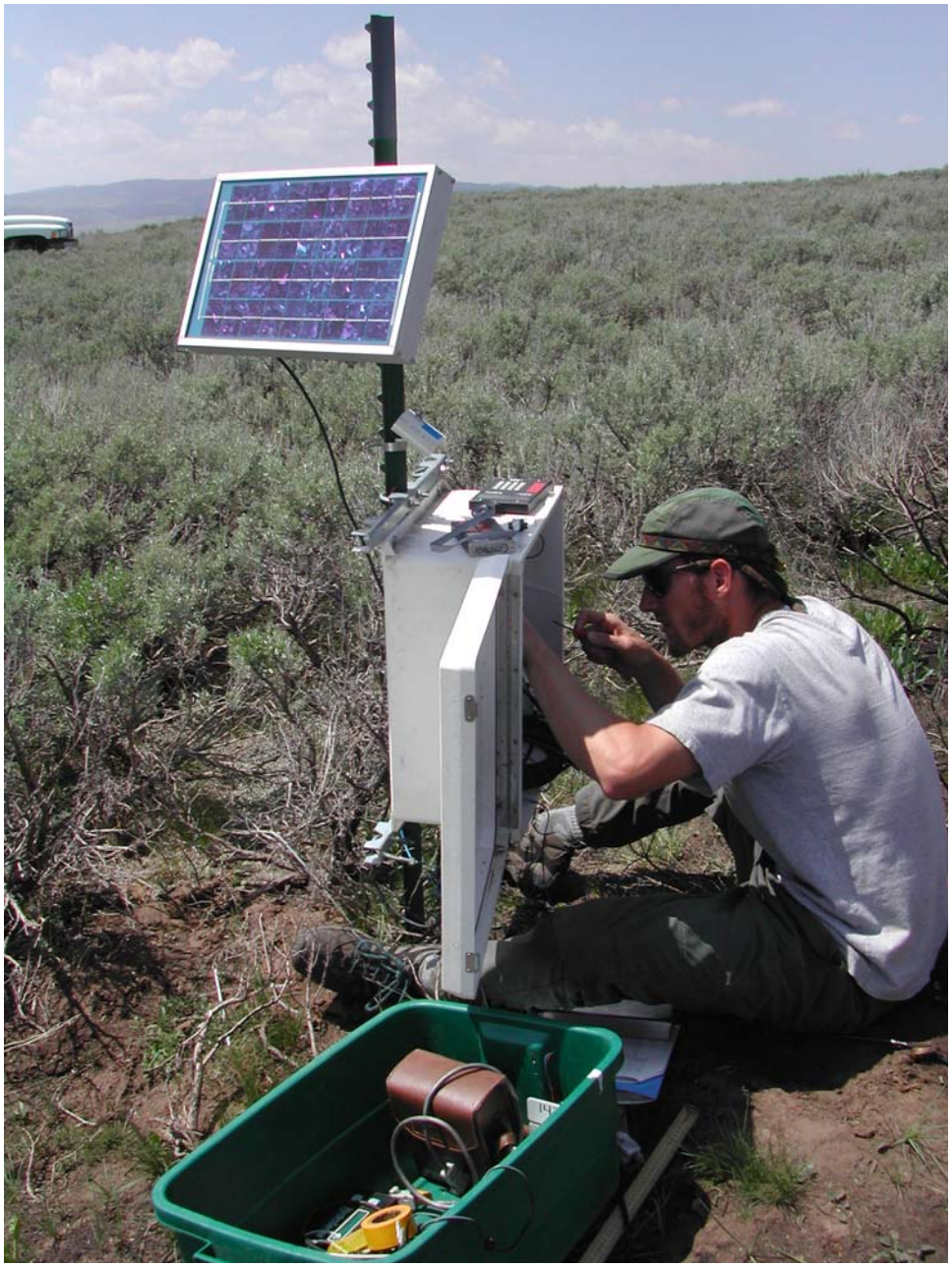
IDAHO STATE UNIVERSITY

Stability of rangeland structure and function:

Emphasis on community abundance (eg. plant biomass) and composition (ie. species change due to plant invasion).

1) How have disturbances affected variability in rangeland function?
2) How does disturbance affect site resources in ways that favor invasive plants?
3) Potential implications of plant invasions for rangeland function.



PART 1:

A retrospective study of fire and grazing effects on remotely-sensed indices of vegetation over the past ca. 20 years

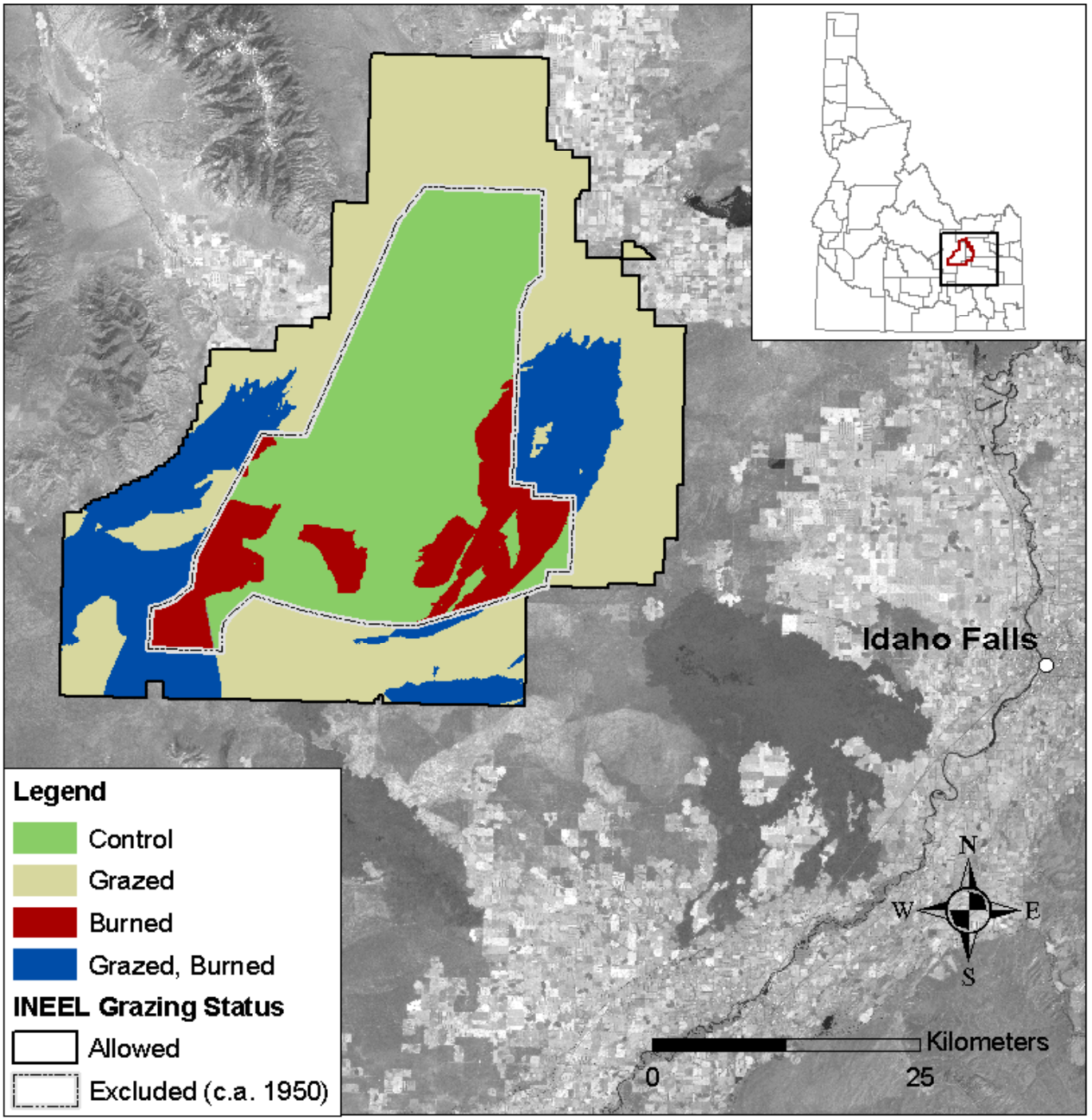
Ryan Baum,
MS candidate

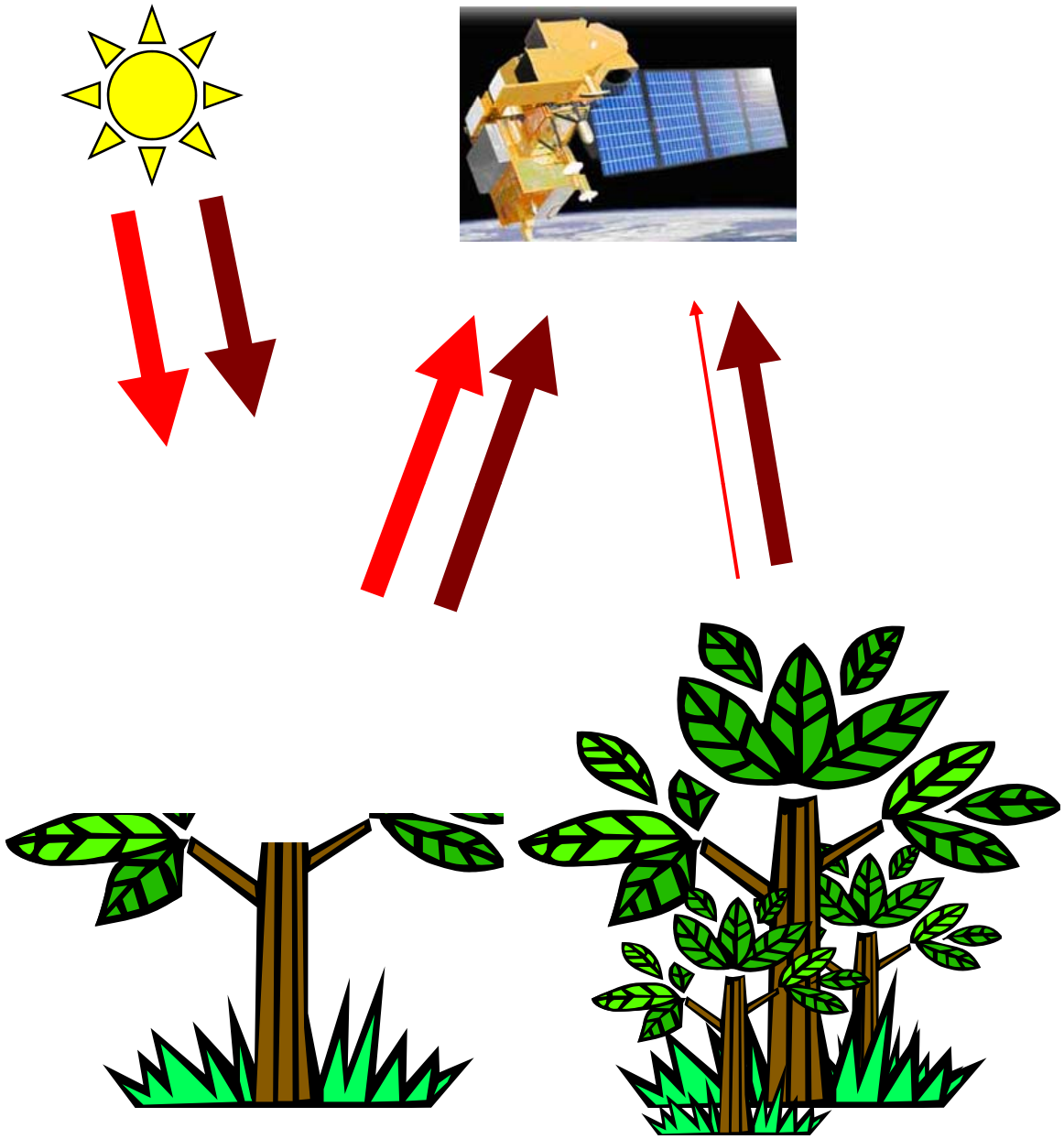
↑ Disturbance→

↓ (diversity)→

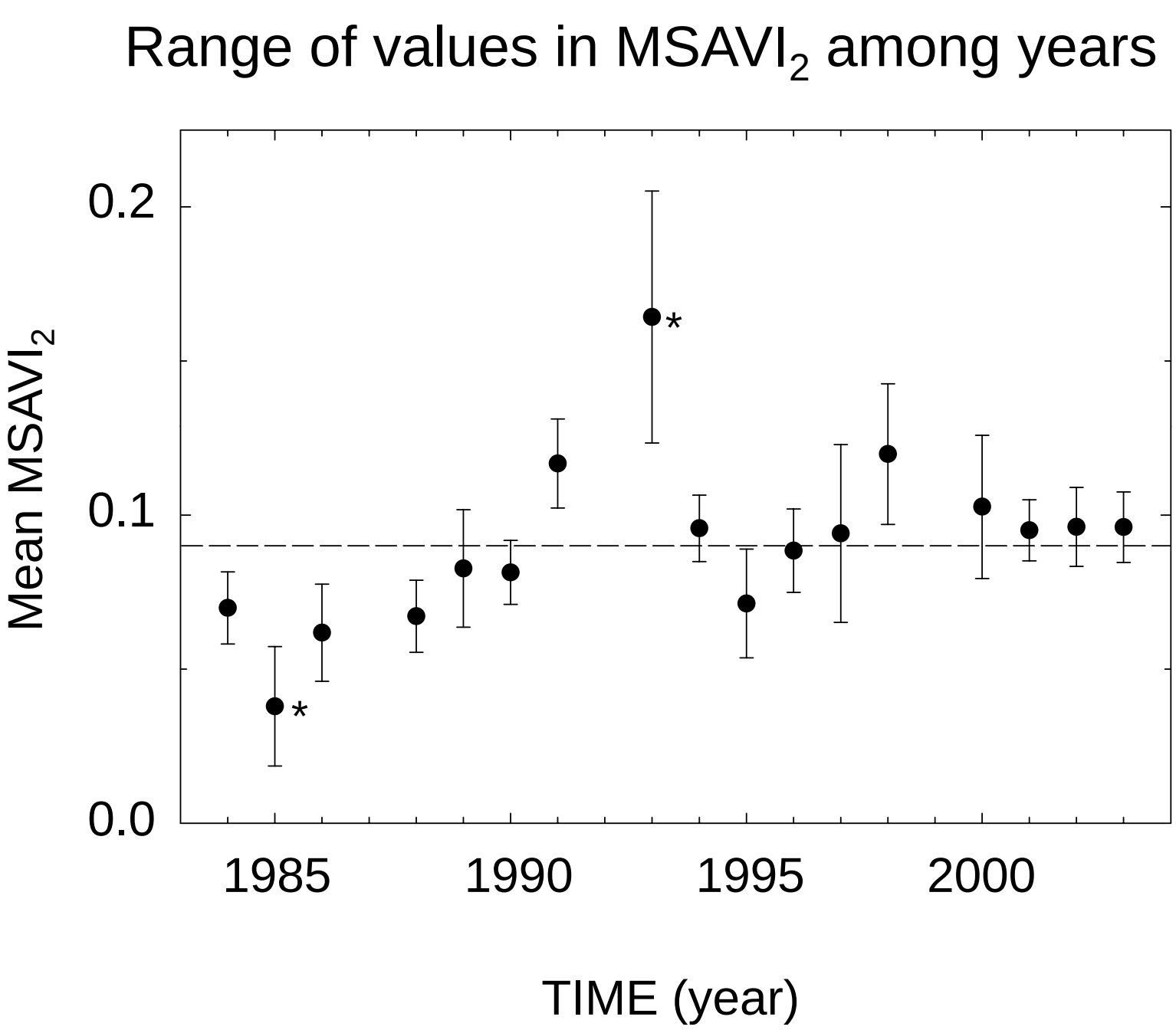
↑ variability in ecosystem/rangeland function

?

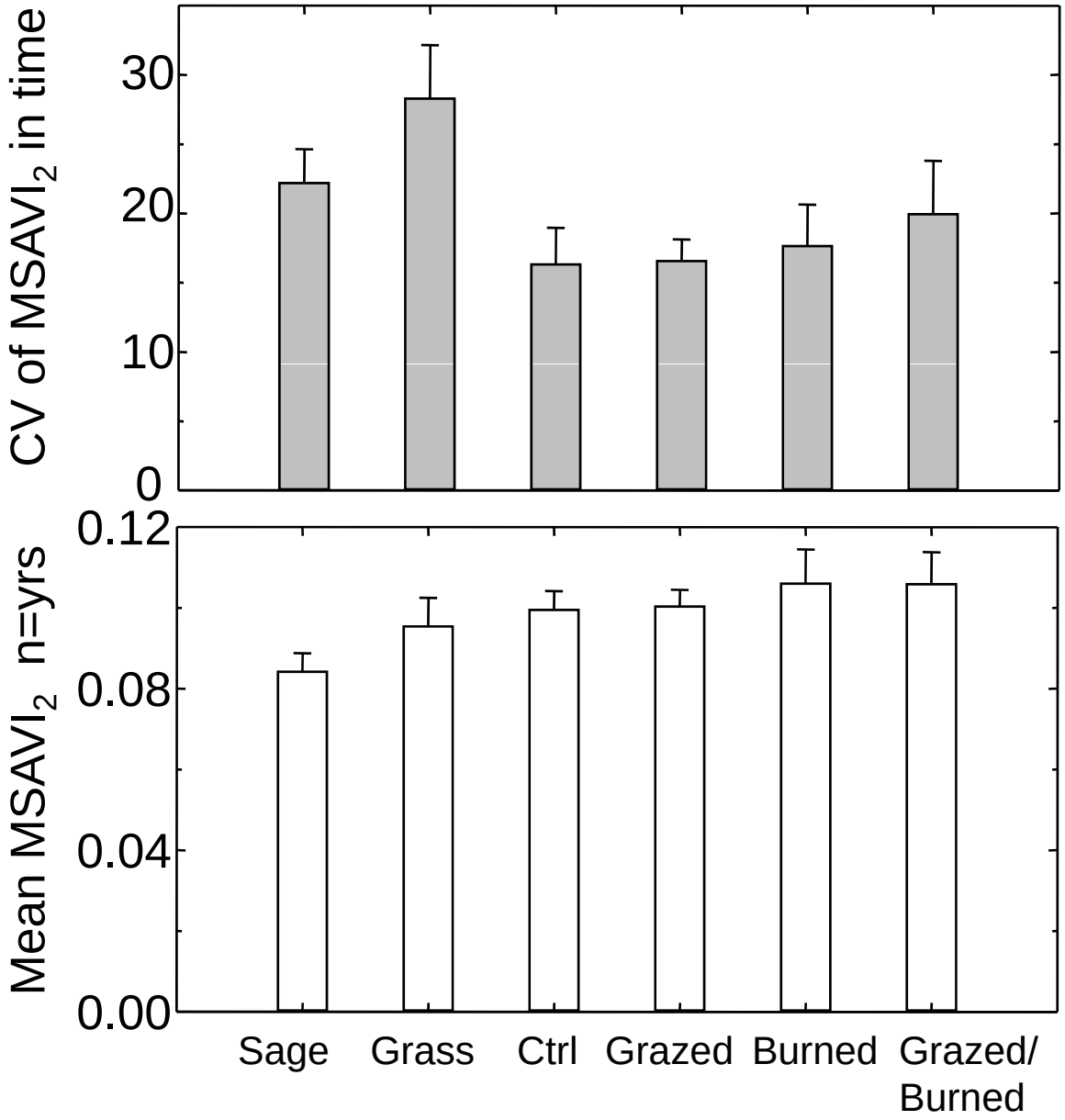

Idaho Falls
Legend
Control
Grazed
Burned
Grazed, Burned
INEEL Grazing Status
Allowed
Excluded (c.a. 1950)
N
W
E
S
Kilometers
0
25



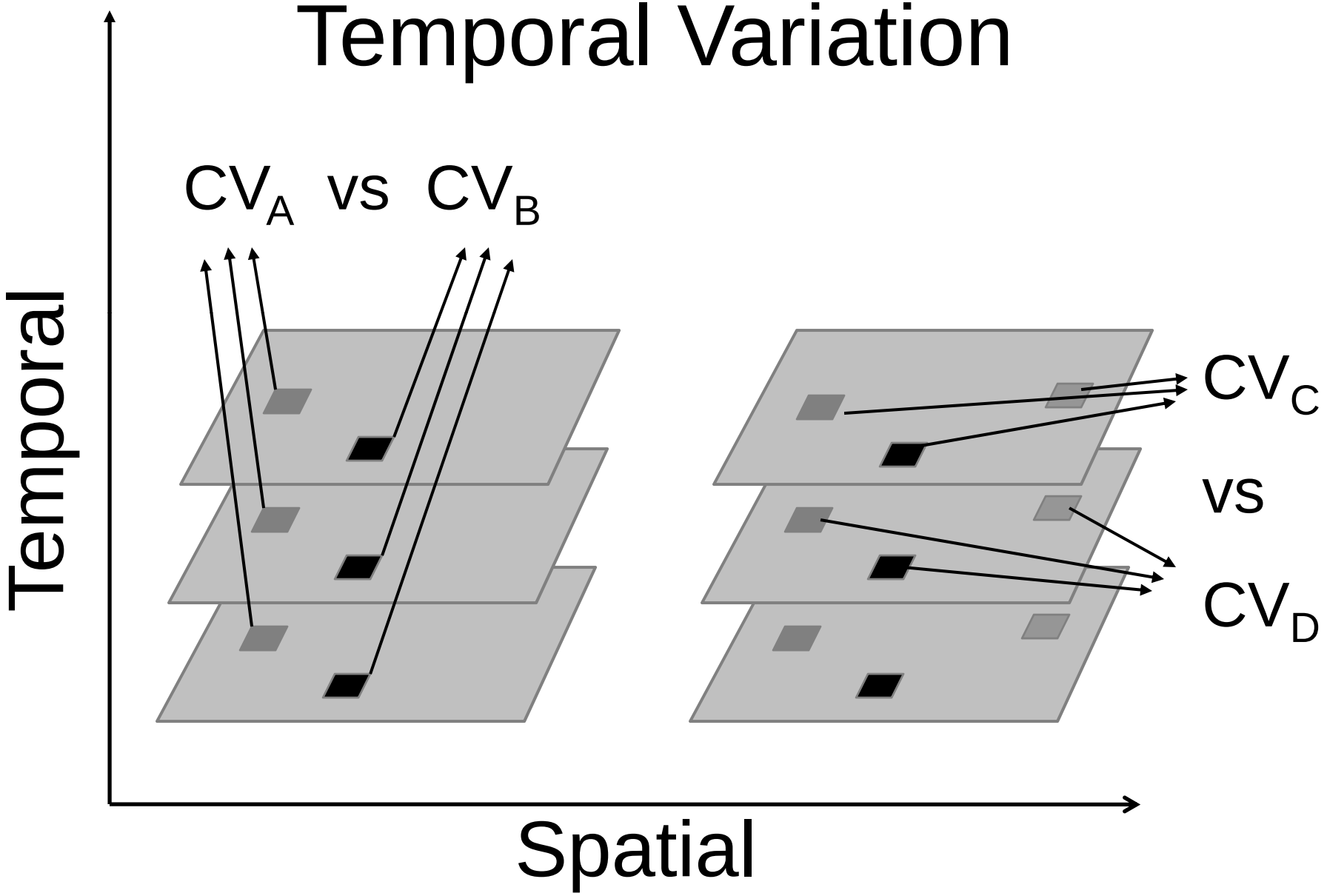
- Calculated MSAVI from Landsat images
- SAVI is similar to the more well known NDVI
- Normalized ratio of red:near infrared radiation reflected from vegetation


Range of values in MSAVI2 among years
Mean MSAVI2
0.2
0.1
0.0
1985
1990
1995
2000
TIME (year)
*
*

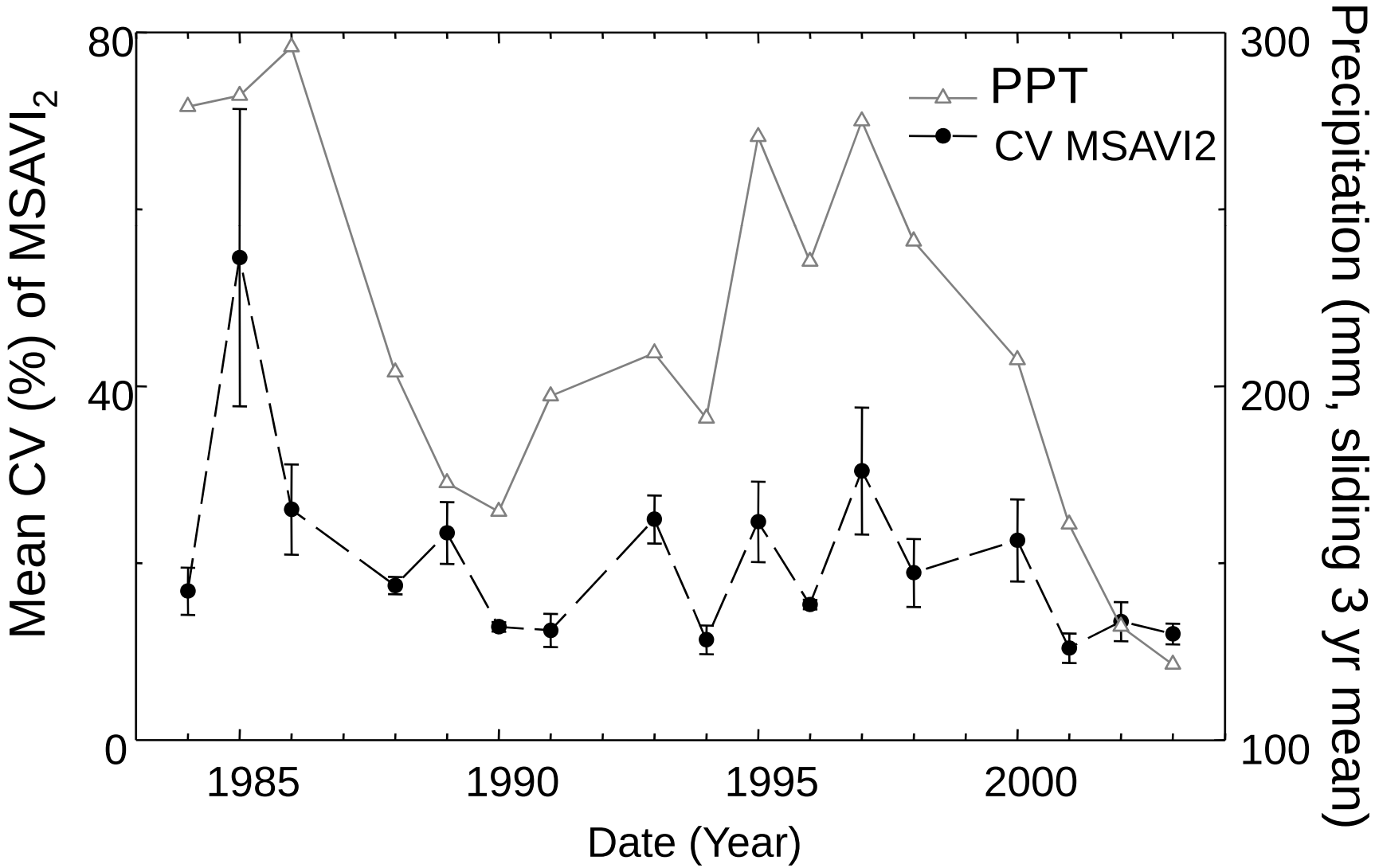
MINIMAL DIFFERENCES IN MEAN OR TEMPORAL VARIABILITY OF $MSAVI_2$ AMONG LANDTYPES

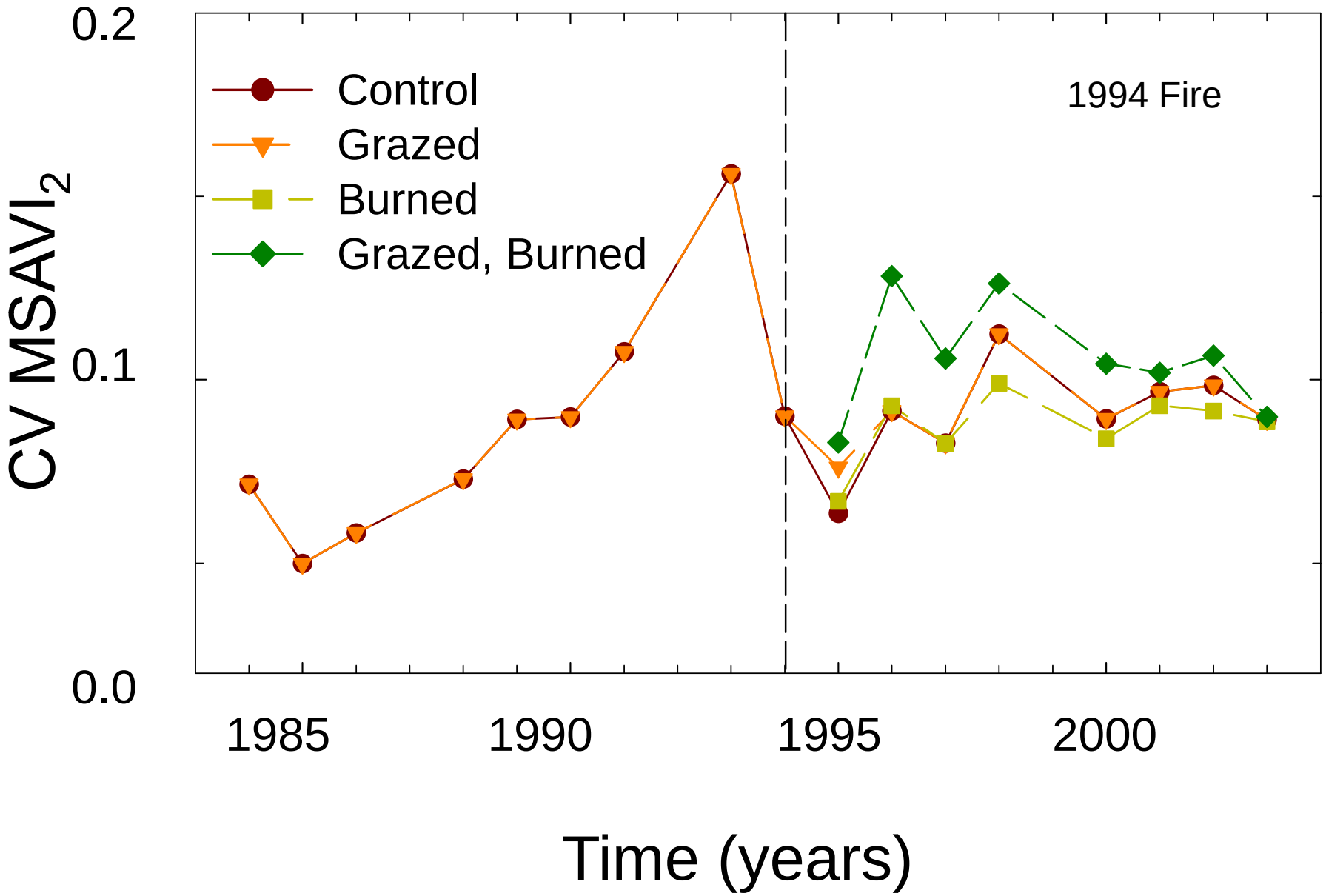


Interactions of Spatial and Temporal Variation

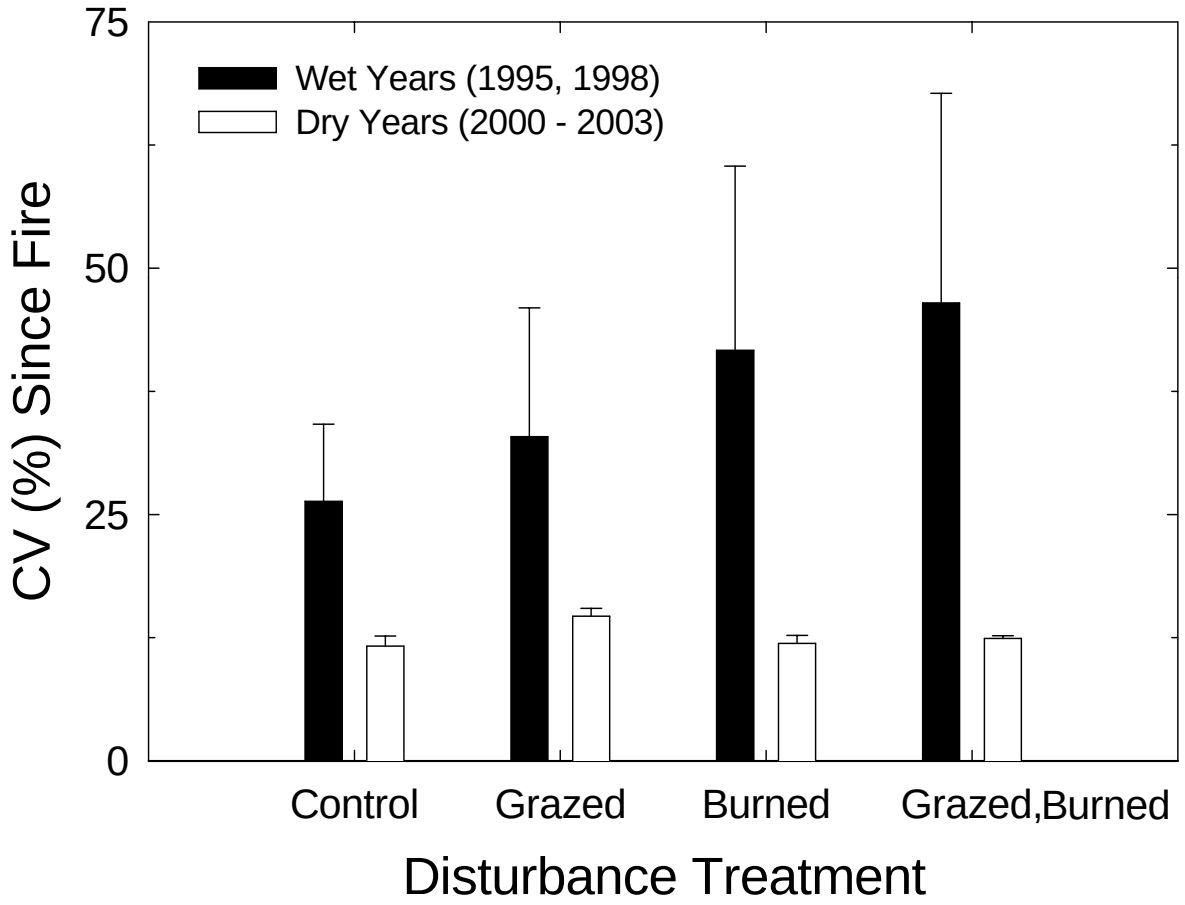


MEAN $MSAVI_2$ NOT WELL CORRELATED TO YEARLY VARIATIONS IN PPT, BUT SPATIAL VARIABILITY IN $MSAVI_2$ IS.




0.2
0.1
0.0
CV MSAVI2
Control
Grazed
Burned
Grazed, Burned
1994 Fire
1985
1990
1995
2000
Time (years)

Interaction of fire, grazing, and weather leads to greatest spatial variability.

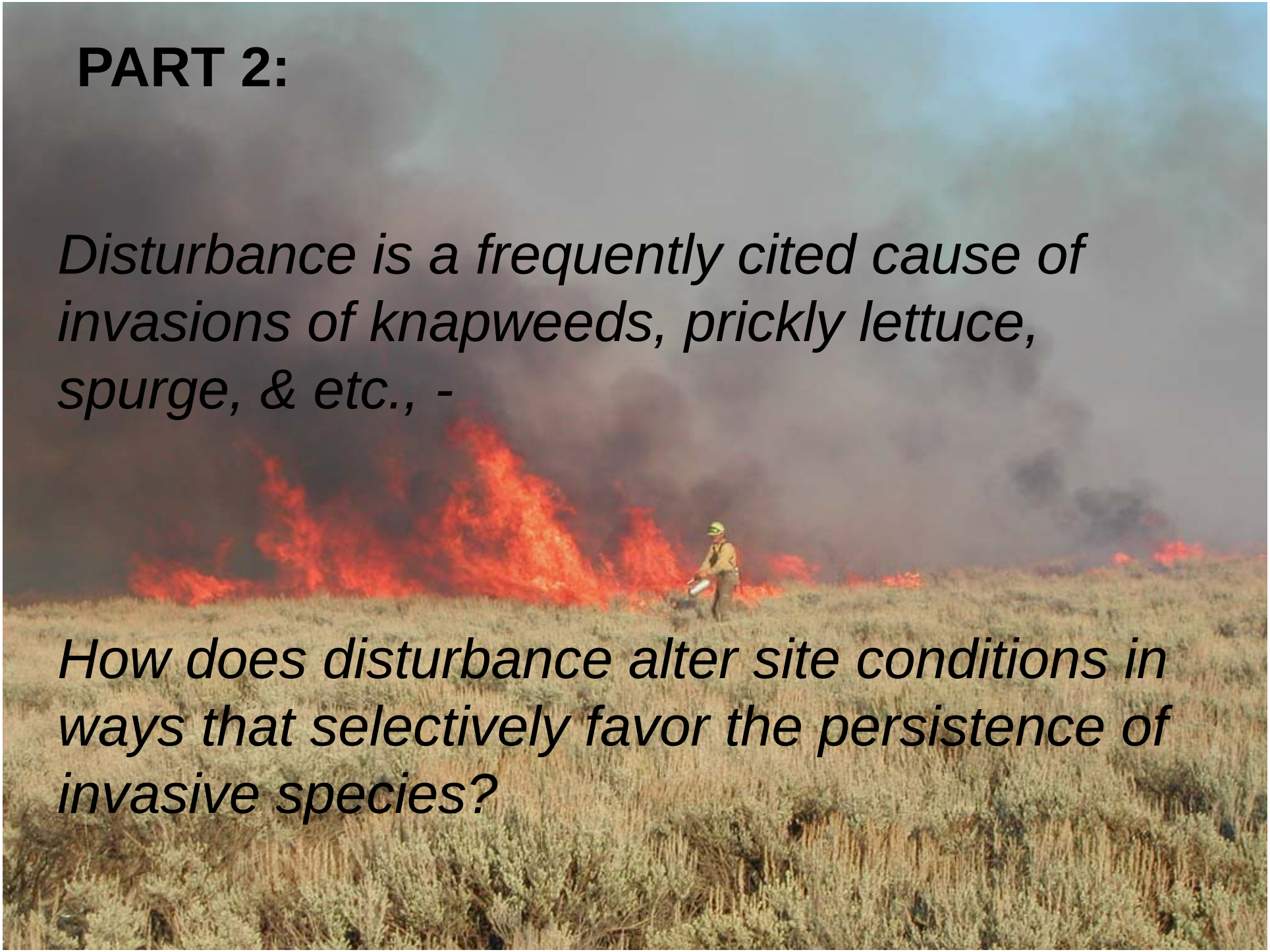


Summary:

Variation is important! Remote sensing key for evaluating variability.

Multiple disturbances can interact in complex ways to affect rangelands.

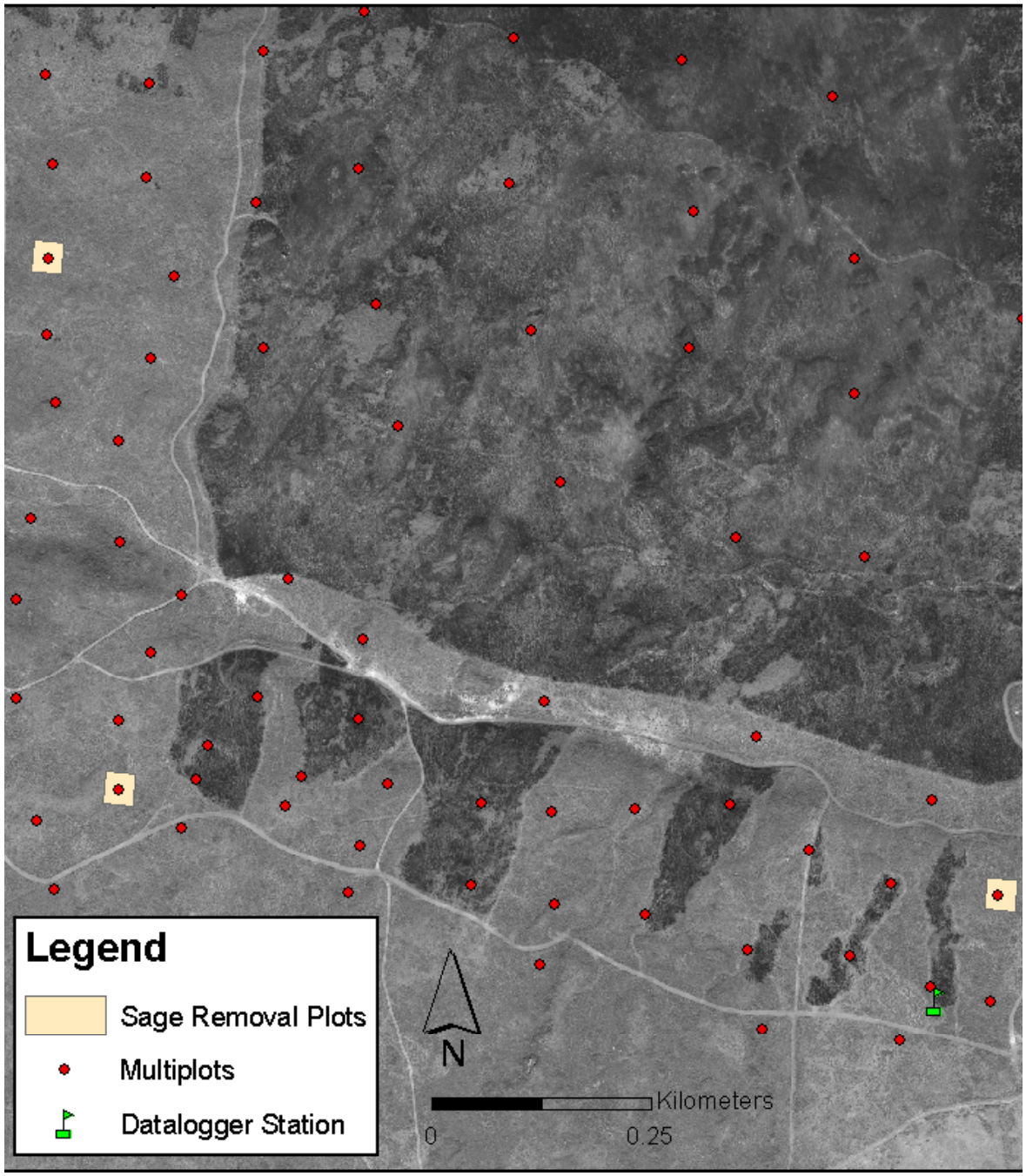
Future research: how does variability relate to invasibility?



PART 2:

Disturbance is a frequently cited cause of invasions of knapweeds, prickly lettuce, spurge, & etc., -

How does disturbance alter site conditions in ways that selectively favor the persistence of invasive species?



USSES

~6000 ft ASL

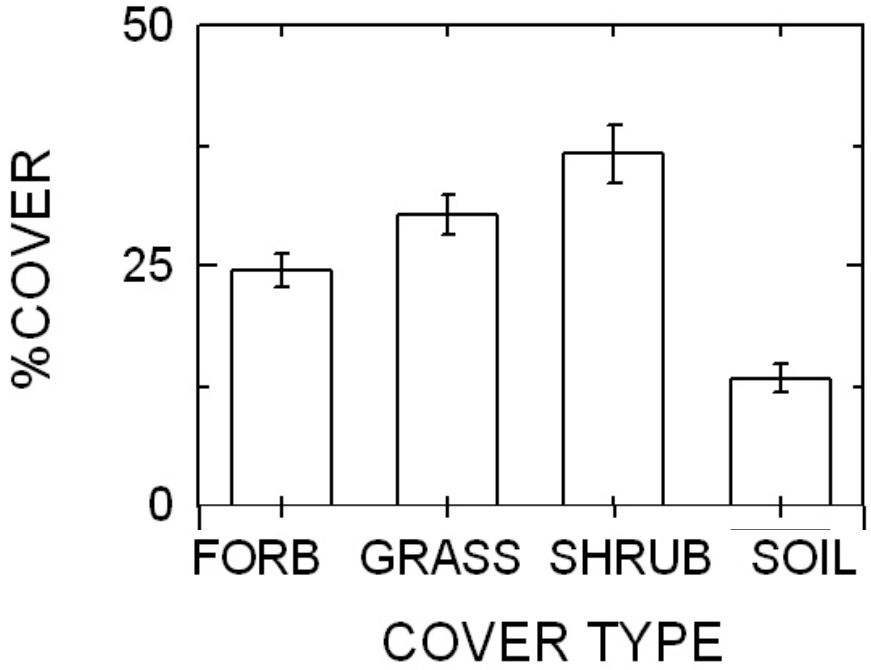
Most ppt in winter/spring

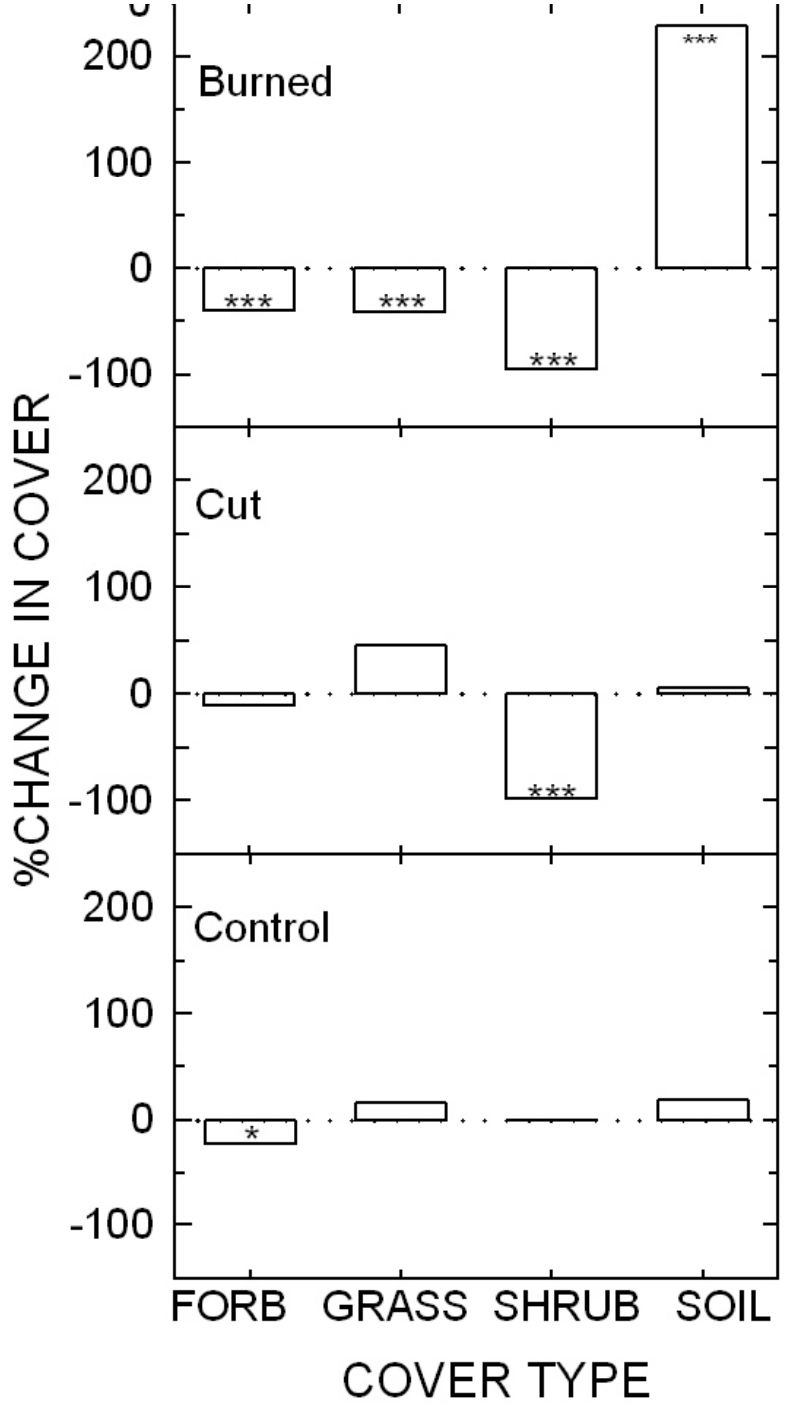
Mountain Big Sage (*A. tridentata* ssp. *vaseyana*)

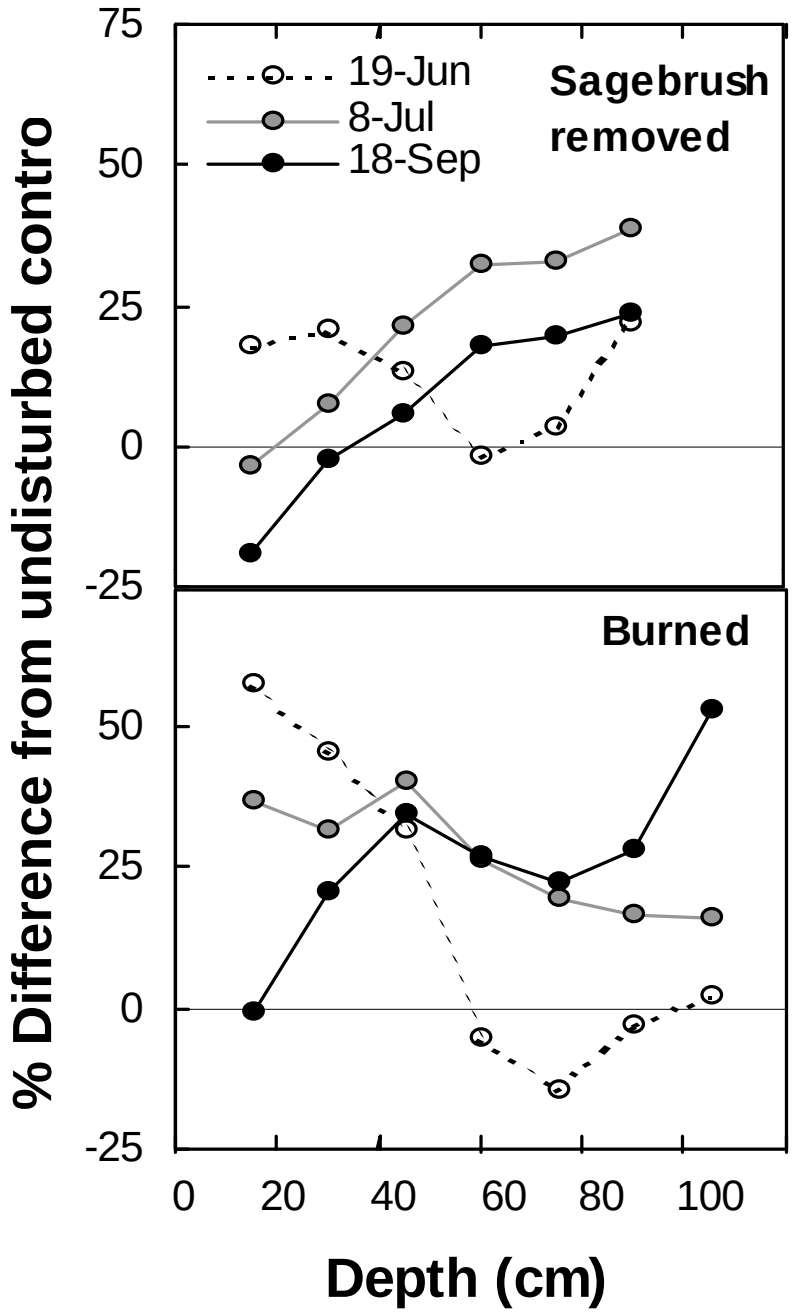
Few invasive plants in NE corner of USSES

Dry years during study

Ground and remotely-sensed based measurements of vegetation


50
25
0
%COVER
FORB
GRASS
SHRUB
SOIL
COVER TYPE

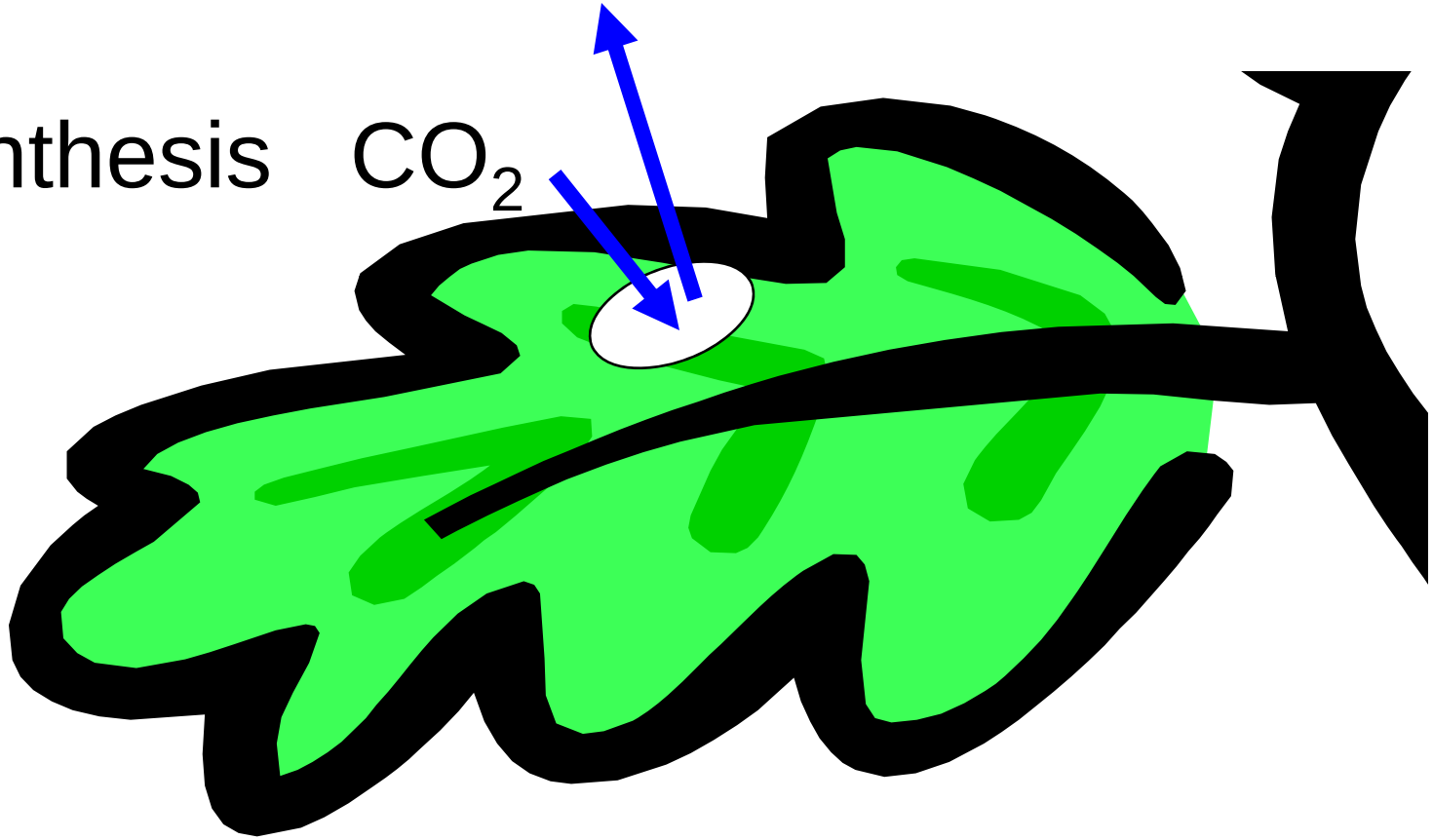

200
100
0
-100
Burned
***
***
***
***
Cut
***
Control
*
%CHANGE IN COVER
FORB
GRASS
SHRUB
SOIL
COVER TYPE


75
50
25
0
-25
19-Jun
8-Jul
18-Sep
Sagebrush removed
Burned
% Difference from undisturbed contro
0
20
40
60
80
100
Depth (cm)

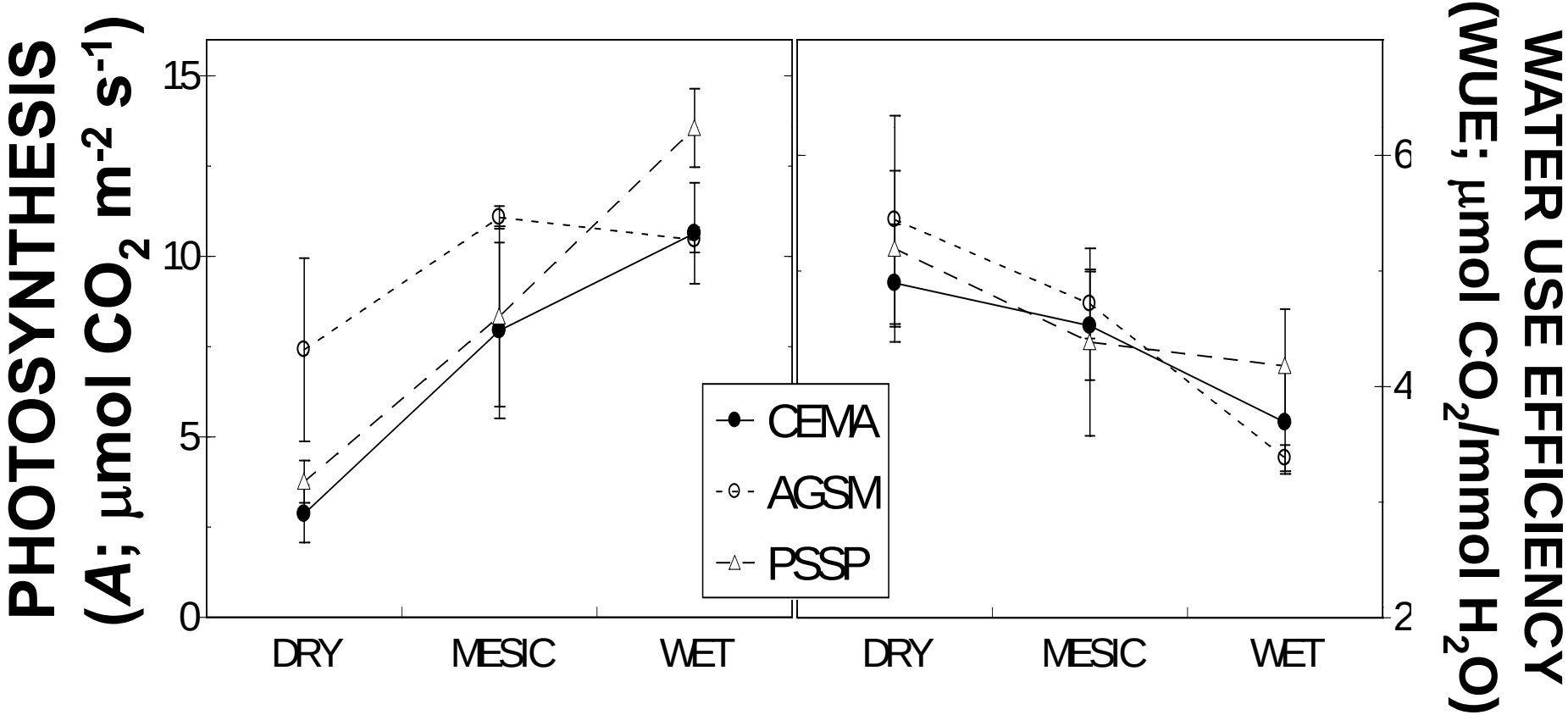
PART 2b:
Responses of invasive forbs to soil water
Judd Hill, PhD candidate

Evapotranspiration H_2O

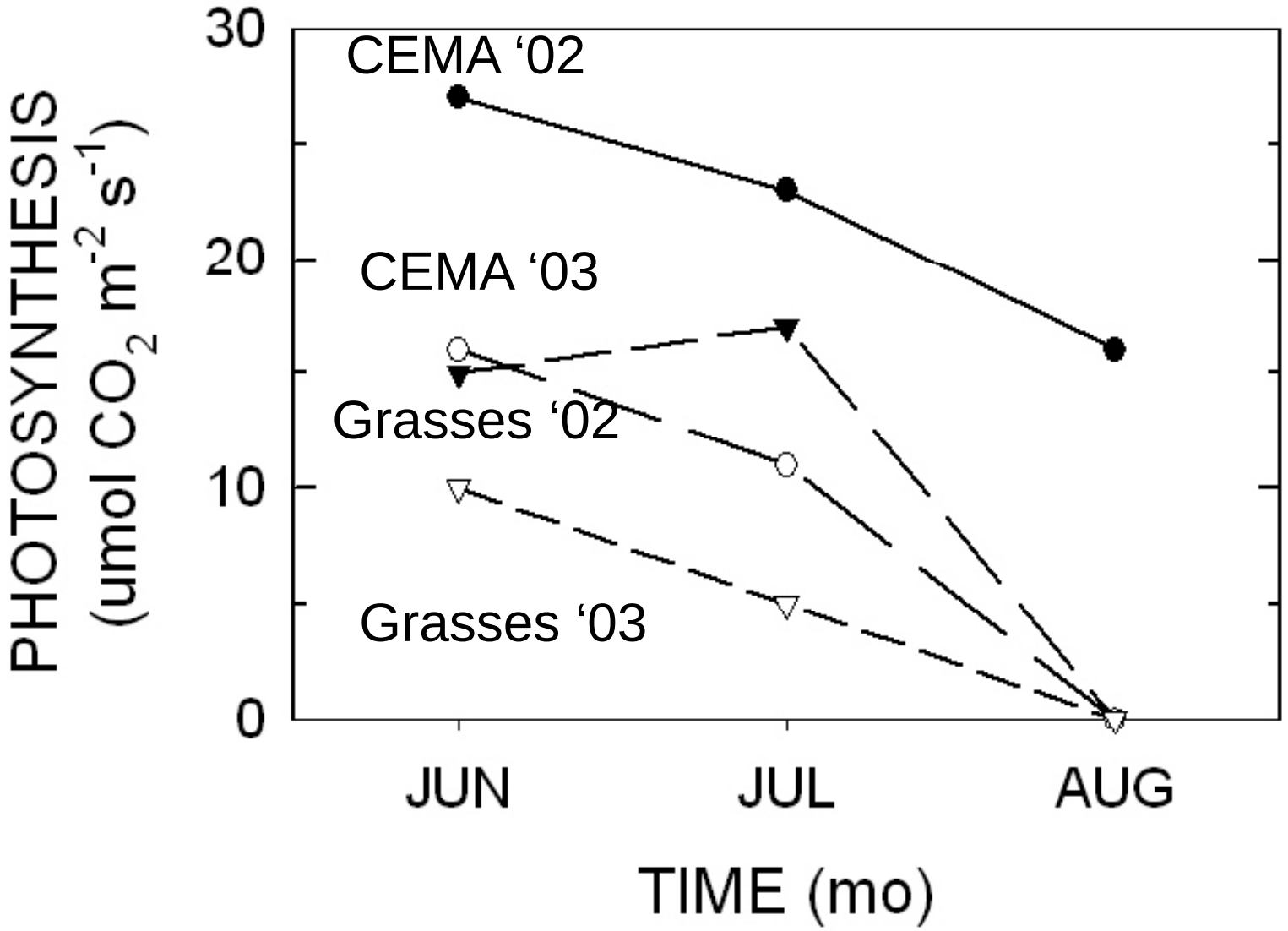
Photosynthesis CO_2

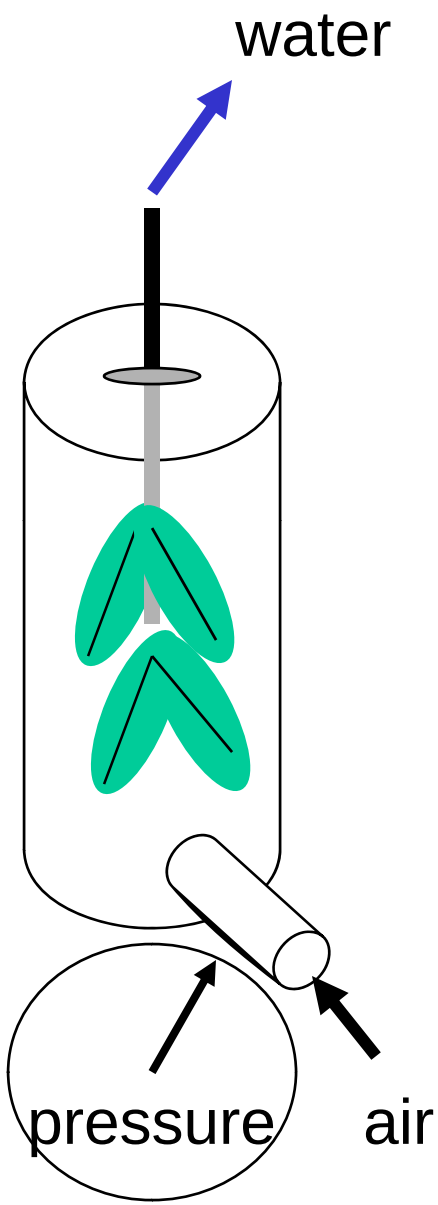


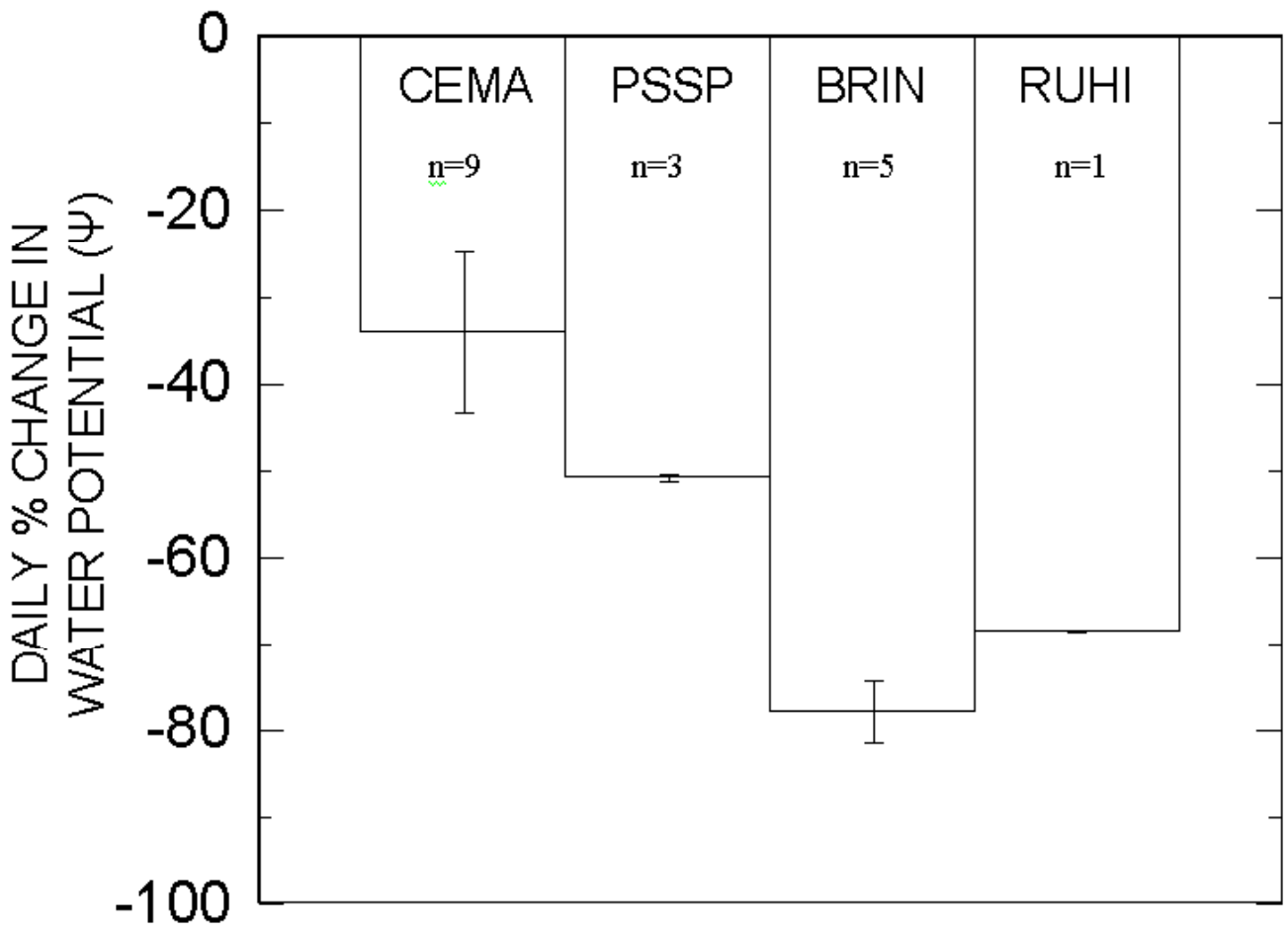
In greenhouse, knapweed similar to grasses



In field, WUE similar in knapweed and grasses, but C-uptake much greater in knapweed




water
pressure
air

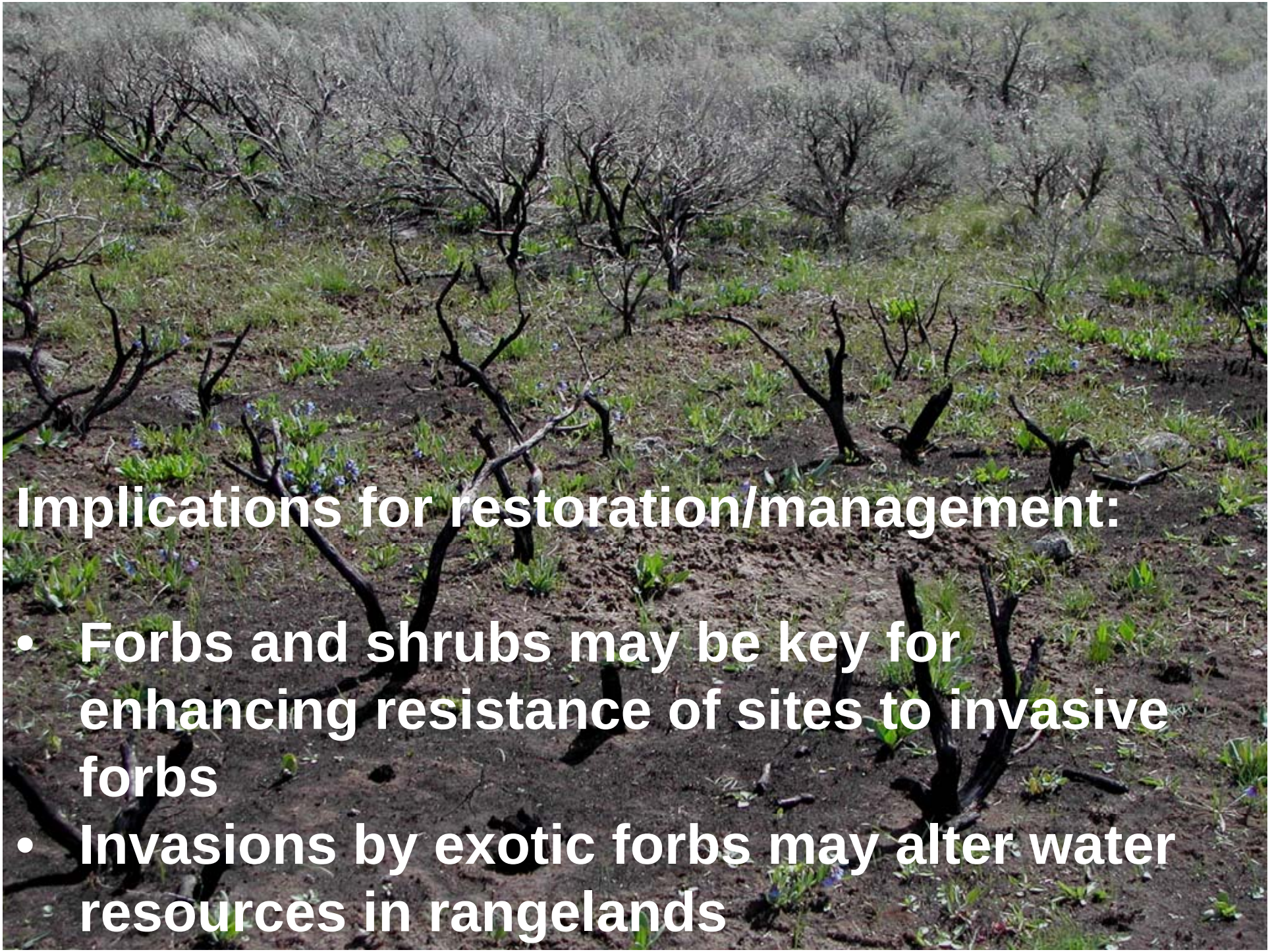

DAILY % CHANGE IN
WATER POTENTIAL (Ψ)
0
-20
-40
-60
-80
-100
CEMA
n=9
PSSP
n=3
BRIN
n=5
RUHI
n=1

Summary:

- **Spotted knapweed appears reliant on deep soil moisture for assimilating more carbon than established competitors.**

- **Burning and shrub removal led to greater soil water contents, especially in deep soils and mid-late summer**

- **Altered soil water patterns appear attributable to changes in vegetation**

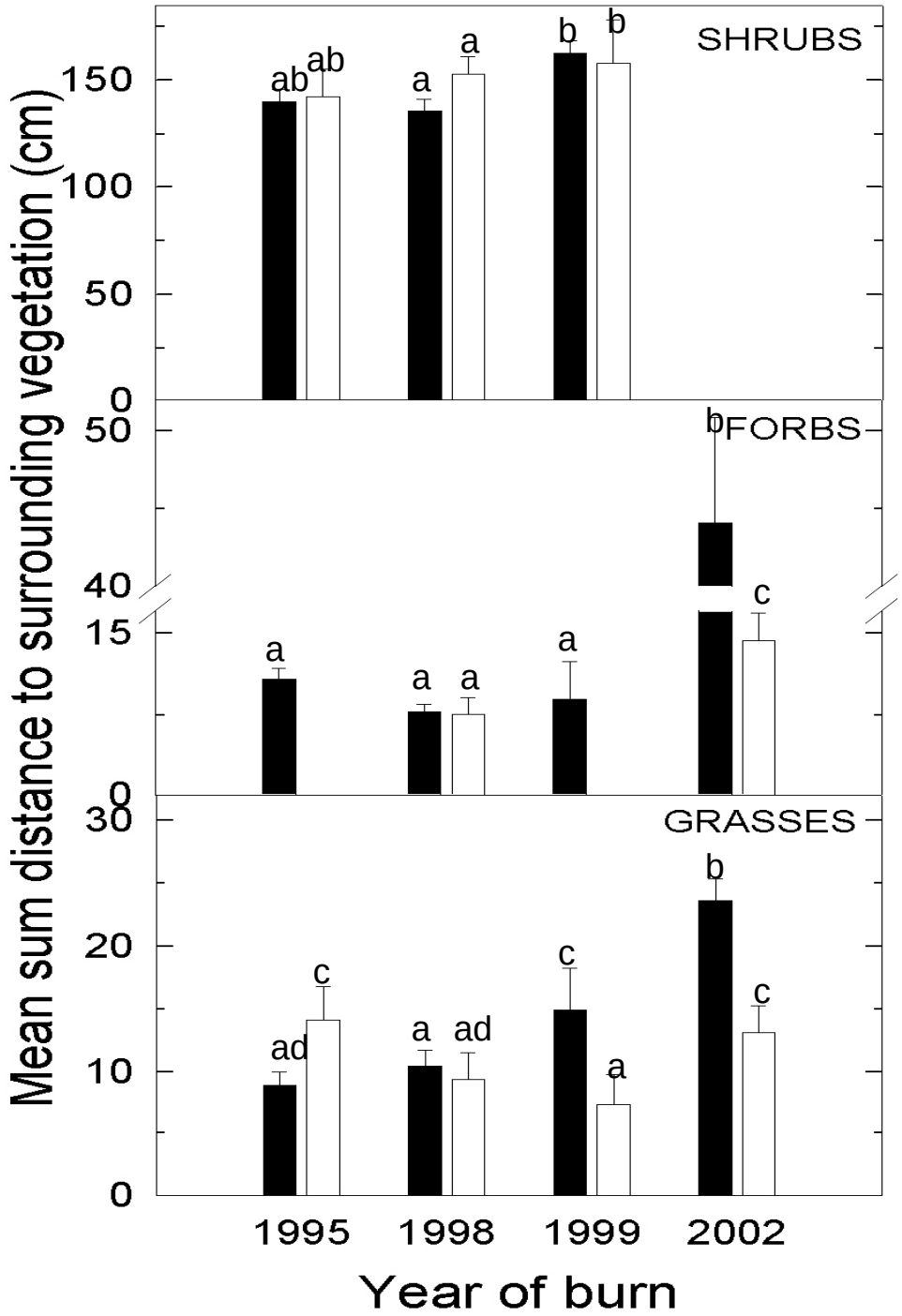


Implications for restoration/management:

- **Forbs and shrubs may be key for enhancing resistance of sites to invasive forbs**
- **Invasions by exotic forbs may alter water resources in rangelands**

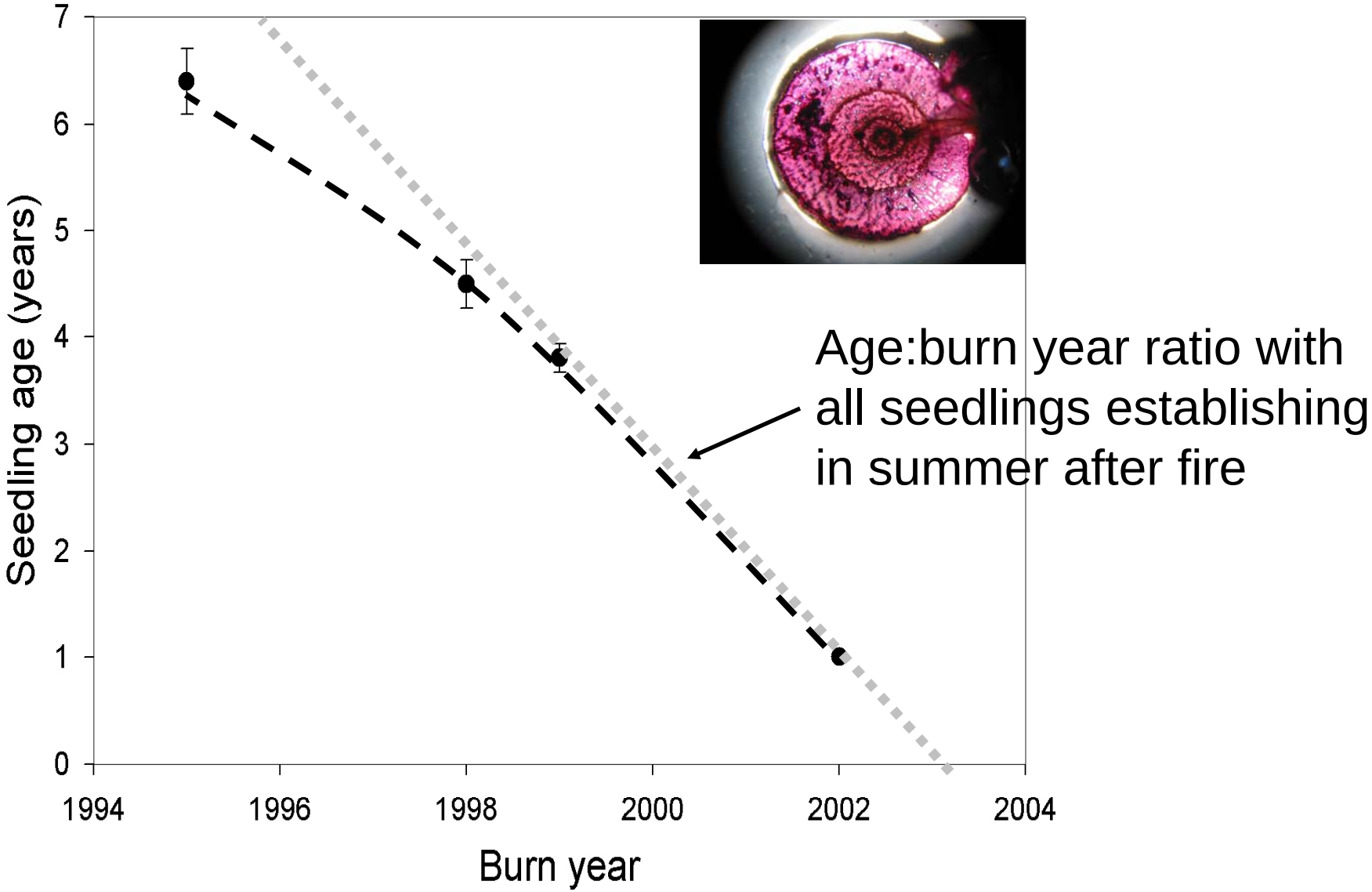
PART 3
Responses of sagebrush seedlings to neighboring plants following fire

Katie DiCristina, MS candidate



Seedlings of mtn big sagebrush appear to select microsites away from neighboring vegetation, especially when the neighbors are forbs.

Sagebrush seedlings appear to establish primarily in the year after fire, when herbaceous cover is temporarily low



Summary

- The ‘window’ for sagebrush establishment may occur in the year following fire, when herbaceous competitors are still recovering to pre-fire abundances.

- Forbs appear particularly effective in competitively displacing sagebrush seedlings.

Effects of exotic annual grasses are known, but how will invasions by exotic forbs affect sagebrush recovery and rangeland function?

Land management can be greatly enhanced by a mechanistic understanding of ecosystem function.