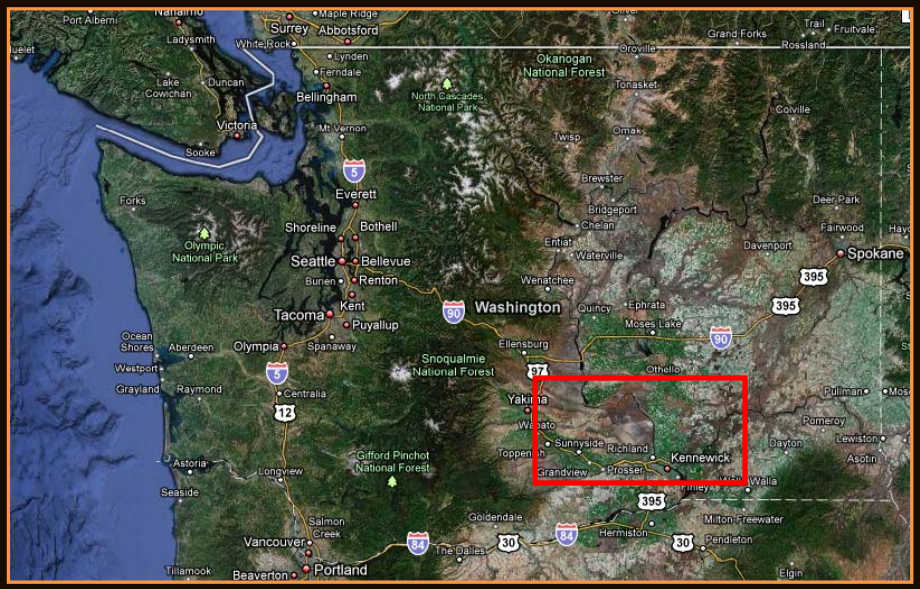
The impact of multiple wildfires on trajectories of change and stable states in sagebrush-steppe ecosystems

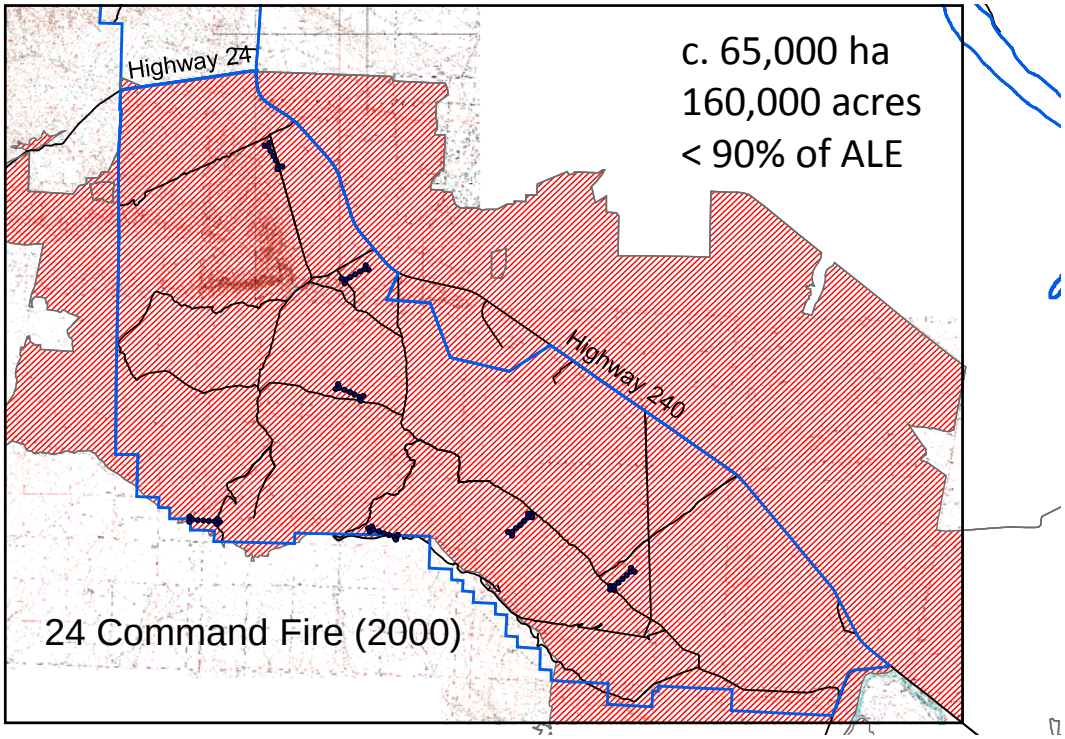
G.M. Davies, E. Dettweiler-Robinson, J. Bakker, P. Dunwiddie, J. Evans, S. Hall & J. Downs

Fitzner-Eberhart Arid Lands Ecology Reserve



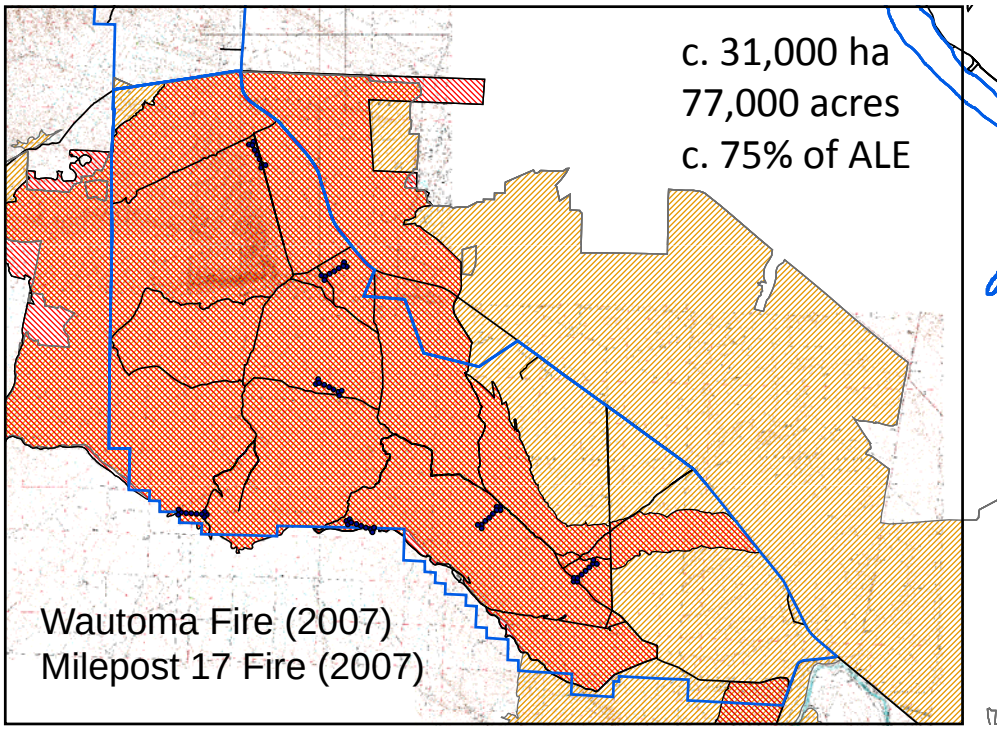
Fitzner-Eberhart Arid Lands Ecology Reserve

31,000 ha
77,000 acres

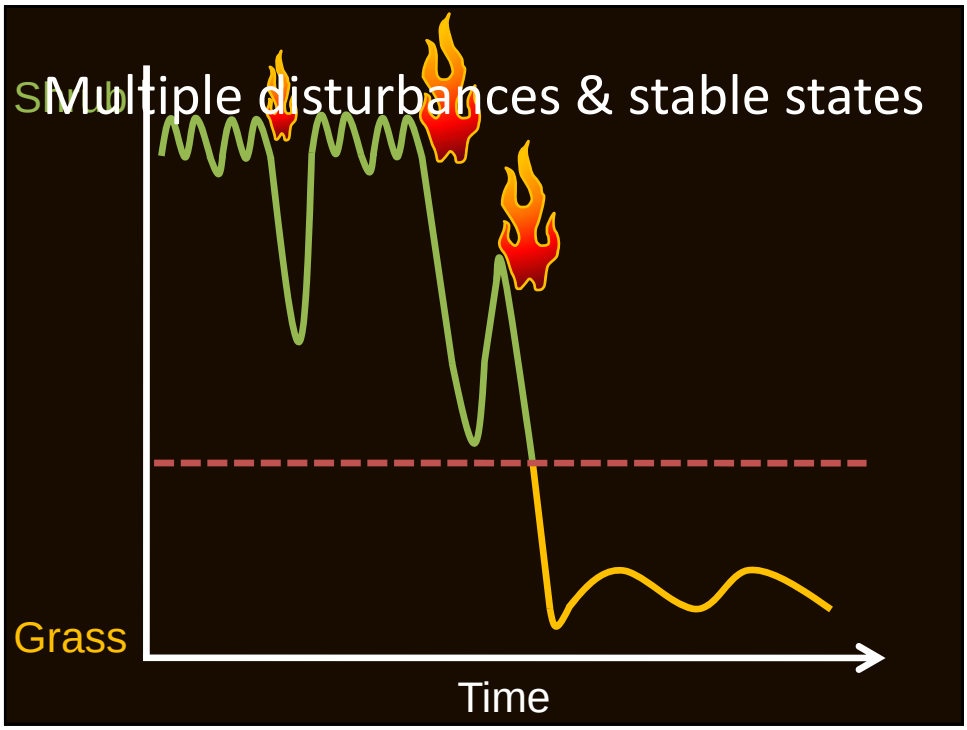

Highway 24
c. 65,000 ha
160,000 acres
< 90% of ALE
Highway 240
24 Command Fire (2000)


24 Command Fire aftermath
Heidi Newsome (USFWS)
6 29'00


NATIONAL WILDLIFE REFUGE
AREA
CLOSED
Wautoma Fire (2007)
Milepost 17 Fire (2007)
Photo by Kevin Goldie (USFWS)

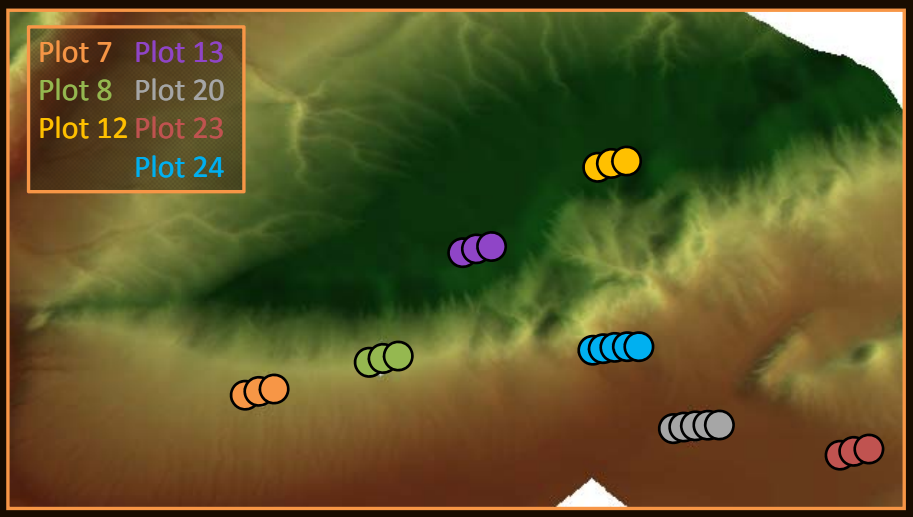

c. 31,000 ha
77,000 acres
c. 75% of ALE
Wautoma Fire (2007)
Milepost 17 Fire (2007)


Wautoma Fire aftermath
Photo by Kevin Goldie (USFWS)


Multiple disturbances & stable states
Shrub
Grass
Time

Objectives

- Examine effect of multiple disturbances
- Understand changes in vegetation communities
- Examine “trajectories” of change
- Discuss evidence for changes in stable states



- Plots = 3 or 5 100 m transects (200-400m apart)
- 20, 20 x 50 cm quadrats per transect
- Species % cover: 1996, 2001 through 2004, 2009

Data analysis 1

- 1996, 2002 and 2009 examined in detail
  (NB fires in 2000 and 2007)

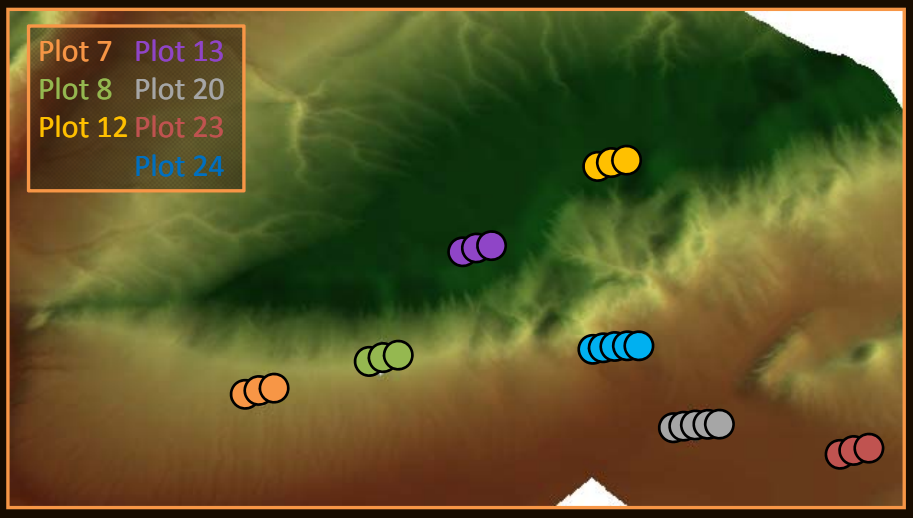
1. Spatial autocorrelation (Mantel tests)
2. ID broad community groups (Cluster Analysis)
3. Test significance of differences in communities (PERMANOVA)

Data analysis 2

4. Developmental trajectories and community change

   Non-metric Multidimensional Scaling (NMDS)

- Analysis completed in R (vegan, labdsv)



- Significant spatial autocorrelation between transects
- Partial Mantel test: $P < 0.001$, r = 0.49
  (controlling for elevation)

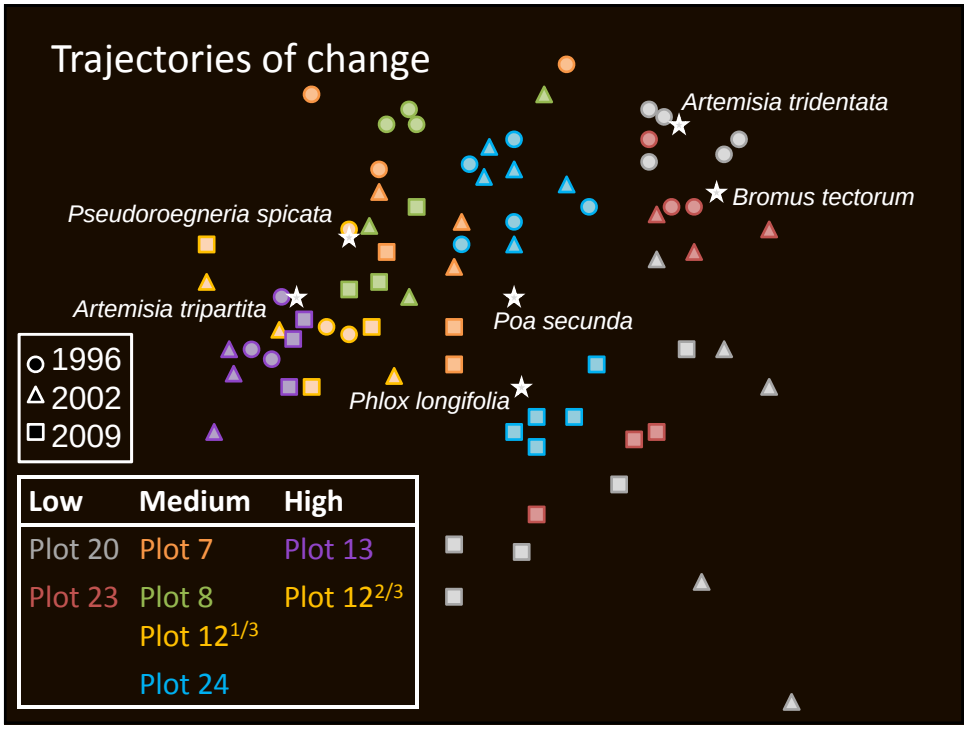
- Cluster analysis identifies 3 community types
- 1996 significant difference in communities ($P < 0.001$)
- 2009 significant difference in communities ($P < 0.001$)

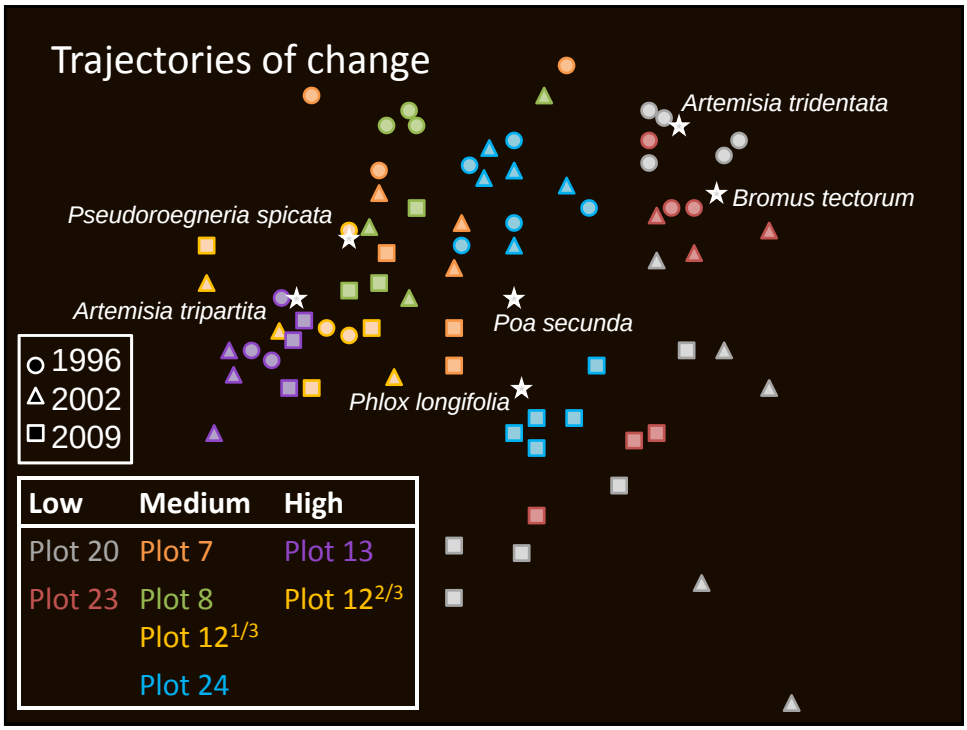
- Cluster analysis identifies 2 community types
- Significant difference in communities ($P < 0.001$)

Trends in functional groups

Trajectories of change

NMDS for all years and all transects


Trajectories of change
Artemisia tridentata
Bromus tectorum
Pseudoroegneria spicata
Artemisia tripartita
Poa secunda
Phlox longifolia
1996
2002
2009
Low
Medium
High
Plot 20
Plot 7
Plot 13
Plot 23
Plot 8
Plot 12 2/3
Plot 12 1/3
Plot 24


Trajectories of change
Artemisia tridentata
Bromus tectorum
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Artemisia tripartita
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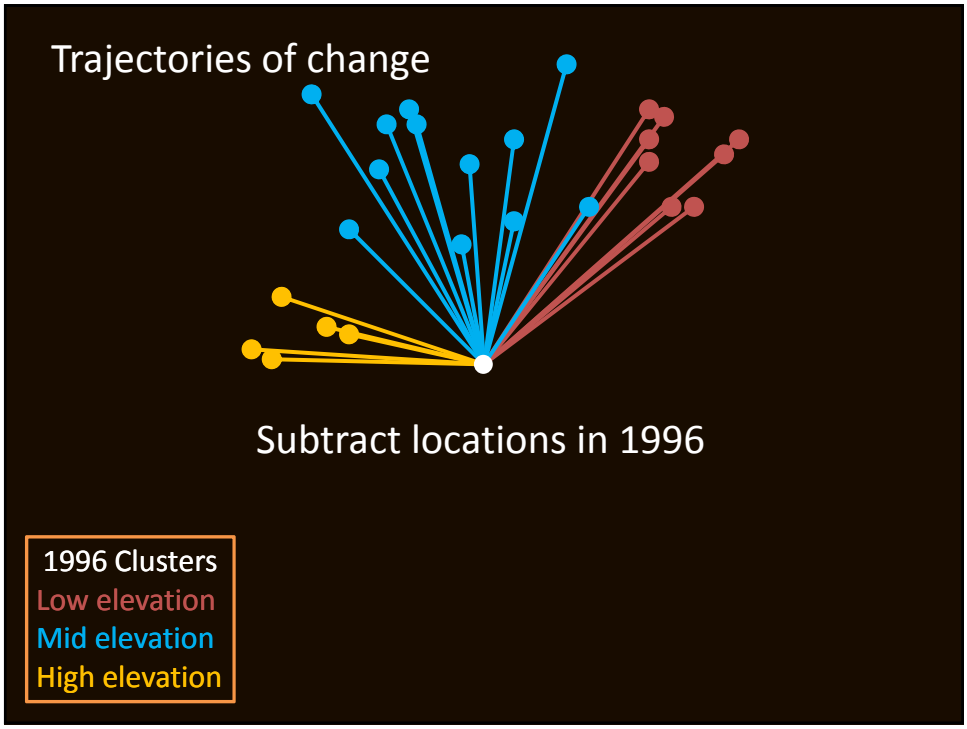
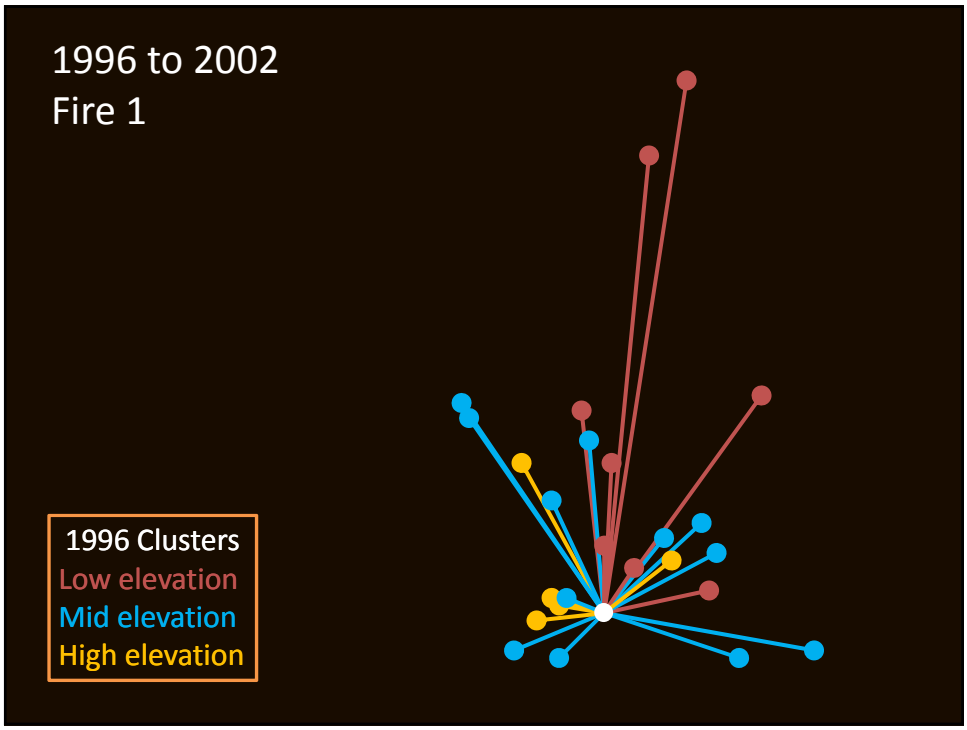
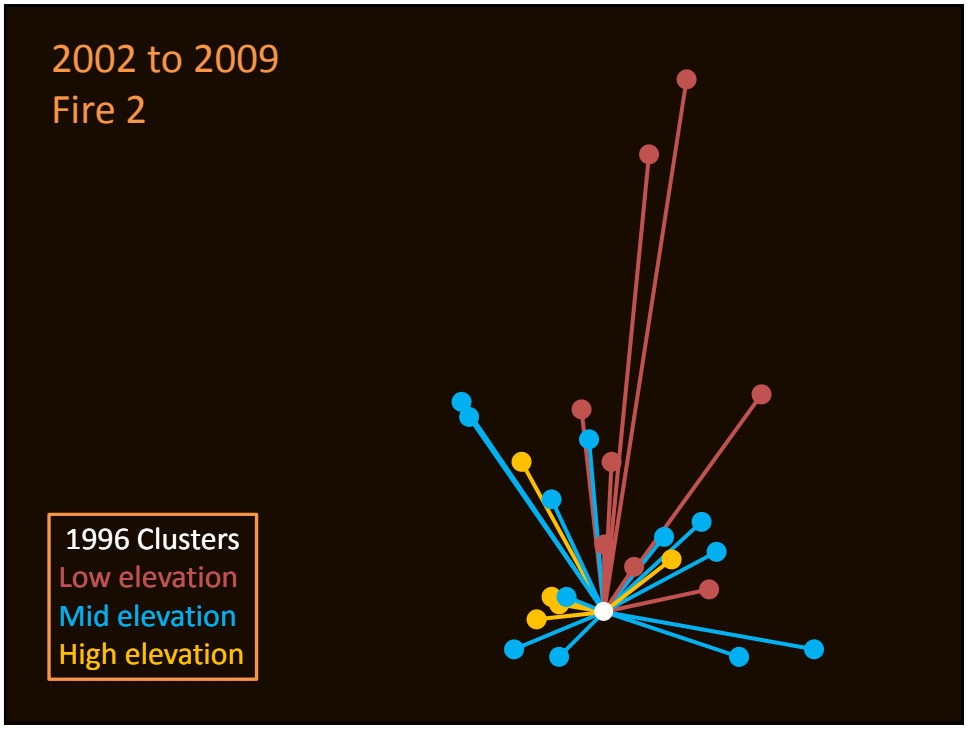
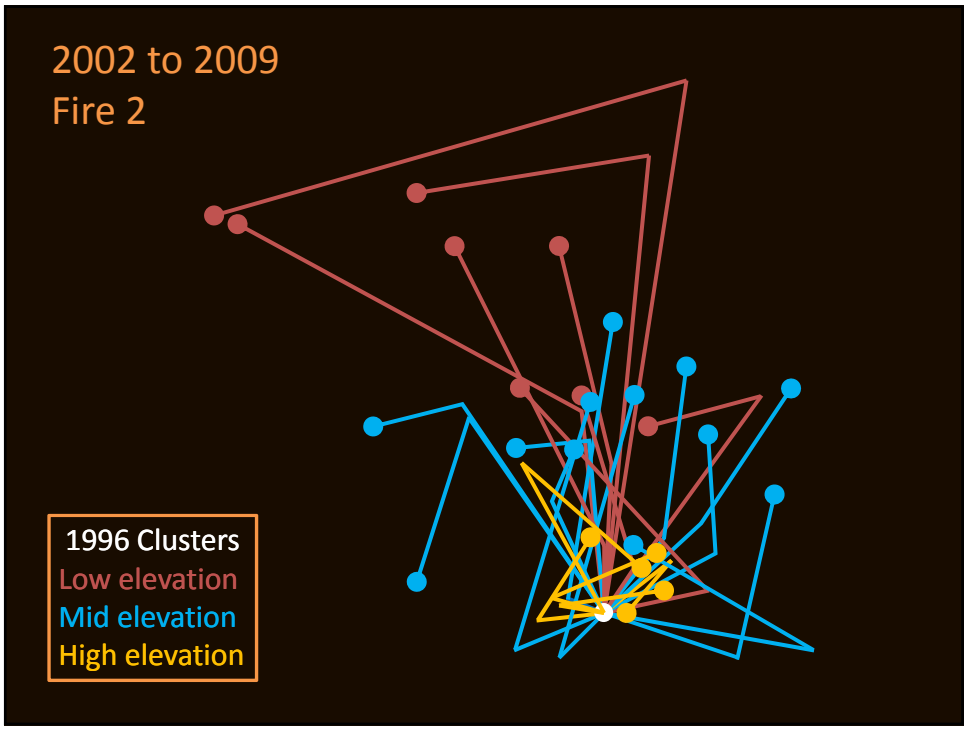
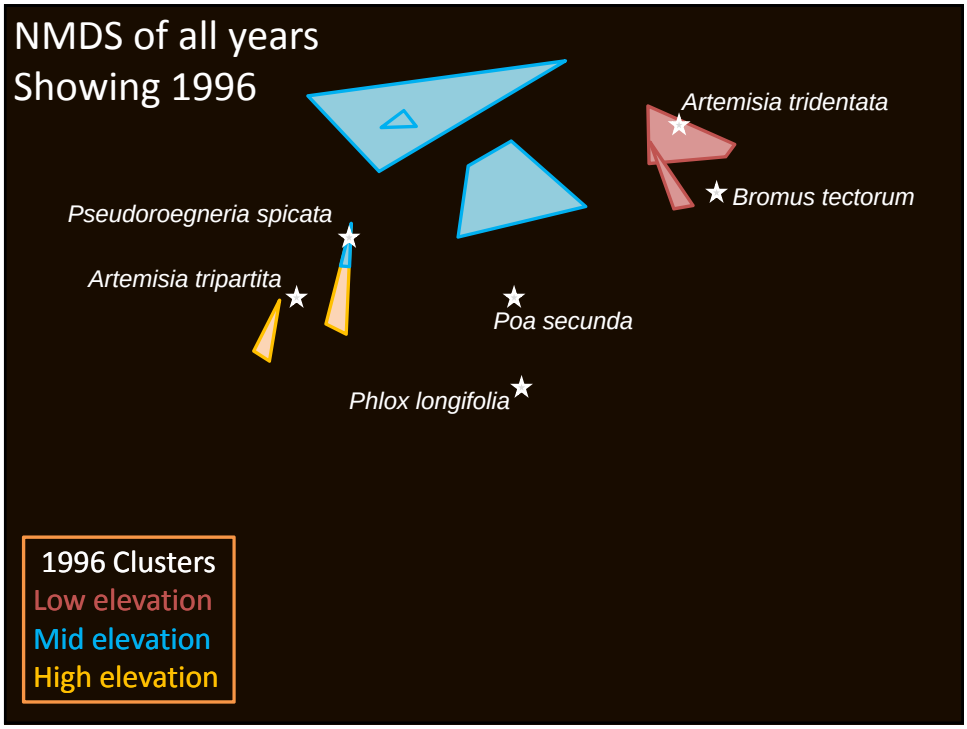
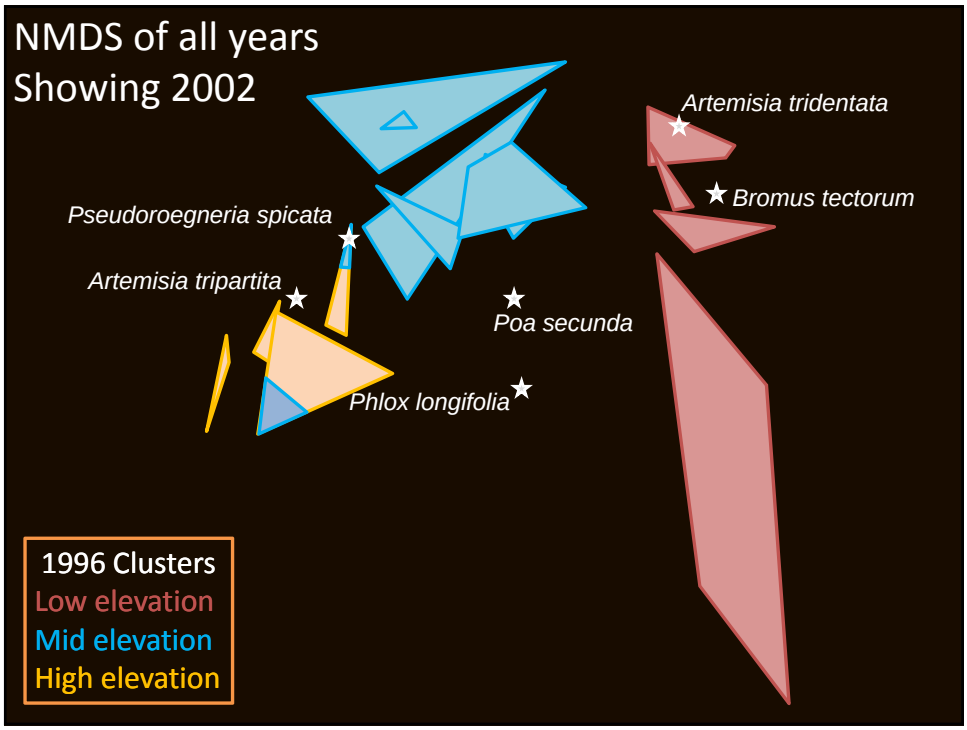

Trajectories of change
Subtract locations in 1996
1996 Clusters
Low elevation
Mid elevation
High elevation

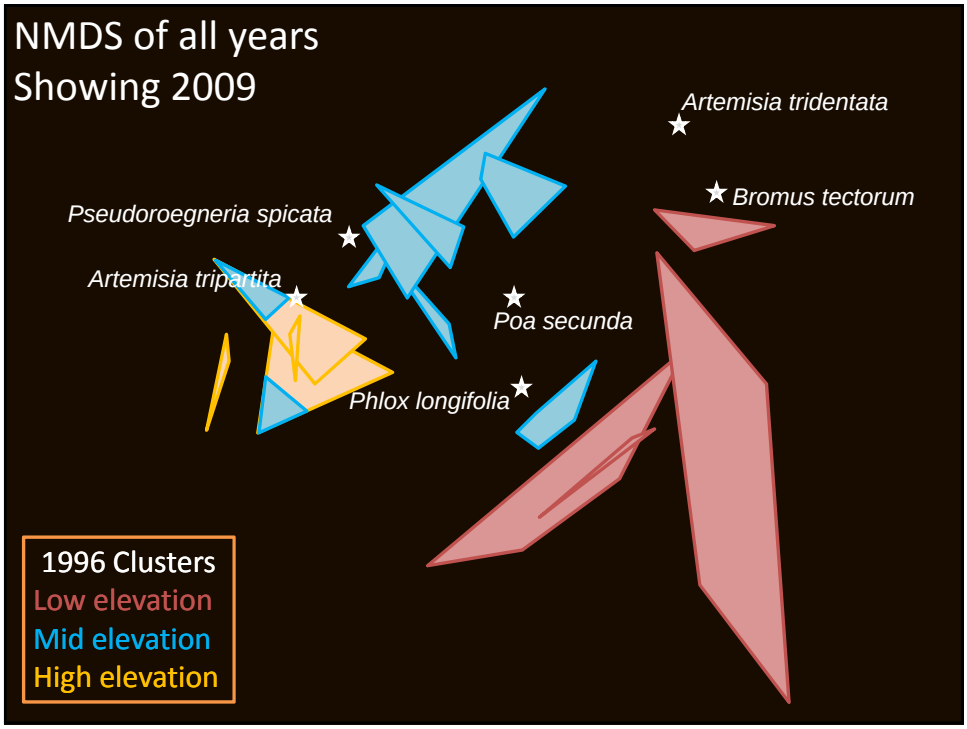

1996 to 2002
Fire 1
1996 Clusters
Low elevation
Mid elevation
High elevation

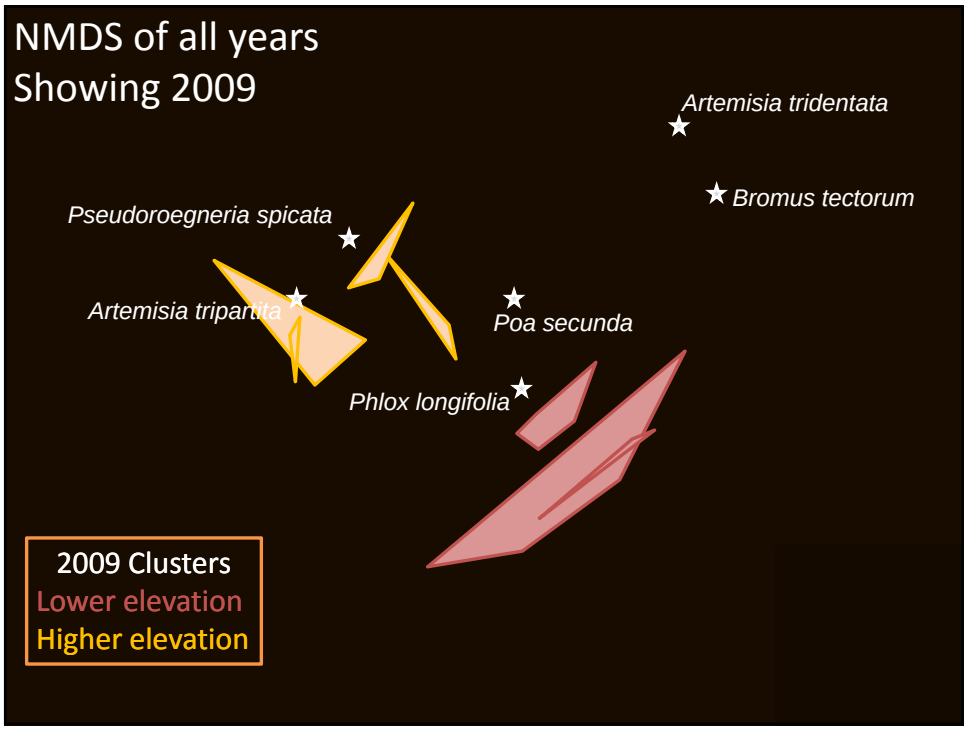

2002 to 2009
Fire 2
1996 Clusters
Low elevation
Mid elevation
High elevation

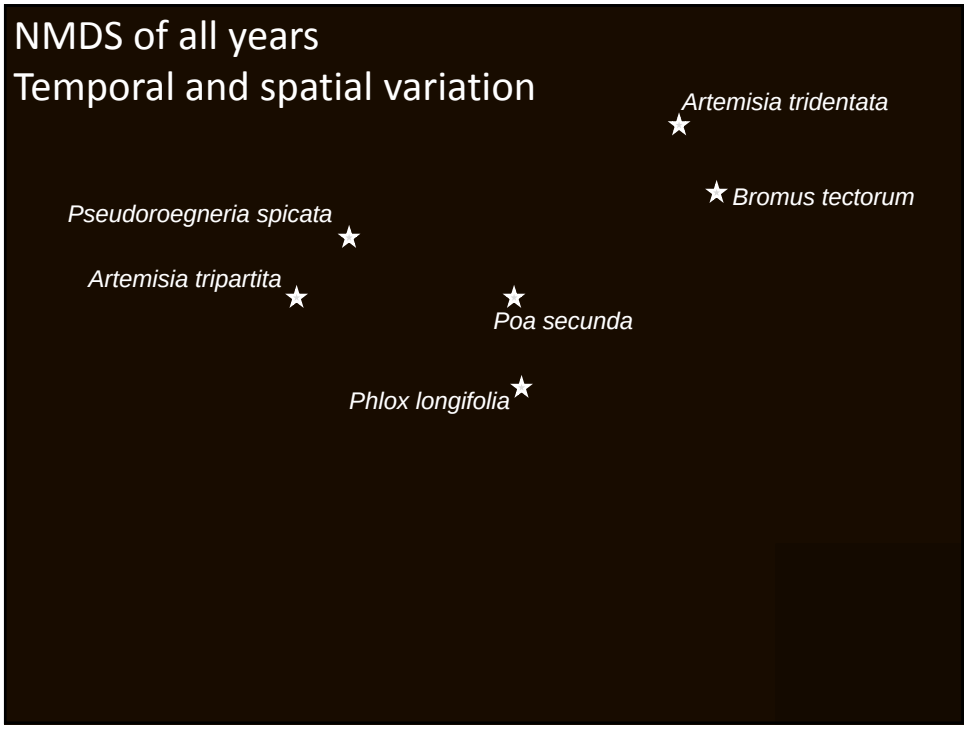

2002 to 2009
Fire 2
1996 Clusters
Low elevation
Mid elevation
High elevation

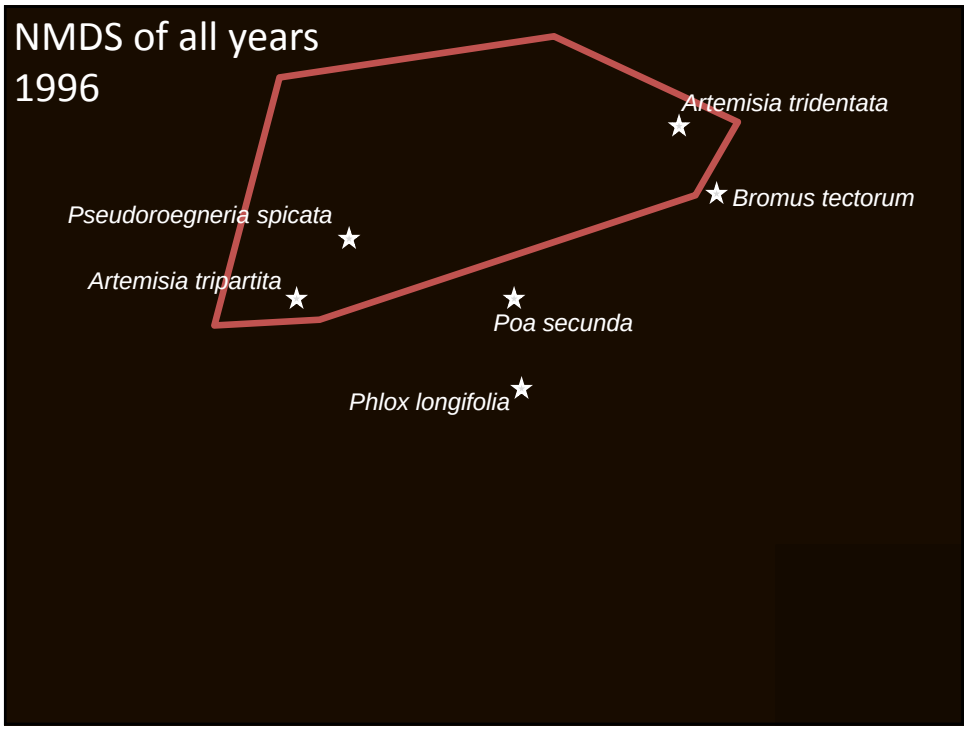

NMDS of all years
Showing 1996
Artemisia tridentata
Bromus tectorum
Pseudoroegneria spicata
Artemisia tripartita
Poa secunda
Phlox longifolia
1996 Clusters
Low elevation
Mid elevation
High elevation

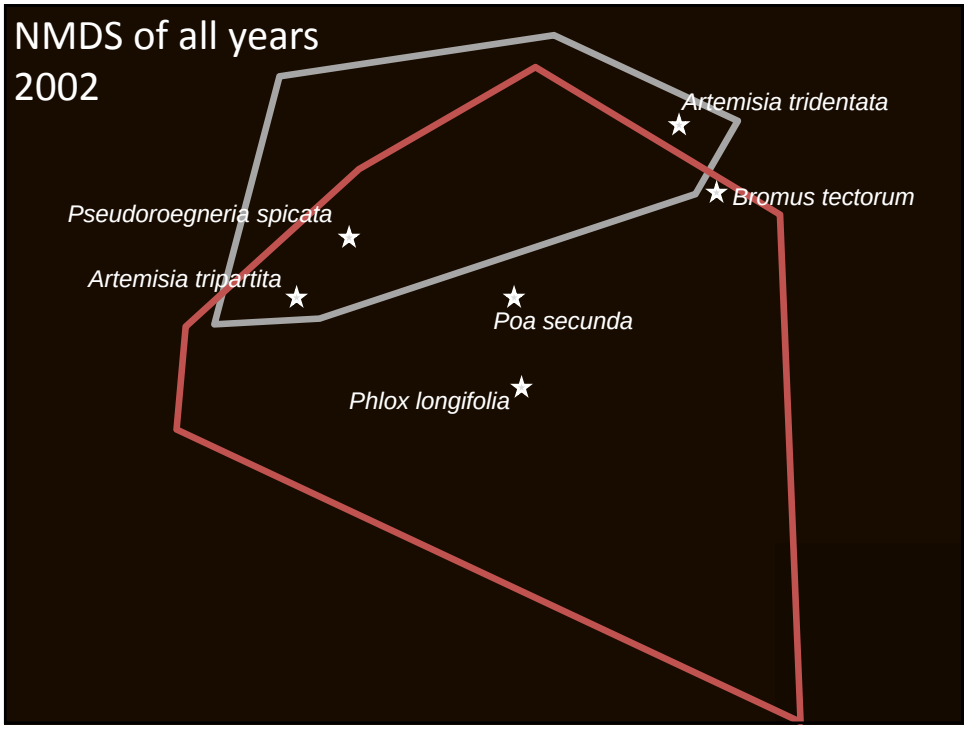

NMDS of all years
Showing 2002
Artemisia tridentata
Bromus tectorum
Pseudoroegneria spicata
Artemisia tripartita
Poa secunda
Phlox longifolia
1996 Clusters
Low elevation
Mid elevation
High elevation

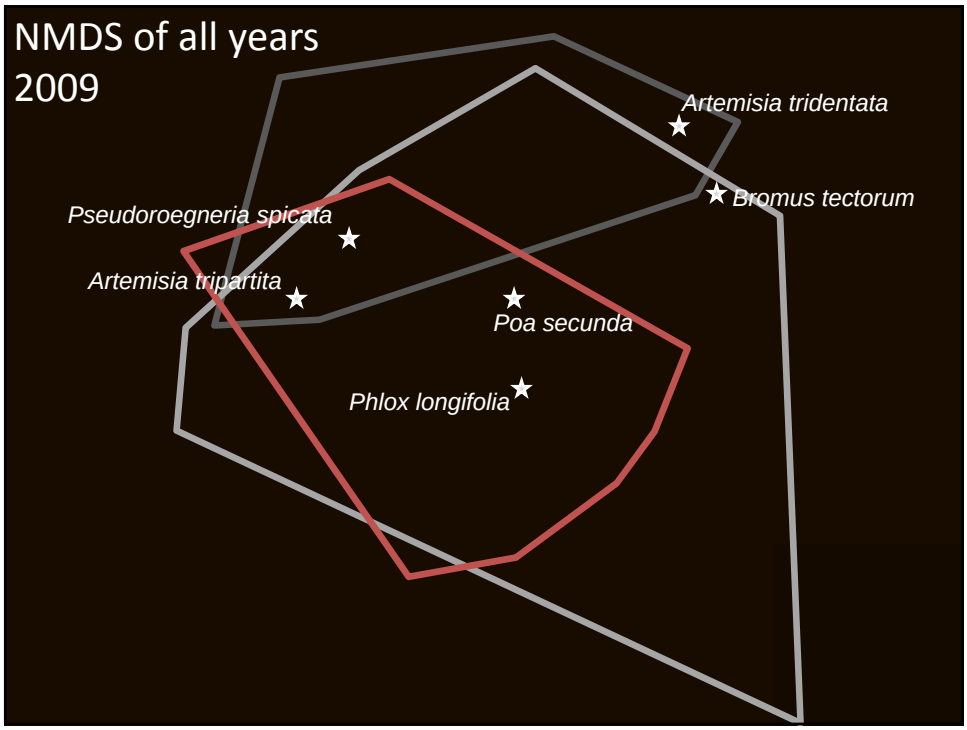

NMDS of all years
Showing 2009
Artemisia tridentata
Bromus tectorum
Pseudoroegneria spicata
Artemisia tripartita
Poa secunda
Phlox longifolia
1996 Clusters
Low elevation
Mid elevation
High elevation


NMDS of all years
Showing 2009
Artemisia tridentata
Bromus tectorum
Pseudoroegneria spicata
Artemisia tripartita
Poa secunda
Phlox longifolia
2009 Clusters
Lower elevation
Higher elevation

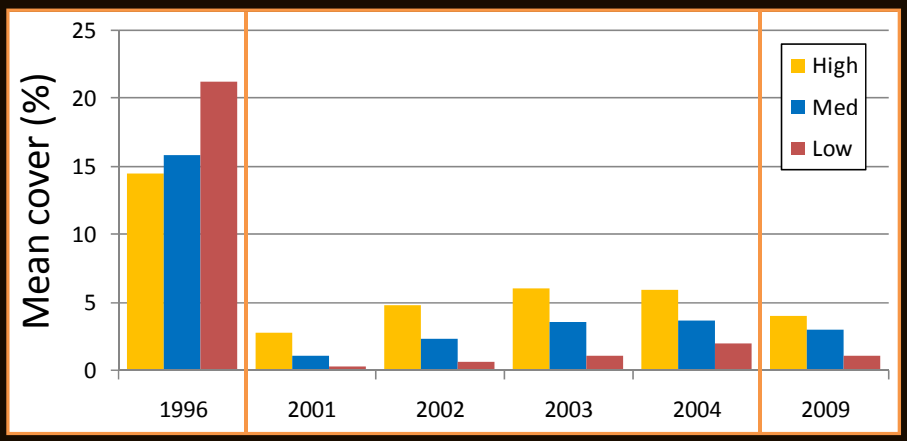

NMDS of all years
Temporal and spatial variation
Artemisia tridentata
Bromus tectorum
Pseudoroegneria spicata
Artemisia tripartita
Poa secunda
Phlox longifolia


NMDS of all years
1996
Artemisia tridentata
Bromus tectorum
Pseudoroegneria spicata
Artemisia tripartita
Poa secunda
Phlox longifolia

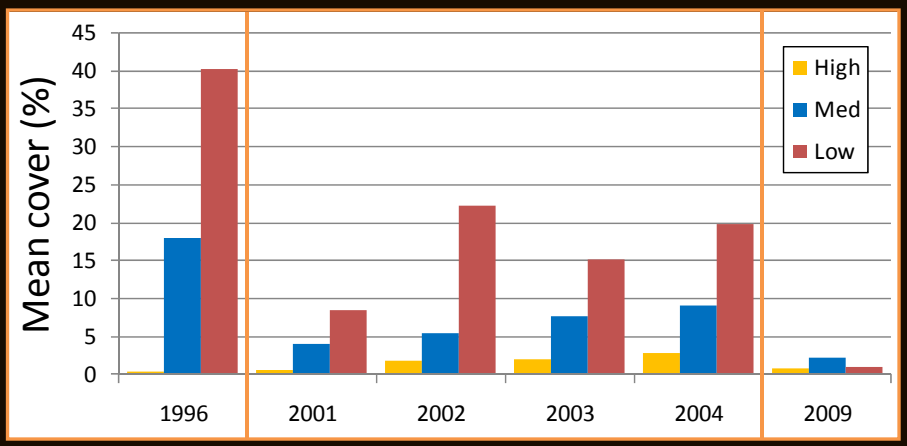

NMDS of all years
2002
Artemisia tridentata
Bromus tectorum
Pseudoroegneria spicata
Artemisia tripartita
Poa secunda
Phlox longifolia

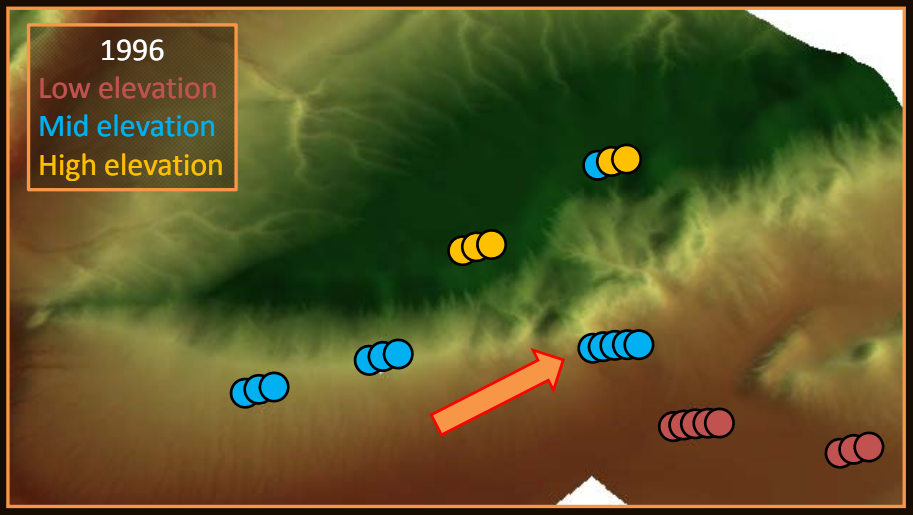

NMDS of all years
2009
Artemisia tridentata
Bromus tectorum
Pseudoroegneria spicata
Artemisia tripartita
Poa secunda
Phlox longifolia

Change in shrub cover



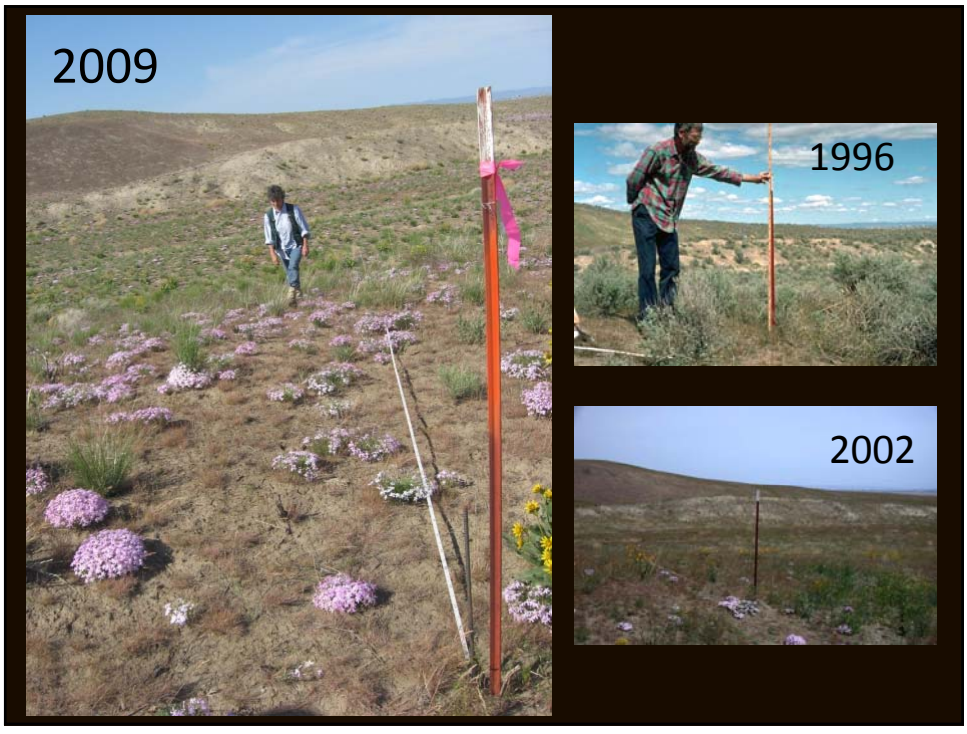
Change in cheatgrass cover

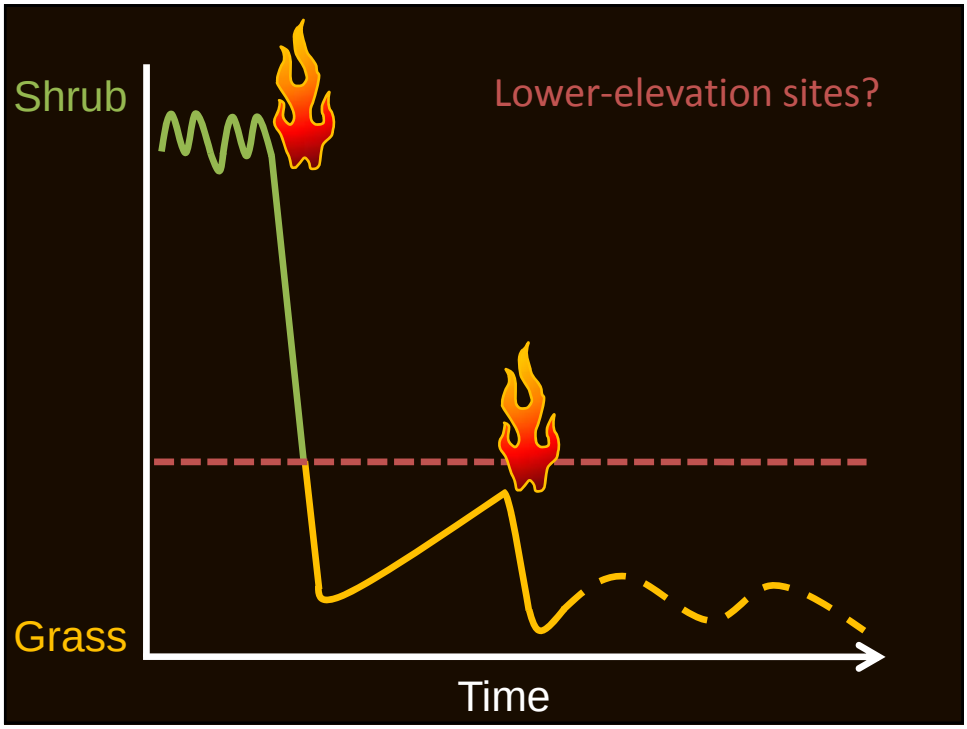


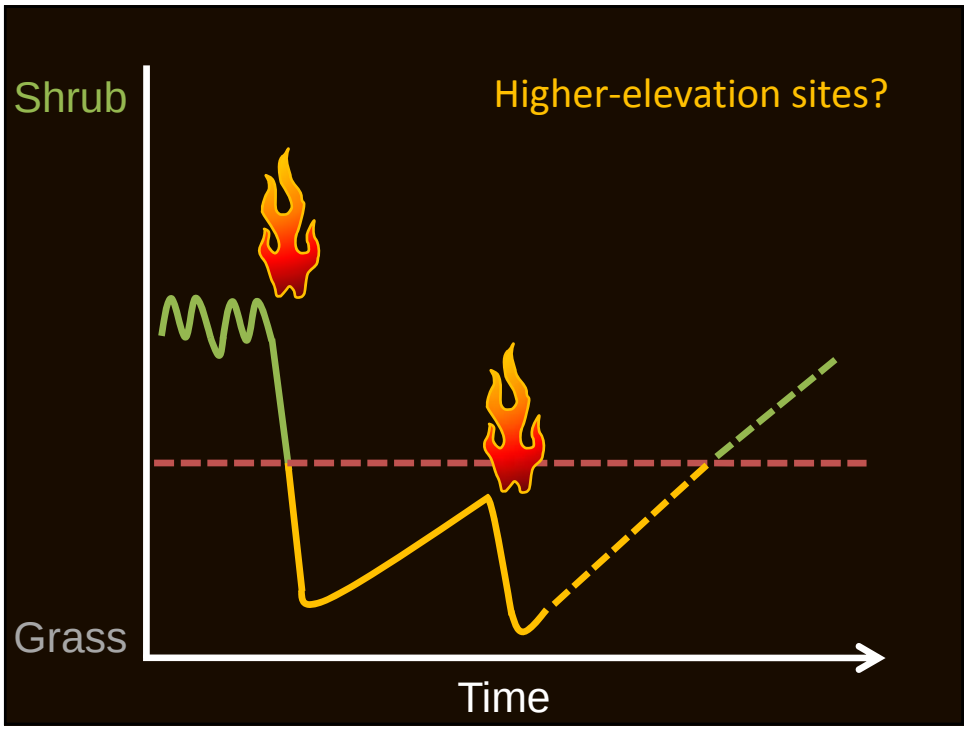


Permanent photo point near mid elevation plot


2002


2009
1996
2002


Shrub
Lower-elevation sites?
Grass
Time


Shrub
Higher-elevation sites?
Grass
Time

Conclusions

- Habitats differ in response to disturbances
- Lower elevation sites heavily invaded
- Higher elevation recovering?
- Plant traits may partially explain differences
- Impacts on sagebrush obligate and other wildlife

M[illegible]n: http://depts.washington.edu/firesale
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