Plant Community Response to the Angora Fire: The Effects of Fire Severity on Diversity and Tree Regeneration

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Background

- These forest types were historically characterized by frequent low severity (5-25 FRI)
  - Increased potential species pool at low-moderate at these severities
  - Pines seedlings benefit from this disturbance regime
- Time since fire is an important variable: usually just see a snap-shot at one time point

Community Changes Over Time

Moderate Severity

thinned pre-fire

2008

2009

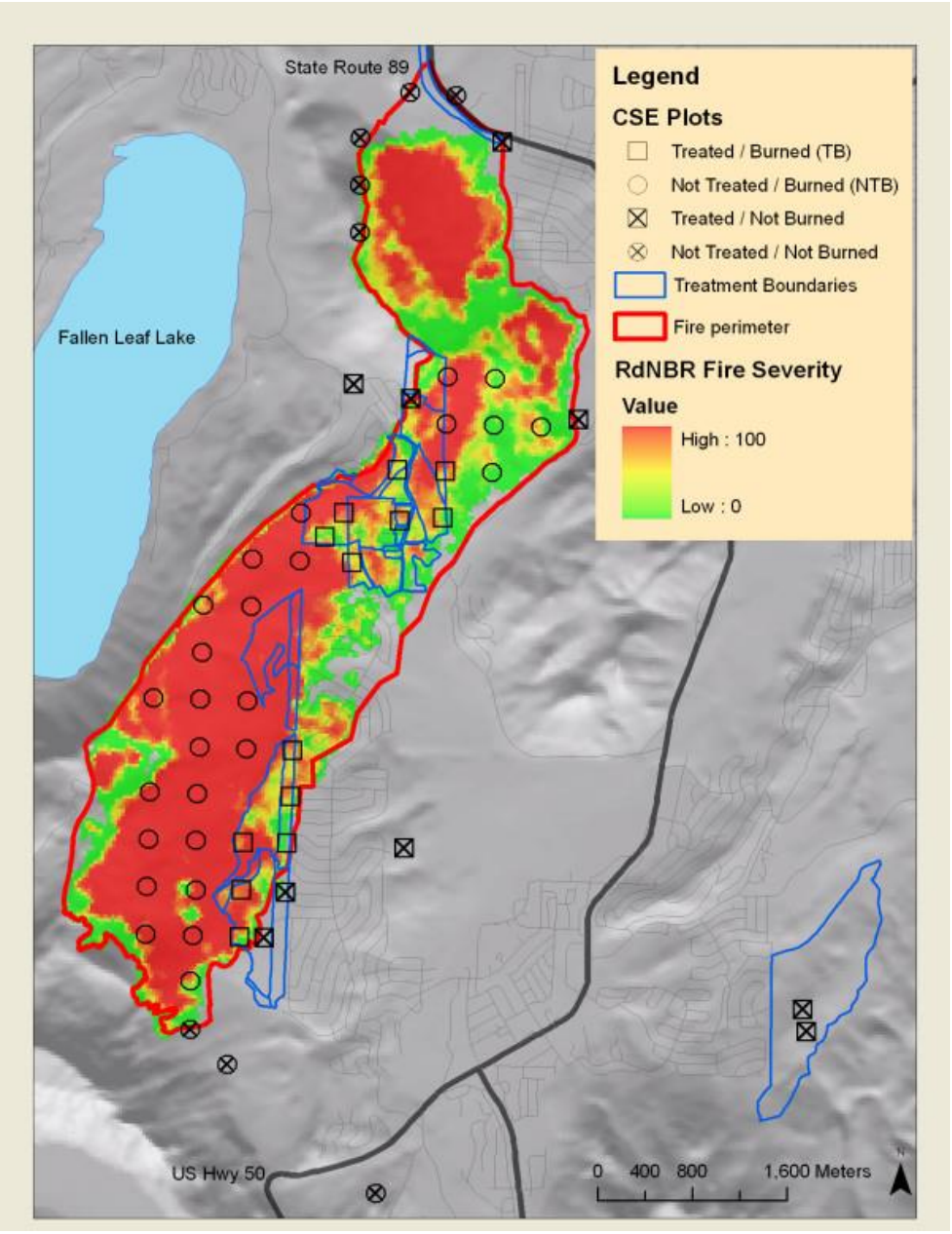
2010

2011

2016

Objectives

- Effect of fire severity on:
  - Plant species richness over time
  - Natural tree regeneration
- Hypothesis: lower fire severity → increased species richness & regeneration of pine species



Chris H. Carlson et al. 2012

Fire Severity Classes

Unburned

Low: < 50%
overstory mortality

Moderate: 50-75%
overstory mortality

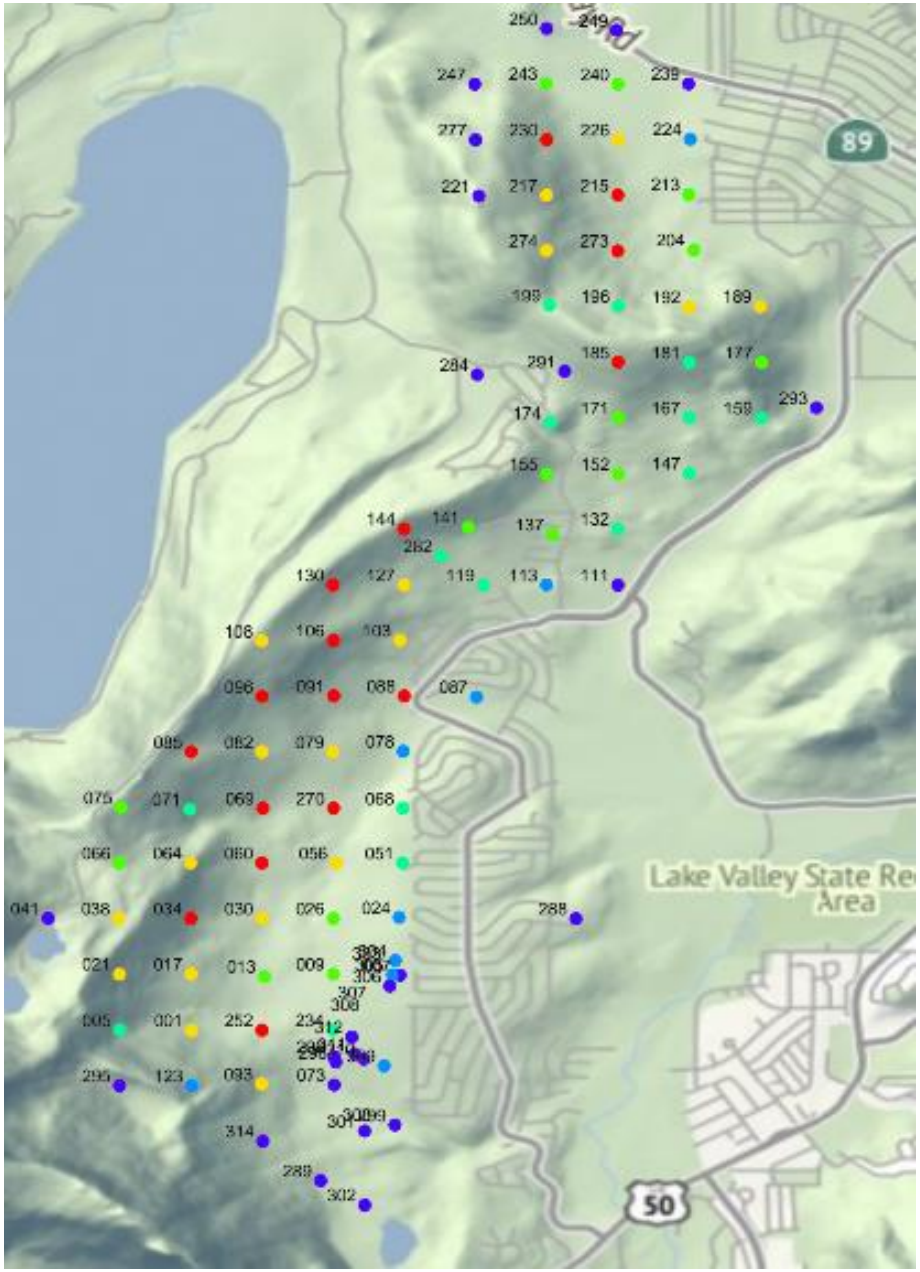
High: 75-90%
overstory mortality

Very High: > 90%
overstory mortality

Fire severity classes: 1 year after fire

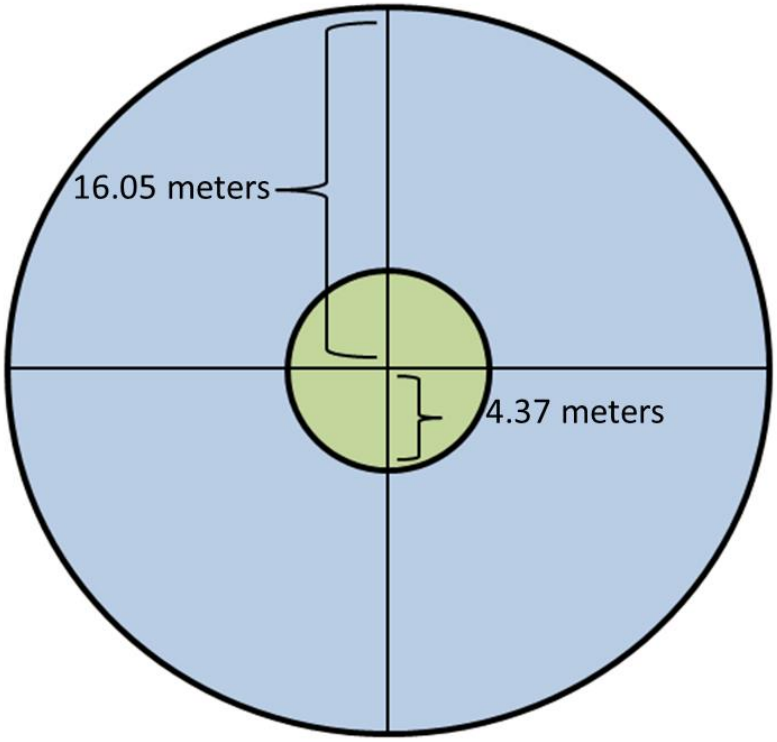
Fire severity classes 9 years after fire

CSE Plot Locations



Protocol

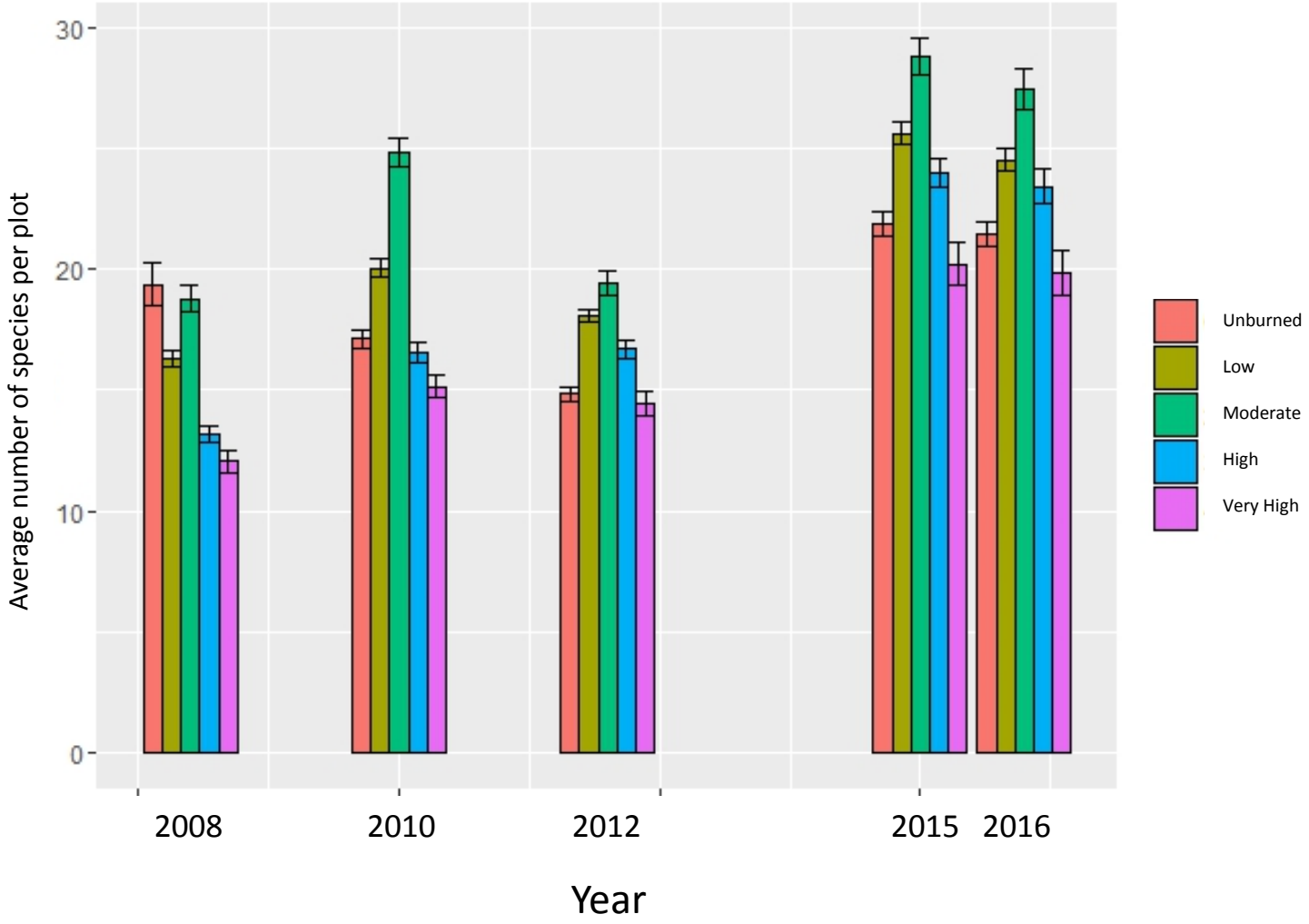
- Species Composition plots:
  - All species cataloged along with %cover
  - (809m2 area)
- Tree Regeneration plots
  - Age and species for each seedling
  - Height and last year's growth recorded for tallest individual of each species
  - (60m2 area)



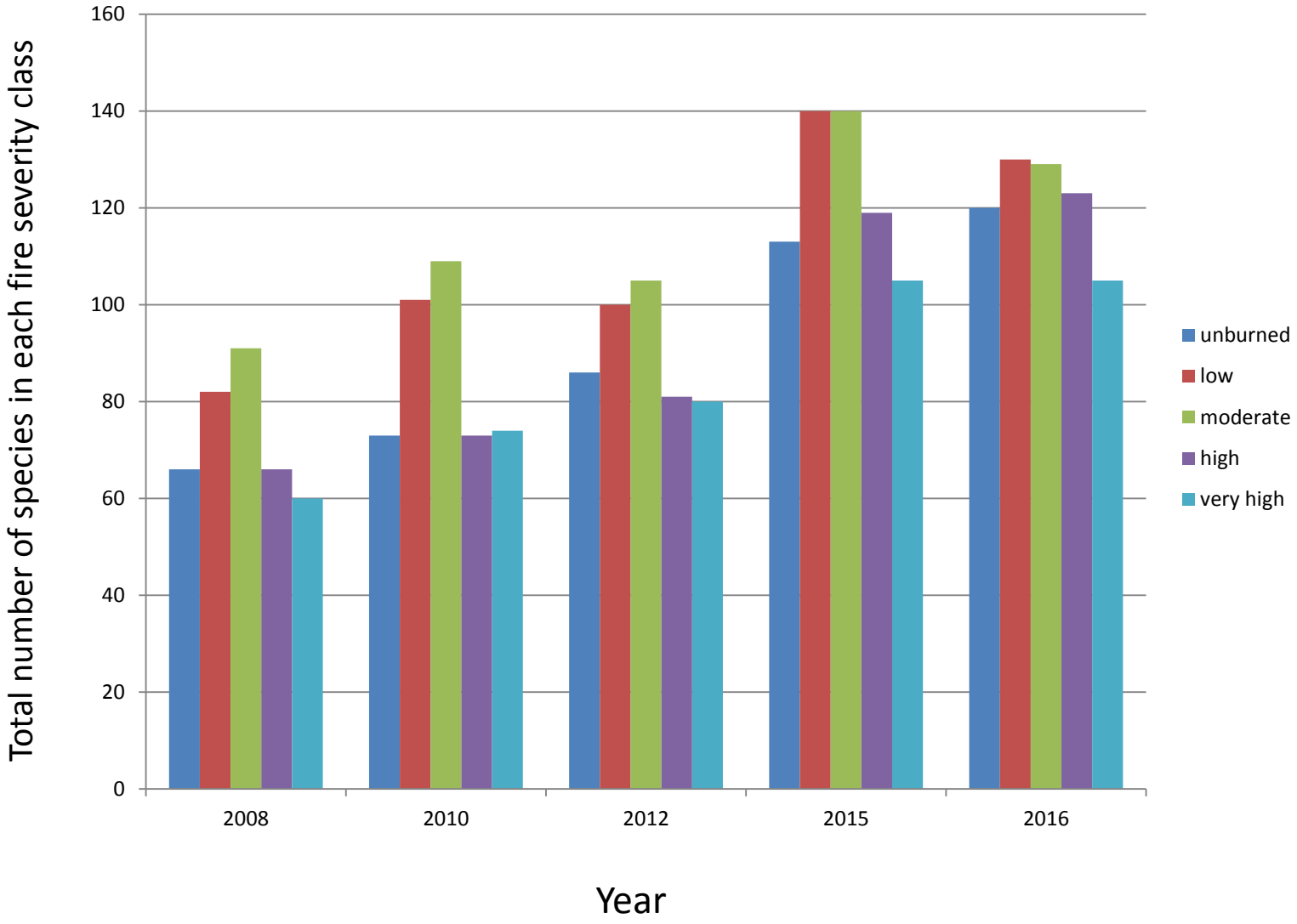
Species Richness Results

- Species richness at the plot scale over time
- Overall species richness for each fire severity class over time

Average Plot Species Richness



Overall Species Richness



Conifer Regeneration Results

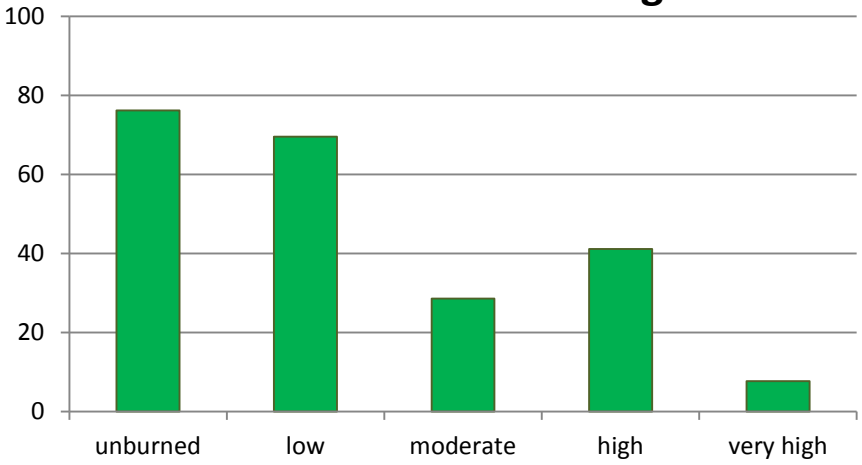
- 2016 only
- Divided seedlings into shade tolerant and shade intolerant species
  - Presence and absence of these two categories
  - Medians across fire severity classes

Shade Tolerant vs Shade Tolerant Tree Species

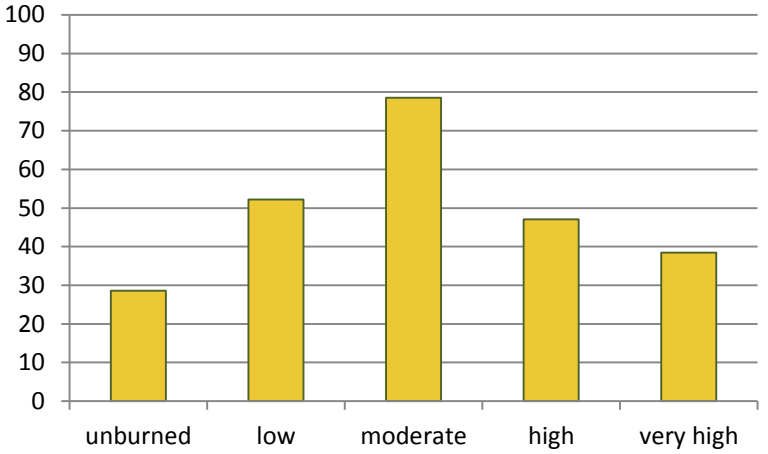
Shade Intolerant Species:
- Jeffery Pine
- Lodgepole Pine
- Sugar Pine

Shade Tolerant Species
- White Fir
- Red Fir
- Incense Cedar

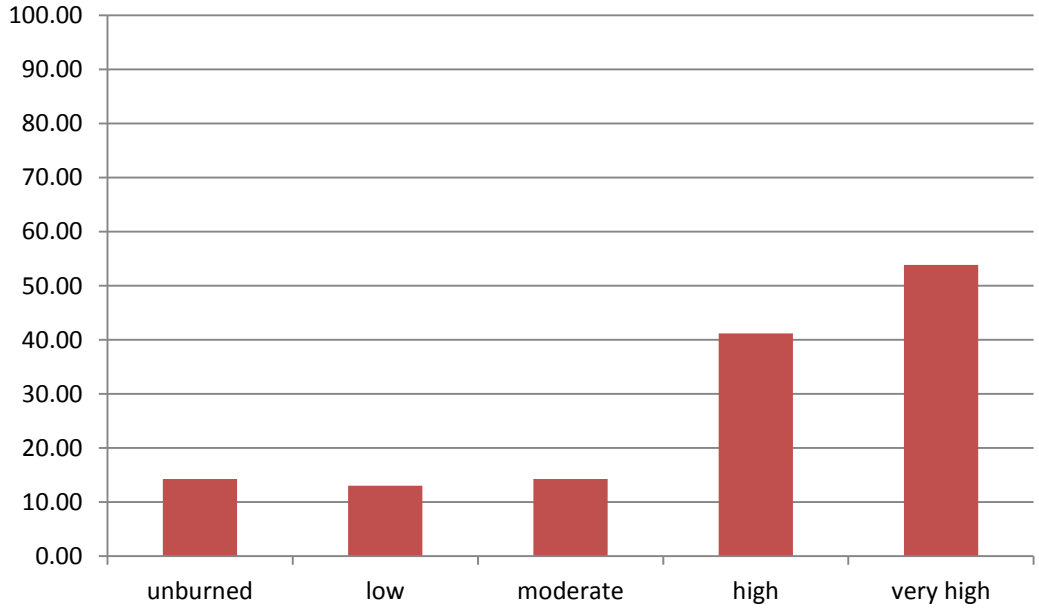
Percentage of Plots Containing Shade Tolerant seedlings

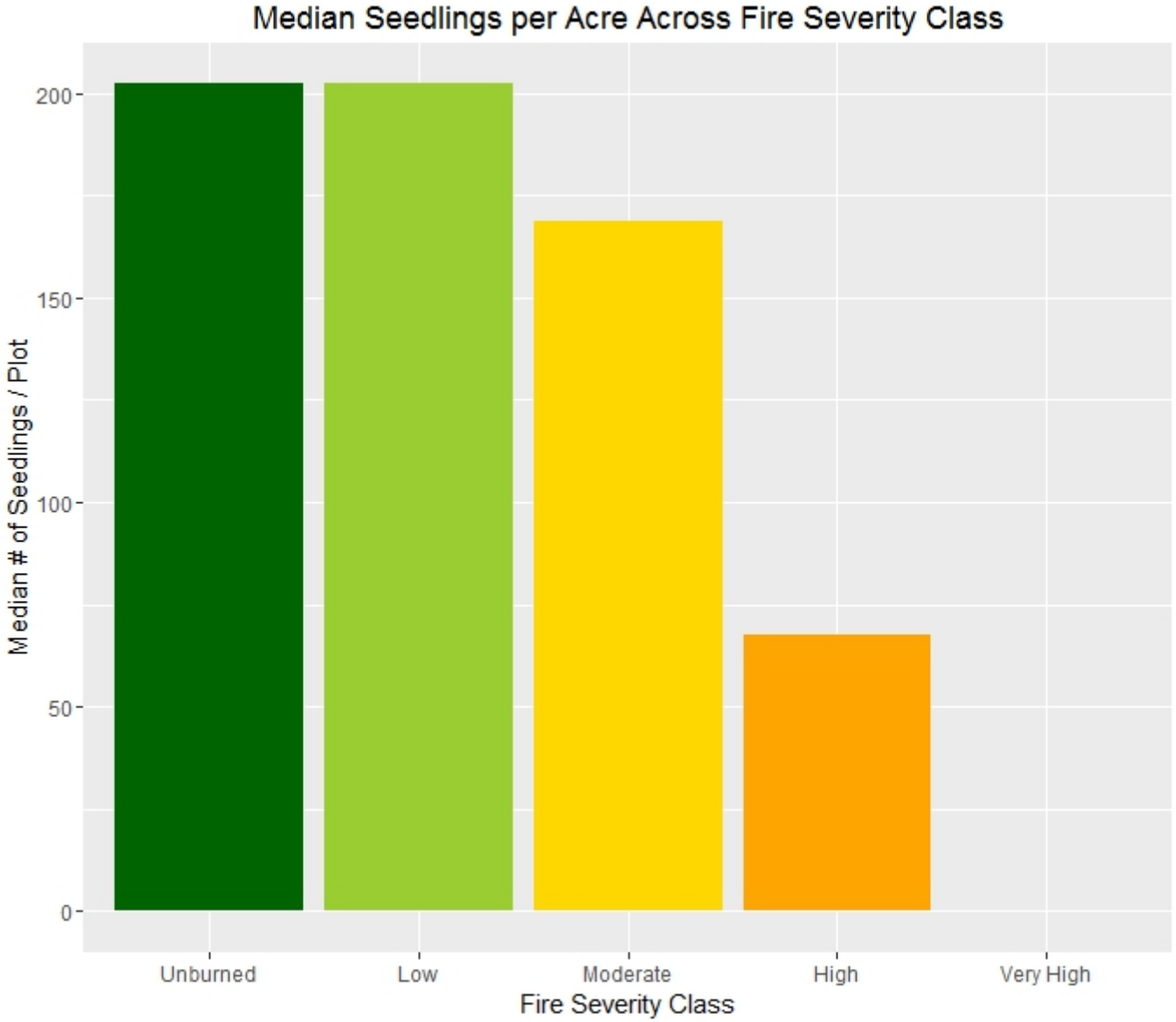


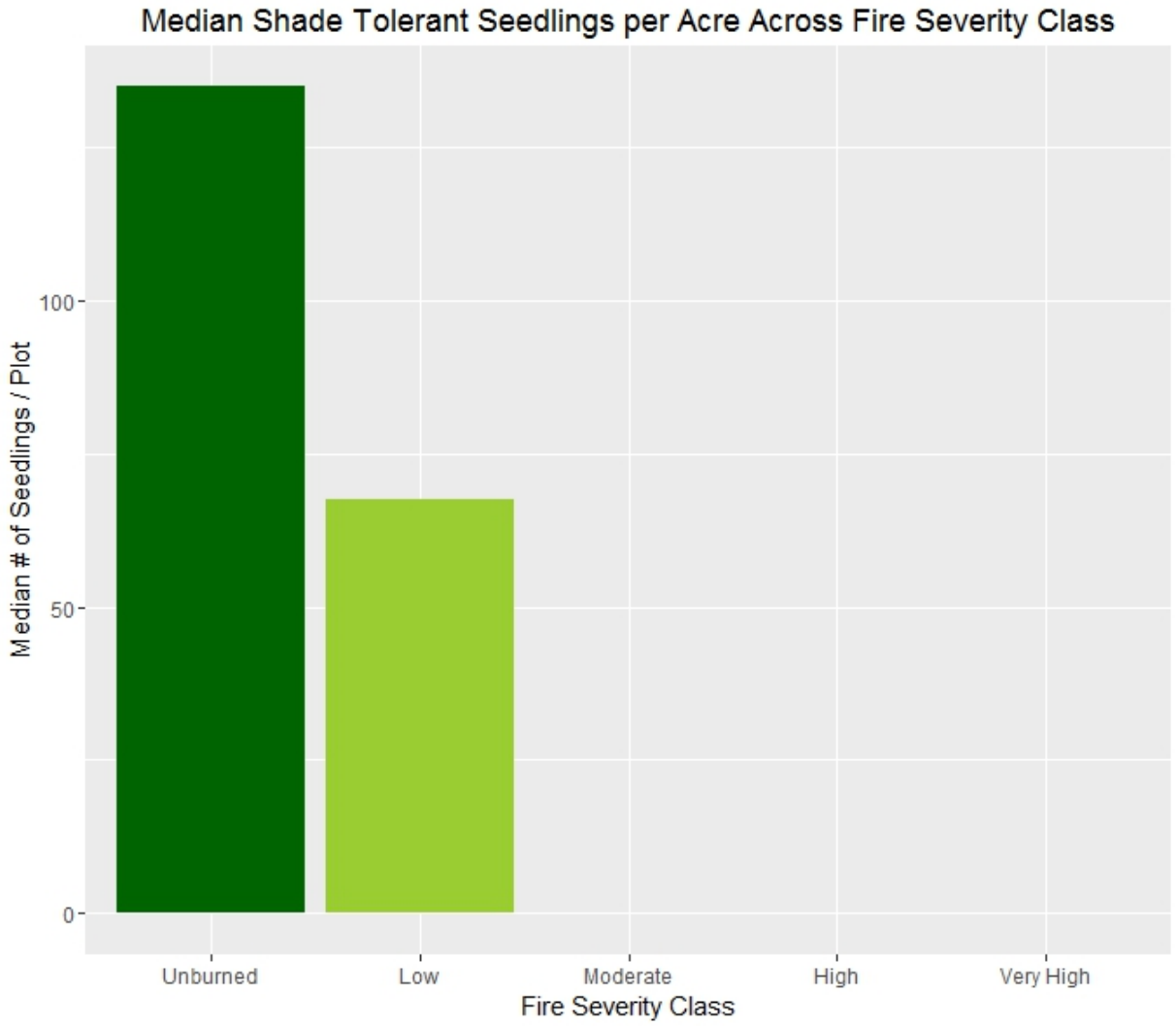
Percentage of Plots Containing Shade Intolerant Seedlings

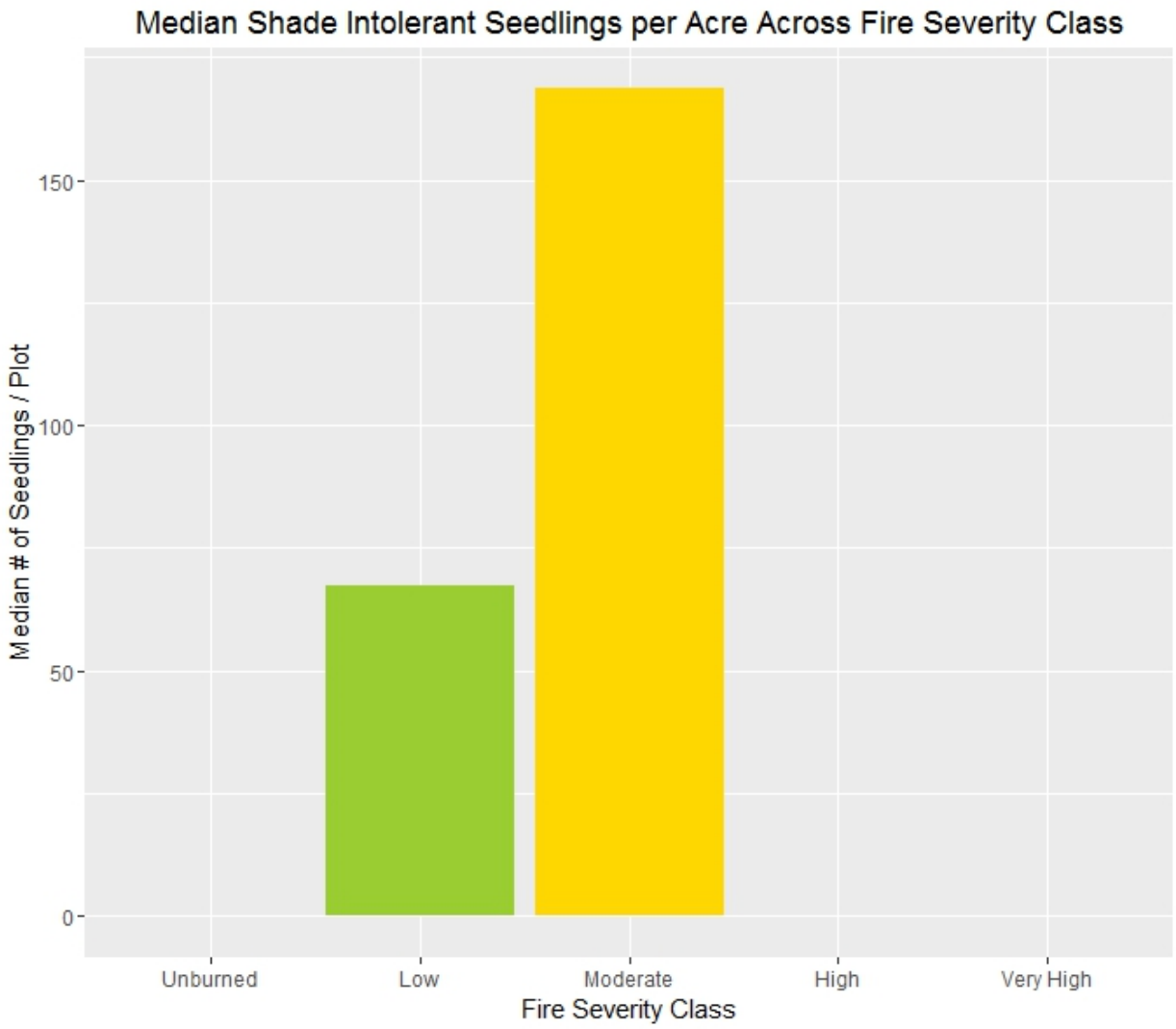


Percentage of Plots with No Seedlings




Median Seedlings per Acre Across Fire Severity Class
Median # of Seedlings / Plot
200
150
100
50
0
Unburned
Low
Moderate
High
Very High
Fire Severity Class


Median Shade Tolerant Seedlings per Acre Across Fire Severity Class
Median # of Seedlings / Plot
100
50
0
Unburned
Low
Moderate
High
Very High
Fire Severity Class


Median Shade Intolerant Seedlings per Acre Across Fire Severity Class
Median # of Seedlings / Plot
150
100
50
0
Unburned
Low
Moderate
High
Very High
Fire Severity Class

Natural Regeneration continued

- Overall averaged seedlings/acre (all species and fire severities combined)
  - Means
    - Including unburned plots: 716 seedlings/acre
    - Including only burned plots: 580 seedlings/acre
  - Medians
    - Including unburned plots: 67 seedlings/acre
    - Including only burned plots: 67 seedlings/acre
- Overall plots with no natural regeneration
  - Including unburned plots -25%
  - Including only burned plots – 28%
- Total percentages of seedlings
  - Including unburned plots
    - 75% shade tolerant
    - 25% shade intolerant
  - Including only burned plots
    - 70% shade tolerant
    - 30% shade intolerant
- Percentage of individual species in shade tolerant and intolerant categories
  - Shade intolerant:
    - Jeffrey Pine – 67%
    - Lodgepole Pine – 23%
    - Sugar Pine – 10%
  - Shade tolerant:
    - White Fir - 64%
    - Red Fir – 26%
    - Incense Cedar – 10%

Conclusions

- Important beneficial ecological responses at low and moderate fire severities.
  - species diversity at local and regional scales are highest at these severities
  - seedling regeneration of pine species is very low outside of these fire severity classes, even after 9 years
  - Pre-fire management responsible for most of the area that burned at low-moderate severity
- Time scale
  - While species richness follows similar trend overtime, there is variation.
    - Can extrapolate to some degree based on one year's data

Acknowledgements

- Hugh Safford
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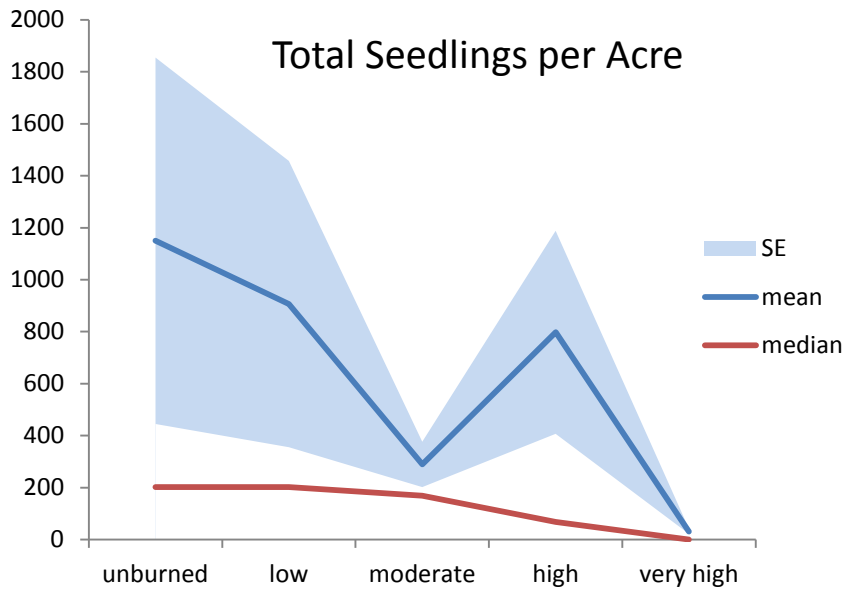
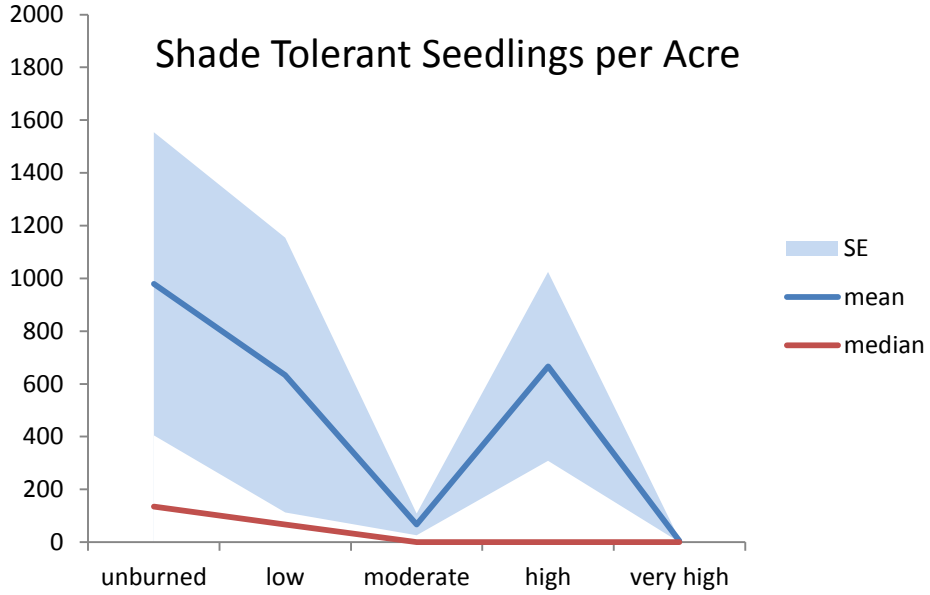
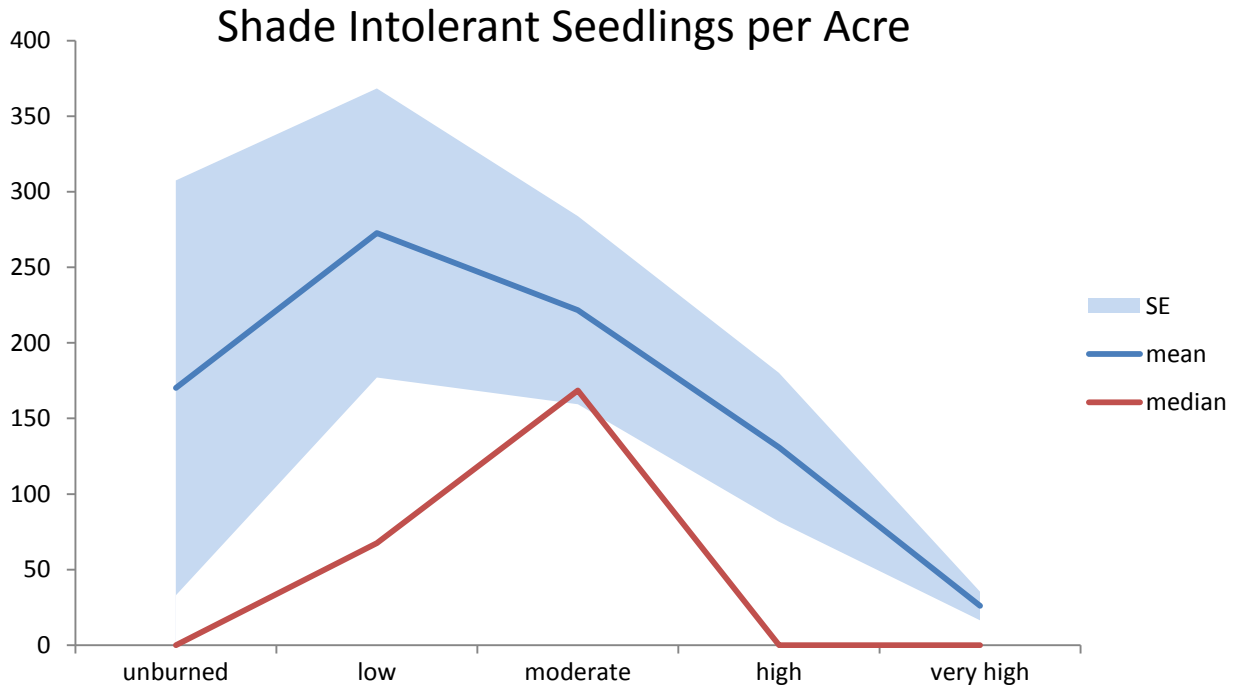
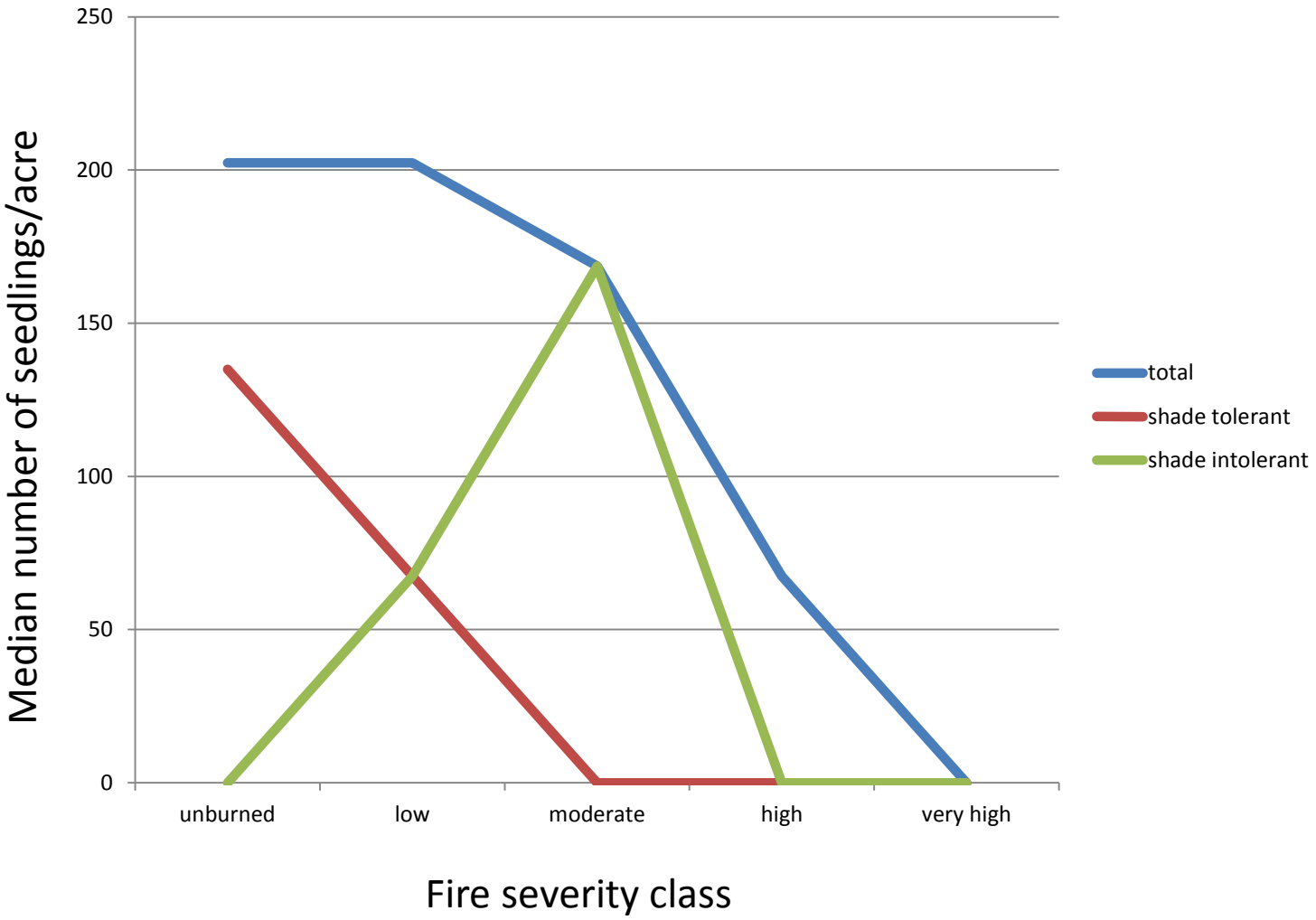
- All the crew members that have worked on this over the years: Gabrielle Bohlman, Chris Carlson, Svetlana Yegorova, Amy Jirka, Kevin Welch, Jesse Miller, Steve Aliberti, Emily Okal, Brennon Touryon, Amy Brodbeck, Daniel Safford, Marcel Safford and many others!!!!


Total Seedlings per Acre
2000
1800
1600
1400
1200
1000
800
600
400
200
0
unburned
low
moderate
high
very high
SE
mean
median

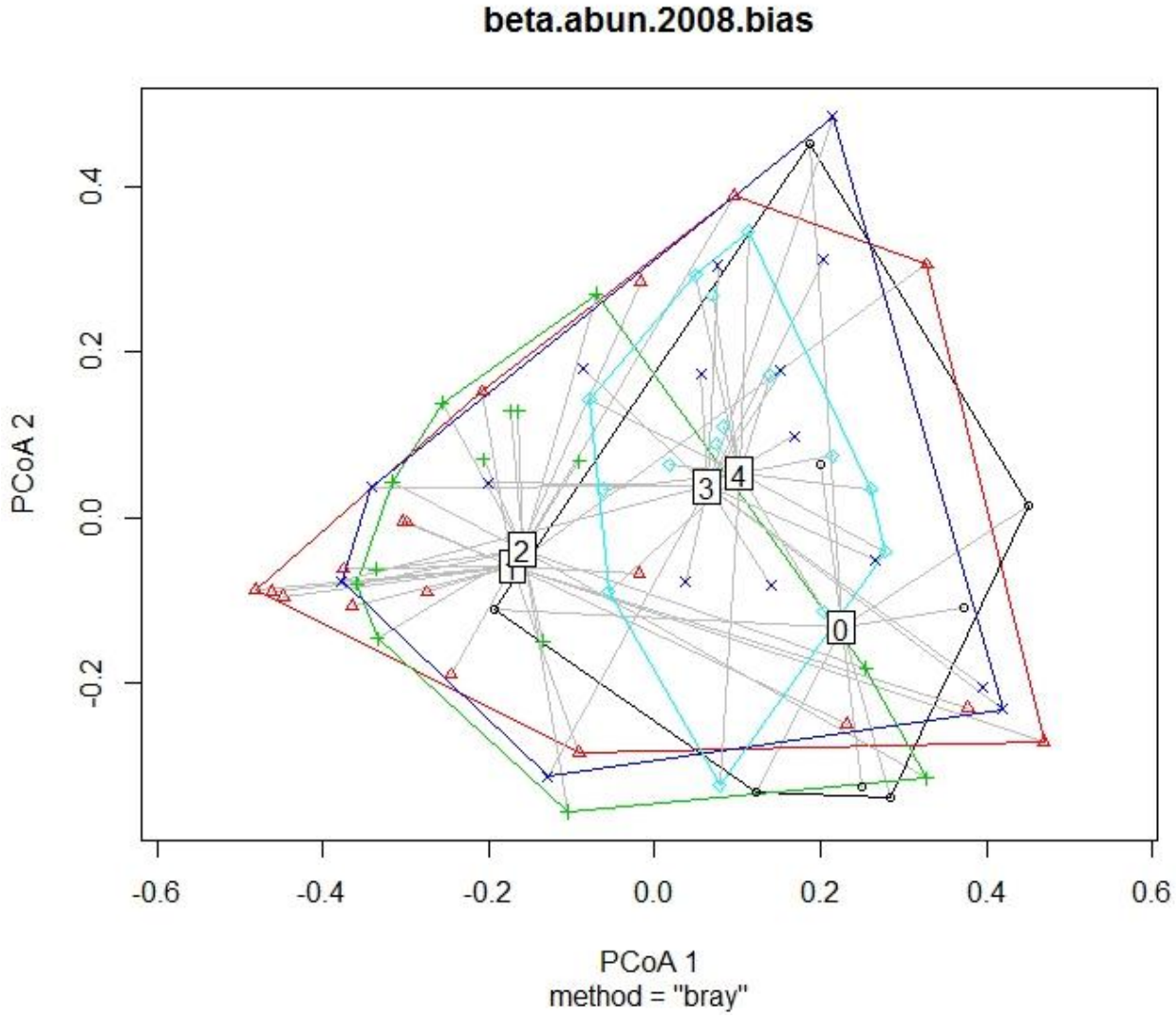

Shade Tolerant Seedlings per Acre
2000
1800
1600
1400
1200
1000
800
600
400
200
0
unburned
low
moderate
high
very high
SE
mean
median

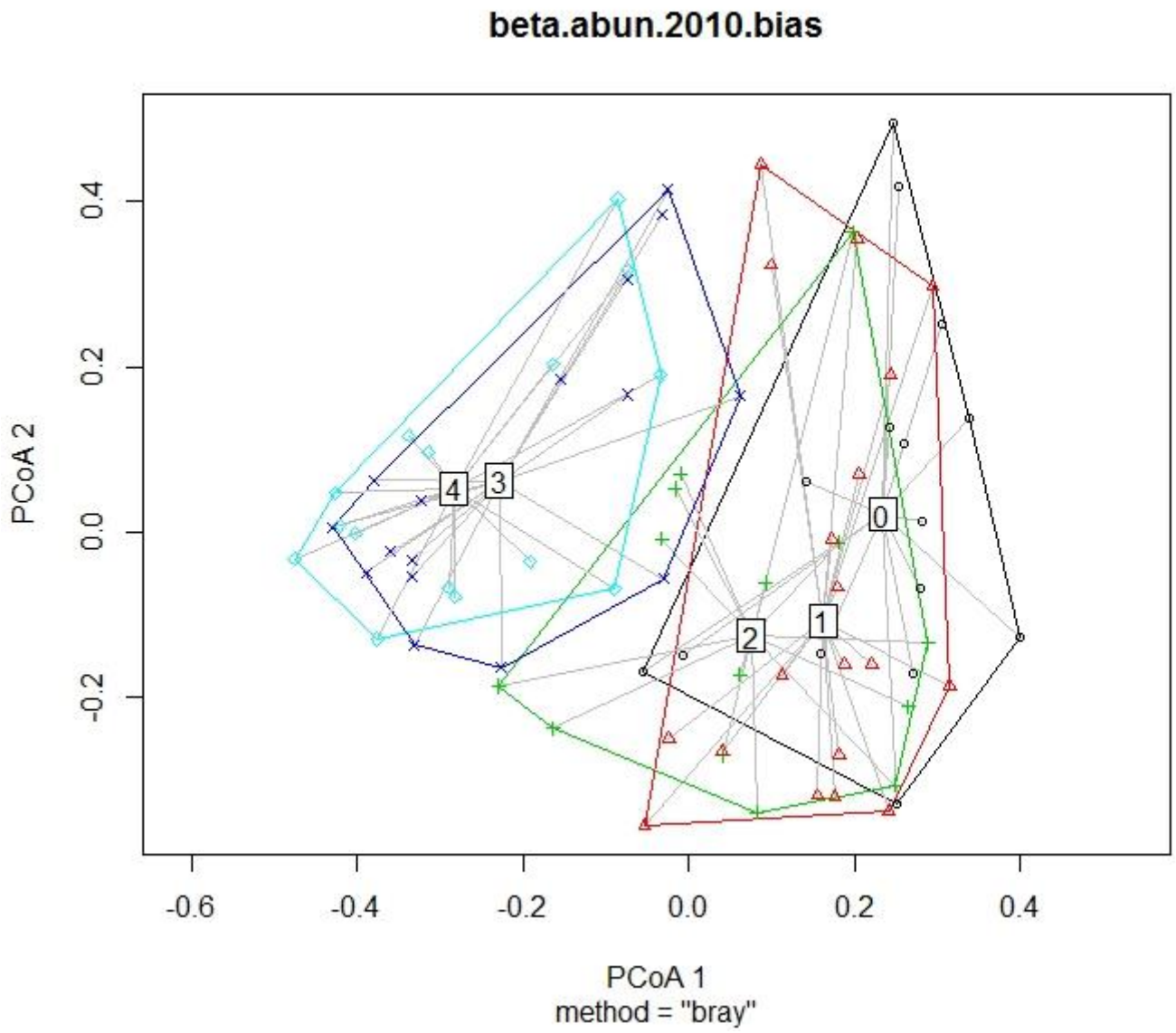

Shade Intolerant Seedlings per Acre
400
350
300
250
200
150
100
50
0
unburned
low
moderate
high
very high
SE
mean
median

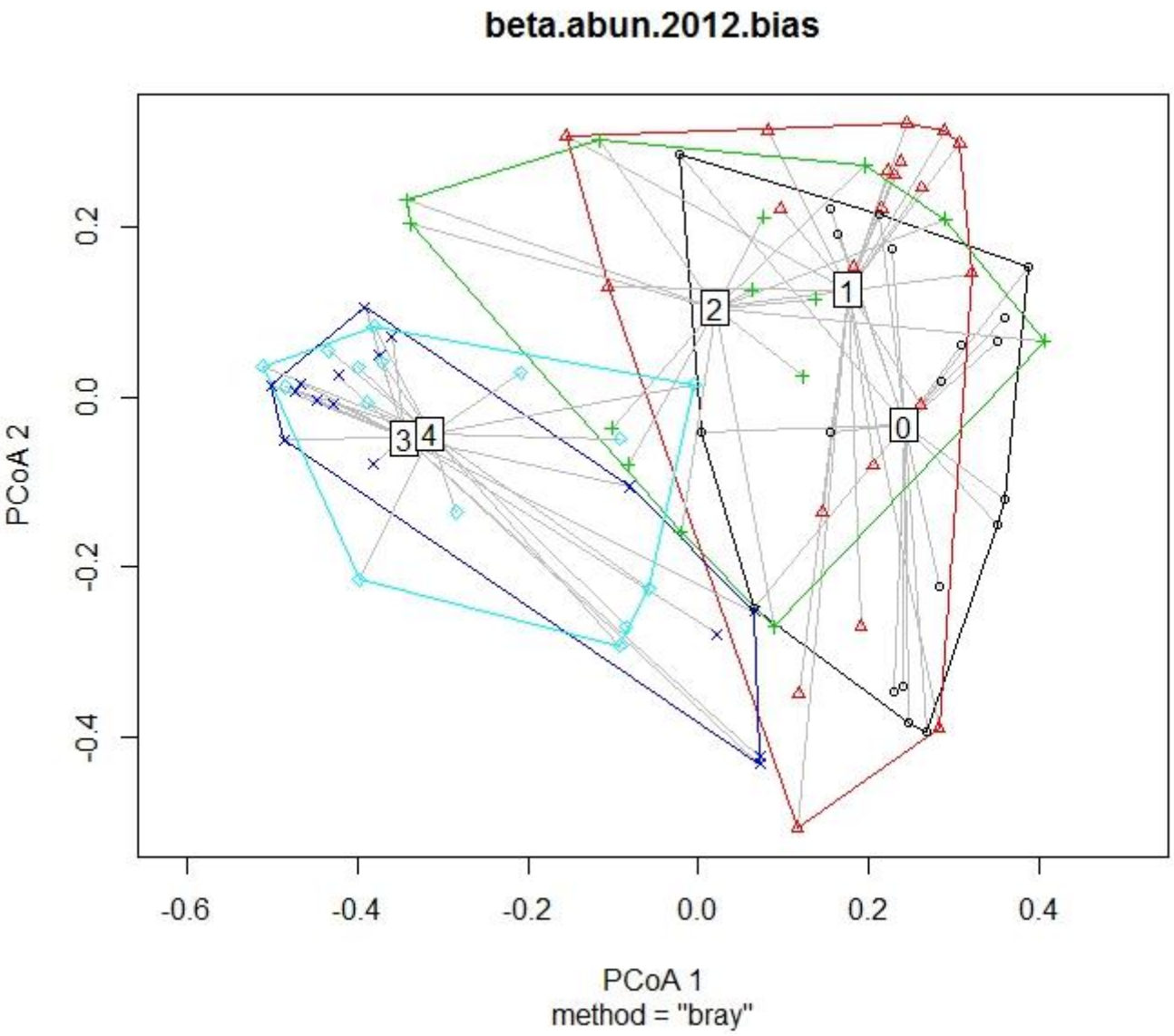
Median Seedlings per Acre

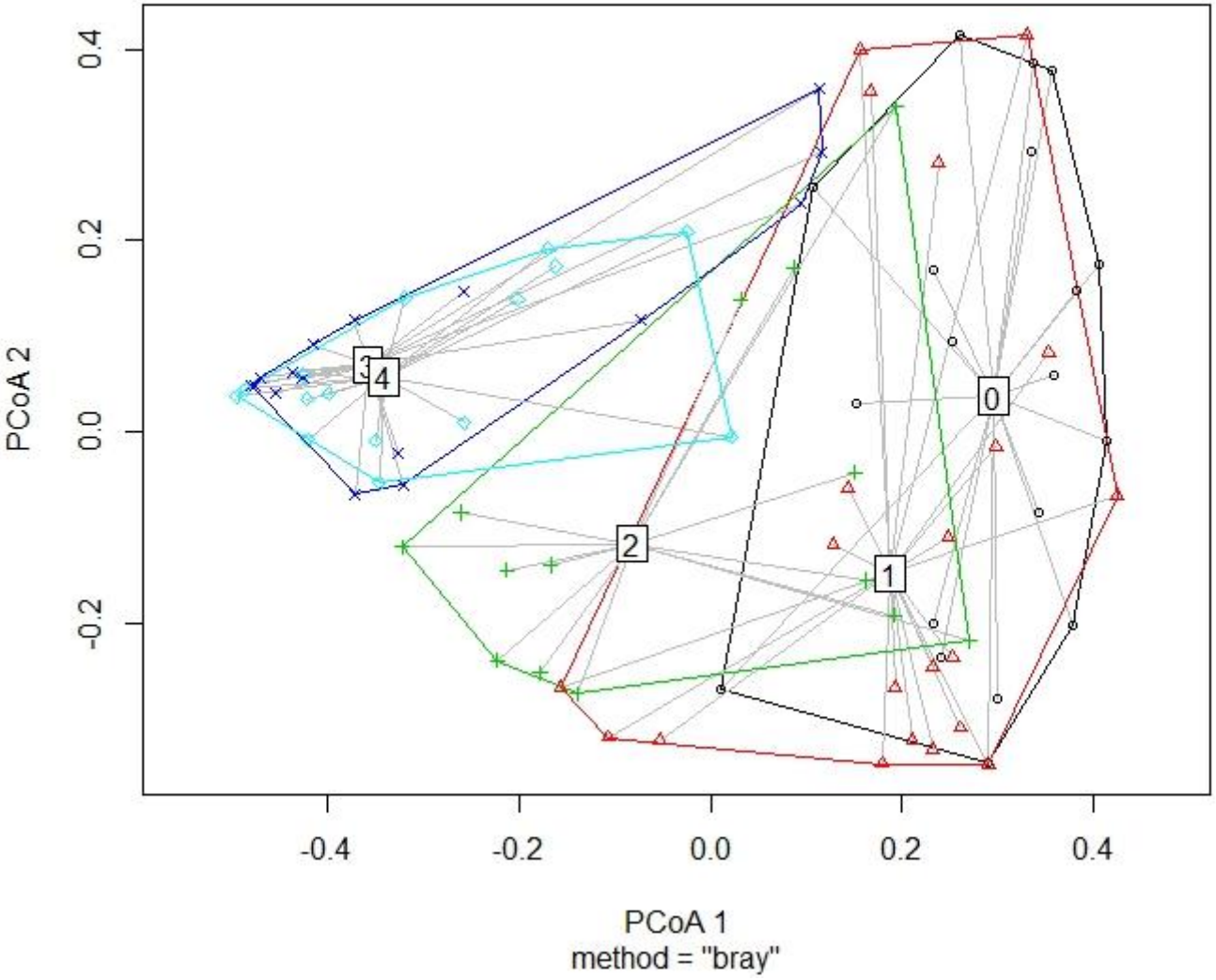


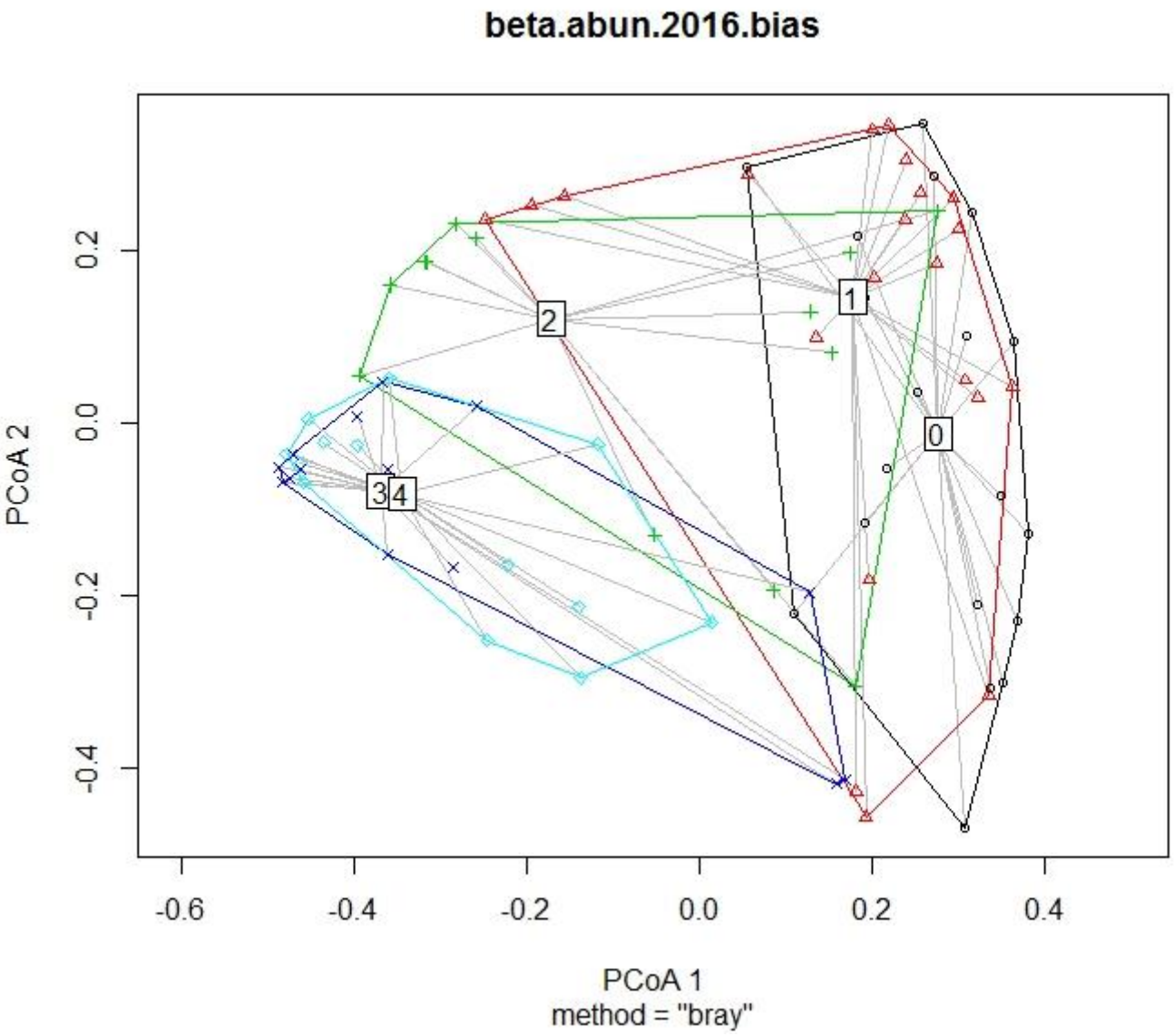
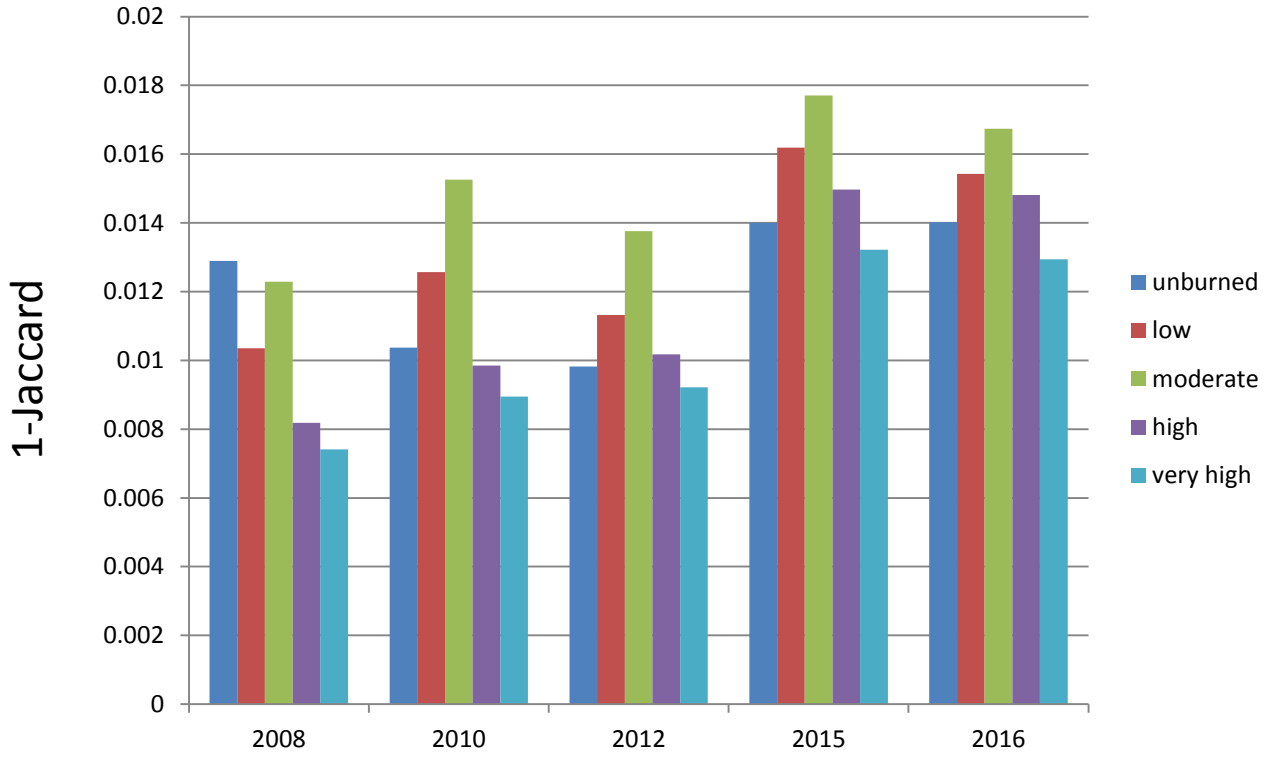
PCAs for Beta Diversity




beta.abun.2010.bias
PCoA 2
0.4
0.2
0.0
-0.2
-0.6
-0.4
-0.2
0.0
0.2
0.4
PCoA 1
method = "bray"
4
3
0
2
1


beta.abun.2012.bias
PCoA 2
0.2
0.0
-0.2
-0.4
-0.6
-0.4
-0.2
0.0
0.2
0.4
PCoA 1
method = "bray"
0
1
2
3
4


beta.abun.2015.bias
PCoA 2
0.4
0.2
0.0
-0.2
-0.4
-0.2
0.0
0.2
0.4
PCoA 1
method = "bray"
0
1
2
4


beta.abun.2016.bias
PCoA 2
0.2
0.0
-0.2
-0.4
-0.6
-0.4
-0.2
0.0
0.2
0.4
PCoA 1
method = "bray"
0
1
2
3
4

Beta diversity