Differences in population size structures drive grass response to long-term livestock removal

Research Insights in Semiarid Ecosystems

RISE

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UNIVERSITÀ DI TORINO

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Differences in population size structures drive grass response to long-term livestock removal

Background

Exclosures are used worldwide to study the effect of livestock removal on plant community.

Characteristics of the studies that used long-term (≥ 10 years) exclosures in Desert Grasslands, in other vegetation types of the world and in the present study.

	Desert Grasslands median (min-max)	Other Vegetation Types median (min-max)	Present Study
Maximum age of the exclosure (years)*	28 (14-74) N = 16	30 (10-83) N = 61	104
Number of exclosures	1 (1-9) N = 16	3.5 (1-36) N = 62	10
Average exclosure size (ha)	72.40 (0.15-1x10^6) N = 16	1 (0.01-6800) N = 49	1.1
Number of measurements	1 (1-6) N = 16	1 (1-30) N = 62	4
Length of the experiment (years)**	1 (1-74) N =16	1 (1-72) N = 60	10
Number of growth forms (herbaceous/non-herbaceous)	2 (1-2) N = 16	2 (1-2) N = 63	2
Number of variables (cover, density, biomass)	1 (1-3) N = 15	2 (1-3) N = 64	3
Number of studies accounting for repeated measurements***	2 / 5	10 / 21	Yes

Research questions

1. How does Desert Grassland vegetation respond to long-term grazing removal?

2. Is grass response the result of differences in the number or the size of plants?

3. Does the response differ over time and in relation to precipitation patterns?

Methods

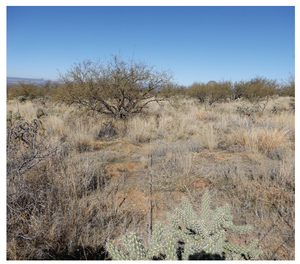
Where? Santa Rita Experimental Range (Arizona, USA). 10 long-term (88-104 yr) exclosures on Sandy Loam Upland Ecological Site.

When? 4 measurements over 10 years (2011-2020).

What? 3 measures of abundance (cover, density, biomass) of native and non-native grasses and cover of woody species.

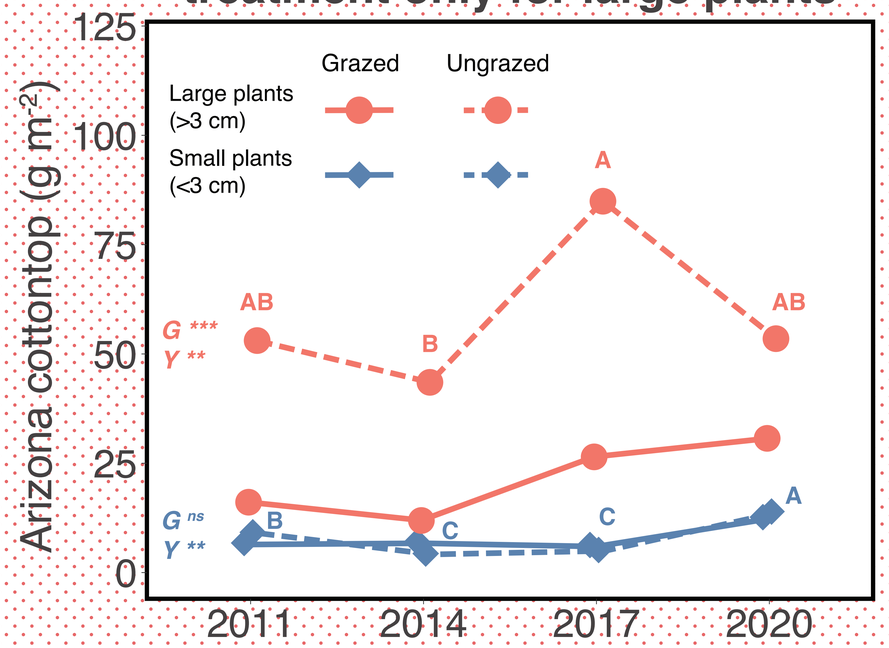
How? Linear mixed models (fixed factors: grazing, year, GxY; random factor: transect).

Exclosure 40 - grazed transect



Exclosure 40 - ungrazed transect

Biomass differs by grazing treatment only for large plants



Native perennial grass plants are larger in long-term ungrazed areas in Desert Grasslands

SCAN ME

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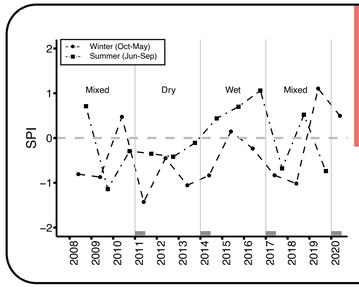
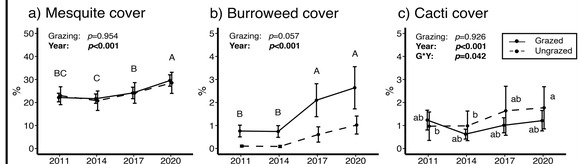
Results



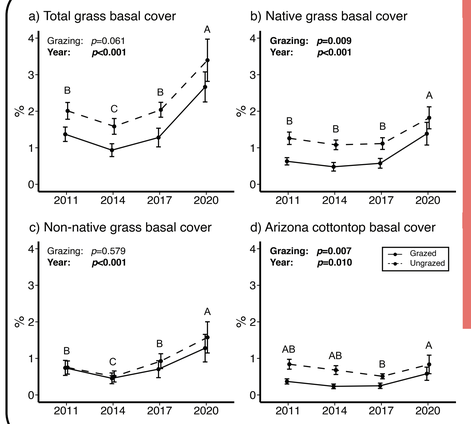
Precipitation trends affect plant abundance more than grazing removal

Standardized Precipitation Index (SPI) for winter (October-May) and summer (June-September) precipitation from 2008 to 2020. The horizontal line at 0 SPI represents the long-term 1895-2020 average for each season, negative SPI values indicate periods drier than the mean, positive SPI values refer to wetter periods. Vertical lines and grey rectangles on the x-axis indicate years when vegetation measurements were made.

Canopy cover of (a) mesquite, (b) burroweed, and (c) cacti from 2011 to 2020 in grazed and ungrazed treatments. Values and bars represent means and standard errors, respectively.



No grazing effect on woody and cactus cover



Grazing affects only native grass cover

Basal cover of (a) total, (b) native, (c) non-native, and (d) Arizona cottontop perennial grasses from 2011 to 2020 in grazed and ungrazed treatments. Values and bars represent means and standard errors, respectively.

Conclusions

1. Long-term (>80 yr) grazing removal affected native perennial grasses, but not non-native grasses and woody species.

2. Response of native grasses to livestock removal was characterized more by plant size rather than the number of plants. This suggests that grazing may limit natives' vigor and longevity.

3. Fluctuations of winter and summer precipitation patterns influenced vegetation dynamics.