Measuring exotic grass invasion through historical aerial photographs

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Introduction

Exotic annual grasses have been shown to dominate the landscape after back-to-back fires as a result of chaparral shrub species being extirpated and opportunistic exotic annual grass ("grass") species expanding into the open canopy[1,2,3].

We can quantify type conversion (i.e., chaparral conversion to grass cover) through monitoring post-fire recovery. However, monitoring post-fire landscapes can be challenging if the location is inaccessible and/or if conversion rates differ between the edge and interior of the fire scar.

To address these challenges, we used historical aerial photographs to quantify vegetation cover before and after short-interval fires (2 fires in ≤5 years) and adjacent locations that experienced a long-interval fire (only the second fire).

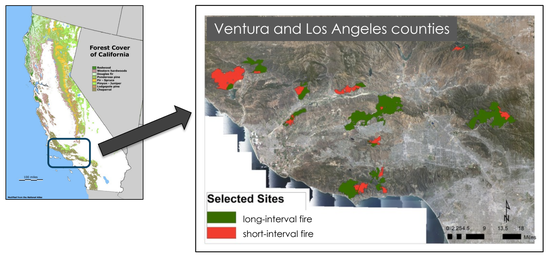
By comparing these two fire intervals we can quantify how much conversion has occurred following a single short-interval fire and will help predict how much conversion may occur in the future.

Questions

1. How has vegetation recovery differed following long- and short-interval fires?
2. How much type conversion is predicted to occur following a single short-interval fire?

Methods

1. Identify 12 paired long-interval and short-interval fires within Ventura and Los Angeles counties. (11 pairs presented here.)
2. Acquire historical aerial photographs (1950s-2000s) for each fire scar.
   - pre-fire: as close to before the first fire to capture pre-fire vegetation
   - post-fire image: as far into the future without another fire to capture maximum vegetation regrowth
3. Record pre- and post-fire cover in 5-10 50 x 50 pixel plots (1 m resolution) per fire scar using a 10 x 10 dot grid to quantify vegetation: chaparral, grass, sage scrub, tree, bare ground.



Results

1. Vegetation recovery

Pre- and post-fire cover following a single long-interval or short-interval fire.

Long-interval fire (1 fire in 5 years)

	chaparral % (# pixels)	grass	sage scrub	tree	bare ground	total
pre-fire	47% (4312)	8% (758)	35% (3163)	8% (772)	1% (95)	100% (9100)
post-fire	47% (4291)	9% (785)	35% (3142)	9% (799)	1% (83)	100% (9100)

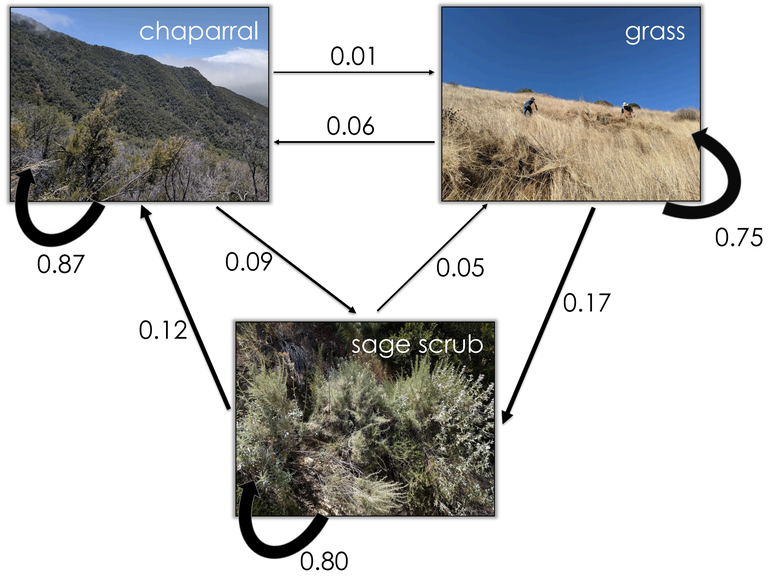
Short-interval fire (2 fires in ≤5 years)

	chaparral % (# pixels)	grass	sage scrub	tree	bare ground	total
pre-fire	47% (4263)	12% (1047)	36% (3208)	4% (334)	2% (147)	100% (8999)
post-fire	45% (4071)	11% (1034)	39% (3512)	3% (263)	1% (115)	100% (8999)

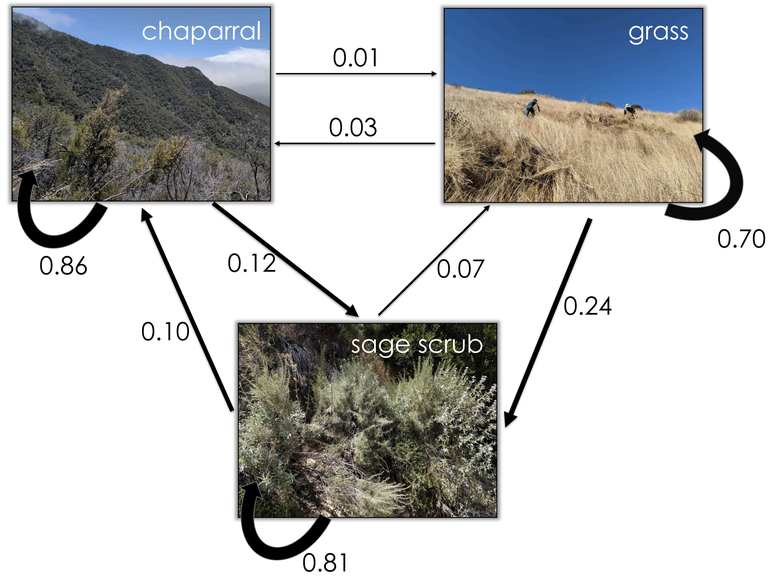
2. Predicting type conversion

Conversion rates between chaparral, grass, and sage scrub following a single long-interval or short-interval fire.

Long-interval fire (1 fire in 5 years)



Short-interval fire (2 fires in ≤5 years)



Conclusions and Discussion

1. Veg. recovery was similar between long- and short-interval fires. Ratios of pre- and post-fire cover were similar. Pre-fire cover roughly predicted post-fire cover.
2. Type conversion is more likely to occur between chaparral → sage scrub → grass than chaparral → grass. Sage scrub appears to be a transition state between chaparral and grass. These results are supportive of other researchers' findings[4,5].
3. These conversion rates may be conservative compared to future conversion rates as temp. and precip. patterns are expected to change (i.e., hotter, less frequent & more intense) and site aridity is a known driver of type conversion[4,5,6].

Future Work

1. Analyze data with explanatory variables (e.g., elevation, distance from road, mean annual precipitation, etc.) to explain observed trends and transition rates in vegetation recovery.
2. Investigate water availability in years immediately before and after fire to determine how current conditions impact vegetation recovery.
3. Compare data to more arid locations (e.g., San Diego County).

Citations

(1) Zedler PH, et al. (1983) Veg. change in response to extreme events: the effect of a short interval between fires in Cal. chaparral and coastal scrub. Ecology 64: 809-818. (2) Haidinger TL and Keeley JE (1993) Role of high fire frequency in destruction of mixed chaparral. Madroño 40: 141-147. (3) Keeley JE and Brennan TJ (2012) Fire-driven alien invasion in a fire-adapted ecosystem. Oecologia 169: 1043-1052. (4) Syphard AD, et al. (2018) Drivers of chaparral type conversion to herbaceous veg. in coastal So. Cal. Diversity and Distributions 25:90-101. (5) Shane Dewees, personal communication. (6) Park IW, et al. (2018) Impacts of climate, disturbance and topography on distribution of herbaceous cover in So. Cal. chaparral: Insights from a remote-sensing method. Diversity and Distributions 24: 497-508.

Acknowledgments

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