CALIFORNIA FIRE SCIENCE CONSORTIUM

JOINT FIRE SCIENCE PROGRAM

Research Brief for Resource Managers

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Post-Fire Recovery Four Decades after Desert Wildfires

Abella, S.R., D.M. Gentilcore, and L.P. Chiquoine. (in press). Resilience and alternative stable states after desert wildfires. Ecological Monographs. doi:10.1002/ecm.1432

Management Implications

- On average after 31 Mojave Desert wildfires, perennial plant diversity recovered fastest followed by cover. Species composition was projected to require 500+ years to recover
- While resprouting did not result in full resilience of shrubs such as yucca species, it enabled population persistence
- Sites burned only once may become top priorities for managing hazardous fuels to limit reburning

Understanding plant community recovery is a key part of managing burned desert landscapes. Will desired species reestablish naturally or do they require active restoration to meet timeframes for recovery needed to attain management goals? Do different components of ecosystems, such as vascular plants compared with soil biocrust organisms, recover at similar rates? Will recovering plant communities provide habitat functions required by priority wildlife species? These are some of the many questions helpful to address to aid post-burn management planning.

We studied recovery of plant communities, soil properties, and soil biocrusts (surface layers of lichens, mosses, or cyanobacteria) on 31 wildfires in the eastern Mojave Desert that had burned between 1 and 36 years previously (1980 to 2007 burns). We also measured changes in live and dead annual grass plant fuel as an indicator of reburn potential. We compared recovery in low-elevation creosote bush (*Larrea tridentata*) communities with recovery in mid-elevation blackbrush (*Coleogyne ramosissima*) communities. We assessed whether ecosystem components showed trends toward resilience (convergence with conditions on paired unburned areas) or alternative stable states indicative of persistently changed ecological conditions.

Perennial species richness on average was fully resilient within 23 years after fire in both community types. Perennial cover was fully resilient within 25 years in the creosote community, but recovery was projected to require 52 years in the blackbrush community. Species composition shifts were persistent, and in the blackbrush community, the projected compositional recovery time of 550 years and increasing resembled a deflected trajectory toward potential

Fig 1: Left and middle columns: example burned plots in 2007 (top) and 2019 (bottom; photos by S.R. Abella). Right column: burned-unburned contrasts on two fires (photos by E.C. Engel).

alternative states. Resprouting produced limited resilience for the large shrubs creosote and *Yucca* spp. important to population persistence, but did not forestall long-term reduced abundance of the species. Burned sites contained a perennial species composition of predominately short-statured forbs, subshrubs, and grasses, contrasting with the larger-statured shrub and tree structure of undisturbed sites. These contrasting vegetation structures could lead to different wildlife habitat values, such as for federally listed desert tortoises benefitting from the protective functions of large shrubs.

The nonnative annual grass red brome increased on burned sites over time, suggesting persistently abundant non-native plant fuels and reburn potential. Native annual plants showed little variation with burn status and were only a small part of the total annual plant community which was dominated by non-native species. Biocrust cover on burned sites was half and species richness a third of amounts on unburned sites. Soil nitrogen was 30% greater on burned sites and no significant trend was evident for it to decline on even the oldest burns.

The study provided both theoretical implications for developing models of ecosystem recovery after disturbance, and practical applications for post-fire restoration and management planning. For example, one of the theoretical implications considered was how to assess ecosystem resilience if half the components of an ecosystem were resilient while the other half trended toward alternative stable states, invoking a question as to whether resilience is a property of entire ecosystems or components of ecosystems. Some of the practical applications included identifying when opportune windows might occur for management interventions to guide post-fire recovery.

Suggestions for further reading:

Abella, S.R., R.J. Guida, C.L. Roberts, C.M. Norman, and J.S. Holland. 2019. Persistence and turnover in desert plant communities during a 37-yr period of land use and climate change. Ecological Monographs 89:e01390.

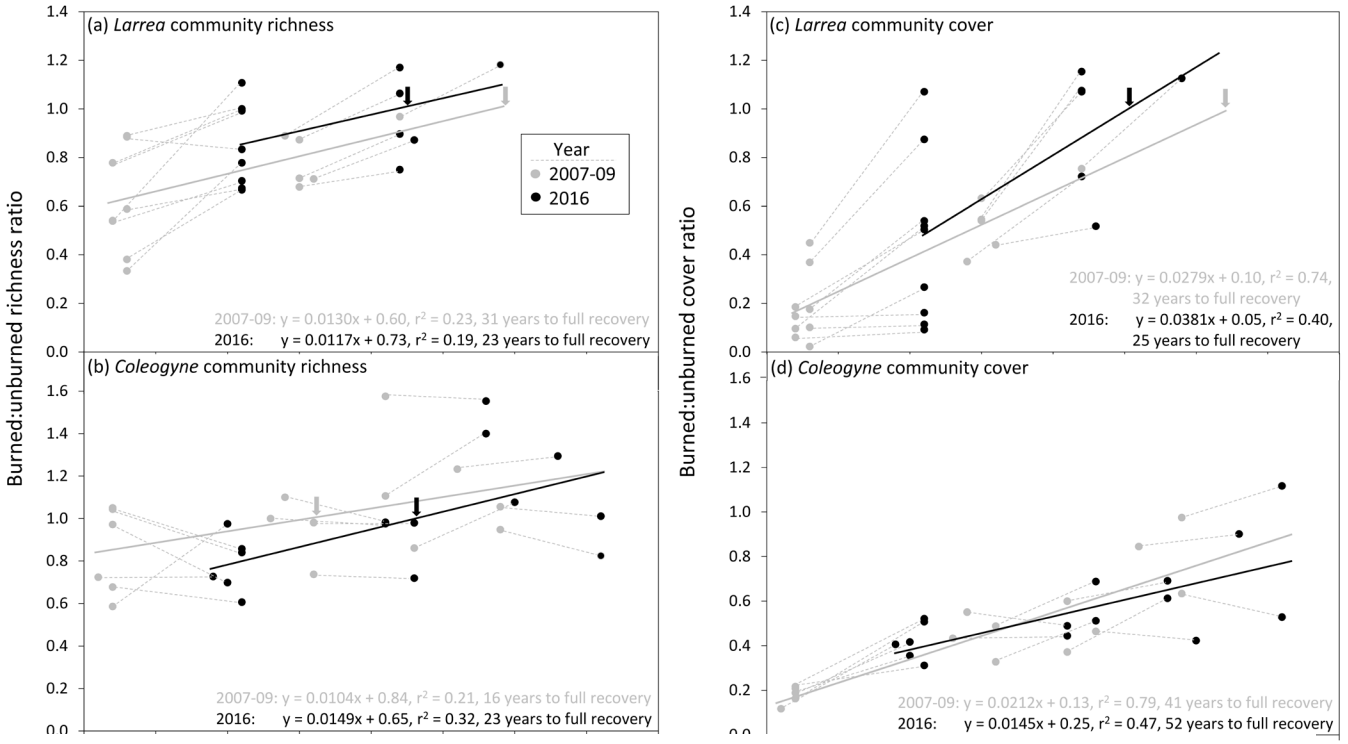

Fig 2: recovery rates of perennial species richness (/100 m²) and cover in creosote and blackbrush communities. Data are shown as the ratio of burned to unburned conditions as a function of time since fire in 2007-09 and 2016 when the chronosequence was remeasured.