



Research Brief for Resource Managers

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Contact:

Stacey Sargent Frederick
Morgan Tingley

Phone:

510-642-4934
860-486-2984

Email:

ssfederick@berkeley.edu
morgan.tingley@uconn.edu

California Fire Science Consortium Statewide Coordinator | 130 Mulford Hall MC #3114, Berkeley, CA 94720

Pyrodiversity Promotes Avian Diversity in Semi-Arid Forests

Tingley MW, Ruiz-Gutiérrez V, Wilkerson RL, Howell CA, Siegel RB. 2016 Pyrodiversity promotes avian diversity over the decade following forest fire. Proc. R. Soc. B 283: 20161703. DOI: 10.1098/rspb.2016.1703

Pyrodiversity

Pyrodiversity is a term used to capture the complexity of how fires shape an ecosystem over time. The assumption, derived from ecological theory, is that “pyrodiversity begets biodiversity.” The definition of pyrodiversity can vary but generally includes elements of fire regimes (e.g. size, severity, frequency, and spatial configuration) and the role this plays in shaping biodiversity. In this paper, the authors measure pyrodiversity as the spatial arrangement of burn severity patches within fires. Having a heterogeneous mix of burn severities has been shown to increase diversity of plant and animal species in some ecosystems. This relationship is especially true in semi-arid forests with historically fire-prone and semi-arid forests like the Sierra Nevada montane conifer forests.

Methods

The extensive dataset included over 1,100 bird records across 465,000 ha of burned montane forest (almost 100 fires) from the northern to southern Sierra Nevada. Chosen fires had all burned within the last 10 years at the time of first sampling. Within each fire, bird surveys were conducted at up to 12 survey points, and these points were revisited for up to 7 years. Models tested for relationships between the presence of bird species and a number of variables including time since fire, average burn severity, and the

Management Implications

- This study adds evidence that pyrodiversity is an essential component to species diversity in some ecosystems, especially in the fire prone semi-arid forests of the Sierra Nevada.
- Pyrodiversity may increase biodiversity in the short term, but the benefits may continue to increase as time goes on.
- Looking at the patterns of severity within a fire rather than the overall severity can offer insights into projected post-fire recovery.
- When looking at fire effects, it's important to consider the “patchy” patterns of burn severities as this is a stronger driver of species diversity.

burn severity dispersion. Severity dispersion used the standard deviation as a measure to show how dissimilar or how “patchy/pyrodiverse” the burn was. Questions were tested at both the local site and the fire-level scales.

Results

Overall, the results of this study add support to the existing theory that diverse fire increases biodiversity in fire-prone forested ecosystems. Specifically, this study showed that higher diversity of fire severity patterns within a fire lead to more bird diversity. This result shows how the diversity of burn severity within a fire, rather than the average fire severity, are important considerations when managing for diversity. In

contrast, fires that were more severe on average had an overall negative effect on bird diversity.

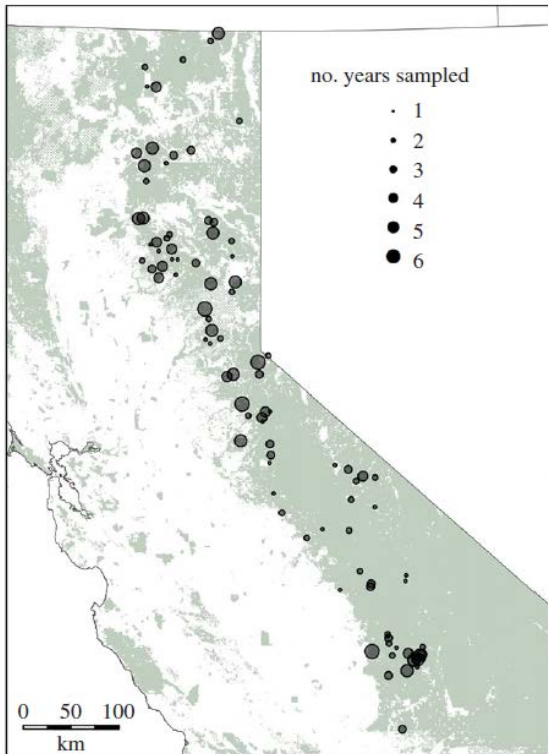


Figure 1. Map of study areas in California where avian surveys were conducted at multiple points in burned forest. Each dot represents a single surveyed fire with the size of the dot corresponding to the number of years each fire was surveyed. Green background shows all public lands in California. (Online version in colour.)

This study also suggests that fires with differing effects may be even better at creating diverse habitats when compared to other disturbance and succession events. Bird diversity was highest in study sites 10 years after a “patchy” fire. One explanation is that as time since fire progressed, forest structures become more diverse and more unique. While a disturbance like a mudslide will recover from early to late successional, a fire disturbed area may not follow an identical successional progression, as retained elements like snags or live trees may alter the trajectory.

Implications

Wildland fires in the Sierra Nevada have become increasingly homogenous, in part due to forest management practices and fire suppression. Less diverse fires may lead to less diverse flora and fauna. The impacts of climate change on the

species themselves, as well as the fire behavior patterns, may be exacerbated by less diverse fires.

Further Reading:

The term “pyrodiversity” is a conceptual way of thinking about the diverse impacts of fire and how these interact with the ecosystem. The original concept was first published in 1992 (see Martin, RE and DB Sapsis).

In some ecosystems, having diverse fire effects can increase diversity of plants and animals. In other ecosystems, even ones that are fire-prone like Australian shrublands, fires may decrease biodiversity. The emerging distinctions between these two effects are associated with specific life traits of the species present. See further reading (Kelly, LT and L Brotons, 2017) for additional discussion on how pyrodiversity influences different ecosystems.

Kelly LT, and L Brotons. 2017. Using fire to promote biodiversity. Science, 355(6331), pp.1264-1265. DOI: 10.1126/science.aam7672

Martin RE, Sapsis DB. 1992. Fires as agents of biodiversity: pyrodiversity promotes biodiversity. In Proc. of the Symp. on Biodiversity in Northwestern California, 1991 (ed. HM Kerner), pp. 150–157. Berkeley, CA: Wildland Resources Centre, University of California.