Stand-replacing decay coefficient– clarifying concepts and extensions

Michael J. Koontz[1,2,*], Others?

[1]Graduate Group in Ecology, University of Californa, Davis, CA, USA

[2]Department of Plant Sciences, University of California, Davis, CA, USA

[*]Correspondence: michael.koontz@colorado.edu

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Abstract

Introduction

Collins et al. (2017) and Stevens et al. (2017) introduce a new metric– the "stand-replacing decay coefficient"– as an alternative means to characterize forest fire regimes that incorporates spatial patterns of wildfire severity. Further, Collins et al. (2017) and Stevens et al. (2017) demonstrate its utility as a broad-sense landscape metric as well as a tool for detecting drivers of changing fire regimes in a case study of California mixed-conifer systems.

Benefits:

1. Summarizes complex spatial configurations of severity within a wildfire in a single number.
2. Captures key macroscale relationships between fire effects and their drivers (e.g., suppression effects, climate conditions during burning)
3. Is founded on critical ecological first-principles with respect to regeneration potential of dry forest without nearby seed sources.
4. Makes clever use of fusion between probability theory and geometric theory by exactly measuring the *probability that a point will be further than X distance from the edge of an arbitrary polygon.*

Limitations:

1. Can only be measured on wildfires that experience any high severity fire.
2. Doesn't incorporate any area that burns at low- to moderate-severity, or tree islands– area within the fire perimeter that doesn't burn at all.
3. Can be computationally demanding to calculate.

4. Relies on an imperfectly-fitting logarithmic model to describe a relationship better defined and described in a probability framework (i.e., cumulative distribution functions, probability density functions, geometric relationships between the area of polygons and the probability of a point within them being some distance from the edge).
5. Has no intuitive connection to measurable ecological parameters.

Here, we describe the stand-replacing decay coefficient in terms of probability theory, offer a computationally less-demanding approach to approximating it (by 2 orders of magnitude), and extend the concept to a) contexts beyond fire ecology and b) incorporate less-than-stand-replacing severity in the broader-sense alternative characterization of fire regimes.

References

Collins BM, Stevens JT, Miller JD et al (2017) Alternative characterization of forest fire regimes: Incorporating spatial patterns. Landscape Ecology 32:1543–1552. doi: 10.1007/s10980-017-0528-5

Stevens JT, Collins BM, Miller JD et al (2017) Changing spatial patterns of stand-replacing fire in California conifer forests. Forest Ecology and Management 406:28–36. doi: 10.1016/j.foreco.2017.08.051