CALIFORNIA FIRE SCIENCE CONSORTIUM

Research Brief for Resource Managers

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Field Guide for Estimating Desert Invasive Grass Fuel

Abella, S.R. 2020. Cover-biomass relationships of an invasive annual grass, Bromus rubens*, in the Mojave Desert. Invasive Plant Science and Management 13:288-292.* doi: 10.1017/inp.2020.33

Non-native annual grasses, such as red brome (*Bromus rubens*), have increased the amount and continuity of fine fuels in drylands of the southwestern U.S. These invasions have heightened fire risk in many desert habitats in which fires are thought to have been rare historically and in which fires are considered destructive to mature habitats (Fig. 1).

Estimates of plant biomass as a measure of fuel and potential for fire spread can aid fire management planning. For example, knowledge of fuel load thresholds for fire spread could assist managers in identifying levels of invasive plant treatment effectiveness required to keep fuel loads below thresholds supporting fire spread in different weather scenarios.

Fig. 1: Mature Mojave Desert shrubland invaded by red brome in southern Nevada. Red brome is the beige, senesced material covering much of the ground and increasing the amount and continuity of fuel.

Management Implications

- Biomass as fuel for the invasive annual grass red brome can be reliably estimated using the proxy variable of cover, which is easier and faster to measure.
- For every doubling of cover, predicted biomass increased by 78% to 144%.
- A provisional threshold of 100 g/m^2 of red brome biomass required for fire spread was exceeded at 19%, 25%, and 45% red brome cover among sites.

However, measuring biomass is time-consuming, typically can only be done in small areas, and requires destructive sampling. An alternative could be developing equations to relate biomass to an easier-to-measure proxy, then using the proxy to estimate biomass. Being comparatively fast and non-destructive to measure, plant cover could be an ideal proxy for estimating biomass. Not all species are suited for estimating biomass from cover, however, and consistency of cover–biomass relationships varies among species. As a result, assessing which species and growth forms have reliable cover–biomass relationships, developing new biomass equations for species without known relationships, and refining existing equations (e.g., tailoring to site factors or climatic variability) represent an active research area.

The objective of this study was to assess feasibility of developing regression equations using a fast, non-destructive measure (cover) to estimate aboveground biomass for red brome, a widespread non-native annual grass in the Mojave Desert. At three study sites, including one measured for three consecutive years, red brome cover spanned 0.1% to 85% and aboveground biomass 1 to 321 g/m^2. In linear regressions, red brome cover accounted for 68% to 96% of the variance in red brome biomass among sites. For every doubling of percent cover, biomass was predicted to increase by 78%, 83%, and 144% among the three sites.

At a site measured for three consecutive years, which ranged in rainfall from 65% to 159% of the long-term average, regression slopes each year differed from other years. Regression results among sites were insensitive to using cover classes (10 classes encompassing 0% to 100% cover) compared with simulated random distribution of integer cover within classes.

Fig. 2: Example of part of the photographic guide for estimating biomass of red brome using cover classes. In this 0.5 m × 0.5 m quadrat, red brome had a cover of 17.5% (10-25% cover class) and an oven-dry biomass of 151.3 g/m^2.

In applying the equations to estimate fire-risk thresholds of hazardous fuels using cover, a provisional threshold of 100 g/m^2 of red brome biomass required for fire spread was exceeded at 19%, 25%, and 45% red brome cover among sites.

The equations — and suggested refinements in future work — can enable rapidly estimating fuel loads and assessing effectiveness of invasive plant management, including levels required to keep fuels below wildfire spread risk thresholds. Biomass of red brome was amenable to estimation in the field using cover, and such estimates may have applications for desert fire modeling.

Accompanying the equations in the research paper, a photographic guide showing cover classes and their associated biomass is provided as a field guide for rapidly estimating red brome fuel loads (Fig 2).

Suggestions for further reading:

Abella, S.R., T.M. Embrey, S.M. Schmid, and K.A. Prengaman. 2012. Biophysical correlates with the distribution of the invasive annual red brome (Bromus rubens) on a Mojave Desert landscape. Invasive Plant Science and Management 5:47-56.

Brooks, M.L., R.A. Minnich, and J.R. Matchett. 2018. Southeastern deserts bioregion. Pp. 353-378 in van Wagtendonk, J.W., et al. (eds.). Fire in California's ecosystems. University of California Press, Berkeley.

Rao, L.E., and E.B. Allen. 2010. Combined effects of precipitation and nitrogen deposition on native and invasive winter annual production in California deserts. Oecologia 162:1035-1046.