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Herbaceous Vegetation Responses (1992–2004) to Restoration Treatments in a Ponderosa Pine Forest

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Abstract

Ecological restoration treatments are widely applied in southwestern ponderosa pine forests to convert them to an open canopy structure similar to that found at the time of Euro-American settlement. An experiment was initiated in northern Arizona in 1994 to evaluate long-term ecosystem responses to 3 restoration treatments: 1) thinning from below (thinning), 2) thinning from below plus forest floor manipulation with periodic prescribed burning (composite), and 3) an untreated control. Results focus on total herbaceous and functional-group standing crop response to these restoration treatments. Pretreatment data were collected in 1992 and posttreatment responses were measured from 1994 through 2004. Total herbaceous standing crop was significantly higher on the 2 treated areas than on the control over the entire posttreatment period, but did not differ between the thinning and composite treatments. Plant functional groups responded differently to treatments and to drought. In general, the graminoid standing crop responded within several years after the initial treatments and continued to increase through time, until a series of severe droughts reduced standing crop to pretreatment levels. C₃ graminoids dominated the standing-crop response, of which bottlebrush squirreltail (*Elymus elymoides* (Raf.) Swezey ssp. *elymoides*) was the primary contributor. C₄ graminoids had a minimal response to restoration treatments, possibly because they were less abundant before the experiment began or because they were adversely affected by autumn burning. Legumes and forbs exhibited a 4–5 year lag before responding to the thinning and composite treatments. Annual and biennial plants showed a large biomass increase approximately 5 years after implementation of the composite treatment. The restoration goal of optimizing herbaceous standing crop must be weighed against the competing goals of increasing the abundance of specific functional groups, increasing biodiversity or rare plants, and managing invasive plant species.

Resumen

Los tratamientos de restauración ecológica son ampliamente aplicados en los bosques de “Ponderosa pine” del sudoeste para convertirlos en una estructura de cobertura abierta similar a la que se encontró en el tiempo de la colonización Euroamericana. En 1994, en el norte de Arizona, se inició un experimento para evaluar las respuestas a largo plazo del ecosistema a tres tratamientos de restauración: 1) aclareo desde abajo (aclareo); 2) Aclareo desde abajo mas manipulación del piso del bosque con fuego prescrito periódico (compuesto) y 3) control sin tratar. Los resultados se enfocaron en la respuesta de la biomasa total herbácea y de grupos funcionales a estos tratamientos de restauración. Los datos pre-tratamiento fueron colectados en 1992 y las respuestas post-tratamientos fueron medidas de 1994 a 2004. Durante todo el periodo post-tratamiento la biomasa total herbácea de las dos áreas tratadas fue significativamente mayor que la del área control, pero no difirió entre los tratamientos de aclareo y compuesto. Los grupos funcionales de plantas respondieron diferente a los tratamientos y la sequía. En general, la biomasa de las gramíneas respondió varios años después de iniciar los tratamientos, incrementándose continuamente a través del tiempo hasta que una serie de severas sequías redujo la biomasa a los niveles presentes antes de aplicar los tratamientos. Las gramíneas C₃ dominaron la respuesta de la biomasa, de las cuales el “Bottlebrush squirreltail” (*Elymus elymoides* (Raf.) Swezey ssp. *elymoides*) fue el principal contribuyente. Las gramíneas C₄ tuvieron una mínima respuesta a los tratamientos de restauración, posiblemente porque ellas fueron menos abundantes antes de que el experimento comenzará o porque ellas fueron afectadas adversamente por la quema de otoño. Las leguminosas y hierbas mostraron un retraso de 4-5 años para responder a los tratamientos de aclareo y compuesto. Aproximadamente 5 años después de implementar el tratamiento compuesto las plantas anuales y bianuales mostraron un gran aumento de la biomasa. La meta de restauración de optimizar la biomasa herbácea debe ser ponderada contra las metas de incrementar la abundancia de grupos funcionales específicos, aumentando la biodiversidad o las plantas raras y manejar las especies vegetales invasoras.

Key Words: understory production, overstory-understory relationships, thinning, prescribed fire, ecological restoration, *Pinus ponderosa*, Southwest, Gus Pearson Natural Area

Nomenclature: National PLANTS Database (USDA NRCS, 2004)

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