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Source: Rangeland Ecology & Management, 65(2):208-212. 2012.

Published By: Society for Range Management

DOI: <http://dx.doi.org/10.2111/REM-D-11-00069.1>

URL: <http://www.bioone.org/doi/full/10.2111/REM-D-11-00069.1>

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Research Note

Indirect Measurement of Leaf Area Index in Sagebrush-Steppe Rangelands

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Abstract

Leaf area index (LAI) is defined as the one-sided area of leaves above a unit area of ground. It is a fundamental ecosystem parameter that is a required input of process-based plant growth and biogeochemical models. Direct measurement of LAI is the most accurate method, but is destructive, time-consuming, and labor-intensive. LAI is highly variable in time and space on sagebrush-steppe rangelands, and a rapid, nondestructive method is desirable to understand ecosystem processes. The point-intercept method is nondestructive and has been demonstrated to provide accurate LAI estimates, but the method is time-consuming. LAI measurement with the Accupar ceptometer (Decagon Devices, Pullman, WA) is nondestructive and faster than the point-intercept method, but has not been evaluated on sagebrush-steppe rangelands. The objective of this study was to evaluate the ceptometer for measurement of LAI in sagebrush-steppe rangelands. Ceptometer and point-intercept LAI data were collected at six sites in sagebrush-steppe rangelands and the values were compared. We found that 1) ceptometer LAI data were consistently greater than point-intercept LAI data, 2) ceptometer data were much more variable than the point-intercept data based on standard deviations, and 3) the overall correlation between the two methods was very weak ($r^2 = 0.15$). The much greater ceptometer LAI values were, at least partly, due to the large woody component of the vegetative cover. We attribute the high variability of ceptometer-measured LAI to high instrument sensitivity of the angle of the instrument relative to the sun.

Resumen

El índice de área foliar (IAF) se define como el área de hoja verde (un solo lado) por unidad de área de suelo. Este es un parámetro fundamental en los ecosistemas que requiere un proceso basado en el crecimiento de la planta y modelos bio-geoquímicos. Mediciones directas de IAF es el método más preciso pero es destructivo, consume tiempo y mucho trabajo. IAF es muy variable en tiempo y espacio en los pastizales de matorrales de estepa, por lo que se requiere un método no destructivo para entender el proceso del ecosistema. El método del punto de intercepción es no destructivo y ha demostrado en proveer estimaciones de IAF precisas. El Accuper ceptometer (Decagon Devices, Pullman, WA) es un método no destructivo que es más rápido que el punto de intercepción pero no ha sido evaluado en pastizales de estepa con artemisa. El objetivo de este estudio fue evaluar el ceptometer para medir el IAF en pastizales de estepa con artemisa. Se recolectaron datos de IAF del ceptometer y del punto intercepción en seis sitios de pastizal de estepa de artemisa y los valores fueron comparados. Encontramos que 1) los datos de IAF del ceptometer fueron más consistentes que los del punto intercepción, 2) los datos del ceptometer fueron mucho más variables que los del punto intercepción y 3) la correlación general entre los dos métodos fue muy endeble ($r^2 = 0.15$). Los valores de IAF mayor con el ceptometer el menos en parte se debió a la gran composición de material leñoso de la cubierta vegetal. Atribuimos la alta variabilidad de las medidas de IAF del ceptometer a la alta sensibilidad del ángulo del instrumento relativo al sol.

Key Words: ceptometer, gap-intercept, LAI, point-frame, quadrat, shrubs

INTRODUCTION

Leaf area index (LAI) is defined as the one-sided area of leaves above a unit area of ground (Kirkham 2005), and is related to plant-atmosphere gas exchange and plant growth (Kirkham 2005). The leaf is the location of many of the plant's most vital processes and is the primary organ on vascular plants that absorbs sunlight energy for conversion to glucose, absorbs carbon dioxide from the atmosphere, and releases oxygen and water into the atmosphere (Barbour et al. 1999). The measurement of LAI is critical for the study of many biogeochemical cycles in ecosystems (Breda 2003) and is also an essential input parameter in many process-based plant

Research was funded by the USDA-ARS and the NRCS Conservation Effects Assessment Project.

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Manuscript received 14 April 2011; manuscript accepted 1 November 2011.

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