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Agreement Between Measurements of Shrub Cover Using Ground-Based Methods and Very Large Scale Aerial Imagery

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Abstract

Very large scale aerial (VLSA) photography is a remote sensing method, which is collected and analyzed more efficiently than ground-based measurement methods, but agreement with ground-based measurements needs to be quantified. In this study, agreement between ground- and image-measured cover and precision, and accuracy of image locations and scale, were assessed. True image locations were determined by georeferencing images and conducting a ground search. Accuracy and precision of planned, aircraft, and georeferenced locations were evaluated by comparison with true image locations. Shrub cover was measured at true image locations using ground-based line-intercept and on the image using point-intercept. Sagebrush (*Artemisia* spp. L.), antelope bitterbrush (*Purshia tridentata* [Pursh] DC.), and spineless horsebrush (*Tetradymia canescens* DC.) were distinguished in the imagery. Agreement between ground- and image-based measurements was quantified using limit-of-agreement analysis. True ground locations of the VLSA images were within a 41-m radius of the aircraft location at the time of image acquisition, with 95% confidence. Using a panchromatic image from the QuickBird satellite (0.6-m pixel resolution) as a base map, 90% of true ground locations were within a 5-m radius of the location estimated from georeferencing the VLSA image to the base map. VLSA image-measured cover was, in general, unbiased with mean absolute differences between VLSA- and ground-based methods less than 1.3%. The degree of agreement and absence of bias between VLSA image–measured and ground-measured cover is sufficient to recommend using VLSA imagery to measure shrub cover.

Resumen

Las imágenes aéreas a larga escala (VLSA) es una metodología de sensores remotos que se recolecta y analiza más eficientemente que las mediciones basadas en métodos terrestres, pero al igual, necesitan cuantificarse con las mediciones terrestres. En este estudio, la precisión, exactitud, localización y escala de la cobertura, medida con imágenes, se evaluó comparando con medidas de cobertura a nivel del suelo. La verdadera localización de la imagen se determinó con imágenes georeferenciadas y mediante búsquedas dirigidas en tierra. La exactitud y precisión de localizaciones aéreas y georeferencias se evaluaron por comparación con verdaderas localizaciones de imagen. La cobertura de arbustos se midió con localización de imágenes verdaderas, usando mediciones terrestres basadas en el método de intercepción de línea y con imágenes utilizando el punto de intercepción. Sagebrush (*Artemisia spp*, L.), antílope bitterbrush (*Prussia tridentata* [Pursh] DC.), y horsebrush sin espinas (*Tetradymia canescens* DC.) se identificaron en las imágenes, la concordancia entre medidas terrestres y de imagen aérea se cuantificaron utilizando el análisis de limite de concordancia. Las locaciones terrestres de las imágenes aéreas a larga escala (VLSA) estuvieron entre un radio de 41 metros de la localidad aérea al tiempo de adquisición de la imagen, con un 95% de confianza. Utilizando una imagen panorámica del satélite QuickBird (a una resolución de 0.6 mega píxeles) 90% de las localidades verdaderas estuvieron dentro de un radio de 5 metros de las ubicaciones gereferenciando la imagen de VLSA en el mapa base. Las mediciones de cobertura de las imágenes VLSA fueron en general no tendenciosas con una diferencia absoluta promedio entre las imágenes de VLSA y los métodos terrestres de 1.3% El grado de concordancia y la ausencia de tendencia entre las imágenes VLSA y las medidas terrestres de cobertura son satisfactorios para recomendar el uso de las imágenes VLSA para medir cobertura de arbustos.

Key Words: antelope bitterbrush, georeferencing, limit-of-agreement analysis, mountain big sagebrush, spineless horsebrush

INTRODUCTION

For decades, managers have lacked statistically adequate data to properly guide rangeland management because of the high cost of conventional data collection (West 1999). Very large scale aerial (VLSA) imagery has been used for experimentally measuring attributes such as invasive weed cover, vegetation cover, and bare ground (Seefeldt and Booth 2006, Blumenthal et al. 2007, Booth and Cox 2008). VLSA imagery has the advantage that numerous samples can be collected over large land areas in a short period of time at less cost than conventional methods. The cost of obtaining VLSA imagery–based vegetation cover measurements in a landscape-scale sampling was significantly less than even ocular measurements due, in large part, to travel costs between sample locations (Seefeldt and Booth 2006).

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