Image-based Rangeland Monitoring at Multiple Scales

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Introduction

Sustainable rangeland management is enhanced by accurate ecological assessments and these, in turn, can be enhanced by advancing technology and decreasing labor costs. Image-based, multi-scale monitoring can reduce data-collection costs and reveal pattern and process (Wu, 1999) to allow, for example, assessing the relationship between the functional integrity of ecosystems and biodiversity across regions (Ludwig et al., 2004). Here we examine the potential benefits of image-based, multi-scale monitoring protocols.

Materials & Methods

Fifty plots were located in 4 plant communities of the Jornada Experimental Range (JER), NM, USA. Ground cover for the plots was obtained using, (a) 1-mm ground sample distance (GSD) ground-based images analyzed with object-based image-analyses methods, and (b) the line-point-intercept (LPI) sampling method (Laliberte et al., 2007a). A QuickBird satellite image acquired over the study area was segmented at 4 different scales, resulting in a hierarchical network of image objects representing the image information in different spatial resolutions (Laliberte et al., 2007b). This allowed for differentiation of individual shrubs at fine scales and delineation of broader vegetation classes at coarser scales. At the Central Plains Experimental Range (CPER), CO, USA, 1-mm GSD images were acquired for 200 locations across 3 pastures using ground and aerial photography (Booth and Cox, In Press). Ground cover was measured from the CPER images using ‘SamplePoint’ software.

Results & Discussion

Image acquisition and object-based analysis for ground cover at JER gave 80% correlation with LPI data but required half the labor. Work at CPER complemented that at JER in that 1-mm GSD imagery obtained from the ground or the air was equally effective for detecting ground-cover differences due to pasture stocking rate, thus demonstrating the potential to save data-collection time and cost by aerial image acquisition. The combination of multi-resolution image segmentation and decision tree analysis of the QuickBird image facilitated the selection of input variables and helped in determining the appropriate image-analysis scale, thus enhancing vegetation-mapping accuracy over conventional methods.

Conclusions

Image-based monitoring using 1-mm GSD ground or aerially acquired images reduces data-collection costs; multi-scale data expands pattern detection possibilities enhancing vegetation mapping accuracy. Together these technologies contribute to our rangeland monitoring and sustainable-management capacity.

References

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