

Surveyor in the Sky: Using Very High-Resolution Drone-Collected Data to Monitor Ecological Restoration¹

G. J. Koenemann, T.J. Minnick, A. Langton, and R. Alward²

Abstract: We are implementing ecological restoration monitoring using multi-spectral remote sensing on a drone platform. Lands disturbed by oil and gas operations must be restored and meet several performance-based standards, including vegetation monitoring and reporting at regular intervals. Rigorous quantitative monitoring, using conventional methods, can be expensive since it entails high-skill, labor-intensive procedure that must be deployed during a limited growing season. We estimated vegetation cover and species composition on seven reclaimed well pads and two reference sites in Rio Blanco County, Colorado, using standard line-point-intercept techniques. We compared these results to those obtained using a 5-band multi-spectral camera with sub-meter resolution flown over each of these nine sites. Pixel-based supervised classification of the resulting multi-spectral imagery allowed us to accurately estimate the herbaceous, shrub, and tree composition of these well pads compared to the LPI method (achieving R^2 values of 0.9). We could also reliably identify several woody species including *Juniperus osteosperma*, *Pinus edulis*, *Artemisia tridentata* spp. *wyomingensis* from the imagery. Additional species that we could distinguish, with lower accuracy, included *Erica nauseosa* and *Gutierrezia sarothrae*. We will apply this classification to the regions beyond the small plots assessed using LPI to determine its capability to monitor larger restoration areas. Further analyses of these areas will include object based image analysis (OBIA) and will potentially increase the accuracy of the remote sensing-based classification. Our results indicate that remote sensing techniques can provide land managers with an effective but more cost-efficient alternative to ground-based monitoring. A further strength of this type of monitoring effort is the ability to scale-up to the landscape-level rather than being restricted to the small areas that can be assessed using standard field methods.

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 2. Grayson J. Koenemann, Student, Colorado Mesa University, Grand Junction, CO, 81503; Tamera J. Minnick, Professor, Colorado Mesa University, Grand Junction, CO, 81501; Alicia Langton, Environmental Consultant, EcoloGIS, Grand Junction, CO, 81501; and Richard Alward, Professor, Colorado Mesa University, Grand Junction, CO, 81501.