THE "POLE CAM": CORROBORATING FIELD ESTIMATIONS WITH HIGH SPATIAL RESOLUTION IMAGERY

Ben McMahan, Dan Narsavage, and Keith T. Weber
GIS Training and Research Center
Idaho State University
Pocatello, ID 83209-8130
(http://giscenter.isu.edu, e-mail: giscenter@isu.edu)

ABSTRACT

Traditional methods of quantifying vegetation cover are time intensive and may not represent patterns necessary for use in landscape scale remote sensing analyses. We used visual assessments to determine percent cover at the scale of four LANDSAT pixels (~60m^2). To compare visual assessments with ground cover characteristics, we took RGB images using a digital camera mounted on a four-meter pole. We used maximum likelihood classification to assign pixels to one of five classes (shrub, grass, litter/duff, bare ground, and shadow). We calculated proportions of each class and compared them to our ocular assessments to determine the difference between observed and actual percent cover.

Keywords: remote sensing, field estimates, correlation

INTRODUCTION

Point-quarter, Daubenmire frame, and line transect are common methods to characterize vegetation cover and structure but are also time consuming and tend to collect data at scales that are impractical for remote sensing image analysis (e.g., Landsat ETM 7+ with 30mpp resolution and approximately 150km x 150km scene extent). Ocular estimates of vegetation cover (e.g., using shrub, grass, litter, and bare ground categories) has proven to be a successful method to characterize vegetation for use in remote sensing studies (cf. chapters 1 and 2). However, no studies known to the authors have evaluated the agreement between estimates made by field observers and cover classifications derived with image processing techniques. The primary reason for this is surely the lack of high-spatial resolution imagery necessary to support such a study. The recent (c. 1999) commercial availability of high spatial resolution multi-spectral imagery changed this, and made it possible --albeit theoretically-- to classify sites using <2.5mpp imagery.

METHODS

During the summer of 2002, we collected field vegetation samples (n = 370) using ocular estimates of vegetation type and percent cover within a 30 meter radius of each sample point. This area approximated four Landsat pixels (60 x 60m). To test the agreement between ocular and remote sensing estimates, we developed a method using small plots (~2m x 3m) that were digitally imaged using a 3.3 mega-pixel camera. The digital camera was mounted to a four-meter pole and used to acquire three aerial RGB images at each of 19 plots (a subset of the original 370 sample sites) using the highest resolution setting on the camera (1600 x 1200 pixels). The camera's lens was always parallel to the ground. This was ensured by the use of a bubble level and "kickstand" attachment for the pole. Imagery was downloaded (n = 57) and opened with ENVI software .We digitized training polygons for five vegetation classes on each image (shrub, grass, litter, bare ground, and shadow), and generated a maximum likelihood supervised classification of each image. We then calculated the percent cover of each class as a proportion of the area not classified as shadow. These proportions were then compared with ocular estimations of percent cover.

RESULTS

Based on maximum likelihood supervised classification of the pole-cam photos, shrub cover was underestimated in the field an average of 3% per plot, grass cover was overestimated in the field an average of 8% per plot, litter was overestimated in the field an average of 23% per plot, and bare ground was underestimated in the field an average of 10% per plot (Figures 1 and 2).

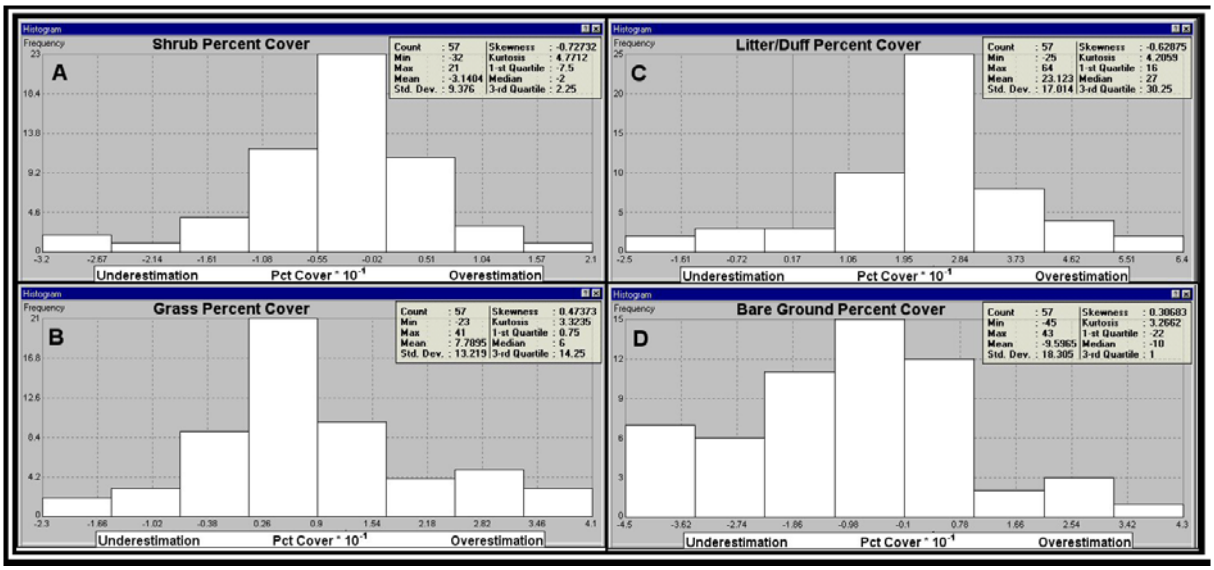

Figure 1. Distribution of agreement between ocular estimations and classifications of vegetation cover.

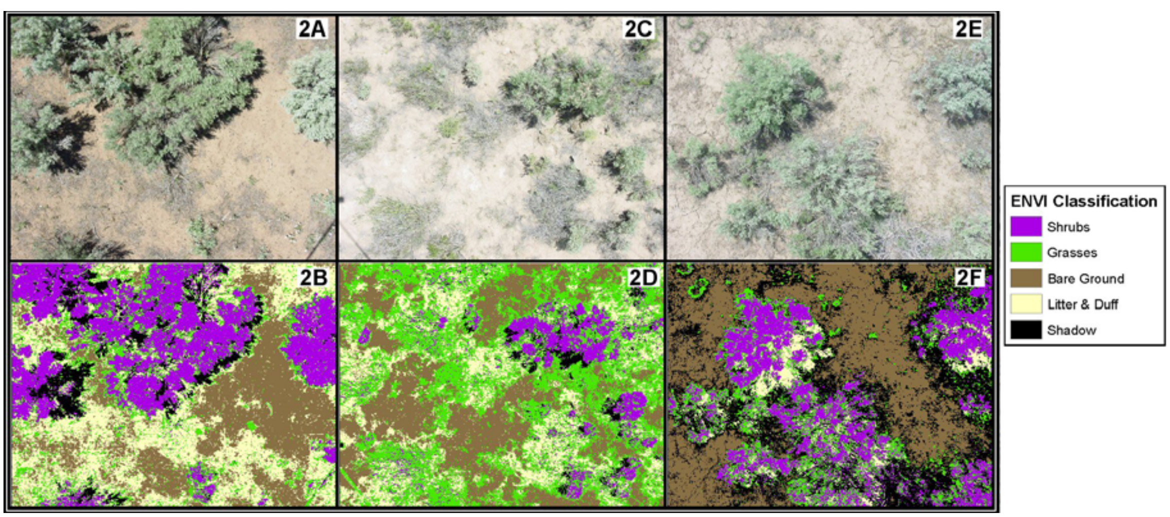

Figure 2. Original "pole-cam" photos (A, C, and E) and ENVI classifications (B,D, and F) .

DISCUSSION

We were satisfied with the agreement between ocular estimates and remote sensing classifications. The relatively small difference between ocular estimates and ENVI's classification gives us confidence in the precision of our field estimates. The differences between the ocular estimations and ENVI classifications of shrub, grass, and bare ground cover were all <10%. Further, the ocular estimations implemented in our remote sensing studies are always recorded in ordinal classes where classes have a range of 15%. This suggests that under most circumstances, field estimates will agree well with remote sensed imagery.

There were four systematic errors that had an effect on accuracy, all of which help explain the errors between ENVI's classification and ocular estimations. 1) The 'core' areas of grass clumps were occasionally mis-classified as shrubs by ENVI. This helps account for some of the overestimation of shrubs (cf. Figure 2b, 2d, and 2f). 2) The edge of shrubs were often mis-classified as grass resulting in a moderate underestimation to the shrubs category and an overestimation of the grass category (cf. Figure 2b and 2f). 3) Dry shrub branches were often mis-classified as litter resulting in moderate overestimation of litter and minor underestimation of shrubs (cf. Figure 2f). 4) Desiccation cracks in the soil were occasionally mis-classified as grass resulting in a minor overestimation of grass (cf. Figure 2f).

These four errors amplify differences between estimations and classifications and are the result of imagery having similar RGB values within different classes (e.g., the bright green of young green rabbitbrush looks quite similar to grass, and woody branches of sagebrush look similar to litter within the visible portions of the electromagnetic spectrum recorded by the digital camera). This error could be resolved with the use of a multispectral sensor that incorporates one or more bands in the near-infrared portion of the electromagnetic spectrum.

AKNOWLEDGEMENTS

This study was made possible by a grant from the National Aeronautics and Space Administration Goddard Space Flight Center. ISU would also like to acknowledge the Idaho Delegation for their assistance in obtaining this grant.

LITERATURE CITED

ENVI, 2003. Environment for Visualizing Images. RSI Inc., Boulder, Colo. 80301.