Mapping and monitoring of disturbance from military training at Fort Riley, Kansas and an investigation into the stability of grassland ecotones using satellite remote sensing

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ABSTRACT

Tallgrass prairie is a very dynamic ecosystem. Although complex when examining species composition, the plant canopy is relatively homogeneous making it difficult to identify plant communities from a remote sensing platform. This study could discriminate disturbed and undisturbed areas at Ft. Riley KS with 70% accuracy. This level of accuracy is typical of other remote sensing studies of tallgrass prairie. Although the kappa statistic for disturbance classification was higher than for plant community classification, the kappa statistics were not significantly different ($p = 0.14$). Logistic multiple regression indicated that disturbance was more indicative of the cover classes than plant communities were. Multi-date analyses did not show a significant improvement over single date analyses ($p = 0.29$). The Normalized Difference Vegetation Index (NDVI) was able to discriminate between disturbed and undisturbed areas but was not indicative of the level of disturbance. Ft. Riley is a very dynamic landscape with patterns of disturbance changing from year to year. These results point to the need to collect field data from the same year as the imagery. If field data and imagery are not from the same time, errors are introduced into the analysis. Initial results indicate that remote sensing can be an effective management tool for monitoring disturbance at military installations.

Boundaries or edges in ecosystems can be variously defined as spatial discontinuities of soil and/or vegetation, a zone of transition with a unique set of characteristics, or as phase transitions from one system to another. One can identify boundaries in two ways using remotely sensed data. If the data have been classified into discrete units and the classes identified then the juncture of two polygons can be defined as an edge. In continuous data sets such as raw band imagery or various vegetation indices edges can be defined as areas with high spatial variance. I tested whether boundaries in the tallgrass prairie at the watershed level could be identified and are stable through time and when identified with different techniques. The techniques used included textural analyses of Normalized Difference Vegetation Index images, classification of 3 channel composite imagery, and one pixel wide buffers created at the edges of the classes. Two areas, a prairie site with no woody vegetation, and a forest site, a riparian forest in a grassland were compared at two different seasons and two different years. Pairwise comparisons of the three techniques and four dates were made to detect whether edges were stable or unstable within the prairie and forest sites. The forest site, where edges between prairie and forest were assumed to be stable and identifiable with these data was used as the control. In all comparisons there was

a significant difference in the accuracy of prairie-forest edges and edges within grasslands. Edges defined in grasslands fluctuated between seasons and years. In creating maps in grasslands using remotely sensed data researchers need to account for both the error they can measure (i.e., error matrices, kappa statistics) but also acknowledge the error that is a function of the interseasonal and interannual variability within the plant communities or management treatments.