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A MULTITEMPORAL APPROACH FOR CLASSIFYING AND MAPPING RANGELAND VEGETATION

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ABSTRACT

Landsat multispectral scanner (MSS) data have proven useful for classifying and mapping rangeland vegetation types over large areas. Several studies indicate that the accuracy of Landsat-derived vegetation maps is acceptable for many uses, but that ecologically important vegetation types are not always distinguished by spectral data from a single date. Rangelands in the western United States characteristically have relatively low ground cover. The physiognomy among plant community types which constitute the cover varies greatly. Many of the plant communities are dominated by herbaceous vegetation having definite seasonal growth patterns. Because a satellite's view of the rangeland captures the variations in brightness and greenness among plant community types, it can be hypothesized that brightness and greenness of the scene are two important parameters for spectral classification of plant community types.

Scene brightness is a function of the exposed soil, perennial vegetation cover, and terrain features that change only slightly within a growing season. Greenness within the scene depends on the growth characteristics of the plant community type, and is seasonally dynamic. The first and second principal components of four-band Landsat MSS data are often highly correlated with brightness and greenness, respectively. The transformed variables from principal component analysis are also: (1) linear combinations of the input data; (2) mutually orthogonal, while explaining as much of the original variability as possible; and (3) equal in number to the input variables. Because the variance attributed to each of the transformed variables is known, principal components analyses of spectral data often become an effective data compression technique.

A study was conducted to evaluate the utility of principal components transformations of MSS data for temporal analyses of rangeland scenes. The objective of the investigation was to use multitemporal transformed variables to classify and map plant community types that are dominated by warm and cool season vegetation.

The 594,000-hectare Grass Creek Resource Area in north central Wyoming, administered by the Bureau of Land Management, was selected as the study area. Principal components analyses were run on geometrically corrected MSS data acquired in June 1978 (scene 21233-16553) and September 1978 (scene 30194-17184). Brightness images were created for the first and second principal components of both dates of Landsat coverage. An unsupervised clustering routine was used to develop training statistics for a three band image of the transformed data, which included the first and second principal components from June and the second principal component from September. A maximum-likelihood algorithm was used to classify the scene into 29 spectral classes. These classes were aggregated to 13 land cover classes based on separability and association with field data collected in June 1981.

More than 98 percent of the within-scene variation was accounted for by the first and second principal components on each date. Comparisons of the scene brightness and greenness contrasts indicate the separability that is afforded by the temporal analysis.

Agricultural land and riparian vegetation, comprising about 5 percent of the study area, were identified by 8 of the 29 spectral classes. Rangelands, comprising 89 percent of the area, were identified by 16 spectral classes. These spectral classes described 9 distinct and ecologically significant rangeland plant community types. Forest/woodland types were identified by 2 spectral classes.

Transformed variables from principal components analyses of Landsat MSS data can be easily interpreted and are readily applied to

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mapping rangeland vegetation. Principal components proved to be an effective data reduction procedure in this study. Only three variables, first and second principal components from June and the second principal component from September, were required to classify and map ecologically significant rangeland plant community types. Principal components transformations can be used for rangeland vegetation analyses and the technique provides new opportunities for satellite monitoring of condition and trend of natural vegetation over large areas.