

Assessing grazing impacts by remote sensing in hyper-arid environments

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Abstract

Assessing vegetation status via remote sensing techniques using various vegetation indices has been successfully applied to semi-arid and arid environments. We tested the feasibility of applying such techniques for assessing grazing impact in hyper-arid environments with a high variance in soil type over space. An anticlinal erosional cirque called Makhtesh Ramon in the Negev desert, Israel, was selected for the study. The cirque is typified by low rainfall (40-90 mm per year), a variety of soil substrates and is subject to grazing by a herd of Asiatic wild asses (*Equus hemionus*) reintroduced into the cirque between 1984 and 1987. As a control, we used an ungrazed dry riverbed south of the cirque that runs parallel to the riverbed draining the cirque. We used 5 common vegetation indices derived from Landsat 5 satellite Thematic Mapper (TM). Four images were used, representing dry and wet seasons in above- and below-average rainfall years (1995 and 1987, respectively). To test whether we can detect changes in plant community structure via satellite data we correlated vegetation indices from the TM to ground measurements made along the altitudinal gradient of the cirque. To test whether differences in plant cover could be detected, we correlated the vegetation indices with ground measurements of cover in and out of the cirque (grazed and ungrazed areas). Although ground measurements showed that community structure changed following grazing with altitudinal gradient and ground cover was 30% lower inside the cirque than outside the cirque, none of the 5 vegetation indices correlated with the ground measurements. Transformed Soil Adjusted Vegetation Index (TSAVI) and Normalized Difference Vegetation Index (NDVI) produced the best results. We hypothesize that the low vegetation cover that typifies hyper-arid environments increases the noise to signal ratio. Thus, a 30% decline in vegetation cover in this case is only an absolute decline of 4% from 15.8 to 11.2%. Because TM is sensitive to absolute cover rather than the relative differences, it is difficult to demonstrate differences among TM images. Using ANOVA to test the effect of season and grazing status on TSAVI and NDVI, we found a significant interaction between season and grazing status in 1995 with indices declining more from wet to dry season inside the cirque than outside the cirque. No such pattern was found in 1987. These data suggest that satellite imagery may detect changes in plant cover over time but can not serve as a direct index of plant cover in hyper-arid conditions.

Key Words: Asiatic wild ass, reintroduction, satellite, vegetation cover