MAPPING ECOLOGICAL ZONES IN THE KRUGER NATIONAL PARK USING REMOTE SENSING

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ABSTRACT

Accurate and updated habitat maps are important in conservation. The spatial technology of remote sensing is potentially useful in updating habitat maps, particularly for large protected areas where alternative means of mapping by ground work have limitations. Vegetation types are equivalent to habitats. This research examined the usefulness of moderate resolution Landsat TM imagery of Kruger National Park (KNP) in ecological zone mapping. Kruger National Park is a large park on the north-eastern border of South Africa with Mozambique, stretching about 90 km at its widest and about 450 km long in the north-south direction. The underlying geology divides the park into a more fertile, hilly eastern half and a less fertile western half. A variety of flora and fauna are conserved in the park. The vegetation and other physical features of KNP are influenced by the geology. A classification scheme dividing KNP into 16 ecological zones was obtained from the KNP authorities and taken as test case in the habitat mapping.

Following consideration of literature guidelines for successful habitat mapping by remote sensing, which include timing of the analysis, sensor aspects and image processing algorithms, Landsat TM images were selected for use in the study primarily because of their relatively high spatial resolution and wide swath coverage which enables the coverage of KNP with four image scenes, relatively fewer images in comparison with imagery from multispectral sensors of comparable or higher spatial resolution. Summer time (rain season) imagery was selected because vegetation is at maximum productivity then and habitat differentiation most likely. The image dates used were 16 November 2005 and 14 December 2006 for the northern half of KNP, and 16 February 2007 for the southern half. Vegetation description data in support of image interpretation was collected during field work in December 2007 and February 2008 at accessible, widely spread sampling sites across KNP. Cloud cover over KNP prevented the use of images acquired during the field work period. The images were geometrically corrected and registered to the UTM Zone 36S WGS 84 projection, with sub-pixel root mean square error in spatial location. An initial classification to produce the 16 ecological zones revealed low classification accuracy and considerable departures from the actual boundaries of the zones, mainly due to overlapping spectral signatures for the vegetation in the ecological zones. Consequently, the vegetation mapping was then undertaken by hybrid image classification to produce a gradient in vegetation density and vigour, from dense vegetation to dry cover classes and water. Classification into vegetation density classes yielded more acceptable accuracy and kappa coefficient statistics compared to the initial classification into the ecological zones under analysis. The resulting vegetation density maps from the four separate images were, therefore, combined into a mosaic on which post classification smoothing using 7x7 pixel kernels was performed.

The results indicated that the vegetation zones of KNP cannot be distinguished on the basis of the 16-class stratification system that uses dominant tree species and geology as delineation criteria, partly because of the low spectral resolution of Landsat TM, but also due to the mixed species nature of the 16-class strata being tested. The 16 classes have tree species in common, and in the field some of them are not very distinct, particularly the thorn-related classes. However, at a lower aggregated scale, the vegetation could be mapped on the basis of geologic fertility differences, pointing to the strong influence of geological fertility on vegetation spectral reflectance in

KNP where the vegetation is protected from human disturbances during optimal growth periods. The soils of the high fertility zone, derived from basic rocks, are fine textured and support mainly multiple-stemmed shrubs, whereas the low fertility zone soils are coarse-textured, supporting mixed savannah woodlands. The ability to map the high fertility and low fertility vegetation zones of KNP from remotely sensed imagery is significant for monitoring the park's vegetation, because a number of ecological analyses of relevance to conservation management of the park have used the contrast between the two, or the influence of either or both. It is concluded that, given the ready availability of satellite imagery within South Africa, adoption of remote sensing in routine habitat assessment and mapping as input in the management of protected areas is feasible, on the basis of the research methodology and results. The feasibility of this adoption, however, depends on other factors, including technical and financial considerations.