Comparison of remote sensing data sources and techniques for identifying and classifying alien invasive vegetation in riparian zones

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Abstract

It has been estimated that South Africa will reach the limits of its usable freshwater resources during the first half of the next century if current trends in water use are not reversed. Removing alien vegetation, responsible for the uptake of large amounts of water from riparian zones, is one of the methods of maximising water supply in South Africa. Remote sensing is a cost- and time-effective technique for identifying alien vegetation in riparian zones and remote sensing data can be incorporated into a geographic information system (GIS) which can be used as a tool for the management of riparian zones. In this paper, vegetation identification and classification techniques by using aerial videography, aerial photography and satellite imagery, are assessed in terms of accuracy and cost for a small subcatchment in the KwaZulu-Natal midlands. This was achieved by incorporating the data obtained from aerial videography, aerial photography and ground mapping into a GIS. Accuracies of the different techniques were then examined. Data obtained from satellite imagery were assessed independently using digital image decoding procedures. The costs of each technique were also determined and, together with the accuracy results, used to make recommendations for the most effective manner of identifying alien vegetation in riparian zones. The accuracy results obtained in this study indicate that using manual techniques to identify riparian vegetation from 1:10 000 black and white aerial photographs yields the most accurate and cost-effective results. The least cost-effective data sources were found to be 1:10 000 colour aerial photographs and digital aerial photographs and the least accurate data sources were aerial videography and Landsat thematic mapper (TM) satellite imagery.

Introduction

It has been estimated that South Africa will reach the limits of its usable freshwater resources during the first half of the next century if current trends in water use are not reversed (Department of Water Affairs, 1986). Clearing riparian zones of exotic invasive vegetation is one of the methods of maximising the water supply in South Africa (Department of Water Affairs and Forestry, 1996a). The *Working for Water* (WFW) programme, a water conservation programme aimed at removing alien vegetation from riparian zones, has been instituted by the Department of Water Affairs and Forestry as an initiative to increase water availability in South Africa (Department of Water Affairs and Forestry, 1996b). In order to plan the removal of alien vegetation from riparian zones, detailed mapping of the catchments has to be undertaken.

Remote sensing is the observation of objects and features without contact and includes mapping and digital image processing techniques using aerial photography and satellite imagery. Remote sensing provides up-to-date, detailed information about land condition and land use, and uses instruments mounted on aeroplanes and satellites to produce images of the Earth's surface (Perryman, 1996; Evans, 1997). Remote sensing provides spatial data that can be incorporated into a geographic information system (GIS) which facilitates the management of water resources, land use and land cover as well as urban planning (ESRI Inc., 1990). The primary objective of this study is to identify and assess different remote sensing data sources that are applicable to mapping alien vegetation in riparian areas. These data will enable the removal of such vegetation in efforts to increase streamflow and conserve water. This objective was achieved by documenting the comparison of remote sensing data sources including aerial videography, aerial photography and satellite imagery. Previous studies (Van Wyk, 1997) have compared different satellite data sources for mapping alien invasive vegetation, particularly wattle, although density of such vegetation and other types of riparian vegetation have not been classified. Conventional aerial photography as a data source was also not assessed. Thompson (1997) also details large scale (1:250 000) land cover mapping of South Africa using 'Spacemaps' derived from Landsat TM imagery.

Materials and methods

Study site

Subcatchment No. 18 of the Midmar catchment, located between 29° 32' 02" and 29° 38' 25" South and 30° 03' 30" and 30° 08' 15" East, was chosen as the study site. This catchment is a subcatchment of the Mgeni catchment and is located in the KwaZulu-Natal midlands, 30 km north of Pietermaritzburg. The study site lies immediately south west of the Midmar Dam and is approximately 56 km^2 in size (Armstrong, 1997) (Fig. 1), thus small enough to facilitate ground mapping. All major land-use categories, for example afforestation, pasture, and dryland farming, are repre-

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