Tracking Invasive Tree Species in South Africa

There are approximately 750 introduced tree species in South Africa. Fortunately, only a small percentage of those introduced species have become invasive in the country. These plant species are defined as being non-native to specific ecosystems and spread rapidly by natural means, causing economic or environmental harm. The Agricultural Research Council has developed a study that uses remote sensing and GIS techniques to map and monitor areas that are invaded by those species.

One such example is the Prosopis tree, which was imported to South Africa at the turn of the 20th century to provide shade and wood for fuel. The nature of the tree and its extraordinary ability to adapt in extreme weather conditions, together with the high protein content of its pods – which can be fed to animals in times of drought – made this a very valuable tree up until the end of the 1950s.

However, in the northern parts of South Africa, the Prosopis species and their hybrids became invasive because of their adaptability to the harsh climate, vigorous growth, high seed production, efficient seed dispersal mechanism and the absence of natural seed-feeding insects.

Impact

Invasive alien trees like Prosopis pose significant threats to biodiversity and ecosystem services in South Africa – especially in tree communities near riverbanks. These invasions reduce water yields and suppress indigenous vegetation, as well as causing drastic soil erosion. This can also impact grazing areas for livestock and reduce the productivity of croplands.

Through the national Working for Water (WfW) programme, the South African government is implementing systems to control invasive species. The biggest challenge of this effort is that invaders are not controlled by a single method or single chemical application. As such, the government will leverage geospatial solutions for understanding the Prosopis invasion and identifying potentially high-risk ecosystems.

Geospatial solutions

The Agricultural Research Council (ARC), whose main mission is to conduct fundamental and applied agricultural research for generating new knowledge, developing human capital and fostering innovation to support the agricultural sector, was tasked with using geospatial solutions for tackling this challenge.

The ARC developed a study that uses remote sensing and GIS techniques to map and monitor the current invaded areas, and also to predict and monitor areas susceptible to Prosopis invasion over the long term.

This effort included determining the invasion history of Prosopis in the region for the past 30 years. The ARC also had to provide accurate descriptions of the plant densities and reveal the spatial dynamics in regions where Prosopis had spread. Finally, it had to map out regions that were also susceptible to invasion.

Imagery

The ARC turned to Erdas Imagine from Hexagon Geospatial torectify, view and mosaic imagery. The software also supported the calculations of all classifications, vegetation indices, seasonal spectral signatures for vegetation, as well as median pixel values and zonal statistics. The ARC has been using Erdas Imagine for more than 15 years – with Erdas Imagine Professional and Imagine AutoSync being used for the image process analysis.

Hexagon Geospatial's Spatial Modeler was also used to perform GIS algebra and modeling for the identification of areas susceptible for future invasion. All the raster data was integrated into the ArcGIS environment for further analysis on spatial dynamics, invasion history and transformation of natural vegetation.

The outcomes from this study have allowed the ARC to share detailed and accurate insights into the areas that are most susceptible to invasions. It also shared the historical changes in the growth of Prosopis in the region using Landsat images. The baseline data will inform efforts to estimate the economic impact, determine carbon sequestration, as well as monitor habitat destruction and measure water usage.

The ARC is exploring the implementation of a similar study in neighbouring arid and semi-arid regions of Namibia and

Botswana where Prosopis is also a big threat to the local economy and ecology.

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