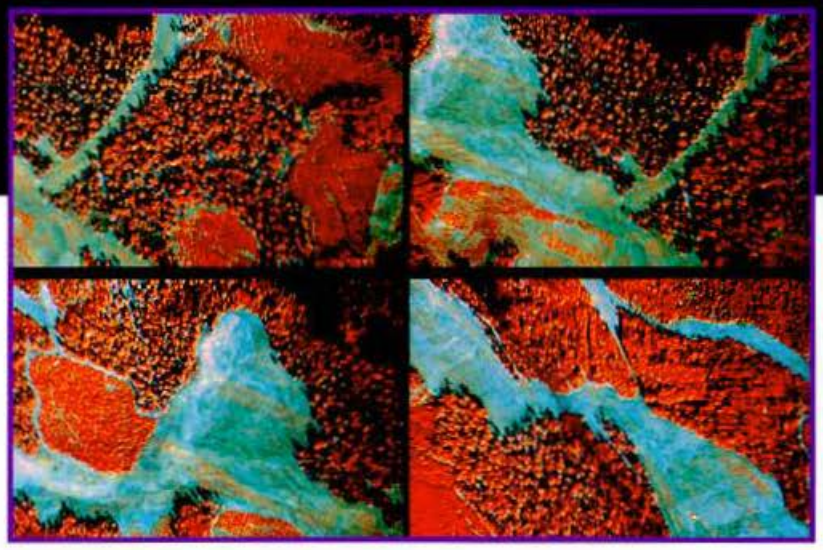
Digital records assess revegetation



These digital multi-spectral video images show a forest south of Perth that has been rehabilitated over a 10-year period. The images have been processed to distinguish between species in rehabilitation areas where acacias and eucalypts are one to six years of age and show variability in their early growth. Monitoring establishment enables remedial management if necessary.

Large areas of native vegetation are rehabilitated each year after open-pit mining. This often involves planting eucalypt seedlings and broadcasting the seeds of a range of species, including many acacias. Objective vegetation measurements, taken before and after mining, are necessary to gauge the success of these projects.

Aerial photography has traditionally been used to monitor the establishment rates and proportional growth of revegetation species. But this technique has its limitations. One is that pictures taken on a broad scale do not show enough spectral detail. Another is that the resulting images require interpretation. The outcome is subjective, and therefore not an accurate basis for making comparisons over time.

A measuring technique that overcomes these difficulties is being tested in a pilot study by CSIRO's Division of Exploration and Mining as part of the Multi-Divisional Minesite Rehabilitation Program. Demonstration of its success is likely to enable its adoption in rehabilitation projects in Australia and overseas.

The technique, called multi-spectral aerial videography, can monitor large areas of vegetation at a fine scale, detecting differences in communities by their spectral characteristics and canopy architecture. The study will evaluate the technique's capacity to distinguish between species in rehabilitation areas where acacias and eucalypts are one to 15 years old, and to monitor growth and species adaptation.

Vegetation re-establishment after mining can result in marked structural differences from surrounding native forest or woodland. A sequence of multi-spectral aerial videography images can help monitor the progress of the revegetation process, identify areas that are 'failing', and provide evidence for the status of the ecosystem before the land is handed back for post-mining use.

How does it work?

Different colour tones on a photograph indicate that solar energy is being reflected at different wavelengths. All vegetation and soils have discrete reflectance characteristics. These 'spectral signatures' can be used to quantitatively determine the proportions of various components of an image that has the same spectral characteristics.

Specific indices, or mathematical combinations of spectral bands, can measure the amount of green vegetation covering the soil. For example, using the visible red waveband and the reflected near infrared waveband, an index relating to the proportion of photosynthetically-absorbed radiation can be calculated.

The CSIRO pilot study is testing a multi-spectral videography unit built in Western Australia by SpecTerra Systems Pty Ltd. This instrument is a low-cost, four-camera digital imaging system. The output from its four channels is linearly related to radiance of the reflected solar radiation. These characteristics make it suitable for high-resolution discrimination of vegetation type and condition. It has been designed to suit light, unpressurised aircraft and helicopters and, as a function of flying height, provides spatial resolution ranging from 30 centimetres to three metres. The data, being digital, is calibrated so that it can be directly compared with data collected days, months or years later, and readily incorporated into geographic information systems.

Field measurements of spectral reflectance of the principal plant species will be taken during the pilot study. This data will be used to determine optimum wavelengths for spectrally differentiating acacias, eucalypts and other species. The information will be used to develop algorithms for processing the multi-spectral images. Sequential time-series images will be analysed by integration with site-specific geographical information.

In some areas, information gathered by the satellite-based 'vegetation watch' project will be used to aid the selection of optimum times for monitoring. Satellite imagery of vegetation in arid areas has revealed that growth is seasonal. In particular, it depends on the occurrence of 'effective rainfall'. For the application of digital videography to monitor the progress of revegetation, it is important to acquire the imagery after a growth flush to assess the contribution of the annual species. Imagery during a dry period permits the contribution of the perennial species to be assessed.

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