difficult to classify weeds into, unnecessary and time consuming. Also ones perception of weed cover may differ slightly from day to day.

Roadside mapping was less accurate and data collection on foot was very time consuming

Weeds initiative – Year 3

A third year weed mapping within the Shire of Melton will involve the following activities:

i. Establish a formal reporting / communication system with Conservation Inspection Officer and NRE (Bacchus Marsh Office) for consistency between parties, optimizing weed mapping and the Environmental Enhancement Policy.
ii. Devise the most appropriate symbology for weed representation when displayed on maps.
iii. Accurately map the location of Melton Shire's five priority weeds: African boxthorn (*Lycium ferocissimum*), artichoke thistle (*Cynara cardunculus*), Paterson's curse (*Echium plantagineum*), prairie ground cherry (*Physalis viscosa*) and serrated tussock (*Nassella trichotoma*) with a GPS Mapping System.
iv. Map in detail heavy weed infested properties and ascertain future weed movement to neighbouring properties and watercourses.
v. Create soil, rainfall, vegetation, land use, and contour coverages in the GIS for full spatial analysis of priority weeds over the three years.
vi. Investigate the role of water, birds and machinery in the distribution of weeds.
vii. Present talks to community, Landcare groups and other relevant groups on the state of weeds within the Shire.
viii. Develop an environmental weed mapping and monitoring system as part of a remnant vegetation condition assessment in accordance with Action Plan P22 in the Werribee Catchment Action Program.
ix. Compare all three (97–98, 98–99, 99–00) weed maps for general state of weeds, spatial variation and new outbreaks within the Shire.
x. Identify and prioritize heavily infested weed areas located in the riparian regions of Werribee River, Toolern Creek and Kororoit Creek.
xi. Map the extent of Chilean needle grass within the Shire (additional hours).

Cheap, effective GIS aids catchment planning

Rick Pope and **Jacinta Burns**, Woady Yaloak GIS Advisory Committee, 6 Mansfield Avenue, Mt. Clear, Victoria 3350, Australia.

Farmers throughout the Woady Yaloak Catchment will soon be able to enjoy the benefits of GIS-based farm plans in a new and exciting community-led project being undertaken in partnership with Alcoa, University of Ballarat Centre for Rural and Regional Information, Corangamite Catchment Management Authority, NRE and the Golden Plains Shire.

The new project is an extension of one of the earliest Landcare group-based GIS projects funded under the National Landcare Program. In 1994, the Pittong Hoyles Creek Landcare Group, located in the upper reaches of the Woady Yaloak Catchment, initiated the project with Rick Pope, a student of the Graduate Diploma in Land Rehabilitation Program at the University of Ballarat.

The farm plans developed from this initial project proved to be a valuable resource to the farmers, so the decision to develop a cheap and effective GIS package for the whole catchment was made.

Alice Knight, Chair of the Woady Yaloak Catchment Committee, said the Pittong-Hoyles Creek Project had given them another management tool for their farm at Linton, but also one for their local neighbourhood.

'We found the GIS very useful for planning in terms of prioritizing areas for works on our property and a useful means of identifying potential linkages of works between neighbours to form a truly integrated approach to catchment management in our area. The only drawback was the somewhat expensive software. For this new project to work, we needed a simple cheap package to do the job', she said.

Since completing his Graduate Diploma, Rick Pope has remained in contact with the group and is happy to see the Woady steering committee continuing his work by expanding the GIS model across the whole of the catchment.

The new model is great. It revolves around the development of a CD-ROM that the farmers can either have access to or purchase cheaply, that contains all the relevant information for their farming system and land rehabilitation efforts at a catchment level, but with enough resolution to go to the individual farm level.

'As Alice said, the stumbling block was the cost of the software, but by using free 'public domain' software, with links to higher resolution maps for the whole catchment, we hope to make it cheaper and easier for everyone to use', Rick said.

The Woady Yaloak group, with support from Alcoa and other sponsors, has now produced the CD-ROM with data covering the Woady Yaloak catchment from Ballarat to Cressy that can be viewed on any modern home computer.

'The base layer is a satellite image', Rick said.

'Overlays include soil types, drainage lines and contours, land uses, title boundaries and more. Farmers can select an area, zoom in on it and print it out on their office printer', he said.

The group's Neighbourhood Project Facilitator, Jen Clarke, works with individual farmers to update their informa-

Landholders and DNRE staff working together in familiarisation with the new GIS.

tion, before sending it through to be updated on the main GIS by local farmer Susie Ellis. Susie is in charge of inputting the data to the GIS and she said the benefits of the GIS package were more than first thought.

'We can collect all the data for proposed rehabilitation projects and combine them to use in grant applications, or to give the Woady Yaloak Steering Committee a better picture of the works proposed, in progress and completed', she said.

Susie pointed out that the mapping of the achievements of the five years of the Woady Yaloak Project is another integral component of the new GIS.

'The GIS gives us a chance to give a pictorial representation of the works undertaken with Alcoa's support, so we can show our sponsor how much as been achieved at a catchment level,' she said.

'But more importantly for the community, it gives individuals a chance to see what they have achieved at their farm level over the past few years – something that is very easy to lose track of', she said.

A farm management issue where systems such as the Woady Yaloak GIS could assist farmers in the future, is on the topic of weed and vermin control. With many Landcare members considering weeds and pests to be a major concern, due to the reduction of farm productivity (and the flow-on effects to farm profitability), the ability to graphically depict the location of both weeds and vermin across not just individual farms, but whole catchment areas.

GIS systems, such as the one used in Woady Yaloak, allow farmers to map the distribution of weeds and pest shelters across their land, and then merge that information with the data of other farmers in the catchment. The result of this data sharing is that farmers can easily see where weeds are predominant, and the effects of these weeds upon their land and crops, at both the farm and catchment levels. A similar approach can be taken to recording the locations of vermin refuges. This information can then assist in an integrated approach to the elimination of both weeds and vermin throughout a catchment. The addition of modelling functions to the GIS system would mean that the consequences of a farmer's weed eradication program (on not only the farmer's land, but also surrounding properties) could be established.

Projects such as this, are best achieved via community education programs, as done in this case. The Woady Yaloak system would not have been possible without people freely giving of their time and knowledge to train the farmers, and the University of Ballarat (Mt. Helen and SMB campuses) who donated resources.

For more information regarding the Woady GIS project, contact Rick Pope via email on rick.pope@nre.vic.gov.au.

Is the application of remote sensing to weed mapping just 'S-pie in the sky'?

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Abstract

The play on words expressed in the title underlies a more significant question regarding the prospects for using remote sensing technology to map the extent of environmental weeds that seriously impact on agriculture: How realistic is the expectation that remote sensing can become routinely applied to weed mapping? This paper presents an overview of remote sensing and how it works, examines how it has been used for land and resource evaluation and monitoring, and describes briefly some of the inherent difficulties associated with its application to weed mapping using, as an example, research on mapping Paterson's curse, a weed of perennial pastures. An explanation is given about some of the key factors relating to the spectral characteristics of the weed, and its behaviour in response to natural and human factors and shows that infested areas can be mapped but that determining weed distribution and density are not always possible using currently available remotely sensed data. In particular, it demonstrates that the use of high resolution data solves some of the difficulties encountered when lower resolution data are employed for weed mapping. In conclusion, it points to answering the above question with the proposition that: Much depends upon the characteristics, behaviour and environments of the weeds; and future developments in remote sensing technology.

Introduction

The applications for remote sensing continue to increase and will most probably go on doing so with progressive improvements in the technology. A large range of applications already exist for remote sensing in areas as diverse as land cover mapping, geology, marine and terrestrial resource evaluation. In 1995 ABARE listed some 120 separate applications for remote sensing (Watson *et al.* 1995), while a Bureau of Rural Resources survey in 1990 list some 136 separate remote sensing projects in agriculture alone (Kelly *et al.* 1990). These statistics are testament to the economies of scale that can be achieved in thematic mapping where areal coverage using satellite imagery can be extensive and, on a per unit area basis, relatively inexpensive. But technological limitations still constrain its employment for routine or 'operational' usage in many cases. These limitations are primarily imposed by the lower spectral and spatial resolution of satellite data on the one hand, and the greater expense of conducting air-borne surveys to obtain higher resolution air-borne data on the other. Although much can, and has been achieved in remote sensing, the limits imposed by current technology still prevent its routine application for some areas of land and resource management. This is particularly the case for weed mapping, where frequently the patterns of their distribution stretch the limits of spatial and spectral resolution available from current satellite data and is generally too expensive for the more appropriate air-borne mapping. It is of no great surprise then, that of the 136 agricultural applications for remote sensing in Kelly's report, only three were related to weed mapping. Improvements in the spectral and spatial resolution of remote sensing data and the increasing number and coverage of satellites and air-borne instruments, will provide greater opportunities for detecting, mapping and managing the environment and earth resources including that of some of our most widespread and worst weed problems.

In order to better understand the limitations of current remote sensing technology referred to above, some basic ideas about how remote sensing works is provided. This paper gives a brief overview of the nature of remote sensing, examples of how it is being used and some of the limitations encountered when applied to weed mapping, drawing on my research into mapping Paterson's curse in north-east Victoria.