MAPPING THE DISTRIBUTION OF WEEDS WITH COST EFFECTIVE REMOTELY SENSED DATA

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Summary Mapping the distribution of noxious weeds is a major task for land management authorities who have responsibilities for large tracts of land. The use of remotely sensed data to assist with broad area weed mapping has not been regularly used because either the weed could not be identified with any accuracy or the available remotely sensed data was acquired at inappropriate times of the year and was far too costly. The usefulness of oblique aerial photography acquired at a suitable time of the year for the identification of furze (*Ulex europaeus* L.), a major weed species of the Ballarat area, combined with vertical aerial photos and a Geographic Information System (GIS) package was assessed. A series of 35 mm oblique aerial photographs covering the Napoleons 1:25 000 map sheet were acquired in August 1995 when furze was in full flower and readily discernible from the surrounding vegetation. The distribution of the weed was transferred to vertical aerial photos and then to a GIS package, and results ground truthed. The accuracy, efficiency and costs of this procedure compared favourably with existing procedures. The inclusion of the results in the GIS provided a baseline from which control programs may be monitored and additional data can be added.

INTRODUCTION

Recording the distribution of noxious weed infestations is a major task of regulatory and control authorities such as the Department of Natural Resources and Environment (NRE). They require the location and extent of infestations for the purposes of planning control activities, assessing trouble spots and monitoring the effectiveness of control programs. The gathering and recording of the distribution data over large areas is a major undertaking in time and, therefore, cost. A process that accumulates distributional data quickly and efficiently, is easy to use, and allows easy recall and updating is capable of providing substantial savings as well as increased information.

Weed management is a regional and local problem and solutions must be available at that level. Some existing recording systems are cumbersome and inappropriate and as a result their use is often resisted by field staff. It is essential to provide a friendly and responsive system which encourages the recording of information at the local level.

The aim of this investigation was to assess the usefulness of the combination of oblique and vertical colour air photos in a GIS environment to weed mapping and recording. This study forms a component of a larger Australian Research Council supported study to investigate the applications of GIS to weed management.

Furze (*Ulex europaeus* L.) was selected for the trial because it is a widespread pest plant in the Ballarat area of Victoria, and it is large and showy when in flower. The Napoleons 1:25 000 map sheet, just to the south of Ballarat (Figure 1) was selected as the study area because furze is known to occur there, and there is a mixture of open farming land and forested areas.

MATERIALS AND METHODS

A series of 35 mm colour oblique aerial photographs were flown of the Napoleons 1:25 000 map sheet in August 1995. At this time furze was in full flower and clearly visible from a light plane at an altitude of 1200 m above ground level. Thirty six standard colour prints were sufficient to cover the entire 15 400 ha (approximately) of the map sheet from at least two directions.

Twelve standard colour vertical aerial photographs of the same area were purchased. These were scanned at 300 dpi into an image file and incorporated into MapInfo® Geographic Information System where they were registered to AMG co-ordinates.

Within the GIS the aerial photograph images and other topographical map data, such as roads streams and fence lines, were displayed and the distribution of furze was determined through comparison of the image with the oblique photographs. Mapping was completed by on-screen digitizing of infestation boundaries, and the results were ground truthed by driven transects.

All mapping and processing was undertaken using MapInfo 3.1 on a 486 IBM compatible personal computer with 8 meg of RAM.

The entire process was completed in four days with one day for the oblique photography, two days for the mapping and one day for the ground truthing.

RESULTS

The furze mapped using the air photo technique covered 126 ha of the 15 400 ha (approximately) of the Napoleons 1:25 000 map sheet (Figure 1). Most of the infestations were in the eastern portion of the study area along fence lines, stream verges, and around old mullock heaps. There were occasional patches within paddocks.

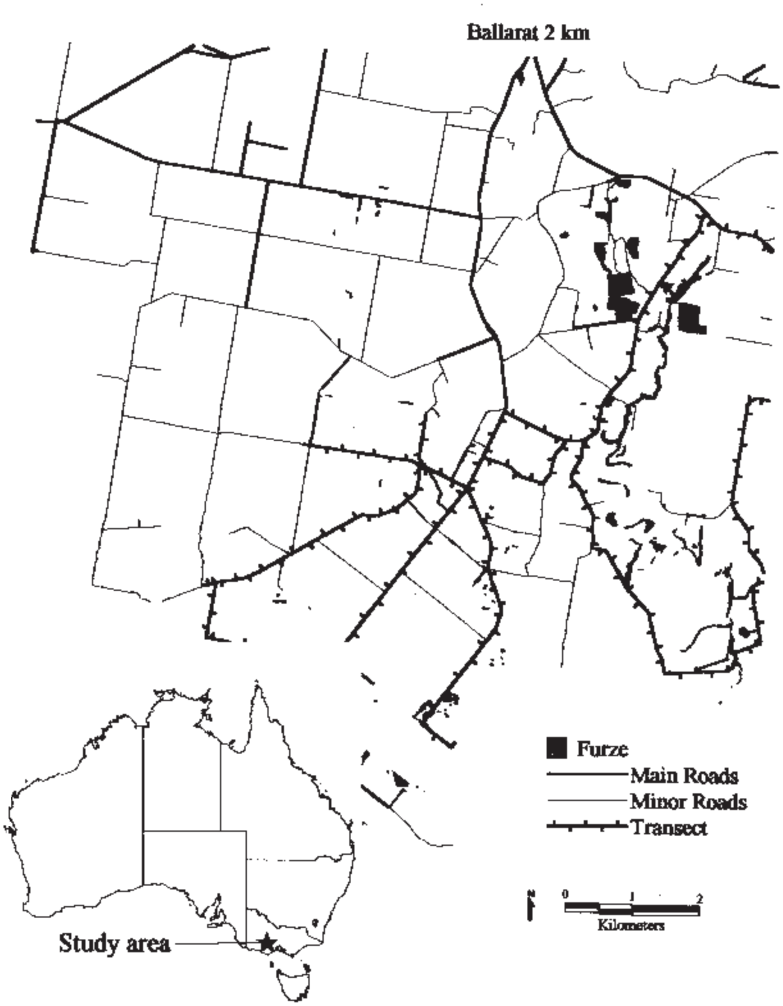

Figure 1. Napoleons 1:25 000 map sheet study area with furze infestations.

Ground truthing via a 40 km driven transect showed that:

- 100% of the areas interpreted as containing furze did in fact contain furze,
- individual plants, and patches of less than 2 m diameter, were not visible on the photos, and
- an additional 3.6 ha of infestations were recorded.

The reason for these additional areas not being recorded through the photo interpretation was that, in two cases the infestation was an understorey below fairly dense tree cover, and the other four cases were contained in an area not properly photographed.

Costs associated with the mapping procedure are provided in Table 1. It was assumed that most offices would have a 486 computer available for use on projects such as this so computer costs were not included. Similarly, MapInfo, which costs around $A3000, has much wider uses than this particular project so it too was not included in the costs.

DISCUSSION

The results indicate that the combination of oblique and vertical air photos in a GIS environment represents an effective and cost efficient method of collecting furze distribution data.

The use of oblique colour aerial photographs provides flexibility and control over the procedure because you may select the best time for the data acquisition.

The procedure presents a number of positive aspects for land managing authorities including:

Table 1. Costs of items used for the mapping of furze.

Item	Cost $A
Hire of aircraft and supply of 36 colour photographs	200
Purchase of 12 vertical aerial photographs	313
Mapping furze distribution in the GIS, 2 days @ $A500	1000
Ground truthing ½ day @ $A500	250
Purchase of topographical data	250
Total	2013

This equates to approximately 13 cents per ha.

- Quick appraisal of weed extent. The mapping and inclusion in a digital database can be completed in two days.
- Provision of a base map from which to extend information. Because the mapping procedure is digital it can be easily and quickly extended to include additional identified areas.
- The ability to see patterns in the distribution.

Mapping in a GIS environment allows patterns of distribution to be interrogated with questions such as: Does the distribution relate to geology? landuse? attitudes? etc.

There are difficulties with the procedure which would make it unsuitable for some weeds or certain conditions. These include:

- Only large clumps of flowering plants could be seen. Thus the method is only suitable for large showy species which are in flower.
- Weeds under thick tree cover could not be discerned.
- Ensuring the area is sufficiently covered from two directions by the oblique air photos. Insufficient coverage can lead to wrong interpretations.
- Registering vertical air photos. Because of the edge distortions of air photographs they are difficult to register to the AMG map base. It is essential to have other map derived topographical data in the GIS to improve the accuracy of recording. Data required include roads, tracks, streams, contours and, preferably, fence lines because weed infestation is often associated with properties.
- Relating oblique photos to vertical or plan view photos requires practice and some perseverance.

While these short comings are acknowledged, it is clear that for mapping large areas the method has many advantages. The procedure is simple in concept and very efficient in terms of the time and energy required to map large areas. It provides an accurate digital base map of the infestations that can be easily extended or modified as more data is gathered.

The procedure does not replace ground inspections or mapping but rather provides another tool for the management of weeds. The simplicity and relatively low technological requirements means that the method is available and useable at a regional level—where the weeds are!

ACKNOWLEDGMENTS

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