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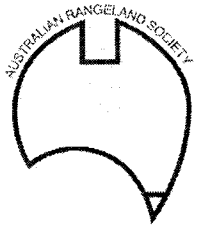

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RAPID MOBILE DATA COLLECTION – A TECHNIQUE TO MONITOR RANGELAND CONDITION AND PROVIDE QUANTITATIVE AND INTERPRETIVE INFORMATION FOR A RANGE OF APPLICATIONS

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ABSTRACT

Rapid Mobile Data Collection (RMDC) is an innovative technique that enables a large amount of data to be collected over extensive areas in near-real time. These data have a wide range of applications: (a) independent assessment of rangeland condition; (b) calibration and validation of remote sensing indices of woody vegetation and ground cover; (c) parameterization, calibration and validation of biophysical models, e.g. AussieGRASS; (d) interpretation of both remote sensing and model outputs; and (e) attribution of management and climate impacts on resource condition. Repeat visits provide an indication of trends in condition. This method is flexible and is easily modified and adapted to record additional attributes of interest. It may be applied or integrated at a range of scales from moderate resolution satellite imagery such as MODIS to property, shire, catchment or bioregion scale assessment.

INTRODUCTION

Rangelands cover approximately 75% of the Australian continent and monitoring this vast area is difficult and expensive. Integration of a range of tools and techniques is required to provide the most reliable information on spatial and temporal variability and impact of management and natural factors in these complex ecosystems. A mobile data collection technique was first developed in Queensland in 1993 to address the need to monitor impacts of drought in extensive grazing lands (Hassett *et al.* 2000). Developments including improved software and modifications to data recording and processing have enabled this technique to be applied to several large scale data collection/monitoring projects, including AussieGRASS and ACRIS. In response to policy and resource management issues, significant additional expansion and development has been introduced since 2002 to extend the range of attributes collected and enable a four-fold increase in volume of data collected. This has resulted in the near-real time generation of large datasets containing both quantitative and qualitative environmental data and allowed spatial and temporal analysis of individual attributes and interpretation of overall condition. A large range of current and emerging applications can now be supported by data not previously available. A combination of this Rapid Mobile Data Collection (RMDC) technique with site sampling, remote sensing and modelling, provides greater confidence and accuracy and a more complete picture of rangeland condition to support policy development and rangeland management decisions.

METHODS

The RMDC technique collects a very high volume and frequency of point data along essentially a very long transect. RMDC is based around a vehicle mounted GPS (with external antenna) connected via a data cable and power harness to a vehicle mounted (or supported by passenger) laptop running locally developed, user configurable software. Geo-rectified imagery such as satellite, topographic, road maps etc. are displayed on screen providing continuous position updates, on screen navigation and the display of logged data as

points. The data logging software is user configurable by creation of simple user defined 'Configuration' files. These text files are read by the software and determine how and what the keyboard "Function keys" will record when activated. Configuration files are easily modified as required and separate files may be created for different applications. Data is able to be recorded in either alpha-numeric, numeric or list format. For maximum speed and efficiency of data entry, numeric input has been found to be the most appropriate. Numeric codes, either new or from existing databases are assigned to biophysical attributes or features being recorded e.g. plant species codes. Data is recorded whilst mobile via direct keyboard input or a programmable numeric keypad. Data logged into the software is recorded as ASCII files and include geographic information, GPS status and accuracy information, configuration file information and the recorded data.

A typical 'Land and Resource Condition' field trip will return >50,000 data points, each containing an average of 4 attributes, across >10,000 km in 14 to 21 days. Data is collected across as many trafficable roads and tracks in Shires, bioregions or catchments, at a rate of between 3 and 5 data points/kilometre (each containing 4 attributes) depending on terrain. At property scale and slower speeds, a higher frequency is possible. The field of view varies between land types, being shorter in undulating country compared with open, flat grassland communities and observations are always made beyond road verges and fence lines when present. Priority is given to surveying minor and local roads and tracks, which are often unfenced. The extent to which the RMDC method has been used throughout Australian rangelands is shown in Figure 1. The data collected by the Climate Impacts and Natural Resource Systems group (excluding the Statewide Landcover and Trees Study project) using this technique, currently stands at more than 960,000 data points, each with multiple attributes.

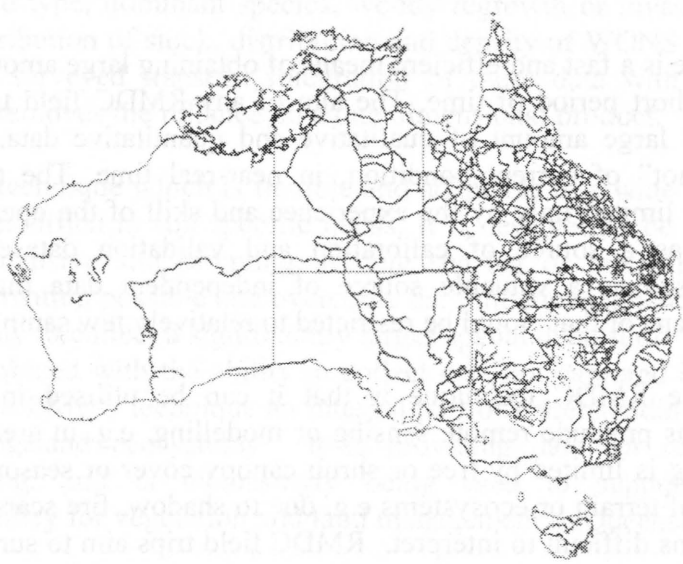

Figure 1: Coverage of RMDC field trips to 2005

Attributes currently recorded are shown in Table 1. Attributes shown may contain up to 10 variables and generate unique datasets for modelling or mapping. Attributes are not restricted to those in Table 1 and the method is applicable to recording or monitoring any characteristic of interest at various scales, levels of detail or complexity.

Calibration of quantifiable data is undertaken on a daily or as required basis at Rapid Assessment Sites (RAS) using a range of techniques for attributes such as pasture biomass, tree basal area and ground cover. Landscape, surface characteristics, flora species and

photographs are also recorded at these sites. When undertaken frequently and intensively, it is possible to maintain regressions between estimated and measured data with correlations (r^2) of greater than 0.9 using simple linear regression.

Table 1: Attributes currently collected using RMDC techniques

Pasture Attributes	Vegetation/Biodiversity Indicators	Land/Resource Condition
▪ % Green ▪ Total standing dry matter kg/ha ▪ Utilisation (% of TSDM utilised) ▪ Dominant Genus or species ▪ % Cover and type	▪ Weeds of National Significance (WONS)(incl. Spp, Density and flowering state) ▪ Woody weeds and increaser spp ▪ Clearing types ▪ Regrowth types ▪ Tree Basal Area (TBA) ▪ Foliage Projective Cover (FPC) ▪ Cropping practices ▪ Termite density	▪ Degraded area characteristics ▪ Stream health ▪ Herbivores and feral spp ▪ Fire characteristics ▪ General soil colour

Following each field trip, daily log files are "cleaned" to remove erroneous data. An ASCII file of the total dataset may be used as an input for modelling. A program reads user defined configuration input and output files and generates a point based shapefile. From this shapefile, a range of "Condition" maps may be created. Statistical analysis by Shire, bioregion, catchment or Interim Biogeographic Regionalisation of Australia (IBRA) region may be conducted within a GIS and repeat trips enable trend monitoring.

DISCUSSION

The RMDC technique is a fast and efficient means of obtaining large amounts of ground-truth data in a relatively short period of time. The aim of any RMDC field trip is to intensively survey and collect a large amount of qualitative and quantitative data, across large areas capturing a "snap-shot" of current condition, in near-real time. The technique has wide ranging applications, limited only by the experience and skill of the operator. In addition to the initial purpose as a source of calibration and validation datasets, it is becoming increasingly recognised as a valuable source of independent data that either cannot be captured by other means or that would be restricted to relatively few sampling sites.

An advantage of the RMDC technique is that it can be utilised in areas even where operational limitations preclude remote sensing or modelling, e.g. in areas or at times when use of remote sensing is limited by tree or shrub canopy cover or seasonal cloud cover and where complexities of terrain or ecosystems e.g. due to shadow, fire scars, topography, make imagery or simulations difficult to interpret. RMDC field trips aim to survey as large an area as possible within the target region and record points at a very high frequency. Although the mobile survey is taken along roads or tracks, the field of view is generally similar to or greater than the distance at which site measurements are taken in intensively sampled plots, which are often restricted by access practicalities to within 500 m from roads.

RMDC cannot provide the full spatial coverage of remote sensing or the long time-series possible through modeling but the datasets contribute to greater confidence and accuracy in remote sensing and modeling products. Broad scale validation of these products is enhanced by utilising tens of thousands of data points covering the range of natural variability in complex ecosystems rather than a "representative" sample of sites or often a small sub-sample

of original calibration data. RMDC also aids the interpretation of products and more informed "inferences" to be made and generally provides a reality check. RMDC supports identification of complexities and possible anomalies in remote sensing or modeling products. For example, groundcover indices may identify areas of high and increasing cover (a positive characteristic) which in reality may be comprised of undesirable species, WONS, detached litter etc. (a negative characteristic). Thus interpretation of whether an area of high ground cover detected using satellite imagery is actually in "good" condition is helped by the additional data provided by RMDC. This information is critical to land management decisions. Any physical characteristic that may be identified and/or quantified whilst mobile may be recorded for validation or interpretation of existing mapped products or for new products, e.g. a prototype national termite density map has been produced.

Each attribute (such as pasture condition, WONS, degraded areas) containing several variables generates a unique dataset or layer. The high frequency of data recorded allows a user to "drill" down through each layer, building not only a picture of condition at a given point but providing information on possible causes of that condition. Interpretation or inferences about land condition based on a single layer of data has little confidence. For example, a single RMDC layer showing a low pasture biomass at a given point indicates little about the condition of the resource. However, if drilling through the available layers of data also indicated high utilisation, the available biomass was green, the species was *Bothriochloa pertusa*, the % cover was low, there were large numbers of domestic stock present, WONS were present, there were areas of gully erosion and scalding, understorey regrowth or invasive species were present, tree basal area was low and soils were favourable, a view on the contribution of management and climate factors can be formed. Change in biomass, utilisation, cover and type, dominant species, woody regrowth or invasion, type and size of degraded areas, distribution of stock, distribution and density of WONS etc. are all able to be analysed along the surveyed transect. Integration of these data with remote sensing and modelling products removes the reliance on a one dimensional product.

Hence, RMDC is a technique which is flexible and adaptable to a wide range of applications and may be easily modified to suit specific needs. It is designed to be integrated with other methods such as intensive site sampling, remote sensing or modelling to provide more comprehensive information possible and overcome the limitations inherent in any one method or product. The ability to collect a significantly larger spatial dataset of "actual" data than site sampling alone, combined with the ability to collect data not captured by remote sensing or modelling, makes the RMDC technique an integral part of understanding and monitoring the complexities of rangeland ecosystems. It is providing data for research projects and rangeland monitoring, and is increasingly being used to support development and implementation of policy for vegetation and land management in Queensland.

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