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Welcome from Editor

It is my pleasure to bring to you the compiled papers from the Science Day of the AFAC and Bushfire CRC Annual Conference, held in the Sydney Convention Centre on the 1st of September 2011.

These papers were anonymously referred. I would like to express my gratitude to all the referees who agreed to take on this task diligently. I would also like to extend my gratitude to all those involved in the organising, and conducting of the Science Day.

The range of papers spans many different disciplines, and really reflects the breadth of the work being undertaken, The Science Day ran four steams covering Fire behaviour and weather; Operations; Land Management and Social Science. Not all papers presented are included in these proceedings as some authors opted to not supply full papers.

The full presentations from the Science Day and the posters from the Bushfire CRC are available on the Bushfire CRC website www.bushfirecrc.com.

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Developing an operational grassland curing system

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Abstract

The extent of grassland curing, the percentage of cured or dead material in a grassland fuel mixture, has a major effect on the Fire Danger Rating system used in Victoria.

The Grassland Curing and Fire Danger Rating (GCFDR) project was created after the 2009 Victorian Bushfires Royal Commission to obtain more accurate grassland curing information for increased accuracy of fire danger ratings. Fire danger ratings are no longer only a tool for fire managers to predict fire behaviour, but also a fire threat prediction tool for preparing the community. Obtaining accurate information about grassland conditions across Victoria is complex and difficult. Using the latest research, the project aims to achieve best practice in collecting, analysing and representing data from variable sources such as visual observations, remote sensing techniques and geo-referenced photos. Grassland observational data will be combined with the latest spatial techniques and satellite data to develop a prototype system tested and implemented over the next three years. The system will eventually be automated and will represent current and accurate data at a detailed scale for the advancement of fire danger forecasting and for information to fire agencies and the community.

Background

Current Victorian System

The fire danger rating (FDR) system is a prediction of fire behaviour which includes how hard it would be to put out a fire once it starts (Cheney and Sullivan, 2008). The degree of grassland curing is used as an input into the grassland fire danger index (GFDI) and fire spread prediction component of the FDR system. Currently the Country Fire Authority (CFA) of Victoria is heavily reliant on the grassland curing observation network to provide curing information across the state. Each Sunday in the fire danger period, the ground observers in the observation network report to CFA headquarters on the state of grassland condition in their area. Headquarters staff then collate this data and validate it with district operational staff. The curing data is used to produce a statewide map which is distributed to the Bureau of Meteorology (BoM) for use as a data layer to produce a spatial map of grassland fire danger across the state. The BoM uses a combination of the grassland fire danger ratings, the forest fire danger ratings and weather predictions to issue fire weather warnings to the general public and for the Victorian fire agencies to determine the need for “Total Fire Bans”.

CFA commenced monitoring grassland pasture and crop dryness via remote sensing from the 1987-1988 fire season (Garvey, 1988), utilising the United States National Oceanic and Atmospheric Administration’s (NOAA) Advanced Very High Resolution Radiometer (AVHRR) satellite data to produce colour graduated maps that show the stages of grassland curing (Barber, 1990). However, there are issues with accuracy and cloud interference and, over time, the satellite data product was replaced by ground-based human assessments alone. The satellite data map continues to be produced, and is displayed on the BoM’s registered users website, but is not used in any public warnings or operational decision making.

The current ground observation data collection process is very time consuming and labour intensive to produce a state wide map of grassland curing condition. The objective of the GCFDR project is to create an automated grassland curing estimation system for improved fire weather forecasting and FDRs. The system will produce a map of grassland curing and later include other aspects of grassland condition such as fuel continuity and fuel load.

Methodology

Visual observations

The accuracy of grassland curing data in Victoria is limited, as it is currently based solely on visual observations. Problems with visual observations include: the geographic coverage, the sparsity of the observation network, experience and/or training of observers and the subjectiveness of visual observations in general (Andrews et al, 2006). Recent studies show that visual observations are more subjective and more variable than any other technique, in the order of +/-25% (Newnham et al, 2011). However, Cheney and Sullivan (2008) argue that with practice, it is possible to make a reasonable visual estimate of curing on a local scale.

CFA acknowledges that there are other techniques for measuring curing, such as the modified levy rod and weighted plate; however one significant limitation is that these techniques are time consuming. CFA needs to be very conscious of the expectations placed

on its volunteer ground observers. The project has determined that, for the initial project phases, the time taken versus the benefit of the various techniques means that visual observations are the preferred option. Comparison of the ground observation results with ongoing field validation from destructive sampling will provide more data on the accuracy and appropriateness of this method.

The project will also conduct a statistical analysis on the distribution and optimal number of observations needed to produce acceptable results. More observers will be recruited and inducted into the network. Trained observers will also be able to assist the CFA with additional information on grassland condition by assisting in measuring other aspects, such as identifying species composition, taking destructive sampling to authenticate results and determining fuel condition and distribution. The additional grassland curing information is an important consideration when looking at fire behaviour, and cannot be collected solely via remote sensing techniques.

Destructive sampling techniques

Destructive sampling is where grass is cut from the source, dried and weighed, to determine various measurements such as fuel moisture content and grassland curing percentage. It is widely known to be the most accurate way to determine grassland curing, however results cannot be determined for at least 24 hours making this method impractical operationally. During the development phase of the project, destructive sampling will be conducted to compare the accuracy of visual observations and satellite results.

Training

Prior to the GCFDR project, observers were provided with the Grassland Curing photo guide booklet (Garvey and Millie, 2000) but no further formal training. The project determined that more comprehensive training of observers was required, especially since a memorandum of understanding was signed with the BoM that fuel load data would be collected by observers in addition to observations on percentage of cured grasslands. During the 2010-2011 fire season a DVD titled “Visually Measuring Grassland Curing” (Country Fire Authority Grassland Curing and Fire Danger Rating Project, 2010) was produced to assist observers in determining curing. The DVD runs for about 6 minutes and is intended to increase accuracy and consistency in visual curing measurement, by distinguishing grass colour and seed head development in relation to percentage cured vegetation.

A CFA grassland observer competency training package is under development for rollout prior to the 2011-2012 fire season. Included in the competency is a new field card for collecting both visual curing and fuel load data. The competency will be used to train observers in using the field card to accurately measure these parameters in the field. Fuel load data requires height and percent cover of the grass to be measured, raising the number of field observation parameters collected from one to three. Observers will also be informed about the use of satellite data and taught to take consistent and repeatable measurements that can be used to directly compare the satellite and ground data.

Further guides or DVDs may also be developed to assist observers to make accurate measurements. Photo books showing grass at different stages of curing and fuel loads, or

guides for using digital cameras or other field tools may also be developed. Data collection via the internet is being considered.

Satellite imagery and remote sensing techniques

Satellite imagery can provide a synoptic landscape scale analysis of the grassland curing state. MODerate resolution Imaging Spectroradiometer (MODIS) satellite data has been received and processed for many years in Australia yet has only recently been processed in real time by the BoM (Newnham et al, 2011). The MODIS satellite is similar in design to the AVHRR with many more spectral bands. The Bushfire CRC research project "Improved methods for assessment and prediction of grassland curing" (Newnham et al, 2011) looked into the technical aspects of MODIS and investigated four different models for determining curing in the Australian landscape. Over the 2009-2010 fire season, CFA and other fire agencies participated in a trial of these models to compare against current operational processes. The project recommended that fire agencies use MODIS satellite data to map curing due to the performance benefit of this method over field techniques (Newnham et al, 2011).

The results of the MODIS trial were very promising, and MODIS data will be a component of the overall grassland curing methodology in Victoria. The project also requires the collation of other grassland parameters which need to occur through an observation network, and these cannot be obtained through remote sensing methods. The project will develop a methodology to amalgamate these data sources.

Spatial representation and automation of system

The amalgamated data will be available as a spatial dataset which will be compatible with BoM forecasting tools and fire behaviour models. An interactive map is also planned to produce the data overlayed in Google Earth® with geo-referenced photos. In the future, ground observers may directly compare their observation data and photos with other observers' data state-wide via an online grassland curing website. The direct comparison method is intended to lead to greater observation accuracy and consistency.

The system will be automated by the end of the project. Automation will not directly improve the accuracy of the system, but it will dramatically reduce the amount of manpower required to collect and collate current data.

Results

The project has completed the first of four phases. During phase one, the project delivered the first instalment of training to volunteers, via DVD development. A new spatial product was also developed in 2010-2011 using GIS analysis, which is compatible with the BoM forecasting tools and fire behaviour models. In future, the project will commence integrating data sources and developing a prototype system which will be trialled and tested over the next three years. A curing competency will be created and delivered to ensure that all observers produce accurate and consistent results.

The current GFDI uses percent cured of grass and fuel quantity. The future fire danger index will use a combination of satellite and ground information to categorise potential fire behaviour and impact in landscape grassland fuels for the purpose of issuing warnings, determining suppression difficulty and potential fire damage. The work will result in developing scalable fire behaviour prediction systems, which categorise expected fire behaviour for major grassland fuel types.

The outputs from the improved grassland curing assessment system will be useful in the declaration of Total Fire Bans, determination of fire suppression difficulty, fire preparedness and community warning, and operational guidance on a district scale.

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