FIREBASE : A Computer System for Storing, Retrieving and Manipulating Forest Wildfire Data.

P.H. Walsh and N.D. Burrows

Department of Conservation and Land Management,

Manjimup Research Centre, Manjimup, W.A., 6358.

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Summary

Each year, about 250 wildfires break out in the forests of south-west Western Australia. Detailed wildfire records have been kept in written report form since the early part of this century. Over the years, the accumulated information has presented storage problems and is difficult to access for statistical analyses or for general information useful in fire control planning. A computer system has been developed which allows wildfire data to be entered at District Office terminals. Data are stored on a central computer and are readily retrievable and accessable for statistical analysis by planners, researchers and managers.

1. Introduction

Protection of the forest estate from destructive wildfires is a key management activity of the Western Australian Department of Conservation and Land Management. It is well known that forest production and conservation values can be diminished by severe wildfires (Peet and Williamson 1968, Atkinson 1984, Bennett, 1984, Cheney 1976, Underwood et

al. 1985, Loane and Gould 1986). Perhaps more importantly, wildfires have caused considerable social disruption and trauma.

In the forest areas of Western Australia, fuel reduction burning, together with efficient fire detection and suppression systems have contributed enormously to reducing the impact of wildfires (Underwood et al. 1985).

Monitoring the effectiveness of management strategies to achieve objectives is an important management function. Fire managers who aim to ultimately prevent or minimise the undesirable effects of wildfires should, therefore, be monitoring their actions in this regard. An accurate record of relevant wildfire data is necessary to monitor wildfire prevention programmes. Such a data base is also important when deciding on future fire management strategies. Historical information such as wildfire occurrence (spacially and temporally) cause, size, intensity, cost and mode of suppression can provide a valuable insight to the success or otherwise of past fire management and can provide the basis for future fire management.

In the south west of Western Australia, wildfire information has been compiled in the form of written reports or recorded on proformas. Each year, the W.A. Department of Conservation and Land Management (CALM) attends around 250 wildfires in forest areas (see Figure 1). Since records have been kept this has resulted in voluminous hand written reports. Even though these reports are now stored on micro-fische, this system has drawbacks. In this form, wildfire

information is not only cumbersome to store and retrieve, but does not lend itself to easy data analysis. As a consequence, it is not readily accessible to land and fire managers.

FIGURE 1 HERE

Today, all Forest District Offices have direct terminal access to the Departmental mainframe computer via an extensive telecommunications network. The current trend is to incorporate the use of IBM XT compatible computers to provide local processing capabilities. It is important that fire management personnel at this level may access and use many years of wildfire data for a range of purposes. These include:

- Preparing annual fire reports and summaries.
- Preparing any wildfire statistics for any time period.
- Identifying localities of high wildfire risk based on historical wildfire outbreaks.
- Generating probabilities of wildfire occurrence (time of year) and frequency.
- Determining the spacial and temporal distribution of wildfires by cause, intensity and size.
- Searching for trends in wildfire occurrence, cause, frequency, size etc.

- Assessing the effectiveness of wildfire control measures such as fuel reduction burning, detection and suppression.
- Preparation of statistics dealing with costs due to wildfires, measured both in terms of dollars and damage to vegetation.
- Preparation of land and fire management plans.
- Validating wildfire behaviour and suppression models.

This paper outlines the processes involved in the development of FIREBASE, a computer based wildfire information storage and retrieval system.

2. Developing FIREBASE

Initially, we developed FIREBASE to reside on the Department's mainframe, a Perkin Elmer 3240. This was the only computer system available at the time and complied with the Department's policy on corporate data bases. FIREBASE Version 1 was completed early in 1985. Features of this version were:

i. mainframe environment,

ii. Fortran VII programming,

iii. 80 fire variables (including detailed information about fire size, locality, cause, detection method, suppression action, fire behaviour, costs) plus 30 weather variables.

iv. Three user modes; data input, generation of fire reports, annual summary of wildfires.

However, the main limitations of this version, which led to the development of Version 2, where:

i. lack of a true relational database structure,

ii. too many variables for practical application,

iii. high maintenance requirement,

iv. scrolling screen displays.

Although desirable, collecting 80 wildfire attributes was impractical, so we decided to reduce the amount of information which needed to be entered into the data base and transported the system to a micro computer environment for further development. The Olivetti M24 micro computer was easier and faster to program and provided greater flexibility in database structure and management. Version 2 was completed early in 1987. Features of Version 2 included:

i. IBM PC,XT or AT compatible,

ii. DBASE III+ database fire structure,

iii. CLIPPER compiled DBASE III+ programming,

iv. reduced to 49 variables and a single database structure,

v. static screen displays,

vi. greater user friendliness,

vii. seven user modes; data input, data maintenance, wildfire reports, annual wildfire summaries, number of wildfires

attended, map grid reference wildfire search, ad hoc database interrogation.

Although this version was an improvement on version 1, there were several limitations:

i. poor display of variable codes,
ii. inadequate user help system,
iii. additional variables required,
iv. additional/updated enquiry modes required,
v. adhoc Requests required the use of Dbase III software to function.

For these reasons Version 3 was developed in early 1988 and is now the system currently in use. This version resembles a commercial system in portability and flexibility under different computing and enviromental conditions. The features of Version 3 include:

i. 52 variables,
ii. online context sensitive help,
iii. code list modification,
iv. fully independant of Dbase III software,
v. 9 user modes; data input/maintanance, wilfire reports, annual wildfire summaries, summary of causual agents, number of wildfires attended, map grid reference search, code list modification, system default modification, adhoc database interrogation.

Although modifications may be necessary in the future, Version 3 is seen as the finished product in the development of FIREBASE in the short term.

3. Selection of database variables

The database variables for FIREBASE Version 1 were selected according to the needs of both operations and research staff. This proved far too extensive to be applied on a practical basis. After consultation with fire researchers and fire managers, we decided on the data base variables for Version 2. This dataset lends itself to the minimal research requirements for updating fire behaviour and suppression models and provides a strong database for monitoring fire management and preparing wildfire statistics. The additional variables for Version 3 are internal to the system and have little effect on the end user.

This database is currently in use for wildfires on land controlled by the Department of CALM. All historical wildfire data are being collected and adapted for downloading into the system. Appendix A contains the database variable list and structure.

4. Report Forms

For output there are five basic report forms provided by the system;

i. "Wilfire Reports" lists all database variables for a single fire.

ii. "Annual Summary of Fires" lists the detection date, map reference, tenure at origin, cause and a breakdown of the area burnt by tenure for all wildfires in a given fire season.

iii. "Summary of Causual Agents" provides the number and percentage of fires, area burnt, and total cost for fires in each cause category over a given period.

iv. Summary of Wilfires Attended" lists the number of fires and area burnt in the current year and number and area burnt over the previous five years for any given year.

v. "Map Grid Reference Search" provides the district, season, serial number, map reference, detection date, cause and area burnt for all fires within an area specified by two map grid references.

5. Adhoc Requests - a FIREBASE utility

The power of FIREBASE as an interactive tool becomes very apparent with the addition of the Adhoc Requests program module. This is a standalone utility which allows the user to sum, average or count database variables for any defined condition. All that is required is a good knowledge of logical operators (and,or) and relational operators

(<,>,>= etc.) and how to group them by parenthisese if required. In this way the user may ask such questions as: "What area of state hardwood forest was burnt by lightning caused fires between 1960 and 1985?". To calculate this manually would normally require many hours of tedious work which would probably need validating. Provided the question is posted with the correct logic, the answer to such a request is now available within seconds.

As well as providing answers to single questions, Adhoc Requests may also be used to compile non-standard report forms if required.

Conclusion

In many respects, FIREBASE can be used in a similar way in which safety statistics are used. Part of CALM's safety programme includes reporting and recording all accidents, including low severity accidents and near misses. By analysing safety statistics we are able to adjust and fine tune our safety programme accordingly and to evaluate our success. Making reports and statistics available to all CALM employees not only promotes an awareness of safety, but also enables everyone to evaluate their performance and contribution to the "team" effort. Making such information readily available (as is the case with the safety programme) also helps prevent repetition of hazardous situations or actions.

Fire managers are expected to do more with dwindling resources. The need to optimise expenditure of fire management dollars is very real. FIREBASE can be used to identify high wildfire risk areas, evaluate the success or otherwise of wildfire prevention programmes and to highlight areas most requiring wildfire prevention expenditure.

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APPENDIX A

VARIABLE LIST

VARIABLE	DESCRIPTION	TYPE	WIDTH	DEC.
DISTRICT	District	N	2	
SEASON	Season	N	2	
SERIAL_NO	Serial number	N	2	
D_DATE	Detection date	D	8	
D_TIME	Detection time	N	4	
A_DATE	Attack date	D	8	
A_TIME	Attack time	N	4	
S_DATE	Date running fire stopped	D	8	
S_TIME	Time running fire stopped	N	4	
REPORT	Report method	N	1	
CAUSE	Cause	N	2	
ORGANSTN	Organisation	N	1	
QUARANTINE	Quarantine (Y/N)	C	1	
FDI_1	Fire danger index - day 1	N	4	
HFROS_1	Head fire rate of spread - day 1	N	5	
FUEL_1	Dominant fuel type - day 1	N	2	
FDI_2	Fire danger index - day 2	N	4	
HFROS_2	Head fire rate of spread - day 2	N	5	
FUEL_2	Dominant fuel type - day 2	N	2	
FDI_3	Fire danger index - day 3	N	4	
HFROS_3	Head fire rate of spread - day 3	N	5	
FUEL_3	Dominant fuel type - day 3	N	2	
MAP_REF_1	CALM map grid reference - northings	C	2	
MAP_REF_2	CALM map grid reference - eastings	N	3	
MAP_REF_3	CALM map grid reference - grid coords.	N	2	
TENURE	Land tenure at origin of fire	N	1	
SFH_AREA	Area burnt - state forest hardwood	N	9	3
SFS_AREA	Area burnt - state forest softwood	N	9	3
NP_AREA	Area burnt - national parks	N	9	3
NR_AREA	Area burnt - nature reserves	N	9	3
OCL_AREA	Area burnt - other crown land	N	9	3
PP_AREA	Area burnt - private property	N	9	3
TOTAL_AREA	Total area burnt	N	9	3
OFFICERS	Number of officers attending fire	N	3	
WAGE_EMP	Number of wage employees at fire	N	3	
PUMPERS	Number of pumpers at fire	N	2	
DOZERS	Number of dozers etc. at fire	N	2	
VOLUNTEERS	Number of volunteers at fire	N	3	
LOC_WAGES	Cost - wages in local district	N	9	2
LOC_PLANT	Cost - plant in local district	N	9	2
OTH_WAGES	Cost - wages from other districts	N	9	2
OTH_PLANT	Cost - plant from other districts	N	9	2
TOTAL_COST	Total cost	N	9	2

APPENDIX A cont.

VARIABLE LIST

VARIABLE	DESCRIPTION	TYPE	WIDTH	DEC.
LIT_AREA	Light damage - area burnt	N	8	3
LIT_VT	Light damage - dominant veg. type	N	2	
LIT_TENURE	Light damage - land tenure	N	1	
MOD_AREA	Moderate damage - area burnt	N	8	3
MOD_VT	Moderate damage - dominant veg. type	N	2	
MOD_TENURE	Moderate damage - land tenure	N	1	
SEV_AREA	Severe damage - area burnt	N	8	3
SEV_VT	Severe damage - dominant veg. type	N	2	
SEV_TENURE	Severe damage - land tenure	N	1	
OP_INITIALS	Operators initials	C	3	
REMARKS	Remarks	M	10	
	Total bytes per record		256	

Legend to type codes:

N Numerical
D Date
C Character
M Memo record