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THE MAPPING OF BURNED AREA IN FOREST BY IMAGE-100 SYSTEM

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16.Summary/Notes

Multi-date LANDSAT data were used to estimate the forest fire burned area using Image-100 system. The fire boundary was satisfactorily delineated and a 87.10% area estimation accuracy was achieved. This accuracy is considered very high owing to the relatively small area (≅ 100 ha.) that was mapped. The results of this study indicate that Image-100 has the capability of determining the areal extent of forest fire damage accurately and rapidly for foresters' policy and decision making.

17.Remarks *This paper was presented to the UN Regional Seminar on the use of Satellite Technology for disaster application in São José dos Campos, SP, Brazil, October 2 ~ 13 1978.*

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LIST OF FIGURES

1. INTRODUCTION

Accurate and timely information concerning forest fire boundary delineation and acreage estimation, play an important role to foresters in calculating timber volume losses and planning regeneration program. However, the time lapse between start and finish of fire damage assessment, using conventional methods, have the difficulties of collating and collecting data in a single time frame; even aerial survey has the restrictions of cost and time. To meet the increasing need of less expensive and faster data acquisition for forest management, the automatic processing of LANDSAT is the most promising alternative due to its data handling speed and versatility of both analysis and display capability. One of the feasibility studies of burned area mapping using LANDSAT (ERTS-1) data was carried out by Lauer et al. (2), who indicated that a 10:1 cost advantage was obtained by visual interpretation of satellite data over conventional methods. Seevers et al. (3) also reported range fire mapping using ERTS-1 channel 7 imagery. Computer-aided analysis was used with certain success by Hitchcock et al. (1) and Wilson et al. (5).

The objective of this current study is to test the capability of Image-100 system for forest fire mapping.

2. MATERIAL AND METHODS

2.1 - STUDY AREA

The Campininha pine experiment station of the Forestry Institute of São Paulo State (IFSP) is located in Mogi-Guaçu, northwest of São Paulo State. This plantation was chosen as our study area because a forest fire occurred in November 1973 and destroyed around one hundred hectares of *Pinus elliottii* at the northwest corner. The ground truth data of the fire damage was provided by IFSP.

2.2 - LANDSAT DATA STORAGE AND RETRIEVAL

LANDSAT CCTs of the path number 236, row number 75, on August 18th, 1973 and September 13th, 1975 were used for Image-100 analysis. In order to quick-retrieve the multi-date LANDSAT data for analysis, the CCTs' information were transferred to the disk pack RP-04 which has a higher loading and processing speed. For this transformation the CCTs were read by Image-100 and the correspondent imagery was shown on the image monitor at the scale of approximately 1:700,000. The electronic cursor was then located at the center of our study area and the program "Escala de imagens LANDSAT no I-100" (LANDSAT image scaling of I-100) was called to enlarge the study area to the scale of 1:100,000, which is the most appropriate scale for Image-100 analysis. This enlarged study area was stored in Image-100's memory through the program "INPERTS" and then the stored information was transferred to disk pack RP-04 using the program "video disk save restore". After the LANDSAT data preparation the file names Mogi-73 and MOGI-75 were assigned to the 1973 and 1975 LANDSAT passages respectively.

2.3 - LANDSAT DATA ANALYSIS SYSTEM

The LANDSAT data sets were collected two growing seasons after the forest fire. For meaningful detection of changes in the *Pinus elliottii* (PE) plantation, the same training areas should be used in Image-100 analysis for both passages. The file name Mogi-75 was first retrieved from the disk pack and nine PE training areas of 36 pixels/area were located by the electronic cursor on the image monitor. The total sampled-pixel was equivalent to 3,5% of the study area and their locations were stored in one of the eight themes (theme 8) for further use (Figure 1). The information of the training areas was used for "MAXVER" classification which is based on the decision rule of maximum likelihood. The classified PE was then stored in theme 1 (Figure 2). To substituted the study area of 1975 on the

image monitor, file name Mogi-73 was retrieved and the stored training area locations were also called from theme 8; again "MAXVER" classification was carried out and the result was stored in theme 7. The burned area was then estimated by the difference of pixel sets of classified PE in 1973 to 1975; only those PE-pixels which existed on the 1973 passage but not on the 1975 passage were alarmed (Figure 4). The alarmed area was 107 ha and corresponded to 87.10% (Table 1) of the burned area estimated from the ground truth map.

3. DISCUSSION AND CONCLUSIONS

A burned area of 123 ha in Campininha pine experimental station was tested by Image-100 system for automatic forest fire assessment study. Multidate LANDSAT data of 1973 and 1975 were used for burned area mapping. The approach was based on the difference of the classified PE pixel sets of 1973 and 1975. The high classification accuracy of *Pinus elliottii* from other pine species (4) ensured that the satisfactory result of burned area estimation which was found equivalent to 87.10% of the damage estimated by ground-crew mappers. Comparing Figure 2 and Figure 3 some "increased" Image-100 recognizable PE pixels were noted and this area could be estimated by calculating the difference of the classified PE pixel sets of *1975* and *1973*. The results are very encouraging, considering the relatively small area that was mapped and the two growth seasons between the multi-date LANDSAT data that were used. This study shows that the information on the burned area and boundary delimitation can be provided by Image-100 analysis for forest management policy and decision making.

Fig. 1 - Locations of P. elliottii training area (imagery of 1975)

Fig. 2 - Classified P. elliottii in 1973

Fig. 3 - Classified P. elliottii in 1975

Fig. 4 - Image-100 classified "burned area" by the forest fire of November 1973.

TABLE 1

COMPARISON OF IMAGE-100 ESTIMATED P. ELLIOTTII AREA AND GROUND TRUTH

CLASS	AREA (ha)		R.V.†
	IMAGE-100	GROUND TRUTH	
PE 73	1388.10	1486.72	93.37%
PE 75	1319.80	1363.72	96.78%
BURNED AREA	107.10*	123.00	87.10%

* Calculated by the difference of the classified PE-pixel sets of 73 and 75

† Recognition value = $\frac{\text{Image-100 estimated area - Ground truth area}}{\text{ground truth area}} \times 100$

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