WILD AREAS MONITORING USING LANDSAT DATA

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Comission VII

1. INTRODUCTION

The "Instituto Florestal", organism hold by the Natural Resources Research Coordinating of Secretary of Agriculture and Supply of São Paulo State, is responsible for the state forest policy, according to the following basic guidings: a) studies and researches related to forest resources; b) forest resources conservation, and c) rational exploitation of forest resources.

In the context of natural forest resources, the Instituto Florestal maintains under its administration 12 Parks, 20 Reserves and 2 Ecologic Stations, totalizing an area of 700,000 ha, approximately 3.00% of São Paulo State.

One of the greatest problems in preservating these areas, especially of large extension, consists on the degradation of their vegetation cover, due to extrativism activities (charcoal, firewood, palm cabbage), followed by a nomad and routine agriculture, the most common practice utilized by the invaders of public lands.

This study developed at the Jacupiranga State Park, was made with the objective to establish methodology for utilizing LANDSAT multispectral imagery to wild areas protection and preservation, whose technology according to CONITZ & LOWE (1977), can provide various levels of information needed for assessing monitoring or extracting resources.

2. LITERATURE REVIEW

Since the ERTS (Earth Resources Technology Satellite) launching by NASA in 1973, several researches have been developed by using remotely sensed data to solve problems related to natural resources preservation. However, to VINOGRADOV (1977), the most feasible, although the least developed direction in remote ecological botany is observation of the condition of vegetation and the monitoring of the environment.

According to BENTON et alii (1976), one of avowed purposes of remote sensing is to provide a quick and easy method of detecting, identifying, quantifying or monitoring a particular phenomenon, condition or category of object.

Several authors, among them TANAKA et alii (1977), THOMPSON (1977) and MILLER & WILLIAMS (1978), realized that the temporal aspect provided by Landsat data is extremely valid in the vegetation cover monitoring. WILLIAMS et alii (1979), considers that such aspect permits the occupational dynamic analysis of determined area.

However, to WALSH et alii (1982), remote sensing, will not replace the need for ground surveys, but it will increase the efficiency and effectiveness of gathering data for large area inventories and monitoring programs. Moreover, to WEISMILLER (1977), a quantitative evaluation of the change detection procedures developed would require the collection of a comprehensive set of reference data (ground observations and/or aerial photography) coincidint with the Landsat overpass.

HEGYI & QUENET (1981) have been verified that in a large forested area experiencing dynamic changes due to forest clearcutting, the Landsat digital data has been used successfully to monitor the areal distribution of the harvested areas. To GREGORY et alii - (1981) the change detection of clearcut location and acreage can be assessed over time and can be reported, for example, by county, watershed, or subwatershed units, and to WALSH et alii (1982) the Landsat data can be used to inventory regeneration within those clearcut.

3. MATERIAL AND METHODS

3.1. Material

3.1.1. Study area

It was chosen the Jacupiranga State Park, due to its extension, topography, primary vegetation cover, and mainly, to the degradation problems occurence. The Park occupies an area of 150,000 ha and is located in the south of São Paulo territory (FIG. 1).

The climate by Köeppen classification is Cfa, tropical with hot summer, without dry season in winter. The soils are mostly HI + PVL Group, or Hidromorphic soils and Yellow-Red Podzolic intergrade to Yellow-Red Latosol (BRASIL, 1960). The relief, very irregular or mountainous in the most part, was classified by CHIARINI & DONZELLI (1973) as belonging to the class VIII, lands only approppriate to fauna and flora protection or recreation.

The predominant vegetation is tropical forest, constituted physiognomically by well developed individuals, with 30 to 40 m height, very dense and with high number of species (CAMARGO et alii, 1972). Besides, there are areas of "campo natural" (grassland) at the mountain top, whose origin can be due to the influence of soils (BORGONOVI & CHIARINI, 1969 and CHIARINI & SOUZA COELHO, 1969), and/or to the extreme oscilation of temperature (CAMARGO et alii, 1972).

3.1.2. Landsat products

The Landsat multispectral imagery (photographic and digitalized products) are presented at TABLE 1.

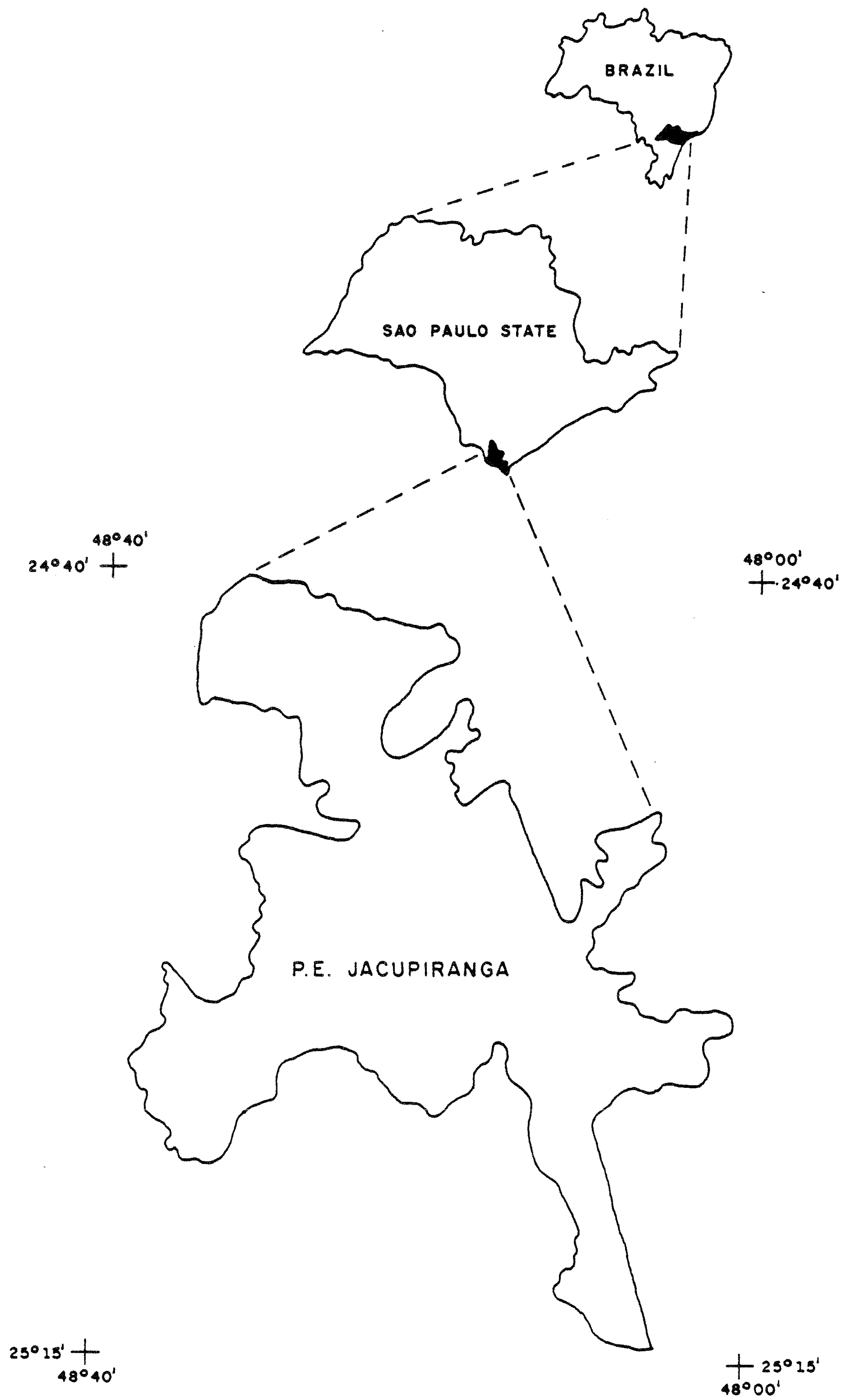

FIGURA 1 - Localization of Jacupiranga State Park

TABLE 1 - Landsat products utilized

PRODUCT	ORBIT/ POINT	DATE	BAND	SCALE
Photographic image	178/20	31.07.73	5 and 7	1:500,000
	178/20	10.05.75	5 and 7	1:500,000
	178/20	15.06.76	5 and 7	1:500,000
	178/20	10.08.78	5 and 7	1:500,000
	178/20	03.06.79	5 and 7	1:500,000
CCT	178/20	31.07.73	4,5,6 e 7	—
	178/20	10.08.78	4,5,6 e 7	—

3.1.3. Photographic and Cartographic documentation

- photoindex at the scale 1:100,000 of 1973 and 1980/81
- panchromatic aerial photography at the scales 1:25,000 and 1:35,000 of 1973 and 1980/81, respectively.
- 8 topographic maps from CPRM (SUDELPA Project) at the scale 1:50,000, of 1974.
- 4 topographic maps from DSGE, at the scale 1:100,000, of 1971.

3.1.4. Interactive Multispectral Image Analysis System (IMAGE - 100)

The automatic treatment of Landsat multispectral imagery was made employing IMAGE-100, that extracts thematic informations and makes salient contrasts among interested targets, through the enhancement technique (GENERAL ELETRIC COMPANY, 1975).

3.2. Methodology

3.2.1. Analysis of Landsat products:

a) Visual analysis - Imagery of bands 5 and 7, at the scale 1:500,000 were compared based on photographic tonality and texture criteria, utilized by SANTOS & AOKI (1980).

b) Automatic analysis - The Single Cell and Maxver algorithm described respectively by CARVALHO (1978) and VELASCO et alii (1978), to obtain spectral signatures based on preestablished training areas were utilized.

3.2.2. Photo interpretation

The aerial photographs analysis of 1981 provided subsides to visual and automatic interpretation of MSS LANDSAT data, constituting of fundamental importance in this study.

3.2.3. Ground observations

Several visits on study area were made in order to confirm the vegetation types, relief, degradated areas, land use, etc., observed in images and in aerial photographs.

4. RESULTS AND DISCUSSION

a) Visual LANDSAT imagery analysis

It was verified that the degradated areas studied on multispectral imagery of 1973 still 1979, present practically identical dimension, probably due to the scale used (1:500,000), which didn't permit distinguish and separate new small clearcuttings. However, it was possible to establish some critical areas of devastation: as along BR-116 road, border of Turvo river, and to northwest and to west of the Park.

b) Automatic CCT analysis

The automatic analysis and the aerial photographs data are presented at table 2 and in the figure 2 shows the map of natural vegetation, deforestation, afforestation and degradated areas obtained from aerial photographs at 1981.

The data obtained by automatic interpretation show that the alterations can be detected, possibiliting the accompaniment of its evolution and/or involution with good accuracy; the afforestation and grassland areas were not identified due to the small size. Hence the importance of aerial photographs and ground observations to obtain a confiable automatic interpretation.

There was a difference between aerial photographs and Landsat imagery analysis, in terms of degradated and forest areas, because the initial regeneration areas were classified as forest in the automatic interpretation. However, the increase of degradated areas in both analysis percenterally was the same.

5. CONCLUSIONS

The Jacupiranga State Park have been experienced 2,845 ha of devastation since 1973 until 1981 due to the invaders and this small deforestation verified can be due to existence of larger devastated areas a long time ago, nearly 22,000 ha detected in 1973 by photointerpretation.

The causes of this devastation can be attributed mainly to the construction of roads, vigilance defficiency and indefinite patrimunial situation.

The detection of small clearcuttings was not possible by visual analysis of Landsat imagery due to its small scale.

The automatic interpretation can be used to identify, quantify and accompany the evolution and/or involution of devastated areas with reazonable accuracy.

TABLE 2 - Aerial photographs and automatic MSS imagery analysis data.

AREA / CATEGORY	BY AERIAL PHOTOGRAPHS ANALYSIS				BY AUTOMATIC MSS IMAGERY ANALYSIS			
	1973		1981		1973		1981	
	ha	%	ha	%	ha	%	ha	%
Natural forest + brushwood	127,181	84.40	124,336	82.68	134,808	89.72	130,896	87.07
Devastated	22,331	14.81	24,675	16.45	13,072	8.70	15,618	10.39
Grassland	1,176	0.79	1,218	0.81	—	—	—	—
Afforestation	—	—	147	0.06	—	—	—	—
Not Classified	—	—	—	—	2,381	1.58	3,811	2.54
TOTAL	150,688	100	150,375	100	150,261	100	150,325	100

Distribution of vegetation types and devastated areas, obtained by photo interpretation.

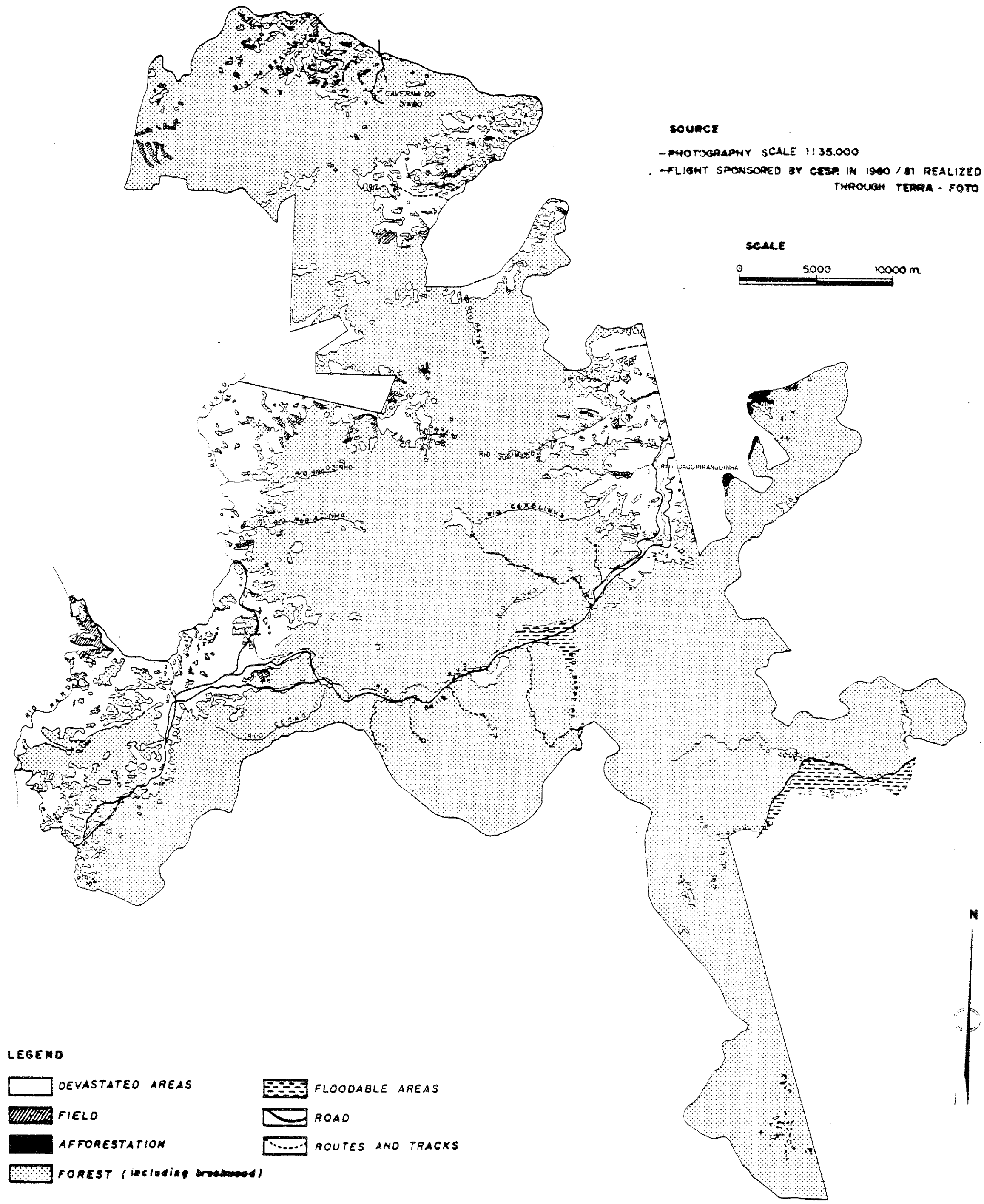

FIGURA 2

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