QUANTITATIVE ANALYSIS OF THE VEGETATION COVER ALTERATION IN THE CAMPOS DO JORDÃO COUNTY.

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Brasil

Comission VII

1. INTRODUCTION

The classification of the vegetation and its subsequent inventary are basic steps towards the management of natural resources. Through the use of topographic maps at scale 1:10000, introduced by the "Plano Cartográfico do Estado de São Paulo", in combination with air photographs, it has proved possible to develop a routine procedure for evaluation of forestry resoruces. This methodology allows the periodic checking of these resources.

This develops the methodology for the application of air photography techniques in combination with maps. It deals with the importance of each forest area for the county of Campos do Jordão. This county was chosen because it showed the greatest occurrence of native forest (52.84%), as well as the greatest afforestation index (11.08%), according to the "Inventário Florestal do Estado de São Paulo - Vale do Paraíba (1983)".

This study analyzes quantitatively the modifications in the vegetation cover and its spatial distribution which took place throughout a 15 year period (1962 to 1977). This will permit the adoption of legal measures aiming at the preservation of the remaining areas.

2. LITERATURE REVIEW

According AOKI et alii (1977) air photography associated with field data is indispensable for obtaining inventaries, since both sources complement each other thus significantly reducing both the time and the cost of the survey.

SPURR (1945, 1946, 1948) showed the utility of air photographs for the management of forests because of the short time needed to obtain an inventary of the natural resources of a country.

The Inventário ... (1983) quantified the areas showing vegetation cover and afforestation in 32 counties in the Vale do Paraiba region. This was based on standards for photographic images.

3. MATERIAL AND METHODS

3.1 Material

The material used consisted of the area of study, air photogrametric material, and equipment.

3.1.1 Area of Study

The county of Campos do Jordão is located within the administrative jurisdiction of São José dos Campos, in the eastern region of the State of São Paulo. The county is located between parallels 22º34'00" and 22º47'40" S, and meridians 45º24'00" and 45º40'30" W. The altitude varies from 1100 m to 2000 m. The climate is classified by Koeppen as cfb, which means sub-tropical mountain climate, mesothermic and humid, without a dry season, and temperature of the hottest month lower than 22ºC. (FIG. 1).

3.1.2 Air Photogrametric Material

The cartographic bases used were maps at scale 1:10000 produced according to U.T.M. projection - Universal Transversa Mercator, with quadrangles at every 1000 meters and contour intervals of 5 meters. Panchromatic vertical air photografies at scales 1:25000 and 1:45000 were used, the former obtained in a flight conducted in 1977.

3.1.3 Equipment

The following equipment was used:

- mirror stereoscope with a magnification of 3 to 8 times.
- simple microscopes
- digitalyzer coupled a microcomputer

3.2 Methods

The methofology used in this study was divided in three parts.

3.2.1 Photointerpretation

The air photographs were studied and the photointerpretation was made with stereoscopes, following the definition based on the structure and appearance of the different kinds of natural vegetation cover already used in a previous survey (SERRA FILHO et alii, 1975). According to this previous survey:

> "Forest
> Definition: vegetation consisting fully of trees, of complex structure, showing a great diversity of species, and having three well-defined levels: upper level relatively sparse, consisting of specimens from 15 to 20 meters high, cylindrical trunks, from average to dense branching; intermediary level highly dense, specimens from 10 to 15 meters high, tree tops denser; lower level consisting of shrubs and herbs up to 3 meters high, may have a richer species content and

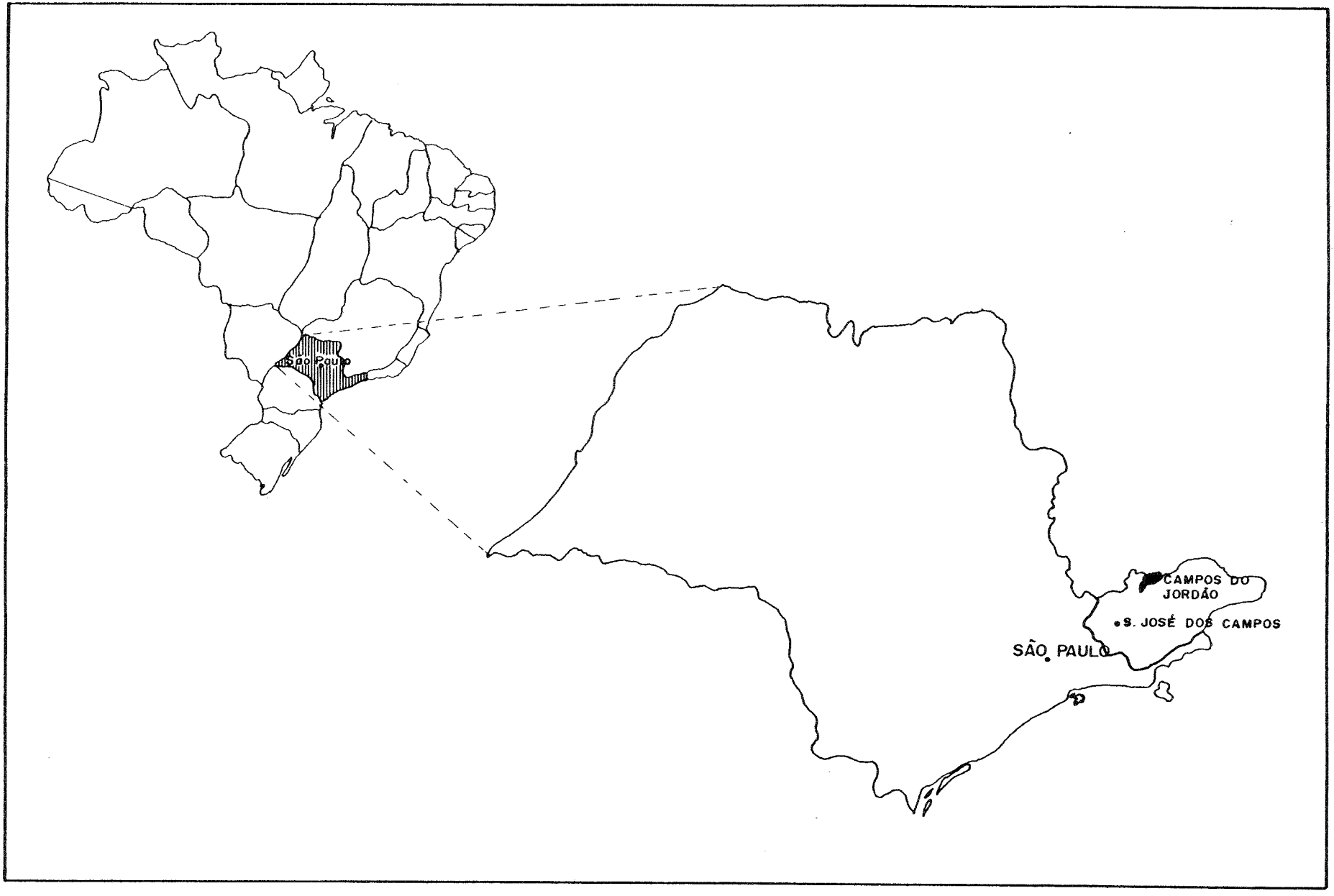

FIG. 1 Location map of county Campos do Jordão

epiphytes and lianas, depending on local humidity.
Note: under this category are included tropical slope humid broad-leaved forests, needle-leaved forests, mixed Araucaria Podocarpus forests, and sub-tropical mountain forests; all these have been listed in the "Levantamento de Reconhecimento de solos do Estado de São Paulo".

Standards of Photographic Images:

Texture:---------- fine, average, coarse
Tonality: ---------- average and dark
Vegetation height: --------- tall
Tree tops covering: -------- non-uniform

Brushwood

Definition: Secondary vegetation developing after the original forest has been cut. Consists of woody specimens with secondary growth, usually belonging to species of the first type of vegetation above, and spontaneously growing species invading the cut areas. The vegetation type ranges from shrubs to trees, but the latter are thin and densely distributed.

Standards of Photographic Images:

Texture: ---------- fine and/or average
Tonality:---------- average
Vegetation height: --------- average
Tree tops covering:--------- uniform or non-uniform

Grassland

Definition: this kind of vegetation is characterized by grasses and herbs, and the absence of trees. According to "Levantamento de Reconhecimento do solo" this vegetation can be divided into two kinds: "clean" grassland and mountain grassland.
The former occurs at altitudes of 700 to 800 meters.Mountain grassland occur solely at certain areas above 1200 meters at "Serra da Bocaina"and"Serra da Mantiqueira".

Standards of Photographic Images:

Texture:---------- continuous
Tonality:---------- clear
Vegetation height: -------- close to the ground

Afforestation

Definition: this category comprises homogenious and well-ordered vegetation, as far as species content is concerned.The species are cultivated in big plots for industrial supply,or else in isolated plots for local consumption.

Standards of Photographic Images:

Texture:---------- fine to average
Tonality:---------- average to very dark
Vegetation height:--------- average to heigh
Tree tops covering:-------- uniform

Note: this kind of vegetation usually has regular borders and clear-cut roads.

3.2.2 Mapping

This consisted in transfering the photointerpreted details onto the maps.

3.2.3. Determination of the area

In order to measure the area that was mapped and classified, a digitalyzer coupled to a microcomputer was used. The program was designed to compute the areas according to the process of triangulation of the points of Cartesian coordinates in the x- and y- axes.

4. Results and Discussion

The results are shown both through maps through tables, which allows a more detailed analysis. Tables 1 and 2, and Figures 2, 3, and 4.

It was found in this study that the county of Campos do Jordão has not undergone significant modifications throughout a 15 year period as far as the natural forest areas (forest + brush-wood) are concerned. In 1962 there were 15650.61 ha (53.70%) of the county's area covered by natural forest, and in 1977 there were 15334.82 ha (52.84%).

The areas covered by grassland vegetation decreased in 2014.32 ha during same period; in 1962 there were 5774.77 ha (19.81%) and in 1977 there were 3760.45 ha (12.96%) in the total county area.

There was a more than four-fold increase in afforestation, from 740.27 ha (2.54%) in 1962, to 3214.50 (11.08%) in 1977.

Table 2 shows that the area covered by natural forest (forest + brushwood) has not undergone significant modification at Campos do Jordão State Park; in 1962 this area amounted to 5769.90 ha (69.90%) and in 1977 it amounted to 5655.10 ha (68.77%).

The areas covered by grassland decreased in 125 ha, from 930.31 ha (11,27%) in 1962 to 803.98 ha (9,78%) in 1977.

There was a significant increase in afforestation, from 638.90 ha (7.74%) in 1962 to 1617.03 ha (19.66%) in 1977.

Figure 4 shows that of the total area covered by natural forest at the county of Campos do Jordão, 36.87% was located within the State Park limits in 1962, and this value was approximately the same in 1977 (36.88%).

In 1962 the Park included 16.11% of the total grassland area of the county, whereas in 1977 it comprised 21.38%. This shows that the decrease in the grassland covered area for the county was higher than that for the Park during the same period.

On the other hand, in 1962 (86.31%) of the total afforestation area

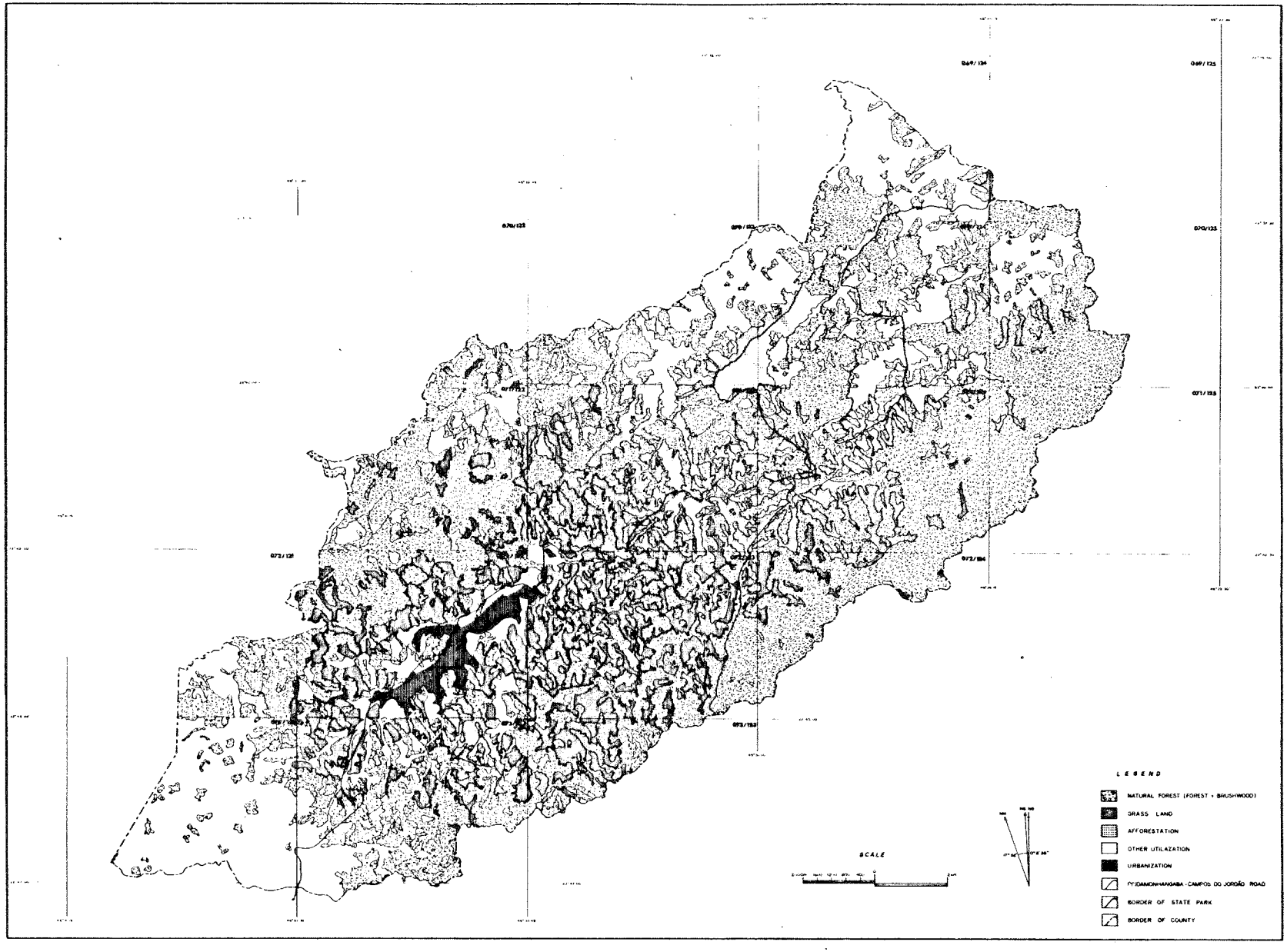

Fig. 2 — Vegetation map of Campos do Jordão county (1962).

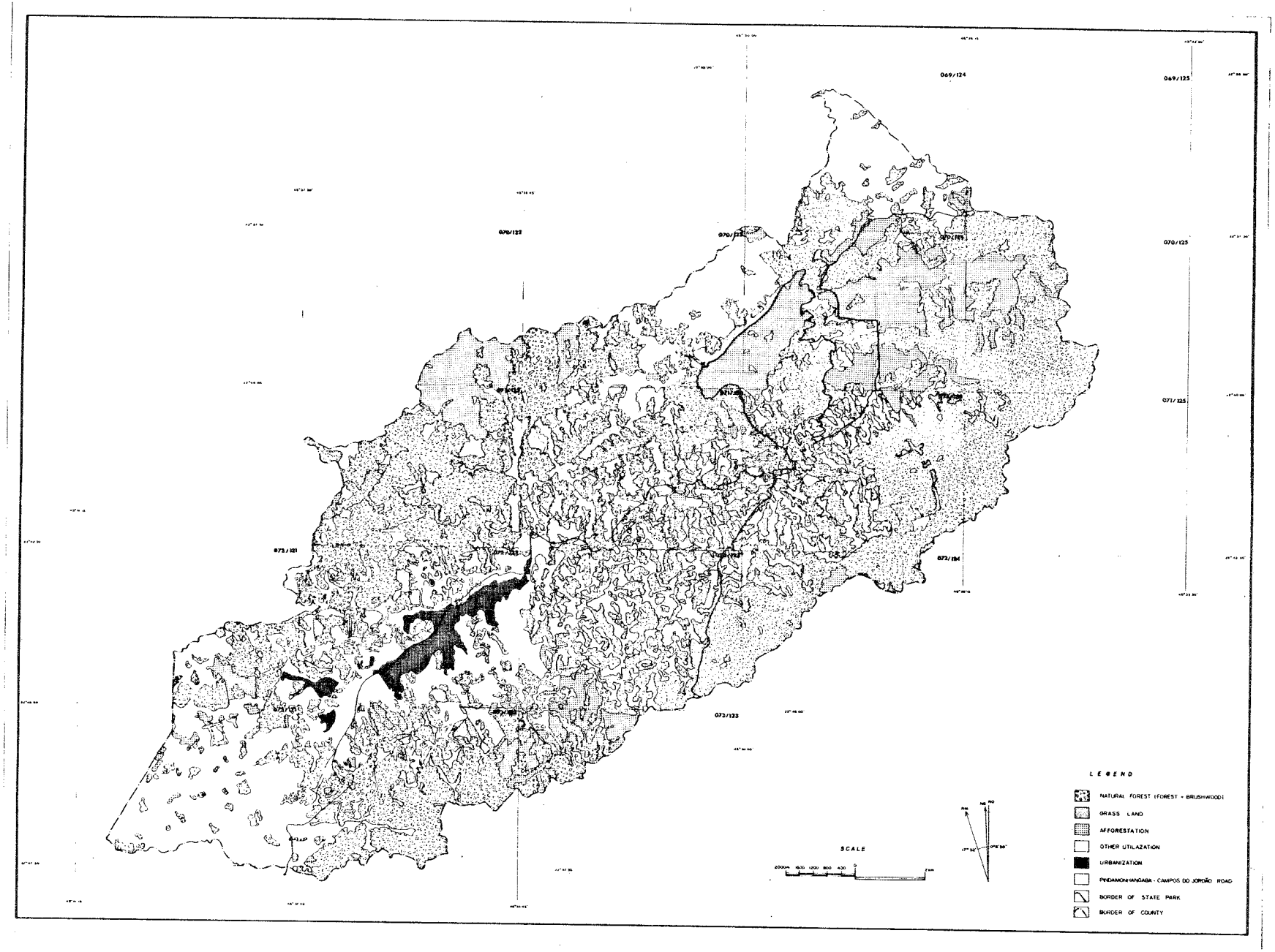

Fig. 3 — Vegetation map of Campos do Jordão county (1977).

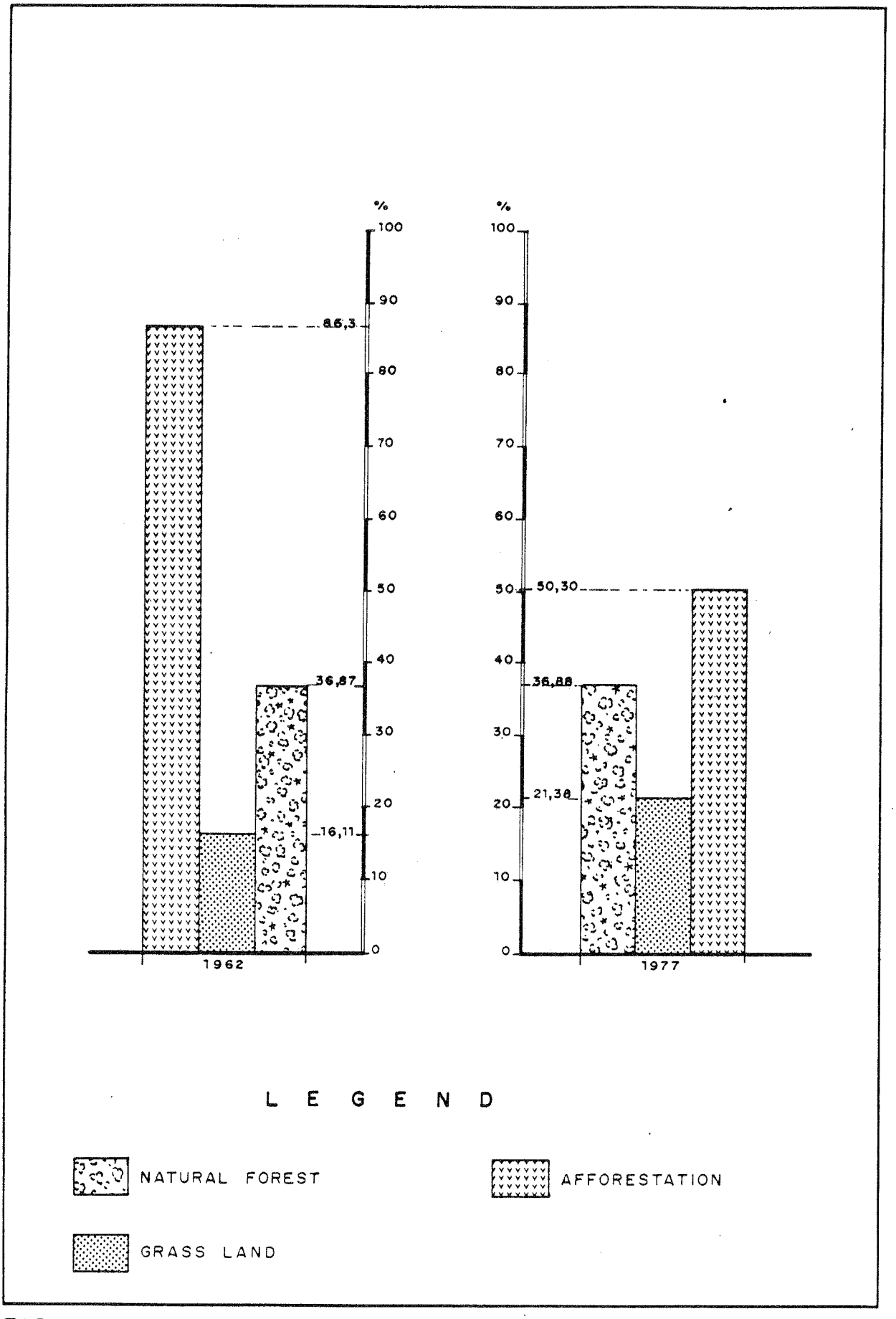

FIG. 4_ Percentage of Natural Forest (Forest + Brushood), Grassland and Afforestation within Campos do Jordão state park in relation to their total area in the county.

TABLE 1 - County of Campos do Jordão - area of natural forest (forest + brushood), grassland and afforestation in hectares, and percentage of occurence of these vegetation types in relation to the county's area.

Map number	Natural Forest		Grassland		Afforestation		County's area	
	1962	1977	1962	1977	1962	1977	1962	1977
069/124	379.06	358.65	32.88	-	-	56.50	1210.04	1206.05
069/125	115.86	119.20	15.96	-	-	9.77	135.80	133.99
070/122	200.73	36.51	14.97	-	13.11	257.44	303.95	304.24
070/123	695.36	602.02	116.07	92.11	119.39	199.13	1596.57	1589.31
070/124	1475.14	1235.02	200.36	64.94	486.20	1250.70	2967.48	2948.48
070/125	548.46	1131.95	64.95	-	3.07	263.35	1412.11	1410.43
071/122	1607.85	1470.64	243.72	195.75	25.57	277.95	2136.94	2129.68
071/123	1538.02	1807.91	1274.97	1052.61	16.20	56.05	2999.37	2978.47
071/124	2140.45	2128.09	709.34	709.73	35.43	97.68	2952.10	2935.50
071/125	592.81	534.11	20.05	19.24	-	-	615.87	613.35
072/121	383.06	332.04	14.15	9.32	32.64	71.37	687.78	687.12
072/122	1075.17	958.51	827.68	225.29	-	32.44	2923.62	2924.21
072/124	1557.93	1392.18	1288.62	1032.02	-	128.34	2931.44	2921.72
072/124	820.75	775.18	132.46	139.18	-	31.46	954.91	940.55
073/121	227.27	226.34	2.01	-	4.30	74.96	1860.11	1851.66
073/122	1450.99	1757.51	559.67	199.01	4.36	84.76	2650.60	2642.82
073/123	424.01	384.56	256.81	21.25	-	322.60	742.06	737.61
074/121	-	-	-	-	-	-	18.60	18.66
074/122	17.67	34.40	-	-	-	-	44.84	44.84
Total	15650.61	15334.82	5774.77	3760.45	740.27	3214.50	29144.27	29018.68
%	53.70	52.84	19.81	12.96	2.54	11.08		

TABLE 2 - Campos do Jordão State Park - area of natural forest (forest + brushood), grassland and afforestation in hectares, and percentage of occurence of these vegetation types in relation to the Park's area.

Map number	Natural Forest		Grassland		Afforestation		Park's Area	
	1962	1977	1962	1977	1962	1977	1962	1977
069/124	25.43	48.81	-	-	-	23.87	112.33	113.23
069/125	115.86	119.20	1.45	-	-	9.77	125.29	133.99
070/123	-	-	-	-	119.39	118.07	122.50	1 8.07
070/124	1094.97	819.35	99,20	5.15	464,81	1098.10	2045.62	2039.97
070/125	948.46	1131.95	64.95	-	3.07	263.35	1412.11	1410.43
071/123	1.15	-	2.29	-	16.20	16.40	25.11	25.64
071/124	1919.55	1913.65	518.11	607.30	35.43	56.01	2561.73	2545.75
071/125	592.81	600.93	20.05	19.24	-	-	615.87	613.35
072/123	250.92	246.03	31.80	33.11	-	-	282.79	282.49
072/124	820.75	775.18	132.46	139.18	-	31.46	954.91	940.55
Total	5769.90	5655.10	930.31	803.98	638.90	1617.03	8254.19	8223.47
%	69.90	68.77	11.27	9.78	7.74	19.66		

was within the Park limits, but in 1977 only 50.30% of this area was within the Park limits. This shows that the increase in afforestation area was higher in the county than in the Park.

5. CONCLUSIONS

The increase in the afforestation area in the county of Campos do Jordão took place both in wasted areas, which in the present study have been classified under "other uses", and in areas formerly covered by grassland. Consequently, little has been cut of the natural forest in order to afforest.

At the Campos do Jordão State Park, afforestation has occurred mainly at wasted areas, and at a few grassland areas. The areas covered by natural forest have hardly been touched.

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