EVALUATION OF THE EXTENSION AND DEGRADATION OF MANGROVE AREAS IN SERGIPE STATE WITH REMOTE SENSING DATA

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ABSTRACT

Mangrove areas in the estuarine system of the Piaui and Real rivers, SE, Brazil, were estimated using techniques of remote sensing. It was also investigated the mangrove degradation as a result of growing industrialization in the region. 1:25,000 scale aerial panchromatic photographs of the area were interpreted to select mangrove areas and identify other types of vegetation and soil uses. MSS and TM LANDSAT data were digitally analysed for multitemporal and multispectral information, providing thematic maps of the region. Field work supplied data which corroborated the remote sensing evaluations of mangrove areas.

1. OBJECTIVE

The objective of this work was to evaluate the extent and degradation of mangrove areas in the estuarine system of the Piauí and Real rivers, in the South of the Sergipe State, Brazil, using aerial photography and satellite imagery. This evaluation was made for dates before and after 1979, when industrial activity begun in the area.

2. STUDY AREA

The study area above mentioned is located between the latitudes of 11°18' and 11°45' South and the longitudes of 37°17' and 37°37' West - see Figure 1. The prevailing mangrove species in the region are Rhizophora mangle and Laguncularia racemosa (Adema, 1984), which can be found at coastal planes of sea or fresh water. The climate is tropical and rainy with annual precipitation above 1,100 mm and one to two dry months, generally December and January (Atlas de Sergipe, 1979).

3. AERIAL PHOTOGRAPHS

38 aerial panchromatic photographs from 20/December/1984 covering the study area in the 1:25,000 scale obtained and provided by the Brazilian Air Force were used to select areas of interest. A mirror stereoscope was used in the interpretation and helped to differentiate soil covers, vegetation patterns, and to map mangrove areas. Deforested areas were divided in three classes: of forest, mangrove and

of regenerating forest. This map was subsequently used to select and characterize training areas for the semi-automatic digital processing performed in the LANDSAT images.

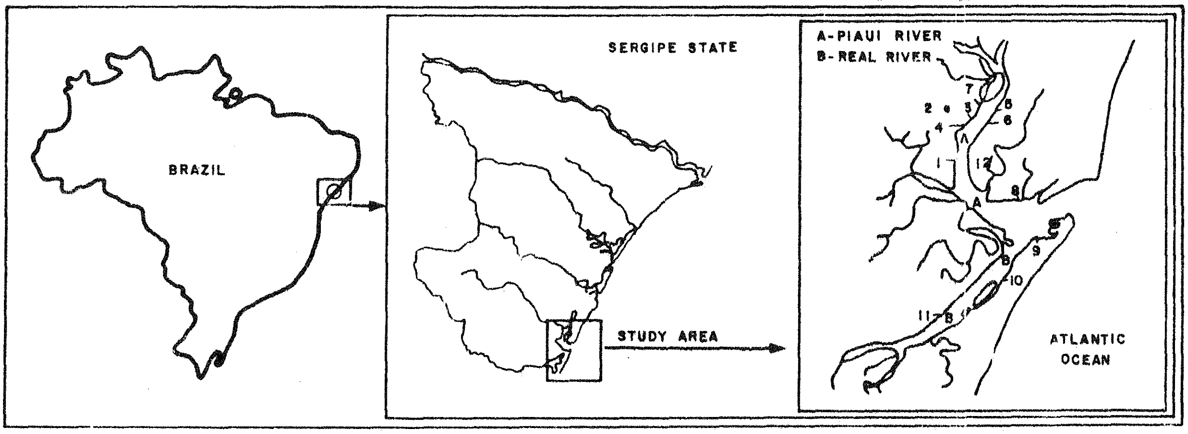

Fig. 1 - Study area. Numbers 1 to 12 represent places where field work conducted to check remote sensing information.

4. LANDSAT IMAGERY

The following LANDSAT images provided by the Brazilian Space Institute - INPE were processed.

Image date	Satellite & Sensor	Orbit, Point	Channel	Inst.Field of View
26/Mar/79	LANDSAT-3 MSS	230,68	5(0.6-0.7) 7(0.8-1.1)	80M 80M
19/Jul/84	LANDSAT-5 TM	215,69	3(0.6-0.7) 5(1.6-1.8)	30M 30M

5. IMAGE PROCESSING

The above LANDSAT images were processed with semi-automatic digital processing techniques using INPE's interactive system IMAGE 100, I-100.

Radiometric correction was performed in each image to minimize differences between satellite sensors which produce stripping effects at regular intervals associated with each scan of the radiometer. Working in the scale of 1:50,000 control points at same geographical location were selected in the MSS and TM images, which were next digitally overlayed using a polynomial adjustment algorithm. This program allows a quick location of corresponding points and areas in different images.

The image pixels were then separated in eight bi-spectral classes with the use of the non-supervised K-Means algorithm. Samples of the images were next selected based on the areas indicated by this algorithm and on the map made with aerial photos, and were used by a supervised Maximum Likelyhood Gaussian Classifier algorithm to produce a thematic map.

6. FIELD WORK

Field work was conducted from 3 to 11/November/1986 at the study estuarine area to verify places for which the classification presented dubious interpretation regarding mangrove vegetation and soil cover patterns.

7. RESULTS

The mangroves in the study area were identified almost in their totality by the digital analysis. With their same spectral pattern were also classified areas of forest shadow in high terrain and of wet places along sandbanks. Nevertheless, these areas were not mistaken with mangroves since they were located away form the mangroves and drainage channels and could be easily differentiated. A few narrow tide channels presented spectral response similar to that of mangroves with low density vegetation. In the K-Means classification, short mangrove vegetation was only partially identified since it could not be easily distinghished from tall mangroves. See figures 2 and 3 for examples of this classification.

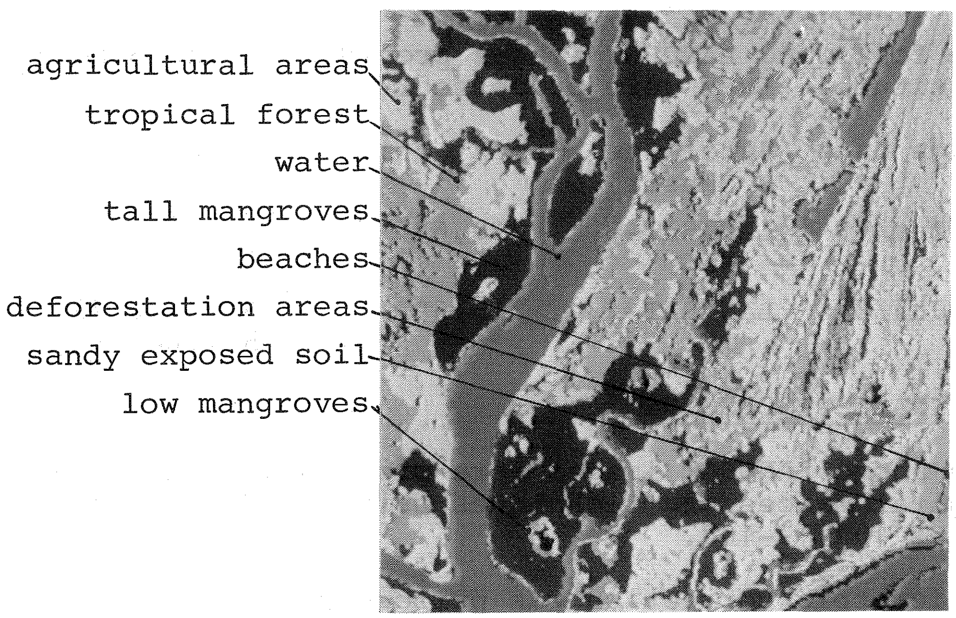

Fig. 2 - K-Means classification of the Piaui river area.

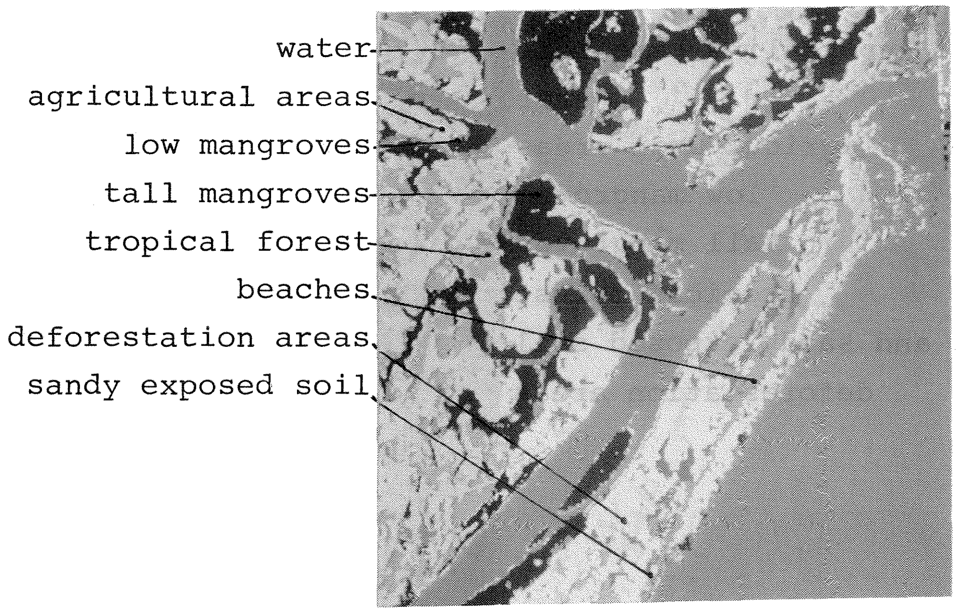

Fig. 3 - K-Means classification of the Real river area.

A good definition between short and tall mangroves as corroborated by aerial photos was obtained with the Maximum Likelyood algorithm. These two classes amount to 138 km² at the Piaui river area, and to 87 km² at the Real river area. Results of this method are presented in Figures 4 and 5.

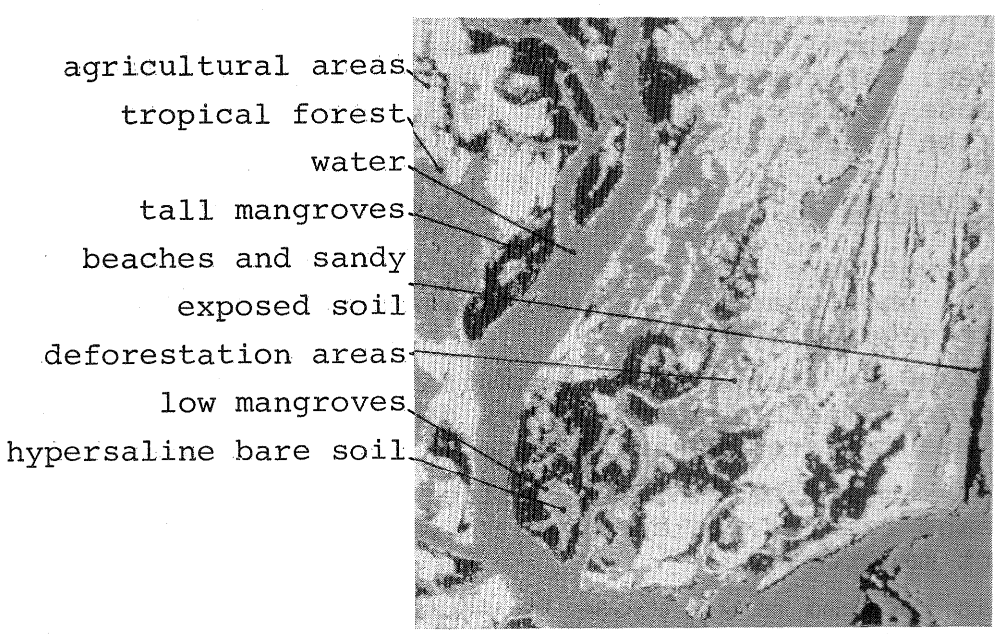

Fig. 4 - Maximum Likelyhood classification of the Piaui river area.

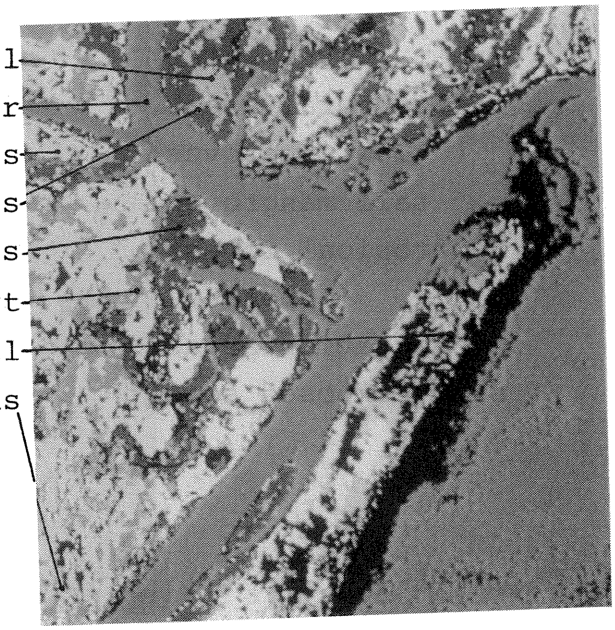

Fig. 5 - Maximum Likelyhood classification of the Real river area.

Eight classes were obtained in the supervised classification, with an average performance of 98.5%, an indication that most pixels were associated to their corresponding spectral classes. This technique misclassified some tide channels and small rivers, and also caused deforested mangrove areas to present similar spectral response to hypersaline bare soil or short mangroves. Deforested areas were easily identified since they were close to river shores, but could not be digitally mapped trough the overlay technique quoted above.

8. CONCLUSIONS

1. Mangroves were very well defined in 1:25,000 panchromatic aerial photographs, as were their dense-tall and sparse-short vegetation types.
2. The K-Means unsupervised classifier proved to be adequate to discriminate mangroves from other soil covers when near and mid infrared bands are used.
3. The Maximum Likelyhood Classifier algorithm used with K-Means results was adequate to differentiate tall from short mangroves.
4. Areas located at or close to shores and classifyed as short mangroves were in fact areas where the existing regular tall mangroves had benn cut. This was verifyed through field work.
5. Areas in the aerial photos and satellite images defined as tall mangrove have Rhizophora sp as main species, while Laguncularia sp and Avicennia sp were predominant in short mangroves.

6. Accretion mangrove areas were not observed in aerial photos or satellite images, possibly due to their small size and of the specimens.

7. Mangrove degradation resulting directly from industrial activities or pollution was not observed, and was associated with human activities.

9. <u>REFERENCES</u>

ADEMA, 1984. Levantamento da flora e fauna dos bosques de mangue do Estado de Sergipe. Administração Estadual do Meio Ambiente, Governo do Estado de Sergipe.

Atlas de Sergipe, 1979. Convênio Universidade Federal de Sergipe-Secretaria de Planejamento do Estado de Sergipe.