# DISCRIMINATING COASTAL RANGELAND PRODUCTION AND IMPROVEMENTS WITH COMPUTER AIDED TECHNIQUES



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## INTRODUCTION

In preparing for rangeland management, a working concept for rangelands must be realistically broad in definition. The term range implies a land-use dominated by the grazing of domestic animals. In a broader sense, it includes lands with either a potential for or past history of grazing by either native or domestic herbivores.

In this context, range management has been defined as the art and science of planning and directing range-use to obtain sustained maximum animal production, consistent with perpetuation of the natural resources (ref. 1). This definition gives the production of domestic livestock and wildlife a priority status in a developing and expanding discipline while recognizing other potential goods and services that can be provided by rangelands. Scientific range management stands on the premise that vegetation can be used perpetually for grazing while simultaneously providing society with high quality air, water, open space and recreation (ref. 2).

The role of remote sensing in range management is to provide information important to decision-making. This information is inventory-related and can include such parameters as species composition, environmental relationships, range condition and vegetation productivity. Also, the data products are frequently used as base maps to display management plans.

The purpose of this study was to test the feasibility and utility of using satellite data and computer-aided remote sensing analysis techniques to conduct range inventories. Both the inventory levels and accuracies and the analysis techniques were tested.

Coastal rangeland along both Gulf and Atlantic coasts has been largely overlooked in rangeland studies. Although acreage is small compared to other grazing regions, the area is important for animal production. A high potential exists for extensive range improvement practices and corresponding resource information. The study site was chosen to represent rangelands within the Gulf coast portion of the prairie and marshland region.

The Gulf coast region occupies approximately 9,500,000 acres along the Texas coast. The coastal prairie is nearly level, poorly drained plain less than 150 feet above sea level. Frequent rivers, bayous or other streams dissect the area. The marshlands are limited to a narrow belt immediately adjacent to the coast and occasionally projecting inland along the bayous.

Most of the region is grazed by cattle with a few sheep, goats and horses scattered throughout the area. Ranches and rangelands of the prairie uplands are interspersed with farms. The better soils are highly productive under cultivation or as improved pastures. Wildlife, especially deer, is abundant enough throughout the region to be economically important.

The principal climax plants of the prairie are tall bunch grasses such as big bluestem (Andropogon gerardi), seacoast bluestem ( A. littoralis), Indiangrass (Sorghastrum nutans), eastern gamagrass (Tripsacum dactyloides), and a gulf muhly (Muhlenbergia capillaris, var. filipes). Much of the area has been invaded by trees and brush such as mesquite (Prosopis juliflora, var. glandulosa), oaks (Quercus spp.), pricklypear (Opuntia, spp.) and several acacias. The marsh areas typically support species of Carex, Cypress, Juncus, Scirpus, several cordgrasses (Spartina), seashore saltgrass (Distichlis spicata), and marsh millet (Zizaniopsis miliacea). Introduced grasses such as bermuda (Cynodon dactylon), dallisgrass (Paspalum dilatatum), and carpetgrass (Axonopus affinis) are common in tame pastures and have become locally established in some native range areas (ref. 3).

The animal carrying capacities of these rangelands are highly variable. The native grasslands historically require 6 to 8 acres to carry one animal unit for a year. Where brush or trees have invaded, this capacity is lowered. Range improvement practices such as brush removal and seeding to improve grasses raises the carrying capacity to 1 acre per animal unit. Even though the marshlands are grazed, they are considered unproductive.

## STUDY SITE

An initial rangeland survey was conducted over a 250,000 acre site in Galveston and Brazoria Counties along the Texas Gulf Coast (fig. 1). Features in the study site include intensive agriculture, urban areas, industrial complexes, coastal marshes, and rangelands. Much of the area is covered by water from numerous bays, inlets, and bayous. The coastal marshes normally have a high vegetative cover (over the shallow water) but may be completely inundated after heavy rains or tidal winds. The rangelands consist of improved pastures, native grasslands, and the coastal marshlands.

## GROUND BASE

Rectified enlarged aircraft color infrared photographs (1:24,000), film type Kodak 2443, of this site (Mission 208, August 30, 1972) were used as the ground truth base. The different land categories were identified, delineated and measured. These photographs were used both to help select training areas and as a standard to test classification accuracy.

## COMPUTER-AIDED CLASSIFICATION

In the analysis, multispectral scanner (MSS) bulk data from the LANDSAT-1 pass of August 29, 1972 (ID 1037-16251) over the Texas Gulf Coast was obtained from the Goddard Space Flight Center (GSFC). During the preprocessing procedure, the entire scene was screened and edited to select the 101,175 hectares (250,000 acres) intensive study site.

The digital data processing flow is diagrammed in fig. 2. The pattern recognition system used in this study was the Image 100 System, a multispectral image processing and analysis system. This system utilizes a PDP-11 series computer with standard "peripherals" (image analyzer console, line printer, graphic display terminal, magnetic tape drives, input scanner unit, solid state refresh memory) (fig. 3). Computer printout, cathode ray tube (CRT), and film positive options were available for display of classification results. At present, four channels of eight bit MSS data can be input. The console screen displays 512 by 512 picture elements.

Using an adjustable electronic cursor, the analyst spacially defines training areas that depict a feature. The areas classified as a feature are both visually displayed on the screen and tabulated as pixels per feature. The classification results can be output as a grey scale printout or as a digital tape (ref. 4).

## CLASSIFICATION RESULTS

An intensive study area of approximately 250,000 acres was selected incorporating parts of Galveston and Brazoria counties along the Texas Gulf Coast.

Features of interest were delineated on the image console giving the number of picture elements classified (fig. 4). The picture elements (pixels) were converted to acreages. The results are shown in the following table.

| | |
|---|---|
| Water | 52611 hectares (130,000 acres) |
| Marsh | 4452 hectares ( 11,000 acres) |
| Range | 21044 hectares ( 52,000 acres) |

The remaining 23068 hectares (57,000 acres) in the scene (urban, cropland, industrial and transportation networks) were unclassified.

To evaluate the accuracy, three intensive test sites were selected within the marshes. Site 1 is a large marsh surrounded on the west by range and on the east by Galveston Bay. Site 2 is a marsh surrounded by other types of vegetation. Site 3 is marsh surrounded on the west by Swan Lake and on the east by Galveston Bay (fig. 4). Each area was classified and pixels per feature determined. The classification results were then compared to the aerial photo statistics as a measure of classification accuracy. Results were tabulated in the following table:

| Feature | Classified | Ground Truth | Accuracy |
|---|---|---|---|
| Site 1 | 323 hectares (822 acres) | 350 hectares (866 acres) | 95.5% |
| Site 2 | 83 hectares (207 acres) | 191 hectares (191.3 acres) | 92.3% |
| Site 3 | 68 hectares (169 acres) | 149 hectares (149.6 acres) | 88.8% |

Accuracies for computer aided classification of coastal marshes range from 89% to 96%.

## SUMMARY

This study has successfully demonstrated that broad rangeland types can be accurately separated to acceptable levels on LANDSAT bulk data with a computer aided classification

procedure. Although this was a pilot study, the output classification could be used by land managers as an input to their rangeland inventory. It is important that area range managers be able to separate the range types that were classified in this study. The marshes have very low productivity for livestock but are important as wildlife habitat. The native rangelands conversely are very productive and potentially can be made even better under more intensive management.

It was also determined that this first step just "scratched the surface" in extracting inventory information. A second step to further refine the classification is needed to differentiate improved pastures from the native rangelands.

A third step would be to monitor changes as native rangelands are converted to improved pastures and as climatic or seasonal aspects influence these lands.

These steps are necessary for the development of a dynamic model based on inputs from remotely sensed data, and to predict variations in carrying capacity of rangelands as affected by seasonal variations and range improvement practices. This model could take advantage of the unique multispectral and repeat coverage characteristics of the LANDSAT type satellites. The products of this model have the potential of aiding the range manager to become a more efficient and more accurate decision maker and at lower cost.

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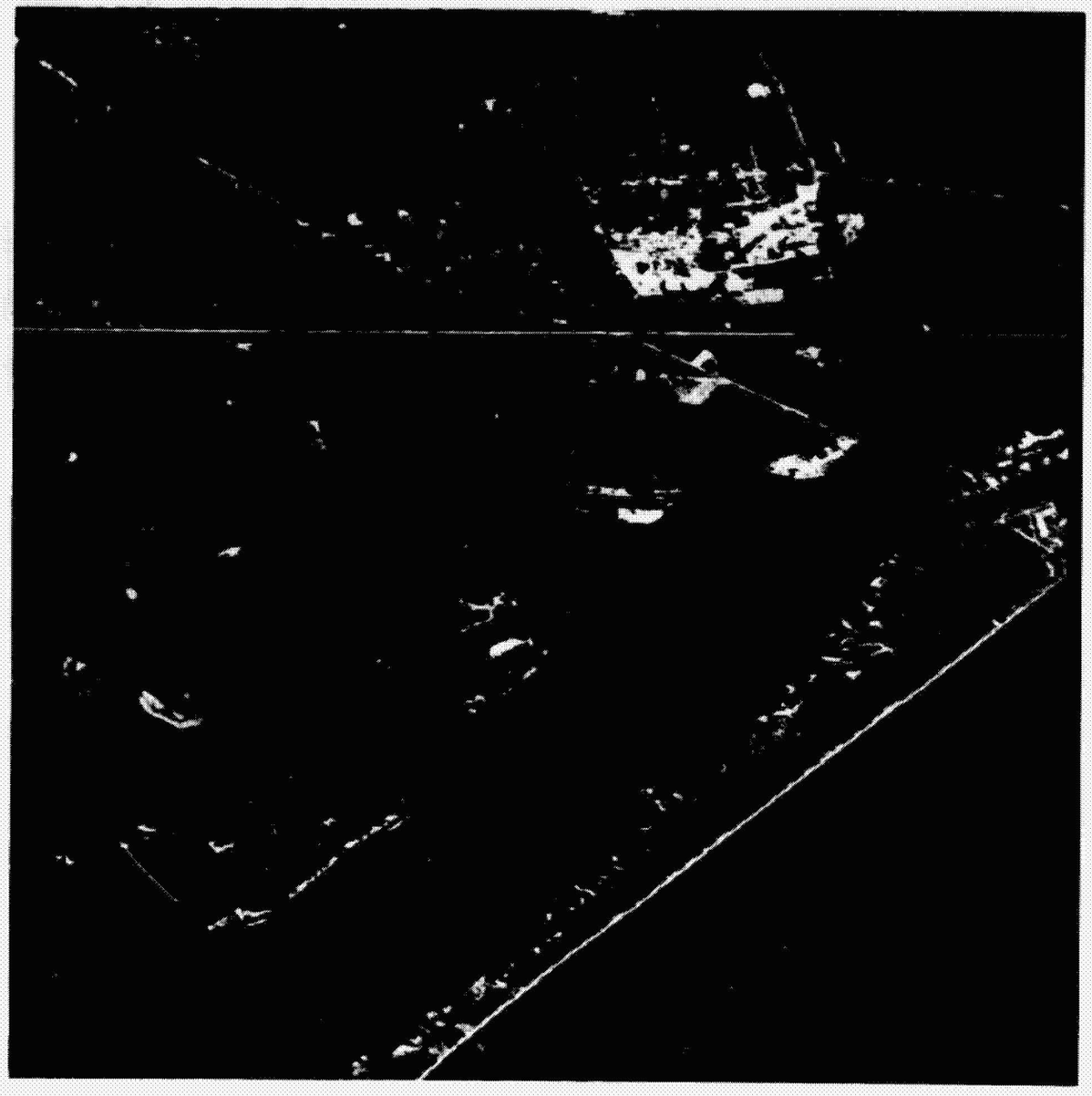

FIGURE 1 LANDSAT-1 IMAGERY AUGUST 29, 1972
(ID 1037-16251) OF STUDY SITE

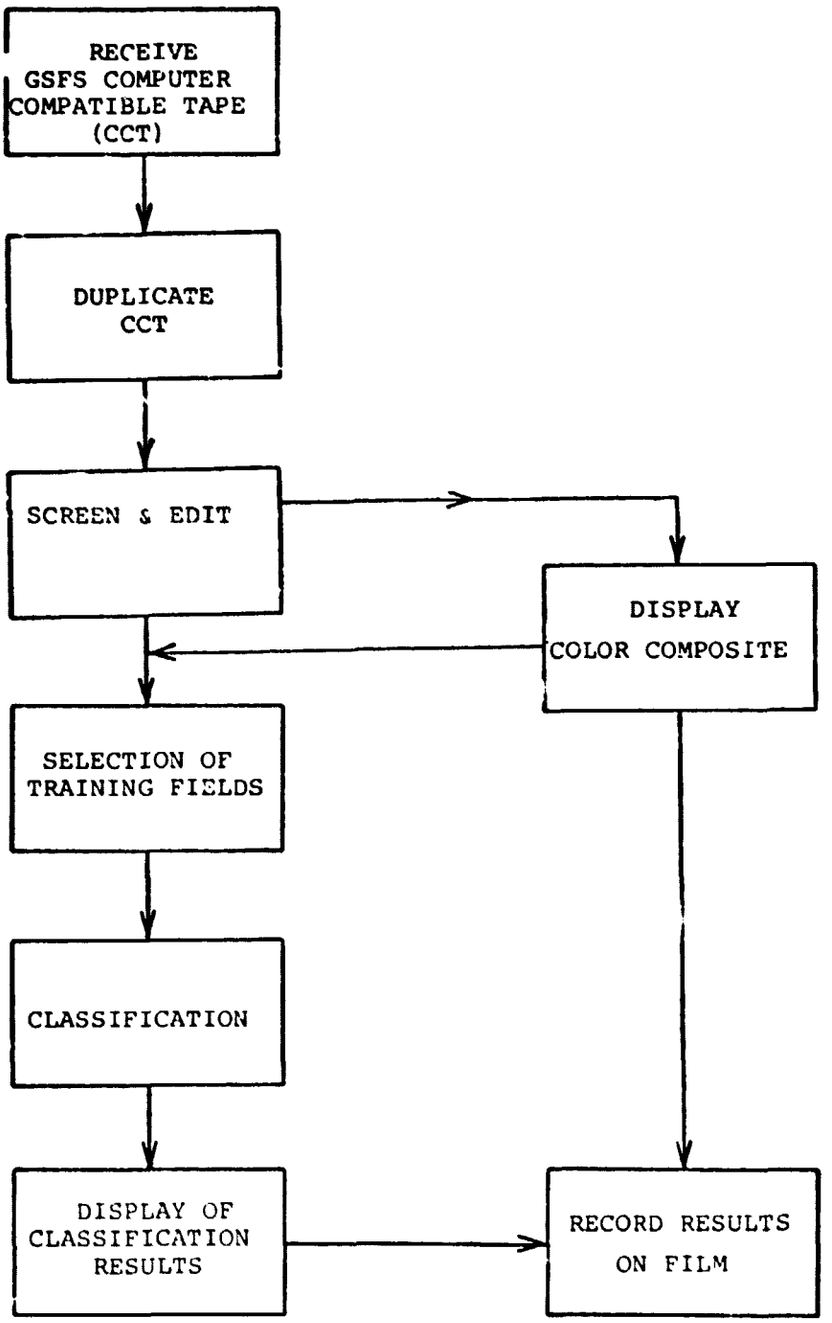


FIGURE 2 DIGITAL DATA FLOW DIAGRAM

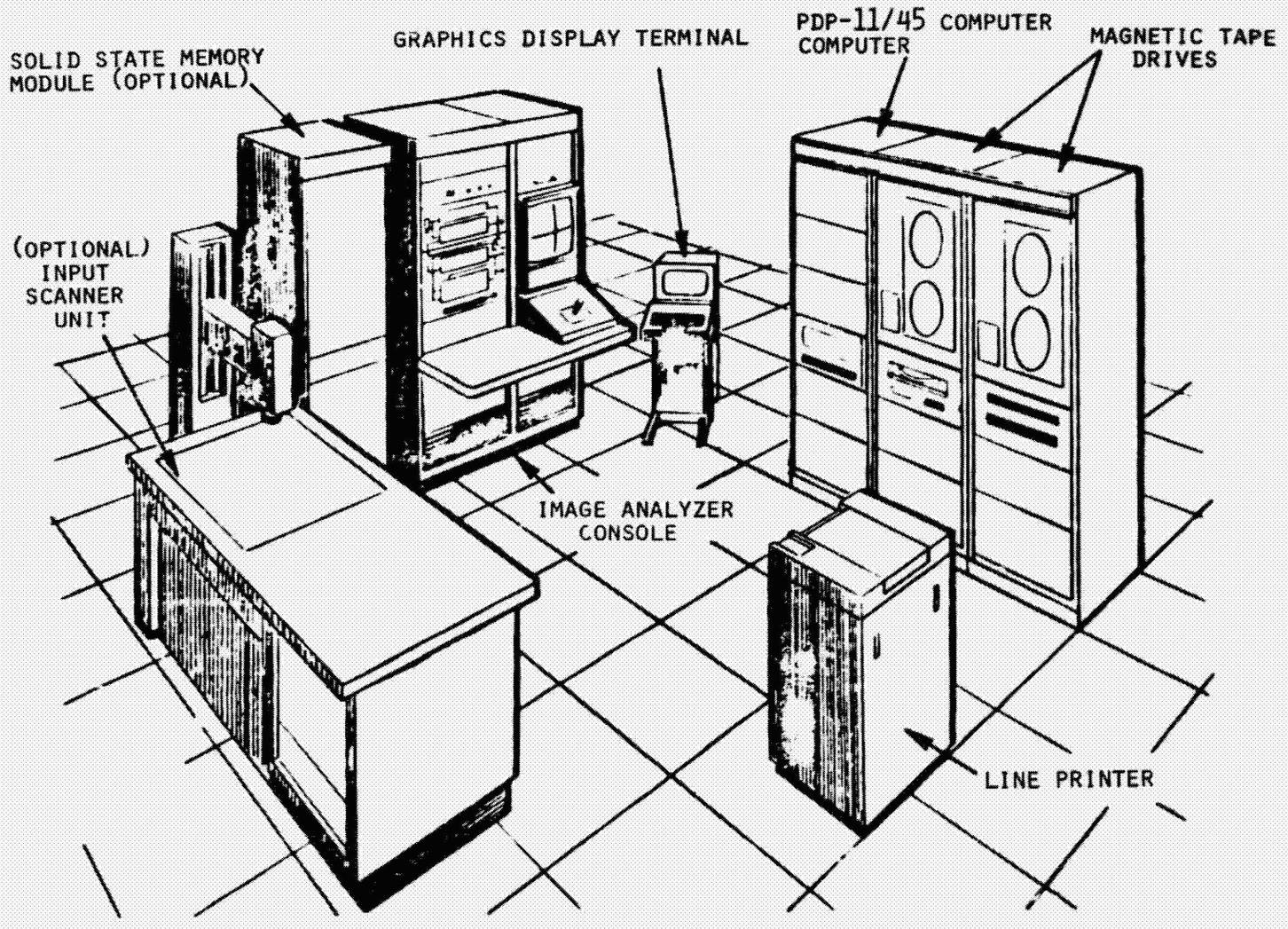


Figure 3. – Image 100 System.

FIGURE 4 - CLASSIFICATION MAP OF STUDY SITE, GREEN-RANGE, BLUE-WATER SALMON-MARSH, RED AND WHITE - OTHER.