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TYPE I PROGRESS REPORT  
For Period  
4/16/73 to 6/16/73

- A. A study to explore the use of orbital remote sensing to determine native arid plant distribution.
- B. Principal Investigator: William G. McGinnies, GSFC #UN613
- C. Problems: Determining radiance from density of areas on ERTS imagery.

Results of the preliminary densitometric analysis of ERTS imagery (see section D4 of this report) present some problems. One difficulty arises from the fact that on the ERTS imagery the density of many of the study sites are in the low range where density does not vary significantly with radiance. This prevents a determination of radiance from density. Radiance values are required by our method for determining spectral reflectivity signatures (see our Type II Progress Report for 8/16/72 - 2/16/73). Specially processed imagery, which has greater contrast at the light end of the gray scale, should solve this problem. Retrospective orders for such imagery will be submitted as it becomes necessary.

D. Accomplishments during the reporting period:

- 1. Feasibility of low-altitude photography for ground truth data collection.

On May 2, 35mm color photographs in the Avra Valley study area (desert grassland site) were taken from a light plane. This flight, under the supervision of Dr. Larry Lepley, was undertaken primarily to provide data for other investigations by Office of Arid Lands Studies personnel. The purpose of our participation in the flight was to estimate the feasibility of using low-altitude 35mm photographs to supplement ground truth data for the Avra Valley study sites. From the photographs which were taken, it appears that low-altitude 35mm photographs from a hand-held camera can be used to determine tree and shrub densities. If color infrared photography is used, it may be possible to qualitatively evaluate the relative influence of each major species on the overall spectral signature of the area.

- 2. Presentation at Arizona Academy of Sciences Annual Meeting.

On May 4, some results of our investigations were presented to the Biology Section of the annual meeting of the Arizona Academy of Sciences held at the University of Arizona. An abstract of the presentation is enclosed with this Progress Report, (section F).

(E73-10659) A STUDY TO EXPLORE THE USE  
OF ORBITAL REMOTE SENSING TO DETERMINE  
NATIVE ARID PLANT DISTRIBUTION Progress  
Report, 16 Apr. - 16 Jun. 1973 (Arizona  
Univ., Tucson.) 4 p HC \$3.00 CSCL 08F

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### 3. Communication with other ERTS investigators.

a) An excerpt from our Type II Progress Report for the six-month period ending 2/16/73 was sent to seven ERTS investigators and to one other scientist who has done research on the spectral signatures of desert plants. The excerpt describes the theory of our method for obtaining spectral reflectivity signatures from ERTS data. Criticisms and comments on the method were solicited.

Excerpts were sent to the following investigators:

Barry J. Schrupf, #UN618  
Robert C. Heller, #AG014  
Roger B. Morrison, #IN404  
Philip N. Slater, #UN237

Ernest Fish  
Gordon Bentley, #IN417  
Charles H. Lowe, Jr., #UN610  
John Jones, U. S. Geological Survey

b) Discussions were held with Carol Breed of the U. S. Geological Survey regarding the ERTS investigation with which she is involved (MMC #131, A study of morphology, provenance, and movement of desert sand of sand seas in Africa, Asia, and Australia; Principal Investigator: Edwin D. McKee, GSFC ID #IN402). Ground truth data for their study areas are scarce or non-existent, and for interpretation of the ERTS imagery they must rely on comparisons with North American analogs for which ground truth data are available. Our correlations between ERTS and ground truth imagery of "desert pavement" areas in the Yuma study area aided them in their interpretation of similar dark areas which are seen on ERTS imagery of Saudi Arabia.

### 4. Preliminary densitometric analysis of ERTS imagery.

Through the courtesy of Joel Gray, access to a Macbeth TD504 densitometer at the University of Arizona Medical College was arranged. Some preliminary analyses were made of 9.5 inch black and white transparencies of ERTS images 1030-17271 (all MSS bands) and 1210-17282 (MSS bands 4, 5, and 6). Spot size was set at 1mm for these analyses.

On the 22 August 1972 imagery (1030-17271), densitometric resolution of the seven lightest steps in the annotation gray scale was impossible. The density differences between these steps were less than the density variations within any one of them. On imagery of Bands 4, 5, and 6, the density of at least one area of the image (a mine tailings area) was significantly less than the density of the lightest step of the annotation gray scale. According to the ERTS Data Users Handbook, this brightest step in the gray scale corresponds to maximum radiance. The density values for most of our Avra Valley study sites were in or near the density levels where the density of adjacent steps was not significantly different. A discussion of the problems presented

by these imagery characteristics appears in Section C of this Progress Report.

Imagery of 18 February 1973 was much more suitable for densitometric analysis. Only the brightest four steps of the annotation gray scale could not be densitometrically resolved. Density values of all of the Avra Valley study areas, including the mine tailings area, fell within the range where radiance could be determined from density. However, this may have been partly due to the wetness of the soil surface, as this overflight was preceded by a rainy spell.

The 1mm spot size was not quite small enough for some of the areas. Therefore, we expect to order two images of the Avra Valley study area retrospectively to perform a trial run of our method for determining spectral reflectivity signatures from ERTS imagery. From one of these, the Avra Valley area and the annotation gray scale will be removed for photographic enlargement. The other copy will remain intact and be used for analysis of the area as a whole.

#### 5. Dry season ground truth data collection in the Yuma study area.

On June 8 through 10, ground truth data were collected in the Yuma study area. Color and color infrared photographs were taken at the same areas which were previously photographed at the peak of development of the winter annuals. The June photos will show the dry season aspect of these areas.

#### Accomplishments planned for the next reporting period:

##### 1. Avra Valley study sites.

Color and color infrared 35mm photographs of the Avra Valley study sites will be taken in late June or early July. Radiometric measurements of reflectivity will be made of the same scenes. These photographs and data will be taken at the peak of the fore-summer drought period and will be compared with earlier data from the winter rainy season.

##### 2. Spectral reflectivity signature determination.

We will obtain ground truth reflectivity measurements of our calibration areas on or about June 25, the day of the next ERTS overflight of the Avra Valley. These measurements, along with radiance measurements from appropriate ERTS imagery, will allow us to calculate a factor to convert ERTS radiance measurements in this frame to reflectivity values. This method is described in our Type II Progress Report of 2/16/73.

3. Yuma Study area.

When late spring or early summer ERTS imagery of the Yuma study area becomes available, we will analyze the imagery, using the ground truth data obtained in late March and in early June to aid in its interpretation.

E. Significant Results: None.

F. Abstract of a paper presented May 4, 1973, at the 17th Annual Meeting of the Arizona Academy of Science, at the University of Arizona in Tucson:

THE USE OF ERTS-1 MULTISPECTRAL IMAGERY  
TO DETERMINE NATIVE DESERT PLANT DISTRIBUTIONS

H. Brad Musick and Edward F. Haase

The use of ERTS-1 multispectral imagery is being evaluated as an aid to determination of native desert plant distribution in the Avra Valley west of Tucson, Arizona. Analysis and interpretation of the imagery is being accomplished through the use of a conventional light table, multispectral additive viewer, and video display density analyzer. Low platform 35mm color and color infrared photography is obtained near times of satellite over-flights at study site locations as an aid to imagery interpretation.

The evaluation of ERTS-1 imagery has emphasized the analysis of spectral signature differences at adjacent study sites and the detection of time sequence signature changes which correlate with phenological changes in the vegetation. Preliminary analysis indicates that study site spectral signatures are strongly influenced by the microtopography, color, and amount of bare soil surface.

G. Recommendations: None

H. Changes in Standing Order Forms: None

I. ERTS Image Descriptor Forms: None

J. Data Request Forms: None

K. Other Information: None