EREP BIMONTHLY PROGRESS REPORT - NUMBER 14

Period: September 16, 1974 - November 15, 1974

INVENTORY OF FOREST AND RANGELAND RESOURCES, INCLUDING FOREST STRESS

Registration No. 418

Contract No. T-4106B

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Coinvestigators: Frederick P. Weber
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A. Overall Status

1. Manitou, Colorado - range inventory site (161313)

Preparations have been completed for the evaluation of SL-2 and SL-3 photographic products and the support aircraft photography. This consisted of constructing clear acetate overlays on which sampling locations for specific Series (Level II) classes of vegetation were located precisely to accommodate the various photo scales. The Series classes identified for evaluating the above products include:

Forest	Shrub	Grassland
1. Ponderosa Pine	1. Willow	1. Shortgrass
2. Spruce/Fir		2. Mountain Bunchgrass
3. Douglas-fir		3. Wet Meadow
4. Lodgepole Pine		
5. Quaking Aspen		

The original plan was to have at least 100 locations or cells plotted to represent each class, 50 of which would be used for training photo interpreters and 50 for testing procedures. Also, our original Skylab evaluation plan was designed to work with five land units, each 583 square kilometers in area. However, cloud cover in both the SL-2 and SL-3 scenes precludes this, and we are now adjusting our plan to compensate for the cloud cover problem. We are relocating some of the training and testing cells and making more comprehensive analyses of two of the five large units.

Three photo interpreters are being used in our photo interpretation test. One has completed work on all the satellite photography. The test is designed to avoid as much bias as possible; that is, the test cells are coded and assigned for interpretation at random. All interpreters have a reasonable knowledge of the landscape within the selected units.

Enlargements of the SL-2 and SL-3 photographic products have not been received from the JSC photo lab.

2. Augusta, Georgia - forest inventory site (177512)

The following SL-3 and SL-4 data have not been received and are important to the successful attainment of our experimental objectives:

SL-3 S190B Pass 36 Roll 86 - Frames 284, 285

SL-4 S190A Pass 54 Roll 52 - Frames 070, 071

A $30,667 increase in our Contract T-4106B funding was received and will allow us to complete the work in the agreement.

a. Photo interpretation of forest and other land use:

Positive transparencies of S190A data for SL-3 Pass 36 were received on October 22. The four black-and-white film bands were combined and enhanced on our I^2S color combiner and an 8- x 10-inch color internegative made of several combinations. Enlarged positive transparencies will be made from these negatives and used in our data analysis.

Forest and other land-use classes are being mapped for two 10,000-meter UTM grid cells using RB-57 Mission 274 1:120,000 CIR photographs taken in April 1974. The maps are being plotted at a 1:24,000 scale using USGS 7½-minute topographic map sheets as control. A Bausch and Lomb Zoom Transfer Scope (ZTS) is used to interpret and transfer land-use boundaries to the map. One map is now complete and the other should be complete by December. The maps will be taken to the test site in early December and checked for accuracy. Once the maps have been verified, they will provide ground truth for photo interpretation tests and a microdensitometer land-use mapping test using Skylab photographic products.

b. Sampling designs for forest stratification and forest area estimates:

All Level I land-use classes (forest, nonforest, and water) and Level II classes (pine and hardwood) are being mapped at 1:50,000 scale from RB-57 Mission 274 1:120,000 scale CIR photography for McDuffie County, Georgia. The mapping interpretation is being done using a ZTS. The interpreted classes are mapped directly on a control base enlarged from the 1:250,000-scale USGS Athens, Georgia, quadrangle. When completed, the map will be used to test different sampling designs for use on Skylab S190B photographs. Mapping of this county is about 50% complete.

ASCS photography used by Forest Survey for their most recent (1972) forest resource inventory has been received from the Southeastern Forest Experiment Station. These are 1:20,000-scale panchromatic prints and cover a four-county area within the common coverage of SL-3 (36-43-40, 12 Sept. 1973) and SL-4 (54-19-52, 30 Nov. 1973). Locations of permanent ground sample plots have been transferred from the panchromatic ASCS photography to the RB-57 Mission 274 photography for McDuffie County. Sixteen point clusters at these locations will be photo interpreted on the RB-57 and Skylab photography for comparison with ground data.

c. Microdensitometer classification and mapping of forest and nonforest land-use classes:

A comprehensive survey of the literature relating to the fields of automated photo interpretation and mapping has been conducted and an extensive bibliography and reference file compiled.

In preparation for producing color coded, digitized, computer-generated forest and related land-use maps, the Photo Data Systems (PDS) Model 1010 microdensitometer was serviced and checked. A new photo multiplier tube was installed and the instrument recalibrated. Tape reading programs written in FORTRAN for the PDS companion data acquisition system, Model 2300 process computer, are being updated for use with a new "Executive 8" operating system on the Univac 1108 computer. Algorithms for analyzing digitized photographic data, developed during the ERTS-1 program, are being improved and integrated into a new system to analyze the microdensitometer data.

Two 10,000-meter UTM cells within the Augusta site have been selected to be mapped by microdensitometer and computer classification techniques. Three scales of photography (1:2,800,000, 1:900,000, and 1:120,000) have been picked for the study and the site locations annotated on photo overlays in preparation for scanning. One site will be used to develop the classifiers for an automated land-use recognition system. The other site will be used in an operational test of the system.

d. Reflectance measurements for correction of Skylab photographic data:

In October, the alternate test site in the Whiskeytown Reservoir-Redding, California, area was flown by the Forest Service for medium-scale (1:15,000) CIR photography. The very large-scale video flight lines flown on January 27, 1974, will be mapped on the photographs to aid in locating the S190A imagery taken that same date on SL-4 Pass 93. This will be essential for locating the microdensitometer scan lines in the quantification of the S190A photographic data.

Further computer programming and testing has been performed to facilitate microdensitometer data analysis of EREP photographs. This work is reported under Significant Results.

3. Black Hills, South Dakota - forest stress site (191312)

There is no status report for this reporting period due to the transfer of the responsible coinvestigator (F. P. Weber) to Washington, DC. The investigation status for this period will be included in the report due January 15, 1975.

B. Recommendations Concerning Decisions Required to Ensure Attainment of Experiment's Scientific Objectives

1. Manitou, Colorado - range inventory site (161313)

None for this reporting period.

2. Augusta, Georgia - forest inventory site (177512)

Delivery of the following SL-3 and SL-4 photographic products are needed to ensure attainment of experiment's scientific objectives.

SL	Data	Pass	Product	Roll	Frame
3	S190B	36	Contact enlargement	86	284, 285
4	S190A S190B	54	Contact enlargement	52	070, 071

3. Black Hills, South Dakota - forest stress site (191312)

None for this reporting period.

C. Expected Accomplishments

1. Manitou, Colorado - range inventory site (161313)

All visual interpretation will be completed within the next reporting period and data analysis will be started. Microdensitometric analysis of the Skylab photographic products will be initiated.

2. Augusta, Georgia - forest inventory site (177512)

a. Ground truth maps for two 10,000-meter UTM cells will be completed and preparations for the photo interpretation test will be completed.

b. A two-man field crew will spend 10 days on the site in early December. All mapping accomplished up to that time will be checked and ground truth data recorded to describe the phenological state of vegetation and its image characteristics 1 year following the SL-4 data pass (November 1973). In addition, local farming and timber management practices will be observed to aid in interpretation.

The forest map for McDuffie County will be completed from the RB-57 photography. The forest area will be measured on the map by intensive sampling using 16-point clusters and other designs and compared with the Forest Survey estimate. Once an efficient design has been determined, it will be tested on enlarged Skylab S190B photographs.

c. Two 10,000-meter UTM grid cells identified on S190A, S190B, and aircraft photography will be scanned by microdensitometer and the data recorded on tape. Computer classifiers and mapping algorithms will be developed and tested on one area.

d. In the next reporting period we will scan the cloud-free portion of the S190A photographs with a Photometric Data Systems microdensitometer and convert the density values to absolute log exposure values. We will also make a conversion to absolute radiance. The reflectance data for the vidicon flight should be computed by that time, and we can begin comparing the two data sets.

D. Significant Results, Practical Applications, and Operational Problems

1. Manitou, Colorado - range inventory site (161313)

None for this reporting period.

2. Augusta, Georgia - forest inventory site (177512)

Sensitometry data for EREP film products are being used to calibrate the density measurements we will make on S190 films. To do this we have calibrated our Photometric Data Systems microdensitometer to the diffuse (D_d) measurements used in the Photographic Technology Division (PTD) at JSC.

Step tablet samples of the two black-and-white copy films (2420 and 2430) used for S190A products have been scanned and the microdensity (M) recorded in digital form at 212 micrometer intervals. This gives about 48 measurements in each step. A program was developed to skip data values near the border lines between steps and find mean values for the steps. Scanning 10 lines along the length of the step tablet produced 10 sets of mean density values for each of the 21 steps. The mean

value of these 10 stepwise means was then regressed against the PTD diffuse density values. A linear equation ($D_d = aM + b$) and a second order equation ($D_d = aM^2 + bM + c$) were tried using a least squares fit. The linear equation could be fit with a standard error of about 0.04 diffuse density units for the two films. The standard error of the second order equation was always better than 0.005 for 2420 film and 0.008 for 2430. The correlation coefficient (r), using the second order equation, was 1.0000 in all cases.

To reduce the scanning time for this density calibration procedure we considered the effect of just three central scan lines. Here the second order equation fit the data to better than 0.009 for all cases and r was again 1.0000.

A test of two aperture sizes, 28 μm and 56 μm diameters, resulted in standard errors differing only about 0.0003 to 0.0006. Truncating the data from steps 1, 19, 20, and 21 decreased the standard error by a lesser amount.

We plan to scan the step tablet each time we scan imagery to thoroughly calibrate the microdensitometer and its digital data system to the PTD diffuse density domain. We are now working on the programming to convert PTD duplicate density to absolute log exposure in engineering units.

3. Black Hills, South Dakota - forest stress site (191312)

None for this reporting period.

E. Travel Plans - November 16, 1974, to January 15, 1975

1. Manitou, Colorado - range inventory site (161313)

None planned during this reporting period.

2. Augusta, Georgia - forest inventory site (177512)

Two men to Augusta, Georgia, site - December 2 through December 13, 1974 - to gather ground truth.

3. Black Hills, South Dakota - forest stress site (191312)

None planned during this reporting period.