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EREP BIMONTHLY PROGRESS REPORT - NUMBER 15

Period: November 16, 1974 - January 15, 1975

INVENTORY OF FOREST AND RANGELAND RESOURCES, INCLUDING FOREST STRESS

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INVENTORY OF FOREST AND RANGELAND RESOURCES, INCLUDING FOREST STRESS

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A. Overall Status

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

Photo interpretation tests of the standard SL-2 S190A and S190B color photo products have been completed using a point-sampling technique. This has been done to determine the effectiveness of these products for plant community classification to the Regional (coniferous forest, deciduous forest, montane grasslands, etc.) and Series (kind of coniferous forest, kind of montane grasslands, etc.) levels of ECOCLASS classification. These classes correspond approximately to Andersen's Level 1 and 2 categories. In addition interpretations by point sampling have been completed for RB-57 Missions 239 and 248 for the same classes.

The vegetation classes and cultural features in two approximately 10,000-meter-square land areas are now being mapped. Existing vegetation maps, verified and corrected last summer by ground reconnaissance and 1:50,000 CIR photographs from Missions 239 and 248, were used for this process with the aid of a Bausch and Lomb ZTS. These maps will be used for "ground truth" to evaluate interpretation of Skylab photographic products.

The microdensitometer (MDT) measurements of the SL-2 and SL-3 photographs have been completed. This was done to determine differences and similarities between and within the vegetation classes as a prelude to possible semiautomated MDT classification. The analysis of the data has not yet been completed.

Large-scale (1:600-1:1,000) color and CIR photographs secured by our Forest Service aircraft were used to determine the proportionate amounts of live vegetation and bare ground for selected grassland locations. Although it is our intent to use these data in sampling to quantify ground surface characteristics from the Skylab photographs, the results have been variable. At one location, Eleven-Mile, the correlation

coefficients (r) between ground-measured and photo-measured bare ground surface and herbaceous cover was .93 and .89, respectively. At the other location, Antero, the correlation coefficients of these two parameters by ground and photo measurements was .53 and .14, respectively. The reason for the low (r) values at Antero is currently speculative, but could be related to the facts that the film emulsions were cracked and the photography was flown under poor light conditions. It could also be related to poor photo interpretation because of these factors. We are attempting to improve the measurement relationships to develop sampling designs for community parameter estimates.

2X enlargements of the SL-3 S190B photographic products have been received. The enlargements of the SL-2 and SL-3 S190A photographic products have not been received.

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

Enlarged (2X) positive color transparencies of S190B imagery for SL-3 (Sept. 17, 1973) and SL-4 (Nov. 30, 1973) were received on January 3, 1975. Cloud cover over most of the site makes the September 17 imagery unusable for this study. The SL-4 photos are cloud free and will be used for future data analysis.

a. Photo interpretation of forest and other land use:

A two-man field crew visited the study site during the period of December 2-13, 1974. Forest and nonforest land classes were checked on six 10,000-meter UTM grid cell sample blocks within the common coverage of SL-3 and SL-4 imagery. Two sample blocks being mapped for ground truth data were checked for accuracy by marking changes on a 1:35,000 scale photo copy of the mapped Level III forest and nonforest classes.[1] In addition, on all six sample blocks the following data were collected:

(1) Two to five sample strips within each block were enlarged from the RB-57 Mission 274 imagery to a scale of 1:10,000. Vegetation characteristics observed from passable roads were marked on the strip photos for later identification on the S190B imagery.

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[1] Heller, R. C., R. C. Aldrich, R. S. Driscoll, R. E. Francis, and F. P. Weber. 1974. Evaluation of ERTS-1 data for inventory of forest and rangeland and detection of forest stress. Pacific Southwest and Rocky Mountain Forest and Range Experiment Stations, Forest Service, U. S. Department of Agriculture. Final Report, NASA Contract S-70251-AG. p. 26.

(2) Local timber management practices that often cause image characteristics that are difficult to classify without prior knowledge were noted and documented, i. e., shortleaf pine (Pinus echinata Mill.) stands are cut in this area using the seed-tree method. This involves harvesting all but a few of the better pines which are left uniformly distributed on each acre to reseed the area naturally. The photo image of a stand treated in this manner appears lighter in color than a cutover stand of loblolly pine (Pinus taeda L.).

Other accomplishments during the field trip include:

(1) Twenty-four photo points on one of the sample blocks originally located in June 1973 were relocated and ground photographs were taken.

(2) Ground photographs of a gray-scale panel were taken on several pastures located west of Atlanta. Comparable pastures were located within the Augusta site and the gray scale was rephotographed. These photographs will be used to relate the Forest Service Airborne Silicon-Vidicon radiometer data taken over the original Atlanta Skylab site in January 1974 to Skylab imagery taken over the Augusta site.

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

The two-man crew mentioned above covered nearly 20 percent of McDuffie County by extensive ground checking; the entire county was traversed during the course of this sampling. Land-use mapping annotations were made directly on 1:35,000 scale print enlargements made for this purpose. Six percent of the county area was intensively mapped on 1:10,000 scale print enlargements. In addition to the ground truth obtained, much was learned about local forestry and agricultural practices and their relation to land use.

The mapping of McDuffie County from 1:120,000 scale CIR photography has fallen behind schedule, but is currently being given high priority for early completion. When the map is completed the area of each of the Level I and II land-use classes--pine, hardwood, nonforest, and water--will be determined. The map will then be sampled using several schemes and results compared with forest survey estimates. A sampling scheme will be selected to be used on Skylab S190B photographs.

We now have the land classification data for 42 16-point clusters (672 points) in McDuffie County which were ground checked by Forest Survey. These same points will be photo interpreted on 1:120,000 scale CIR transparencies for comparison with the ground data. It may be

possible that high-altitude CIR photography can be used in lieu of ground checks for some Level I inventory sampling.

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

In preparation for producing color-coded, digitized, computer-generated forest and related land-use maps, the following has been accomplished:

(1) Tape-reading programs written in FORTRAN for the PDS companion data acquisition system, Model 2300 process computer, have been updated for use with the new "Executive 8" operating system on the Univac 1108 computer.

(2) Algorithms for analyzing digitized photographic data, developed during the ERTS-1 program, have been improved and completely documented and are being integrated into a new system to analyze the microdensitometer data.

(3) One 10,000-meter-square area chosen to develop classifiers for an automated land-use recognition system, along with the appropriate sensitometric data, has been scanned with the PDS microdensitometer and the digital data is being prepared for computer processing using the above systems.

(4) Procedures relating to the processing of film transparencies and their sensitometric data are being continually updated and documented as experience dictates.

d. Reflectance measurements for correction of Skylab photographic data:

The lateral coverage of four radiometer flight lines (filters matched to S190A B&W bands) flown in January 1974 was mapped on 1:15,000 scale photography as described in the previous bimonthly report. There was excellent sidelap on three lines and the fourth line was displaced only 250 meters from the others at the most divergent point. Time marks on the video tape audio channel (recorded concurrently with the radiance measurements) were very helpful in locating features on the radiometer analog records. However, data reduction would be faster if we had time marks in the corner of the video picture. This is something that should be investigated to improve the radiometer for operational use.

Radiance and irradiance data for all flights are now being digitized for computer analysis.

The sensitometric data in the form of step tablet density measured on S190 duplicate film types and density of the original PTD step

tablet have been modeled by least-square fitting to obtain a calibration equation. Twenty-eight sets of duplicate density values for S190 black and white and color films were used. These will support all the Skylab sites and pass coverages that we might wish to calibrate. A tentative standard error of 0.05 diffuse density units was set as an acceptable fit. Preliminary indications show the following:

(1) Truncating the shoulder and toe of the characteristic curve to slopes greater than about 0.1 density units per step usually works for a third-order polynomial in log E.

(2) If the exact density range of the photo is known, one can usually truncate further and fit the data to a second-order equation.

(3) The three data sets we will use first and foremost for correlation with reflectance data were fit to a standard error of better than 0.034 by both methods above.

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

a. S192 MSS Processing at the University of Kansas:

Under the direction of Dr. Robert Haralick, a software package was written which provides line straightening and geometric correction to raw S192 multispectral conical scan data. Prior attempts to use conical data were unsuccessful due to the inaccuracy of locating training areas on the unstraightened data.

Processing results to date for Black Hills data have revealed the need to select training areas (for a particular class) both in full sunlight and in the shadows. Without stratifications of training classes, the error rate in pixel classification was unacceptably high. This problem resulted because S192 scanner data were collected early in the morning with a low sun angle and long shadows.

A histogram and divergence analysis of S192 data indicate the following array of scanner channels yield the best classification results for the Black Hills test site:

S192 Band	Spectral Region	Range (μm)	S192 CCT Channels
3	Green	.52 - .56	1, 2
6	Far red	.68 - .76	7, 8
8	IR	.98 - 1.08	19
12	IR	2.10 - 2.35	13, 14
13	Thermal IR	10.2 - 12.5	15, 16, 21

The quality of the first four bands (above) are superior and appear to contribute 90 percent (plus) of the classification information for the Black Hills. Band 13, in spite of the best efforts of JPL, ERIM, and NASA remains of marginal quality at best. Our selection of the thermal band (13) was an a priori choice not based on the divergence analysis. Thus, in the end, we may drop Band 13 if it proves to be a confusion factor rather than contributing to classification accuracy.

Of the 5½ seconds of S192 scanner data that were provided for June 9, 1973, (SL-2) we plan to process and use only that portion of the data which includes the northern Black Hills. Our approach has been to train and test the classification model on two 16-square-mile blocks. Classification maps have been made for these blocks at a scale of 1:24,000. The entire northern Black Hills will ultimately be mapped at a scale of 1:125,000. As yet there is no data on the effects of data compression or classification accuracy.

To date, detection of stress areas in the northern Black Hills from S192 MSS data has not been encouraging. However, this is not unexpected as June remains the poorest time of year for detection of dead and dying trees caused by attack of the mountain pine beetle.

b. Analysis of Mission 247 MSS Aircraft Data:

Analysis of supporting aircraft multispectral scanner data flown by the NASA C-130 aircraft using the Bendix 24-channel scanner is nearly complete. Results of the Mission 247 analysis flown in support of SL-3 show a high degree of stress detection and mapping accuracy. A quantitative summary of these results is planned for the final Skylab report. Based on a resolution destruction experiment performed to simulate S192 scanner parameters, there is little doubt that (at worst) the largest infestation spots would have been detected and mapped had the scheduled September 18, 1973, S192 scanner experiment not been cancelled at the last moment.

From this analysis it was determined that 24-channel scanner data (even that flown at 7,500 feet above the ground) must be preprocessed to remove scan angle and nonuniform detector radiance response for acceptable detection and mapping accuracies. This was demonstrated in the signature extension experiments.

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

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

The enlargements of the SL-2 and SL-3 S190A photographic products are needed.

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

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

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

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

None.

C. Expected Accomplishments

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

Analysis of variance for visual interpretation of the S190A, S190B, and support aircraft photography should be completed.

Ground-truth maps of vegetation Regions and Series should be completed for the two 10,000-meter-square areas.

A map that updates the cultural changes that have happened since previous resource maps were made will be started using SL-3 S190B color photographs as an information base.

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

a. The ground-truth map for the 10,000-meter microdensitometer training area completed during the last reporting period will be corrected based on ground data collected in December. From this adjusted version a final map will be made. A map of the 10,000-meter-square test area will also be completed in its final form.

We will complete preparations for a land-use classification accuracy study using ground data furnished by the Forest Survey. These data are the ground classifications for 16-point clusters in four counties within the Augusta test site. We will prepare enlargements of the S190B data to a 1:120,000 scale. These enlargements will be used by two independent interpreters to classify 16 points in a grid overlay. Point-by-point comparisons of the photo land use with ground classes will disclose both inaccurate classifications and changes in land use. Where changes have occurred, they will be checked against 1:120,000 CIR photographs taken in April 1974.

b. A map of Level I and II land-use classes--pine, hardwood, nonforest, and water--will be completed for McDuffie County. Area in each class will be measured by intensive dot count or other appropriate method. Sampling schemes to stratify the forest area, measure forest acreage, and compute sampling error will be tested.

c. A land-use computer map will be produced for one 10,000-meter-square test area using algorithms developed for analyzing digitized S190B photographic data.

d. Microdensitometer scanning with digital output has not been performed on the Whiskeytown, CA (Pass 93) imagery due to commitment of the machine to other tasks. This work will be done in the next reporting period. In correlating this data to the reflectance derived from the radiometer flights, we will correct the former data sets for curvature of the flight line. We will also compress or expand portions of the flight data to correct for variations in aircraft ground speed and possible changes in the analog recording time-base. Final results on the sensitometric curve-fitting should be cataloged soon and made ready for preprocessing the data used in computer classification work.

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

a. The effort to process and analyze S192 MSS imagery at the Aerospace Sciences Laboratory of the University of Kansas will be completed during February 1975. A final report is expected March 1.

b. Final analysis of S190A multiband photography depends on receipt of the 1:36,000 and 1:60,000 color enlargements requested through the Forestry Applications Project at JSC. To date these products show the greatest promise for a useable mapping classification and planning format.

D. Significant Results, Practical Applications, and Operational Problems

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

None this reporting period.

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

None this reporting period.

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

None this reporting period.

E. Travel Plans - January 16 to March 15, 1975

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

   None planned.

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

   None planned.

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

   None planned.