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EREP MONTHLY PROGRESS REPORT - NUMBER 10

Period: January 16, 1974 - March 15, 1974

INVENTORY OF FOREST AND RANGELAND RESOURCES, INCLUDING FOREST STRESS

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A. Overall Status

1. Alternate test site - northern California, GT-6, January 27, 1974

Since no EREP coverage was acquired over the primary test sites in Atlanta, Georgia, and Black Hills, South Dakota, which could be applied to our vidicon underflights, it was necessary to choose an alternate site. The objectives at this new site were to show the usefulness of low-altitude reflectance measurements in the quantitative analysis of EREP photos with emphasis on computing atmospheric coefficients. An area along Track 6 was chosen in the vicinity of Redding, California, and coverage was arranged by our technical monitor, Clayton Forbes.

On January 27, the day of EREP pass 93, the Forest Service aircraft and the NP3A NASA aircraft (on Mission 259) obtained imagery in the area. The Forest Service vidicon flight was a west-to-east line from Whiskeytown Reservoir to the Redding Airport. Bands AA, BB, CC, and DD of the S190A experiment were recorded. A light, variable cirrus overcast was present. The sunlight was not diffused too much for meaningful specular reflectance measurements, but we must see whether there are clouds on the SL-4 imagery before an analysis is begun. We may require coverage on the February 1 EREP pass over GT-6 to complete this phase of the study.

Postmission calibrations were performed on the vidicon, bore-sighted radiometer, and incident irradiance meter. Preliminary mapping of the targets along the test flight line was begun.

Preparation for the conversion of S190A B/W density values to broadband exposure values was begun. Using the step tablets provided with the SL-2 Sensitometric Data Package (JL12-502), we performed a cross-

calibration of the 23, 56, and 99 micrometer apertures on our microdensitometer (Photometric Data Systems 1010) to the NASA diffuse densitometer. When the prescribed procedures were carried through to a plot of duplicate microdensity against relative exposure, the results for all bands were smooth curves. The exposure range over which confident calibration can be done (distance between shoulder and toe on the curves) is less for the duplicate copy than for the original film sensitometry. Proper exposure and processing in the duplication step is required to include most of the exposure levels of interest in the straight part of the curve. Judging from the measured density distributions of selected well-exposed frames presented in the Sensor Performance Report* (MSC05528) all pixels could be calibrated accurately with original sensitometry. But many pixels would fall outside the region where the slope of the duplicate density versus original log exposure curve is greater than 0.5. A slope of 0.5 would yield an uncertainty of about 9% in exposure for a density error of 0.02. These pixels, however, are primarily in highlighted areas which are probably of little interest in forestry studies.

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

Mission 260, RB-57 photography in support of an SL-4, January 21, 1974, pass over the Black Hills forest stress site was received and has been reviewed. Snow conditions and heavy cloud cover over the Black Hills on the day of the RB-57 flight (January 22, 1974) make it doubtful that the imagery will be of much help. However, the mission was reflown on February 1, 1974, and we are hopeful of receiving good imagery although we know mechanical problems with the plane made it necessary to cut short the mission after only one of the scheduled seven flight lines was flown.

After working further with the Black Hills SL-3 imagery of the September 13, 1973, pass over the Bearlodge Mountains, we now believe this data set will be the best for the forest stress investigation. Since there was no RB-57 imagery flown over the Bearlodge Mountains as requested in support of the SL-3 overpass, we have purchased a set of aerial color photos (prints) that were flown for the Black Hills National Forest during August 1973 at a scale of 1:15,840. Although they cannot provide as convenient information as the RB-57 photography, they will provide sufficient ground truth information for classification and mapping purposes. They will greatly enhance the aerial reconnaissance data which was gathered from our mapping flight over the Bearlodge on September 18, 1973.

* MSC-05528 (SL-2). Sensor Performance Report V.1 (S190A) (Engineering Baseline and SL-2 Evaluation), November 5, 1973. Contract NAS8-24000, Amendment JSC-145, NASA JSC, Houston, Texas.

In addition to three intensively mapped subblocks in the main part of the Black Hills, we have added a fourth subblock in the Bearlodge Mountains. The main Bearlodge block used for the overall mapping and classification by ADP procedures is about 72 square miles in size, while the type-mapped area (subblock 4) of intensive interest is about 16 square miles. Within the area encompassed by the subblock are a substantial number of current mountain pine beetle infestations ranging in size from a few trees to perhaps as many as 100 trees. The exact number of infested trees and the locations of the spots will be determined from interpretation of the newly acquired resource photography.

Color-enhanced MSS imagery of C-130 Mission 247 (September 17, 1973) was received and is being evaluated. The final processing effort for line 1-1 (flown at 2,000' HAT) was received with the adjusted processing coefficients having been made. The imagery over our instrumented test site looks very good in terms of identification of beetle-killed pine; however, we have not completed the correlation analysis of classification elements versus numbers of trees. We believe that although all trees will be accounted for on the larger scale (line 1-1) there will be greater variability introduced in the number of elements per tree than will be the case at the smaller scale (line 4-1). All things considered, the color-enhanced imagery now in hand is the very best that we have seen from an aircraft (MSS) digital scanner.

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

All data products for both SL-2 and SL-3 are now on hand. These are summarized below and also included are notes about data quality, especially the photographic products.

SL-2: S190A photographic products - Good exposure and good quality in all bands. High, very thin cirrus clouds over most of the site. This will have some effects on photo interpretation but the seriousness is not yet known. These are the products received for SL-2.

SL-3: S190A photographic products - The 2443 film is overexposed so that grassland vegetation differences are nearly indistinguishable except for vegetation with high reflectance such as wet meadows. We will try to rectify this somewhat in our photo laboratory. Exposure on the other photographic products is good to excellent considering the complex scene (wide variety of grassland and forestland) imaged.

S190B photographic products - The scene appears slightly underexposed. We will try to rectify this in our photo laboratory.

S191 - The CCT's were received February 10, 1974, and we have not had opportunity to evaluate the data.

S192 - The CCT's are on hand, as well as screening imagery from channels 2, 7, and 11. The screening imagery is not as clear as we believe it should be. Also, these bands are not the most useful to provide probable maximum data about vegetation, the subject of our investigation. Therefore, screening imagery from channels 3, 5, 6, and 8 is being requested by letter to our technical monitor.

Training and testing templates for interpreting Skylab S190A and S190B color and CIR photographic products by visual and densitometric techniques have been completed. The hypothesis to be tested will be that this imagery can be used to discriminate plant community systems at the Series level of ecoclass classification. Visual interpretation will be done using stereoscopes, monoscopes, and our newly acquired Zoom Transfer Scope (ZTS). Densitometric interpretation will be accomplished by spot sampling with the GAF microdensitometer.

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

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

To date we have not received the positive 70 mm. transparencies from SL-3 (September 13, 1973) S190A, AMPS cameras 39, 40, 41, and 42. Two sets of negatives of the imagery from these cameras were received.

Special Request -- In order to work effectively with the SL-3 data set of the Black Hills (September 13, 1973) we require three additional data products, and herewith submit the request: (1) a set (2) of 9-inch x 9-inch enlargements of S190B frame 88-021. We request that the frame be enlarged in such a way that no portion of the northeast or southeast sides of the original frame will be deleted; (2) a set of 9-inch x 9-inch enlargements of S190A frames 39-211, 39-212, and 39-213. The original 70 mm. transparencies received are so dark (underexposed) that they cannot be used. However, we believe if in the creation of the enlargements the imagery can be overexposed by a factor of 2 or perhaps even 4, the results can be a great improvement. Again, we hope that special attention will be given to not deleting any part of the northeast or southeast edges of the original imagery. Frame 39-213 is particularly important to our study and hope that the Black Hills National Forest which is located in the extreme southeast portion of the frame can be brought up to a usable brightness coefficient; (3) a set of 9-inch x 9-inch enlargements of S190A frames 40-211, 40-212, and 40-213. As mentioned above, the original transparencies we received were so dark over the Black Hills that they cannot be used for our evaluation. We feel certain that adjustments can be made in photo processing so as to adequately increase the brightness over the Forest, even if it results in "washing out" the rest of the frame. As with the other imagery, it will

be important not to delete any part of the northeast or the southeast portions of the original frame.

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

We will need to realign our plans on use of the S191 and S192 data as soon as we know with certainty the material available for all three sites (312, 313, and 512).

C. Expected Accomplishments

1. Alternate test site - northern California, GT-6, January 27, 1974.

Mapping of prospective target areas along the vidicon flight line for quantitative comparisons with EREP data could have been facilitated by the use of the intermediate scale of photography obtained by NASA high-altitude aircraft. However, only about 10% of our flight line was covered by NASA Mission 259. In the next reporting period we will use available ERTS imagery or available aerial photography to get a relatively current view of the test site. We will try to predict which areas recorded at very large scale on the video tape will be detectable and have measurable radiance values on S190A imagery. Any detailed radiance analysis will await receipt of a usable EREP image.

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

Accomplishments for the next reporting period will depend on receiving new imagery. We hope to accomplish the following tasks during March and April:

a. Complete the interpretation and analyses of the August resource photography taken by the Forest Service over the main part of the Black Hills.

b. Interpret the new resource photography of the Bearlodge Mountains and work up type map of subblock 4. Also, plot the precise locations and sizes of all mountain pine beetle infestations in the entire 72-square-mile Bearlodge block.

c. Begin interpretation of the RB-57 photography taken February 1, 1974, over the Black Hills which was to support the SL-4, January 21, 1974, pass over the Hills. This may not be a large task in that only one flight line was flown, yet the information, no matter how limited in scope, is required for evaluation of the SL-4 imagery.

d. By the end of April we hope to have the final DAS-processed imagery in hand and analyzed from C-130 Mission 247. The result would be

(1) our recommendations concerning the use (or nonuse) of the C-130 scanner as an operational survey tool, (2) the reliability of processed imagery for providing locations and actual tree counts, and (3) the actual specifications for producing optimum user products for stress detection and mapping from C-130 MSS imagery.

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

Now that all EREP photographic products are in hand, we will be able to start making comparative statements about seasonal requirements of this kind of data for plant community classification.

D. Significant Results, Practical Applications, and Operational Problems

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

There are no additional significant results or practical applications to report at this time. Operationally, we are concerned about the following problems:

a. The quality (dark and underexposed) of the SL-3, S190A imagery taken over the Black Hills September 13, 1973. We believe that proper adjustments can be made in the photo duplication process to produce good-quality and usable S190A products.

b. Changes in the shipping date for SL-2, S192 MSS image tapes. If the tapes will not be ready until June 1 instead of April 15 as is the most recent information we have, we would like to request additional products for our use in the interim. It would be most useful to us if we had one set each of 4 1/2-inch negatives and positives of all S192 image channels for the SL-2, June 9, 1973, pass over the Black Hills test site. With the positive transparencies we would like to try some single-channel, magnified viewing for comparison with existing S190A imagery. With the negatives we would like to make some scaled enlargements for interpretation and comparison with our existing ground truth type maps.

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

Relationships between actual measured ground parameters and CIR photo images of those parameters have been developed using 1:600 scale sampling photography. The correlation coefficient between amount of bare soil surface, as measured on the ground versus the photos, is 0.93. The herbaceous and plant litter cover were combined as a class due to the inability to discriminate between the two in the large-scale photography because of low plant density and random distribution of the individual plants. The correlation coefficient between ground estimates and photo estimates of the herbaceous litter class is 0.89. The ground/photo

relationship of shrub cover estimates is not good: $R=0.50$. This is due primarily to small sample size. We will attempt to improve this relationship. These analyses, however, provide a stage of measurement for plant communities to relate by multiple sampling to the Skylab imagery.

F. Travel Plans - March 16 to April 15, 1974

As soon as SL-4 imagery is available for viewing at JSC, Aldrich or Greentree will examine SL-2, SL-3, and SL-4 S190A imagery over a selected area in Southeastern United States. This is necessary because no Skylab imagery was ever collected over the designated Atlanta, Georgia, test site. Round trip plane fare (\$255.00) and 5 days per diem (\$125.00) for a total of \$380.00 will be required.