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CR-129130

Type 1 Progress Report

a. "Use of Satellite Imagery for Wildland Resource Evaluation."

b. GSFC Identification Number - U263

c. Statement of Problems

The ERTS imagery of the Nevada study sites has been taken during the latter portion of the growing season. In order to relate spectral differences to plant phenological stages, sequential imagery must be available throughout the growing-season. The lack of coverage has limited our evaluation of the ERTS imagery. The sequential U-s imagery taken during April, May and June were used to determine the influence of plant phenology on multidate image signatures. However, "grow-ing season" imagery from either U-2 or ERTS-1 is missing during the time period June 14 to August 10, 1972. Complete ERTS coverage will hopefully be available during the next growing season.

Color composites have not been received by the University of Nevada. We feel that color composites will add much to our study of wildland resources. The acquisition of color samples would permit a more complete evaluation of potential ERTS appli-cations.

Certain ERTS MSS frames in all bands have tended too much towards the lighter shades of the gray scale. This has caused the light colored playas and valleys to wash out, making most features blend together.

d. Accomplishments

Introduction

The first ERTS-1 data were received by the University of
Nevada in mid-September. Since that time imagery has been
sporadically received until we now have complete coverage of
Nevada and two sequential dates in central Nevada. All frame
identification numbers are included in the attached Image
Description Forms.

The information covered in this initial progress report is
concerned with all identifiable features. This was done to gain
familiarity with the data and to make scale and resolution determina-
tions. As more sequential coverage becomes available, this investi-
gation will concentrate on the seven detailed study areas outlined
in the proposal. Features subjectively studied were: cities and towns,
roads and railroads, landform features, vegetation communities, soil
surfaces, water surfaces, water courses, and recent and old fire
scars.

Scale and Resolution

Scale determinations made on the 9.5 inch transparencies
and prints appeared to be very close to 1:1 million. Ground
coverage for one ERTS frame was calculated to be approximately
12,500 square miles. The resolution of the MSS data was found
to be better than expected. One water body, 275 feet across, was
identifiable on the number seven band. More recent imagery appears
to have better resolution than that for the first date.

The cities of Reno, Las Vegas, and Carson City are easily dis-
tinguishable on all bands. The number seven band was best adapted
for identification of the smaller towns. Only a few were identifi-
able depending upon contrast between the town and surrounding terrain.

Only limited numbers of roads and railroads were visible on the
ERTS imagery. Four-lane paved roads and freeways were visible only
when they were in high contrast with the adjacent terrain. The
number seven band was found to be superior for identification of
these roads. Only rarely were two-lane paved roads identifiable.
However, many of Nevada's wide dirt roads traversing the valley
bottoms were visible due to their high reflectance. In the moun-
tainous areas no dirt roads were identifiable. The seven band was
found best for dirt road identification. Railroads were rarely
identifiable from ERTS imagery. These were identified only when
surrounding vegetation was quite dense or where large cuts were made.

Landform, Vegetation, and Soil Evaluations

An attempt was made to identify, delineate, and quantify broad
landform features (Table 1). Mountains, valleys and playas, stream
courses, canyons, and alluvial fans could be easily delineated on
ERTS imagery. The number five band was the most useful for identifi-
cation of these general landform types. Steep canyons were identi-
fied easily with the number seven band where dense phreatophytic
vegetation occurred. The large valleys and playas were easily iden-
tified on all bands.

Some broad vegetation types and zones occurring in Nevada were identified on ERTS imagery. Crested wheatgrass seedings were most easily identified, delineated, and quantified (Table 1) on the seven band. Quantification included mapping seedings and computing their area with a dot grid. The seedings reflected highly on all bands (at the dates studied) and were identified by their characteristic straight line borders. Irrigated fields and pastures were identified easily by color enhancing the number five and seven bands simultaneously. Color enhancement was performed with three 70 mm projectors utilizing various filter combinations. Exact registry was not possible with this method and therefore the resolution was much poorer than the separate frames. Results to date indicate that the number five band with a green (Wratten #61) or blue filter (Wratten #38), and the number seven band with a red filter (Wratten #25A) was the optimum combination. The four band added little to the enhancement because it washed out the scene and made registration more difficult. The number six band was not used for our color enhancements because it contained information very similar to the seven band.

Green, healthy fields reflected strongly in the infrared region and were identified easily by color enhancement. Fallow fields appeared highly reflective on all bands and therefore were identifiable. These irrigated fields were separated from the non-irrigated meadows and phreatophytic types by their constant tone and characteristic straight line borders.

Heavy timber was delineated by again enhancing the five and seven bands. No distinction could be made between coniferous types

and only dense coniferous growth could be delineated.

Mountain brush communities were identifiable only in areas where brush species were extremely dense. These areas were best identified by detecting their high infrared reflectance on the enhanced five and seven bands.

The valleys in the state are sparsely vegetated with shrubby, desert vegetation. These areas appear fine textured on ERTS imagery, and usually have a light gray tone on all bands, depending on soil type. Separations have not yet been possible for the northern desert shrub, southern desert shrub, or salt desert shrub vegetation except for geographical location and landform position. Soil surface colors seem to produce more tonal differences than do the vegetation in these valleys. The northern desert shrub and pinyon/juniper ecotone is apparent in some locations and will probably lead to a detailed mapping of this vegetation type as our study progresses.

Many phreatophytic vegetation types occurring along the Truckee River and Las Vegas Wash have been identified on ERTS imagery. This information will provide a means of estimating the amount of water these phreatophytic plants are using in our water depleted arid lands. The feasibility of this is now being evaluated in our laboratory.

The ERTS imagery is extremely well adapted for a 1:1 million scale base map for mapping vegetation. Although all vegetation zones are not visible on the imagery, this map base is extremely valuable. Field notes, reconnaissance flights, and larger scale photography will be used to map vegetation that cannot be distinguished on ERTS imagery.

Attempts to relate plant phenological events to signatures visible on the ERTS imagery have not been possible to date because only limited sequential coverage is available for the study areas. Ground phenology notes have been collected for the seven study areas for the entire growing season. We are now relating plant phenology to signatures seen on pre-ERTS multispectral and color infrared U-2 photography flown by NASA. This photography covered the study sites on three to six dates between April 3, 1972 and June 14, 1972.

The black and white multispectral U-2 bands were analyzed by assigning standard Munsell shades of gray to each vegetation type on each date. The infrared band was found to be most valuable in the detection of the various vegetation growth stages. While many vegetation types were recorded, only a few will be noted here. Annual grassland (cheatgrass) in the Reno area showed a general increase in infrared reflectivity with increased vegetative growth. Brush areas in the Reno study area showed the same relationship. Imagery was not available for the summer dormant period for these areas. We have not been able to determine the rate with which reflectance decreases as the plants begin to dry. Overexposure problems contributed to an incomplete analysis of phenology-tone signature relationships during the growing season.

The color infrared U-2 photography was also compared to vegetation phenology. The annual grasses (cheatgrass) in the Reno area were identified on the sequential photography as green and healthy from April 19 to May 5 (the best time for cattle grazing). The

May 31 photography revealed that this grass was completely dry
(past optimum period for cattle grazing), providing no reflect-
ance in the infrared region. Field observation supported this
conclusion.

In the Ruby Marsh study site (Northern Nevada) several
management units occur in which the water levels have been mani-
pulated for control of the heavy stands of bulrush (for inter-
spersion to promote duck nesting). On the April 20 U-2 photography,
three of these units appeared identical. Later photo dates revealed
higher infrared reflectance in one of the three management areas.
Ground notes showed the water level to be equal in the three areas
on April 20. Later one area was dropped to a very low water level
for bulrush control. On this area the phenology was more advanced
than the other units with a corresponding increase in infrared
reflectance.

A mountain brush community occurring in eastern Nevada was
also studied on the ground and with U-2 color infrared photography.
This important cattle and mule deer range was covered with 1 foot
of snow on April 20. By May 3, the area was free of snow but
showed no infrared reflectance (indicating a lack of spring growth).
The June 14 imagery showed this area to be growing vigorously (high
infrared reflectance). A practical use for imagery such as this
would be to use infrared photography to govern the date that cattle
would be turned onto the range. Good range management requires that
stock be kept off the range until the desirable plants have had time
to start their spring growth. It is expected that similar correlations

and associations will occur between vegetation phenological stages and actual ERTS signatures.

Other Features

The extent of water surfaces was easily evaluated with ERTS imagery. The best band found for delineation of standing water was the seven band. Water depth and/or turbidity was best evaluated by studying all four bands simultaneously. Many of the playas in Nevada appeared different on all bands indicating information content on each. We have not been able to pinpoint these differences as yet. Algae blooms were identified best at the inlet of Pyramid Lake on the number six and seven bands. This is attributable to the infrared reflectance of the algae as recorded on infrared imagery.

Recent and older fire scars were visible on ERTS imagery. Very recent burns (within a few days) appeared dark on all bands and were easily identified. Older burns (1 year or more) usually had higher reflectance than surrounding vegetation on all bands and were identified due to their light toned seral vegetation (mostly annuals). These areas are usually differentiated from crested wheatgrass seedings by their irregular outlines.

e. Significant Results:

   Accurate identification and delineation of crested wheatgrass

seedings has enabled a broad inventory of this resource. For exam-

ple, the acreage of crested wheatgrass seedings was quickly determined

(2 or 3 hours) on 12,500 square miles of central Nevada (Table 1).

The entire State of Nevada is currently being inventoried for crested

wheatgrass seedings.

   Irrigated fields and pastures may be monitored closely from ERTS

imagery. These highly infrared reflective areas are easily visible

and were quantified in total acres on 12,500 square miles of central

Nevada (Table 1).

   Recent fire scars may be monitored and inventoried from ERTS

imagery. A quantitative estimate of acreage burned may be easily

obtained. The sequential nature of ERTS data is particularly well

adapted for this type of inventory.

   Inventory and quantification of large native meadows of Nevada

have been accomplished on one frame of ERTS-1 data (Table 1). This

inventory would not have been economically feasible with any known

ground inventory method.

   The U-2 sequential data taken in the spring over Nevada revealed

several resource management oriented phenological changes in the vege-

tation. For example, (1) the "green-up," maximum growth and drying was

detected on an annual grassland near Reno, Nevada. These events are

important for determining optimum grazing dates for livestock. (2)

Water level manipulations in the Ruby Marsh were readily detected by

noting changes in vegetation growth and reflectance. (3) A mountain brush plant community occurring in eastern Nevada is an important deer and cattle use area. The "green-up" of the grasses and shrubs was detected on the imagery and supplied a good indicator for livestock "turn-out" dates.

f.   No published articles, papers, pre-prints, etc. have been released during this reporting period.

g.   No recommendations for practical change will be made at this time. Data is presently being acquired by the University of Nevada in a sporadic pattern. This will hopefully become more systematic as the NASA facility catches up with the standing orders.

h.   No changes have been made in our standing order forms.

i.   Image Descriptor Forms - attached

j.   Data Request Forms - no data request forms were submitted during this reporting period.

Table 1. Area in square miles of identifiable features for one frame
          OF ERTS imagery (12,500 square miles)* of Central Nevada.

Feature	Area (sq. mi.)	% Total Area
low or flat lying areas	1,852	14.6
alluvial fans	6,465	51.1
mountains	4,333	34.3
Total	12,650	100.0

Feature	Area (sq. mi.)	% Total Area
seedings	230	1.8
meadows	186	1.5
playas	167	1.3
irrigated fields	132	1.1

* Frame I.D. number 1018-17592-m

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ERTS IMAGE DESCRIPTOR FORM
(See Instructions on Back)

DATE _____ November 6, 1972 _____

PRINCIPAL INVESTIGATOR ___ Dr. Paul T. Tueller _____

GSFC _____ U263 _____

ORGANIZATION _ University of Nevada; Remote Sensing Lab __

| PRODUCT ID (INCLUDE BAND AND PRODUCT) | FREQUENTLY USED DESCRIPTORS* | | | DESCRIPTORS |
	Basin/Rge	Playa	Desert	
1018-18001-M	x	x	x	Mountain Lakes
1018-17585-M	x		x	Mountains
1018-17583-M			x	Agriculture
1018-17594-M	x	x	x	Desert Vegetation
1018-17592-M	x	x	x	Seeding
1034-17470-M				Agriculture, Lava
1034-17484-M	x	x	x	
1034-17473-M	x	x	x	Lake, Agriculture
1034-17475-M	x	x	x	
1035-17531-M	x		x	Seeding
1035-17525-M				Agriculture, Lava
1052-17490-M	x	x	x	Lake, City
1052-17470-M				Agriculture, Lava
1052-17472-M	x	x	x	Lake, Agriculture
1052-17484-M	x	x	x	Mountains
1052-17481-M	x	x	x	Agriculture
1052-17475-M	x	x	x	
1053-17524-M				Lava, Agriculture
1053-17531-M	x		x	Lake
1053-17540-M	x	x	x	
1053-17542-M	x	x	x	Mountains
1053-17545-M	x	x	x	Mountains
1053-17533-M	x	x	x	Marsh, Seeding
1055-18041-M		x	x	Agriculture, River
1055-18053-M	x	x	x	Lake
1055-18055-M	x		x	Lake, Mountains
1055-18044-M	x	x	x	Mountains
1055-18050-M	x	x	x	Agriculture
1056-18111-M	x	x	x	Mountains, Lake
1056-18102-M	x	x	x	
1056-18100-M		x		Lake

*FOR DESCRIPTORS WHICH WILL OCCUR FREQUENTLY, WRITE THE DESCRIPTOR TERMS IN THESE COLUMN HEADING SPACES NOW AND USE A CHECK (✓) MARK IN THE APPROPRIATE PRODUCT ID LINES. (FOR OTHER DESCRIPTORS, WRITE THE TERM UNDER THE DESCRIPTORS COLUMN).

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301-982-5406

GSFC 37-2 (7/72)

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DATE ___November 6, 1972___

PRINCIPAL INVESTIGATOR ___Dr. Paul T. Tueller___

GSFC ___U263___

ORGANIZATION ___University of Nevada; Remote Sensing Lab___

PRODUCT ID (INCLUDE BAND AND PRODUCT)	FREQUENTLY USED DESCRIPTORS*			DESCRIPTORS
	Basin/Rge	Playa	Desert	
1056-18105-M	x	x	x	Lake
1019-18041-M		x	x	Agriculture
1019-18055-M	x			Agriculture, Mountains
1019-18050-M	x	x	x	Agriculture
1019-18044-M	x	x	x	
1019-18053-M	x	x	x	Lake
1014-17375-M				Mountains
1051-17425-M			x	Mountains
1051-17432-M	x		x	Canyon
1051-17423-M	x	x	x	
1051-17434-M	x		x	Lake
1054-17594-M	x	x	x	
1054-17592-M	x	x	x	Agriculture
1054-17583-M				Agriculture
1054-18001-M	x	x	x	Mountain Lakes
1054-17585-M	x		x	Mountains
1057-18170-M				Agriculture
1057-18163-M	x	x	x	Lake
1057-18161-M	x	x	x	Lake
1057-18154-M	x	x	x	Lake

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