E7.3 10.4.5.0.
CR-131250

Type II Progress Report

March 1973

a. "Use of Satellite Imagery for Wildland Resource Evaluation in the Great Basin."

b. GSFC Identification Number - U263

c. Statement of Problems for last two months:

The exposure of the ERTS MSS imagery is a problem at times, but is considerably better than it was during the last reporting period.

Cloud cover continues to be a problem at times. Many frames are obscured by cloud formations, preventing the analysis of, and at times, identification of the area. This, of course, reduces the potential usefullness of the 18-day intervals.

Some color composites from MSS data have been received, but there is still a general lack of available MSS color data.

(E73-10450) USE OF SATELLITE IMAGERY FOR WILDLAND RESOURCE EVALUATION IN THE GREAT BASIN Progress Report (Nevada Univ.) 18 p HC $3.00 CSCL 08B

N73-20410

Unclas
G3/13 00450

Statement of Problems - Six month summary (excluding this reporting period)

Lack of suitable imagery during the growing season has been and is a problem. This imagery is necessary to relate spectral differences to plant phenological stages. Data during this time period was obtained with sequential U-2 imagery, but the exposure was generally poor.

The exposure on many dates of ERTS-1 and U-2 imagery has been a major problem. Darkness and reduction in contrast makes interpretation, and at times even identification of major features difficult. Recent dates have been much more useful.

The lack of color composites from MSS data was a problem for many months. More recently, several composites have been received and are an important aid in the evaluation of ERTS-1 imagery.

Cloud cover has been a problem; obscuring study sites and preventing adequate sequential analysis of areas for which we have ground data.

d. Accomplishments past two months:

Cloud free weather in the Great Basin has allowed complete coverage of Nevada during the past two months. Many areas are covered by more than one date. A mosaic of the state was constructed using 21 black and white prints at a scale of 1:1 million (24 by 36 inch sheet) and 1:2 million (12 by 18 inch sheet). The red band (MSS 5) was used to construct the mosaic because landform features appeared more striking. This mosaic is being used as a base to map resource features and compare changes on other imagery types and dates.

The pinyon/juniper-northern desert shrub ecotone is being evaluated by identifying individual ecotones of varying length. The success of accurately defining these ecotones on ERTS-1 imagery has been determined (Table 1). Color infrared has proven superior and was not as susceptible to error caused by the appearance of landforms as was the black and white imagery. Small amounts of infrared reflectance caused by the presence of pinyon/juniper is detectable with the Color IR imagery, thus preventing possible confusion with other features. Larger scale (1:110,000) RB57F photography and aerial reconnaissance have been used to verify the true locations of the ecotones.

With the use of a dot grid and RB57F photography, the minimum density of pinyon/juniper that can be recognized on ERTS-1 Color IR has also been determined. It was found that a density as low as 16.4 trees per acre could be seen on ERTS-1 color IR imagery if the trees were close and continuous. Areas of pinyon/juniper as small as 55 acres could be seen with a density of 29.5 trees per acre. A discontinuous area of pinyon/juniper with a broken pattern having trees only on the lower slopes of many close ridges showed sufficient reflectance to be identified only when the density exceeded 43.9 trees per acre. Generally, a pinyon/juniper community with a density of 30 trees per acre and larger than 55-60 acres can be identified on ERTS-1 Color IR imagery.

Pinyon-juniper ecotones have also been mapped using ERTS-1 Color IR imagery obtained during the winter, when snow is on the ground. This is possible because pinyon/juniper is the only vegetation type exhibiting IR reflectance at this date. It has been a very

Table 1. Success of identifying the pinyon/juniper-northern desert shrub ecotones in the Great Basin.

Imagery	% Success	% Closure	% Failure	Total no. Evaluated
ERTS 1-Fall	39.4	45.5	15.1	33
ERTS 1-Fall (Color IR)	81.8	9.1	9.1	11
ERTS 1-Winter	54.5	33.3	12.2	33
RB57F - 1:110,000	100.0	0.0	0.0	33
Total (ex. RB57F)	51.9	35.1	13.0	77

difficult task to do this without the aid of color composites. Some images have been enhanced on the I^2S Corporation's Addcol Viewer, and more recently, we have used color composites made from diazochrome transparencies. These have proven to be very valuable for our work.

The presence of snow has also aided in the identification and delineation of crested wheatgrass seedings previously undetected on ERTS MSS imagery. Since there is no occurence of shrubby vegetation in seedings, the snow covers all vegetation and gives the seedings a distinct appearance.

Wildfire scars, both recent and old, are being inventoried and monitored. A quantitative estimate of the number of acres burned may be obtained easily. We are identifying these burns by relative age: less than one year, 1-10 years, and over 10 years. These are fairly rough estimates and are based on secondary succession textural changes.

Standing water surfaces were inventoried using mid-September imagery as a base. Reservoirs, lakes and ponds were identified on MSS 7 images (Table 2) and named from existing topographic maps. The surface area was quantified by acreage using a system similar to that described earlier. Each water surface is being analyzed for area changes on new imagery as it becomes available. These changes can be related to water consumption, evaporation, climatic conditions, and amount of potential irrigation water available, all of which are important considerations in the arid Great Basin. Freezing and thawing are also being evaluated. A technique is currently being developed to assign a gray scale to each water body on each MSS band to correlate with water turbidity.

Inputs on a few lakes or reservoirs that are being monitored can provide correlative data that can be extrapolated to remote water surfaces. For example, the thawing date of a reservoir will affect the type of recreation potential. The freezing date of another pond may limit its value for waterfowl use.

Landforms are being mapped on a 1:1 million scale base mosaic.

Table 2. Standing water resources inventory from selected Nevada Counties.

Counties	Acres	%
Washoe	128,488	43.4
Mineral	37,890	12.8
Clark	65,842	22.1
Douglas	18,949	6.4
Churchill	10,579	3.6
Pershing	9,657	3.3
Total	271,405	91.6
Total in Nevada	295,872	100.0

Because of its high resolution, the MSS 5 band is used to locate landform boundaries. This information can be used to properly manage land for wildlife, vegetation, recreation, water resources, and for any other management application where data on landforms can be helpful. The geologic and meteorologic applications are obvious.

Phreatophytic vegetation is being mapped, using ERTS-1 Color IR composites and MSS 7 band imagery, and quantification is nearly complete. The location of phreatophytes can give a fairly reliable indication of the presence of water above or near the soil surface, which will in turn enable land use planners to find new sources of water for municipal and agricultural consumption.

Accomplishments - Six month summary (excluding this reporting period)

Upon receipt of ERTS-1 imagery, scale and resolution determinations were made. It was found that the scale was quite close to the anticipated 1:1 million, and that each ERTS-1 frame had a coverage of approximately 12,500 square miles. A water body 275 feet across was identified on the MSS 7 band as a determination of (maximum) resolution.

Large cities (Reno, Las Vegas, Carson City) were easily distinguished on all bands. Paved highways and railroads were able to be identified but only when there was extreme contrast between these structures and the surrounding areas. Large dirt roads were identified using the MSS 7 band due to their high reflectivity. Landforms were identified on all bands, but the MSS 5 band proved superior in this respect.

Vegetation of varying types was identified using the MSS 7 band. Crested wheatgrass seedings were identified, delineated, and quantified according to county and land status. Fields and agricultural areas were identified as was phreatophytic vegetation. Timber, pinyon-juniper, sagebrush, mountain brush, and annual grassland communities were identified on selected frames of ERTS-1 imagery.

Phenology comparisons of selected test sites were made using available sequential U-2 imagery. It was found that gray scale and color IR changes relating to the phenology of certain annual grassland, mountain brush, and marsh communities could be identified.

Poor exposure and coverage precluded an adequate analysis.

Color enhancement was tried with selected ERTS-1 frames, and it was found that the best method was to use a green or blue filter on the MSS 5 band and a red filter on the MSS 7 band. The MSS 4 and 6 bands were not used because they added little or no valuable information. Resolution was poor with this technique but fair results were obtained. Recent work with diazachrome transparencies is showing considerable promise. For example, winter scenes inhanced with diazachrome film transparencies are very valuable for mapping vegetation.

Water bodies were identified and delineated using the MSS 7 band. Turbidity of different water bodies were analyzed by assigning gray scales to bands 4 and 5. Turbidity also showed up nicely on the color composites in different shades of blue.

e. Significant Results - Six Month Summary

The major thrust of our investigation has been to study the practical uses of ERTS-1 as related to natural resources management. The first of these uses has been inventory of natural resource features. Along with this we are studying change detection, which goes a step beyond inventory and provides systematic time dependent data useful to resource managers.

Early in our studies we evaluated a single frame of 12,500 square miles in Central Nevada. The total area of such features as seedings, meadows, playas, irrigated fields, alluvial fans, mountains, and lowlands was obtained successfully in 3 man days. These data are shown in a previous progress report. All bands were useful, but the MSS 5 and 7 bands proved to be superior for the identification of landform and vegetation features, respectively. More recently NASA generated color composites and diazochrome transparencies have proven their usefulness to us. Of particular value have been winter dates for evaluating features such as pinyon/juniper distribution. The value of sequential imagery seems very clear.

Native vegetation has been plowed and planted to introduced grasses to increase grazing potential. These crested wheatgrass seedings have been thoroughly and accurately quantified using a mid-September ERTS date, and more recently, winter dates with snow cover have aided in identification of seedings not previously detected. Seedings were easily identified because they are highly reflective and generally have a straight-line border which contrasts with the surrounding vegetation. Identification in some cases was confirmed with larger scale aerial photography and field checks. Quantification (in acres) was accomplished using various dot grid and millimeter square techniques. Acreage was determined by ownership or administration: public, private, Bureau of Land Management, Forest Service, and others.

By comparing seedings at different dates, it seems apparent that differences due to moisture condition, maturity, and successional stages can be detected. These data will enable the land manager to evaluate the relative condition of the seedings and to properly manage them in relation to grazing and brush control.

In the same manner, water bodies within the state have been identified and their acreages computed. The MSS 7 band proved most useful for delineation purposes, but by comparing all of the bands, the water bodies can be rated as to turbidity. By contrasting the surface areas of the same water body on two different dates, relative water use can be estimated. Freezing and thawing of these bodies can also be detected using ERTS-1 imagery. This information is proving extremely valuable to people concerned with water resources. The relative "cleanliness" of a lake, as well as its freezing and thawing dates, affects its potential for municipal, recreation, and wildlife uses. The knowledge of the approximate volume of a reservoir gives an indication of the water situation in a city and county. Water is a precious, valuable resource in arid Nevada, and to provide for the needs of all the inhabitants, be it man or beast, the water must be monitored closely. ERTS-1 imagery is proving to be valuable in this respect and has already served to update relatively recent water resource maps of the Nevada Division of Water Resources.

Playas have also been inventoried, again using ERTS-1 imagery and various dot grid techniques. Playas have no great value in most of Nevada, but by comparing them over different dates, we can get a good idea of the relative moisture content of the surrounding areas. Dry playas show high reflectivity and appear almost white on all MSS bands. As the playas become moist, they appear darker. Knowledge of the moisture condition of these playas, and the subsequent knowledge of the moisture content of the surrounding areas we think will enable the resource manager to predict the future condition of the forage resource. A good year for forage may show up as a year when many of the playas were moist during the winter and spring.

The U-2 sequential data taken in the spring over Nevada revealed several resource management oriented phenological changes in the vegetation. 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.

A vegetation map of the entire state of Nevada is a major objective of this investigation. Seedings have been mapped as a result of the inventory work. Pinyon/juniper ecotones and phreatophytic vegetation have been mapped with considerable success. A comparison of pinyon/juniper identification on different imagery has been completed, and it was found that color IR composites provide the greatest accuracy in delineating ecotones. Phreatophytic vegetation is easily delineated with the use of color IR composites particularly on snow-covered terrain.

The knowledge of the location of phreatophytic vegetation provides for an understanding of Nevada's water resources. This vegetation type is a good indicator of the presence of water, be it surface or subsurface. Proper location of residential and agricultural developments with regard to water availability can be assumed using this information gathered from ERTS-1 imagery.

The presence of pinyon/juniper is an indication of a greater availability of moisture than is found in the lower, more arid, sagebrush zones. It is also an indicator of good wildlife habitat, or at least of areas which can be improved for wildlife. The resource manager can use this information regarding the distribution of pinyon/juniper to make plans for developing range or wildlife habitat improvements, and thereby increase the recreational resources in Nevada.

Using cloud free imagery, a mosaic of the state of Nevada has been constructed. This is proving to be very valuable to many researchers and agencies throughout the state as well as numerous private individuals. Not only does it provide a superb base for mapping natural resource features, but this mosaic enabled one to grasp many concepts relating to Nevada with one overview of the state. Geologic information, such as fault lines and mountain formations can be readily observed. Soil types can be delineated. Population growth can be mapped, as can water availability, wildlife habitat distribution, and a host of other information important to the agencies and people of Nevada. Also, it is upon this mosaic that our final vegetation map shall be produced. This will be especially valuable to resource and agricultural agencies in making management decisions. In addition, a state-wide land use plan map is being constructed in cooperation with state agencies using the mosaic as a base. Decisions may be made faster, more accurately, and less expensive with the use of this mosaic.

f. Published articles, papers, pre-prints, etc. released during this reporting period:

1. Tueller, Paul T. and Garwin Lorain, 1973. ERTS-1 Evaluations of Natural Resources Management Applications in the Great Basin. Proceedings 1st ERTS-1 Symposium on Significant Results. March 5-9, 1973. 9pp.

g. No recommendations for practical change will be made at this time.

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

i. Image Descriptor Forms - attached

j. Data Request Forms - none

B

ERTS IMAGE DESCRIPTOR FORM

(See Instructions on Back)

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DATE March 25, 1973

PRINCIPAL INVESTIGATOR Dr. Paul T. Tueller

GSFC U 263

ORGANIZATION University of Nevada

PRODUCT ID (INCLUDE BAND AND PRODUCT)	FREQUENTLY USED DESCRIPTORS* basin range	playa	desert	DESCRIPTORS
1123-17432 M	x	x	x	
-17434 M				mountains
-17441 M	x		x	canyon
-17443 M	x	x	x	lake
1122-17385 M	x	x	x	
1125-17533 M	clouds			
-17540 M	clouds			
-17542 M	x	x	x	marsh, seeding
-17545 M	x	x	x	
-17551 M	x	x	x	mountains
-17554 M	x	x	x m	mountains
1127-18050 M				agriculture
-18053 M	x	x	x	mountains
-18055 M	x	x	x	agriculture
-18062 M	x	x	x	lake
-18064 M	x		x	mountains, lake
1129-18163 M	x	x	x	lake
-18165 M	x	x	x	lake
-18172 M	x	x	x	lake
-18174 M	x		x	mountains, lake, agriculture
1130-18224 M				mountains
1124-17475 M				agriculture
-17481 M	x	x	x	lake, agriculture
-17484 M	x	x	x	
-17490 M	x		x	agriculture, mountains
-17493 M	x	x	x	mountains
-17495 M	x	x	x	lake, urban
1128-18114 M	x	x	x	lake
-18120 M	x	x	x	mountains, lake
1143-17533 M				agriculture
-17540 M	x		x	lake
-17542 M	x	x	x	marsh, seeding
-17545 M	x	x	x	

*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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GSFC 37-2 (7/72)

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DATE March 25, 1973

PRINCIPAL INVESTIGATOR Dr. Paul T. Tueller

GSFC U-263

ORGANIZATION University of Nevada, Reno

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PRODUCT ID (INCLUDE BAND AND PRODUCT)	FREQUENTLY USED DESCRIPTORS* basin range	playas	desert	DESCRIPTORS
1143-17551 M	x	x	x	mountains
-17554 M	x	x	x	mountains
1144-17592 M			x	agriculture
-17594 M	x		x	mountains
-18001 M	x	x	x	seeding
-18003 M	x	x	x	
-18010 M	x		x	mountains
1126-17594 M	x		x	mountains
-18001 M	x	x	x	seeding
-18003 M	x	x	x	
-18010 M	x	x	x	
1140-17385 M	x	x	x	
1141-17432 M	x	x	x	
-17435 M				mountains
-17441 M	x		x	canyon
-17444 M	x	x	x	lake
1159-17431 M	x	x	x	
-17433 M				mountains
-17440 M	x		x	canyon
17442 M	x	x	x	lake
1164-18103 M		x		lake
-18105 M		x	x	agriculture
-18112 M	x	x	x	lake
-18114 M	x	x	x	mountains, lake
1160-17474 M				agriculture
-17480 M	x	x	x	lake, agriculture
-17483 M	x	x	x	
-17485 M	x	x	x	agriculture
-17492 M	x	x	x	mountains
-17494 M	x	x	x	lake, urban
1161-17532 M				lava, agriculture
-17534 M	x		x	lake
-17541 M	x	x	x	marsh, seeding

*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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PRODUCT ID (INCLUDE BAND AND PRODUCT)	FREQUENTLY USED DESCRIPTORS* basin range	playa	desert	DESCRIPTORS
1161-17543 M	x	x	x	
-17550 M	x	x	x	
-17552 M	x	x	x	mountains
1162-17593 M	x		x	mountains, lake
-17595 M	x	x	x	seeding
-18002 M	x	x	x	
-18004 M	x	x	x	
1163-18051 M	x	x	x	mountains
-18054 M	x	x	x	
-18060 M	x	x	x	lake
-18063 M	x		x	lake, mountains
1165-18161 M	x	x	x	lake
-18164 M	x	x	x	lake
-18170 M	x	x	x	lake
-18173 M				agriculture
1176-17382 M	x	x	x	
-17385 M	x	x	x	
1178-17474 M				agriculture
-17481 M	x	x	x	lake, agriculture
-17483 M	x	x	x	
-17490 M	x	x	x	agriculture
-17492 M	x	x	x	lake, urban
-17495 M	x	x	x	lake
1179-17552 M	x	x	x	mountains
1180-17590 M	x	x	x	mountains
-17592 M	x		x	mountains, lake
-17595 M	x	x	x	seeding
-18001 M	x	x	x	
-18004 M	x	x	x	
1181-18044 M				agriculture
-18051 M	x	x	x	mountains
-18053 M	x	x	x	
-18060 M	x	x	x	lake

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ORGANIZATION University of Nevada, Reno

PRODUCT ID (INCLUDE BAND AND PRODUCT)	FREQUENTLY USED DESCRIPTORS*			DESCRIPTORS
	basin range	playa	desert	
1181-18062 M	x		x	mountain, lake
1182-18103 M		x		lake
-18105 M		x	x	agriculture
1183-18164 M	x	x	x	lake
-18170 M	x	x	x	lake
-18173 M				agriculture
1184-18220 M				mountains, lake
-18222 M				mountains, lake, agriculture
1194-17385 M	x	x	x	
-17391 M	x	x	x	

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