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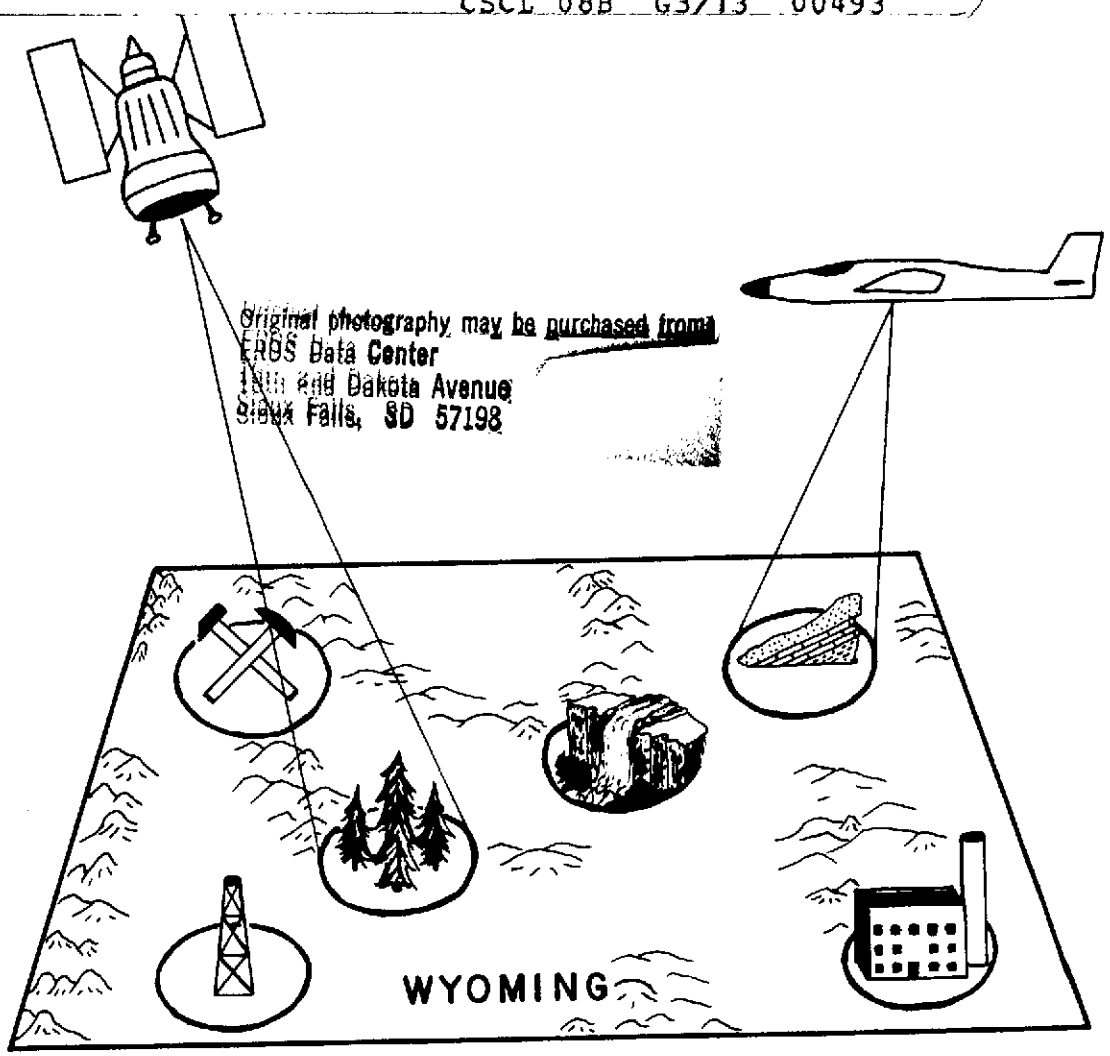

Range Vegetation Type Mapping and Above-Ground Green Biomass Estimations Using Multispectral Imagery

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16. Abstract

Range vegetation types have been successfully mapped on a portion of the 68,000 acre study site located west of Baggs, Wyoming, using ERTS I imagery. These types have been ascertained from field transects over a five year period. Comparable studies will be made with EREP imagery. Above-ground biomass estimation studies are being conducted utilizing double sampling techniques on two similar study sites. Information obtained will be correlated with percent relative reflectance measurements obtained on the ground which will be related to image brightness levels. This will provide an estimate of above ground green biomass with multi-spectral imagery.

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Figure 2. Technical Report Standard Title Page

PART 1

1.1 The Project

The Department of Geology, through the Remote Sensing Section, has enlisted the help of a Range Management Graduate Student, Robert C. Gordon, to assist in the assessment of ERTS-1 imagery for range inventory work.

1.2 The Range Management Project

The Range Management Project is twofold: It's objectives are to use ERTS-1 imagery to map range vegetation type boundaries and to use plant reflectance to estimate above ground green biomass.

The first objective was chosen to determine the usefulness and degree of accuracy available to researchers interested in the delineation of vegetation types by using satellite imagery. The second objective was taken to show that more than the mapping of vegetation boundaries can be accomplished by using this new resource inventory tool.

The use of satellite imagery will not eliminate all ground checks and biomass estimations, but will hopefully reduce the amount of time required for them and allow more time and manpower for other projects.

1.3 Work Schedule

The project period will be two full years. This will allow two summers of data collection and sufficient time during the school year for analysis of data, preparation of a final report and completion of the student's Master's degree requirements. The final composite report will be submitted in December of 1974.

The project itself is broken into two basic parts. The first compares ERTS imagery and data to aircraft photography and ground truth information.

The second portion is a three-way comparison concerning the amounts of data from ERTS-1 and aircraft and ground truth to EREP data collected for the same area.

PART 2

2.1 Study Site

The study site is located west of the town of Baggs in southwestern Wyoming (Fig. 1). It is comprised of 68,000 acres of rest rotation pasture supervised by the Bureau of Land Management. The variety of topography and vegetation types qualify the area as an excellent test location. Background information on the vegetation of the study site is provided by five annual reports concerning grazing system research between 1967 and 1971 (Fisser & Gibbens 1971; Gibbens et al. 1968, 1969; Gibbens & Fisser 1970, 1972). This study was conducted by the University of Wyoming as a cooperative research report to the Bureau of Land Management.

2.2 Methodology

2.2.1 Vegetation Mapping

Vegetation types delineated from ERTS bands 4, 5, 6, 7 at the smallest possible scale and then transferred to base maps of 1:24,000. Vegetation base maps are compiled from ground reconnaissance supplemented by low altitude imagery.

The accuracy of the ERTS based maps is compared using transparent overlays placed on the field checked range types. The accuracy of the ERTS-1 based maps is compared to transparent overlays of aircraft and ground checked maps. Similar comparisons will also be made using maps of the vegetation types prepared from EREP imagery when it becomes available.

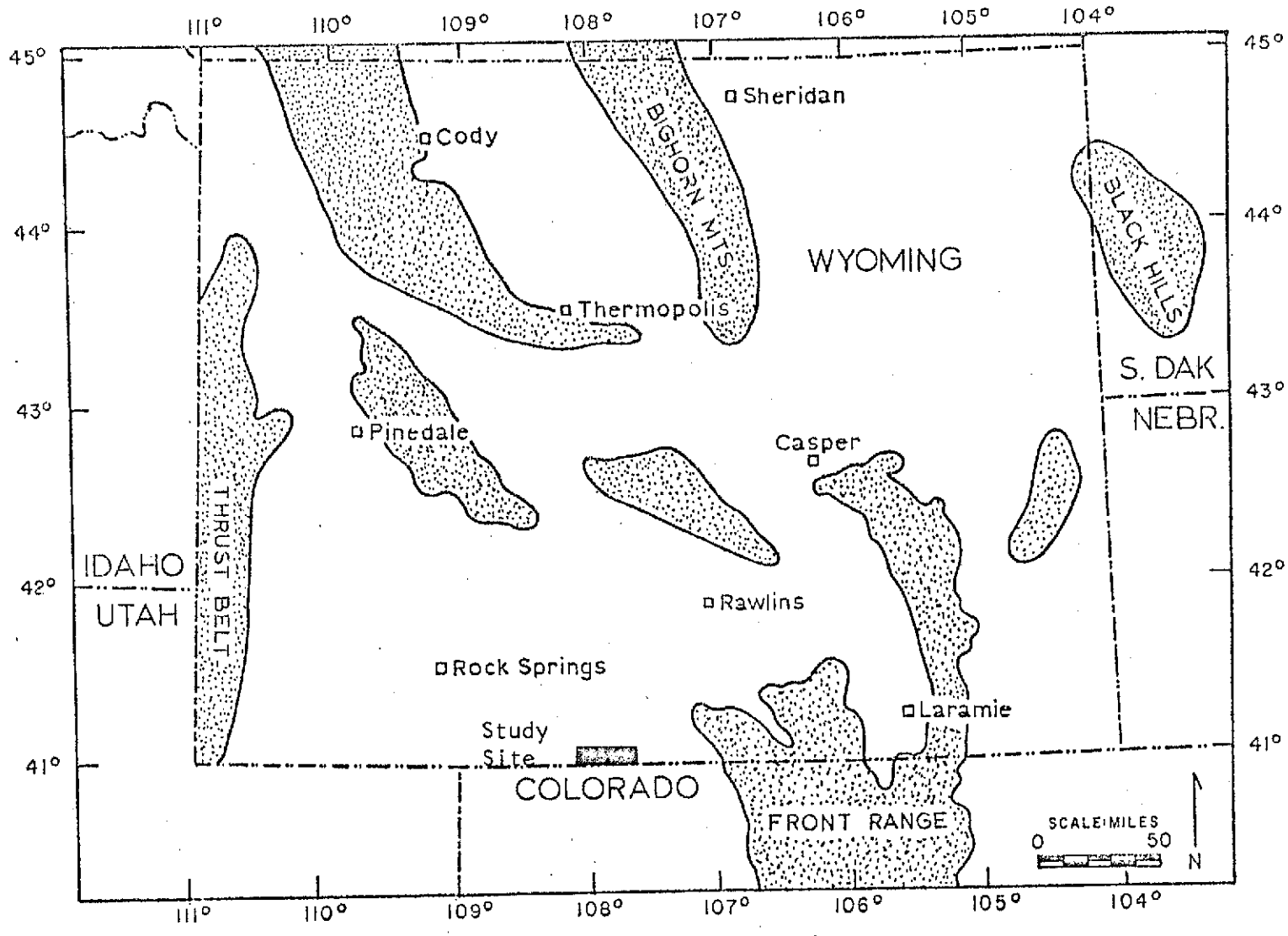

Figure 1 - Index map of Baggs Study site.

2.2.2 Above Ground Green Biomass Estimations

The above ground green biomass of two sites within the study area will be estimated by relating green biomass to reflectance. The information required to establish this relation was collected by the following methods.

Ten representative plots, two meters by three meters, were established on the two selected sites and reflectance measurements were taken of these plots during the ERTS overpass. Soil moisture, texture and color estimates will also be obtained on these sites.

Plot reflectance is measured in the same 4 bands as the ERTS imagery using a multispectral camera array. A photometer and filter cards are used to obtain relative reflectance values in all four bands. Plot and percent reflectance are taken at a constant angle, height, time and location. Both measurements include the entire study plot. (Fig. 2).

In addition to the 20, two by three meter, representative plots, 125 biomass sampling plots were established on each of the 2 sites (Fig. 3). Twenty-five plots per site were measured for emittance and above ground green biomass after each summer overpass of the satellite. The oven dry weight of all the shrubs and grasses and forbs were estimated by a double sampling technique. The amount of litter was also obtained along with soil type, texture, color and moisture content estimations (Fig. 4).

After the fourth overpass, one transect on each site, a total of 50 plots, was clipped bare, and the samples oven-dried to test the accuracy of the double sampling method.

Photometer measurements and biomass data from one of the sites will be graphed to establish a regression line on which the emittance readings from the second site may be plotted to estimate its above ground green biomass.

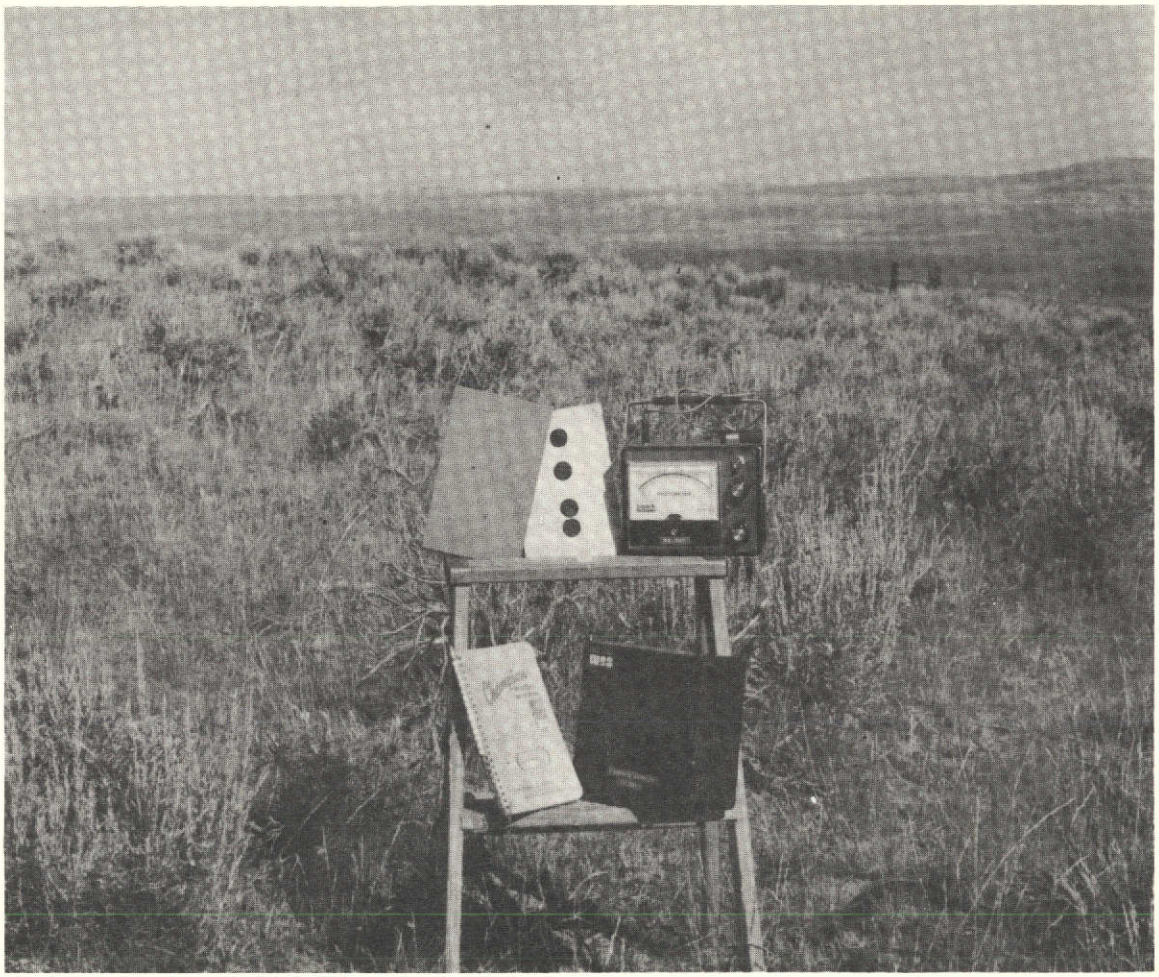

Figure 2 - Relative Reflectance Measurement Equipment - includes photometer, filter card, and standard grey card.

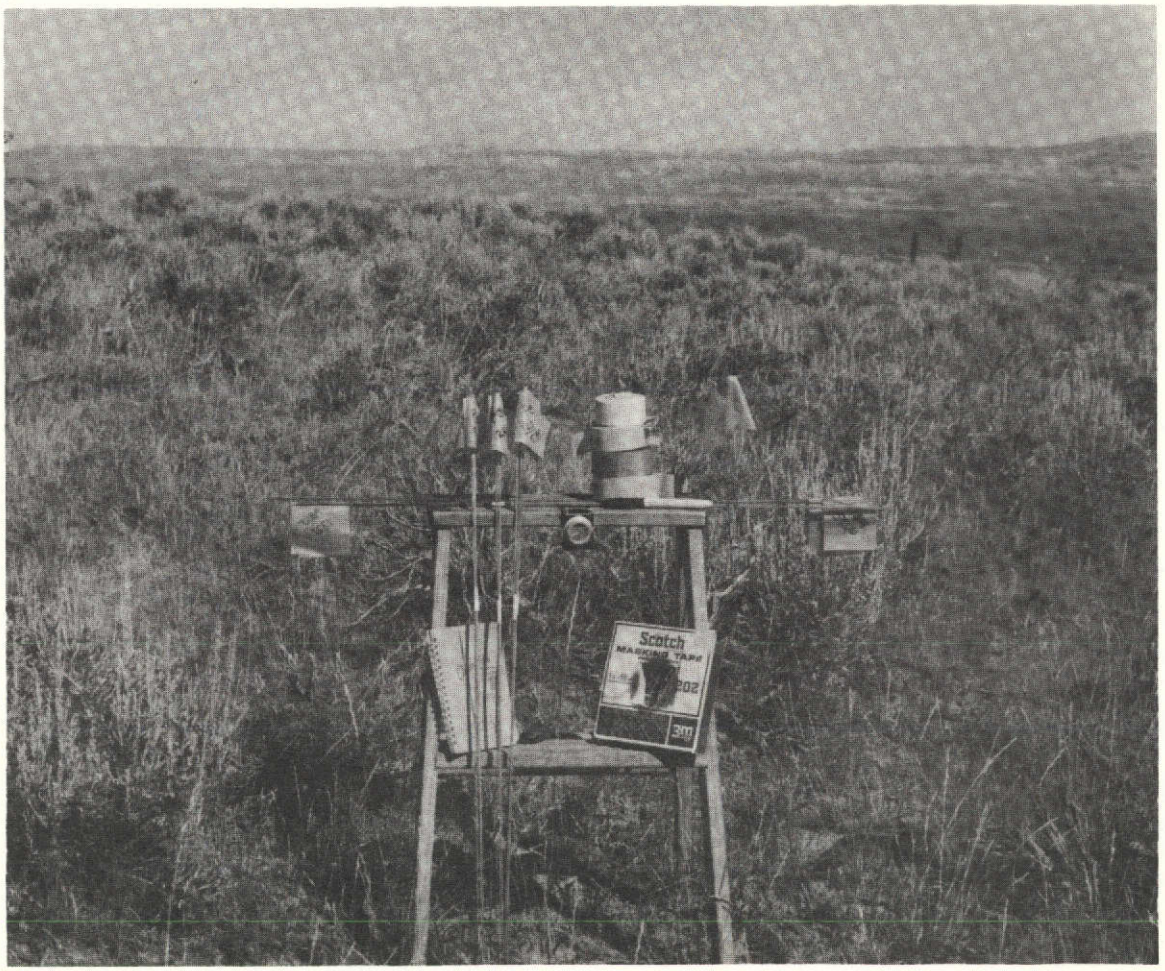

Figure 3 - Equipment used to locate transects and plots

Figure 4 - Equipment used to clip plots for above-ground green biomass check. Soilmoisture bags are also shown.

Biomass data collected for the second site will serve as a check. The biomass estimation technique will be tested on other areas if successful at the Baggs site.

PART 3

Progress:

The summer field season was utilized to collect data pertaining to the classification and mapping of vegetation types and estimations of the above ground green biomass.

To date, broad vegetation-type base maps have been prepared from aerial photographs and ground reconnaissance (Fig. 5). A comparison of a large section of the study area base vegetation map with a map produced from ERTS-1 imagery showed a high correlation for the broad vegetation types. The ERTS-1 imagery band 5 enlarged to 1:250,000 (Fig. 6) and then transferred to a base map at 1:24,000 (Fig. 7). The high correlation exhibited between the broad vegetation type boundaries did not extend to the smaller vegetation types which are distinguishable on lower altitude images. This problem may possibly be eliminated using the better imagery obtained after this preliminary overlay was produced and by improved enlargement quality. The images received during the 1973 field season have been viewed and those taken on June 3, July 12, July 30, and Aug. 17, 1973 and in bands 5 have the highest potential. Photographs of vegetation types on the entire study have been recorded and organized for reference.

All of the above ground green biomass samples have been air dried, oven dired, weighed and tabulated and at present await further analysis. Soil. moisture samples have also been oven dried, weighed to the nearest one hundredth gram and tabulated.

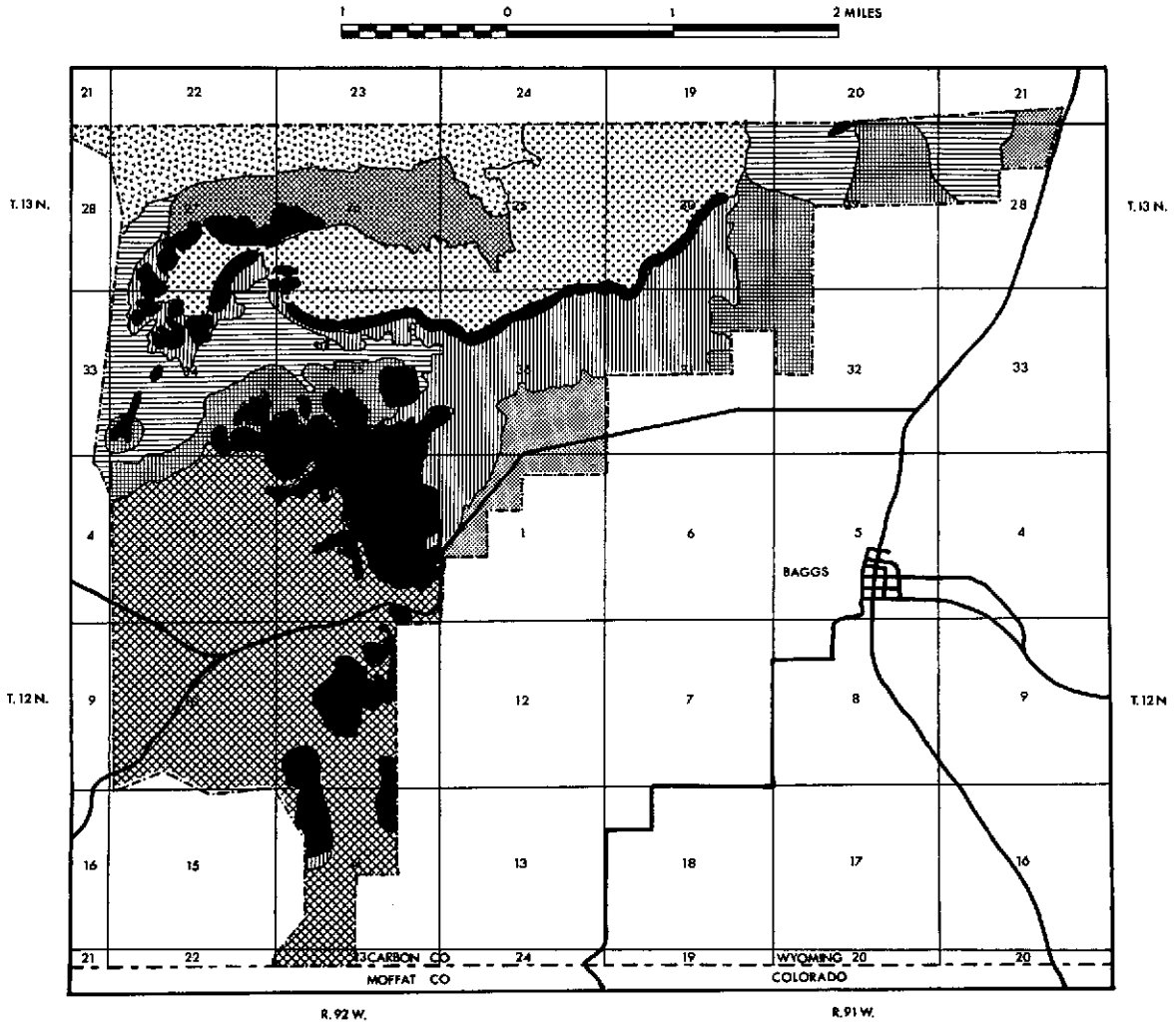

Figure 5. Vegetation Map Compiled From Low Level Imagery Supplemented With Ground Reconnaissance

Type Ia. Artemesia tridentata--Agropyron smithii: Basin big sagebrush and Western wheatgrass

Ib. Artemesia tridentata--Agropyron smithii

Ic. Artemesia tridentata--Agropyron smithii

Id. Artemesia tridentata--Agropyron smithii

Type II Juniperus osteosperma: Utah juniper

Type III Sarcobatus vermiculatus: Black greasewood

Type IV Agropyron smithii: Western wheatgrass

Type V Sprayed Artemesia tridentata--Agropyron smithii: Sprayed Basin big sagebrush and Western wheatgrass

Type VI Barren: lichens and bare ground

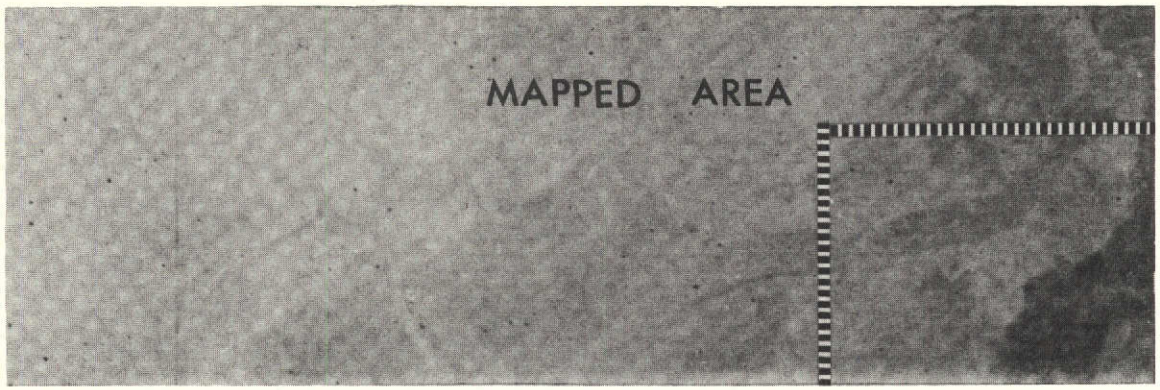

Figure 6 - ERTS-1 Image of Baggs Study Site. Scale 1:250,000

Image No. 1030-17242 Band 5

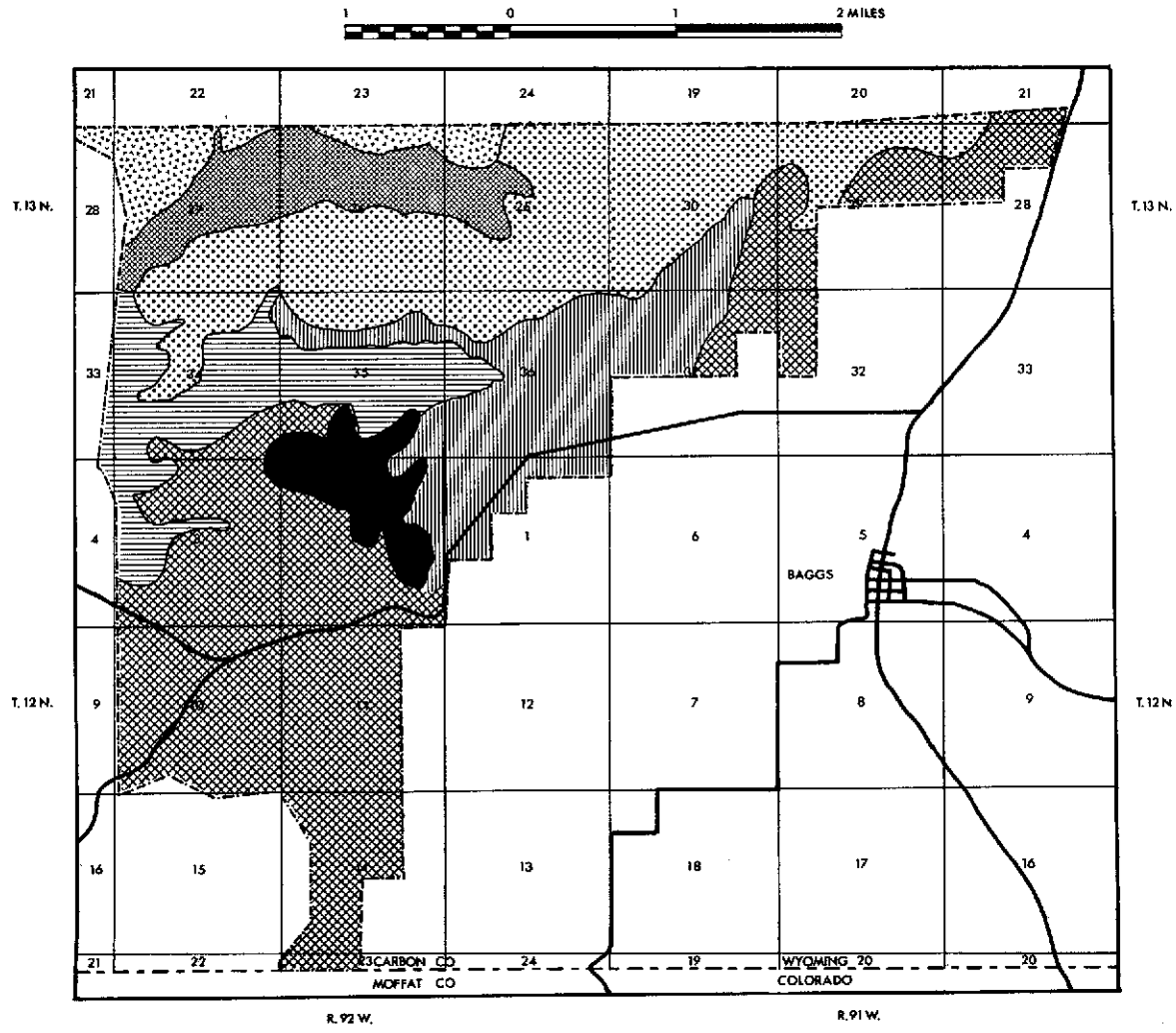

Figure 7. Vegetation Map Compiled From ERTS-1 Imagery

Type Ia. Artemesia tridentata--Agropyron smithii: Basin big sagebrush and Western wheatgrass

Ib. Artemesia tridentata--Agropyron smithii

Ic. Artemesia tridentata--Agropyron smithii

Id. Artemesia tridentata--Agropyron smithii

Type II Juniperus osteosperma: Utah juniper

Type III Sarcobatus vermiculatus: Black greasewood

Type IV Agropyron smithii: Western wheatgrass

Type V Sprayed Artemesia tridentata--Agropyron smithii: Sprayed Basin big sagebrush and Western wheatgrass

Type VI Barren: lichens and bare ground

PART 4

4.1 Problems:

The primary difficulty found to date lies in the delineation of the smaller vegetation types on ERTS-1, color and black and white imagery. This difficulty arises from one or more of the following reasons:

1. cloud cover and haze on ERTS imagery
2. shadow effects on ERTS-1 imagery especially on north-facing slopes
3. poor quality of processing on low-altitude black and white and color imagery from Mission 213.

The delineation of these small vegetation types cannot be overlooked because of their potential value to the management offices of the state in monitoring the pasture system and, with the development of advanced machinery, a precise type map will be required to test the significance of maps made on these new machines using the ERTS imagery.

4.2 Solutions

The aforementioned problems may possibly be corrected by reprocessing of aerial photograph techniques, by ratioing images to eliminate shadow, through analysis of computer tapes and the advancement of analytical machinery.

Future Work:

During the 1974 summer sesason data will again be collected for above-ground green biomass estimation as well as soil moisture information. Information on vegetation spectral emittance will also be collected on previously tested sites with the possibility of extending emittance data collection to several other vegetation types. Also, as only macro vegetation types were

considered during the initial study period, greater emphasis will be placed on the delineation of the smaller vegetation types. This will lead to the establishment of additional plant frequency transects that can be directly compared to existing data collected for the area from a previous study conducted from 1967-1971. The final report of this project will be submitted in December of 1974.

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