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AN INTEGRATED STUDY OF EARTH RESOURCES IN THE STATE OF CALIFORNIA BASED ON SKYLAB AND SUPPORTING AIRCRAFT DATA

A report of work done by scientists
on 2 campuses of the University of
California (Berkeley and Riverside) and
of the California office of the Bureau of Land
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UNIVERSITY OF CALIFORNIA, BERKELEY

AN INTEGRATED STUDY OF EARTH RESOURCES IN
THE STATE OF CALIFORNIA BASED ON
SKYLAB AND SUPPORTING AIRCRAFT DATA
(EPN NO. 454)

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Chapter 1 SKYLAB DATA AS AN AID TO RESOURCE
MANAGEMENT IN NORTHERN CALIFORNIA
(EPN NO. 454, TASK 4.3) ✓

Chapter 2 USE OF SKYLAB DATA TO ASSESS AND
MONITOR CHANGE IN THE SOUTHERN
CALIFORNIA ENVIRONMENT
(EPN NO. 454, TASK 4.6)

and ✓

THE CALIFORNIA DESERT PROGRAM --
RESOURCE INVENTORY AND ANALYSIS
(EPN NO. 454, TASK 5.0)

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Chapter 1

SKYLAB DATA AS AN AID TO RESOURCE MANAGEMENT IN NORTHERN CALIFORNIA (EPN NO. 454, TASK 4.3)

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1.1 INTRODUCTION

The time lag involved with receiving "clean" Skylab S192 data has provided an opportunity to apply multistage sampling procedures and manual photo interpretation techniques to demonstrate a timber inventory with Skylab S190 photography as the first stage. This study is intended as a demonstration of a resource inventory, for a reasonably large area, that is timely, cost-effective, and can be performed without need for a computer. The research work as originally proposed will be completed when the necessary data becomes available (see Quarterly Progress Report, 30 November 1973) and this demonstration project will be done in addition.

1.2 WORK PERFORMED DURING THE PERIOD COVERED BY THIS REPORT

1.2.1 Selection of a Study Area

An area closely approximating that found on the USGS Bucks Lake quadrangle has been located on a Skylab S190 color infrared transparency and enlarged to a scale of (1:170,000) on an 8 x 10 inch print. The area, 12 miles by 16 miles on the ground, was chosen previously for discriminant analysis and has been selected for this project as well, for comparison purposes.

1.2.2 Volume Estimates by Human P.I.'s

The selected area has been divided into 48 squares, each 2 miles on a side. Within each square, interpreters have estimated the percentages of the area occupied by (1) a timber density of less than 10,000 bd. ft. per acre, (2) a timber density of 10,000 - 20,000 bd. ft. per acre, (3) timber density greater than 20,000 bd. ft. per acre, and (4) non-timber (brush, hardwoods, bare soil, rock, grass, etc.). The interpreters based their estimates on comparisons with training areas

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chosen from 1:120,000 scale color infrared photography acquired by the RB57 aircraft.

1.3 WORK PLANNED DURING THE NEXT REPORTING PERIOD

1.3.1 Selection of Blocks for Subsequent Aerial Photography Acquisition

The percentage volume class estimates will be weighted as follows: (1) less than 10,000 bd. ft. per acre = 0.5; (2) 10,000 - 20,000 bd. ft. per acre = 1.5; (3) greater than 20,000 bd. ft. per acre = 2.5; and (4) non-timber = 0. For each block the volume estimate will be multiplied by the appropriate weight and a weighted total for the block will be calculated. A number of the blocks will be chosen for further analysis by list sampling the weighted totals of the blocks. The list sampling procedure provides for the probability of selection of the blocks to be proportional to their estimated volumes (variable probability sampling).

1.3.2 Selection of Flight Lines and Photo Acquisition

Each block selected in the step above will be divided into five (5) flight lines. Each flight line will be a rectangular area 2 miles long and approximately 2,100 feet wide. The chosen blocks will be delineated on high altitude 1:60,000 photography, and the flight boundaries will be added at that point. For each flight line the gross timber volume will be estimated based on the percentages of the four volume classes present, similar to the blocks above. A number of the flight lines, then, will be chosen for further analysis by again sampling the weighted total volume estimates with probability of selection proportional to estimated volume.

Two 35 mm cameras will be used to obtain low altitude photography of the selected flight lines at two different scales. A 24 mm focal length wide-angle lens will be used to acquire coverage of each line at an approximate scale of 1:7,500 and a 200 mm focal length lens will obtain large scale stereo triplets, scale approximately 1:1,000, from which to make precise photo estimates of timber volume.

1.3.3 Timber Volume Estimates on Low Altitude Photography of the Flight Lines

A skilled photo interpreter will estimate the volume found within an accurately drawn .4 acre circular plot to be located in the center of the center photo of each large scale stereo triplet on each line. The .4 acre plot will be delineated after calculating the scale of each photo to achieve a high degree of accuracy in plot size. The volume estimates will be totaled and also a running total is kept to facilitate list sampling procedures to choose the plots to be visited on the ground (chosen based on probability proportional to estimated volume).

1.3.4 Selection of Trees for Precise Ground Measurement of Timber Volume

All trees of merchantable size within each selected photo plot will be pinpricked and numbered. For each tree, some relative measure of individual tree volume will be applied to obtain tree volume estimates. For each plot a small number of trees will be selected with probability proportional to size (list sampling) to be precisely measured by a dendrometer on the ground.

The dendrometer measurements will be used to arrive at calculated tree volumes which in turn will be expanded, based on the probability sampling design, to estimate the total timber volume present on the 192 square mile test area.

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Chapter 2

USE OF SKYLAB DATA TO ASSESS AND MONITOR CHANGE IN THE SOUTHERN CALIFORNIA ENVIRONMENT (EPN NO. 454, TASK 4.6)

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THE CALIFORNIA DESERT PROGRAM -- RESOURCE INVENTORY AND ANALYSIS (EPN NO. 454, TASK 5.0)

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2.1 INTRODUCTION

Skylab research accomplishments to date at the Riverside campus have been limited. Because of prevailing inclement weather over a significant portion of the test site during the initial Skylab pass, only marginally useful imagery had been received and analyzed. Additional imagery of a portion of our study site has been received and is now being analyzed. Research being accomplished focuses on studies in the Mojave Desert, along the Colorado River and the Delta, and in the Coachella-Imperial Trough. Abstracts of these studies follow under Section 2.2.

2.2 WORK PERFORMED DURING THE PERIOD COVERED BY THIS REPORT

2.2.1 A Remotely Sensed Evaluation of the Tectonic Controls

Affecting Resource Distribution in a Portion of the Mojave

Desert and Coachella-Imperial Trough, California

The purpose of this project is to assess the tectonic controls important in resource distribution in portions of the Mojave Desert and Coachella-Imperial Trough with the aid of remotely sensed imagery.

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Rather than assess all of those resources that would be affected by tectonic controls; e.g., groundwater, oil and gas, minerals deposits, and geothermal energy, none of these resources will be evaluated in each of the two study areas.

The tectonic controls on groundwater resources are currently being studied in the south central Mojave Desert. A map of the tectonic framework of the area has been prepared using Mission 164, ERTS-1, and Skylab imagery. Permeable, semi-permeable, and non-permeable rock units have also been mapped. From this information infiltration efficiency has been estimated and groundwater basin boundaries have been delineated. The movement of groundwater through basins by underflow across faults is also being studied.

The aforementioned procedures will be expanded to the Coachella-Imperial Trough where the resource being evaluated will be geothermal energy. A tectonic map of the trough will be prepared using U-2 and Skylab imagery. This map will then be used for locating favorable sites for ground-based exploration.

2.2.2 Colorado River Delta -- A Skylab Automatic Mapping Project

This task is an outgrowth of earlier interpretation of ERTS-1 imagery. It is the intent of this mapping project to expand and demonstrate a capability for automatically mapping a dynamic physical environment. The project is viewed as a method of exploiting existing and future acquisitions of sequential spacecraft imagery; i.e., ERTS and Skylab. Its purpose is to depict, using automatic computer mapping techniques, variations in surface forms as witnessed in the Colorado River Delta, the Sonoran Coast and Desert (Desierto del Altar) of Mexico, and the Gulf of California.

A classification system is being developed for the various landforms and water surface features identified in the area. Three separate generic classifications are requisite in order to adequately represent the three distinctly different environmental types found in the region: (1) the Coastal and Delta Landforms; (2) Immediate Shore Features; and (3) Offshore Water Features. To date, offshore tones only have been mapped and classified as it is extremely difficult to accurately interpret true water depths or actual subsurface features from the imagery. Tonal signatures were mapped from normal color Skylab imagery (2 June 1973). The completed map depicts only relative water depths in the Gulf and is indicative of only the visible color gradations recorded on the imagery.

Further correlations of the above water depth surrogates to existing bathymetric data are being conducted. Also water depth surrogates are being mapped from existing ERTS-1 imagery of the nearshore delta waters. These depth surrogates will then be incorporated into the

automatic mapping system initiated previously and included into the correlation model of bathymetric data as developed above. Initial impressions obtained from cursory interpretation of the data indicate that actual water depths in the delta waters can be interpreted and mapped from Skylab and other spacecraft imagery.

Mapping of the geomorphic features of the Desierto del Altar is in progress, but as yet these data have not been incorporated into the automatic mapping system.

2.2.3 Computer Projection of Lake Cahuilla Pleistocene Shorelines

Research has been initiated to attempt to accurately locate the Pleistocene shoreline of Lake Cahuilla, the Pleistocene lake which was impounded in the Coachella-Imperial Trough. To date, approximately two-thirds of the shoreline has been mapped. No tectonic displacement of the shoreline has been identified.

2.2.4 Historical Geography of the Piute and Lanfair Valleys

from Spacecraft Imagery (Areal Distribution of Relict
and Active Cultural Features of the Northern Lanfair Valley
and Surrounding Areas of California-Nevada)

The availability of Skylab imagery has made it possible to obtain on a single frame the history of land use over a given region. Through the use of this imagery it is possible to observe sequential changes in the patterns of land use and to place those patterns within their proper time horizon. An example of Anglo occupancy is given using Skylab imagery for a portion of the southwestern United States.

Patterns have been reconstructed which represent four distinct epochs in the development of the Piute and Lanfair Valleys during the period of Anglo occupancy. These patterns are closely related to changes in transportation technology and changes in the perception of the value of this land. Examination of these patterns are continuing.

2.2.5 Yuha Desert Ecological Study

The Department of Earth Sciences of the University of California, Riverside, and the Bureau of Land Management (BLM) office in Riverside have initiated a joint feasibility study in the Yuha Desert of southern California. The purpose of the study is to determine the value of Skylab and supporting aircraft imagery for delimiting ecotypes in the desert environment (soils-vegetation-slope). To date, the initial results obtained from field survey and image analysis had been poor. If no encouraging results are obtained, this study will be discontinued.

2.2.6 Big Bend Anomaly

Perusal of Skylab imagery has revealed the presence of a geomorphic feature which is anomalous to its surroundings. The feature is located in the vicinity of the Big Bend on the Colorado River, approximately five miles south of Davis Dam. Examination of 15-minute quadrangles of the region and existing geologic maps seem to indicate that the feature is early-Cambrian in age, though it is not visually apparent by interpretation of the topography. The site does show conformance with surrounding structures.

Initial field work at the site has indicated that the feature is at least superficially more youthful than geologic maps would indicate. Reported geologic work in the region has been scanty, and there is a lack of published material on the area. As a result, future study of the anomaly will be devoted to interpretation of the feature's geomorphogenesis.

2.2.7 Vertical Distribution of Vegetation in the

Lanfair Valley/New York Mountains Region of California

Initial field work has been initiated in order to assess vegetation responses to various environmental changes as indicated by altitudinal differences. Because this study was to use methodologies developed in the Yuha Study (2.2.5), no further work will be done until a decision is made on 2.2.5.

2.3 WORK PLANNED DURING THE NEXT REPORTING PERIOD

Researchers at the Riverside campus will continue work on the studies reported in Section 2.2. Work initiated in the Owens Valley-Mojave Desert and Imperial-Coachella Trough will be expanded if additional Skylab imagery is received, in addition to expanded research topics.