SECTION 14

N72-29315

SUMMARY OF 1971 LAND REMOTE SENSING INVESTIGATIONS

by

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INTRODUCTION

The Land Remote Sensing Application Group of the Earth Resources Laboratory has as its primary objective to develop techniques to provide land use up-date information using remotely sensed data and automatic data processing technology.

The approach to this objective is to utilize the multispectral scanners, the associated Data Analysis Station, and the Pattern Recognition Programs to identify and classify land surface characteristics, including Wetlands, and to convert these data to demonstration type experiments in the various disciplines.

Within the framework of developing these techniques, application studies are being conducted which utilize remote sensing and its products and which are more immediately useful. A summary of some of these application studies is presented in the Appendix.

The detailed objectives of these land studies are:

1. The evaluation of the 24-channel multispectral scanner as a tool for identifying and classifying surface characteristics to altitudes of 20,000 feet.

2. The evaluation of the 10-channel Bendix multispectral scanner as a tool for identifying and classifying surface characteristics to altitudes of 60,000 feet.

3. The evaluation of existing and modified Pattern Recognition techniques and scanner resolutions for mixed target areas; for example, urban, forest, agriculture, and marshland.

4. The demonstration of techniques to applications; for example, surface classification for land use planning and plant community delineation for mosquito control.

5. The evaluation of extension capabilities of techniques to larger areas of varying geography.

6. The definition of elements of a system for area land use up-date; for example, satellite measurements and accuracies and computer output formatting for the user community.

It is recognized that at this time the 24-channel MSS and the associated DAS have not passed performance specification checks and are not fully operational. However, it is felt that system requirements for technique development can be met by the system in its present operating condition. It is also felt that the data system refinement and technique development can progress together and produce a useful product at the earliest possible date.

LAND USE STUDY

The initial step toward the primary land use objectives was the selection of a study area along the Gulf Coast region of Mississippi. The area is a typical flat land coastal area which is representative of a considerable amount of land in Mississippi and Louisiana. The site was selected because in addition to being convenient to the location of the Earth Resources Laboratory, it is a rapidly developing urban complex along the Coast with agriculture and forest in the hinterland and this provides a study area with mixed land use practices. There is an active planning commission (Gulf Regional Planning Commission) in the area which provides a point of application for land use information for the purpose of regional planning. In addition, there are other active user applications of land use information such as mosquito control and forest management. For the initial experiment specific areas in Hancock County, Mississippi, plus three Agricultural Experiment Stations in Louisiana, were chosen for targets.

The team of investigators on this experiment are Dr. R. H. Griffin, Soil Scientist and Agriculturist; Dr. Armond T. Joyce, Forester; Dr. Robert H. Cartmill, Hydrologist/Meteorologist; and Mr. Paul L. Vegas, Regional Planner.

With the area selected a ground truth gathering exercise was started in the target area in June 1971. It was decided that the most effective way to gather ground truth information for this type mission would be to conduct a 100% field check of a one-mile wide strip along the flight lines (Figure 1) and to select primary training sample and test sample areas from within the areas of 100% ground truth coverage. Approximately one hundred square miles of detailed ground truth information was gathered. The procedure followed to gather this ground truth information was:

1. To obtain from the files existing vertical photographic data.

2. To enlarge the vertical photographs to a workable scale and mosaic them into strips covering the selected ground truth areas.

3. Using these strip mosaics and mylar overlays, the field inspection teams transcribed the ground truth information directly onto the overlays.

4. A legend and scale were added and through a photographic process the information on the mosaic and the overlay were transferred to a black and white presentation with land use classifications identified.

An example of the final product of the factor map is shown in Figure 2.

With the aid of the factor maps and photographs taken by the field teams, the team of investigators selected several training sample areas for each of the land use classifications. Figures 3 through 6 are photographs of typical test sample areas. These selected sites were studied by the investigators to confirm that they were good homogeneous samples and large enough to be utilized as training samples. These confirmed areas were then identified as the final training samples for the individual flight lines.

The procedures followed in ground truth acquisition on mission day were:

1. A photographer visited each training sample site and photographed the area in prescribed detail.

2. A photographer in a light aircraft obtained oblique photographs for all selected training sample areas as well as any noticeable changes in other areas.

These mission day photographs were then packaged with the appropriate factor maps and identified so that the investigators could make ready use of them.

At this time it appears that one of the most important operations in this type of experiment is the adequate gathering of ground truth information. It has been the experience that the proper selection of training samples can be assured only with good ground truth coverage.

Also in June 1971 copies of the Pattern Recognition Program software were obtained from the Manned Spacecraft Center and the modifications to adapt them for use with the Univac 1108 computers at the Slidell Computer Center were started. In addition, each step in the processing of MSS data with these programs was studied in detail by each of the team members.

With a background of ground studies and data processing technique development, a MSS data acquisition flight was requested. The mission was flown on September 7, 1971 in very poor weather conditions. The flight plan called for four flight lines to be flown at 20,000 feet, and seven flight lines to be flown at 4,000 feet. Three of the 4,000 foot flight lines were underflights of portions of the 20,000 foot flight lines and were flown to provide data for evaluating the effects of scale differences. A layer of scattered clouds at approximately 4,000 feet, varying from 10% to 80% cloud cover, was present most of the day. The 20,000 foot flight lines were flown and it appears at this time that the data from areas with 20% or less cloud cover is useable. Only two of the 4,000 foot flight lines were flown on September 7 because of the cloud layer.

On September 7 the scanner was operating with 20 of the 24 detectors on line with the roll compensation system inoperable and with some noise in Array 3 (2.1 to 4.75 microns). While this noise presented some problems, the primary loss of data on September 7 was due to cloud cover with only about 40% being useable. The mission day ground truth activities were conducted with no anomalies or loss of data.

A second attempt to complete the mission was conducted on September 9, again with inclement weather. On this second mission the scanner was operating with 22 of the detectors on line, with the roll compensation system inoperable, and with Array 3 cleared of the noise that was present on September 7. Although the 4,000 foot lines were flown with scattered clouds, most all of the data was generally useable. Again, on the second day, the ground truth was gathered without anomalies.

The photographic data from the MSS mission was processed in approximately ten days. The investigators used this data in three ways:

1. Cross-checking against the earlier ground truth data,

2. Locating cloud cover and evaluating its effects,

3. Correlation of time of flight and training sample locations as an aid to the DAS operator in locating training samples on MSS tape.

Approximately two weeks after the mission, the MSS data was screened and reviewed on the DAS. During this review the samples were identified by scan line and a tape containing all training coordinates was produced.

It was decided at this point that a small amount of data should be processed end to end through the system to confirm that the Pattern Recognition Programs as adapted to the local computer system were operational before starting the bulk data processing efforts.

The next step in the processing of the MSS data is built around the Purdue Pattern Recognition Programs. The "Pictout" program was run on the pilot data using a single channel (1.18 to 1.3 microns) for the purpose of confirming location of training samples. Figure 7 is a presentation of the product of "Pictout" for that one channel. The "Stat" program was run against training sample data for the various classifications and the "Select" program was used to determine from those statistics the best six data channels for the classifications. These six channels were then processed using the "Classify" and "Display" programs and the first product of this experiment is a color display showing six categories of land use from the pilot project. Figure 8 is a color presentation of that product.

The results of the pilot project, which was a very small amount of data, are encouraging and it appears that there is considerable improvement to be gained by better selection of training sample and threshold values and by improved versions of the Pattern Recognition Program.

It should be noted that the Pattern Recognition Programs are for the most part not capable of handling a 24-channel multispectral scanner with 700 resolution elements per scan; instead the programs are written to accommodate 12-channel data with 222 resolution elements per scan. Because of these limitations, the Earth Resources Laboratory is expending considerable effort in modifying these programs to accept the 24-channel data and also in incorporating a much faster "Classify" program which will allow the same amount of data to be processed using much less computer operating time. The details of these program modifications will be covered in the next presentation made by Mr. Sid Whitley of this Laboratory.

To date the data from one other flight line from the September missions has been reduced to computer tapes and those tapes are presently being processed through the Pattern Recognition Programs at the Slidell Computer Center. The schedule for the Land Use Study is shown in Figure 9.

In summary, the 1971 activities have centered around planning the study projects and cooperative efforts supporting the studies, conducting data acquisition, and completing a pilot data processing project. During 1972 data acquisition phase will continue but the big objective is to move data processing to large scale processing and demonstration of application of the techniques.

ATCHAFALAYA WETLANDS STUDY

Early in October 1971 the Chairman of the Joint Legislative Committee on Environmental Quality for the State of Louisiana requested that NASA, along with other agencies, participate in a wetlands study project involving the lower Atchafalaya Basin.

The Atchafalaya River became a distributary of the Mississippi River in 1500 A.D. and the uninhabited basin serves as a floodway for the Mississippi River with flood gates at Old River and Morganza. The average flow in non-flood stage is one-third of the Mississippi River flow or about 150,000 CFS. The designed maximum flood stage flow is 1,500,000 CFS. The basin is indeed a great wetland swamp that has created much interest in ecological circles. The river dumps 100,000 tons of sediment each day in the lower basin such that 60 square miles of new land was formed by accretion between 1930 and 1950. Based on a two to eight year flood cycle there is sufficient sediment to fill the Atchafalaya Lakes by the year 2000. Also in the basin are large reserves of oil and gas as well as much valuable timber resources and rich farm lands. The lower Atchafalaya Basin, in addition to being of significant economic and ecological interest to the State, has features which make it a suitable candidate for the study and demonstration of remote sensing techniques. Specifically, it is a relatively large area, it is for a large part inaccessible by surface means, and it is very dynamic in its land/water make up. Figure 10 shows the location of the study area.

There are both Federal and State agencies participating in the study; a partial list follows:

Louisiana Legislature, Joint Committee on Environmental Quality
Louisiana Forestry Commission
Louisiana Highway Department
Louisiana Department of Wildlife and Fisheries
Louisiana Stream Control Commission
Louisiana State Geologist
Louisiana State Land Office
Louisiana Department of Public Works
Corps of Engineers, New Orleans District
Corps of Engineers, Waterways Experiment Station, Vicksburg, MS
Corps of Engineers, Topographic Research Station, Ft. Belvoir, VA
U. S. Forestry Service, Southern Regional Office, New Orleans
U. S. Geological Survey, Department of Interior
U. S. Environmental Protection Agency, Water Quality Office
Bureau of Outdoor Recreation, Department of Interior
National Oceanographic Atmospheric Administration

The ERL participation plan developed detail objectives and experiments that held some promise of being accomplished by remote sensors in support of the broad objective of the program proposed by the Joint

Legislative Committee. These detail objectives are:

1. Evaluate techniques for monitoring accretion/decretion.

2. Demonstrate technique for determining salt water intrusion by classification of pertinent plant communities. Correlate with adjacent remotely sensed salinity measurements.

3. Demonstrate technique for location and classification of aquatic plants.

4. Evaluate techniques for determination of water characteristics, e.g. turbidity, source, inlet-outlet conditions.

5. Evaluate techniques for locating water/land areas through forest species identification and vice versa.

The study was initiated with a search for existing data in the files, where a considerable amount of valuable data was found. The New Orleans District of the Corps of Engineers has been gathering data in the basin since 1917, the U. S. Forestry Commission has on record some inventory data in the basin and many other agencies have records of environmental and water quality data. After studying some of this data, including film from a 1970 RB57 mission, the ground truth effort was started during mid October 1970 with ground truth teams in boats and a light aircraft.

The initial MSS mission was scheduled for the week of October 25 and the ground truth teams worked in the basin during the entire week. A map of the area showing the flight lines is shown in Figure 11. The team of investigators for this study are Dr. Robert H. Cartmill, Hydrologist/Meteorologist; Dr. Armond T. Joyce, Forester; and Mr. William G. Cibula, Marshland Ecologist. Four ground crews worked in the lower Atchafalaya Basin taking various water samples and hundreds of ground level photographs of the various vegetation covers, from the heavily forested areas, to the mixed swamp lands, to the marsh areas near the Atchafalaya Bay. Participating in the ground truth teams were members of the Louisiana Wildlife and Fisheries Commission, the Louisiana Department of Public Works, and the Corps of Engineers, New Orleans District, along with numerous ERL personnel. In addition to the ground level teams, oblique photographs were taken from a low-flying aircraft in the areas that were inaccessible to the ground teams. The acquisition of ground truth in the basin is difficult because of inaccessibility of many areas. 100% ground coverage of the area is impossible. Therefore, the investigators relied very heavily upon data taken along the waterways and low altitude oblique photographs for their training sample selection. Examples of ground truth photography are shown in Figures 12 through 17.

On October 27 the scheduled MSS mission was flown in very good weather; however, initial screening of the data on the night of October 27 revealed that the scanner recorder had malfunctioned and essentially all data had been lost. The flight and the ground truth activities were rescheduled for October 29. The mission was flown again in very good weather on October 29 with 14 of the 24 channels operating and with two of those noisy. However, it was decided that the twelve good channels would be processed and an attempt to carry out the first part of the study will be made using this data.

The photographic data from both missions was processed; however, the sensitivity of the IR layer was down more than 50% on both rolls of film and the IR qualities were lost. An attempt to enhance the IR qualities by filtering in the duplicating process was only partially successful. This data is being used by the investigators in their interpretation and an uncontrolled mosaic is under construction for the purpose of identifying gross land use classifications.

The investigators using the mission photography as a base located training samples for the MSS data with regard to time, and mylar overlays were constructed showing the location of each sample. The use of the overlays helped insure that training sample boundaries were maintained while locating the samples on the DAS screen for transfer to tape. During the week of December 6 the investigators reviewed the MSS data using the Data Analysis Station and identified the training samples. The coordinates and data from the training samples were transferred to nine-track computer compatible tapes. The training sample data as well as the coordinates was transferred to a nine-track tape in order that the "Stat" program can be run against the training sample tape instead of the bulk data tapes. The twelve good channels of data were identified and nine-track computer compatible tapes have been requested. It is anticipated that the computer tapes will be available to start data reduction with the Pattern Recognition Programs about February 1, 1972. The target date for land use overlays constructed from Pattern Recognition Program output is April 1, 1972.

The October 1971 data provides coverage of the basin while it was at its most dormant state with regard to vegetation cover and at the driest season with regard to rainfall. A second MSS mission has been requested for May 1972 to obtain data of the region in the more lush green and wet time of the year.

In addition to these MSS data, ERL will participate in late February in a major study effort being coordinated by the Louisiana Joint Legislative Committee. All of the participating agencies are involved in this effort and ERL will gather multiband photographs and thermal data for selected areas using a light aircraft. In addition, several ERL ground truth teams will participate in that effort. A schedule for the wetlands study is shown on Figure 18.

A list of the ERL products from this experiment to support ERL studies as well as the other participants are as follows:

1. Color uncontrolled mosaic, 1970 data.
2. Color infrared uncontrolled mosaic, 1971 data.
3. Land use overlay of seven major categories derived by photo interpretation techniques.
4. Land-water characteristics overlay of 20-25 categories transposed from scanner data/pattern recognition computer printouts.
5. Thermal pattern and temperature transect overlays.
6. Partial area controlled mosaic for accretion experiment.
7. Accretion maps as derived from a variety of scales, spectral bands, time variations for experimental area.

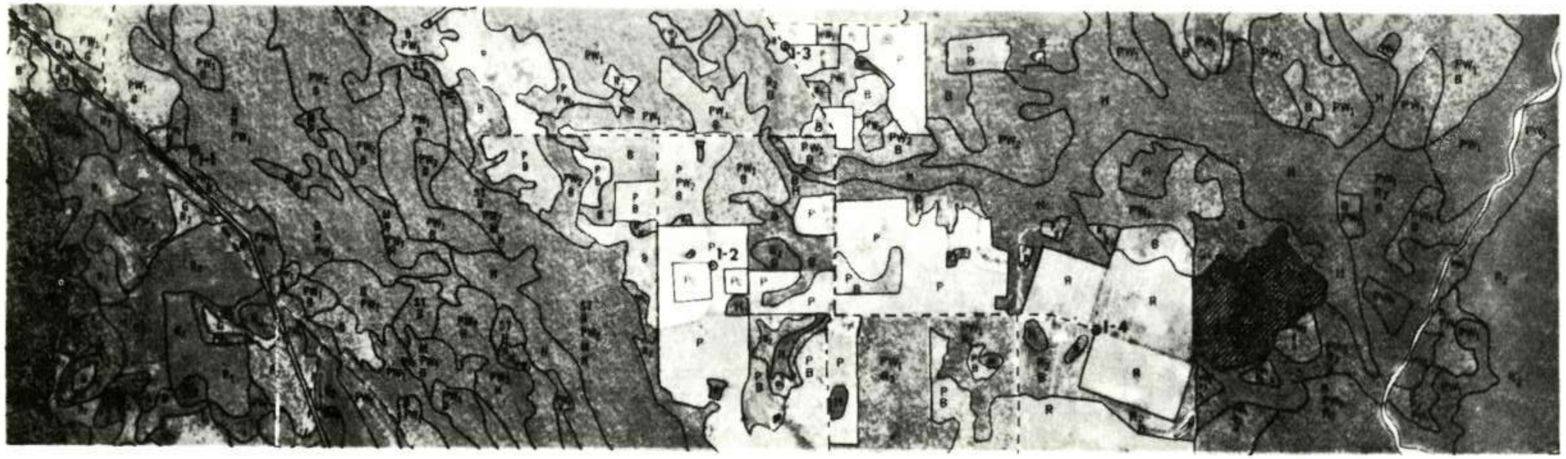
Although none of the MSS data has been processed to completion, the combination of ground truth studies, photo-interpretation studies and the review of the MSS data on the DAS indicates that the proposed objectives of this study should be obtainable by this approach.

Figure 1
Flight lines for September 7 and 9 MSS Mission,
Hancock County, Mississippi.

NASA—ERL/MTF

PHOTOMAP

FLIGHT LINE 1-1 SHEET Nº. 3



Compiled by Lockheed Electronics Company
Aerial photography: 31 October 1970
Ground survey: 8 July to 6 August 1971
Uncontrolled mosaic photo base

FLIGHT LINE LOCATION MAP

SCALE 1:12000

SHEET INDEX

1	2	3	4	5	6

LEGEND

—·—	PRIMARY ROAD	M	MARSH (WETLAND)
-----	SECONDARY ROAD	W	WATER
+++++	RAILROAD	ROW	RIGHT OF WAY
~	STREAM	B	BRUSH
⁓ –	INTERMITTENT STREAM	G	GRASS
U	URBAN	H	HARDWOOD
R	ROW CROP	ST	SAWTIMBER
S	EXPOSED SOIL	PW_2	9"– 11" DBH
P	PASTURE	PW_1	5"– 9" DBH
Pc	CULTIVATED PASTURE	R_2	2"– 5" DBH
O	ORCHARD	R_1	UP TO 2" DBH
●	PICTURE POINT		
▨	FOREST STAND TEST PLOT		

Figure 2
Example of ground truth factor map showing land use classification.

C-5

Figure 3
Typical training sample for soybeans; ladder used for photographs and PRT-5 reading.

Figure 4
Typical training sample for cotton.

Figure 5
Typical pastureland training samples. Interface shows differences in management practices.

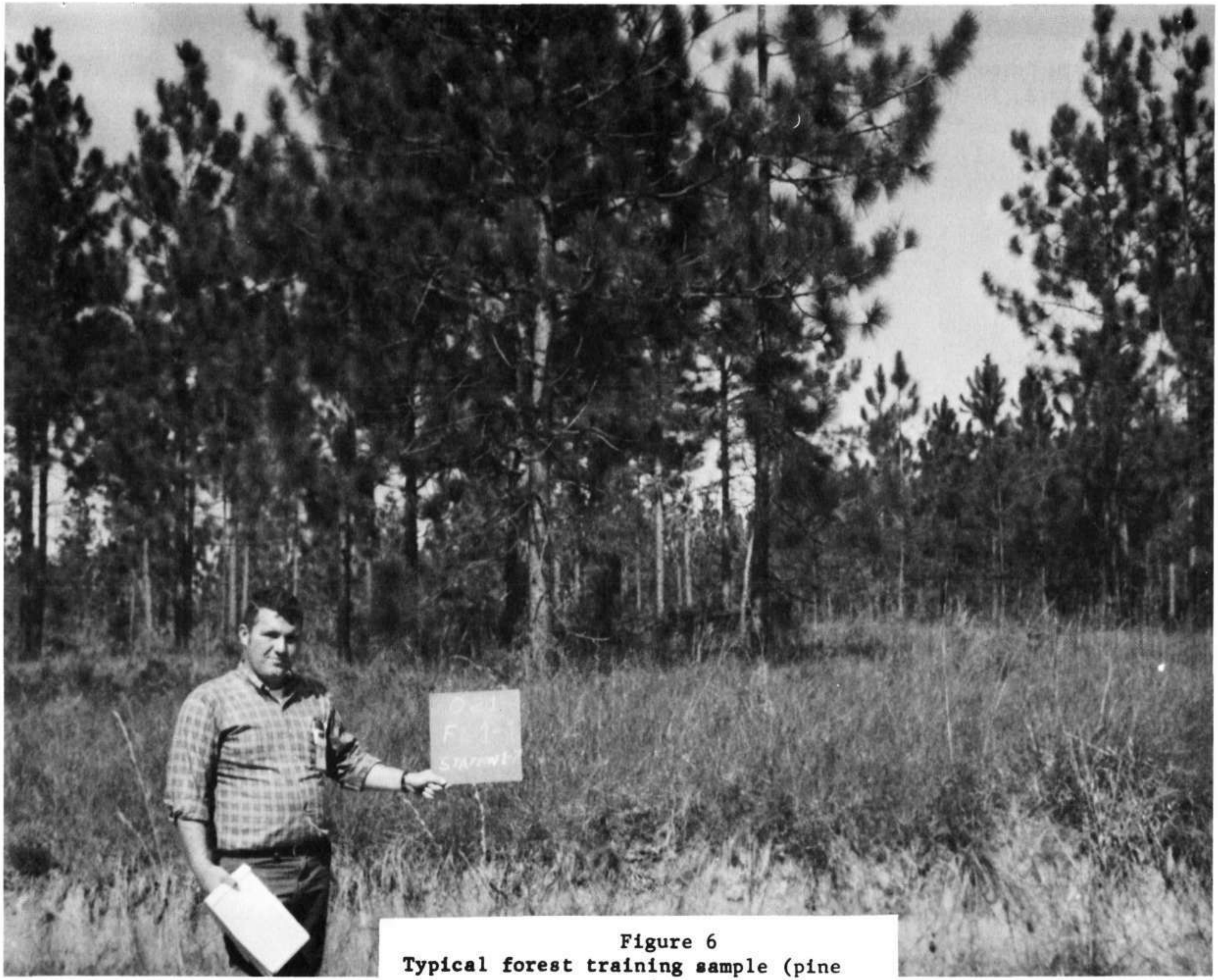


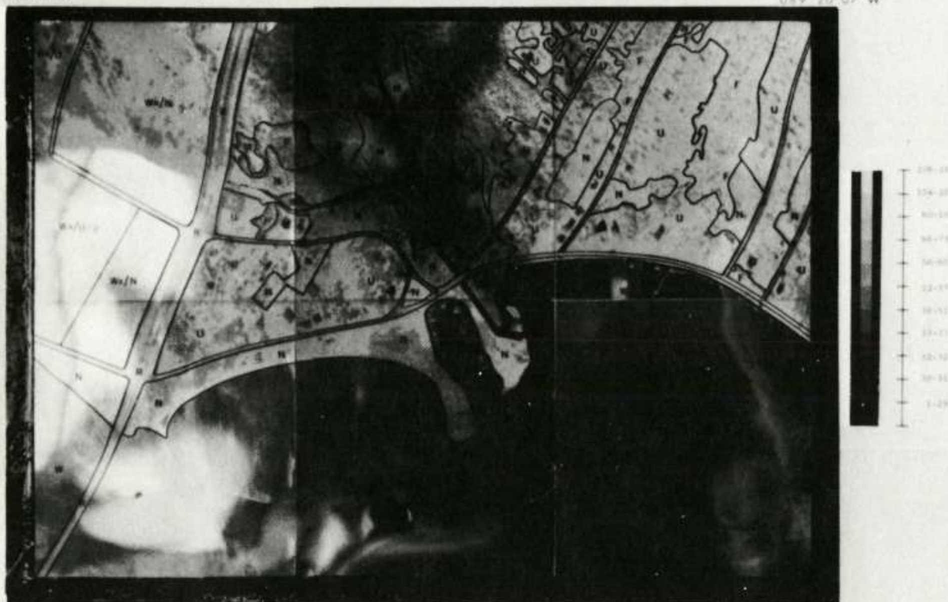
Figure 6
Typical forest training sample (pine reproduction).

MISSION MSS FLIGHT 10 LINE 4 RUN 1

SEPT. 9, 1971

BAY ST LOUIS, MISS.

OUTPUT FROM CHANNEL 11 1.18 to 1.30 MICRONS



SCALE 1:4000

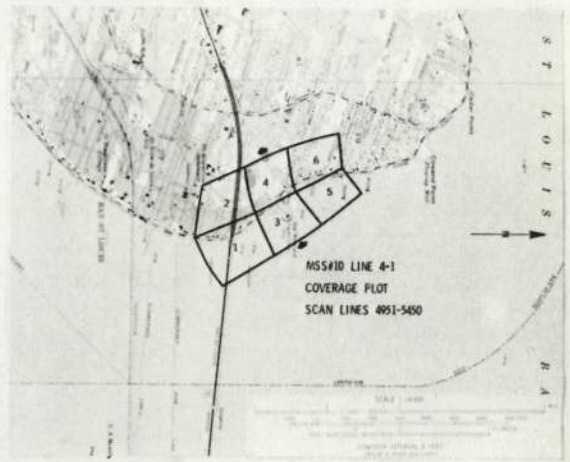


Figure 7
Photographic presentation of "Pictout" Program Channel 11, Bay St. Louis, Mississippi.

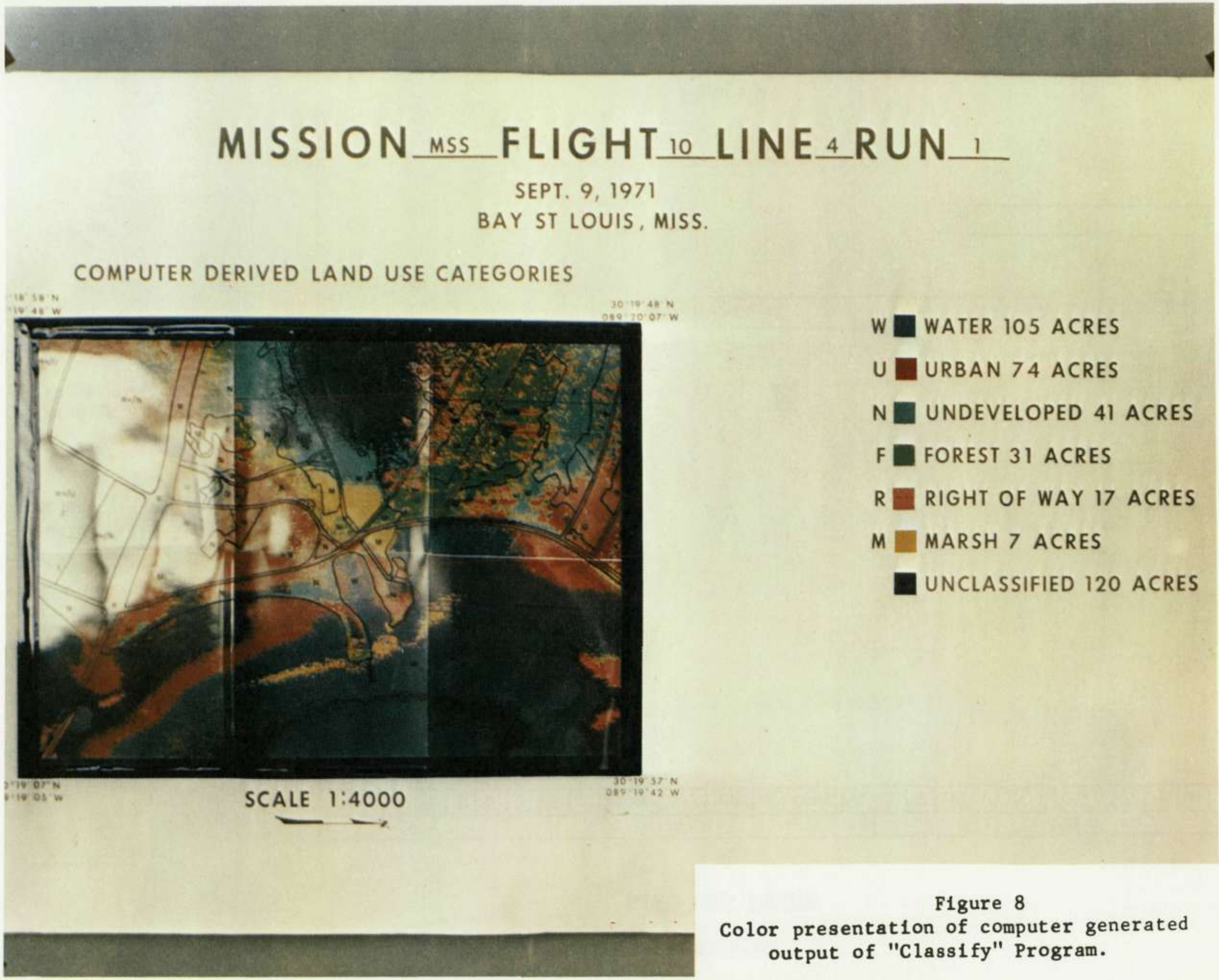


Figure 8
Color presentation of computer generated output of "Classify" Program.

SCHEDULE

LAND USE STUDY

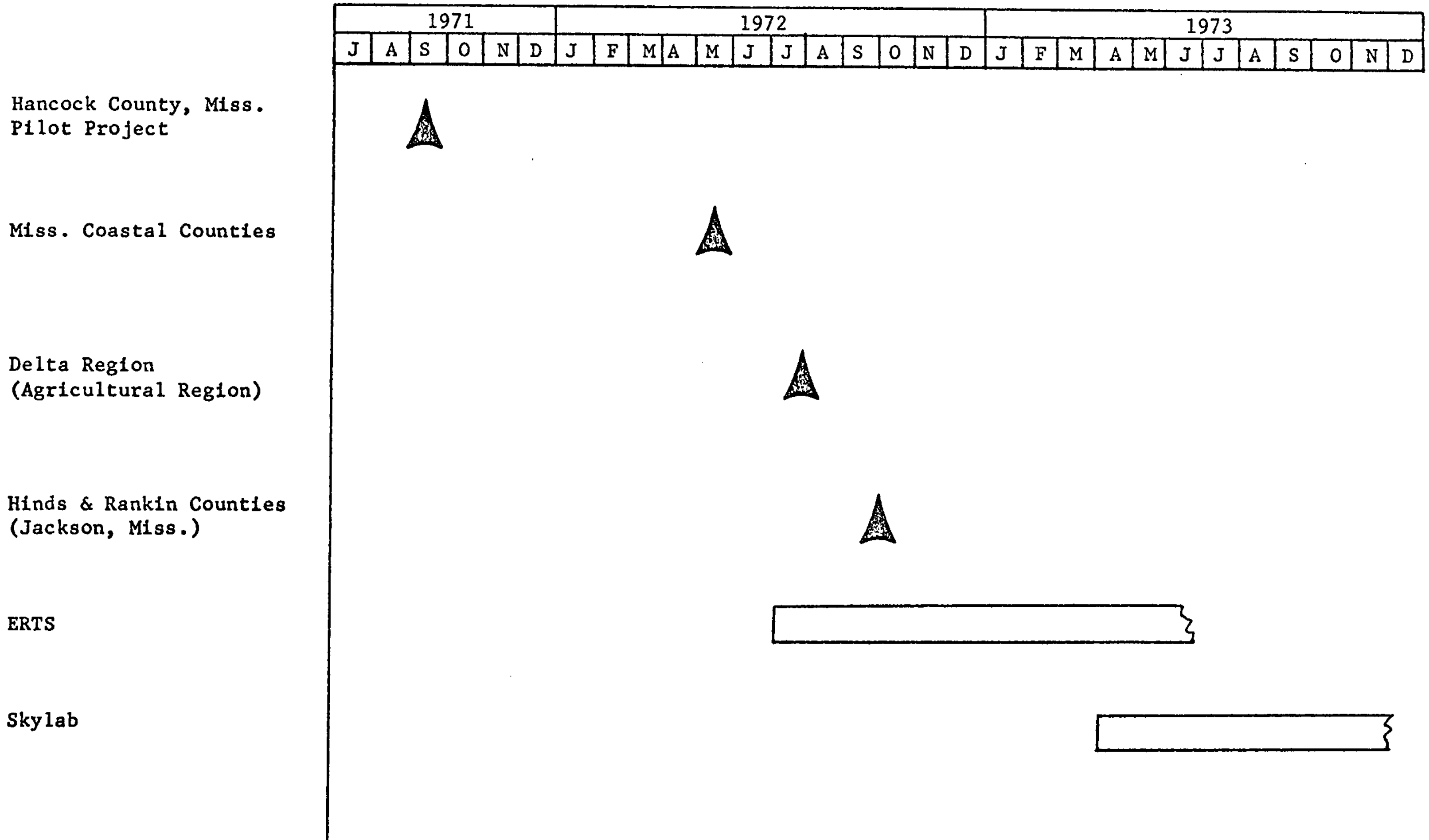


Figure 9

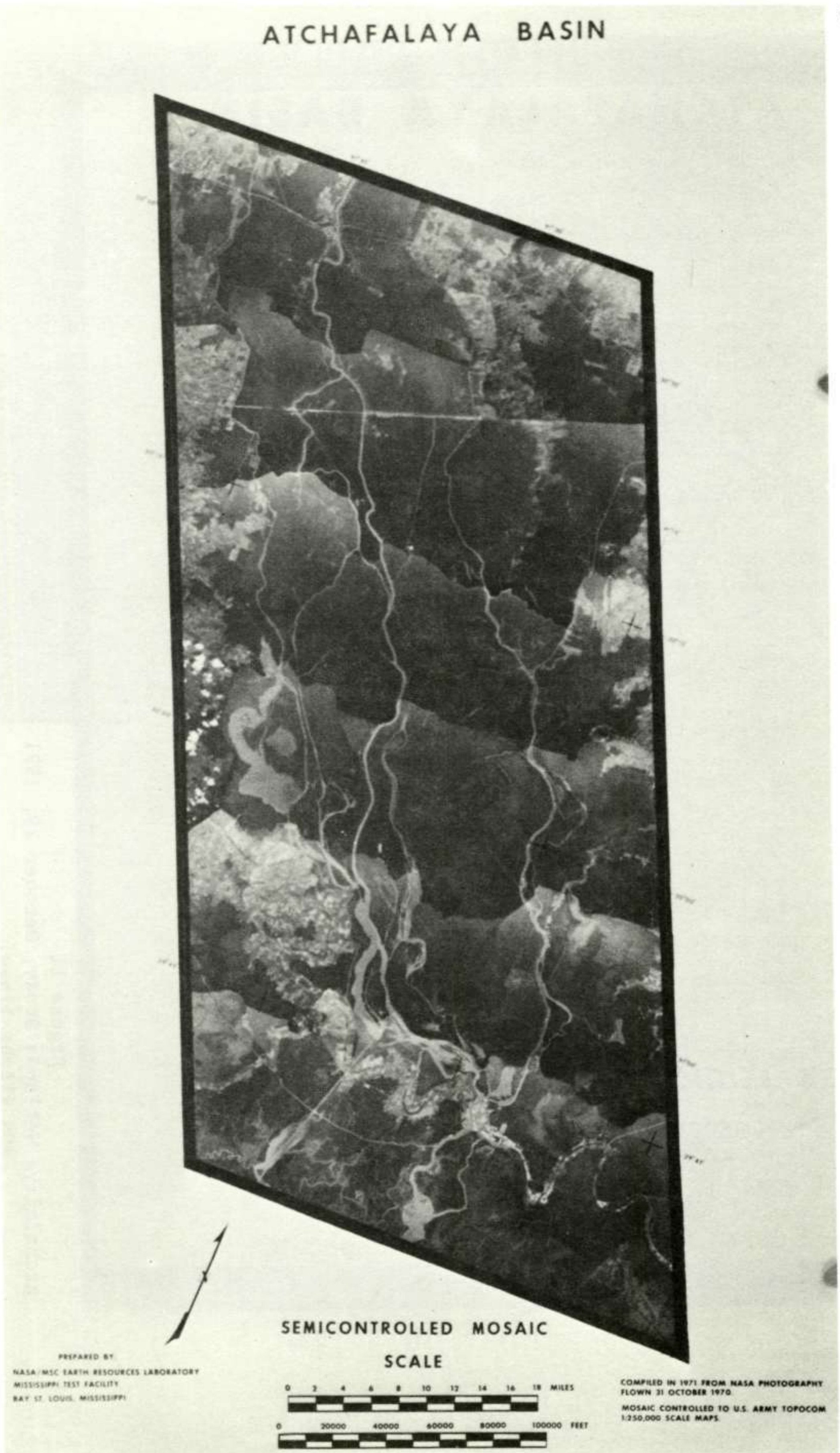


Figure 10
Atchafalaya Wetlands Study area.

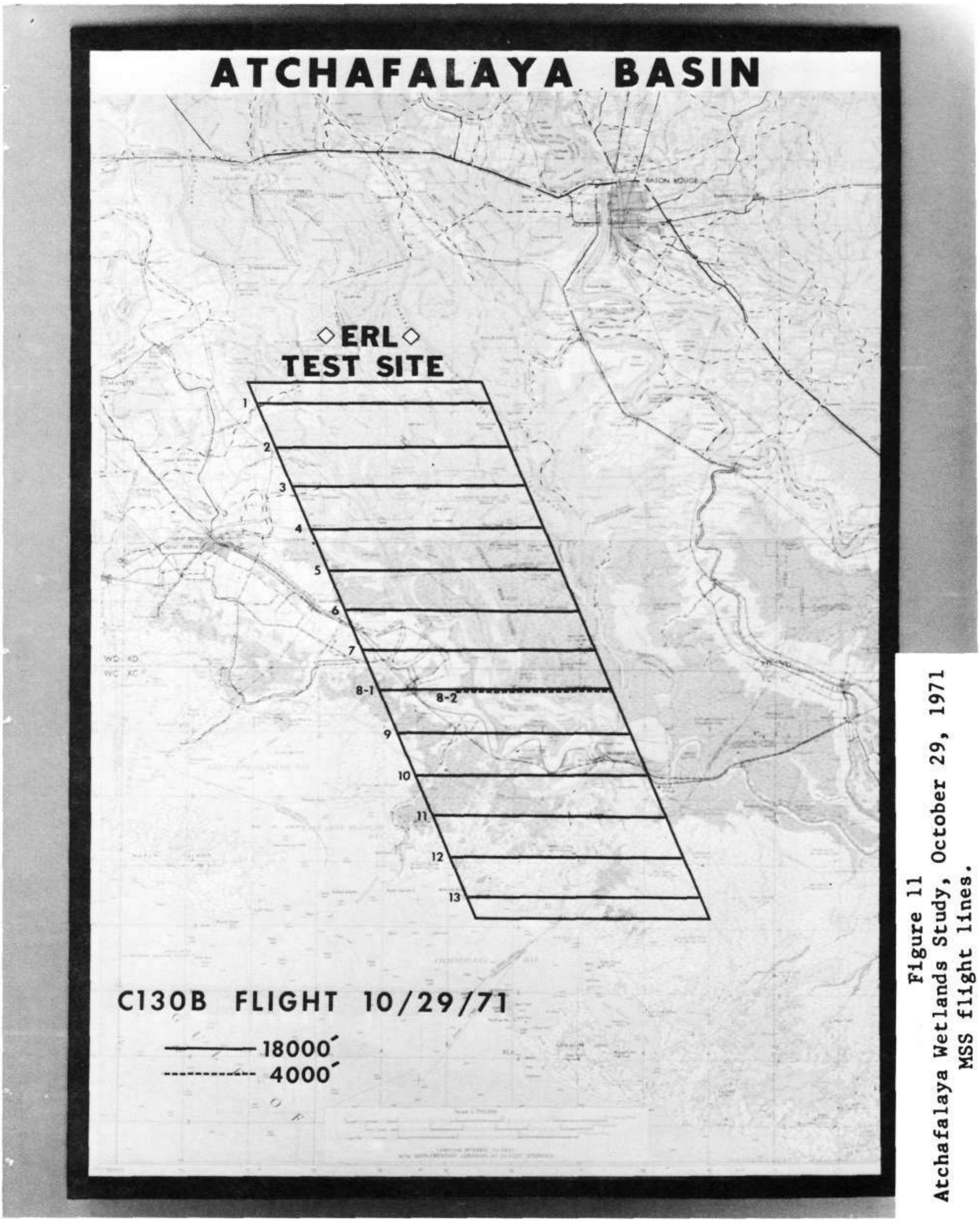


Figure 11
Atchafalaya Wetlands Study, October 29, 1971
MSS flight lines.

Figure 12
Typical forest training sample, Atchafalaya Basin, Water Tupelo trees.

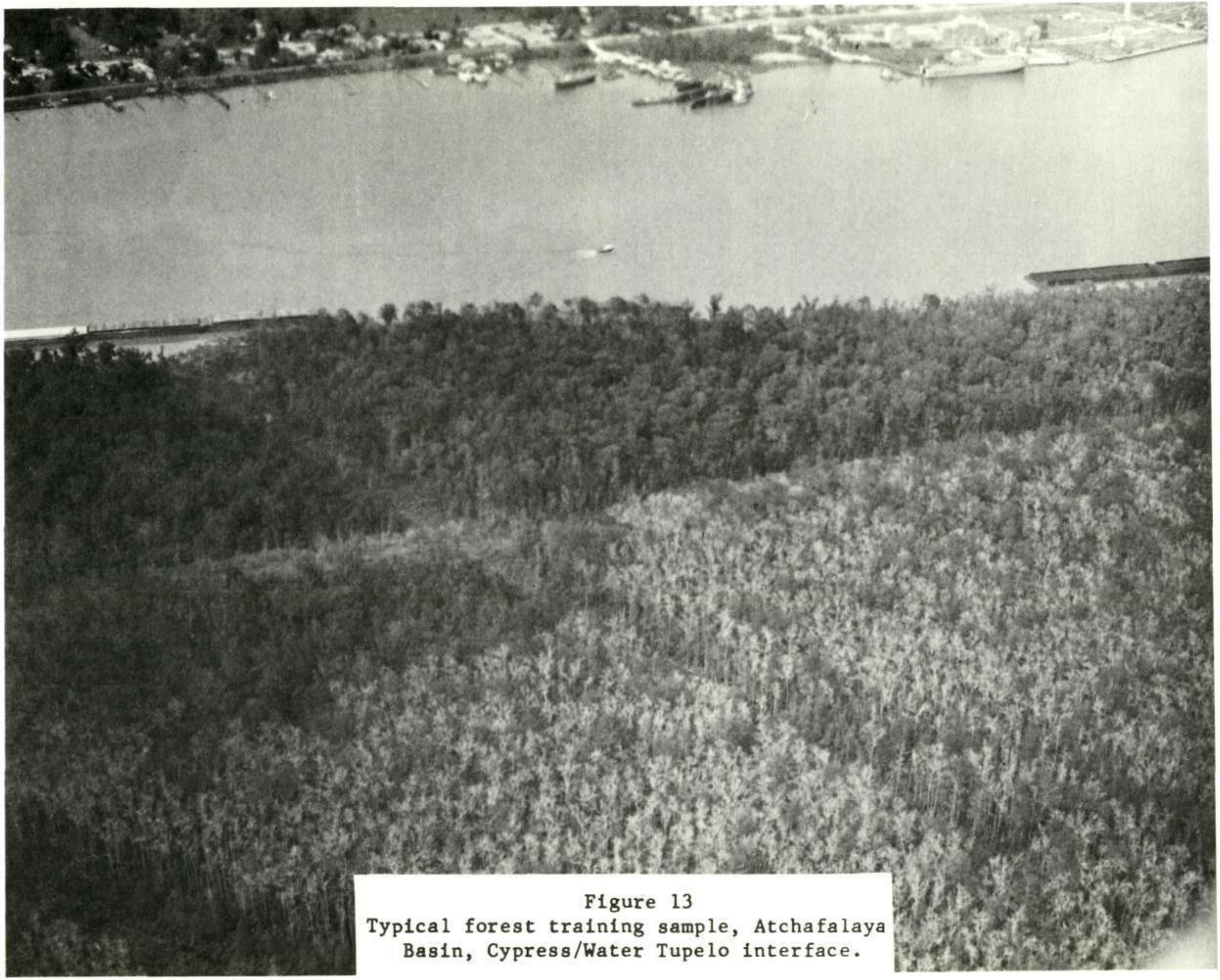


Figure 13
Typical forest training sample, Atchafalaya Basin, Cypress/Water Tupelo interface.

Figure 14
Lower Atchafalaya wet marsh, fresh water standing 100% of time, water hyacinth and Bull Tongue.

Figure 15
Lower Atchafalaya marsh with some filling from sedimentation, dry part time, Smart-weed and Bull Tongue

Figure 16
Lower Atchafalaya marsh, goldenrod including first plant primary succession from wet to dry land.

Figure 17
Lower Atchafalaya marsh, goldenrod and Cotton Seed tree, first succession of forest on dry sediment formed land.

SCHEDULE

ATCHAFALAYA WETLANDS STUDY

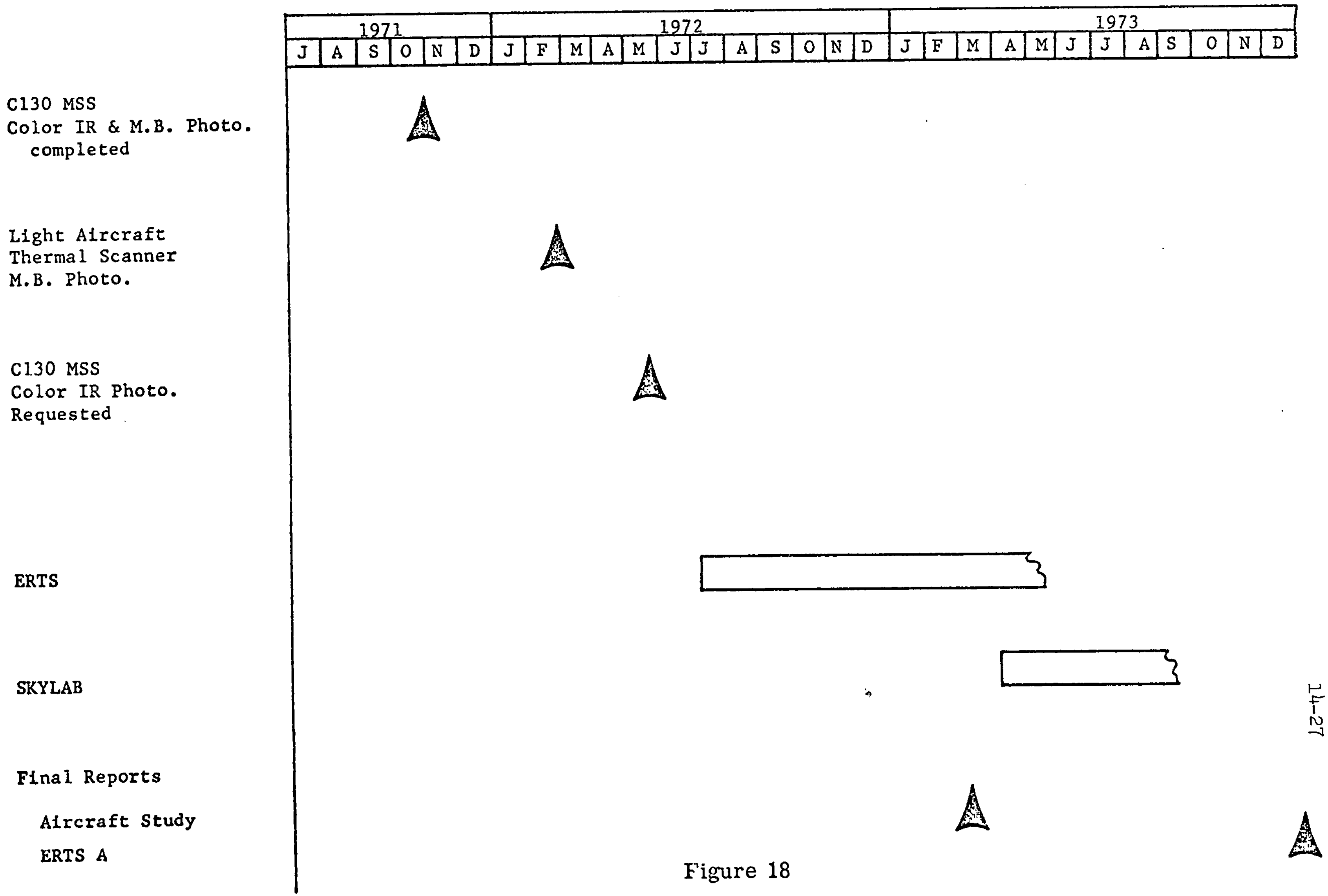


Figure 18

APPENDIX

APPLICATION STUDIES

Mississippi Tornadoes - Disaster Operations Plan

On February 1, 1971 a series of tornadoes occurred in the Mississippi Delta region causing severe damage in numerous small communities and rural areas over a 200-mile path. On February 22, at the request of the Office of the Governor, personnel from the Earth Resources Laboratory acquired low-altitude oblique photographs and ground photographs in the stricken area for the purpose of assessing the need for more extensive vertical photography and to determine the best flight path for obtaining vertical coverage. On February 23 the Manned Spacecraft Center (MSC) C-130 aircraft obtained vertical photography of the tornado paths from altitudes of 2,500 and 8,000 feet. The data was processed on the night of February 23 at the MSC Photographic Laboratory. At 8:00 the following morning, February 24, the data was presented to the Mississippi Office of Civil Defense, Office of Emergency Preparedness, and the Office of the Governor. Accompanying the data were appropriate disciplinary personnel to provide interpretation of the data and assist the disaster recovery teams in their application and use of the data. The results were a very efficient utilization of the imagery by seven agencies engaged in the disaster recovery effort. The utilization ranged from a damage estimate by the Corps of Engineers, to the routing of emergency supplies by the Red Cross, to the location of suitable trailer camp sites by HUD, and many others. An example of the data is shown as Figure A-1. As a result of this experience which proved to be of considerable assistance to the disaster recovery agencies, the Earth Resources Laboratory has been requested to provide similar coverage of disasters occurring in the Office of Emergency Preparedness Southeastern District and has formulated a disaster operations plan which follows the plan used in the tornado recovery and which is shown in Figure A-2.

The total involvement of the Earth Resources Laboratory in the disaster recovery is documented in an ERL report entitled "The Use of an Aerial Photographic Survey in Post Tornado Relief Activities (Mississippi Tornado - February 21, 1971)" dated March 17, 1971.

Participation in the Southern Corn Leaf Blight Study

In the spring of 1971 the corn blight study group at Purdue University requested that the Earth Resources Laboratory monitor several test plots of Texas Male Steril Corn (T cytoplasm) that had been planted in the southern counties of Mississippi for the purpose of determining the severity of the blight in that region. The major part of the corn crop in the State of Mississippi was planted using N cytoplasm corn, a variety not susceptible to southern corn leaf blight. The leaf blight was detected on the T cytoplasm corn located in a test plot in Jackson County, Mississippi when the corn was only 8-10 inches in height. During the unusually dry spring, the infestation appeared to occur at a slower rate than it did later during the wet summer months. Once the drought had ended, the blight progressed at a very rapid rate and the test plots were severely damaged to the point of premature death and yield losses estimated at 50%-100%.

The sites were monitored on a weekly basis from ground level and several observations were made from low-flying aircraft. The results were transmitted to the study group at Purdue each week during the growing season.

A series of photographs of one of the blighted areas from the first notice of the presence of the blight through the end of the study is shown in Figure A-3. The total results of the ERL participation is documented in a report entitled "An Observation of Southern Corn Leaf Blight on Corn Containing Texas Male Sterile Cytoplasm" dated November 1971, by Dr. Gary C. Thomann.

Soil Moisture Study

An experiment was conducted in an effort to determine if the moisture content of the soil could be determined by remote sensors. The equipment used was a multiple frequency microwave radiometer (MFMR) and thermal infrared measuring devices. The scope of the experiment also included the practical problems of obtaining the necessary ground truth, appropriate processing of sensor data, preparation and control of suitable test plots, and conducting the overflight of the prescribed flight line.

The approach of the investigation was to examine the feasibility of measuring soil moisture by two different concepts. The first concept was measurement of the relative thermal response of vegetation under different degrees of moisture stress to the affects of solar radiation. The equipment used for this method was the RS-14 scanner and the PRT-5 radiometer. The second concept was the measurement of radiation intensity in the microwave region of the spectrum. The equipment used for this method was the MFMR operating on frequencies of 1.42, 10.625, and 31.4 GHz.

Several different soil types of different moisture contents were measured. In addition, the cover and surface conditions of the plots were varied in order to determine the effect of these conditions upon the measurement by the sensors. The primary objective was to define in a general manner the most promising techniques for measuring soil moisture using remote sensors.

The investigation is still in progress, the microwave data has been received and is being evaluated, and results of the study should soon be available. A report on the compilation of the ground truth measurements has been published and is entitled "Soil Moisture Remote Sensing Study, Part 1, Surface Measurements" dated July 20, 1971.

Utilization of Photographic Data

Three experiments have been conducted using small scale photography (scale 1:120,000) to determine the optimum cost-effective format and packaging to make widespread use of high-altitude photographic data practical. There are in the NASA files and in the files of other agencies, many rolls of very high quality small scale photographic data. At the same time small regional planning groups are spending a considerable part of their funds to acquire large scale photographic data and ground level data to support their planning efforts.

The first of the experiments was conducted using one frame of small scale photography, enlarging it to the exact scale of the local regional planning commission's base maps, and conducting a cost study of transferring that data by tracing it directly onto the base maps as opposed to the cost of transferring from large scale photography by normal practices of photo-interpretation. At this level, it appears that savings of approximately 40% in cost could be realized and even a larger bonus realized in the time to produce the product.

The second experiment involved an entire county, approximately eleven photographs from an old mission were used and was conducted primarily to determine the practicality of handling and packaging the data at the county level.

The third experiment, presently underway, involves various planning agencies and approximately eight counties covered by these agencies. The area covered is shown on Figure A-4. This phase is a total experiment from packaging to cost effectiveness to accuracy determination. An example of the product of this experiment is shown in Figure A-5. The results of this experiment will be evaluated by follow-up contacts with the involved planning groups. The final product of this experiment should be a proposal to market, through some appropriate arrangements, the existing data in the MSC files, packaged and formatted in some optimum way as determined by the on-going experiments.

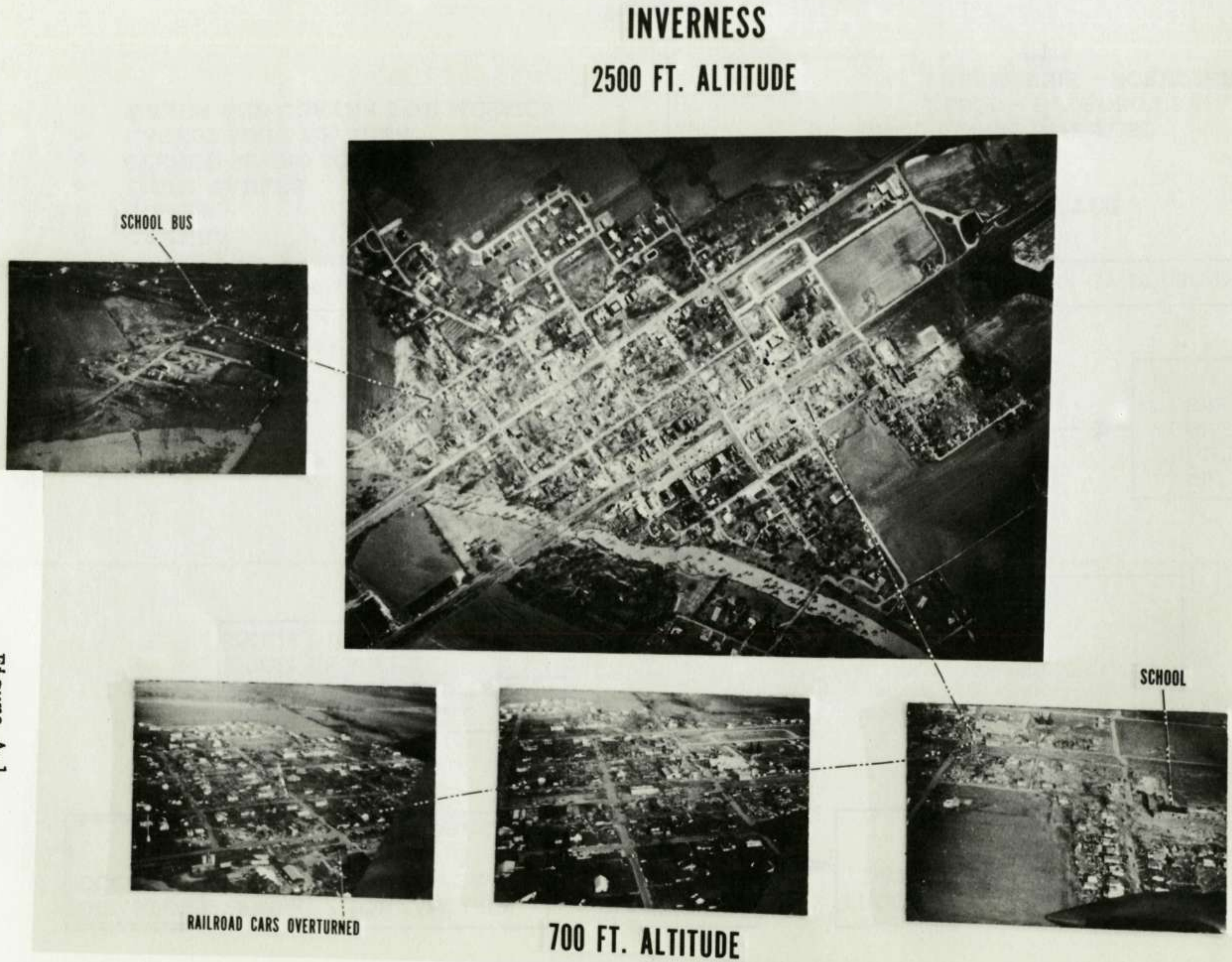
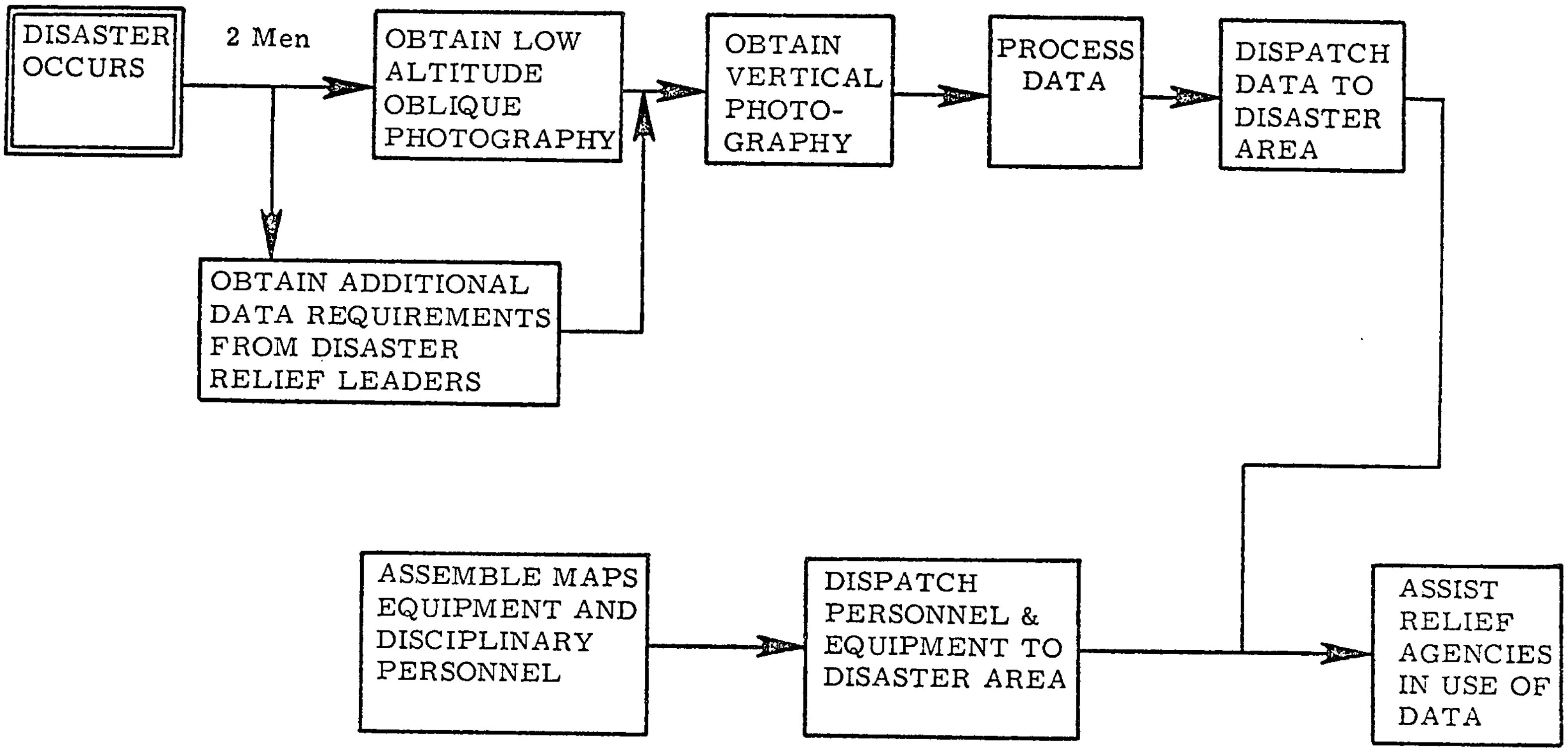


Figure A-1
Example of tornado data.

DISASTER OPERATIONS PLAN



TYPICAL EQUIPMENT	TYPICAL TEAM OF PERSONNEL
o CAMERA	o PHOTOGRAPHER
o COPIER	o PHOTO INTERPRETER
o LIGHT TABLES	o CARTOGRAPHER
o STEREO-MICRO SCOPES	o PLANNER
o LATEST MAPS OF AREA	o DISCIPLINARY SCIENTIST
o WAXER AND COATER FOR MOSAICS	FLOOD - HYDROLOGIST
	FOREST FIRE - FORESTER
	ETC.

Figure A-2

Figure A-3
Example of corn blight data.

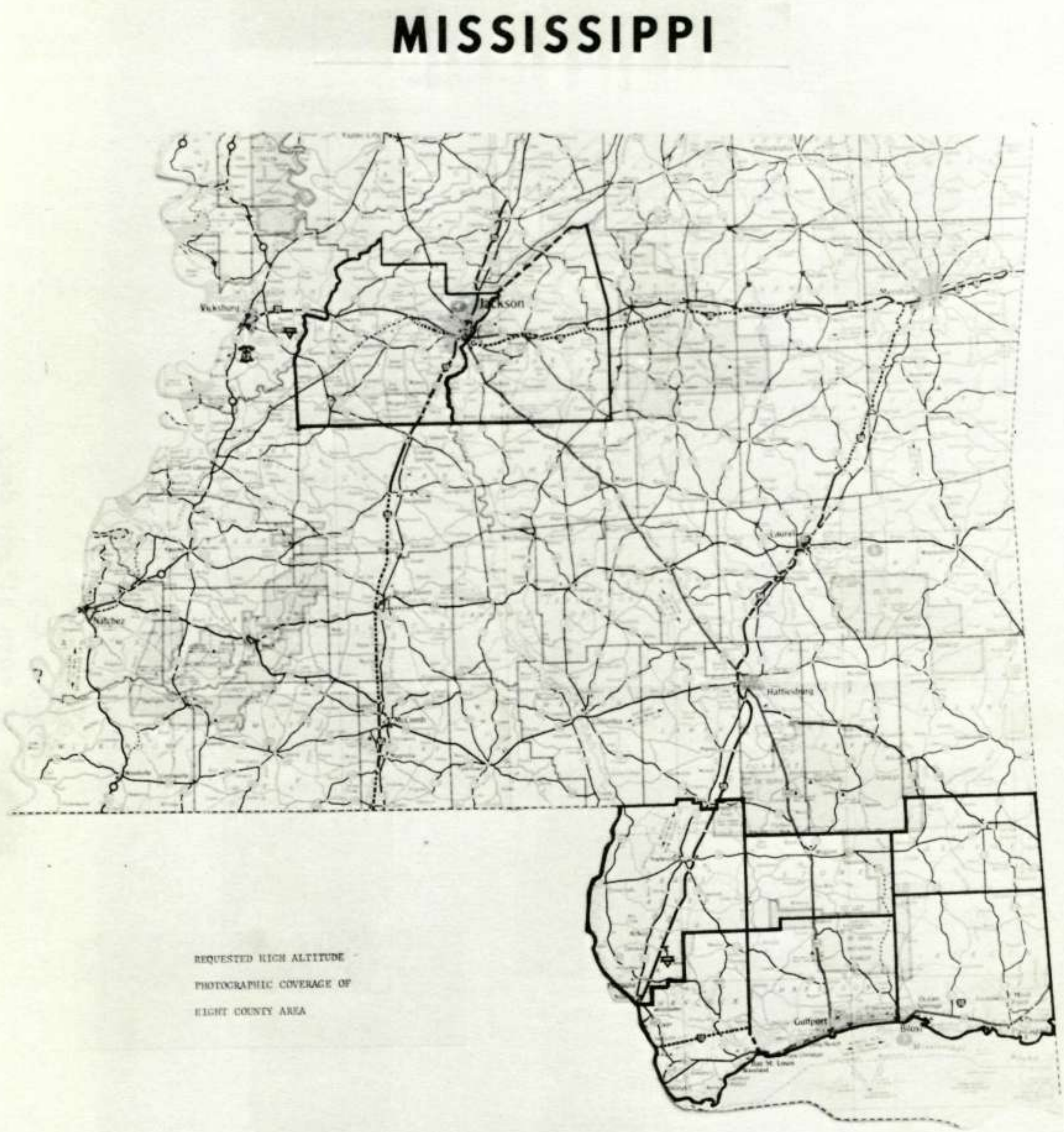


Figure A-4
Test area for small scale photography
experiment.

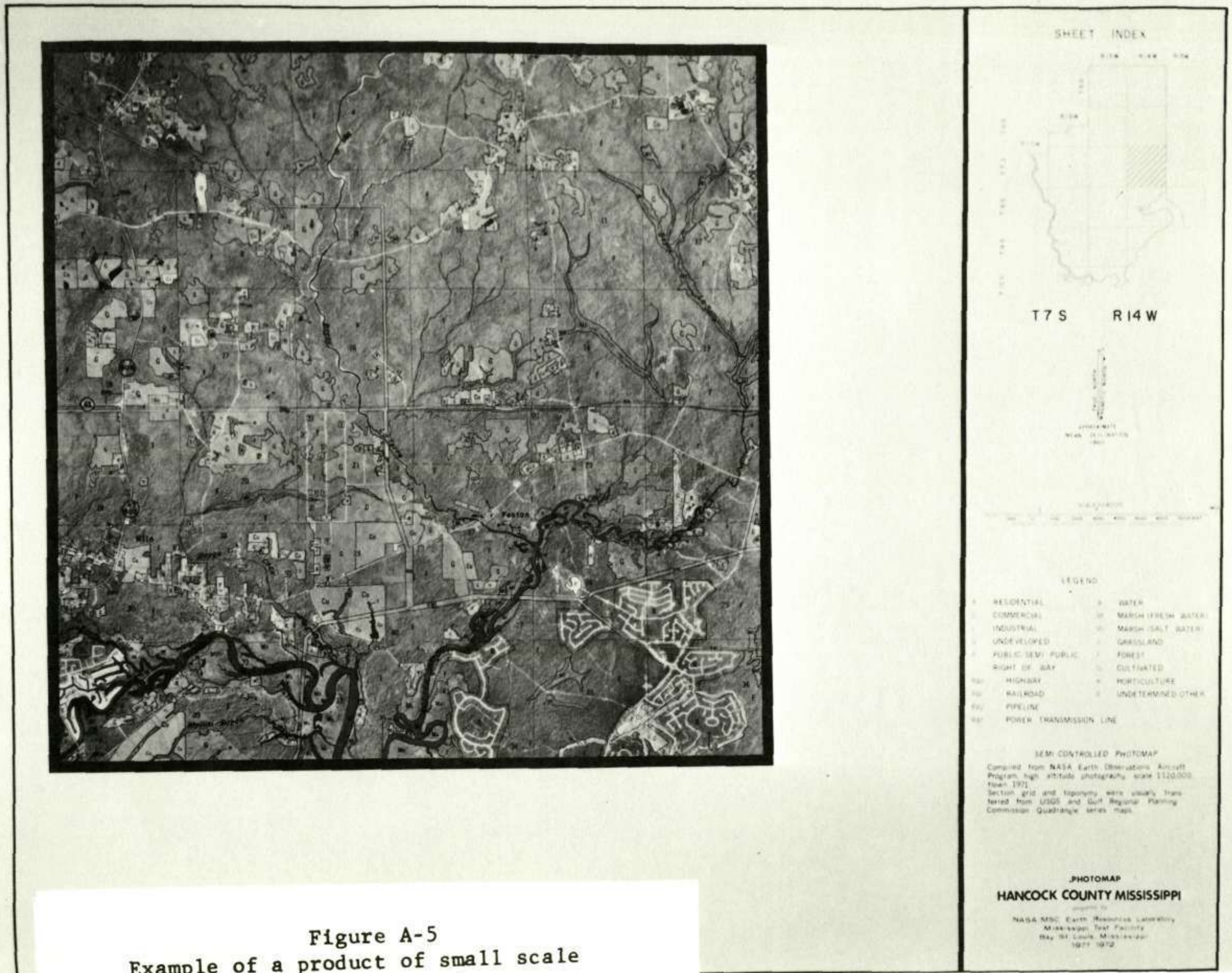


Figure A-5
Example of a product of small scale photography study.