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LAND RESOURCES SURVEY FOR THE STATE OF MICHIGAN

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ABSTRACT

This study is designed to document the usefulness of ERTS-1 satellite imagery as an information source for a statewide inventory of Michigan's land resources. The project is currently relying on photointerpretation of MSS photography and computed processed results. The first task completed was a 1:500,000 scale land use map of the state in four classes: Urban, Forest, Water, and Agriculture and Other. This map was constructed from existing (pre-ERTS-1) information sources including federal, state and county maps, and aerial photography. An ERTS color IR photomosaic for the entire state will also be constructed at a scale of 1:250,000. The Institute is currently working on tape processed data that will include both recognition data as well as a UTM coordinate addressing capability so that the final tape can be inputed directly into computerized land use and transportation corridor analysis models.

1. INTRODUCTION

The State of Michigan, through the State Planning Division of the Bureau of Programs and Budget, has been funding a broad-based program to make it a more effective council for land use and land resource issues confronting decision makers at the state level of government. This program includes efforts at defining problems as well as alternatives to effect more positive decisions as to how we in Michigan are going to treat our land resources. The Environmental Research Institute of Michigan is participating in this program to ascertain how remote sensing systems might effectively contribute to the process of land use and land resource analysis.

2. CURRENT REMOTE SENSING PRODUCTS

The first of several tasks undertaken at the Institute was to map land use for the entire state at a scale of 1:500,000, using five classes: Water, Forest, Agriculture, Urban, and Other. The procedure chosen was to overlay a base map of the state with a square grid corresponding to one mile square and allocate the entire square to that class which dominated (50% +) the cell.

Heavy reliance was to have been placed on existing sources for the classification effort, especially regional and county land use maps, aerial photography and state and federal mapping sources. The plan to rely heavily upon existing information sources fell far short of expectations. Less than a quarter of Michigan's 83 counties have a generalized land use map and only half of these had sufficiently valid information to be useful for our mapping project. Other sources had to be excluded either because they were too out-of-date or because the information content could not be adequately validated as to accuracy. Thus we were forced early in this effort to map but four classes, namely, Water, Forest, Urban, and Agriculture and Other (combined).

Figures 1 and 2 show the results of this work, displaying our classification scheme for the lower and upper peninsulas respectively. The water and forest categories are direct transfers, using the one square mile cell decision procedure, of U. S. Geological Survey thematic masters produced originally at a scale of 1:250,000. This represented an acceptable compromise given that no other adequate sources was readily available for this task, especially in the case of forest cover. The areas mapped Urban were generated using aerial photography supplied by the Michigan Department of State Highways. The photography was collected over all cities in Michigan of 5000 population or greater in 1970. Thus, the map accurately depicts urban development as of that date. The extent of urban development is also being mapped for 1963, using the same procedures and data soruces. The final class, Agriculture and Other, was mapped by a process of elimination, comprising those areas not already classified as Water, Forest or Urban.

The finished map is both valuable and instructive. Its value lies in the systematic procedures used durings its construction. It is instructional in pointing out that while considerable time and resources are spent on inventories and mapping at all levels of government, no attempt has been made to structure data collection, analysis, and synthesis, so that the resulting product can serve as an input to information systems needed in the decision making process. Departments, agencies and planning groups have not yet agreed on uniform formats concerning general purpose land classification, although this process, together with a uniform base mapping program, is now underway in the State of Michigan.

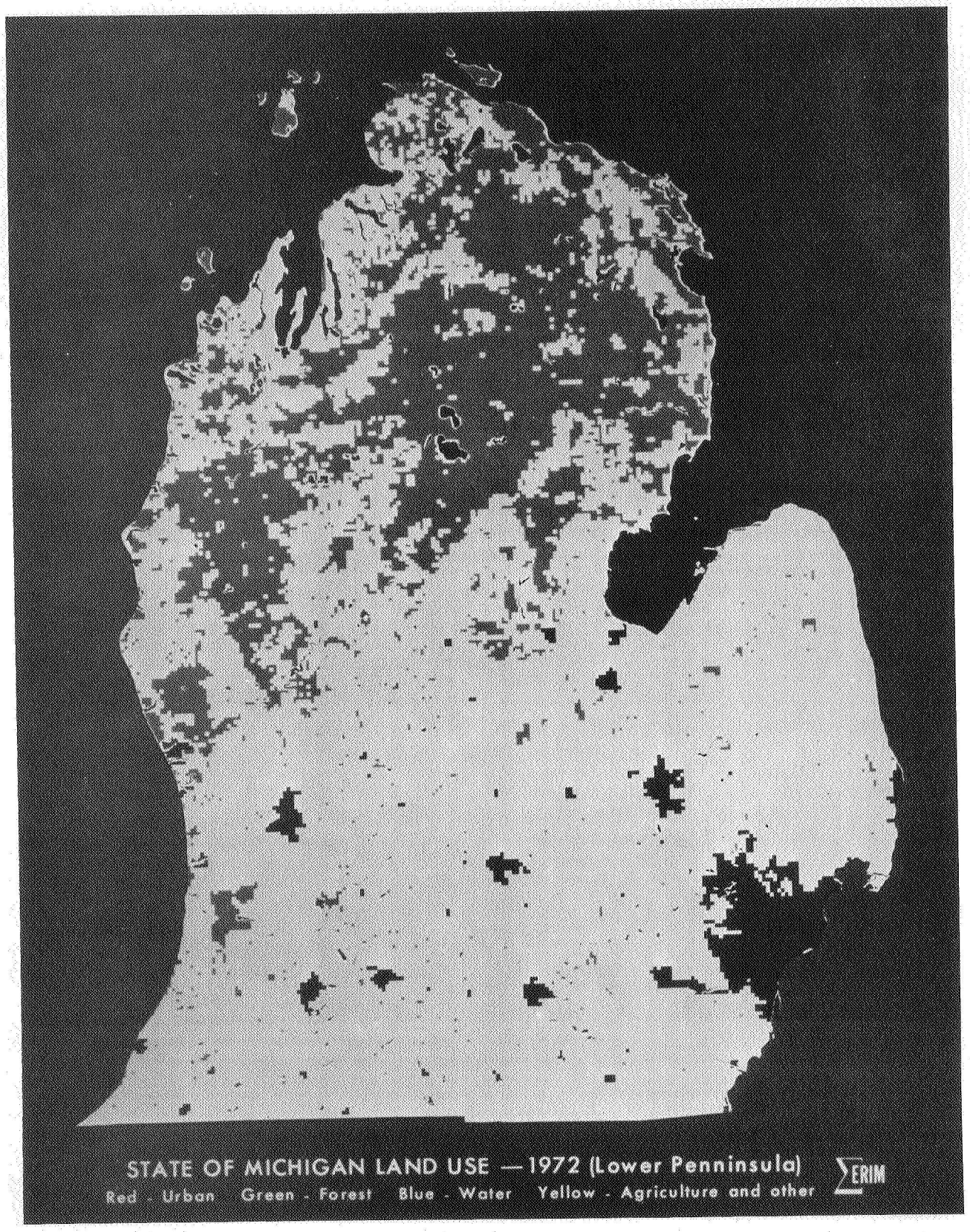
STATE OF MICHIGAN LAND USE — 1972 (Lower Penninsula)
Red - Urban Green - Forest Blue - Water Yellow - Agriculture and other
ERIM

FIGURE 1

C12

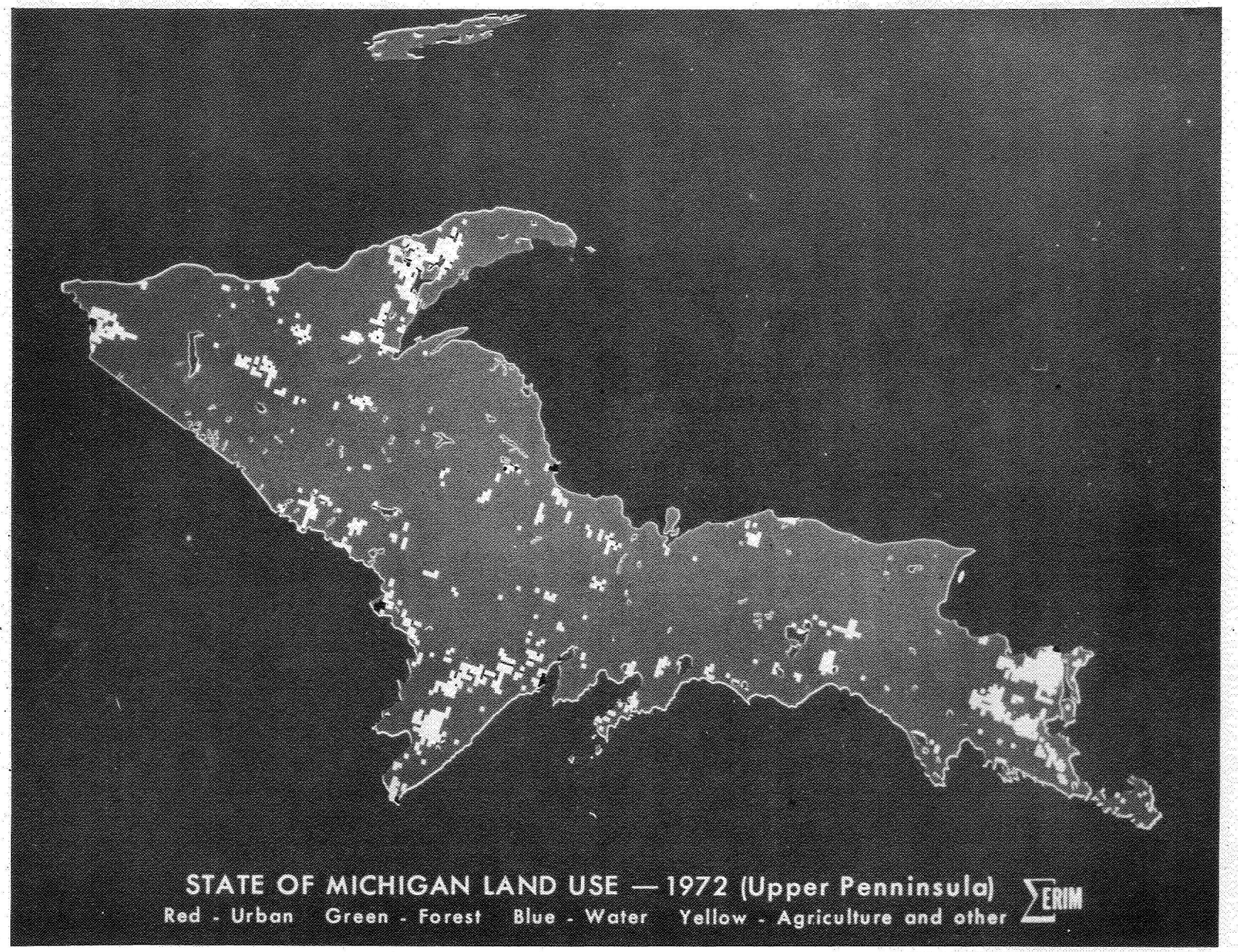
STATE OF MICHIGAN LAND USE — 1972 (Upper Penninsula)
Red - Urban Green - Forest Blue - Water Yellow - Agriculture and other
ERIM

FIGURE 2

The Institute also plans to construct a 1:250,000 scale color IR photomosaic of the State of Michigan from ERTS-1 MSS photography (Bands 4, 5 and 7). The mosaic will be analyzed to document those classes that can be accurately mapped, against those which are discernable, from photointerpretation of the color IR mosaic. This effort is not yet complete since the collection of usable ERTS data was hampered by extremely poor weather conditions over much of Michigan this past fall. These two products, together with interpretations of RB-57 photography for more detailed inventories in urban areas, form the basis of our current products from remote sensed imagery.

3. ONGOING RESEARCH

The Institute has begun a project to make ERTS processed tape data more readily available and usable by various agencies within the state. The program involves not only the solution to data analysis and synthesis, e.g., land use inventory, but also includes the requirement that the data be addressable for computer storage, retrieval, and additional mensuration.

The Institute, together with the Michigan Department of State Highways, is cooperating on a project to use ERTS processed data tapes as a direct input to their computer-based transportation models. The goal is to produce a land use recognition tape, together with a data point addressing system based on UTM coordinates, for use in transportation land use and corridor selection analysis. This would give the Highway Department a current inventory of the location and distribution of the state's land use in a format immediately available to their information system.

The area chosen to test and refine the process centers upon Munising, located in Michigan's Upper Peninsula just north of the Hiawatha National Forest. This heavily forested region was chosen because forest cover as a class covers approximately 50% of the State, and solutions that can consistently and accurately map forest cover situations would be useful for much of the State. Further, the Highway Department will soon begin several major highway studies which must pass through the heavily wooded areas of the Upper Peninsula and the northern half of the Lower Peninsula. We are also expecting to work more closely with the U. S. Department of Agriculture's Forest Service and the State Department of Natural Resources in our analysis of forest cover situations. Thus, we are attempting to coordinate our work and results with as many users as possible.

Figure 3 shows a digital recognition map of the area, annotated with five classes or ground cover features. ERTS photography of MSS Band 5 has been included for comparison purposes. An area of approximately 356 square miles has been mapped to depict water, deciduous and coniferous

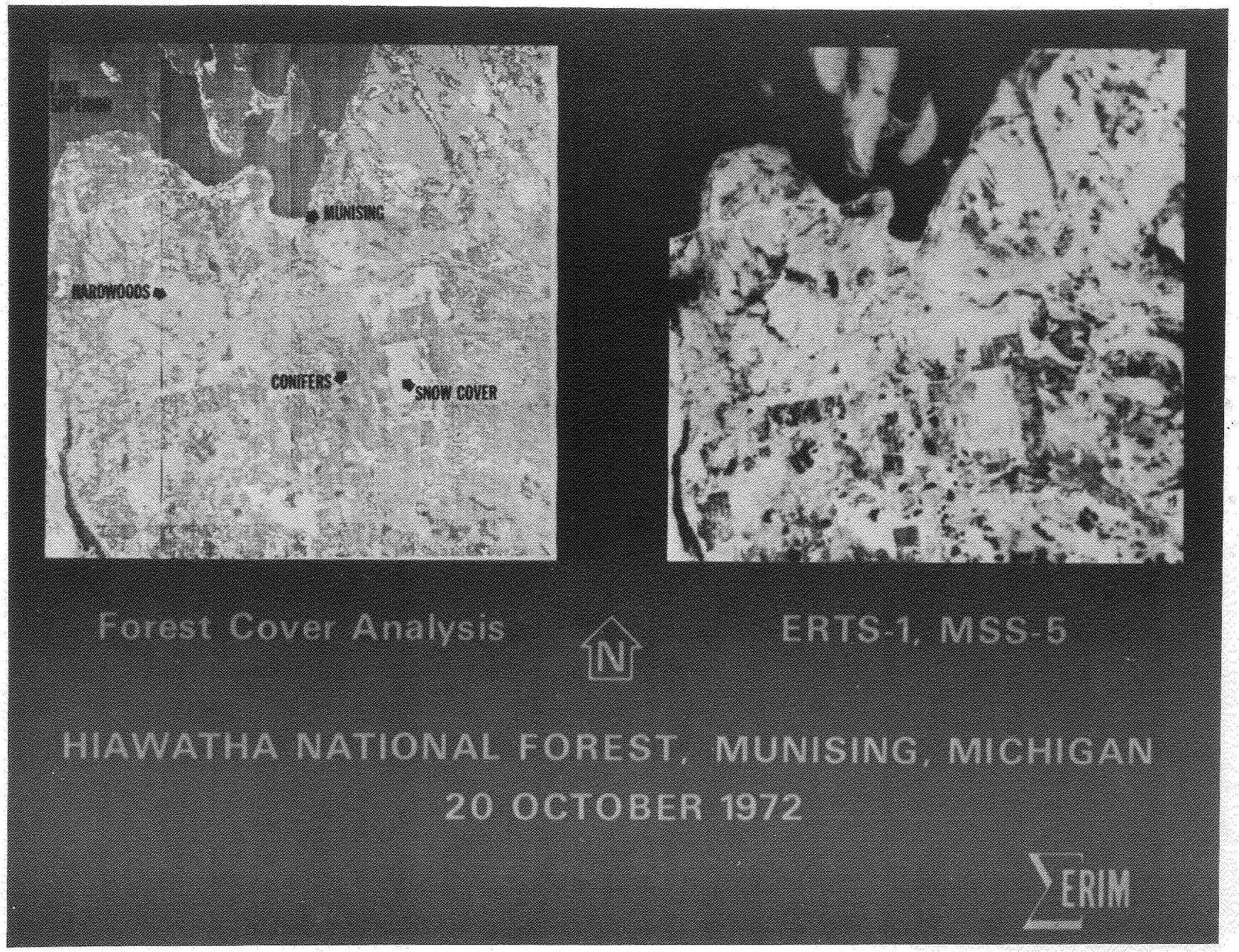
MUNISING
HARDWOODS
CONIFERS
SNOW COVER
Forest Cover Analysis
N
ERTS-1, MSS-5
HIAWATHA NATIONAL FOREST, MUNISING, MICHIGAN
20 OCTOBER 1972
ERIM

FIGURE 3

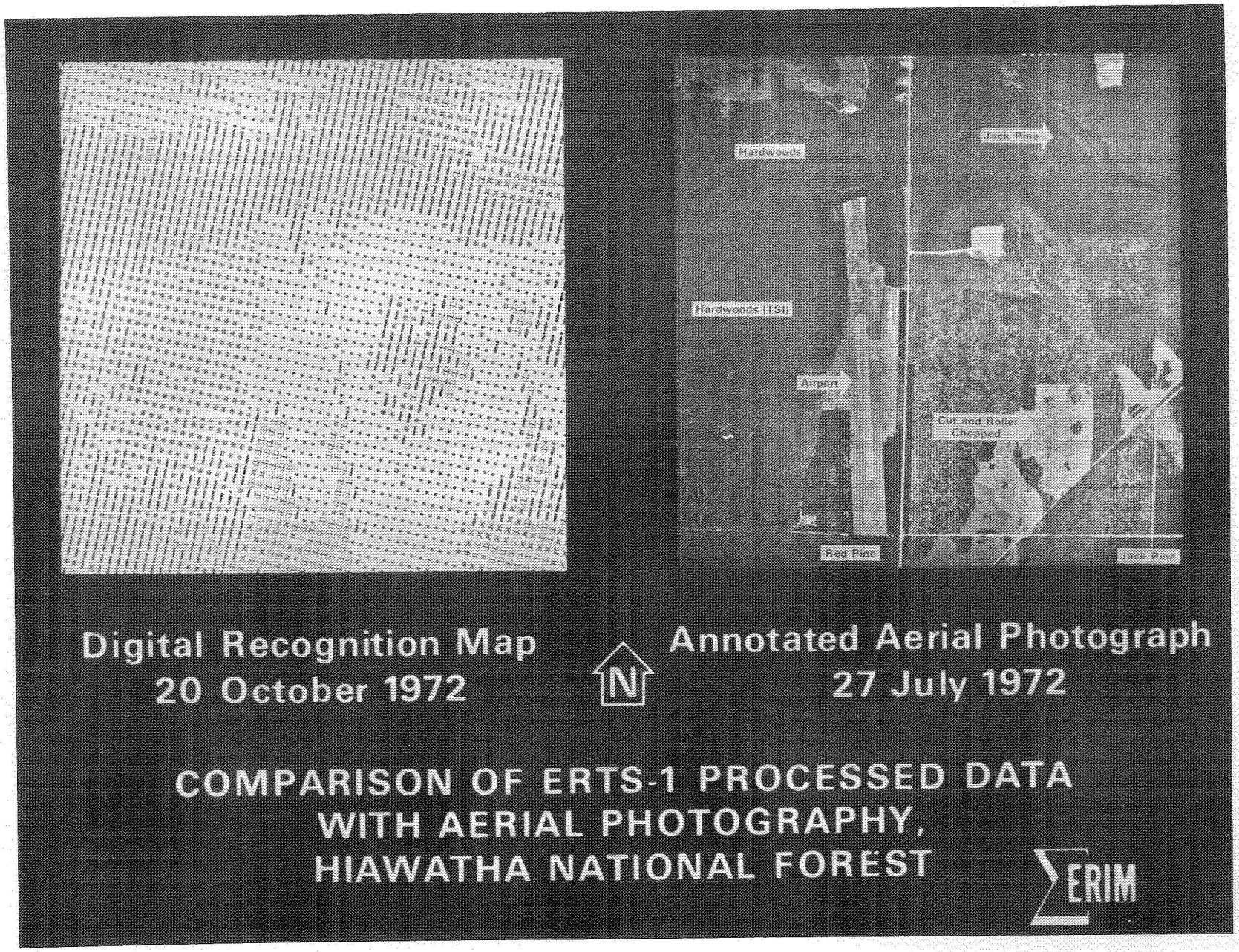
Hardwoods
Jack Pine
Hardwoods (TSI)
Airport
Cut and Roller Chopped
Red Pine
Jack Pine
Digital Recognition Map
20 October 1972
N
Annotated Aerial Photograph
27 July 1972
COMPARISON OF ERTS-1 PROCESSED DATA
WITH AERIAL PHOTOGRAPHY,
HIAWATHA NATIONAL FOREST
ERIM

FIGURE 4

tree stands, and snow cover, which represents unforested areas. The site was covered by five inches of snow and this uniform background greatly increased the accuracy of the recognition results. The map has been compared to forest type maps supplied by the U. S. Forest Service and field checked in specific areas. It is a remarkably accurate product from an initial effort at forest classification.

The area has also been mapped in seven classes, consisting of two hardwood types, mature jackpine and red pine stands, marsh, water, and snow cover. A small portion of this color coded recognition map is shown in Figure 4, together with an annotated aerial photograph taken in July of this year. This map shows the excellent correspondence of the recognition types with the annotated photograph. Of particular interest is the fact that the hardwood stand immediately west of the airport was thinned for selected individuals (TSI) this past summer and registered a distinct spectral signature from the rest of the hardwood stands in the area. It was mapped as a separate class, more by chance than calculation, and was verified as a unique hardwood stand by Forest Service personnel when field checked just a few weeks ago.

4. CONCLUSIONS

The recognition results achieved thus far are sufficiently useful, both in classification content and accuracy, for initial testing in highway modelling programs. The next step will be to address the recognition results on a point by point basis using UTM coordinates. This effort will then begin to achieve the fuller potential of ERTS data as an effective information source in land resource analysis. The mandate of present research in this area is clearly one of formatting the final product such that the users can easily and economically merge remote sensing data into their information systems.