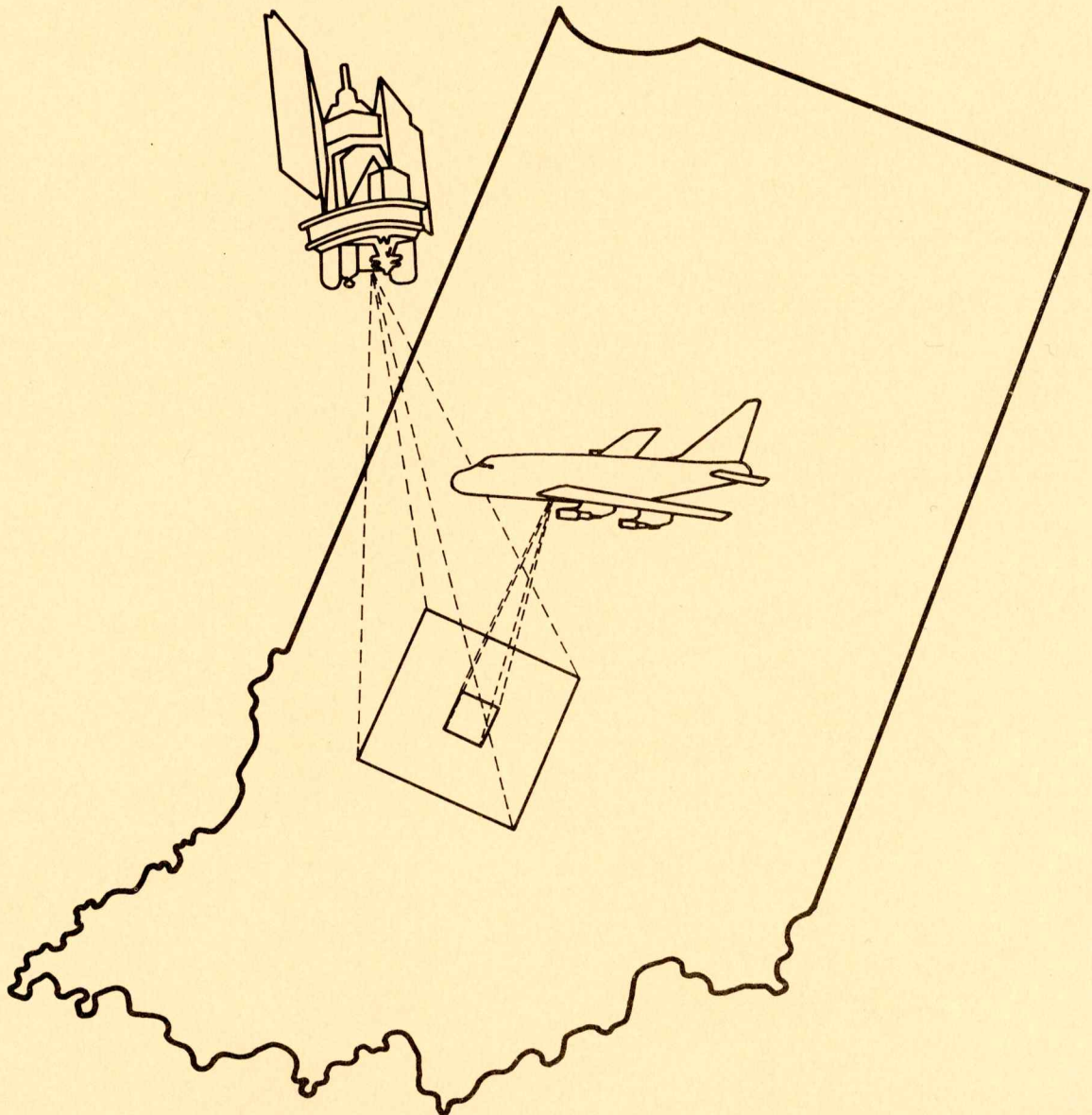LARS Contract Report 053079

Semi-Annual Status Report

Application of Remote Sensing Technology to the Solution of Problems in the Management of Resources in Indiana

Laboratory for Applications of Remote Sensing
Purdue University W. Lafayette, Indiana
December 1, 1978 - May 31, 1979   NGL 15-005-186

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LARS Contract Report 053079

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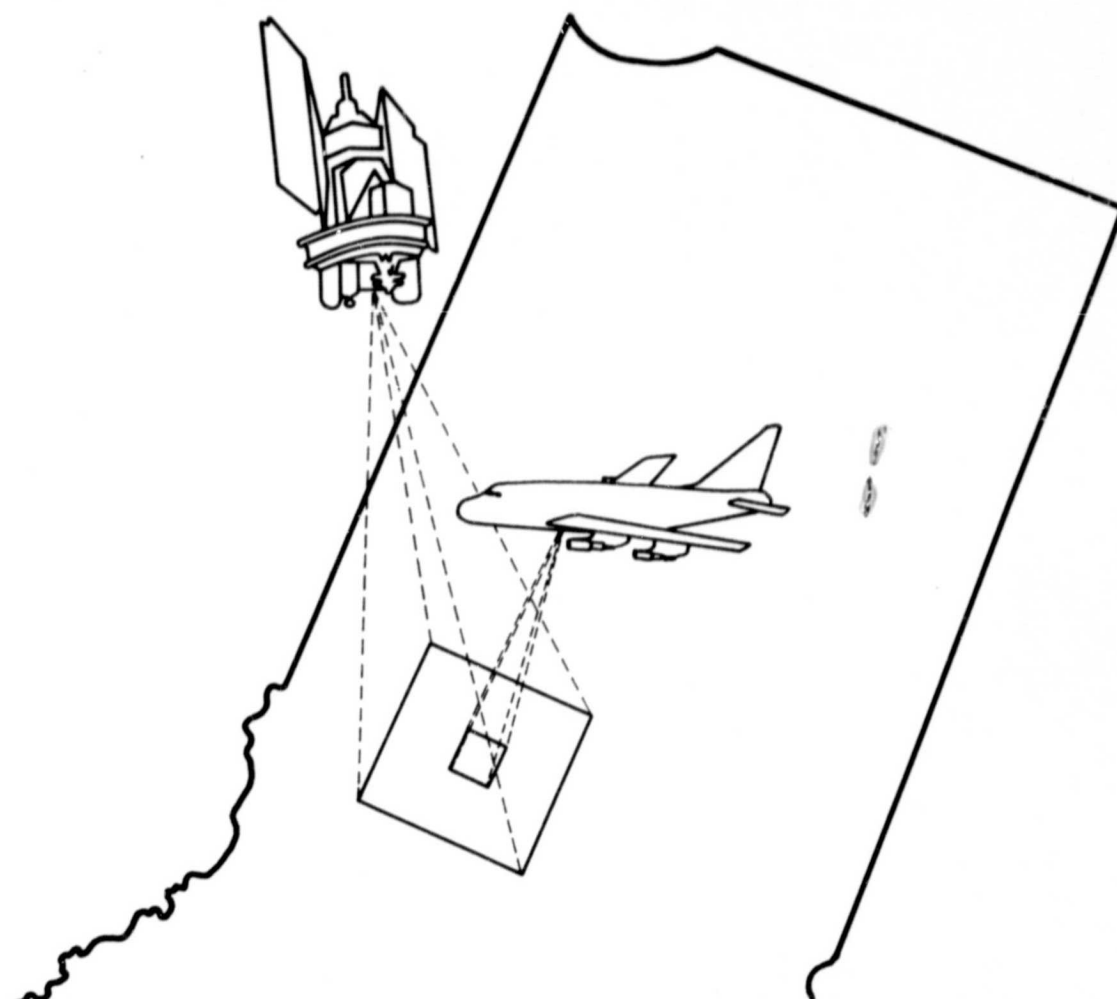December 1, 1978 – May 31, 1979   NGL 15-005-186

SEMI-ANNUAL REPORT

Reporting Period: December 1, 1978 - May 31, 1979

Grant No. NGL 15-005-186

Title of Investigation:

       The Application of Remote Sensing Technology to the Solution
       of Problems in the Management of Resources in Indiana

Principal Investigators:

       R.A. Weismiller
       R.P. Mroczynski
       Purdue University
       Laboratory for Applications of Remote Sensing
       West Lafayette, Indiana   47906

Submitted to:

       The Office of University Affairs
       Code P
       National Aeronautics and Space Administration
       Washington, D.C.   20546

TABLE OF CONTENTS

INTRODUCTION

This semi-annual status report covers the period from December 1, 1978 to May 31, 1979 and contains a review of the research and applications, completed or in progress, as funded by the Office of University Affairs, NASA and conducted by Purdue University, Laboratory for Applications of Remote Sensing.

This reporting period marks the second half of the sixth year of funding for a proposal entitled "The Application of Remote Sensing Technology to the Solution of Problems in the Management of Resources in Indiana." As indicated in this title, the purpose of this work is to introduce remote sensing into the user community within the state of Indiana. The user community includes those local, regional and state agencies involved in the decision monitoring and/or managing processes of the state's resources.

In order to carry out this work it is not only necessary to initiate projects with these agencies but also it is necessary to meet with and provide information to as many people and groups as well as agencies as possible. During the past six months numerous meetings were held with many different groups.

Among the groups that were contacted and received information about this program were:

National Park Service, Indiana Dunes National Lakeshore
Indiana Department of Natural Resources
    Division of Fish and Wildlife
    Division of Forestry
    Division of Reclamation
    Office of the Associate Director

U.S. Department of Agriculture
    Soil Conservation Service

Listed below are the projects that are reported in this document:

Soils Inventory
Wetlands Inventory
Upland Game Bird Habitat Survey.

SOIL INVENTORY PROJECT

With the urgency throughout the country to complete the modern soil survey at the earliest possible date, new techniques and tools are being devised to carry out the soils mapping program. One such new mapping tool is a series of maps, derived from Landsat data, showing the spectral characteristics of soils. These maps should greatly enhance the efficiency of producing a higher quality soil survey. Figures 1 and 2 are examples from a document which contains a set of spectral maps prepared to support the on-going soil survey of Jasper County, Indiana. Whereas Jennings County, Indiana was the first county in the nation to be mapped using aerial photographs as base maps, Jasper County is the first county to be mapped using spectral maps as an aid in the county soil mapping program.

The spectral maps contained in this document depict the pattern and boundaries of the spectral characteristics of the soils occurring throughout the landscape of Jasper County, Indiana. The spectral information was produced using computer-aided analysis (LARSYS) of Landsat-1 multispectral scanner (MSS) data collected on June 9, 1973. Prior to analysis, the Landsat data were geometrically corrected and registered ($\pm\frac{1}{2}$ pixel) to aerial photography (scale 1:15,840) collected for the USDA/Soil Conservation Service on May 3, 1976. Soil parent material boundaries (Figure 3) used in the analysis were interpreted from the Landsat imagery and verified by field investigations.

The spectral classes represented were correlated with soil drainage classes. Although it was sometimes possible to correlate soil properties such as color, surface texture and organic matter content with the spectral classes, these correlations did not prove as consistent as those with soil drainage characteristics. Soils underlying the vegetation class were inferred without the benefit of field data and are subject to discrepancies. Detailed descriptions of the methodology used in preparation of these spectral maps are given in the following two documents:

1. Kaminsky, S.A. August, 1978. An investigation of analysis techniques of Landsat MSS data designed to aid the soil survey. M.S. Thesis, Purdue University, West Lafayette, IN.

2. Hinzel, E.J. December, 1978. Correlation of spectral classes derived from Landsat MSS data to soil series and soil conditions for Jasper County, Indiana. M.S. Thesis, Purdue University, West Lafayette, IN.

Mapping for Jasper County is being carried out on halftone film positive mylars, termed "atlas sheets." These atlas sheets show the aerial photographic image of the mapping area and can be used to overlay the spectral maps. Thus, the soil scientist will have the benefit of both conventional aerial photography and soil spectral characteristics to guide him in delineating map unit boundaries. At a scale of 1:15,840 each pixel represents 0.5 acre and is depicted by a distinctive symbol on the spectral maps. Reference to the accompanying mapping legend provides information which can be used to help determine the nature of the soil within each pixel. Roads have been manually superimposed upon the spectral maps for control purposes. Additional control is available by matching the dark and light soil patterns of both products.
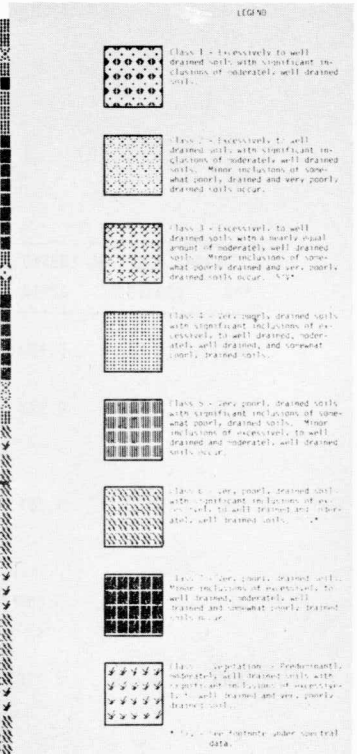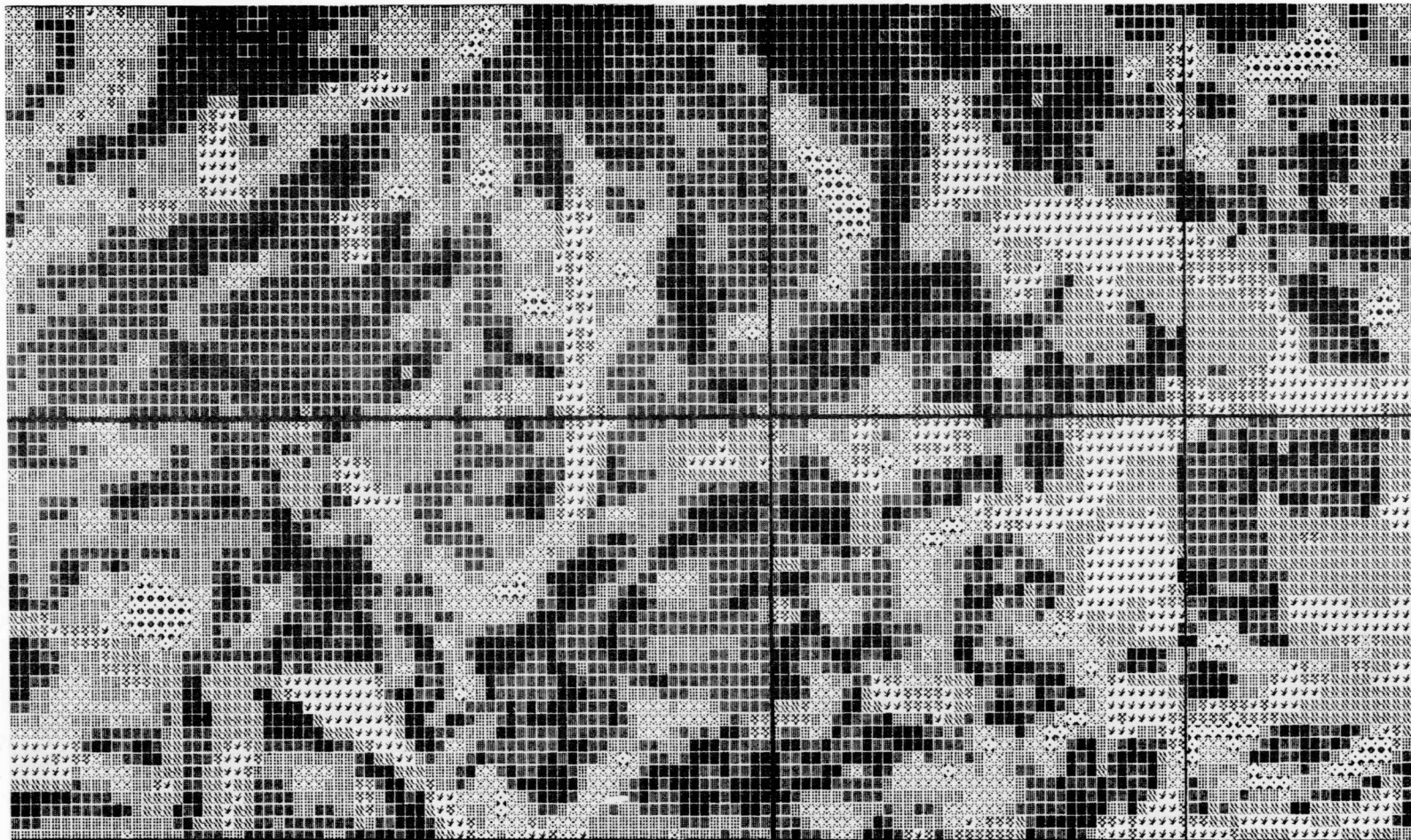
Spectral Classification of Soil Characteristics
Atlas Sheet No. 73
Lacustrine Area
Jasper County, Indiana

Scale 1:15,840

Figure 1. A sample atlas sheet from the Jasper County Soil Inventory Study. This example is from a lacustrine parent material area in the southwestern portion of the county.

3

Atlas Sheet No. **73**
Lacustrine Area
Jasper County, Indiana

WORKING LEGEND
(Soil Series)

Excessively to Well Drained	Moderately Well Drained
Abscota	Alvin
Chelsea	Camden
Dickinson	Foresman
Jasper	Landes
Martinsville	Saylesville
Plainfield	
Sisson	
Sparta	

Somewhat Poorly Drained	Very Poorly Drained
Colwood	Mahalasville
Darroch	Montgomery
Del Rey	Patton
Fulton	Rensselaer
Haskins	Sloan
Hoopeston	(Histosols)
Kibbie	
Odell	
Rimer	
Roby	
Starks	
Strole	
Swygert	
Tedrow	

Spectral Data

DRAINAGE CHARACTERISTICS AND SOIL SERIES OBSERVED IN FIELD (6 quarter sections or 1.53% of lacustrine area)	AREAL EXTENT OF FIELD SHEET			
	POINTS*	ACRES	HECTARES	%**
Class 1 - Excessively to well drained soils (Chelsea, Dickinson) with significant inclusions of moderately well drained soils (Alvin).	148	74.0	30.0	1.6
Class 2 - Excessively to well drained soils (Chelsea, Dickinson, Jasper, Plainfield, Sparta) with significant inclusions of moderately well drained soils (Alvin). Minor inclusions of somewhat poorly drained (Darroch, Tedrow) and very poorly drained (Rensselaer) soils occur.	1046	522.9	21..7	11.6
Class 3 - Excessively to well drained soils (Chelsea, Dickinson, Jasper, Plainfield) with nearly equal amounts of moderately well drained soils (Alvin). Minor inclusions of somewhat poorly drained (Roby) and very poorly drained (Rensselaer) soils occur. S/V***	330	165.0	66.8	3.7
Class 4 - Very poorly drained soils (Mahalasville, Rensselaer) with significant inclusions of excessively to well drained (Chelsea, Dickinson, Sparta), moderately well drained (Alvin), and somewhat poorly drained (Darroch, Roby, Tedrow) soils.	1739	869.4	352.0	19.2
Class 5 - Very poorly drained soils (Mahalasville, Rensselaer) with significant inclusions of somewhat poorly drained soils (Darroch, Odell, Starks, Tedrow). Minor inclusions of excessively to well drained (Chelsea, Jasper, Sparta) and moderately well drained (Alvin) soils occur.	2744	1371.8	555.4	30.4
Class 6 - Very poorly drained soils (Mahalasville, Rensselaer) with significant inclusions of excessively to well drained (Dickinson, Chelsea) and moderately well drained (Alvin) soils. S/V***	834	417.0	168.8	9.2
Class 7 - Very poorly drained soils (Mahalasville, Rensselaer). Minor inclusions of excessively to well drained (Chelsea, Dickinson), moderately well drained (Alvin) and somewhat poorly drained (Darroch, Roby, Starks) soils occur.	1555	777.4	314.7	17.2
Class 8 (Vegetation) - Predominantly moderately well drained soils (Alvin) with significant inclusions of excessively to well drained (Dickinson, Jasper, Plainfield) and very poorly drained (Mahalasville, Rensselaer) soils.	639	319.5	129.3	7.1

   * Each data point = 0.2 hectares (0.5 acres).
  ** % equals percent of this field sheet.
 *** S/V - Spectral characteristics of these classes indicate the presence of both soil and varying amounts of green vegetation.

Figure 2. This is an example of the information that appeared on the reverse side of the atlas sheet map shown in Figure 1.

Index Map

Soil Parent Materials Areas

I Glacial Outwash
II Glacial Till - Rolling Moraine
III Glacial Outwash over Glacial Till
IV Lacustrine Deposits
V Glacial Till - Ground Moraine
(Alfisols)
VI Glacial Till - Ground Moraine
(Mollisols)

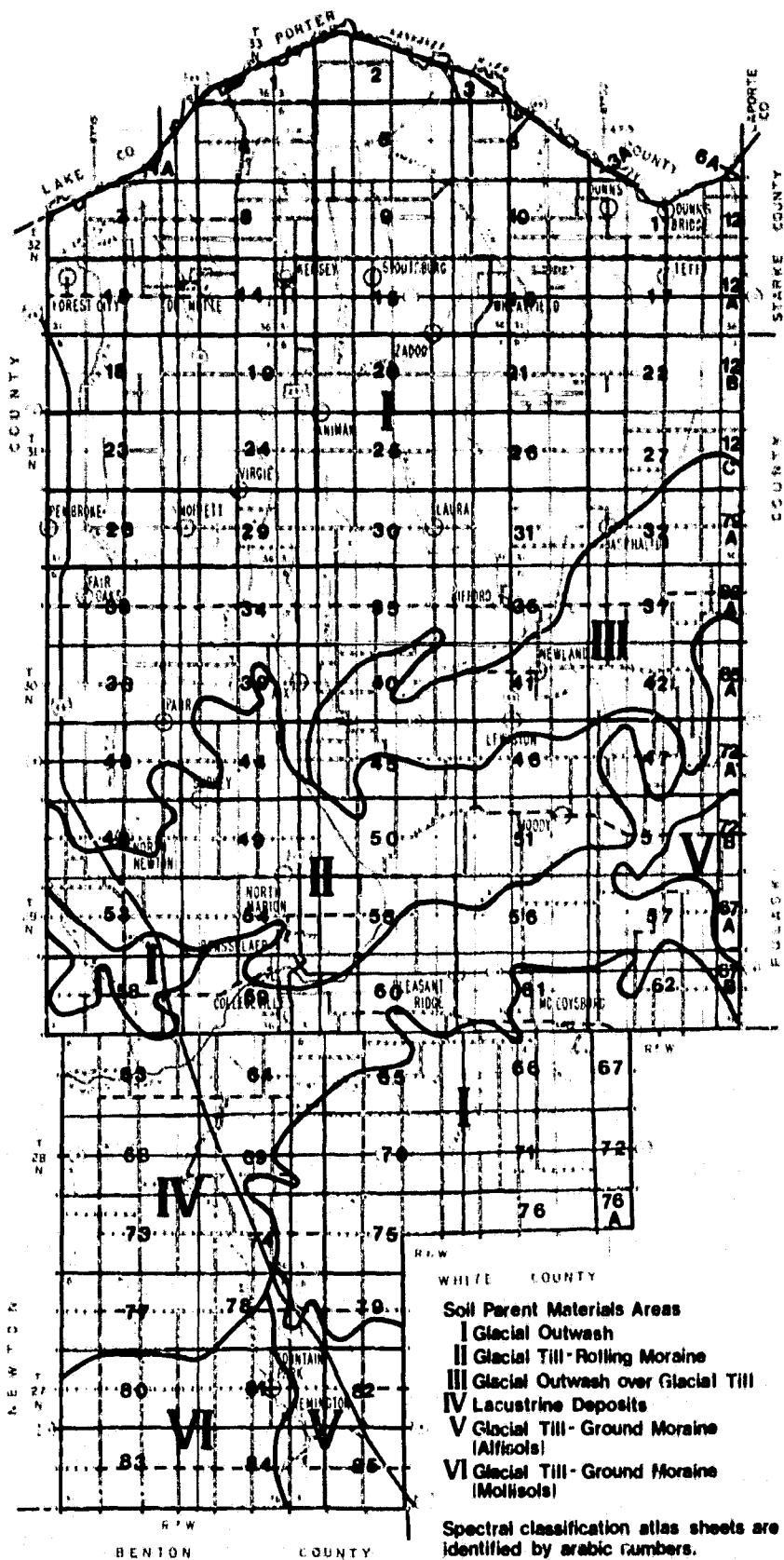Spectral classification atlas sheets are identified by arabic numbers.

Figure 3. Map of soil parent materials for Jasper County derived from interpretation of Landsat data.

The explanatory data appearing on the reverse side (Figure 2) of the spectral map consist of three items:

1. The Working Legend is a listing of the soil series which have been designated as most likely to occur in the county within a given parent material area. Some minor modification in the legend may occur during the actual mapping of Jasper County. This may consist of the deletion of a few series due to the minor acreages mapped or the addition of new series identified during the survey.

2. The Drainage Characteristics and Soil Series Observed in the Field describes the natural drainage classes correlated with each spectral class and names the soil series observed in the field based upon a statistical sampling procedure. These observations covered a limited sized area for each specific parent material region as described under this caption. It should be recognized that inclusions of other parent materials may occur within any named soil parent material area. In addition, the random selections of sample sites may result in some bias, and discrepancies may arise due to errors in sampling or judgement.

3. The Areal Extent of Field Sheet lists the statistical distribution of each spectral class that is represented on each atlas or field sheet. These tabulations permit the evaluation of the extent of each spectral class.

Upon the completion of sufficient mapping in representative areas of the county the utility of the spectral maps will be evaluated and future developmental requirements will be established.

INDIANA WETLANDS INVENTORY

INTRODUCTION

During 1978 LARS staff working in conjunction with personnel from the Division of Fish and Wildlife, Indiana Department of Natural Resources, entered into a study to assess the feasibility of using Landsat data to inventory wetlands. Nationally, there has been increasing awareness over the past twenty years concerning the status of these important resources. IDNR does not currently have a comprehensive inventory of the Indiana wetland resources. Because of cost and time constraints associated with traditional wetland survey methods the probability of undertaking a comprehensive inventory in the near future is small.

However, if Landsat technology could be effectively applied to identify wetlands statewide, legislation to complete a comprehensive survey might be passed by the State Legislature. Therefore, the objectives of this study were developed to address the long range goal of providing a basis upon which a comprehensive wetland survey could be built. Simply stated, these objectives are:

° To assess the feasibility of using machine assisted Landsat data analysis techniques to identify Indiana's wetlands, and

° To determine the extent to which Landsat data can be used to identify various wetland communities (species associations) native to Indiana.

The material presented here is from a paper presented at the International Symposium on Satellite Hydrology which was held between June 11-15, 1979, at Sioux Falls, South Dakota. These results build upon material which appeared in the previous semi-annual report. A detailed discussion of new classification technology is given along with results from the study area.

STUDY AREA DESCRIPTION

A test site in northern Indiana was used in this investigation (Figure 1). A major portion of the study area contains the Pigeon River State Fish and Wildlife Area. The wildlife area and surrounding lands are dotted with numerous small wetlands and lakes formed during the Wisconsin glaciation. Six major wetland types are present in the study area including shallow marsh, deep marsh, open water, shrub swamp, hardwood swamp, and tamarack. These wetland types are described further in Table 1.

MATERIALS AND METHODS

Soils information from the Pigeon River study area was collected from the recently completed but as yet unpublished soil surveys of LaGrange and Steuben Counties (U.S. Soil Conservation Service). Bottomland soil boundaries were identified on the survey and transferred onto respective USGS 7½ minute quadrangles. A bottomland soil was defined as one which is located in a lowland area and classified as poorly drained. The soil boundaries differentiating bottomland and upland areas were digitally
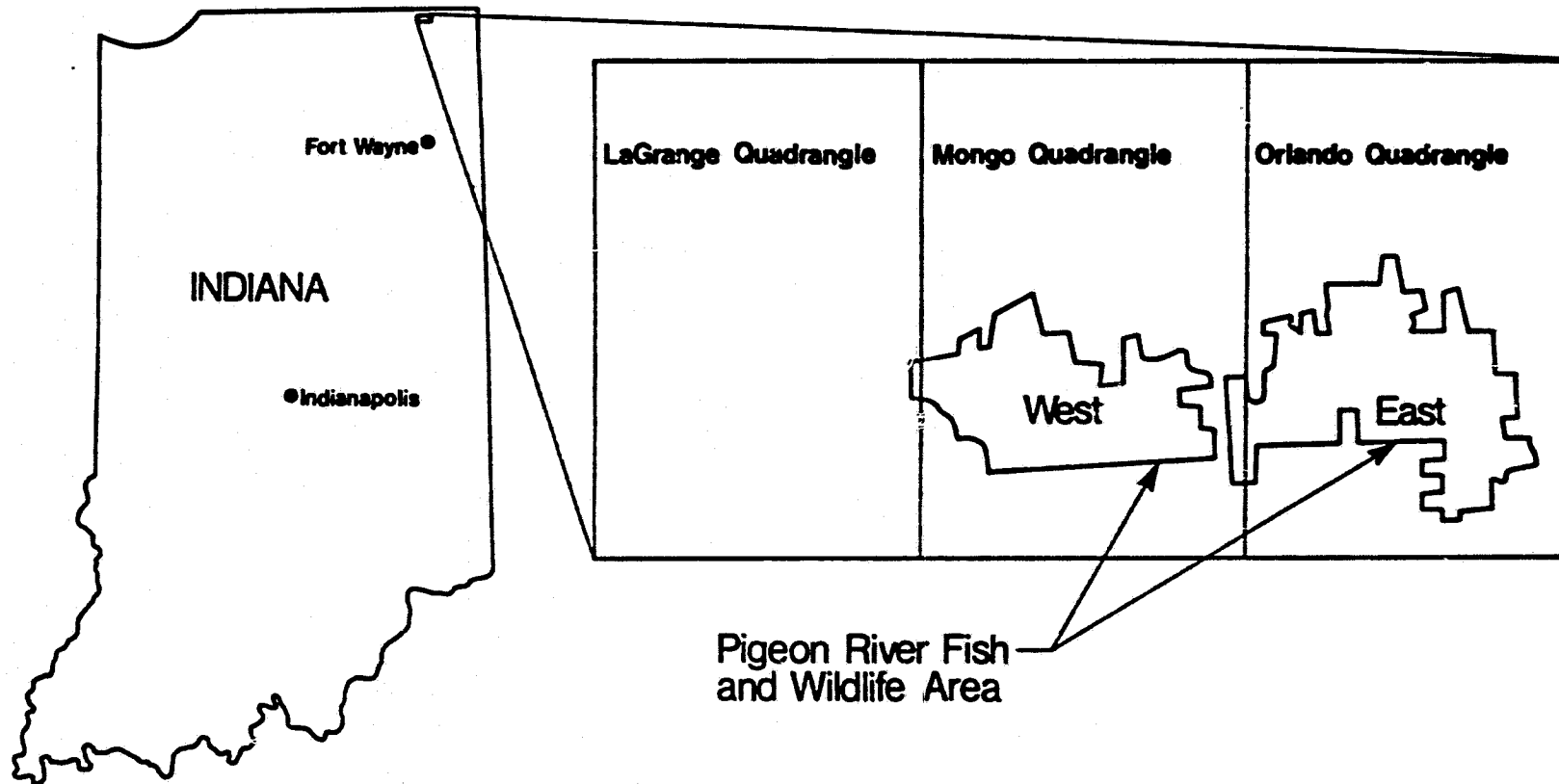
Location of Pigeon River Study Area

Figure 1. Location of the Pigeon River Study Area used to evaluate the use of computer-aided analysis techniques for identifying wetlands.

Table 1. Description of the six major wetland types found in the Pigeon
River Study Area.

Wetland Type	Description
Shallow Marsh	- Soil waterlogged for much of growing season. - Inundated in spring with as much as 6" water. - Vegetation consists of rooted herbaceous hydrophytes (grasses, sedges, smartweed).
Deep Marsh	- Soil covered with 1½-3' water (permanently flooded) - Vegetation consists of submergent plants, floating-leaved plants, herbaceous species (spatterdock, white water lily, cattail, bulrushes)
Open Water	- Water of variable depth - Vegetation consists of submergent species only (vascular plants)
Shrub Swamp	- Dominated by woody vegetation less than 6 m in height - 6^3 - soil waterlogged, dogwood, willow, button brush - 6^4 - soil covered with 1½-3' of water, blueberry, winterberry, choke berry.
Wooded Swamp	- Seasonally inundated with water (flood plains) - Dominant vegetation 6 m in height and greater (aspen, swamp white oak, silver maple.
Bog	- Saturated with water floating (?) - Vegetation consists of needle leaf deciduous (Tamarack)

overlaid onto the Landsat multispectral scanner data collected on June 8, 1978 (Scene ID #E-21234-15135-5). Because of the difficulty in digitizing small or narrow areas, only bottomland soil areas greater than 200 m (approximately 3 resolution elemetns) were included in the soils data channel.

The analysis of soils and spectral data was completed using the LARSYS software. When soils or other ancillary data are available for use in conjunction with spectral data, a classification method which accommodates the different types of information must be applied to identify ground cover types. The "layered classifier" is one such method. The layered or decision tree classifier employs a maximum likelihood algorithm in multistage decision logic. That is, an unknown sample is classified into a known informational class using a maximum likelihood decision function applied in a series of individual steps. The series of decision functions in the layered classifier can be easily visualized as a simple tree structure (Figure 2). Each intermediate node marks a decision stage or layer. Each terminal node denotes the final informational classes of interest.

Two sets of information are always needed when using the layered classifier. The first, called interclass separability, determines how the terminal and non-terminal nodes are linked in the decision tree. The decision tree can be manually defined or constructed by an optimized logic tree design procedure (Swain and Hauska, 1977). The second set of information needed in the layered classifier specifies the channels of data which will be used in the decision functions at all nonterminal nodes.

The flow chart in Figure 3 illustrates the procedure used in t₁ investigation to identify wetland types using the layered classifier. The training statistics for the layered classifier were identical to those used in the maximum likelihood approach to the wetland classification (Ernst, et al, 1977). This training technique involves selecting spectrally heterogeneous areas (i.e., data blocks) and applying a clustering algorithm to these areas to obtain a prescribed number of spectral classes. These classes are then identified according to their information content. Statistics of similar classes that occur in different blocks are pooled to create a final statistics deck which describes spectrally separable informational classes. This procedure was found to be the most effective in terms of analyst efficiency, computer time, and classification performance (Fleming and Hoffer, 1977).

The decision tree used to classify wetlands in this investigation was constructed both manually and with the design procedure. The optimized logic tree design procedure was applied to the existing wetland spectral class statistics. This computer-generated tree was manually attached to two points on the upper portion of the final decision tree. The upper portion of the tree defined upland and bottomland soils classes. Figure 4 illustrates the decision tree that was utilized. An unknown sample is first identified as being an upland sample (A) or bottomland sample (B) using information from the digitized soils channel. From this point on, only spectral channels were used in the decisior functions of the layered classifier to identify ground cover types.

The previous investigation indicated that the identification of wetlands from Landsat MSS data was difficult in some cases because of the
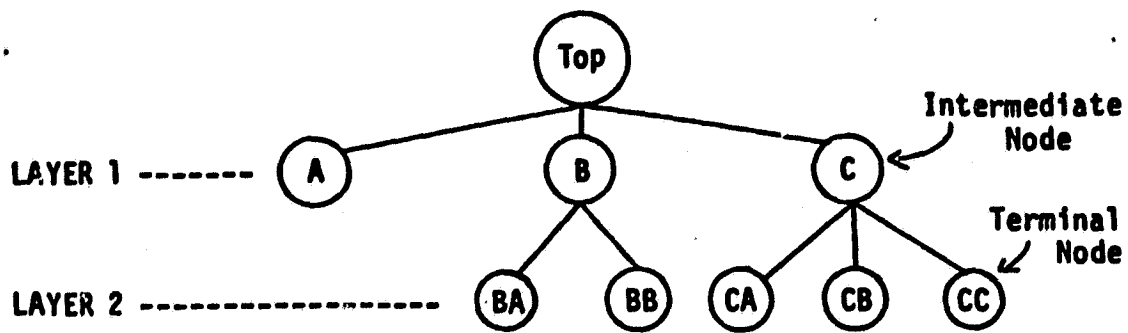
Figure 2. A simple decision tree design.
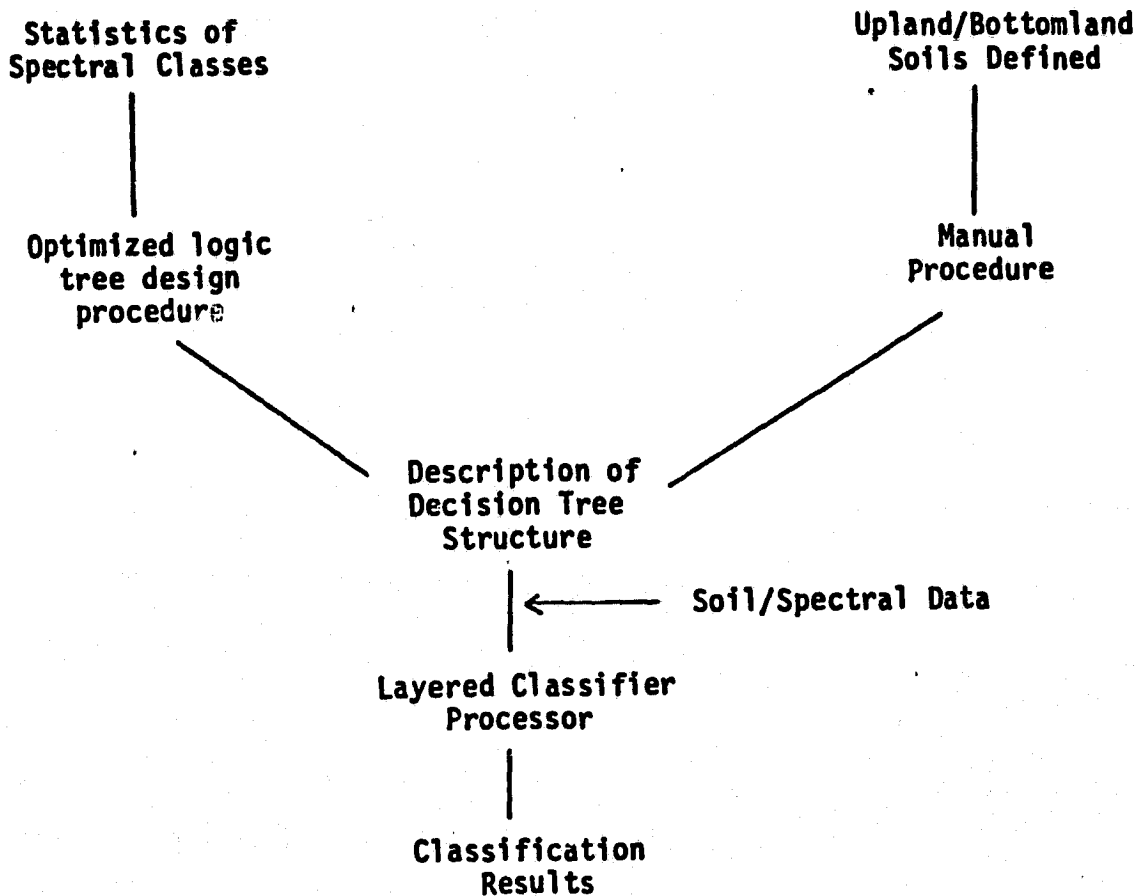
Figure 3. Analysis sequence for layered classification procedure to identify wetlands using Landsat spectral data and soils information.
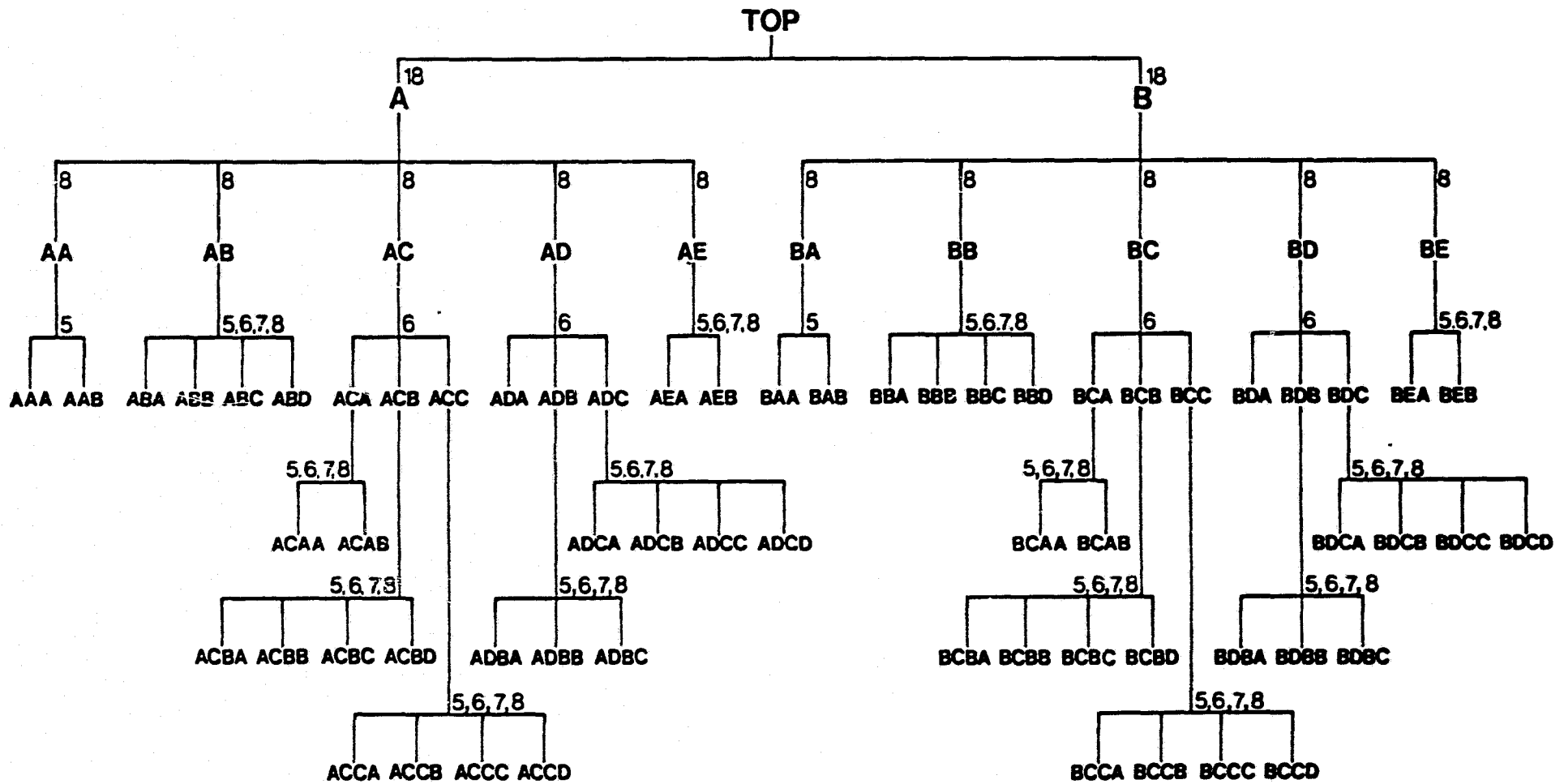
Figure 4. Decision tree used in layered classification procedure to identify wetlands. Letters identify specific spectral or soil classes. Symbols at terminal nodes represent the following information classes: Upland hardwood: AEB, ADCA; Conifer: ACCC, ADCD; Shallow Marsh: AEA, BEA; Deep Marsh: BBC, BCCB, BCCC, BDCD; Open Water: AAA, ABA, BAA, BBA, BBB; Shrub Swamp: BDBC, BDCA; Hardwood Swamp: BDB, BDCA; Mull: AAB, BAB. All other terminal node classes represent agriculture.

confusion between upland cover types and wetland cover types having similar vegetative life forms (for example, swamp hardwoods and upland hardwoods). In the layered classification, spectral classes could be given different informational class names according to whether they occurred on an upland or bottomland site. For example, on the decision tree in Figure 4 classes AEB and BEB have the same spectral characteristics because they are both hardwoods. However, the use of soils data to differentiate upland (A) from wetland (B) habitats in the first layer of the classification sequence enabled class AEB to be identified as upland hardwoods, and class BEB to be identified as hardwood swamp.

The results of the layered classifier were compared to the maximum likelihood classification which uses only spectral data without the aid of any ancillary information. Since this latter classifier involves only one step in the decision logic, the term "single stage" applies to such a classification procedure. The terms "single stage" and "layered" will be used throughout the remainder of this paper to differentiate the two classification techniques used.

RESULTS AND DISCUSSION

Study of the maximum likelihood classification results revealed that hardwood swamps could not be separated from upland hardwoods on the basis of spectral response alone (Ernst, et al., 1979). Both the upland hardwoods and bottomland hardwoods were found to belong to the same spectral class. In addition, shrub swamps were often confused with pastures and upland shrubs or sparse hardwood sites. Deep marshes exhibited fairly good definition. However, because conifer plantations have a spectral response similar to deep marsh, the former were consistently classified as deep marshes. Hence, conifers could not be spectrally identified. Shallow marsh were misclassified as winter wheat, causing the former to exhibit poor classification performance.

The application of the layered classifier to the combined Landsat multispectral scanner and soils data produced a distinct improvement in classification results for some wetland classes. Eight separate cover types were identified on the Landsat data including five of the six major wetland types found in Indiana. Table 2 lists these cover types and test class performance for each type based on a random two percent ground sample of the Pigeon River study area. The ability to separate hardwood swamps from upland hardwoods averages around 66%. Some confusion still existed between these cover types at areas where bottomland soil areas were too narrow to be identified on the soils data channel. Confusion between shrub swamps and hardwood swamps resulted in a low performance for the shrub swamp category. Shallow marshes were often classified as winter wheat. Deep marsh exhibit fairly good definition. Conifer plantations could be separated using the layered classifier. However, the classification performance shown in Table 2 is still rather low for conifers because the study area contained only a few, very small conifer plantations which did not enable an adequately large set of training and test data to be defined. The principle confusion class for conifers was dark exposed soil found throughout the surrounding agricultural uplands.

Figure 5 is a bar graph comparing the single stage classifier and the layered classifier performance accuracy for identifying individual wetland

Table 2. Performance values of layered classification procedure in identifying ground cover types using soils and Landsat spectral data.

| Cover Type	% Performance	Predominant Confusion Classes
Agriculture	87.3	Upland Hardwoods, Shallow Marsh
Upland Hardwoods	63.7	Agriculture, Shallow Marsh
Conifers	26.3	Agriculture, Deep Marsh
Shallow Marsh	27.9	Agriculture, Hardwood Swamp
Deep Marsh	57.3	Agriculture
Open Water	87.8	Agriculture
Shrub Swamp	27.7	Hardwood Swamp
Hardwood Swamp	65.9	Upland Hardwoods
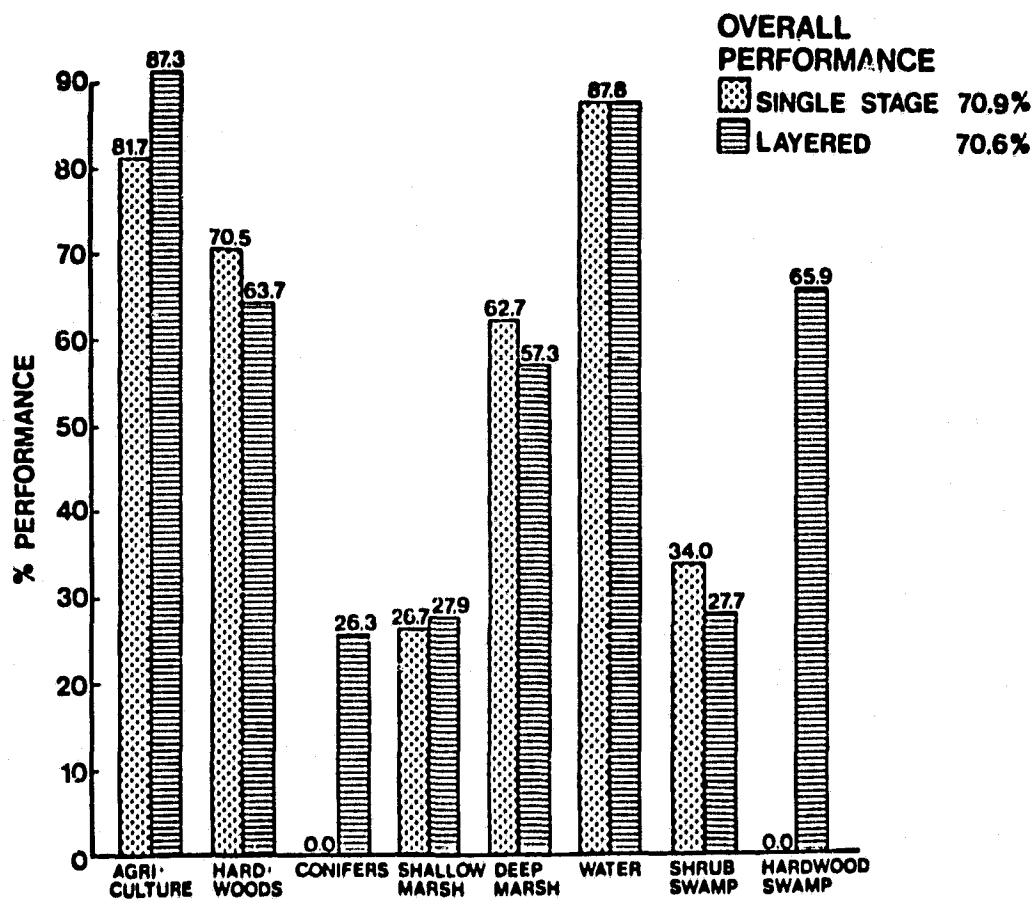
Figure 5. Comparison of classification performance of layered and single stage classifiers for individual wetland and upland types.
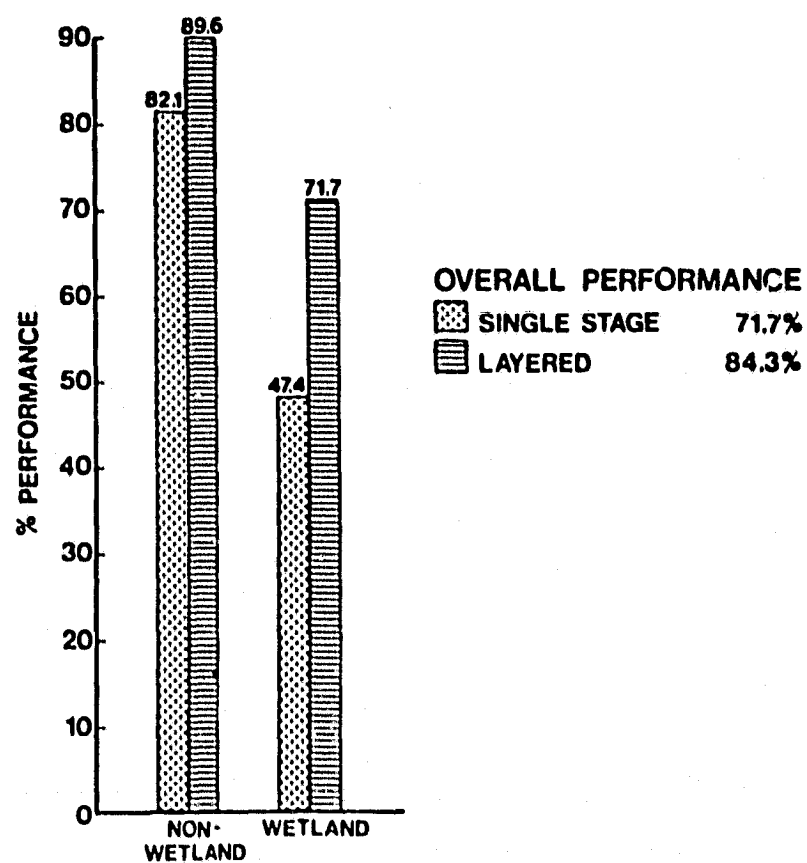
Figure 6. Comparison of classification performance of layered and single stage classifiers for general wetland and non-wetland types.

types. The most striking feature of this graph can be seen in examining performance values for identification of hardwood swamps. Whereas the single stage classifier could not separate upland and bottomland hardwoods, use of the layered classifier enabled hardwood swamps to be identified as a class separate from the upland hardwoods. Another class which could be identified with the layered classifier but not with the single stage classifier was conifers. The low performance value for conifers is largely due to confusion with dark soils as mentioned earlier.

Use of the layered classifier did not significantly improve the identification of shrub swamps, shallow marshes or deep marshes. These wetland types were consistently confused with other spectrally similar cover types which occur on both upland and bottomland areas. This adds further evidence to the earlier findings that the ability to identify these wetland classes is a function of spectral response and not the ability to recognize an upland or bottomland site.

To evaluate the ability to separate wetlands from non-wetland areas, wetland classes identified by each classifier were grouped together into a general wetland category and all upland classes were grouped as non-wetlands. Figure 6 is a bar graph of comparative performance based on the two percent ground sample. The layered classification procedure exhibits a much higher performance for identifying a general wetland category. Overall accuracy for the soils/spectral (layered) classification is 84.3% compared to 71.7% for the spectral classification (single stage). This comparison indicates that using a combination of soils and spectral data, the ability to identify a general wetland category is significantly increased.

SUMMARY AND CONCLUSIONS

This investigation clearly indicated that addition of soils informaation is valuable when trying to separate spectrally similar cover types on different sites. For example, hardwood swamps could be separated from upland hardwoods. However, the identification of other wetland types such as deep or shallow marshes and open water were not improved by combining the soils and spectral data. Even when bottomland soil areas were identified, confusion between cover types of similar leaf structure (for example, shrub and hardwood swamps) occurred. Of particular significance was the fact that use of the combined soils and spectral data enabled additional wetland types to be differentiated from non-wetlands. This resulted in an improved capability to discriminate wetlands as a general category from non-wetland areas. The layered classifier proved to be an effective method of analyzing combined soils and Landsat spectral data.

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(In preparation).

UPLAND GAME BIRD HABITAT SURVEY

INTRODUCTION

During early winter of 1979 personnel from LARS met with staff from the Division of Fish and Wildlife, Indiana Department of Natural Resources, to explore possible applications of remote sensing techniques to upland game bird management. IDNR staff were specifically interested in identifying pheasant habitat in Benton County, Indiana (Figure 1).

A decade ago, Benton County was one of the most productive ringneck pheasant counties in the Midwest. The pheasants, <u>Phasiaus clochicus</u>, once thrived in the highly productive agricultural county located in the North Central Indiana prairie. However, since the USDA abandoned the agricultural set-aside acres program in 1972, the pheasant population began to decline. Severe winters since 1976 have further depressed bird numbers.

This continuing decline in bird population has been of concern to personnel in the Division of Fish and Wildlife. Their concern has resulted in the development of a habitat leasing program, whereby Benton County farmers will be paid to leave land out of production. This would have a long term effect similar to USDA's set-aside acres program in that it would increase available habitat in the county.

Prior to undertaking the leasing program, Fish and Wildlife personnel wanted to survey the county in order to prioritize potential sites. Conventional ground survey techniques would be too costly and time consuming. Furthermore, they would not provide an adequate inventory of the entire county. Remote sensing techniques, however, could be easily applied and offered the potential to provide more detailed information. Working together with the LARS staff, Division personnel decided to use conventional air-photo interpretation techniques to identify potential pheasant habitat. Results from a 100 percent photo-interpretation of the county could be correlated with field data on bird population to identify potential leasing sites.

LARS staff agreed to coordinate the photo survey and provide any reasonable support for this program. The remainder of this report includes a photo-interpretation procedures document developed for this study. The final product of this activity will be a set of township maps and statistical information which identify existing pheasant habitat.
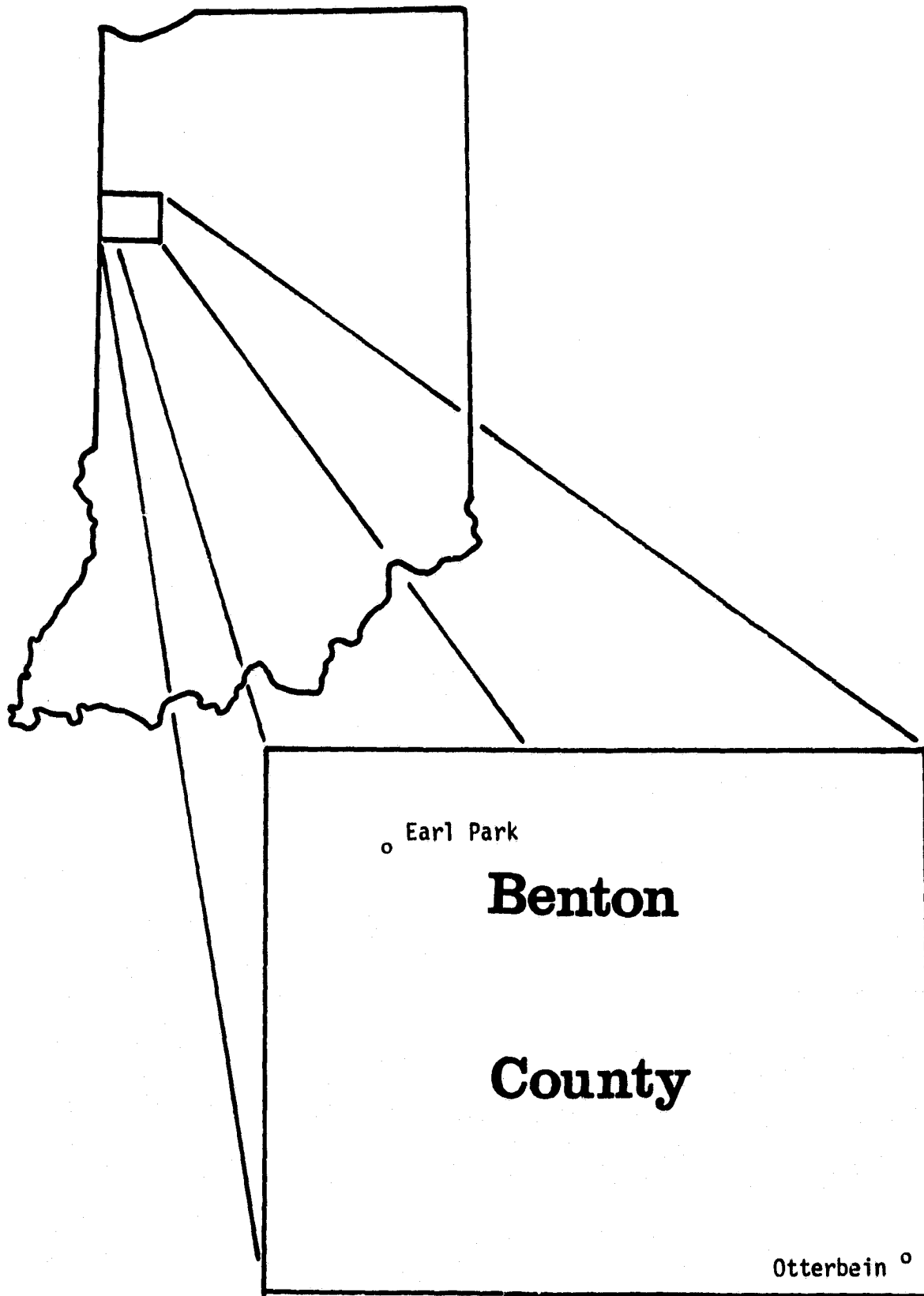
Figure 1. Upland game bird habitat survey study.

Photo-interpretation Procedures
for an
Upland Game Bird Habitat Survey
Benton County, Indiana

February, 1979

Purpose

The purpose of this study is to conduct a survey of the potential
upland game bird habitat in Benton County, Indiana. Black-and-white
aerial photographs and standard aerial photo-interpretation techniques will
be used for the purpose of this evaluation. Results of this study will be
used to prioritize potential nesting areas for inclusion under a state
supported leasing program.

Maps and statistical summaries of acreage for the following general
types of permanent upland game bird habitat will be produced. These include:

- Rights-of-way
- Drainage ways
- Marshlands
- Woodlands
- Fence Rows

Furthermore, information from this survey may be used to help design a sta-
tistical field sampling procedure for the purpose of collecting more detailed
information about the extent and condition of cover in the various habitat
types.

Materials and Methods

The following materials will be used to conduct this survey:

1. Panchromatic, black-and-white, 9 x 9 inch aerial photographs taken by
   the Indiana State Highway Dept., 7/27/77. Approximate scale of these
   photographs is 1 inch to 2000 feet (1:24,000).
2. Photo-interpretation instructions for the Survey of Upland Game Bird
   Habitat.
3. Habitat Tally Sheets
4. Pocket Stereoscope
5. Photo scales and area dot grids
6. USGS 7½' topographic sheets and County Index Map
7. Kern 0.35 mm Prontograph pens and india ink
8. Staedtler Lumocolor 315 pens
9. Finescale Pocket computer

Survey of Upland Game Bird Habitat
Instructions
February, 1979

Indexing

Before beginning any photo-interpretation the aerial photos must be properly indexed. Indexing will consist of marking the appropriate township, range, section, scale, and 7½' toposheet name on the top edge of the photographs.

a. Township, Range, Scale and Map Sheet Name should be marked in ink along the top photo edge as follows (Figure 2).

b. Sections will be marked with a small cross (+) at the corner. Section number will be marked in red with the red lumocolor pens and be placed within the section so as not to obscure any interpretable feature. Only complete (four corner) sections will be marked on the photos.

Every other photo of a stereo pair should be marked in this fashion. Be sure that all sections of a township are identified in this manner before interpretation begins.

Interpretation

Photographs will be interpreted on a section-by-section basis beginning with the first section in a township and proceeding sequentially until every section in the township has been interpreted.

Interpretation Procedures

1. Lay down the photos in the packet to form a mosaic of the township.
2. Using the County Road map, locate the northeast corner of the township. Begin indexing the photos in the manner described under Indexing.

   · Mark section corners and label
   · Record Township, Range and 7½' Map Sheet Name

3. After completing step 2 for all the photos in the township, you may start to interpret the first section in the township. Proceed as follows:

   · Fill in the information required at the top of the tally card (Figure 3).
   · Determine approximate photo scale using the Scale Gauge (Figure 4). Record the scale on the photo as a representative fraction (e.g., 1:24,000).
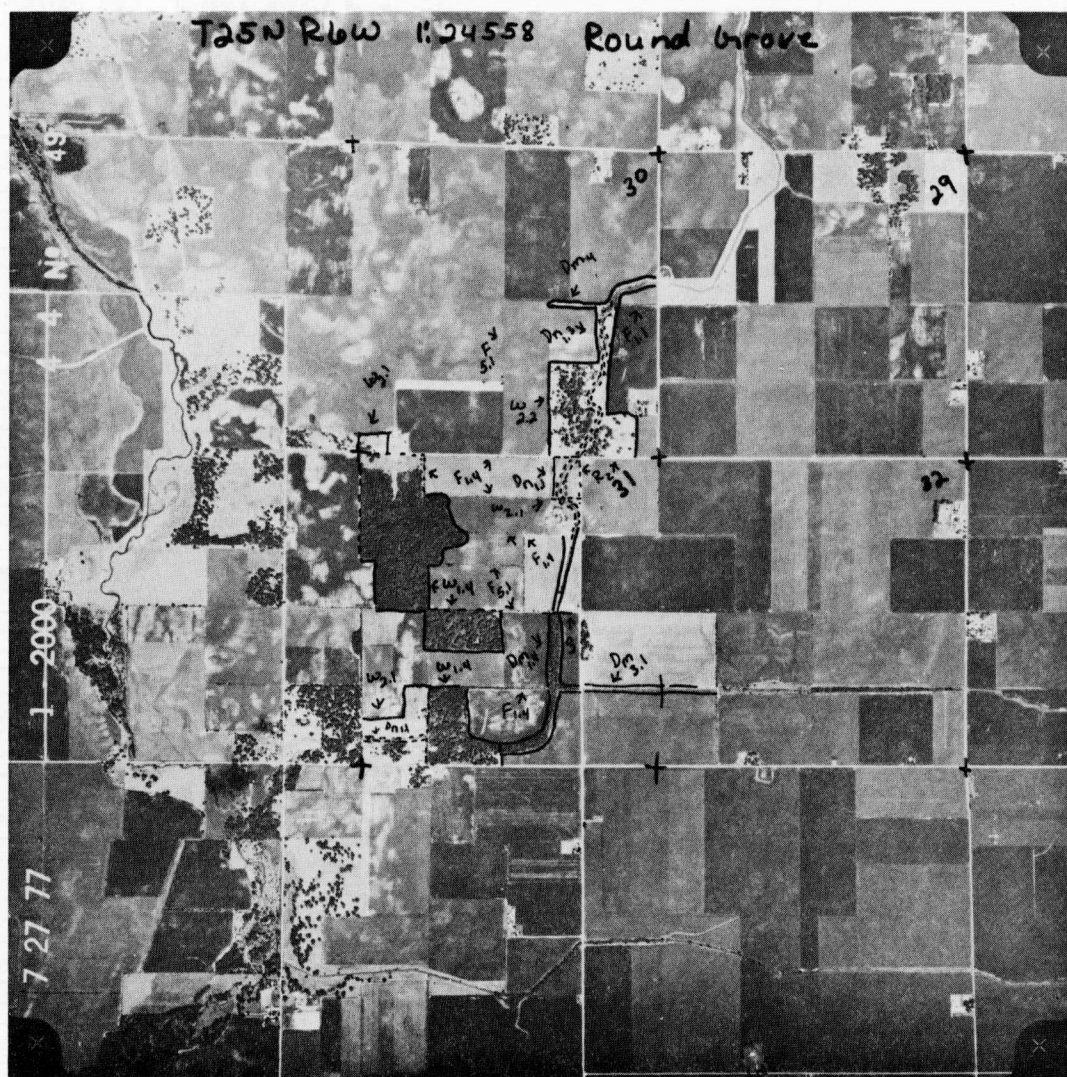
Figure 2.   Example of black and white aerial photograph used for upland game bird habitat survey. Annotation along the top of the photograph indicates that the image is located in Township 25N, Range 6 West; on the Round Grove USGS Quad map. The scale of this particular image is 1:24,558.

Upland Game Bird Aerial Survey Tally Sheet

Acreage Factor •375 Distance Factor 303

Section: 5 Township: 24N Range: 6W
U.S.G.S. Map Sheet Name: Templeton, Round Grove
Photo # 43-31 P.I. I.C. Storer

Map Code	HABITAT TYPE	# Dots	Length .1 in.	Ave. Width .01 in.	Perimeter .1 in.
R	RIGHTS-OF-WAY				
1	Major Highways				
2	County Roads		5.1		
3	Railroads - Active				
4	- Abandoned				
5	Power line				
6	Other				
D	DRAINAGE WAYS				
n	Natural				
1-	Trees (percent cover-Table)				
2-	Mixed (percent cover-Table)				
3-	Shrub (percent cover-Table)				
4	Grass				
m	Man-Made				
1-	Trees (percent cover-Table)				
2-	Mixed (percent cover-Table)				
3-	Shrub (percent cover-Table)				
4	Grass				
5	Other				

PHOTO INTERPRETATION TALLY SHEET

		Map Code	Habitat Type	Dot Tally by Segment						Total/Type*
				a	b	c				
M	MARSHLANDS	Dn1.1	< 25 %							
1-	Tree (percent cover-Table)									
2-	Mixed (percent cover-Table)	Dn1.3	51-75 %			•				
3-	Shrub (percent cover-Table)									
4	Grass									
5	Other									
W	WOODLANDS									
1-	Woodlots (percent cover-Table)									
2-	Pastured woodlots (percent cover-T)	R2	County Roads	1.5	.9	2.7				5.1
3-	Other (percent cover-T)									
F	FENCE ROWS									
1-	Trees (percent cover-Table)									
2-	Mixed (percent cover-Table)									
3-	Shrub (percent cover-Table)									
4	Grass									
5	Other									
O	OTHER									
1	Odd Fields									
2	Permanent Pasture									
3										
4										
5										

LARS-Purdue Univ

*Record total dots, or linear distance by type on front of Card.

Percent Cover Table
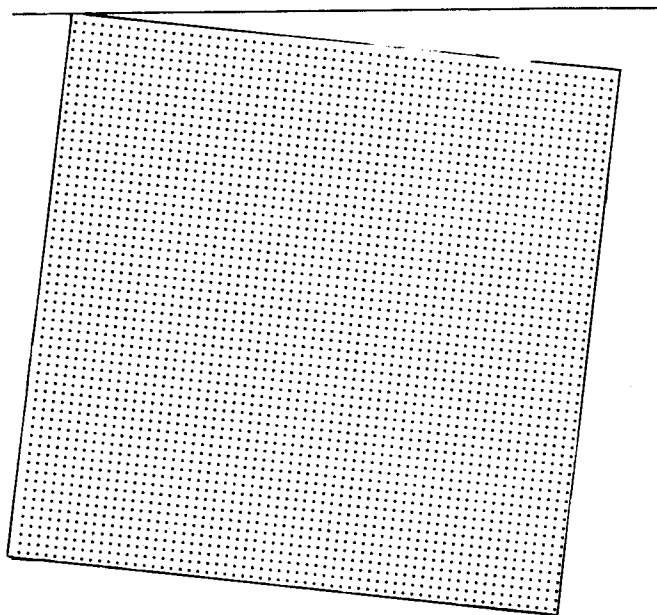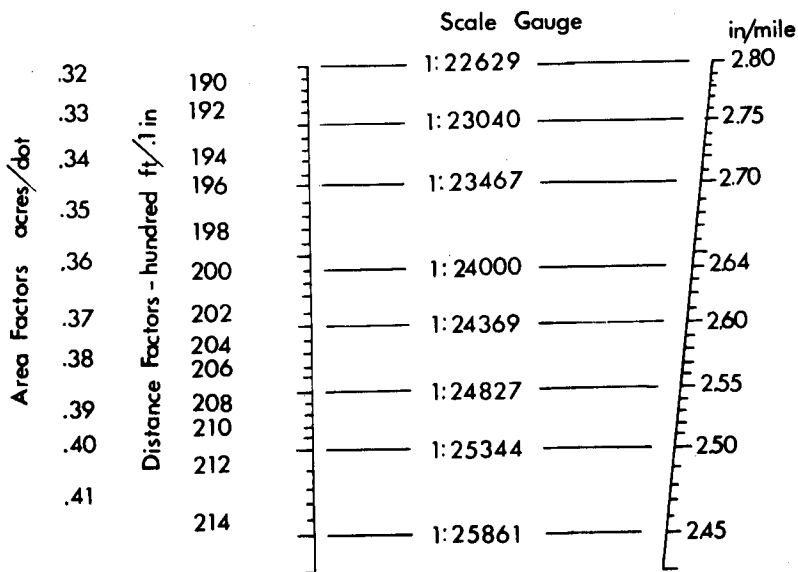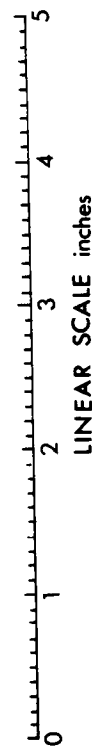(Second numeral in Map Code)

.1   25
.2   26-50
.3   51-75%
.4   75%

Comments: _____

Figure 3. This is an example of the front and back sides of the tally cards used to record habitat information for the upland game bird habitat survey.

DOT GRID
264 dots/sq. inch

Scale Gauge   in/mile

Area Factors acres/dot	Distance Factors - hundred ft/.1 in	Scale Gauge	in/mile
.32	190	1:22629	2.80
.33	192	1:23040	2.75
.34	194		
	196	1:23467	2.70
.35	198		
.36	200	1:24000	2.64
.37	202	1:24369	2.60
.38	204		
	206		
.39	208	1:24827	2.55
	210		
.40	212	1:25344	2.50
.41			
	214	1:25861	2.45

LINEAR SCALE inches

5

4

3

2

1

0

LABORATORY FOR APPLICATIONS
OF REMOTE SENSING

Figure 4. Example of the photo-interpretation aids used for the upland
game bird habitat survey.

- Record the approximate Acreage factor (nearest .005 in.) and approximate Distance factor (nearest 1 ft.) in the boxes at the top of the tally sheet. Acreage and Distance factors are given along the left edge of the Scale Gauge. Interpolate as necessary.

NOTE: These factors should be checked for each section on every photo pair interpreted.

- Once you have completed filling in the tally card, examine the section under the stereoscope.
- Carefully outline with the Kern ink pen every habitat feature you have identified. Table 1 indicates the general photographic characteristics associated with pheasant habitat in Benton County. Label these features with the codes given on the tally sheet. Be sure to include any permanent grassy features, especially those occurring along roads and railroads.

Remember! Only label features that occur within the section you are interpreting.

For all habitat types that contain woody vegetation (i.e., trees, shrubs, or mixtures) you must indicate as part of the type code a designation for crown closure. These four crown closure codes are found on the back side of the tally card.

Example: Trees growing along a natural drainage, approximate crown closure is 60%. This would be coded as:

Dn1.3

If one type occurs with different cover classes, record each occurrence on the back side of the tally card (Figure 3).

- Recheck the section under the stereoscope to insure that you have not missed any type lines and that every type is labeled correctly.
- Using the scale, comparator or dot grid, record the information required on the tally card for each type identified in the section.

a. Measure linear distance (length) to the nearest .1 inch or fraction thereof.
b. Record the average width, use the finescale comparator, to the nearest .005 inch.
c. For dot counting, align the bar at the top of the grid parallel to a section line. Do not align the grid along a section line. The grid is specifically at an odd angle in order to eliminate over-estimations of linear north-south, east-west features.

NOTE: If a type occurs more than once in a section, tally the area for each type segment in the spaces provided on the back of the card. Record the total in the appropriate location on the front of the card.

Whenever possible, avoid making perimeter measurements, since these are prone to errors.

Table 1. General Photo Interpretation Features
Upland Game Bird Aerial Habitat Survey

Habitat Group	General Characteristics	Type	Tone or Appearance
Rights-of-way	Geometric, angular, strong linear patterns usually aligned N-S or E-W.	grassy	Medium gray strip closely associated to edge of right-of-way. Tone generally darker than road way but lighter than ag fields.
		trees	Coarse textured, generally dark, height obvious under stereo.
Drainage ways natural	Meander, generally lacking linear trend	grassy trees	Same as above.
man-made	Angular, strong linear tendency	shrubs	Coarse textured like trees, not as dark in tone, shorter in stereo.
Marshlands	Irregular shape, mottled appearance, often standing water or potholes obvious	grassy trees shrubs	Same as above often darker in tone because of wetness.
Woodlands	Often rectangular in shape, extremely coarse texture	woodlots pastured	Same as trees. Same as trees except animal trails often obvious and crown closure less dense.
Fence rows	Linear and very narrow, angular corners	grassy trees shrubs	Same as above.
Other	Any combination of the above	pasture	Grassy tones, mottled, animal trails apparent, usually enclosed.

- Record any comments that you may have regarding the section.
- Record the time it took you to complete the interpretation, habitat delineation and labeling, and area measurements in the block at the bottom of the card.
- Go to the next section and repeat the above.