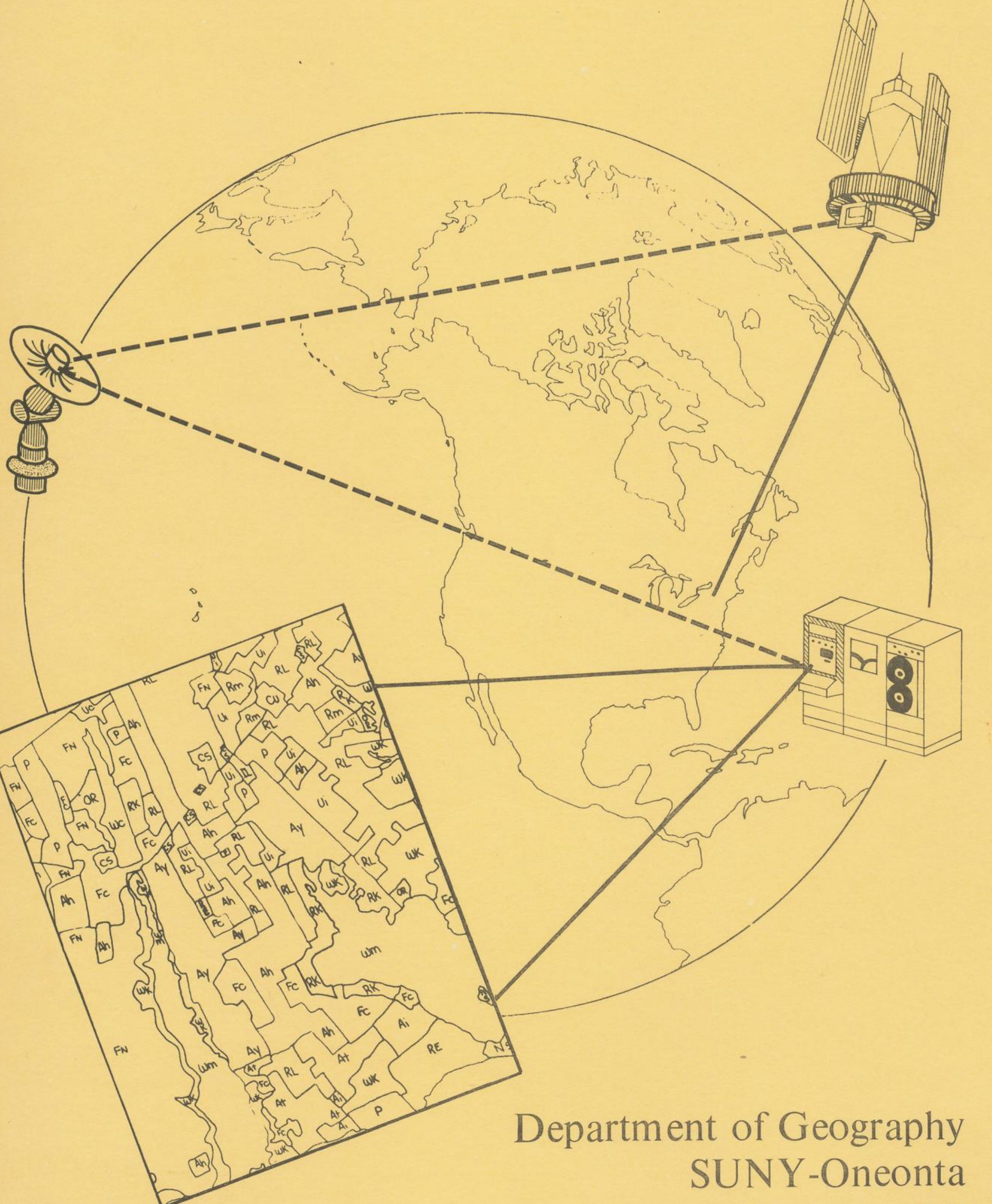
New York Land Cover Project: A Landsat Survey of Schoharie County

Paul R. Baumann



Department of Geography
SUNY-Oneonta
Oneonta, N.Y.

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By
Paul R. Baumann

Department of Geography
State University of New York
College at Oneonta

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INTRODUCTION

This demonstration project was undertaken to examine the utility of operational applications of Landsat data to county and local governments. More specifically, this project was designed to explore the potential use of Landsat for updating the New York State Land Use and Natural Resources (LUNR) maps, which are valuable planning and development tools used by local governments. If successful results could be obtained, the updated maps could pave the path for regular use of Landsat products at the county and local level in New York State. Schoharie County, situated in the Catskills, was the study area. The bulk of the analysis and production work was done by the Oneonta Laboratory for Computer Graphics and Spatial Analysis (OLCGSA), Department of Geography, SUNY College at Oneonta. NASA's Eastern Regional Remote Sensing Applications Center (ERRSAC) developed the final color products. ERRSAC is one of three NASA organizations responsible for carrying out NASA's Remote Sensing Applications Program to transfer satellite remote sensing technology to public use. ERRSAC's regional responsibilities include state and local governments in 19 northeastern and north central states. Through demonstration projects like this one ERRSAC provides opportunities for potential users in this region to discover how to apply Landsat data to meet their information needs.

PROJECT DESCRIPTION

Background

In 1966, the late Governor Nelson Rockefeller directed the New York State Office of Planning Coordination to develop a comprehensive land use and natural resource inventory of the entire state. This inventory, referred to as LUNR, was based on aerial photography taken in 1967 and 1968 of upstate New York and in 1969 and 1970 of Long Island and New York City. From these photographs, land uses were mapped on mylar film overlays, using the standard U.S. Geological Survey 7.5 minute quadrangle as the base.

Land use data for the inventory were divided into two types: area and point data. Two overlay maps, one for area and the other for point data, were made to correspond in coverage and scale to each of the 7.5 minute USGS maps within the state. The area maps delineated all the land within the state according to 51 land use classes. Point maps designated by symbol the specific location of

68 different types of land use. At the county level, the area land use maps have proven to be much more valuable than the point maps because they contain needed information not readily available from other sources. Point information, generally man-made features on the landscape, has been easily obtainable from various public and semi-public agencies at the state level.

From the information on these maps a computerized geodata base was constructed for the state. The data base was structured on the Universal Transverse Mercator (UTM) grid with a cell resolution size of one square kilometer or 247.1 acres. Land use data were recorded either as a percentage of the total cell area or as the number of occurrences within a cell. Two computer programs were designed to analyze and to display information from the data base. This data base has been used primarily at the state government level rather than the county or local level. At the local government level the cell size has been too large for most applications. Also, the one program requires a knowledge of how to formulate sophisticated, quantitative models, a subject about which few county officials have any familiarity or need.

In 1972, the Temporary State Commission to Study the Catskills was established by the state legislature. One of the charges given to this commission was to analyze land use conditions in the seven-county area designated as the Catskills. Schoharie County was one of the seven counties. Based on aerial photographs taken in 1973, updated LUNR maps were made of the region. Thus, the Commission was able to compare the 1968 and 1973 maps, a five-year interval. The geodata base was not updated. In 1976, the Commission was dissolved with no plans for updating LUNR maps in the future.

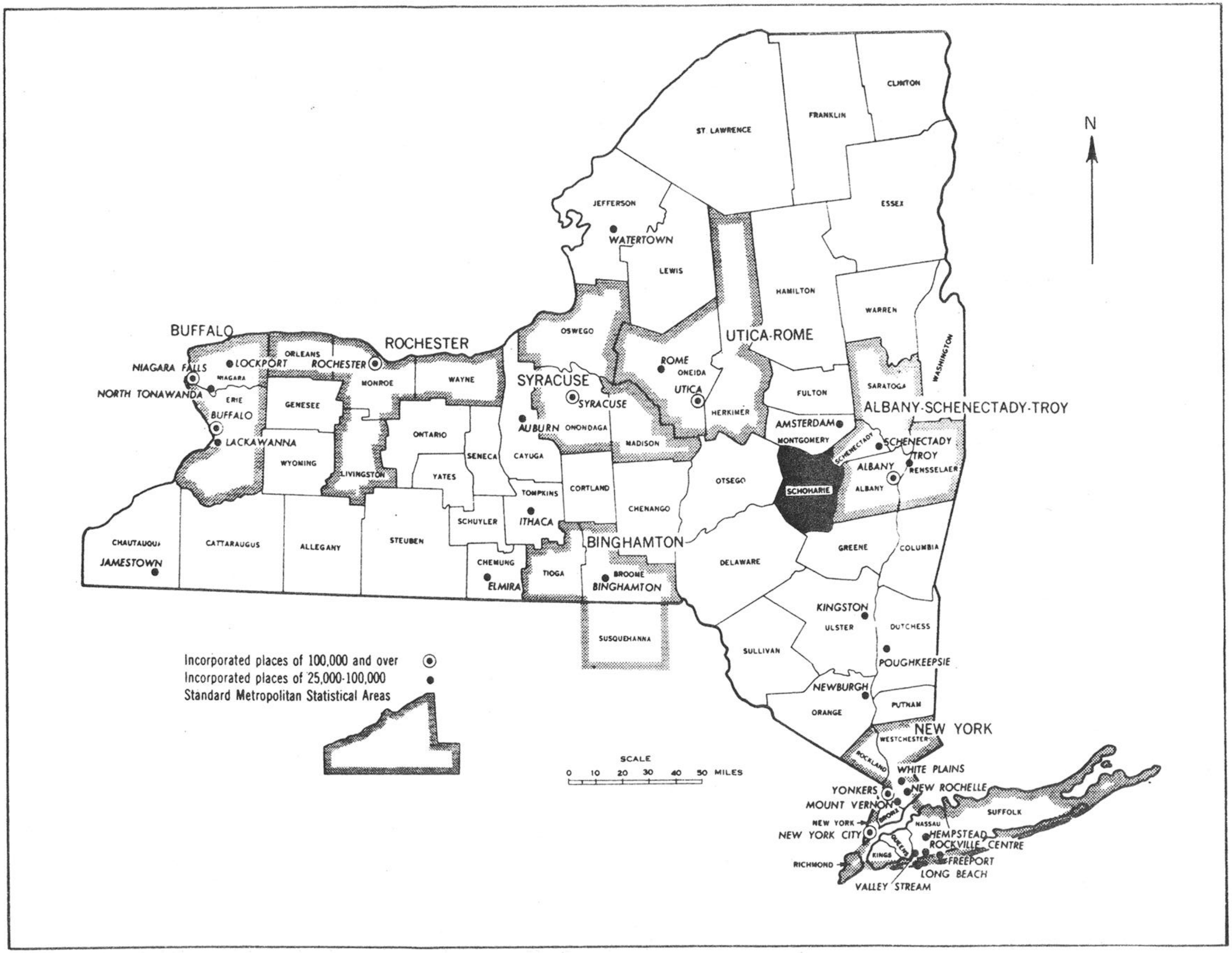
Even though many local governments have expressed a desire to have new, up-to-date LUNR maps and many state agencies have stated a strong need for an updated geodata base, the high costs of acquiring aerial imagery for the entire state, of interpreting the photography, and of manually drafting the maps and entering information into the geodata base make it impossible to maintain the LUNR system. Consequently, the intent of this demonstration project was to determine the effectiveness of Landsat in updating the LUNR system, in particular the maps because of their utility at the county and local government levels.

In 1975 the Schoharie County Planning and Development Agency and OLCGSA entered into a cooperative arrangement called the Schoharie County Cooperative Program (SCCP). Under this program several major projects have been undertaken by OLCGSA for the county. One major project was the development of a countywide automated geographic information system. This information system contains terrain, soil, cultural, and land use data by UTM 1/16 sq. km. (15.44 acres) grid cells. When this information system was developed, land use data were extrapolated manually from the 1973 LUNR maps and entered into the system's geodata base - a long, tedious task. This geodata base is very similar in structure to the State LUNR data base but it has a smaller cell size and additional variables. The land cover information produced under this demonstration project was also entered into the Schoharie County geodata base; thus, the data base now possesses both 1973 and 1978 land use data. Because this information was generated from Landsat digital data, entering it into the data base was an easy automated procedure.

Study Area

Schoharie County, situated in east-central New York State, covers an area of 624 square miles (1616 sq. km.). See Figure 1. Based on the 1980 census, the county has a population of 29,710 with Cobleskill, the largest community within the county, having 5272 people. Dairy farming is the principal occupation followed by service activities and a few small industries. A growing number of people commute to Albany and Schenectady to work. The county faces the problems of high unemployment, decline in agricultural production due to farm abandonment, increase in absentee ownership of land, and demands on its water resources from the New York Metropolitan Area.

The county possesses considerable topographic variation ranging from low rolling hills above the Mohawk Valley in the north to the Catskill Mountains in the south. The northern third of the county averages around 1400 feet above sea level with a local relief of approximately 150 feet. In general, this rolling land produces good crops such as hay, corn, and oats. A relatively high, heavily dissected plateau condition exists throughout the center of the county. With poor soils and steep slopes, the land is mainly in forest and pasture. In the southern part of the county the Catskills rise to elevations of over 2500 feet, 500-600 feet above the general level of the upland plateau. These glaciated mountains with rounded slopes are heavily wooded. Overall the county corresponds closely in area to the drainage basin of the Schoharie River which flows northward from the mountains to the Mohawk River. This river meanders through a wide, fertile valley trenched from 500 to 800 feet below the surrounding uplands. Endowed with rich soil the valley contains excellent farmland and forms the historical heart of the county.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BUFFALO
ROCHESTER
SYRACUSE
UTICA-ROME
ALBANY-SCHENECTADY-TROY
BINGHAMTON
NEW YORK
ST LAWRENCE
FRANKLIN
CLINTON
ESSEX
JEFFERSON
WATERTOWN
LEWIS
HAMILTON
WARREN
WASHINGTON
SARATOGA
OSWEGO
ROME
ONEIDA
UTICA
HERKIMER
FULTON
NIAGARA FALLS
LOCKPORT
NIAGARA
ORLEANS
ROCHESTER
MONROE
WAYNE
NORTH TONAWANDA
ERIE
BUFFALO
LACKAWANNA
GENESEE
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ONTARIO
YATES
SENECA
AUBURN
CAYUGA
SYRACUSE
ONONDAGA
MADISON
AMSTERDAM
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TROY
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SCHOHARIE
OTSEGO
TOMPKINS
ITHACA
CORTLAND
CHENANGO
CHAUTAUQUA
JAMESTOWN
CATTARAUGUS
ALLEGANY
STEUBEN
SCHUYLER
CHEMUNG
ELMIRA
TIOGA
BROOME
BINGHAMTON
SUSQUEHANNA
DELAWARE
GREENE
COLUMBIA
KINGSTON
ULSTER
DUTCHESS
POUGHKEEPSIE
SULLIVAN
NEWBURGH
ORANGE
PUTNAM
WESTCHESTER
ROCKLAND
WHITE PLAINS
YONKERS
NEW ROCHELLE
MOUNT VERNON
BRONX
SUFFOLK
NASSAU
NEW YORK
NEW YORK CITY
HEMPSTEAD
ROCKVILLE CENTRE
QUEENS
KINGS
FREEPORT
RICHMOND
LONG BEACH
VALLEY STREAM
Incorporated places of 100,000 and over
Incorporated places of 25,000-100,000
Standard Metropolitan Statistical Areas
SCALE
0 10 20 30 40 50 MILES

Figure 1

Da+a Sources

The following data sources were employed:

* Digital MSS Landsat-3 data (Scene ID: 30170-15014) from August 22, 1978
* High altitude color IR photography from July, 1975
* Black and white low altitude photography from April, 1973
* 7.5 minute (1:24000) LUNR maps covering Schoharie County and adjacent areas from 1968 and 1973
* 7.5 minute (1:24000) soil maps of Schoharie County for 1969
* 7.5 minute (1:24000) USGS topographic maps of Schoharie County for 1940-1943

PROCEDURE

The initial step was to select an appropriate Landsat scene. Since the LUNR inventories were conducted in 1968 and 1973, county officials expressed a desire to maintain the five year interval between inventories which made it necessary to acquire a 1978 scene. Like much of northeast United States, Schoharie County is located in a hilly-mountainous region usually covered with heavy haze and clouds. This condition made it extremely difficult to find a workable scene. A November 2nd scene was selected initially because it was the only cloud-free data set with high quality rating in all four MSS channels. However, due to the low sun angle at that time of the year shadows darkened the west facing slopes and bright reflecting surfaces appeared on east facing slopes. A variety of ratioing techniques were employed in an attempt to rectify this situation but little success was obtained. In addition, the time of year was not the best for detecting various vegetation patterns. Later, an August 22 scene was acquired. This scene had ratings of "8" in all four channels but some small clouds existed in the upland areas of the county. Due to its good reflectance patterns showing different types of vegetation and the high sun angle during the summer, this August scene became the data base for the study.

After selecting a scene, the next step was the preprocessing of the data. OLCGSA has developed a computer system known as LAP (Landsat Analysis Package) for analyzing multispectral data. Using the LAP system a scene is initially destriped to remove some of the striping conditions resulting from unbalanced radiometric responses in the satellite scanner detectors and reformatted to make the data easier to handle during analysis. Channel 1 (MSS band 4) of the August scene contained some unusual data irregularities making it necessary to prepare a special software routine to correct it. In the final analysis, however, channel 1 was not used since better results were obtained by limiting the study to the other three channels. In general, channels 1 and 2 are highly correlated; therefore, using both channels does not significantly improve a classification.

Once the scene was rectified and reorganized, a modified version of the technique known as SEARCH was used to obtain training fields, and thereby, spectral classes (groups of similar training fields). Originally developed by NASA's Earth Resources Laboratory, SEARCH is an unsupervised method to the extent that training fields are automatically selected and a supervised method with respect to how class statistics are generated. The SEARCH algorithm is based on moving a window of prescribed size through the data set searching for areas which are spectrally homogeneous. Such areas are called training fields. In this study a window size of 3 rows by 3 columns (9 pixels) was used. To establish the level of spectral homogeneity desired for selecting training fields and to stress certain general land cover conditions, an investigator must define a set of parameter values within the SEARCH program. By varying these values, different groups of pixels within the scene will become training fields resulting in various land cover patterns being observed. After investigating numerous combinations of parameter values, an acceptable set was obtained in terms of the specific objectives of this study. Thirty five spectral classes were produced based on these values. These parameter values and the channel means of spectral classes are listed in Appendix A.

TABLE 1: LAND COVER CLASSES

AG	Agriculture
DF	Deciduous Forest
CF	Coniferous Forest
BW	Brushwood
WW	Wooded Wetlands
UR	Urban
SB	Suburban
HA	Hamlet
SM	Surface Mining
WT	Water
RE	Reservoir

The spectral classes were used in conjunction with the maximum likelihood classification technique to classify each pixel within the study area. Each pixel was assigned to a spectral class through the use of the maximun likelihood technique, and each spectral class was then assigned a land cover class by an analyst who compared through photointerpretative methods the spatial and land surface patterns on the aerial photography to similar patterns on the Landsat alphanumeric computer generated maps. Generally, several spectral classes were grouped together to form a single land cover class. The defined land cover classes are listed in Table 1.

Once the scene was statistically classified, it was necessary to redefine the land cover for some pixels. As previously indicated a few small clouds existed over the study area in the August scene. These clouds and their respective shadows were cosmetically removed from the classified scene and replaced by the land cover patterns indicated on the 1975 photography. Each of these cosmetically altered areas related to a mature forest environment and no noticeable land cover change occurred in any of these areas between 1975 and 1981 when they were field checked. Also, in order to show on the land cover maps a continuous water pattern for the Schoharie River, it was necessary to link sections of the river together where overhanging vegetation blocked or modified potential water reflectances and to insert water pixels on the river's bends where the rectangular shaped pixels did not display well formed curves. Finally, certain spectral classes could not be easily assigned to any one land cover. In certain sections of the scene they related to one land cover; whereas, in other sections they were best grouped into another land cover. These spectral classes are identified in Appendix A under the class name "Transitional". Rather than grouping one of these classes completely under one land cover throughout the entire scene, they were assigned to different land covers in different sections of the scene. This procedure was done cosmetically by an analyst using an interactive computer system, a component of LAP, to change the classified values of selected pixels. None of these spectral classes were extensive in their areal coverage and none of them were split between more than two land cover classes.

Validation

Two different methods were employed to validate the accuracy of the land cover classes generated. First, by overlaying the mylar based 1968 and 1973 LUNR maps on the 1978 Landsat computer line printer maps produced at the same scale, visual comparisons were made for general compatibility between land surface features over the three different years. This method allowed the investigators to determine if the Landsat land cover classes corresponded spatially with the land use classes of the earlier inventories. In general, a high degree of spatial correlation existed between the classified maps and the LUNR maps. The noticeable differences were due to either landscape alterations not in existence in either 1968 or 1973 or variations in land cover definitions between inventories.

The second method, a more rigorous test of accuracy, involved the statistical sampling of individual classified pixels. The classified scene was organized in a grid pattern with scan lines and elements sequentially numbered. Using random numbers in correspondence with the numbered lines and elements forty randomly selected pixels were obtained for each land cover class. The selected pixels were compared to the 1975 color IR photography to determine their relative accuracy. Next, a grid was superimposed on the aerial photography covering the classified scene. Employing, again, random numbers in relationship to the lines and elements of the gridded photography, forty pixels were compared to the classified scene. This cross-checking procedure of photography to scene reduces the possibility that certain land cover locations within the study area will be overlooked as might be the case when comparing only the scene to photography. None of the areas altered cosmetically were used for sample points.

Table 2 illustrates the quantitative results of this second accuracy test. Overall, the land cover classes recorded percent marks in the high 80s and low 90s, an accuracy level comparable to most large land use inventories produced under traditional methodologies. The two water classes have very high marks; however, some problems existed in separating water from wooded wetlands. The lowest marks relate to the class entitled "Hamlet". Some hamlets were not detected due to the size of the community and the density of tall, full-crown trees which hid them from the satellite's sensors. Although the accuracy results for this study are very good, they must be considered with respect to the investigator's interpretation of the landscape on the aerial photography.

TABLE 2: COMPARATIVE ACCURACY RESULTS BETWEEN THE LANDSAT CLASSIFIED LAND COVER MAP AND THE PHOTOGRAPHICALLY INTERPRETED INFRARED AERIAL PHOTOGRAPHY

Land Cover	Scene To Photo (Percent)	Photo To Scene (Percent)	Combined (Percent)
Agriculture	92.50	90.00	91.13
Deciduous Forest	95.00	90.00	92.50
Coniferous Forest	87.50	92.50	90.00
Brushwood	85.00	90.00	87.50
Wooded Wetland	87.50	82.50	85.00
Urban	90.00	92.50	91.13
Suburban	85.00	85.00	85.00
Hamlet	70.00	72.50	71.13
Surface Mining	92.50	90.00	91.13
Water	97.50	95.00	96.13
Reservoir	100.50	97.50	98.63

RESULTS

Land Cover Classes

The specific goal of this demonstration project was to examine the feasibility of using Landsat data to update the New York State LUNR information base. The ideal outcome would be to produce the identical land use classes created under the LUNR inventories. This outcome has been partially realized. In general, some of the derived land cover classes correspond to LUNR classes but others need to be refined. The forest classes relate well to LUNR forest classes but the single agricultural class does not provide the detail found in the LUNR system. An agricultural landscape is more dynamic than a forest environment; thus, the timing of the data becomes critical in order to detect certain land cover conditions. For example, to separate cropland from pasture, a late spring data set would be valuable because most cropland would be bare of any vegetation coverage.

To measure the project's outcome based strictly on the direct correlation between the Landsat and LUNR land cover classes is not possible. Certain indirect correlations must be considered. Some LUNR classes are inherent within the Landsat-derived maps although not specifically indicated on then. Classes associated with heterogeneous land surfaces frequently fall into this condition. Brushland, for example, is a mosaic composed of small patches of either grass, shrub, or forest. Under the traditional air photo interpretation methodology, an investigator would identify a brushland area by grouping these mixed patches together under one category. However, the Landsat methodology is based upon classifying each pixel. With a pixel approximately an acre in size, nearly every patch within the mosaic can be identified according to its basic land cover. The Landsat-derived maps display areas consisting of clusters of single pixels and small groups of pixels classified as brushwood, agriculture, and deciduous forest. Collectively, these distinct pixels or groups of pixels form a brushland condition. Individuals working with these maps must recognize the existence of these inherent land cover classes and how these classes apply to the LUNR system or any other land use inventory.

In addition to the inherent land cover classes, another method exists for obtaining LUNR classes indirectly from the Landsat classes. As previously demonstrated in the section entitled "Procedure", different land cover information can be obtained by relating the generated land cover data to other data sets. Elevation and slope data might be used to subdivide the agricultural land cover class into grassland versus cropland. Schoharie County with its geographic information system could relate each pixel classified agriculture with the elevation and slope information available in its geodata base. Other counties without established geographic information systems could overlay Landsat-derived maps on topographic maps and accomplish the same basic outcome.

Statistical Data

Table 3 contains, by township, the acreage estimates of the derived land cover classes. Schoharie County's sixteen townships vary considerably in size as illustrated by the total acreage values shown in the last column of the table. In order to make comparisons between townships, Table 4 presents the percent of land cover in each class to the total land cover within a township. In relating this table to Figure 2, several geographic patterns become apparent. The townships in the northern half of the county average approximately 60 percent of their land cover in agriculture; whereas, the southern townships have between 60 and 70 percent of their land in forest. Also, the southern townships possess a relatively higher amount of land in coniferous forests than the northern townships. These forests generally exist in the higher elevations and on steep north facing slopes, topographic conditions associated with the southern half of the county. The northern townships contain more brushwood. Brushwood is a transitional land cover between a mature forest and abandoned farm land. It has more tree development than brushland, a land use class used in the LUNR inventories. The most significant land use change observed between the 1968 and 1973 LUNR inventories was the decrease in the brushland in the Catskills and the corresponding increase in forest land, indicating that the brushland of 1968 had become forest and that farm land abandonment to brushland had slowed down. The higher percentage of brushwood in the northern townships, as shown in this inventory, indicates the availability of more marginal agricultural land in this section of the county. Most of the marginal agricultural areas of the southern townships have been long abandoned, converting back to mature forests. The agricultural land still available in the south is probably prime farm land, not likely to be abandoned. The land cover patterns briefly mentioned here represent some of the more noticeable patterns. County officials who are much more knowledgeable about the land use trends within the county will be able to interpret in greater detail the patterns nested with the numbers shown on these two tables.

SCHOHARIE COUNTY, NEW YORK

SCALE IN MILES

Figure 2

TABLE 3
LAND COVER BY TOWNSHIP
ACREAGE

	AG.	DF.	CF.	BW.	WW.	UR.	SB.	HA.	SM.	WT.	RE.	TOTAL
Blenheim	3577	14479	2773	193	14	0	0	0	0	208	318	21562
Broome	8906	17685	3707	220	133	0	0	0	1	111	0	30758
Carlisle	12566	6183	26	2496	420	0	0	0	0	192	0	21882
Cobleskill	11944	5024	516	1229	107	41	162	0	209	109	0	19341
Conesville	7852	14629	2613	248	0	0	0	0	0	2	341	25684
Esperance	6716	3411	9	2256	128	0	0	49	0	318	0	12887
Fulton	9697	26129	4707	403	102	0	0	0	0	266	0	41286
Gilboa	12942	19809	3455	584	145	0	0	0	0	216	915	38066
Jefferson	11785	14174	1416	133	17	0	0	17	0	78	0	27621
Middleburg	11253	16205	3133	463	115	0	0	26	27	289	0	31510
Richmondville	11494	6412	404	590	2	26	41	24	0	42	0	19035
Schoharie	11208	5585	867	820	248	2	0	116	17	294	0	19158
Seward	14976	7461	519	203	73	0	0	8	1	79	0	23321
Sharon	17852	6092	106	633	155	0	0	0	0	141	0	24979
Summit	11124	9904	2353	279	48	0	0	0	0	232	0	23940
Wright	10274	7601	723	432	126	0	0	15	16	43	0	18330
COUNTY	174147	179880	27322	11183	1834	69	202	256	272	2621	1573	399360

TABLE 4:
LAND COVER BY TOWNSHIP
PERCENTAGE OF TOTAL TOWNSHIP ACREAGE

	AG.	DF.	CF.	BW.	WW.	UR.	SB.	HA.	SM.	WT.	RE.
Blenheim	16.59	67.15	12.86	.89	.06	.00	.00	.00	.00	.96	1.47
Broome	28.95	57.50	12.04	.71	.43	.00	.00	.00	—	.36	.00
Carlisle	57.54	28.25	.12	11.41	1.92	.00	.00	.00	.00	.88	.00
Cobleskill	61.76	25.97	2.66	6.35	.55	.21	.84	.00	1.08	.57	.00
Conesville	30.57	56.96	10.17	.96	.00	.00	.00	.00	.00	—	.00
Esperance	52.11	26.47	.07	17.51	.99	.00	.00	.38	.00	2.47	.00
Fulton	23.44	63.29	11.40	.97	.25	.00	.00	.00	.00	.65	.00
Gilboa	34.00	52.04	9.08	1.53	.38	.00	.00	.00	.00	.57	2.40
Jefferson	46.67	51.32	5.13	.48	.06	.00	.00	.06	.00	.28	.00
Middleburg	35.71	51.43	9.94	1.47	.37	.13	.21	.08	.08	.91	.00
Richmondville	60.38	33.68	2.12	3.10	.01	.00	.00	.13	.00	.22	.00
Schoharie	58.50	29.15	4.52	4.28	1.29	.01	.00	.60	.09	1.54	.00
Seward	64.22	32.00	2.22	.87	.31	.00	.00	.03	—	.34	.00
Sharon	71.47	24.39	.42	2.53	.62	.00	.00	.00	.00	.56	.00
Summit	46.46	41.37	9.83	1.17	.20	.00	.00	.00	.00	.97	.00
Wright	56.05	36.56	3.94	2.35	.69	.00	.00	.08	.09	.23	.00
COUNTY	43.60	45.04	6.84	2.80	.46	.02	.05	.06	.07	.66	.39

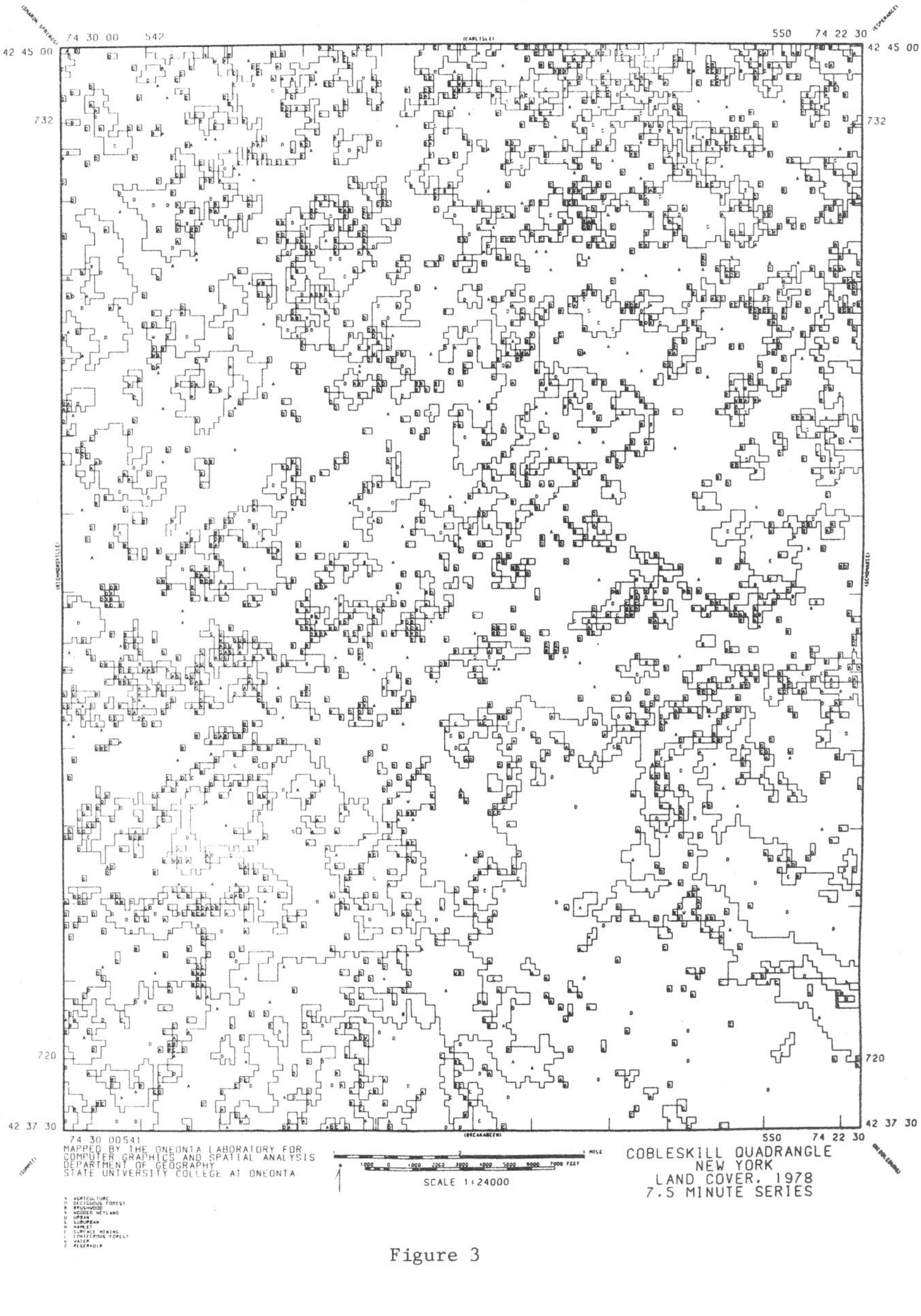
Map Products

Once an acceptable classification was developed, the scene was geometrically corrected and rescaled to relate to the 7.5 minute USGS quadrangle map size. Employing a digital plotter, land cover maps were plotted onto a mylar surface. See Figure 3. These maps were similar to the LUNR maps in appearance. Mylar, a durable mapping surface, is a transparent film making it possible to overlay the land cover maps on the county's topographic and soil maps. This overlay ability will allow county officials to note spatial relationships between terrain, soil, and land cover. Also, the mylar will permit excellent blue print copies of the land cover maps to be made. The blue print copies can be used as work maps for a variety of purposes. These land cover maps are different from the LUNR maps in two ways. First, due to the size and shape of the pixels the land cover patterns on the maps are block-like in appearance. Second, because point data are impossible to detect with the Landsat resolution, only area data are being classified and mapped. Consequently, one land cover map was developed for each 7.5 minute USGS quad rather than two maps which was the case under the LUNR inventories. The elimination of the point data maps is not perceived as a major problem. As previously indicated, county government officials are much more interested in the area land use information.

These maps are best suited as work maps. They are designed to allow county officials to examine in relative detail various planning and development issues spatially. As work maps they fulfill a needed task. However, maps are also very valuable for communicating ideas and patterns. Because these work maps were not designed specifically for communication, a second set of maps was produced to meet this need. Using special computerized hardware at NASA/ERRSAC, color maps at various scales were generated. See Figure 4 and 5. The color patterns and the physical size of these maps make them better as communication devices than the work maps. In promoting different land use policies county officials can use these maps to convey their ideas to various audiences throughout the county. A slide set was made of these maps as a more convenient means of displaying them before groups.

Geodata Bank

The geodata bank component of the Schoharie County geographic information system was expanded to include the derived land cover data. The geodata bank's basic grid cell size is 1/16 sq. km. (15.44 acres) relative to the UTM geographic reference system. With a pixel approximately one acre in size, about 14 pixels were needed to cover one grid cell. The scene was geometrically rotated to the UTM system making it possible to assign each pixel to a grid cell. The percent of each land cover class within a cell was recorded. Structurally, this geodata bank is identical to the LUNR bank. Thus, it is quite feasible to update the LUNR data bank with Landsat classified data. Also, with the basic Landsat data already available in digital form, it is not necessary to utilize vital and expensive resources on manually collecting land cover data from maps and typing them into a computer.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COMPUTER GRAPHICS AND SPATIAL ANALYSIS
DEPARTMENT OF GEOGRAPHY
STATE UNIVERSITY COLLEGE AT ONEONTA
SCALE 1:24000
COBLESKILL QUADRANGLE
NEW YORK
LAND COVER, 1978
7.5 MINUTE SERIES

Figure 3

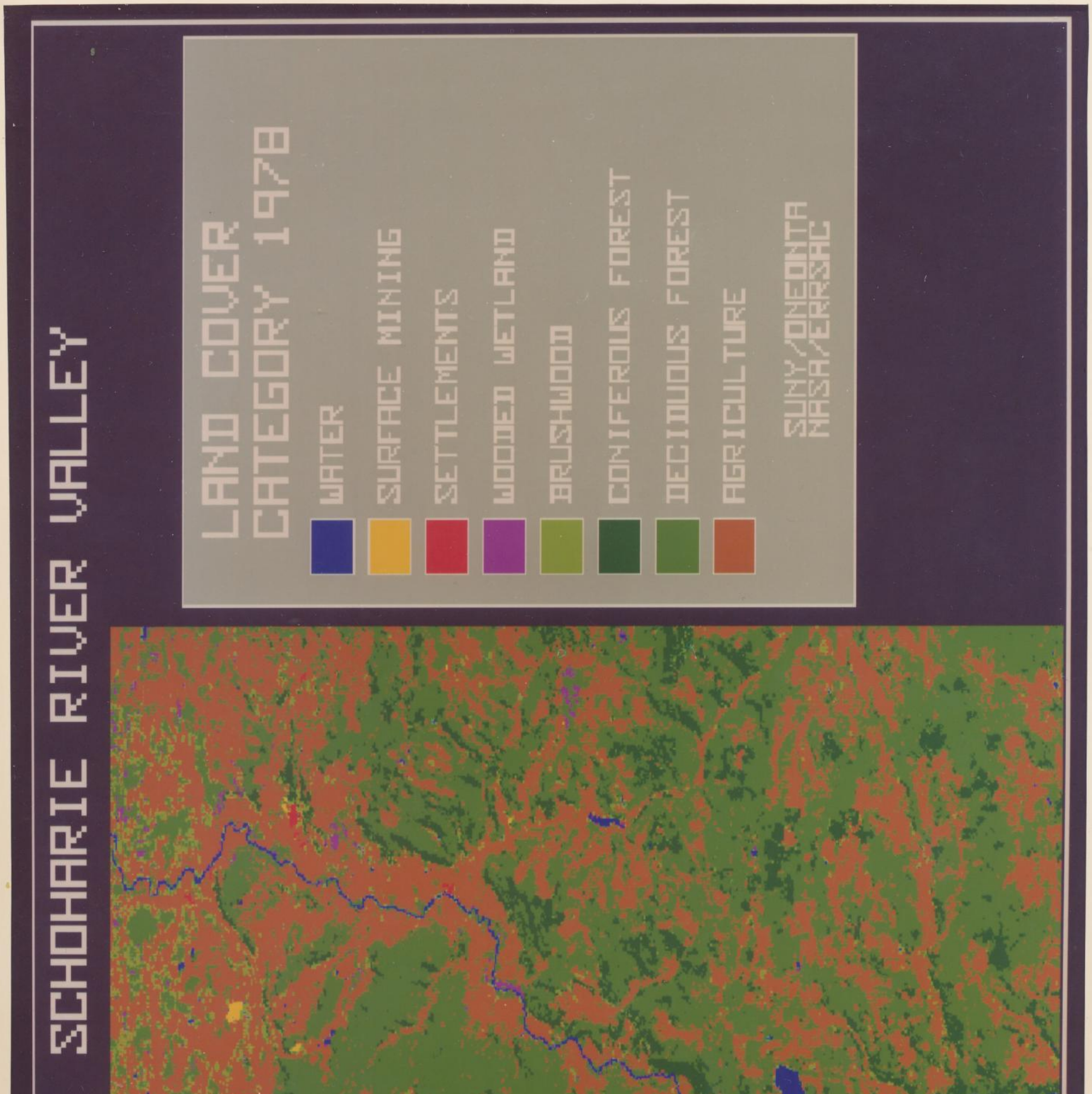
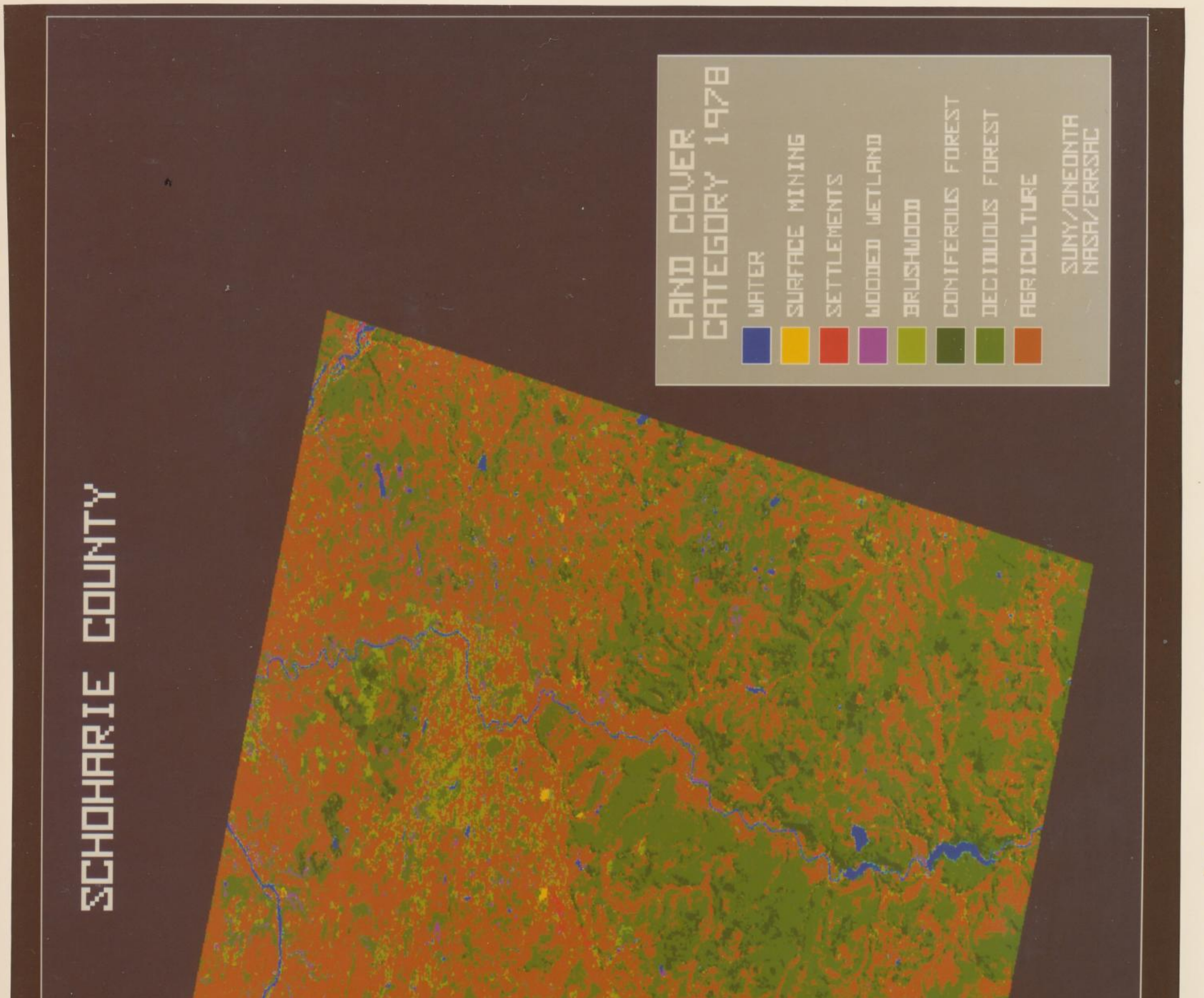

SCHOHARIE RIVER VALLEY
LAND COVER
CATEGORY 1978
WATER
SURFACE MINING
SETTLEMENTS
WOODED WETLAND
BRUSHWOOD
CONIFEROUS FOREST
DECIDUOUS FOREST
AGRICULTURE
SUNY/ONEONTA
NASA/ERRSAC

Figure 4


SCHOHARIE COUNTY
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SURFACE MINING
SETTLEMENTS
WOODED WETLAND
BRUSHWOOD
CONIFEROUS FOREST
DECIDUOUS FOREST
AGRICULTURE
SUNY/ONEONTA
NASA/ERRSAC

Figure 5

SUMMARY AND REMARKS

The results from this project clearly demonstrate the potential of Landsat MSS methodology to update the New York State LUNR inventory. The land cover maps at the 1:24000 scale are comparable to the LUNR maps. The feasibility of updating the Schoharie County geodata bank, structurally identical to the 1968 statewide LUNR geodata bank, has been established. The land cover classes, generated either directly or available through one of the indirect methods outlined, correspond closely to the LUNR classes. The accuracy level for the land cover classes is excellent and would compare favorably to marks received by other large scale inventories produced by traditional remote sensing techniques. Consequently, county and local governments which are presently utilizing outdated LUNR maps to update land use conditions in state agricultural districts, to determine property tax equalization, and to address various local planning issues should welcome the availability of Landsat methodology to provide timely land cover information. Two major hurdles, however, exist in transferring this methodology to the local and county government levels, namely acceptance of images from satellite generated digital data manipulated by esoteric statistical and computer techniques versus the easy to interprete aerial photographs and access to the specialized facilities needed to produce these images.

A limitation associated with most dynamic census or inventory systems is the change over time in the type of information needed and the methodology employed in obtaining it. Such changes make it difficult to compare findings and detect trends between inventories taken at different times. For example, some land use classes were added to the 1973 LUNR inventory at the request of the Catskill counties and others were not used. Consequently, certain comparisons between the 1968 and 1973 inventories are not possible. Also, both inventories used black and white panchromatic aerial photography, originally acquired for various reasons. Recently, experiments conducted by Cornell University relating to the updating of LUNR have been based on infrared photography, a new methodology. LUNR, like many other inventory systems, has had to deal with change and it will be faced with this condition many times in the future. Thus, the ulitization of Landsat methodology in updating LUNR or similar inventories should be viewed as another natural step in this change process.

Although Landsat has been proven to be more cost effective in comparison to conventional remote sensing methodologies, sophisticated computer hardware and well trained individuals are required in order to take advantage of this methodology. The majority of county and local governments do not have the financial resources to acquire and maintain image processing facilities. Also, state agencies find it difficult to obtain such facilities and to keep them up-to-date. Universities and colleges are continually facing the issue of being on the frontier edge of research and instruction. Thus, rather than duplicating image processing facilities in every county and every state agency, the most rational and cost saving path to pursue would be to develop such facilities at selected universities and colleges within a state. These institutions will have the computer specialists, the mathematicians and statisticians, and the scientists in the various fields needed to support such facilities. In addition, state governments will find state universities already attempting to develop these facilities for their research and instructional needs. States should build upon these existing resource bases rather than creating an image processing facility in every county and state agency.

In a state the size of New York and one with such a diverse landscape, it would be desirable to have several image processing units situated throughout the state to meet the needs of the local and county governments. With the State University of New York having 64 campuses scattered across the state, it should not be difficult to find suitable locations for these units within the university. Based on the potential demand for image processed products and the geography of the state, the state should be divided into six regions with each region having a unit associated with one of the state university campuses. These regions should be: the New York City Metropolitan Area and Long Island, the Catskills, the Hudson and Mohawk Valleys, the Adirondacks, the Lake Plain, and the Western Southern Tier. With each region covering ten to eleven counties, local and county government involvement in the use and operation of the facilities can be much more effective in comparison to having these facilities located in state agencies which relate mainly to statewide issues. At the time, working together, these six regions can also address state level issues. In addition, the selected campuses can use their instructional resources to introduce local and county government officials to the Landsat methodology and to future satellite remote sensing techniques.

APPENDIX A

MSS Spectral Class Means

Satellite: Landsat 3
ID #: 30170-15014
Image Date: August 22, 1978

Spectral Class	Land Cover Type	Class Means MSS 2	Class Means MSS 3	Class Means MSS 4
1	Agriculture	13.04	56.62	35.58
2		12.25	49.52	31.23
4		16.34	48.66	29.69
5		19.06	39.11	24.11
8		5.16	53.38	32.88
9		14.17	44.00	27.19
15		16.63	58.11	36.78
22		19.80	44.86	26.38
31		12.47	64.91	42.47
32		17.04	43.56	26.20
33		20.83	50.57	29.86
3	Deciduous Forests	9.27	43.83	28.42
6		9.24	47.72	31.51
12		9.64	52.39	34.67
13		9.74	56.84	38.36
16		9.61	60.91	42.73
19		11.75	42.23	27.07
28	Coniferous Forests	7.60	26.91	17.18
11	Brushwood	15.00	38.67	23.33
17		14.67	33.72	21.89
35		11.74	34.30	22.37
14	Wooded Wetlands	8.86	39.54	25.51
20		8.70	34.99	22.68
21		7.90	30.35	19.65
24	Urban	25.11	28.78	13.78
27	Suburban	25.00	49.44	28.33
30	Hamlet	21.56	37.67	21.33
23	Surface Mining	23.78	64.22	38.33
10	Water	16.22	31.67	19.56

Spectral Class	Land Cover Type	Class Means MSS 2	MSS 3	MSS 4
7	Reservoir	7.22	3.38	1.01
18		4.22	3.11	0.78
25	Transitional	4.78	8.89	4.67
26		10.00	13.89	4.67
29		5.33	13.00	7.33
34		10.11	11.33	4.00

Parameter Input To SEARCH

Maximum Desired Separability For Merger = 2.0
Coefficient of Variation/100 = .05

Standard Deviation Lower Bound For Channel 2 = 0.2
Standard Deviation Upper Bound For Channel 2 = 1.5

Standard Deviation Lower Bound For Channel 3 = 0.2
Standard Deviation Upper Bound For Channel 3 = 2.0

Standard Deviation Lower Bound For Channel 4 = 0.1
Standard Deviation Upper Bound For Channel 4 = 1.5