LAND USE CHANGES IN SOUTHEASTERN WISCONSIN: THE LANDSCAPE PATTERN PROJECT

The influence of human activity on the natural landscape has been documented extensively for specific local areas and in general terms for large regional systems. We are aware of some effects of logging on tropical forests and of the "environmental impact" of an electrical generating plant on the surrounding area. However there are few systematic studies of a region showing the historical development of a landscape beginning at settlement and continuing to the present.

Such a comprehensive study is underway in southeastern Wisconsin with special emphasis on forest distribution and function. This article highlights some of the preliminary results.

Since settlement began in the 1830's, the native forest, wetland and prairie vegetation has been replaced by pasture, cultivated fields, highways, towns and cities. Fragmentation of the forest into smaller and smaller isolated patches influences the biological diversity of the remaining patches, as well as species replacement patterns and dispersal of seed and other propagules. This drastically alters the integrity of the regional system.

This study documents changes in patterns of land use and forest vegetation and investigates factors influencing these changes and the effect of the present pattern on ecosystem maintenance. This work is part of a larger study examining many areas throughout the Deciduous Forest biome.

Selection of Transacts and Grid Location

Three east to west transects were chosen to represent the variety of landscapes present in southeast Wisconsin. Using the UTM system marks on the 1:24,000 USGS topographic maps, a 2500 ha sampling grid was located on each map using a random numbers table. Nine grids were chosen, each a 50 by 50 matrix of 1 hectare cells.

Data Sources

Aerial photographs were obtained from the U.S. Department of Agriculture Soil Conservation Service (USSCS) for 1937. The Southeastern Wisconsin Regional Planning Commission (SEWRPC) kindly provided 1963 and 1975 photos. The aerial photographs were then adjusted photographically to the 1:24,000 scale.

METHODS

Data on ten major elements—topographic aspect, elevation, soil type, original vegetation, land use, natural vegetation, water, linear vegetal features,

linear non-vegetal features and structures were obtained from the photographs. Topographic aspect, elevation, soils and original vegetation were coded first for each grid, the remainder of the elements were coded in order for the 1937, and 1975 aerial photographs. After grid coding was completed field checks were made to check uncertain coding decisions.

In all coding decisions, the predominant areal character of a cell was used except as noted below. For instance, if a cell were 1/3 water and 2/3 residential, it would be coded residential. When equal areas occurred, the higher code number was generally chosen.

Data coded once for each grid included topographic aspect, elevation, soils and original vegetation (1836). Aspect was divided into 8 slope categories facing cardinal directions as well as flat and complex categories. Elevation was determined to be that of the cell center rounded to the nearest 10 ft. Soils were coded from the appropriate USDA S.C.S. county soil maps.

Original vegetation was coded as one of 10 general vegetation types. Data were taken from copies of township maps of original vegetation prepared by R. Finley in 1950. These maps were corrected for river and stream location and wetland soils and were checked against published original vegetation maps.

Other data were coded using aerial photographs from 1937, 1963 and 1975 and topographic map coverage for 1955. Elements used were land use (10 codes), natural vegetation (8 codes), water (7 codes), linear vegetal features (6 codes), linear non-vegetal features (10 codes) and structures (10 codes).

Data from each cell were punched onto standard IBM cards and each card was verified. One card deck was forwarded to Southern Illinois University at Carbondale for computer analysis using the Imgrid program.

RESULTS AND DISCUSSION

To illustrate some of the changes that occur in the process of urbanization, we have chosen a grid in Hales Corners. This area, ten miles from the center of Milwaukee, developed during the last century into an active and prosperous agricultural region. However, over the past 30 years a shift from agricultural to urban land use has occurred, a change which affects natural vegetation and land uses.

Original vegetation in the Hales Corners grid (Fig. 1) was predominately oak forest (46%), wetlands and lowland forest (42%) with smaller areas of sugar maple–basswood forest (8%) and oak savanna (4%). Lowland areas were characterized by two major soil types–Blount silt loam which is a level, poorly drained soil of drainage ways and small depressions and Ashkum silty clay loam which is a level, poorly drained soil of ground moraines. Upland sites were predominately Marley silt loam, a well drained soil type on 2 to 6% slopes.

Proximity to Milwaukee and generally fertile soils gave early impetus to agriculture. At the turn of the century much of the grid area was cultivated or pastured. In 1937, over 70% of the area was agricultural and only 26% of the original vegetation cover remained.

Changes in the forest and other wetland areas in this grid are illustrated by comparing maps for 1937 and 1975 (Figs. 2 & 3). Much of the wetland forest the surveyors recorded in 1836 had already disappeared by 1937 as had virtually

Table 1
Hales Corners Grid
Land Use in 1937, 1963 and 1975

	1937	1963	1975
Land use	Percentage of Area		
Agriculture	70%	62%	55%
Natural Vegetation[1]	26	22	20
Residential	3	10	14
Commercial	0.3	1.0	1.7
Gravel Pits	0.7	2.3	4.0
Natural Vegetation			
Forest	20	21	19
	Percentage of cells containing Feature[2]		
Linear vegetation			
Fencerows	29	26	21
Railroads/Roads[3]	17	16	16
Roads			
Secondary roads	8	12	18
Main (state/county) roads	16	21	18
Highways (4-lane)	0.04	0.5	4
Structures			
Farm houses	2	2	1.8
Rural non-farm houses	3	11	12
Multiple houses[4]	0.4	7.6	13

1. Includes forests, wetlands and abandoned fields.
2. Percentage of 2500 cells with feature.
3. Vegetation along rights of way.
4. 2 or more residences per cell.

all the upland forest save for a few small woodlots. Most of the larger woodlots present in 1937 remain as woodlots today although they have changed shape somewhat and a few have even increased in size as fields have been abandoned and grown back to young timber. However, small woodlots, those mostly under 10 acres, are disappearing and there is only one new stand resulting from field abandonment identifiable on the 1975 photographs.

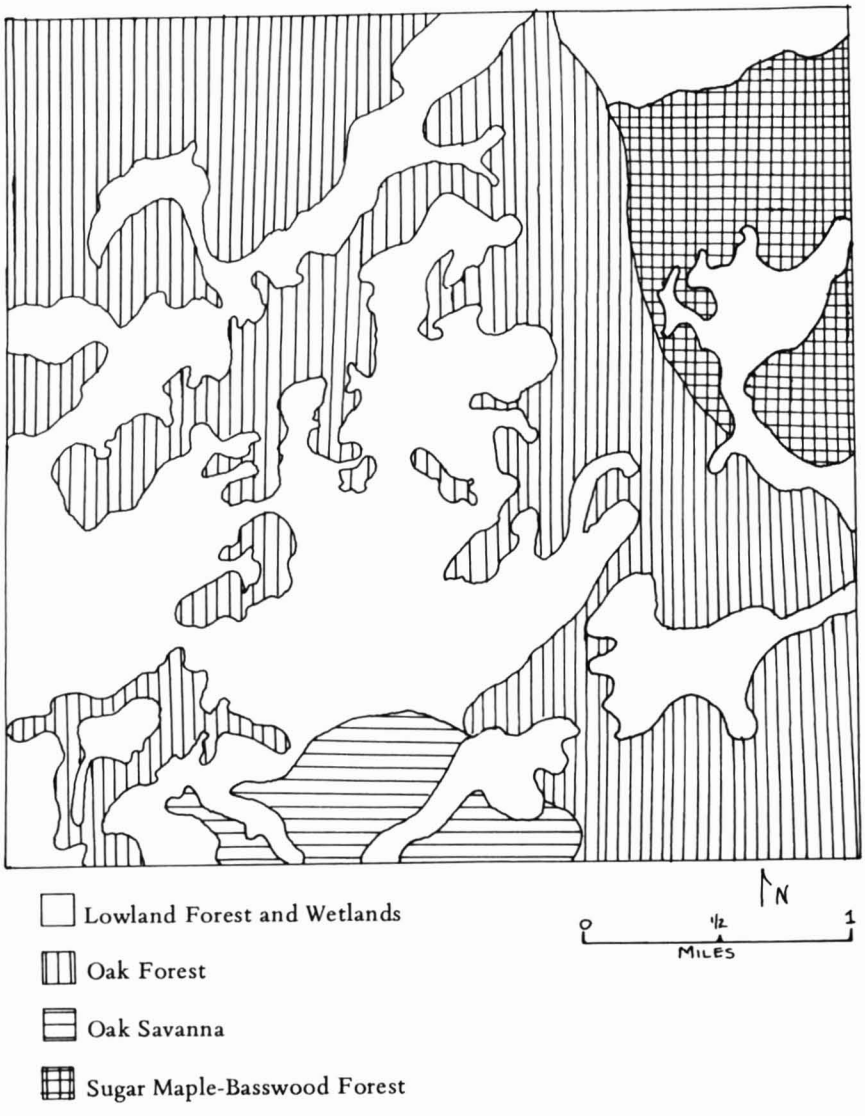

Figure 1. Natural Vegetation in 1836 – Hales Corners area.

The larger wetland units present in 1937 are also present today. Small wetland units appear to have increased in number, possibly as a result of abandonment of land previously cultivated. Some of the gains since 1937 may represent a general shift to a moister climate permitting regrowth of vegetation in areas which, during the drought years, had been plowed and drained and have since reverted to wetland vegetation.

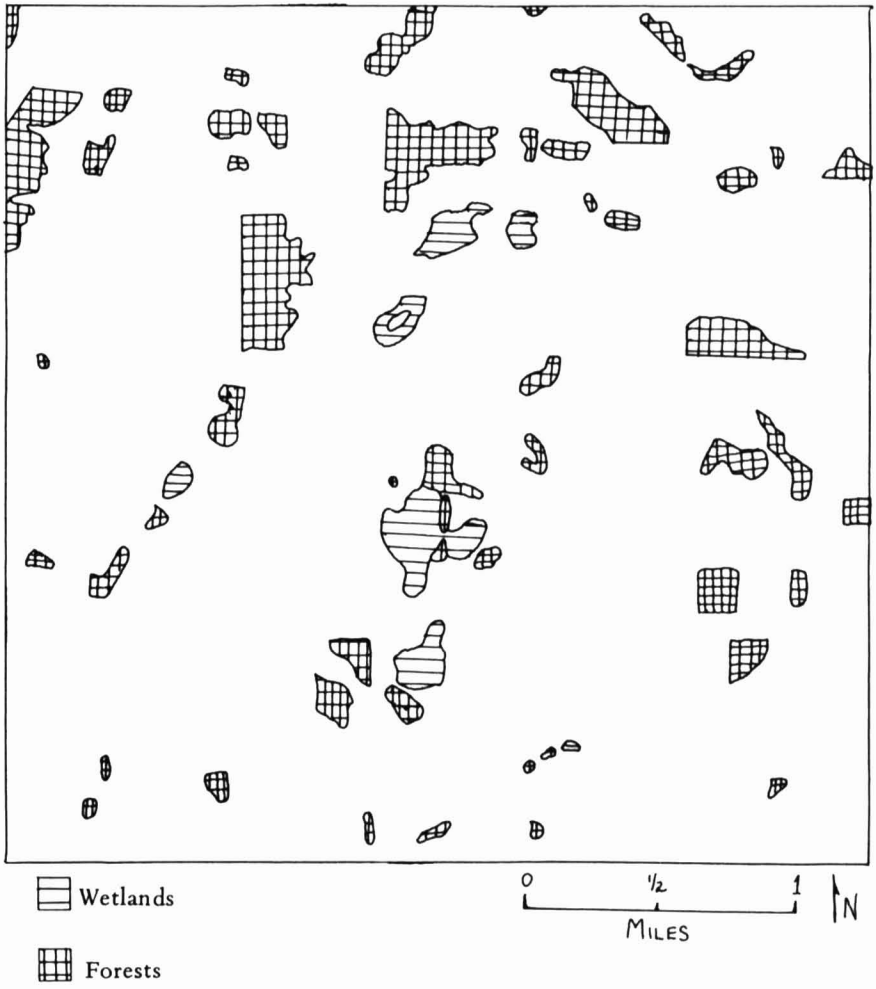

Figure 2. Natural Vegetation in 1937 – Hales Corners area.

Maps (Figs. 2 and 3) provide a graphic analysis of change. They do not however permit detailed comparisons and for this we have utilized a computer program in which changes of land use in a cell of the 2500 hectare grid are recorded and total change tabulated.

Land use changes as a percentage of the area have been dramatic (Table 1). Between 1937 and 1975 agricultural use declined from 70% to 55% of the total

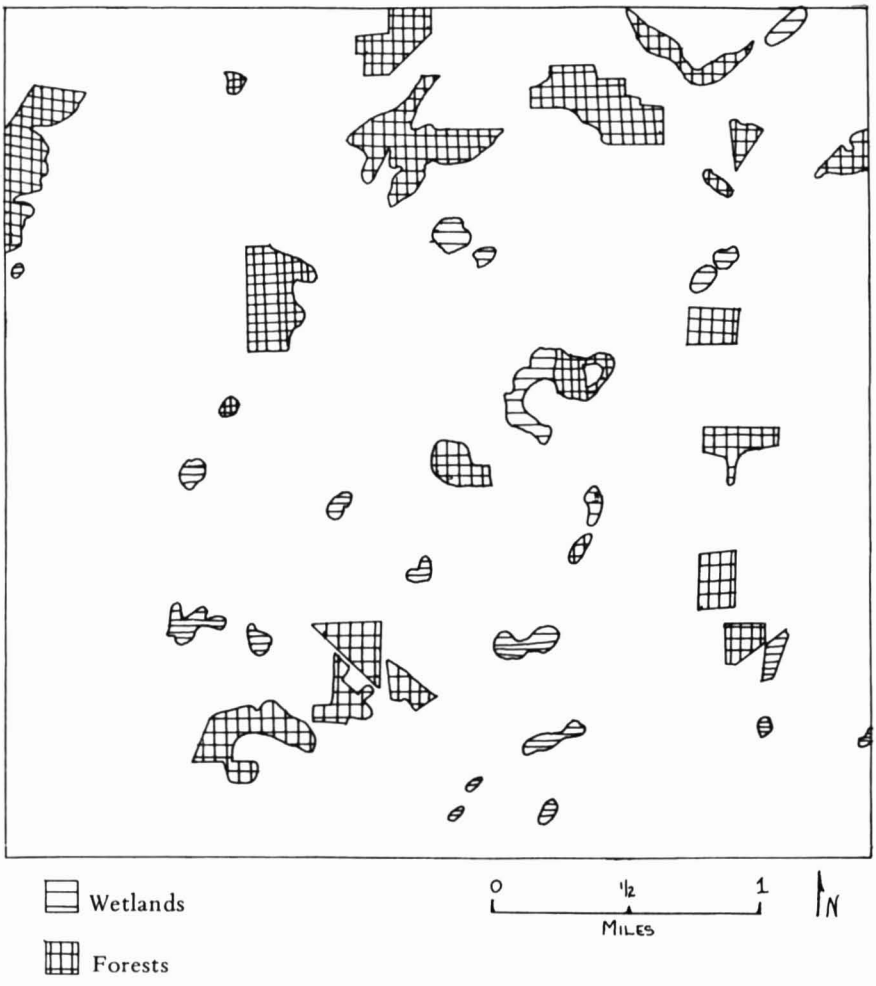

Figure 3. Natural Vegetation in 1975 – Hales Corners area.

area. Natural vegetation also declined (26% to 20%) while the area devoted to residential and commercial uses has increased. The area in gravel pits alone has increased from less than 1% in 1937 to 4% in 1975. Gravel is a vital component of urban development, utilized for construction as well as highways and driveways and its importance is borne out by this increased acreage.

Forest acreage between 1937 and 1975 only dropped by about 1%. In contrast, the percentage of total cells containing fencerows declined 8% during that period. Fencerows as well as vegetation along roads and railroads are important areas for wildlife and also vital areas to provide seed for revegetation of oldfields and disturbed sites. They serve as connectors and links in a landscape that now has relatively few widely dispersed remnants of native vegetation. Their value in urban landscapes is often not apprecieated; in addition to their high wildlife they are of great aesthetic and scenic importance.

As one might expect in an urbanizing area, the number of cells containing secondary roads more than doubled between 1937 and 1975. Cells having main roads have shown little change but those with 4-lane roads have increased greatly. The small drop in cells with main roads from 1963-75 presumably occurred as those roads became 4-lane highways.

Shifts in cells containing structures are also diagnostic of landscape changes. Farm residences have declined. Single family non-farm residence have increased greatly from 3% of the cells containing such structures to 12% in 1975; cells containing two or more residences, i.e., representing subdivisions, have increased from virtually none in 1937 to 13% of the total number of cells in 1975.

Comparing this grid with others which are more highly agricultural, surprisingly we find that urbanization results in greater retention of natural vegetation. In agricultural areas of Wisconsin, fencerows, natural woodlots and wetlands are being destroyed at higher rates than in Hales Corners.

CONCLUSIONS

This brief preliminary analysis suggests the potential for landscape analyses which this approach offers to determine change, causes of change, relationships to productivity and soils and potential for future estimates of change in agricultural, wetland or forest values.

The project has 8 more grids in preparation. These, together with the Hales Corners grid, will permit systematic analysis of landscape change in southeastern Wisconsin as conditioned by human activity, soils and other factors.

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