A postglacial vegetational history of Sauk County and Caledonia Township, Columbia County, south central Wisconsin. No. 168 1990

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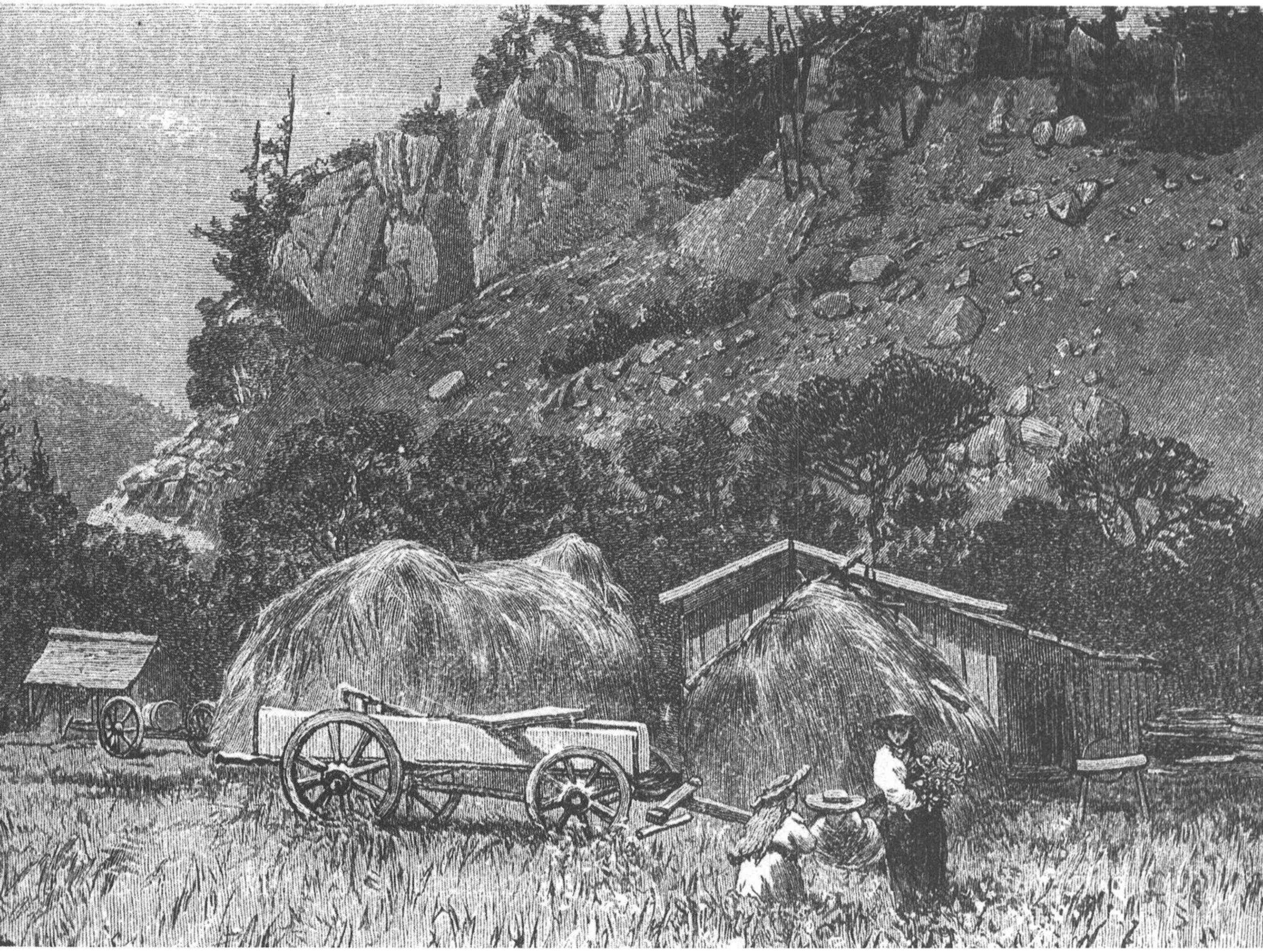

A Postglacial Vegetational History of Sauk County and Caledonia Township, Columbia County, South Central Wisconsin

Technical Bulletin No. 168
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Cover Photo: A farm scene in the Baraboo Hills circa 1880 (Francis 1884). Details include a water wagon on the left and an emery wheel on the right.

ABSTRACT

The vegetational history of Sauk County and Caledonia Township, Columbia County, is presented for the time span from the melting of the last glacier (the Wisconsin Glacier) approximately 10,500 years ago until the present. This time span is termed the Holocene and is herein separated into 3 periods: postglacial time up to white settlement (1838), early settlement (1840-45), and postsettlement (1846 to the present). The last 150 years of the Holocene, corresponding to the years since white settlement, are covered in the most detail. In addition, the late Pleistocene (12,500-10,500 years ago) is treated briefly.

Pollen profiles for the period prior to settlement indicate a transition from a spruce maximum to pine to oak, with a peak in oak savanna-prairie for the period 6,500-3,000 years ago. Oak forest and mesic forest apparently became more widespread after this period. Vegetation prior to settlement was influenced mainly by changes in the earth's orbit and atmospheric chemistry, the frequency and characteristics of air masses, the glacier, fire history, and physical alteration of the environment through landscape change and soil development. Biotic factors were also involved, e.g., the differential migration rates of trees from their glacial refuges once the glacier began melting and diseases and insect pests of plants.

The early settlement vegetation was reconstructed largely from the original land surveys, which were run in the study area from 1840-45, while postsettlement vegetation was determined from published and unpublished historical documents, the Wisconsin Land Economic Inventory of the 1920s and 1930s, Wisconsin forest inventories of more recent years, local newspapers, and field inspections. Changes during these periods are documented with a map, tables, and historical photos and illustrations. Early settlement vegetation consisted of a mosaic of 10 plant communities dominated by oak savanna and oak forest. During postsettlement time, the land cover became predominantly agricultural, although woods and forests have stayed in approximately the same percentage of land cover since the 1840s. However, the composition of these communities has changed.

As elsewhere, climate has been the ultimate determinant of vegetation in the study area, but other factors are now operative. The influence of white settlement has been ubiquitous and pervasive. Today's fragmented landscape is the result of clearing and plowing, grazing, mowing, draining of wetlands, fire exclusion, logging, the introduction of exotics such as certain fungal tree diseases, spreading urbanization, and the change from small, diversified farms to large, specialized agricultural operations.

Environmental instability has been the norm throughout the Holocene, at least in temperate North America, and forest trees and, presumably, temperate plants in general, have evolved during periods of disturbance. For example, in a given ice age the glacial phase, not the interglacial, is the longer and dominant phase.

KEY WORDS: Postglacial vegetation, plant communities, vegetational change, white settlement, Sauk and Columbia counties, pollen profiles, original land survey records.

Financial support for printing this report was provided by Donald Kindschi.

A POSTGLACIAL VEGETATIONAL HISTORY OF SAUK COUNTY AND CALEDONIA TOWNSHIP, COLUMBIA COUNTY, SOUTH CENTRAL WISCONSIN

by Kenneth I. Lange

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INTRODUCTION

The main body of the last glacier, the Wisconsin Glacier, began melting rapidly approximately 10,500 years ago, so that North America essentially was cleared of glacial ice after this time. The time prior to 10,500 years ago has been termed the Pleistocene and the succeeding time the Holocene (Bryson et al. 1970). This study was an attempt to reconstruct the vegetational changes that occurred during the late Pleistocene and the Holocene in south central Wisconsin, specifically Sauk County and Caledonia Township, Columbia County. Factors associated with or causing these changes are discussed in detail.

Sauk County and Caledonia Township were chosen for this study because of their physiographical and biological diversity and the availability of ample research and descriptive material. Included within the area are a number of state-owned public lands: Devil's Lake, Natural Bridge, Mirror Lake, and Rocky Arbor state parks, a portion of the Lower Wisconsin State Riverway, the Bakkens Pond Unit of the Lower Wisconsin River Wildlife Area, Pine Island Wildlife Area, Dell Creek Public Hunting and Fishing Grounds, and Cady's Marsh near Reedsburg. Several county parks, such as White Mound Park near Plain, are also located in the study area. Privately owned sites of special ecological significance include Durward's Glen, Baxter's Hollow and Klondike, Pine Hollow near Denzer, Hemlock Draw near Leland, the Wisconsin Society for Ornithology's Honey Creek property, and the "Wisconsin Desert" near Spring Green.

Vegetational history is presented for 3 periods: (1) postglacial up to white settlement[1] (1838), (2) early settlement (1840-45), and (3) postsettlement (1846-present). Postsettlement vegetational history is limited to Sauk County. Changes in land cover were reconstructed from published results of pollen analyses conducted by other researchers, the original land surveys, records of the Wisconsin Department of Agriculture and the Wisconsin Department of Natural Resources, and published and unpublished descriptive accounts.

Published results of North American pollen analyses did not appear until 1930 (Kapp 1976), so that a researcher attempting to trace the vegetational history of a North American locality before this time, e.g., Gleason (1922), was limited to inferences from known deposits of buried wood and other macrofossils, the distribution of relict colonies of plants, and the known environmental requirements of individual species. Now the researcher has access to numerous pollen analyses and also to the radiocarbon method of dating deposits (Wright 1971). The following pollen studies were conducted, at least in part, in or near the study area: Hansen (1933, 1937, 1939), Truman (1937), Bachhuber (1966), Davis (1975, 1977), Van Zant and Lamb (1980, 1982), Maher (1982), and Winkler (1985).

Numerous investigators have utilized the original land surveys to describe early settlement vegetation. Examples for Wisconsin include the following: Trewartha (1940), Fassett (1944), Cottam (1949), Ellarson (1949), Stearns (1949), Goder (1956), Ward (1956), Neuenschwander (1957), Cottam and Loucks (1965), Stroessner and Habeck (1967), Peet (1971), Barnes (1974), Tans (1976), Finley (1978), Kline and Cottam (1979), Mladenoff and Howell (1980), Liegel (1982), and Rill (1983). Of these accounts, Tans (1976) and Liegel (1982) cover small sections of the study area, and Ellarson (1949) and Stroessner and Habeck (1967) analyze the adjoining counties of Dane and Iowa, respectively.

STUDY AREA

The study area is shown in Figure 1 in its southern Wisconsin setting, bordered by Juneau, Vernon, and Richland counties on the north and west and by the Wisconsin River on the south and east. The study area falls within 2 of the 5 geographical provinces of Wisconsin as mapped by Martin (1965) mainly on the basis of rock characters (see also Fenneman 1916). The size of the study area is approximately 580,000 acres.

A major landform in the study area is the Baraboo Range (also called the Baraboo Hills or Baraboo Bluffs), a Precambrian monadnock of elliptical shape (Fig. 2). This ancient outcrop of quartzite extends between the village of Rock Springs in the west and Cascade Mountain in Caledonia Township in the east, a distance of 25 miles, and has an average width of 5 miles for the enclosed Baraboo Valley (Fig. 3). Greatest relief is attained at mountainous Devil's Lake, where 3 bluffs with associated talus slopes rise 500 ft above the water (Fig. 4). The Baraboo Range is bordered at its eastern end by the Wisconsin River bottomlands of the Central Plain and at its western end by the dissected sandstone and dolomite hills of the Western Upland (Fig. 5). Usually included in the Western Upland, the Baraboo Range is treated here as a separate entity. Major rivers of the study area are the Wisconsin and its tributary the Baraboo. Place names referred to in this report are shown in Appendix Figure 1.

The terminal moraine of the Wisconsin Glacier extends through Sauk County; the eastern third of the study area, including the eastern part of the Baraboo Range, was glaciated, while the remainder of the study area was not. Some glacial sediment was carried beyond the terminal moraine and deposited at varying distances from the wasting ice by glacial meltwater, often forming extensive flats (outwash plains) and outwash terraces. Outwash plains are found just southwest of Baraboo and also just south of the Baraboo Range where the Badger Army

[1]In this report, "white settlement" refers to the arrival and extended presence of non-Native American people in the study area. The non-Native Americans who came to live in the study area from 1838-40 were virtually all white people. They could be divided into 2 groups: "Yankees"—people mostly of English background but also of Irish, Scottish, or Welsh origins, who came to Wisconsin mainly from the eastern states—and immigrants from continental Europe, who came mainly from Germany and Switzerland. Most settlers were Germans and Yankees (Lange 1976:28).

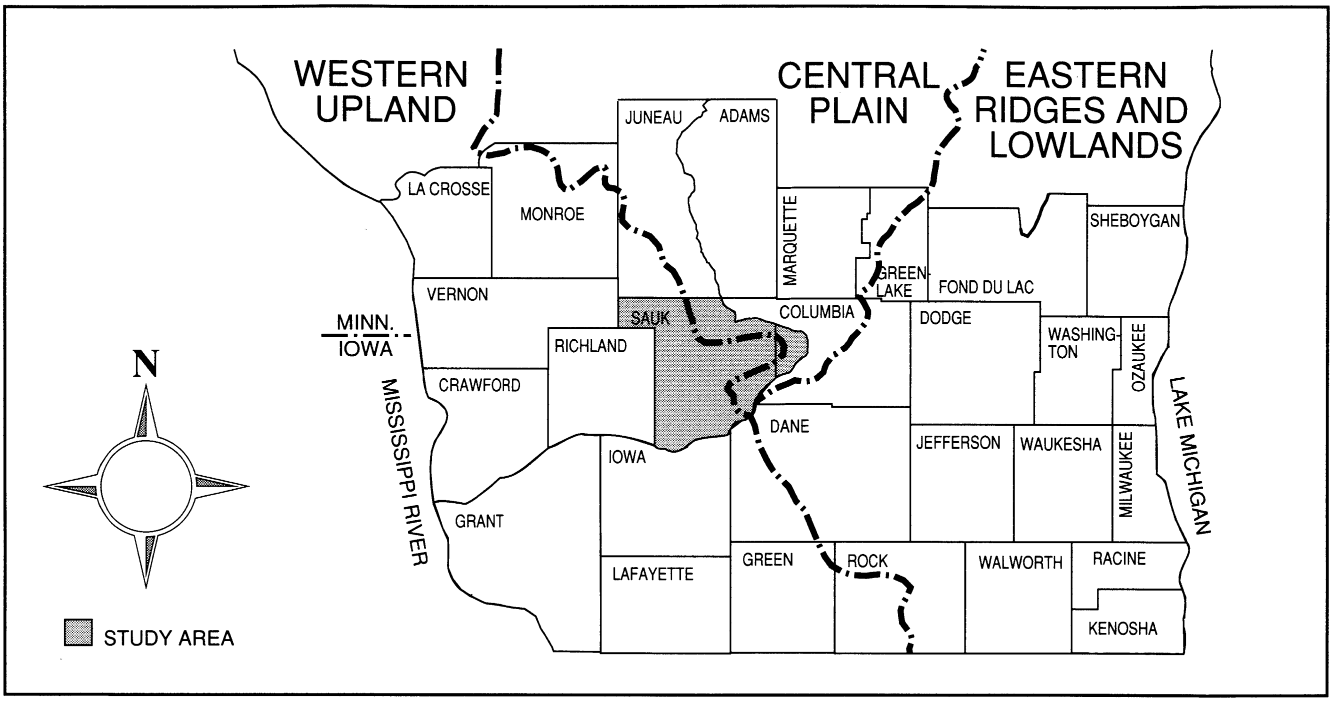


FIGURE 1. *Location of Sauk County and Caledonia Township, Columbia County, in relation to the Western Upland and Central Plain geographical provinces as described by Martin (1965).*

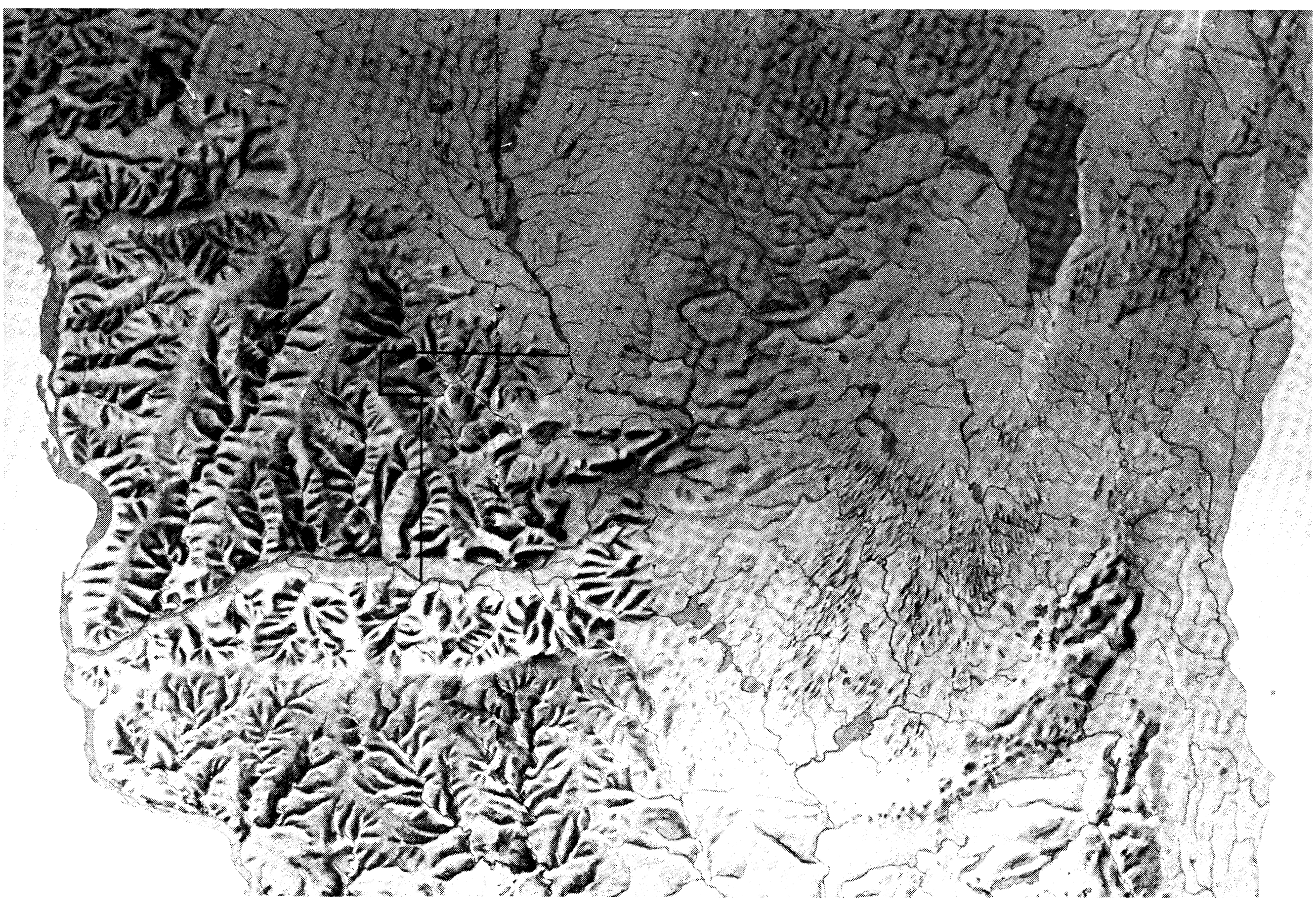


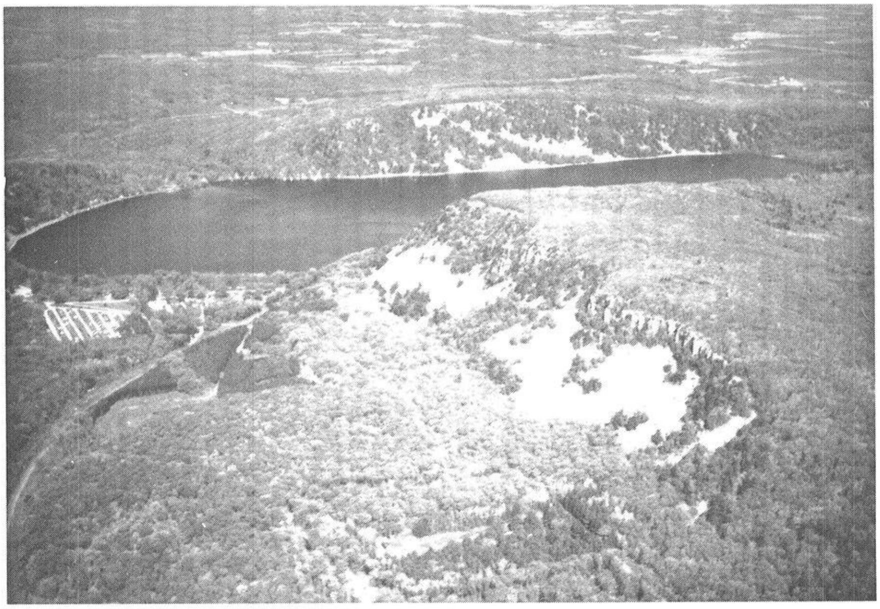
FIGURE 2. *Landforms of Wisconsin, with the study area outlined. Notice the lower ground (the Central Plain) along the Wisconsin River, the higher ground (the Western Upland), and, extending nearly to the Wisconsin River, the arrowhead-shaped Baraboo Range within the Western Upland. Map from the Wisconsin Geological and Natural History Survey.*

Ammunition Plant is now located (Salisbury and Atwood 1900:116-19).[2] Outwash terraces occur in the Wisconsin River valley in a number of places (Gundlach 1980:2-3).

The soils of the study area are primarily silt loams and secondarily loams, clay loams, sand loams, and sands; wet alluvial soils occur along the lower Wisconsin River (Hole 1976, Gundlach 1980). The silt loams of the Baraboo Range developed in 20-40 inches of loess over quartzite bedrock (Hole 1976:59, 66, 131).

The climate is characterized by extremes of temperature and precipitation in any season. The average date of the last 32 F freeze in spring is 10 May, and the first in fall is 28 September. The growing season—the number of days between these dates—averages 142 days (Gundlach 1980:1). There is considerable variation in length of growing season. For example, soils in the western part of the Baraboo Range are especially slow to warm up in the spring, and crops planted there may be 2 weeks behind those planted just outside the quartzite formation (Mossman and Lange 1982:15). The Baraboo Range influences precipitation and temperature (Kopitzke 1967, Adams and Loucks 1971). For example, rain just outside the range often changes to snow as it reaches the range.

[2]For the reader's convenience, page numbers are included in textual references for material that might otherwise be difficult to find.



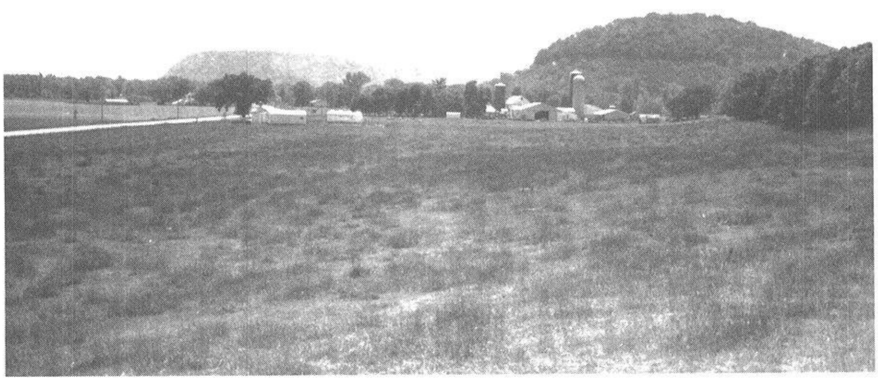


FIGURE 3. *Scene in the Baraboo Range, looking southeast across the Baraboo Valley from the north limb to the south limb, 1986. The Devil's Lake bluffs are in the distance, just to the left of center.*

FIGURE 4. *Aerial view, looking west, of mountainous Devil's Lake in the Baraboo Range. The lake is framed by three 500-ft bluffs: the west bluff (in the distance, center) the east bluff (closer and to the right), and the south bluff (far left). The north shore of the lake is at the upper right, the south shore at the middle left.*

FIGURE 5. *Ferry Bluff on the left and Lodde's Mill Bluff on the right, along the Wisconsin River approximately 5 miles downriver from Sauk City, 1986. These hills form part of the boundary between the Central Plain and the Western Upland.*

METHODS

Pollen Profiles

Each flowering season a rain of dustlike pollen settles over the land, a phenomenon all too familiar to hay-fever victims. But this same pollen that causes misery for some is studied by others to trace vegetational history as far back in time as 15,000 years. This study of lost landscapes, called palynology, is possible because pollen grains settle into wetlands, become incorporated into the sediment, and generally resist decomposition because of their durable outer coats. Palynologists employ a special instrument to remove a core of sediment from the wetland basin. The oldest pollen is on the bottom of the core, the youngest on top. The successive layers of the core sample are examined under a microscope and the pollen identified to family and genus and sometimes to species of the source plant. Such studies also yield information on plant migrations and ancient climates. Palynology is thus a tool for seeing through time. Birks and Birks (1980) discuss palynological techniques, and Leopold (1982) presents a brief popular account.

Results from the pollen studies of Maher (1982) and Winkler (1985) were used in reconstructing the vegetational history of the study area for the period prior to white settlement. Maher's core site was Devil's Lake, while 2 of Winkler's 5 core sites (Figs. 6, 7) were in the study area. The discovery, with Fredrick J. Rich, of a peaty deposit with spruce and fir pollen in a Wisconsin River bank in Fairfield Township, Sauk County, allowed me to experience firsthand some of the excitement and challenge in such investigations.

Several researchers, e.g., Cleland (1966) and Parmalee (1959, 1960), report animal remains from rock-shelters in the study area. This information also can be useful in reconstructing past landscapes (Semken 1983); however, it was not used in this report.

FIGURE 6. *Sedge meadow along the Wisconsin River in the Central Plain (T13N, R7E, Section 34, Sauk County), one of Winkler's 2 core sites in the study area, 1986.*

FIGURE 7. *Washburn Bog in the Central Plain (T12N, R7E, Section 3, Sauk County), one of Winkler's 2 core sites in the study area, 1986. This is a sphagnum bog; leather-leaf is overtopped by bog birch and an occasional tamarack.*

Original Land Survey Records

The early settlement vegetation was extrapolated mainly from the original land surveys for Wisconsin. It is ironic, as Kline (1976:4) has pointed out, that the very system that subdivided and eventually led to the near destruction of the native vegetation should become the best source of information for deciphering that vegetation. The notebooks for these surveys are stored at the State Board of Commissioners of Public Lands (Bureau of Trust Lands and Investments) in the Tenney Building in Madison. Stewart (1935) and White (1983) discuss these surveys, and Bourdo (1956) analyzes their use in reconstructing forest cover.

Government surveyors began working in Wisconsin soon after the Blackhawk War of 1832 and surveyed the study area from 1840-45. One crew established the range and township lines,

FIGURE 8. *Nineteenth century land surveying. A pen drawing from the collections of the State Historical Society of Wisconsin.*

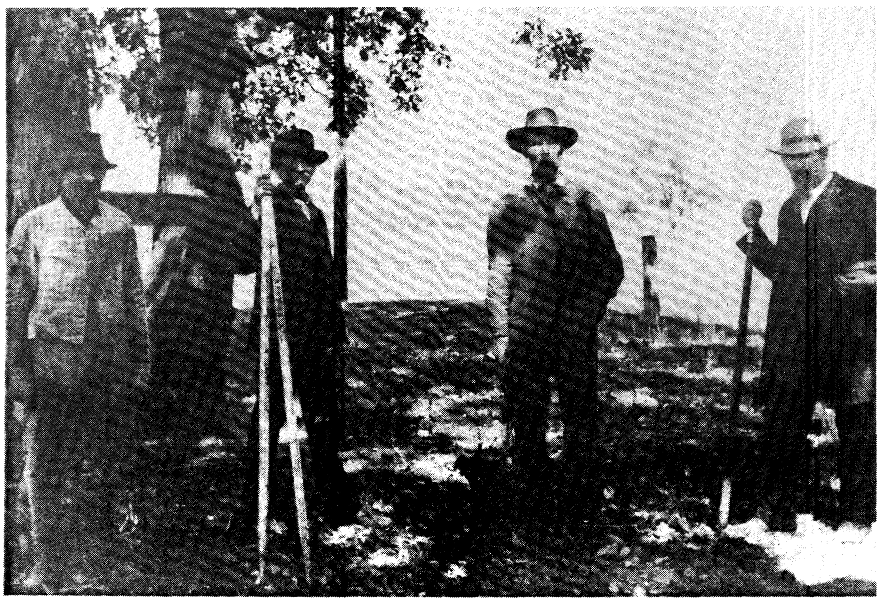


FIGURE 9. *Early surveyors' party in Richland County, Wisconsin, from Coopey (1980:156).*

and another crew later completed the grid by laying out the section lines (Figs. 8, 9). For each section and quarter-section point, the 2 (sometimes 4) nearest suitable trees were selected as bearing trees, and their diameters and distances from the corner were recorded. In treeless areas, e.g., prairies and barrens, the crew merely built a mound of earth at the corner point and recorded that the point was in an open area. For each mile traversed, the surveyors were required to describe the timber and agricultural value of the land, its topography, and its water courses. They were also required to provide a general description and map for each township. This information was then available, at a slight expense for copying, from the government land offices. Land seekers used this information for selecting favorable locations for farms, and speculators used it for promoting likely sites for mills and villages (Kline 1976:4-5, Lange 1976:21).

Using these records, I mapped the plant cover at each quarter-section and section point, the tree species, if any, at the point, and the density of the tree canopy as determined by the distance from surveyor post to tree. If the average distance between trees was less than 50 links (a link being 0.01 of a chain and equaling 7.92 inches), the plant community was mapped as woods. This corresponds to a density greater than 17.4 trees/acre. If the average distance between trees was 50-209 links, or if either bearing tree was more than 80 links from the point, the community was mapped as savanna (a density of 1.0-17.4 trees/acre). If the average distance was greater than 209 links or if either bearing tree was more than 300 links from the point, the community was mapped as prairie (a density of less than 1.0 tree/acre).

My criteria for delineating woods, savanna, and prairie were taken from Curtis (1959), who defined *forest* as a wooded area in which trees form more than 50% canopy, *savanna* as an intermediate area in which trees (more than one per acre) form less than 50% canopy, and *prairie* as an open area of low-growing plants, at least half of which are true grasses, with less than one tree per acre. I calculated density based on Cottam and Curtis (1956) who showed that the distance from any point to the individual tree nearest to that point, on the average, is the same as the distance between any individual and its nearest neighbor. This means that density, i.e., trees per acre, can be calculated from the original land surveys. Quantitative interpretation of wooded areas is most reliable because the bearing trees are a sampling of trees present. Interpretation of nonforested land is less reliable (Curtis 1959:60).

Other Records

Secondary sources for reconstructing early settlement vegetation were published and unpublished historical documents, soils maps, and my own field inspections of present-day vegetation. Noss (1985) discusses these and other methods for characterizing early settlement vegetation; see also Bromley (1935) and Fosberg (1964).

The land cover after 1845 and into the 1980s was extrapolated from the following sources: an early map of Sauk County by Sauk County's first surveyor, William H. Canfield (1859); unpublished papers, filed at the State Historical Society of Wisconsin, of the pioneering scientist Increase A. Lapham, who spent considerable time in Sauk County in the mid-1800s; published and unpublished pioneer reminiscences; early statistical data, e.g., Wisconsin Board of Immigration (1869) and Wood (1871); the Wisconsin Land Economic Inventory (also known as the Bordner Report) of the 1920s and 1930s, in which woodlots, forests, and unforested lands were mapped for the entire state on the basis of a series of transects 1/4-mile apart (Wis. Dep. of Agric. 1928-41, 1956; Curtis 1959:65-66); and Wisconsin forest inventories (Wis. Conserv. Dep. 1959, Wis. Dep. Nat. Resour. n.d., Raile 1985). In addition, all issues of the following newspapers were consulted at the State Historical Society of Wisconsin for information on both early settlement and postsettlement vegetation: *Baraboo Republic* 1855-1923, *Baraboo Weekly News* 1904-63, *Sauk County Democrat* 1880-1920, *Sauk County News* 1876-1953, *Reedsburg Free Press* 1860-1939, *Wisconsin Dells Events* 1903-50, *Wisconsin Mirror* 1856-76. Several Portage papers were consulted as well. In this report, references to newspaper articles that appeared without by-lines are given parenthetically in the text, while articles with by-lines are cited by author.

Written descriptions of past landscapes can be valuable adjuncts to ecological data, but I used them with care. The contemporary researcher must compensate for the relative vagueness of writing and the possible bias of both the writer and researcher by using as many sources as possible, interpreting the descriptions for plant community rather than species type, and excluding vague terminology (Vale 1982).

Historical Photos and Illustrations

Historical photos and illustrations can provide visual corroboration for vegetational changes indicated by surveys and other records. For this study, the main sources of such illustrations were the collections of the State Historical Society of Wisconsin and the Sauk-Prairie Historical Society, the files of the Milwaukee Public Museum, and local histories. Recent photos are primarily from my own collection. Sources for photos other than my own are included with the figure captions.

Taxonomy

The scientific names of all plants mentioned in this report are listed in Appendix Table 1 and essentially follow Kartesz and Kartesz (1980). In general, plant communities rather than species are emphasized in this report.

In the original land survey records, the surveyor typically identified the bearing tree to species (e.g., black oak or white oak), but occasionally such general terms as "oak" or "maple" were used. This use of general terms was minor, however, and, in my judgment, inconsequential. I could find no evidence of fraud in the survey data, as has been reported elsewhere (Tans 1976).

RESULTS AND DISCUSSION

Vegetation Prior to Settlement

The major plant communities and vegetation of the study area from 12,500 years ago to white settlement (1838) were determined from pollen studies and are presented here in relation to climatic changes (Table 1). The area shows a progression through 5 major plant communities: boreal forest (spruce), northern conifers (pines) with mesic hardwoods (maple, basswood), mesic forest, oak savanna, and a mosaic of oak forest and mesic forest (Fig. 10).

Late Pleistocene

Spruce was the first tree to colonize the late-glacial landscape about 12,500 years ago, but the initial spruce cover may have been open (e.g., savanna-like) rather than closed forest (Kapp 1976, Davis 1983). In his study of Hansen Marsh, a wetland in the Baraboo Range approximately 3 miles northeast of Devil's Lake, Bachhuber (1966) reported a pollen mixture from an "upland herbaceous community and a lowland spruce forest" in the lowest stage of his profile, but this could have represented relatively open growth throughout the site.

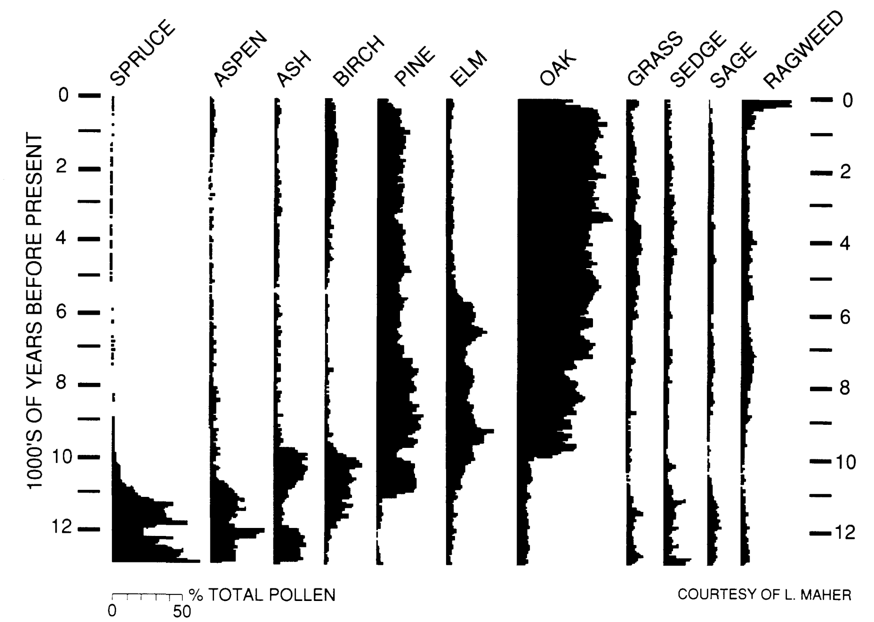


FIGURE 10. *Percentage pollen diagram for Maher's Devil's Lake core, adapted from Maher (1982).*

The climatic change that initiated the melting of the Wisconsin Glacier about 10,500 years ago produced dramatic alterations in surface ocean temperatures and deep-sea sedimentation rates (Broecker et al. 1960) as well as in the pollen spectra of lakes and bogs in the Great Lakes region (Ogden 1967). Spruces declined markedly in south central Wisconsin at about this time (Winkler 1985). At Devil's Lake, pollen counts from core samples indicate that

TABLE 1. *Postglacial vegetational and climatic changes in the study area up to white settlement (adapted from Winkler 1985:104).*

Period	Years Ago	Vegetation	Major Plant Community	Climate
Late Pleistocene	12,500-10,500	Spruce, fir, black ash, birch	Boreal forest	Cool, dry
Early Holocene	10,500-9,000	Jack and/or red pine*, elm, maple, basswood, ironwood**, white pine	Northern conifers with mesic hardwoods	Warmer, wetter
Mesic forest dominance	9,000-6,500	Elm, ironwood**, maple, basswood, oak, pines locally	Mesic forest	Warm, wet with dry intervals
Prairie expansion	6,500-3,000	Oak, grass, composites	Oak savanna	Warm, dry
Oak dominance	3,000-200	Oak, birch, elm, maple, basswood	Oak forest and mesic forest	Cooler, wetter

*Pollen of these 2 species cannot be separated.
***Ostrya* and/or *Carpinus*.

spruce fell below 15% of the pollen sum by 10,800 years ago and below 1% by 9,800 years ago (Maher 1982).

Until nearly the end of the late Pleistocene period, when the climate changed, this boreal landscape of 12,500-10,500 years ago apparently was lacking in pines, which today are common in northern forests. The climatic change presumably produced conditions too warm and dry for spruces but suitable for jack and/or red pines; before this time the pines apparently were confined to the Appalachian Highlands and Atlantic Coastal Plain, perhaps by persistent ice lobes and associated proglacial lakes in the central United States (Wright 1964, 1968*a*, 1968*b*, 1971, 1984).

Early Holocene

From approximately 10,500-9,000 years ago, as the environment became warmer and wetter with short periods of drought and frequent fire (Winkler 1985:212), the major plant community in the study area was northern conifer forest with mesic hardwoods.

Jack and/or red pine already were declining in the Devil's Lake region before white pine arrived; the latter tree was numerous in south central Wisconsin by about 9,850 years ago (Winkler 1985:212) and at Devil's Lake by 9,600 years ago (Maher 1982). Jack and/or red pine pollen continued to decline gradually in the Devil's Lake region until about 7,000 years ago, when it stabilized at a relatively low level, leaving white pine pollen as the dominant type (Maher 1982). Elm, maple, basswood, and ironwood achieved their highest percentages in the Devil's Lake region from 10,000-5,500 years ago (Maher 1982).

Mesic Forest Dominance

By about 9,000 years ago the land cover was mainly a mesic forest of elm, ironwood, maple, basswood, oak, and (locally) pine; the pine (jack and/or red pine and white pine) apparently was confined to exposed bluffs and cooler ravines, much as today. This type of plant cover indicates increasing temperature and precipitation, while dry periods (possibly with fire) are inferred from the increase in prairie and decrease in forest toward the end of this period. A peak in mesic hardwood trees occurred between 8,000-6,500 years ago. The extensive floodplains and terraces formed by the melting glacier during this period may have provided especially suitable habitat for these trees (Winkler 1985:40-41, 212-13).

Prairie Expansion

Beginning about 6,500 years ago, mesic forests were largely replaced by oak savannas as temperature increased, precipitation decreased, and fire became more prevalent (Winkler 1985:40-41, 213). Ragweed and pigweed were at their highest presettlement values in the Devil's Lake region from 9,000-3,600 years ago, suggesting a mid-Holocene expansion of prairie as well (Maher 1982). These events correlate with the final disintegration of the North American ice sheet and the establishment of a postglacial system of atmospheric circulation over North America (King 1981).

Oak Dominance

Pollen and charcoal profiles for the period beginning 3,000 years ago indicate a land cover shift to oak forests and maple-basswood forests (Winkler 1985:213). These findings suggest a climatic change to cooler and wetter conditions and may reflect, at least in part, the presence of the "Little Ice Age," a relatively cool and, in some regions, wet period in the Northern Hemisphere that lasted for some 300 years, from the middle of the 16th century to the middle of the 19th. The end of this period is set at 1838, when white people began settling in the study area (Cole 1918:191). Their presence is announced at core sites by abrupt increases in ragweed pollen from the land disturbances accompanying agriculture (Maher 1982).

Early Settlement Vegetation

The vegetation of the study area for the period 1840-45 is shown in Figure 11. Ten plant communities are delineated. The communities, acreage covered by each, and their percentage of total land cover are shown in Table 2. Oak savannas and oak forests accounted for 67% of the total land cover, with marshes and swamps adding another 22%. Prairies and other types of forests accounted for the remainder.

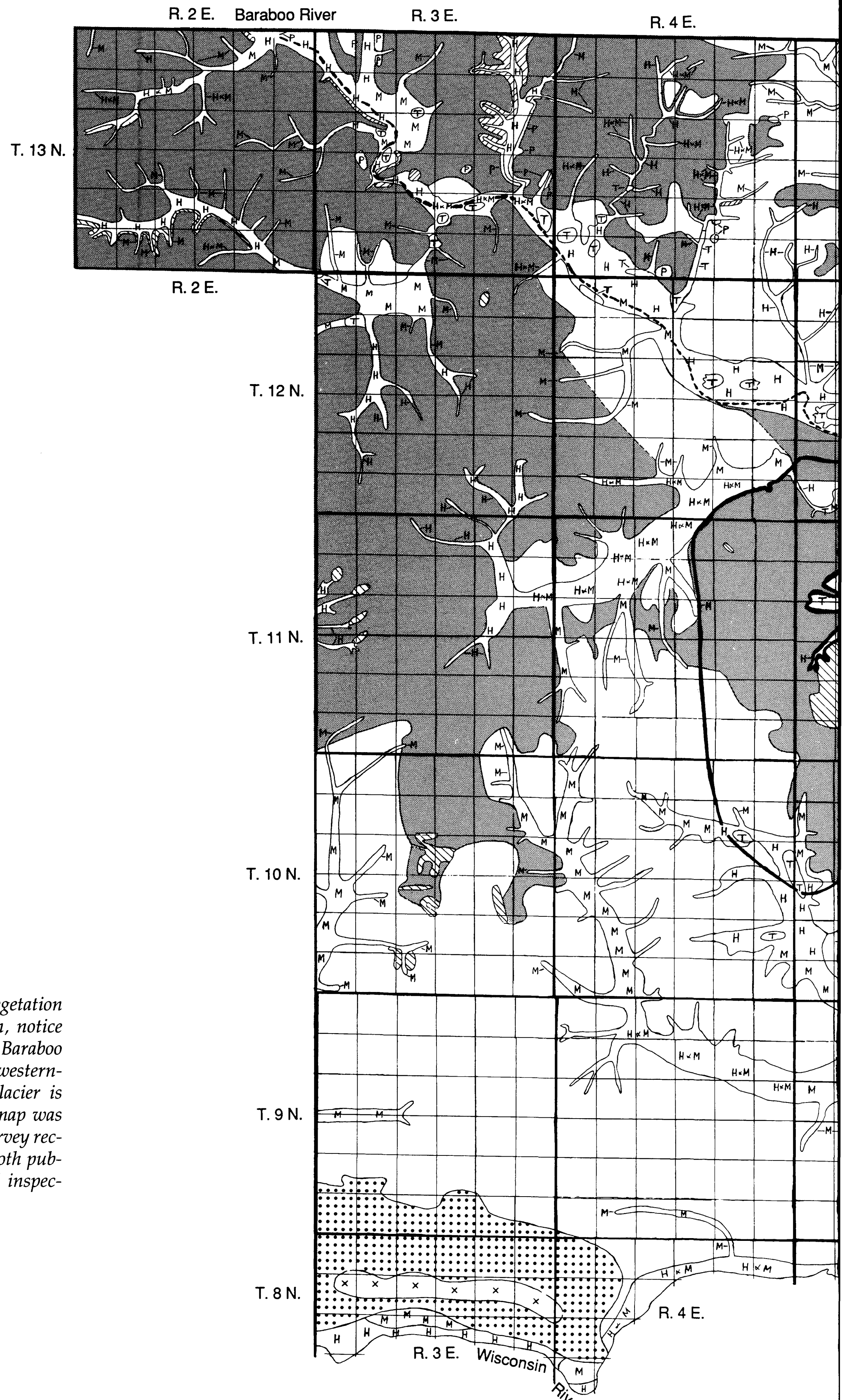
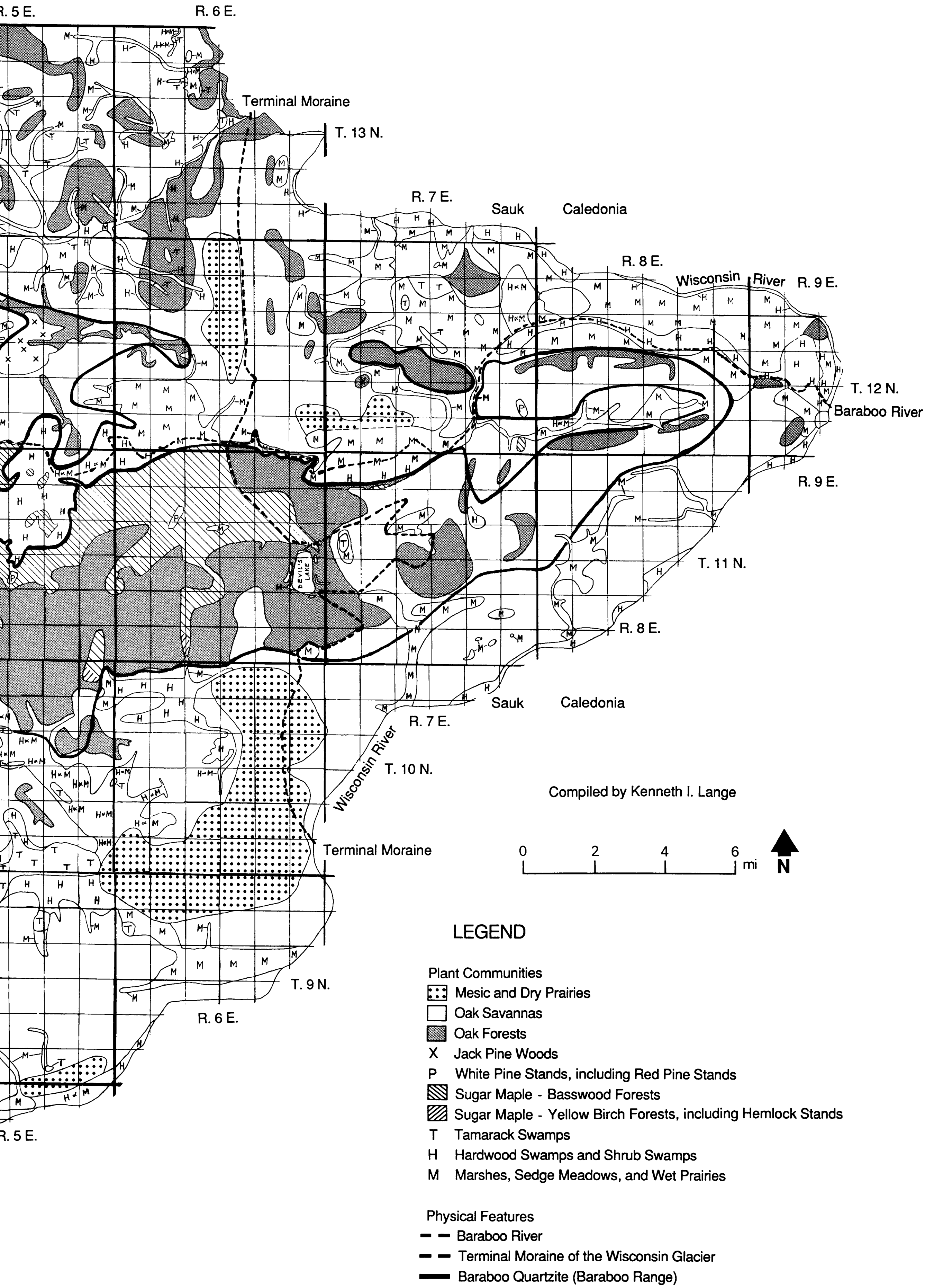


FIGURE 11. *Early settlement vegetation of the study area. For orientation, notice Devil's Lake in T11N, R6E. The Baraboo Range is outlined in black and the westernmost extent of the Wisconsin Glacier is indicated by a dashed line. This map was compiled from the original land survey records, other historical documents both published and unpublished, and field inspections.*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Baraboo River
R. 9 E.
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LEGEND
Plant Communities
Mesic and Dry Prairies
Oak Savannas
Oak Forests
X Jack Pine Woods
P White Pine Stands, including Red Pine Stands
Sugar Maple - Basswood Forests
Sugar Maple - Yellow Birch Forests, including Hemlock Stands
T Tamarack Swamps
H Hardwood Swamps and Shrub Swamps
M Marshes, Sedge Meadows, and Wet Prairies
Physical Features
Baraboo River
Terminal Moraine of the Wisconsin Glacier
Baraboo Quartzite (Baraboo Range)

Mesic and Dry Prairies

Pioneer accounts and field studies, e.g., Whitford (1948), indicate that at the time of white settlement much of the country now heavily wooded was more open; the typical cover then was prairie or, more commonly, oak savanna (oak opening), shrub and briar thicket, or thinly timbered oak forest with brushy understory.

The largest prairies were the Sauk Prairie, approximately 14,000 acres that extended west and northwest of present-day Sauk City and Prairie du Sac (Fig. 12), and an especially dry region called the "Wisconsin Desert," approximately 13,000 acres in the southwestern corner of the study area by present-day Spring Green (Fig. 13). The Sauk Prairie developed in an outwash plain where a variety of soils had been deposited by the melting Wisconsin Glacier, and the Wisconsin Desert formed on sand terraces of the Wisconsin River and the associated south-facing dolomite bluffs. Two other major prairies, Webster's or Pleasant Prairie (2,200 acres), located north of present-day Baraboo, and Cassell Prairie (1,200 acres), located along the Wisconsin River between present-day Sauk City and Spring Green, also formed on glacial outwash; Peck's Prairie (1,600 acres), located east of present-day Baraboo, developed in the glaciated half of the Baraboo Valley on ground moraine. Smaller prairies must have been numerous, although a number of areas so indicated by Canfield on his 1859 map may have been sedge meadows.

An early settler remembered the Sauk Prairie being

> full of flowers, changing almost every week, one closing to make room for another—more blossoms than leaves or spears of grass. (Rendtorff 1861)

Canfield (1861-1901) described the Sauk Prairie as having

> myriads of flowers of every shape, shade and color, and the luxuriant grasses. . . . a handsome picture set in a beautiful frame.

Regarding the nearby Mazomanie Prairie, one of the first settlers wrote that the numbers, colors and beauty of the flowers were beyond his powers of description (Croft 1942) (Fig. 14).

Oak Savannas

Oak savanna was intermediate between oak forest and prairie; it had features of both and graded into them. Prairie grasses and forbs, not underbrush, formed the ground cover, and the oaks grew about 100 ft apart, some-

TABLE 2. *Early settlement land cover (1840-45) of Sauk County and Caledonia Township, Columbia County.*

Plant Community	Total Acres	Percentage of Total
Mesic and dry prairies	32,000	5
Oak savannas	236,000	41
Oak forests	151,000	26
Jack pine woods	4,000	1
White pine stands, including red pine stands	9,000	2
Sugar maple — basswood forests	20,000	3
Sugar maple — yellow birch forests, including hemlock stands	2,000	*
Tamarack swamps	7,000	1
Hardwood swamps and shrub swamps	46,000	8
Marshes, sedge meadows, and wet prairies	73,000	13
Total	580,000	100

* Less than 1%.

FIGURE 12. *Sauk Prairie, portrayed here in an 1851 watercolor sketch by Johann Baptiste Wengler (1815-1899). Wengler visited America in 1850-51. From the collections of the State Historical Society of Wisconsin.*

FIGURE 13. *Wisconsin Desert in 1927. Photo from the Milwaukee Public Museum.*

times with "boughs so long they arched down to the ground again" (Peattie 1938:3). One could drive a wagon through these parklike areas, although a passenger on a coach had to "bow frequently to low-hanging limbs" (Inama 1928). A number of pioneers commented on the charm of the oak openings, calling them "pleasant groves, beautiful beyond description" (Tuttle 1922), and praising the "homestead-like expression they give to the landscape" (Hoyt 1860). Another likened them to ancient apple orchards.

Most common was bur oak savanna (Fig. 15), which in early settlement time could be found in the area of present-day Sauk City and Prairie du Sac (Fig. 16), Merrimac, and the country northwest of Baraboo. Generally it occurred on sandy loam or silty loam soils.

Another type of oak savanna, dominated by black oak and found in dry, sandy soil, sometimes could be differentiated from bur oak savanna (Hoyt 1860). Black oak savanna is not delineated in Figure 11, although both Liegel (1982) and Tans (1976) did so for areas along the Wisconsin River in Fairfield and Caledonia Townships, respectively.

There are numerous references to brushy places and thickets in the study area before the land was significantly altered by white settlers. These areas were generally regarded as brush savannas and mapped in Figure 11 under oak savannas. One couple had to "cut their way through the brush over the bluffs" in traveling to Baraboo in 1838 (Jameson n.d.), while in Honey Creek Township there were places where the grapevines impeded progress (Ragatz 1922). Lapham (1850) had considerable difficulty in surveying Indian mounds in Sauk County because of dense underbrush covering them. In the area of present-day North Freedom in the 1850s and 1860s, oak brush and such shrubs as hazel grew on "most of the land . . . worth clearing" (Toole 1918), and in timbered areas in the western end of the Baraboo Valley in 1859, the pioneers were "obliged to wear buckskin or other very strong material for pants," since there was such a "formidable undergrowth of plum, apple [wild crabapple], prickly ash, briars and vines" (*Baraboo Republic* 26 May 1859). In the Western Upland, north of the Baraboo Range (specifically Township 13 North, Range 4 East, Section 14), the country was "covered with heavy brush" (Kelley 1938). Blueberries and huckleberries apparently were more widespread years ago (*Baraboo Republic* 5 August

FIGURE 14. *"Prairie schooners touch at this point now and then," reported the* Sauk County News, *24 August 1878, in reference to the Sauk Prairie, which might have looked like this in those years. A diorama of a deep soil Iowa prairie, the Milwaukee Public Museum.*

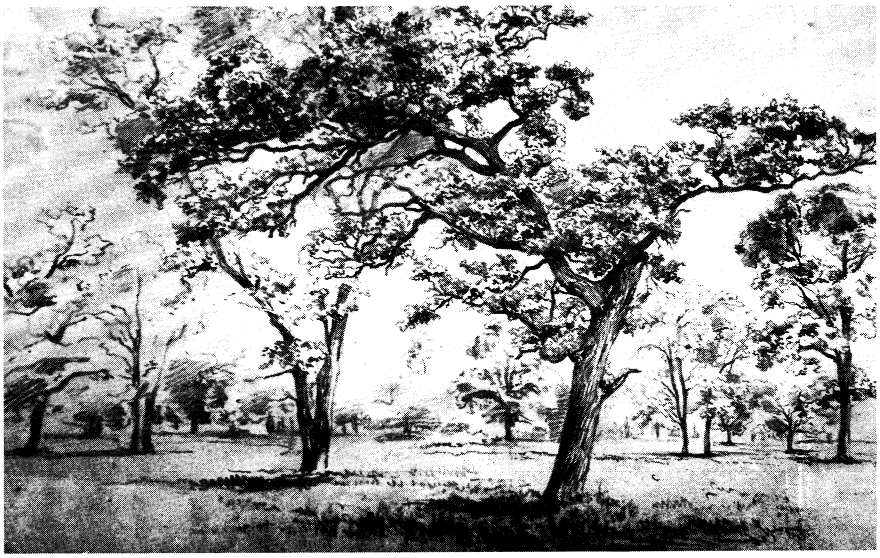


FIGURE 15. *Bur oak opening in Dane County, Wisconsin, as depicted in an 1852 pencil drawing by Adolph Hoeffler. From the collections of the State Historical Society of Wisconsin.*

FIGURE 16. *Meyers Oak Grove, a remnant bur oak opening in Sauk City, 1986.*

1903, *Reedsburg Free Press* 30 June 1887). Before the settlement of Bear Creek Township in southwestern Sauk County, the land cover was mainly brush and scattered trees of large size (Dederich 1948).

Oak Forests and Jack Pine Woods

The most common wooded community in early settlement time was oak forest of varying composition. Mainly it occurred over most of the Western Uplands and the western half of the Baraboo Range. With increasingly xeric conditions, there was sometimes a transition to oak and jack pine cover and finally to jack pine woods and barrens (Fig. 17). This latter cover type developed on dry sands of the Central Plain and in the northwestern corner of the Baraboo Range and on Wisconsin River sand terraces in the southwestern corner of the study area. Jack pine is more drought resistant than any species of oak and an aggressive pioneer after fire (Ahlgren and Ahlgren 1983, Bourdo 1983).

Another xeric forest community, a forest of stunted shagbark hickory and white ash, occurs today in a few places, notably on top of the south end of the east bluff at Devil's Lake (Devil's Lake pygmy forest) (Fig. 18). This pygmy forest originated in 1904-05, according to cross sections of trees that were cut for trail work; the plant cover before its establishment is not known but may have been dry prairie. This community may also have been present in the period prior to white settlement. The pygmy forest is confined to a west-facing slope, essentially the 20° slope of the rock in the southern half of the Baraboo Range. The soil here appears to be merely a veneer over the impervious quartzite; downslope drainage over this thin soil produces a net loss of moisture, which restricts growth. Microclimatic factors such as hot and dry thermals and/or cold-air drainage might also be involved in creating the environmental conditions suitable for this community, and a likely firebreak in the form of an ancient ravine is located a short distance to the north. Reich and Hinckley (1980) studied a similar ecosystem in Missouri and suggested that very low levels of some soil nutrients, especially calcium and magnesium, plus very high levels of other nutrients may be producing deficient and/or toxic conditions for normal tree development.

FIGURE 17. *Jack pine — oak woods in the northwestern corner of the Baraboo Range, 1978. Photo courtesy of Michael J. Mossman.*

FIGURE 18. *Devil's Lake pygmy forest composed of shagbark hickory and white ash, 1974.*

White Pine Stands

Three major stands of white pine, totalling approximately 110 acres, were delineated in the western part of the Baraboo Range by Canfield on his 1859 map. These stands were not recorded on the original land surveys. Pines also grew among exposed talus slopes and cliffs such as at Devil's Lake and may have been more abundant on rocky slopes throughout the southern limb of the quartzite formation, as suggested by the comment that at one time the North Freedom area had "Pine, Oaks and Hickory predominating up in the hills" (Griep n.d.). There were also extensive white pine stands in the Western Upland along the Baraboo River and its branches. One was located along Big Creek in eastern La Valle Township, where Lake Redstone is today, and another was found northwest of present-day La Valle, extending into Plum Valley (Canfield 1859). Canfield estimated that 12 miles of pine timber grew along the Baraboo and its tributaries (*Baraboo Republic* 2 June 1859). The natural lifetime of a white pine forest is 250-300 years, so if fire occurred at these intervals, pine was regenerated via seed from adjacent unburned stands (Ahlgren and Ahlgren 1983). Red pine, though present, was relatively insignificant in the study area.

Sugar Maple — Basswood Forests

A sugar maple — basswood forest indicates a long history of fire exclusion, a favorable moisture regime, and usually a loamy soil (Harper 1963). In early settlement time this community occurred on diverse sites in the Baraboo Range: the terminal moraine and glacial lake sediment between Devil's Lake and the Baraboo River, Paleozoic sandstone and dolomite, and Precambrian quartzite, e.g., north-facing slopes throughout the quartzite formation and the extensive upland in its western half (Fig. 19). The glacier left a mantle of porous till over the eastern half of the range, whereas the unglaciated western half was relatively unaltered during this period, with impermeable quartzite remaining at or near the surface. Fire must have swept periodically over the range, but apparently was checked in the western section, for the most part by the steep, rocky substrate and/or the relatively cool and poorly drained soils that formed here without a till cover (Mossman and Lange 1982:15). Outside the range, sugar maple — basswood forest occurred only in certain sites in the Western Upland, namely the heads of ravines such as those on the west side of Marble Ridge, located in Bear Creek Township, and steeper, north-facing slopes, especially in the narrower valleys.

FIGURE 19. *Sugar maple — basswood forest in the extensive upland of the western part of the Baraboo Range, 1974.*

FIGURE 20. *Hemlocks in Honey Creek Valley in the southwestern corner of the Baraboo Range, 1974. Notice the outcrop of Cambrian sandstone.*

Sugar Maple — Yellow Birch — Hemlock Forests

The more northerly forest type dominated by sugar maple and yellow birch, often with hemlock, was of limited occurrence in the study area. It was found in the Western Upland on Cambrian outcrops along the Baraboo River and some of its tributaries and in the Baraboo Range in certain gorges and associated slopes (Fig. 20). At these sites (at least those in the Baraboo Range) the climate approaches that of more northerly regions (Kopitzke 1967, Adams and Loucks 1971).

Wetlands

Tamarack swamps (Fig. 21) were found in the Baraboo Range (mainly in the Baraboo Valley), the Central Plain along Dell Creek and Hulburt Creek, and the Western Upland along the Baraboo River and certain tributaries. Hardwood swamps of varying composition occurred along the Wisconsin River (Fig. 22), the Baraboo River, and other drainages. Shrub swamps were widespread and typified by alder thickets and willow brush.

An especially large and varied wetland complex occurred on glacial lake sediment in the western part of the Baraboo Valley; it included a tamarack swamp of approximately 1,000 acres, extensive hardwood swamps, alder and willow thickets, and a cranberry marsh of several acres (Mossman and Lange 1982:15). The Baraboo Range and the Baraboo River evidently protected this wetland complex from fire in early settlement time.

The cranberry marsh in the Baraboo Valley was the only one definitely known for the Baraboo Range. Another was located in the Western Upland in La Valle Township (Canfield 1859) and several occurred in the Central Plain. Winkler (1985:155-96) demonstrated that Washburn Bog in the Central Plain (see Fig. 7) formed in response to climatic change some 3,000 years ago and hence is not a glacial relict. The origins of the other bogs (cranberry marshes) of the study area are unknown.

Sedge meadows (see Fig. 6), bluejoint meadows, cattail marshes, and wet prairies were widespread, particularly along the drainages.

FIGURE 21. *Tamarack swamp along Dell Creek in the Central Plain, 1986. The shrubs are tag alder.*

FIGURE 22. *Silver maple — American elm swamp along the Wisconsin River in the Central Plain, late summer aspect, 1986.*

Postsettlement Vegetation

The changes in land cover in historic time are shown for Sauk County in Table 3 and for the Baraboo Range in Table 4. It is difficult to fully comprehend the vast changes in the native landscape that occurred during the last 150 years. In a relatively short time, white settlers changed the land the Indians knew into a different world. Except for forests, the natural communities of the study area have either decreased in land cover percentage or disappeared. Oak savannas (Nuzzo 1986) and prairies, especially, have suffered. For the most part, we are left only with haunting word descriptions of vanished landscapes.

It should be stressed that remnants of native vegetation remaining today are not necessarily typical of the time prior to white settlement. They often occur on sites that were judged undesirable for agriculture because of steep topography, thin and rocky soil, or poor drainage (Whitford 1983), and they have been subjected to different disturbances than those present in presettlement time. Oak forest is a good example (Cottam 1984, McCune and Cottam 1985). Although it occupies the same percentage of land cover today as it did in early settlement years, the composition of this community has changed.

People continue to fragment natural communities into ever smaller units; this island effect (MacArthur and Wilson 1967) is becoming a highly significant feature of the modern landscape.

Woods and Forests

A primary task of the white settlers in forested areas was to cut the trees, which numbered several hundred per acre. The men selected the logs suitable for buildings and fences, saved some wood for fuel, and if a sawmill was nearby, perhaps took some there. But most of the cut trees were piled into heaps and burned in huge conflagrations. Logging bees, they were called, and they were "jolly times." While the accumulated growth of many years went up in smoke, the loggers and neighbors sat down to a feast and often had a dance afterwards (Lange 1976:66). The stumps were removed

TABLE 3. *Postsettlement changes in Sauk County land cover.*

	1840-45*		1938**		1968[a]		1983[b]	
Plant Community	**Acres**	**%**	**Acres**	**%**	**Acres**	**%**	**Acres**	**%**
Woods and forests	183,000	34	183,000	34	172,000	32	199,000	37
Prairies	32,000	6	—	—	—	—	—	—
Oak savannas	215,000	40	—	—	—	—	—	—
Wetlands	107,000	20	27,000	5	11,000	2	5,000	1
Agricultural land	—	—	327,000	61	306,000	57	285,000	53
Urban and industrial land	—	—	—	—	48,000	9	48,000	9
Total	537,000	100	537,000	100	537,000	100	537,000	100

*From the original land surveys.
**Wisconsin Department of Agriculture 1928-1941, 1956.
[a]Wisconsin Department of Natural Resources n.d.
[b]Raile 1985.

TABLE 4. *Postsettlement changes in Baraboo Range land cover, from the original land surveys and present-day estimates.**

	Original Land Surveys		Present-day Estimates	
Plant Community	**Acres**	**%**	**Acres**	**%**
Woods and forests				
Oak forests	49,000	38	43,000	33
Jack pine woods	1,000	1	1,000	1
White pine stands, including red pine stands	1,000	1	1,000	1
Sugar maple forests	17,000	13	10,500	8
Mesic and dry prairies	1,000	1	—	—
Oak savannas	45,000	35	—	—
Wetlands				
Tamarack swamps	1,000	1	—	—
Hardwood swamps and shrub swamps	6,500	5	1,000	1
Marshes, sedge meadows, and wet prairies	6,500	5	1,000	1
Agricultural land	—	—	64,000	50
Urban and industrial land	—	—	6,500	5
Total	128,000	100	128,000	100

*Estimated total area of the Baraboo Range = 200 miles^2.

later (Fig. 23). This clearing was done to make room for a house and to have open areas for cultivation and pasture.

The pioneer family lived at first in a shanty or dry-goods box, or camped out. A log cabin usually was regarded as transient quarters; the family moved into a log house as soon as possible or, if there was a sawmill nearby, built a frame house (Fig. 24).

The first sawmill in Baraboo was built in 1839-40, and the first raft of lumber was "run out of the river" the following winter (Canfield 1861-1901). Most of the logs handled at the sawmills were from deciduous trees, but the amount of white pine converted into lumber and shaved shingles was considerable in the early years. Local pineries supplied a million feet of pine logs to a Baraboo sawmill in 1857 (*Baraboo Republic* 21 May 1857) and another million feet in 1861 with a "large amount" from another sawmill (*Baraboo Republic* 24 July 1861). By 1867 these pineries apparently were being depleted, as in that entire year just a quarter-million feet of pine logs were taken (*Baraboo Republic* 20 March 1867).

The extensive oak and maple forests of the western half of the Baraboo Range were altered significantly by logging and the fires that often followed. Fire was mentioned specifically for this area in 1894 (*Baraboo Republic* 15 August 1894) and 1901 (*Baraboo Republic* 24 July 1901). Logging of hardwoods was especially pronounced in this area in the late 1800s; Hackett (1963:6, 24), for example, refers to the "great forests" around North Freedom being harvested during the 25 years following the coming of the railroad to that community in 1872. In the uplands, the greatest changes from logging probably were in the sugar maple — basswood forest south and east of North Freedom. The *Baraboo Republic* of 25 February 1874 reported that the Baraboo sawmills were annually consuming a million board feet of lumber, chiefly basswood and maple, from the North Freedom area.

Many cords of wood were consumed by the lime kilns scattered throughout the study area (Fig. 25). These kilns produced lime for fertilizer and as an ingredient for plaster and mortar. Eventually, lime production was abandoned due to increasing use of cement for building purposes and a decreasing fuel supply. Much cordwood was also used to produce charcoal, especially for use in smelting ore for the Ironton Iron Works near Ironton, from the 1850s into the late 1800s (Lange 1976:93) (Figs. 26, 27). Cutting cordwood was an ongoing activity (Fig.

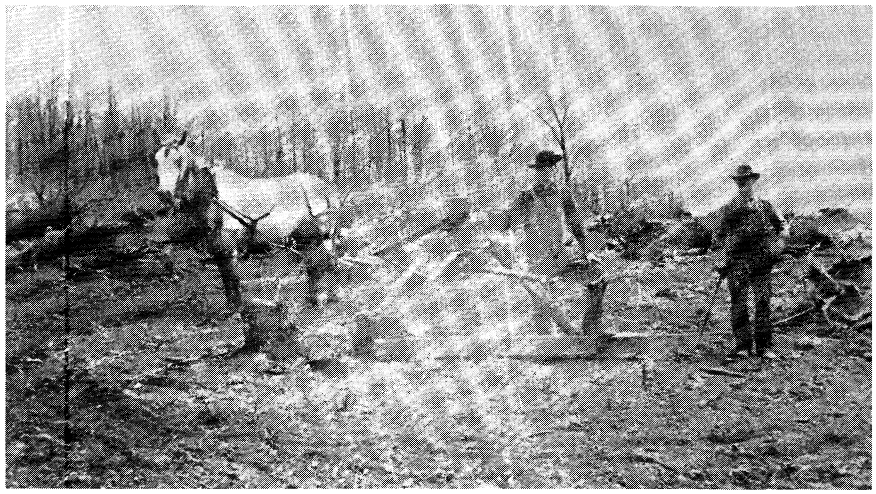


FIGURE 23. *Clearing the land of stumps with the aid of a horse near North Freedom in the Baraboo Range. From* The Story of the Town of Freedom and the Village of North Freedom, *Sauk Cty. Publ. Co., Baraboo, Wis.*

FIGURE 24. *Early dwelling near North Freedom in the Baraboo Range. From* The Story of the Town of Freedom and the Village of North Freedom, *Sauk Cty. Publ. Co., Baraboo, Wis.*

FIGURE 25. *Remains of a lime kiln in White Mound County Park in the Western Upland, 1974.*

28). After a winter in North Freedom, for example, there might be 5,000 cords of hardwood piled 8 ft high on the railroad property; during the summer the wood was shipped to cities for fuel (Griep n.d.). An average family used 8-10 cords a year (Doll 1985).

Certain specialized uses of wood from those years now are obsolete, e.g., butts for woolen mill looms from hickory (species not indicated), barrel hoops from bitternut hickory, barrel stave bolts from basswood, beer keg stave bolts from white oak, and poles for hop vines from poplar, oak, and especially tamarack (Griep n.d., *Baraboo Republic* 13 February 1867, *Reedsburg Free Press* 20 November 1879, True 1918, *Baraboo Daily News* 5 February 1920). Winfield Township in the Western Upland was cut heavily for railroad ties in 1919 (*Baraboo Weekly News* 27 March 1919), so that much of the forest cover in this township today is still relatively young.

Logging is an ongoing industry in the study area (Fig. 29). The erosion from logging and construction, along with such earth-moving activities as quarrying, continue to affect the land cover.

Despite this intensive removal of trees due to logging and land clearing for agriculture, the percentage of forest land cover in the study area has stayed about the same or increased slightly from early settlement to present day. The removal of trees has been offset by the conversion of oak and brush savanna to oak forest and the more recent reclamation of abandoned farmland by forest trees (Fig. 30). However, the nature of the forest community has changed dramatically. The typical early settlement oak forest appears to have been dominated by white oaks and perhaps black oaks, with red oak, red maple, and black cherry being relatively scarce; today these latter species characterize the oak forest.

The increase in red oak in postsettlement time is especially striking. Relatively unimportant in the early settlement forest, it is now a major dominant. Any disturbance, e.g., fire or cutting, that opens the canopy (especially in mesic sites) greatly favors this species, apparently in part because of increased sprouting of younger trees (Kline 1976, Lorimer 1983). Frequent fire may also reduce competing plants that are less tolerant of fire (Crow 1988).

Red maple is a common understory tree in the more mesic oak forests of the study area. Both this species and black cherry have been favored by the changed environment. Fire suppression is perhaps the main factor favor-

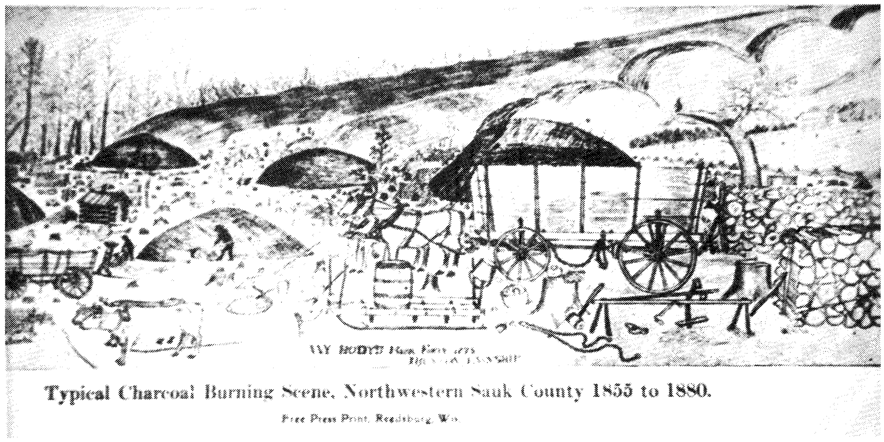


FIGURE 26. *Sketch depicting a "Typical Charcoal Burning Scene, Northwestern Sauk County 1855 to 1880." The smaller caption reads: "Any Body's Back Forty 1875 Ironton Township." From the* Reedsburg Free Press.

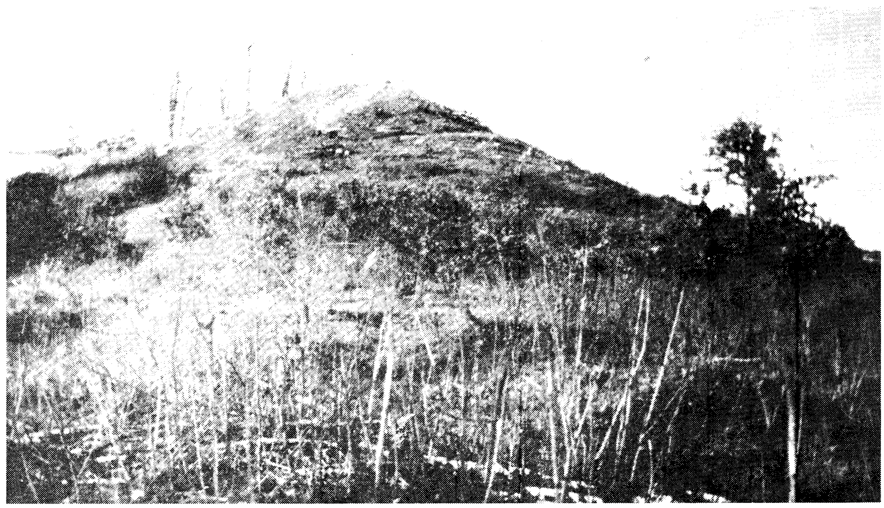


FIGURE 27. *Hill near Ironton denuded for cordwood to feed the charcoal industry. The hill is now forested. From Krug 1929.*

FIGURE 28. *Cordwood for fuel stacked in the North Freedom area of the Baraboo Range. The date is uncertain, but probably is the early 1900s. From* The Story of the Town of Freedom and the Village of North Freedom, *Sauk Cty. Publ. Co., Baraboo, Wis.*

ing these species, but grazing and selective cutting have also been important influences. Grazing in oak forests generally results in mast destruction and the establishment of species such as red maple and black cherry that have abundant seed production and low-to-moderate shade tolerance. The removal of trees, e.g., oaks, that are more valuable for firewood or structural timber, has also benefited these species (Auclair and Cottam 1971, Dodge and Harman 1985, Dodge 1987). The Red Oak Natural Area in Devil's Lake State Park is an example of a red oak forest with red maple understory (Fig. 31). Loggers operated a sawmill here for two years at the turn of the century and undoubtedly cut trees from this forest (Fig. 32).

After being extensively logged in about 1980, a 40-acre red oak forest in the Baraboo Range came up to brush followed by heavy red maple reproduction. Red maple reproduction in an adjoining, undisturbed red oak forest was minimal (Grant Cottam, Univ. of Wis., pers. comm., 1983). Paster et al. (1982), in a study of Blackhawk Island in the Wisconsin River just north of the study area, found that red maple increased as red oak decreased and suggested that in southern Wisconsin red maple is a permanent understory species, being out-competed by sugar maple on mesic sites and requiring a canopy of oak or pine to reduce heat load to its canopy on xeric sites.

Shagbark hickory is probably also more frequent in present-day oak forests of the study area because of fire exclusion. Dodge (1987) found this to be the case in his south central Michigan study site. Another tree likely to be more numerous now than in early settlement time is ironwood (*Ostrya*), as its ecological distribution (disturbed sites and second-growth forests) suggests an aggressive species adapted to a wide range of environments (Greenidge 1984).

All stages of grazed woodlots can now be found in the study area. Grazing has been widespread in bottomlands, steep slopes, and wooded areas. In the case of woodlots, grazing indicators have been tabulated by a number of researchers, e.g., Cawley (1960) and Kline (1976:131). When cattle are initially turned into an ungrazed deciduous woodlot, the forage cover is quickly exhausted, and within a few weeks the animals are browsing on the less palatable shrubs and the foliage of younger trees. Trees up to 3 inches or so in diameter are injured not only from browsing but also from trampling. Soil compaction also is detrimental. Con-

FIGURE 29. *Logging near Devil's Lake, 1979.*

FIGURE 30. *Forest trees invading abandoned farmland in Devil's Lake State Park, 1978. The stone fence marks the boundary between former pastureland (the area with older trees on the left) and former workland (the area with younger trees on the right).*

FIGURE 31. *Red Oak Natural Area in Devil's Lake State Park, 1978.*

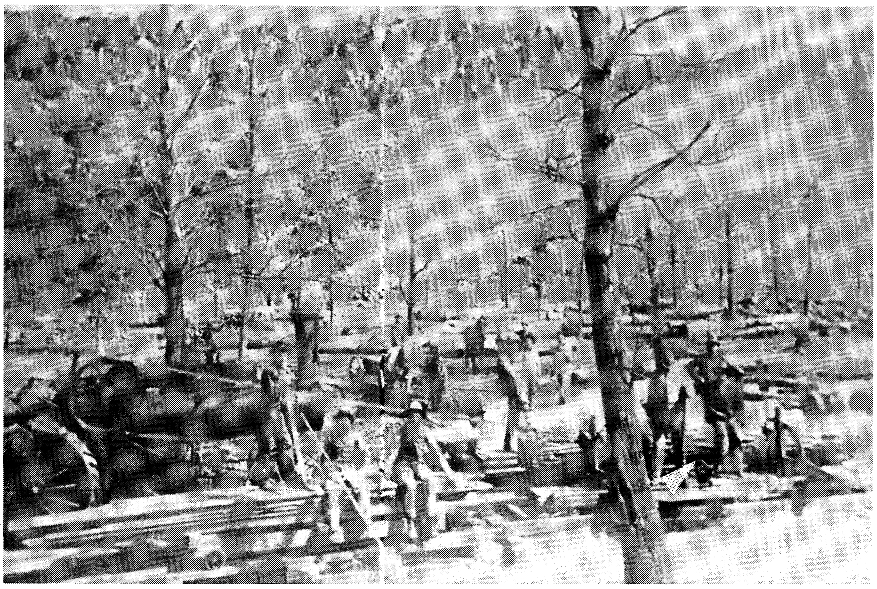


FIGURE 32. *This steam engine sawmill operated at the south shore of Devil's Lake for 2 years at the turn of the century. Photo via the Badger Steam and Gas Engine Club.*

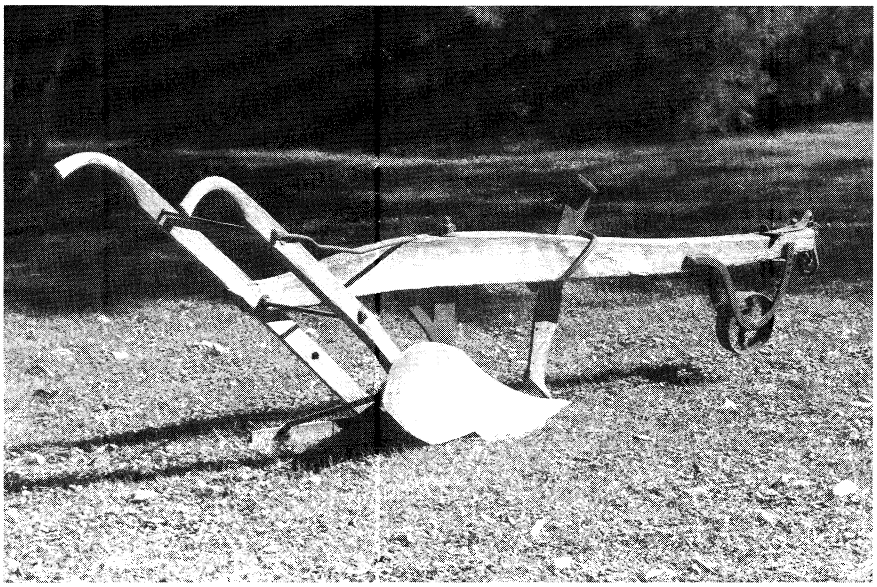


FIGURE 33. *Sodbusting plow, now owned by the Sauk-Prairie Historical Society, which was used in Sauk County.*

tinual grazing intensifies damage and eventually can lead to a relatively open community, where there is virtually no tree reproduction and where the main understory woody plants are such unpalatable species as prickly gooseberry and exotic grasses such as bluegrass (Cawley 1960).

Prairies and Savannas

Prairies and savannas were quickly converted to farmland by the new settlers. Sauk Prairie was heralded for its rich agricultural potential at an early date (Shumard 1852), and the prairie was an obvious place of entry into Sauk County. The stage coach route was nearby, and in those years the only ferry on the Wisconsin River between Portage and the Spring Green area was located at Sauk City (Lange 1976:119). And so the Sauk Prairie sod was quickly broken. A pioneer family in Honey Creek Township had 6 pair of oxen with a 30-inch plow that turned some 2 ft of sod at a time (Fig. 33). With this sod-breaking outfit, they usually took a 10-20 acre patch and plowed around it toward the center. The roots clung to the soil and

> every inch was a hard pull—often a struggle. . . [but] furrow by furrow, we triumphed over the wilderness. . . . There is a deep thrill in all such effort—it causes a leaping of the heart incomprehensible to one who has not had the experience. (Ragatz 1935)

Seymour (1885) described the work of Sauk County sodbusters as follows:

> We then to break our land, hitched two, three, or four yoke of oxen to the long, beamed, heavy breaking plow, and while one man, with his long fish pole whip, drove the oxen, another held and managed the plow, and they could break from one to three acres per day, the amount depending largely upon the condition of the land and the strength and smartness of the team. (Fig. 34)

FIGURE 34. *A sod-breaking team of oxen. Exact location unknown, but probably somewhere in the former Sauk Prairie. Photo from Robert J. France.*

In 1867 a newspaper correspondent wrote that the Sauk Prairie was "dotted with farm houses" (*Baraboo Republic* 17 July 1867). The bounty was rich—"it makes a person wish to be a farmer" (*Reedsburg Free Press* 31 August 1876). In the summer of 1884, the editor of a local newspaper rode through the Sauk Prairie and saw cornfields, rye, oats, wheat, and barley; to him this represented "food for the hungry and joy to the husbandman" (*Sauk County News* 5 July 1884).

By 1856 the landscape of prairie and savanna between Baraboo and Lake Delton (Webster's Prairie) was being promoted as one of the "better farming regions in the west" (*Wisconsin Mirror* 27 May 1867), and every quarter section had a farm "well improved" (*Wisconsin Mirror* 10 July 1867). By 1867 this area was being described as "well cultivated" (*Baraboo Republic* 7 August 1867). The Wisconsin Desert had many homesteads by 1859 (*Baraboo Republic* 24 February 1859) and many cornfields by 1882 (*Spring Green News* 19 May 1882).

By 1868, just 30 years after the sod had been broken in Sauk County, 85,000 acres, accounting for 16% of the county land cover, had been converted to agricultural use (Wis. Board of Immigr. 1869), and just 2 years later the "improved" land had increased to approximately 137,000 acres, or 26% of the county land cover (Wood 1871). By 1938 agricultural land accounted for approximately 3 out of every 5 acres in the county. Agriculture continues to be the leading business in the study area (Lange 1976:66-68).

Prairies and savannas not converted to farmland were invaded by woody growth. Photos taken in the early 1900s in the Wisconsin Desert show the south-facing bluffs to be open, with only scattered red cedars, whereas in recent years red cedars have become numerous on these bluffs and the adjacent terraces (Figs. 35, 36). The invasion by this tree is probably due to its tolerance for xeric conditions, widespread seed dispersal by birds, and fire exclusion, since red cedar is fire sensitive (Holthuijzen and Sharik 1984). Black locusts have also proliferated in recent years in the study area, especially in prairies (e.g., the vicinity of Spring Green), presumably from plantings for erosion control. Black locust is most characteristic of roadsides and abandoned pastures. Sprouting from stumps and roots is its usual means of regeneration (Boring and Swank 1984).

Leykauf's Bluff, near the Wisconsin River about halfway between Sauk City and Spring Green, was the site of the first Fourth of July observance by local citizens in 1850, when it was bare of trees (Babington 1950:105); now it is covered with red cedars and hardwoods (Fig. 37). Comparative photos of other prairies also show increasing woody cover (Figs. 38-40).

Other than the Wisconsin Desert and a few sand prairies, virtually the only prairies remaining today are those scattered on steep slopes—"hill prairies" (Figs. 41, 42). The Sauk Prairie has been reduced to only about 25 acres of sand prairie, preserved by The Nature Conservancy, and this is land that is recovering from plowing. A small mesic prairie in Cady's Marsh along the Baraboo River southeast of Reedsburg is exceptional (Fig. 43).

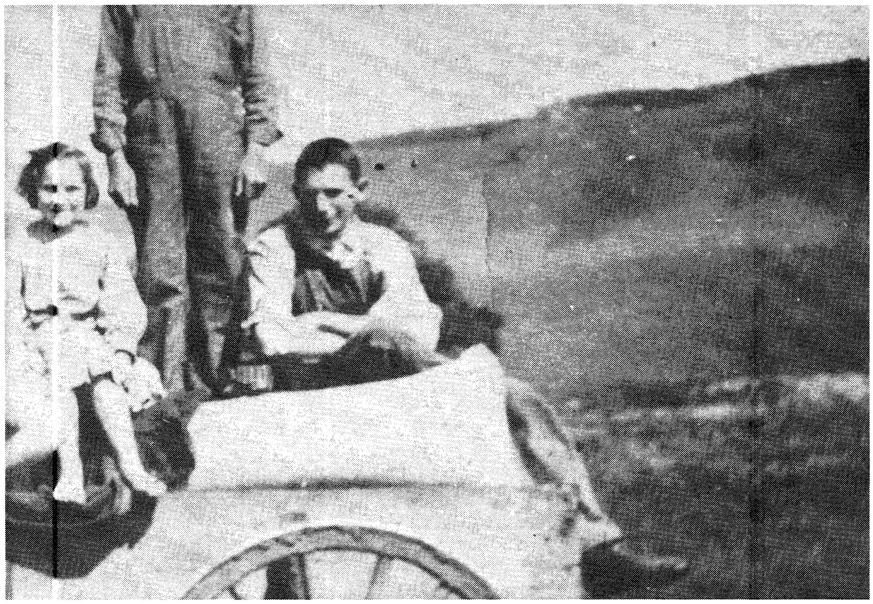
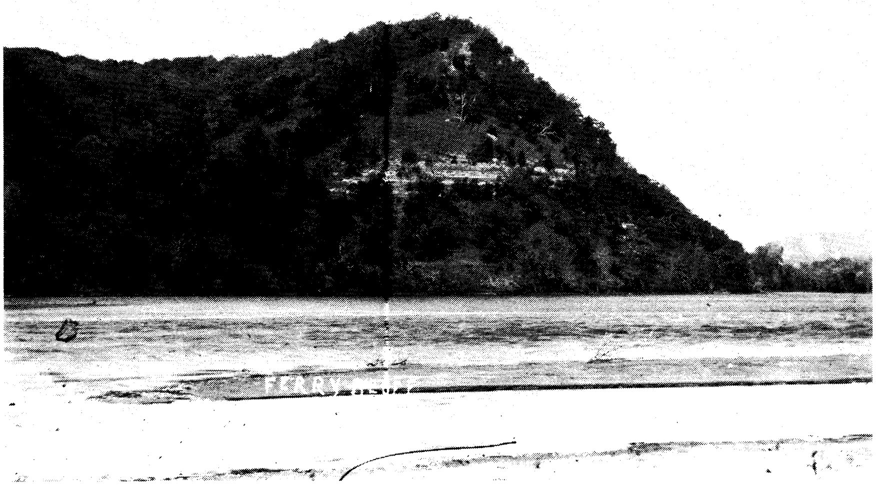


FIGURE 35. *The dolomite bluffs in the Wisconsin Desert were virtually bare of trees when this picture was taken in 1908. Photo from Gerald McKune. Compare with Figures 13 and 36.*

FIGURE 36. *Dolomite bluffs in the Wisconsin Desert as they appeared in 1971.*

FIGURE 37. *Leykauf's Bluff near the Wisconsin River, between Sauk City and Spring Green (T9N, R5E, Section 34) in 1972.*

FIGURE 38. *Ferry Bluff in (a) the early 1900s and (b) 1980. This Wisconsin River landmark is located at the mouth of Honey Creek approximately 5 miles downriver from Sauk City. The early 1900s photo from Ralph Marquardt.*



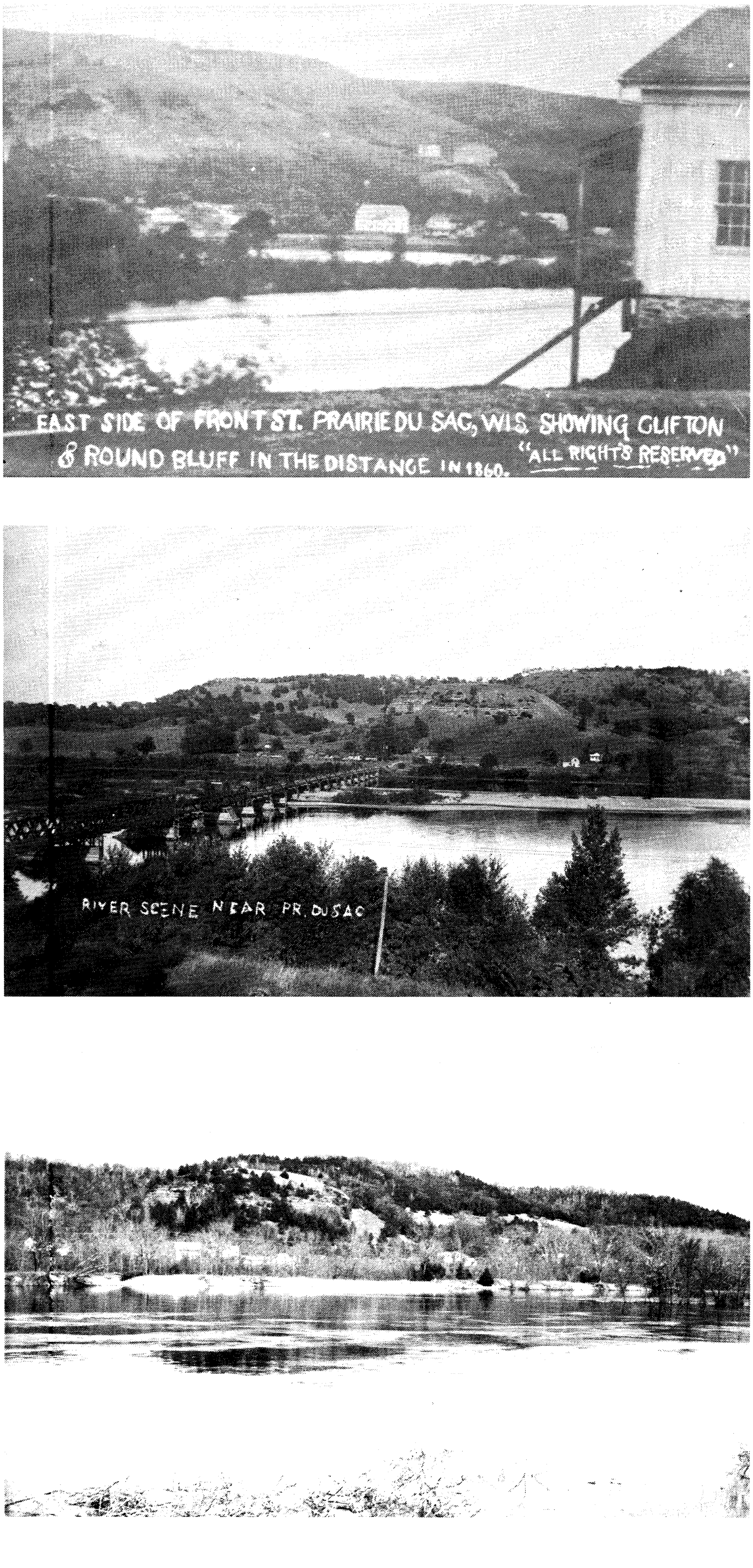
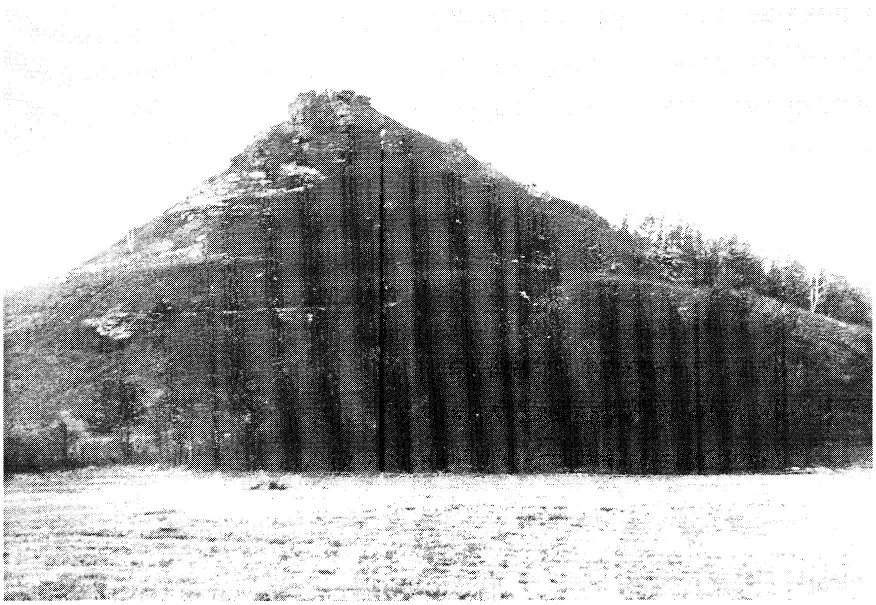


FIGURE 39. *Round Bluff or Sugar Loaf in (a) 1860, (b) early 1900s, and (c) 1974. The bluff is located in extreme northwestern Dane County, across the Wisconsin River from Prairie du Sac. Photos (a) and (b) from Ralph Marquardt.*



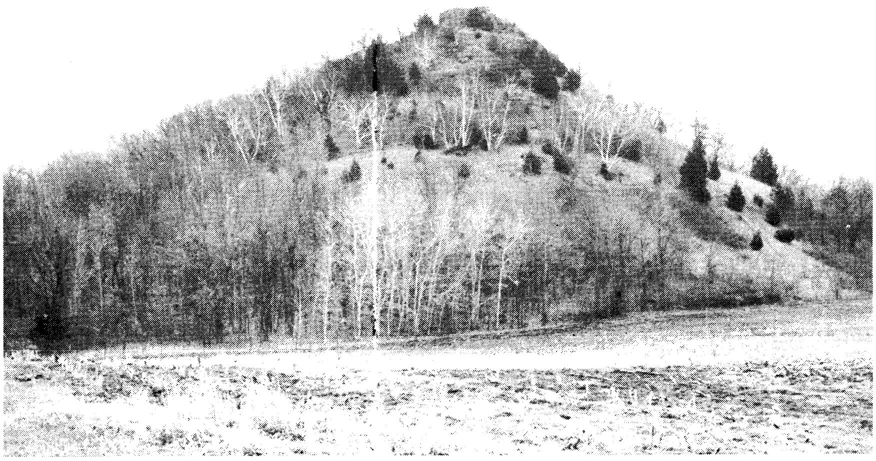


FIGURE 40. *Blackhawk Ridge in (a) 1896 and (b) 1972. Blackhawk Ridge is located in extreme southwestern Columbia County across the Wisconsin River from Prairie du Sac. The 1896 photo from the collections of the State Historical Society of Wisconsin.*

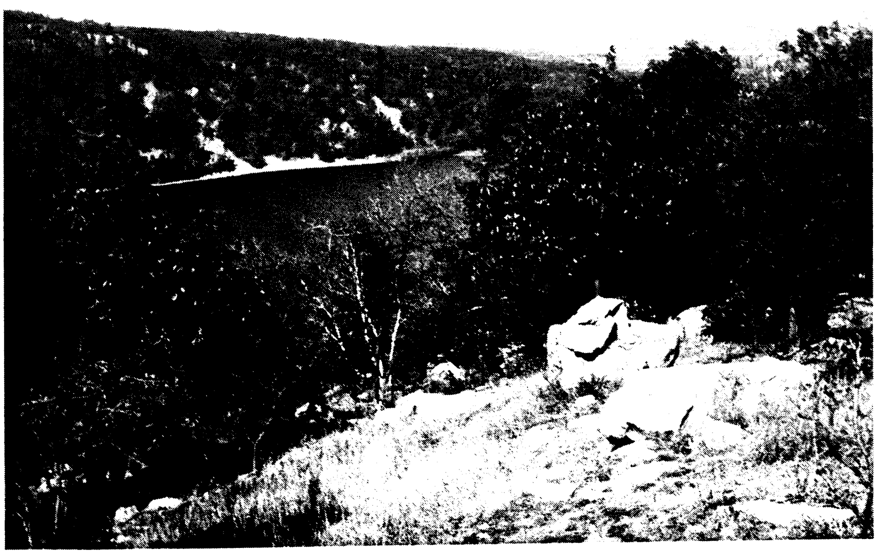


FIGURE 41. *This dry prairie on quartzite (foreground) adjoins the pygmy forest (see Figure 18) on top of the south end of the east bluff, Devil's Lake State Park, 1986.*

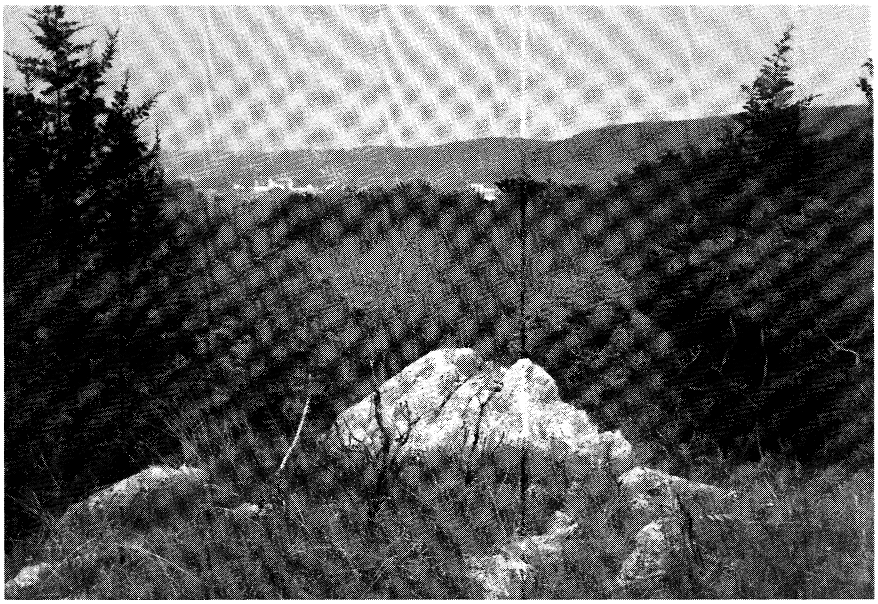


FIGURE 42. *This dry prairie on rhyolite (foreground) is located in the north limb of the Baraboo Range, 1986.*

FIGURE 43. *Cady's Marsh, seen here to the right of a fence and a cornfield, 1978.*

Wetlands

The settlers typically wanted open land nearly ready for the breaking plow, a woods for timber and fuel, and a meadow for pasture and hay (Lange 1976:27). Wetlands were an early source of wild hay. Although alfalfa was being advertised by 1881 (*Reedsburg Free Press* 20 January 1881), it was not grown in Sauk County until the early 1900s and was not widespread in Sauk County until 1924 (*Sauk County News* 26 June 1924). It was first grown in the Lime Ridge area in the Western Upland (*Reedsburg Free Press* 21 April 1910). The acreage of corn was insignificant, and farmers did not cut the stalks for winter feed. Although wheat and oat straw were saved, only the oat straw had much food value. The first white settlers on the prairies could cut the native grass, but most farmers had no wild grass. Thus there was a big demand for marshland where wild hay could be obtained (Babington 1950:43-44).

Long processions of oxteams pulling sleds with hayracks could be seen during the late 1800s on winter mornings in Fairfield Township, heading toward the big marsh for the hay that had been cut and stacked there (Jackson 1918:556). Along the Wisconsin River in Fairfield and Caledonia townships, a number of farmers cut marsh hay for stock and also for the elephants of the Ringling Circus, which was quartered during winter in Baraboo from 1884 through 1918 (Ray Turner, Fairfield Township farmer, pers. comm., 1975). An acre of sedge marsh yielded 2.0-2.5 tons of hay (*Baraboo Republic* 18 November 1858). Some marshes were converted to reed canary grass (Fig. 44). Farmers liked this new grass because it could be mowed or pastured into late summer; by 1936 it was being grown on hundreds of Wisconsin farms (*Wisconsin Dells Events* 20 June 1935, 3 September 1936).

The introduction of reed canary grass into a wetland was more damaging than mowing the wild hay, since this species is especially aggressive and typically proliferates and chokes out native cover (Apfelbaum and Sams 1987). Mowing on a regular basis prevented the succession of shrubs (White 1962, 1965; Stevens 1985) but otherwise had relatively minor impact. Draining, of course, was a different matter.

Marshes and meadows in the study area were grazed and/or drained, while swamps provided timber before being converted into agricultural fields with the assistance of drainage ditches. Virtually all the study area can be reached by a stream affording an outlet for drainage waters. "Reclaiming" lowlands was pursued avidly, especially in the early 1900s, and drainage canals, or "miniature Panamas" (as a local newspaper editor called them), were dug in many places. The wetlands of the Baraboo Valley especially suffered (Mossman and Lange 1982:73-74). One simply has no way of comprehending all the changes. For example, there was once a pond in Baraboo (possibly of glacial origin) that was filled with dirt in the 1890s to become part of a city addition (*Baraboo Republic* 5 October 1898).

Wetlands today comprise approximately 1 of every 100 acres in Sauk County—a drastic reduction from the estimated 1 of 5 acres in early settlement time. The only significant wetlands remaining today are those in the Dell Creek Public Hunting and Fishing Grounds, and along the Wisconsin River. With the draining of recent years and the near absence of mowing and burning, alder and different species of willow are converting some of these wetlands into shrub carrs.

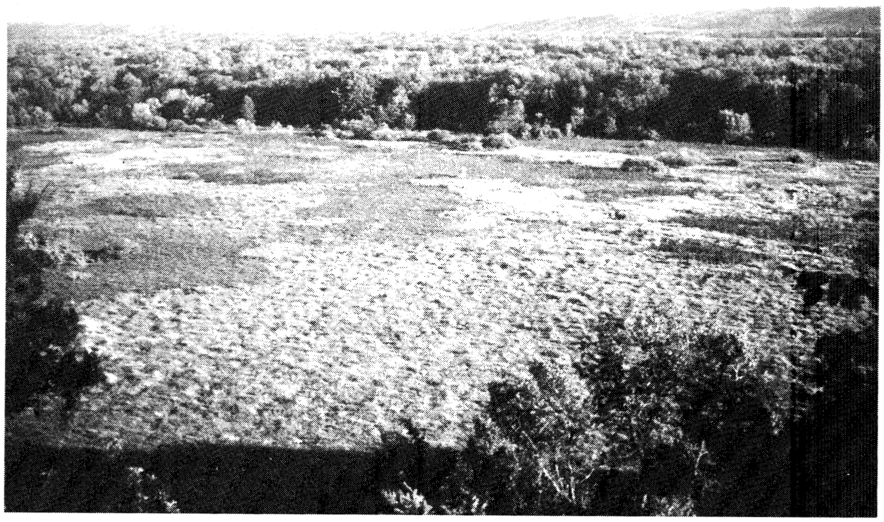


FIGURE 44. *Marsh along the Wisconsin River between Sauk City and Spring Green, 1973. Most of the cover (the lighter color) is reed canary grass, which was introduced by white settlers for domestic stock feed.*

Agricultural Land and Urban and Industrial Land

Wheat was the major crop and the main source of income in the study area during the 1840s and 1850s. In fact, wheat became vital to the local and state economy and influenced population growth and the direction of settlement. But any monoculture invites trouble, and with wheat it took the form of the chinch bug (*Blissus leucopterus*). Local farmers were ready for a new crop by the 1860s; that new crop was hops. Old-timers even today relate stories that they heard about raising hops, for this was a crop that fired dreams of an easy life. But the hop industry collapsed very quickly, and farmers came to realize they had to diversify. The result was a more broadly based agriculture in the form of dairying and the livestock industry, cheese factories and creameries, and a variety of grain crops (Lange 1976: 67-68).

By 1938, approximately 3 out of 5 acres in Sauk County were agricultural land, with urban and industrial land use unrecorded. The major agricultural change since the end of the Second World War has been a shift from small, diversified farms to large, specialized operations (Whitford 1983:168-69). In the period 1975-87, Sauk County farms decreased in number and increased in average size by 9-10% (Wis. Agric. Stat. Serv. 1988, Wis. Stat. Rep. Serv. 1976). Since the Second World War, urban (Fig. 45) and industrial land has increased and now occupies approximately 1 of every 10 acres of Sauk County.

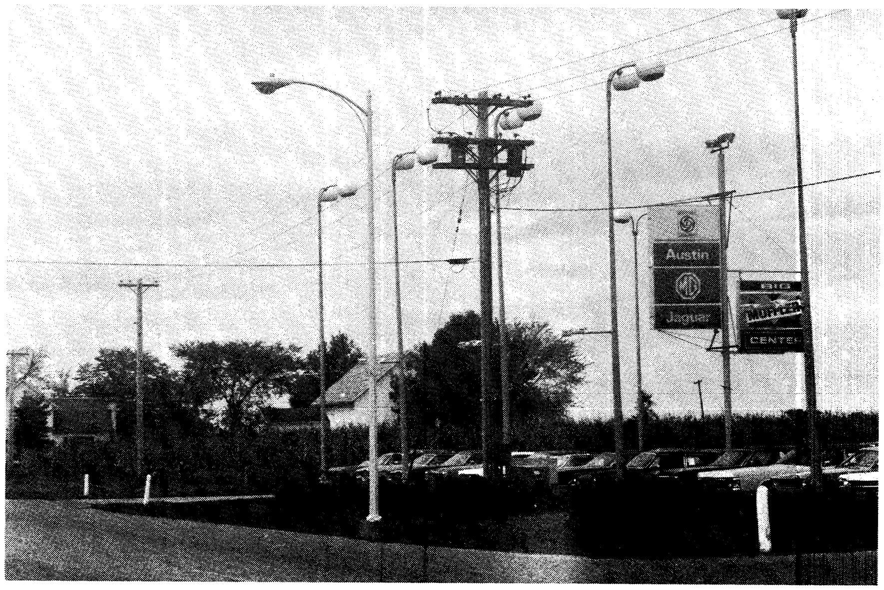


FIGURE 45. *Spreading urbanization, as illustrated by Sauk City extending into the country, 1974.*

Impact of Fire

Much of the landscape of the 1840s resulted from fire. In the absence of fire, open plant communities generally evolve into closed communities. For example, sedge meadows convert into shrub carrs, and oak and brush savannas into oak forest. The presence of open-grown savanna trees surrounded by smaller, forest-grown trees in many local forests attests to the impact of fire (Fig. 46) (Whitford 1983). Fire generally causes heavy mortality of forest trees but only minimal damage to savanna trees; the reduced amount of fuel in a savanna seems to be a significant factor (Anderson and Brown 1983).

For a number of years after white settlement, many brushy areas had dead stubs in varying stages of decay among the growing shoots, and the roots of these stubs were capped with broad, callous "stools" (Toole 1918). The drivers of a plow could tell when they were approaching a stool or "shell" by the thick clump of brush around it (Kelley 1938). Such places obviously had been burned repeatedly. Brush savanna usually was dominated by trees such as black oak, white oak, and shagbark hickory, capable of producing post-fire sprouts from both stools and stumps (Bray 1955:111-18).

Fire originated from both natural causes (e.g., lightning strikes and spontaneous combustion) and artificial causes (e.g., fires set by Native Americans). Native Americans started fires in the fall, when tens of thousands of acres might be ablaze (Foot 1836). The Native Americans inhabiting the study area when white settlers began to arrive—the Winnebago—burned for a variety of reasons: to provide grazing for native herbivores, to clear the land for hunting, to drive game, and to provide for renewed growth of blueberries and huckleberries (Dorney 1981, Lange 1976:24). In November 1835 the country at the eastern edge of the study area near present-day Portage was burning from Native American fires for 40 miles around Fort Winnebago (Foot 1836). These fires could be awesome:

> Previous to the settlement of Wisconsin by the whites, and for some years thereafter, the fires annually swept through the prairies and openings. The grass was thick and upon the wet prairies especially, was tall and rank. Among the grandest sights which shall be witnessed . . . were these autumnal fires, upon a dry windy night; marching grandly through the tall grass, roaring and crackling, as they swept onward with the speed of a race horse, the heavens being all aglow with the light, so that a person could see to read the finest print a mile away. (Dwinnell 1874)

In recent years there has been a re-evaluation of the impact on vegetation of Native American-set fires, with some authors (Forman and Russell 1983, Russell 1983) contending that regular and widespread burning by Native Americans in North America was unlikely. However, these researchers based their conclusion solely on written historical accounts. An integrated approach, utilizing evidence from a variety of sources (the distribution of fire-adapted communities, data from fire scars, pollen and soil analyses, and archeological and anthropological findings), indicates that Native American fire use was widespread and had a major impact on vegetation (Myers and Peroni 1983).

Fires were started by early white settlers for much the same reasons as for Native Americans, but for white settlers the major concern was land clearing (Palmer 1908, Toole 1918, Kelley 1938, Dederich 1948). An early white settler, viewing the Wisconsin River bottoms in the vicinity of present-day Mazomanie in October 1847, commented:

> Oh I would give a good deal for you to see what I have seen today. You must live to be old before you would forget half of it. Trees 50 feet in the trunk, and 100 feet to the top, burnt and falling in all directions, with a crash that makes the earth tremble, and sometimes into the river that makes the water boil again, while the deer and other animals plunge headlong into the water as their only protection. Still it is necessary to burn, or else the country would be one mass of forest, and does no harm when people are prepared for it. . . . The grass on the marsh, and the brush in the forest being so thick, it was quite impossible to get across . . . but now good travelling . . . since the fire. . . . We want frost and snow now to make it passable for oxen. (Croft 1942)

Fires set deliberately sometimes got out of control and became running fires (Toole 1918), and fires were also started accidentally, as in the case of a forest fire in Delton Township in the Central Plain in 1857 (Marshall 1923:116-18).

Fires in the Baraboo Range were reported in local newspapers for 1857, 1860, 1886, 1894, 1895, 1899, 1900, and 1901. Extensive marsh and swamp fires were reported in the Baraboo Valley, in its eastern end in 1864 (*Baraboo Republic* 7 December 1864) and in its western end in 1891 (*Baraboo Republic* 1 October and 8 October 1891). After 1901, significant fires in the Baraboo Range were reported for 1913, 1915, 1918, 1927, 1928, and 1976. For the Baxter's Hollow area, the largest stretch of unbroken forest in the range, fires after 1901 were reported for 1930 (approximately 100 acres) (*Baraboo Weekly News* 13 November 1930), 1931 (30 acres in Section 30, Baraboo Township) (*Sauk City Pioneer Press* 7 May 1931), and 1934 (800-900 acres) (*Baraboo Weekly News* 10 May and 17 May 1934). At least 6 of these 19 years were drought years in Wisconsin (Mitchell 1979).

FIGURE 46. *Ancient white oak surrounded by younger trees, an example of oak savanna converting to oak forest in Bear Creek Township. This white oak had a circumference of approximately 8.5 ft and a diameter at breast height of 33 inches when this picture was taken in 1971.*

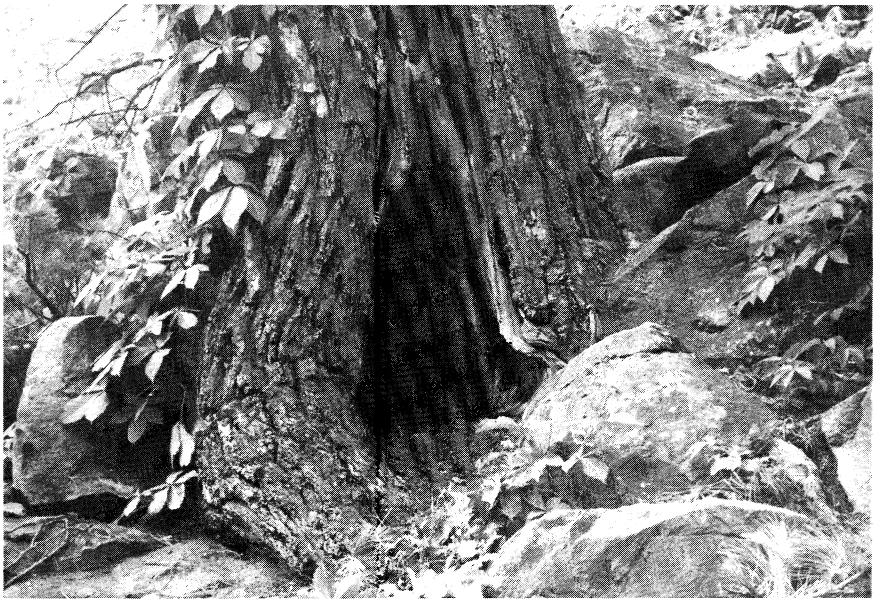


FIGURE 47. *Fire scar on white pine, Devil's Lake State Park, 1976.*

FIGURE 48. *Remains of a charred white pine stump from a 1928 fire, south end of the west bluff, Devil's Lake State Park, 1974.*

Major fires in the Western Upland were reported in local newspapers for 1860, 1873, 1874, and 1895. Certain areas, e.g., Cady's Marsh southeast of Reedsburg, burned repeatedly; fires occurred there in 1872, 1874, 1934, and 1957.

Fire was widespread and prevalent through 1901; it then became much less frequent, especially after 1934. Since 1934 there have been only a few fires of 40 acres or more in the study area: a 40-acre woods fire in the Western Upland near the Juneau County line in 1946 (*Reedsburg Times-Press* 25 April 1946) and an 80-acre woodland and sand prairie fire in the northwestern corner of the Baraboo Range in 1976 (*Baraboo News-Republic* 5 May 1976). Fire control is a major feature of the historical environment (Liegel 1988).

Many old white pines bear fire scars (Fig. 47). In a few places, e.g., the west bluff at Devil's Lake, one can still find evidence of a known burn (Fig. 48).

Impact of Other Disturbances

The study area has been subjected to natural disturbances other than fire. Catastrophic windthrow, although relatively uncommon in the forests of southern Wisconsin (Canham and Loucks 1984), does occur. The original land surveyors reported 3 windfalls: one of approximately 1,500 acres and another of 40 acres in the Western Upland and one of 200 acres in the Baraboo Range. Burley and Waite (1965) tabulated Wisconsin tornadoes by county through 1964; for the study area they found references to tornadoes for 1857, 1882, 1883, 1884, 1915, 1918, 1919, 1926, 1933, 1946, 1959, 1960, and 1963. Unfortunately, their compilation is incomplete; for example, a violent wind storm struck the Western Upland townships of La Valle, Winfield, and Reedsburg in July 1907, tearing and twisting trees and destroying buildings (*Reedsburg Free Press* 4 July 1907, *Reedsburg Times* 12 July 1907). In more recent years, 4 strong wind storms have passed through the study area: one in August 1966, in the area of Hillpoint, Reedsburg, and Rock Springs; one in June 1969, in the Devil's Lake area, which toppled trees like matchsticks over a 40-50 acre area on the south bluff, then touched down again and twisted and toppled trees along the south shore road; one in May 1988, which uprooted and cracked trees in a number of places, notably the north end of the east bluff in Devil's Lake State Park; and one in June 1989, in the Devil's Lake-Baraboo area, Lake Delton, Loganville, and Hillpoint.

Thunder and lightning storms could also be regarded as agents of disturbance and change. A storm in the summer of 1881, the "most terrific in the memory of the oldest inhabitant," left numerous signs of its violence, such as split and shattered white pines in many places in the Baraboo Range (*Baraboo Republic* 7 September 1881).

Ice storms in Wisconsin are more characteristic of the southern part of the state than the northern. There were major ice storms in the study area in February 1922, March 1976, and February 1986; undoubtedly they have occurred throughout the Holocene.

The 1976 ice storm extended over southern Wisconsin and northern Illinois and across Lake Michigan into lower Michigan. At Devil's Lake it coated tree limbs with up to 1.5 inches of ice, causing the limbs, and often the trunk, to snap off. Shagbark hickories up to one foot in diameter at breast height cracked or snapped from the weight of an estimated ton or more of ice. Large numbers of conifers, elms, paper birch, and soft maples also were bent and broken; least affected were white and bur oaks. Sections of the Devil's Lake bluffs and elsewhere in the Baraboo Range looked as though explosives had been detonated. Branches, white pine boughs, entire trees, and pieces of bark and wood were strewn over large areas. Bruederle and Stearns (1985) studied the damage from this ice storm in southeastern Wisconsin and found that the most susceptible species there was red elm; factors responsible for species susceptibility included growth form, mechanical properties of wood, tree age and degree of decay, and canopy position.

In the 1986 storm, elms, popples, and white birch were especially bowed and broken (Fig. 49). There seemed to be more broken branches but fewer broken trunks than in the 1976 storm. Strong winds and thaw followed the 1976 storm, whereas below-freezing temperatures persisted for 11 days after the 1986 storm.

Diseases and insect pests of plants can also modify vegetation. Hemlock declined rapidly throughout its range approximately 5,000 years ago and did not recover its former abundance for some 2,000 years. A fungal disease has been suggested as the most likely cause for the decline (Davis 1981, 1983). Oak forest has been a major community in the study area for much of the Holocene, and oaks, as we have seen, have been evolving within their present geographic range for approximately 7,000 years. It therefore seems likely that any native diseases or insect pests of these trees were here long before the white settlers arrived. Oak wilt is caused by a fungus (*Ceratocystis fagacearum*) that kills mainly red and black oaks; up to one half of infected white and bur oaks may recover. This disease apparently originated in the upper midwest (Himelick and Fox 1961, Anderson and Anderson 1963). Oaks are also attacked by a number of defoliating insects (Solomon et al. 1980); fall and/or spring cankerworms (*Alsophila pometaria* and *Paleacrita vernata*) have been especially prevalent in the study area. Outbreaks occurred in 1876 (*Reedsburg Free Press* 15 June 1876), 1878 (*Baraboo Republic* 12 June and 17 July 1878, *Reedsburg Free Press* 4 July 1878), 1881 (*Reedsburg Free Press* 16 June 1881), 1938-39 (*Reedsburg Free Press* 17 June 1938, *Wisconsin Dells Events* 25 May 1939), 1964, 1975-76, and 1985-86. Doubtless there were others in earlier years. It is uncertain whether these outbreaks are causes or symptoms of stress, although the latter seems more likely. Still another insect infestation occurred in the study area from approximately 1975-78, when the two-lined chestnut borer (*Agrilus bilineatus*) girdled and killed thousands of red and black oaks that had been stressed by the 1975-76 drought, the 1975-76 cankerworm outbreak, and the 1976 ice storm (Fig. 50) (Hall 1978, Haack et al. 1983).

FIGURE 49. *Hardwood trees bowed and broken from the ice storm of February 1986, Devil's Lake State Park.*

FIGURE 50. *An opening in the oak woods on the south bluff, Devil's Lake State Park, 1978, caused by the death of oaks girdled by the two-lined chestnut borer in the 1975-78 infestation. The man is standing in brambles.*

Humans inadvertently introduced 2 fungal tree diseases into the study area, white pine blister rust and Dutch elm disease; both are native to the Old World. The white pine blister rust fungus (*Cronartium ribicola*) was first detected in the study area in the 1920s (Miller et al. 1959) and has since killed thousands of white pine. Devil's Lake State Park was initially worked for currant and gooseberry bushes, the alternate hosts of this fungus in 1936-37 (H. F. Williams, Wis. Dep. Agric., in a letter to the author dated 21 October 1968) and in subsequent years, most recently in 1977. At these times, the park was surveyed for the bushes, which were eradicated when found. The Dutch elm disease fungus (*Ceratocystis ulmi*) and associated European elm bark beetle (*Scolytis multistriatus*) first appeared in Illinois in 1950 and Wisconsin by 1956

(Hafstad et al. n.d.); the fungus reached Devil's Lake State Park by 1960. American elm has been decimated by this disease.

Broad climatic change, some of it possibly caused by civilization, may also have altered the vegetation of the study area in recent years. We know that a relatively warm period occurred from approximately 1850-1950, and that in the interval from 1955 to 1980 the average temperature of the United States decreased 1 F from the average temperature of the interval from the 1920s to the mid-1950s, with most of this cooling taking place in the eastern part of the country (Wahl 1968, Wahl and Lawson 1970, Diaz and Quayle 1980).

Stability vs. Instability

Climatic control of the landscape—expressed through succession to stable climax communities—undoubtedly has been operative throughout postglacial time, but instability in nature, at least in temperate climes, may be more the norm than the exception. A biotic community can be viewed as a restless, changing mosaic, rather than an ecosystem in equilibrium with its environment. Research with computer models indicates that forests in a much disturbed landscape actually may remain in a perpetual state of non-equilibrium (Shugart and West 1981). Current studies (see Cook 1981 for a popular summary) indicate that plant assemblages are largely the result of disturbances, such as glaciation or fire, that destroy some forms of life but at the same time create conditions suitable for other forms of life.

This interpretation of nature is very different from the older idea of stable climax communities with a more or less predictable and orderly mechanism of repair—succession—for restoring the permanent community after it has been altered in some way. In this newer perspective, disturbance as an ecological factor has been incorporated into the individualistic concept of plant associations of Gleason (1926, 1939), which stresses the different origins and histories of plant species and their varying tolerance of environmental factors. At the same time, it should be realized that the vegetation of Wisconsin is dominated by more or less similar groups of species recurring from place to place—certain trees over most of the state—so that we can recognize, for example, an oak-hickory forest or a sugar maple forest. The groups are not discrete; they shift in composition as the dominants vary along a soil-moisture gradient (Curtis 1959:51).

Forest trees, and presumably temperate plants in general, have evolved during periods of environmental instability. Recent research demonstrates that there were more glaciations than the 4 typically attributed to the last ice age (the Pleistocene) and that each glacial episode consisted of a relatively long glacial phase (50,000-100,000 years) and a relatively short interglacial phase (10,000-20,000 years). In other words, glaciation has been the dominant phase; the Pleistocene, which began some 2 million years ago, has been an essentially cold era interrupted by relatively brief, warm intervals.

The present warm interval, the Holocene, began 10,500 years ago and attained a temperature maximum approximately 6,000 years ago, thereby resembling a normal interglacial phase. The first 1,000-1,500 years of the Holocene were especially mutable. The glacier continued to influence climate, and with the melting of the glacier the outwash formed a new landscape of extensive floodplains and terraces. Soil development after glaciation also affected plant growth (Winkler 1985:219). The plants of the study area can be regarded as the survivors of a number of glacial-interglacial cycles, perhaps more than a dozen, and each interglacial phase could have been as complex in its history as the Holocene (Davis 1976, 1981, 1983). However, it must be stressed that direct evidence is available for only a few glaciations in Wisconsin.

It now appears that changes in the earth's orbit and atmospheric chemistry control the timing and extent of glacial episodes and, by inference, cause vegetational changes as well. Summers were warmer and winters cooler 9,000 years ago, when the earth was closest to the sun in July, and this enhanced seasonality might partially explain the existence of different plant communities in south central Wisconsin before 7,000-6,000 years ago, compared with the period after 3,500 years ago, when perihelion shifted into January (Winkler 1985:39, Monastersky 1988).

In her late-glacial and Holocene fire history of south central Wisconsin, Winkler (1985:197-209) reported 3 charcoal peaks: about 11,000-10,000 years ago, about 8,800-8,200 years ago, and about 6,500-3,500 years ago. The first fire peak might have hastened the demise of the initial tree cover—spruces—whereas the second and third peaks might have benefited the northern conifer and oak savanna ecosystems, respectively, since many of the plants of these ecosystems are fire-adapted.

But climate remains the ultimate ecological control of vegetation; the frequency and characteristics of air masses are especially significant (Bryson and Wendland 1967, Webb et al. 1983). For example, the general configuration of the ecotone between prairie and deciduous forest in the north central United States is determined largely by climate (Davis 1977), while the 5 presettlement vegetation types of the Kickapoo watershed in this same region have been attributed to gradients of climate and fire (Kline and Cottam 1979).

Climatic change was the ultimate cause of the postglacial migrations of species of trees from their glacial refuges, now believed to have been in the southeastern United States (Delcourt and Delcourt 1984). But these migration rates varied, so that vegetation changes were thrown out of balance with climate as distance from the glacial refuges increased (Brubaker 1981). Oaks, for example, migrated north after the melting of the last glacier faster than some trees with light, windblown seeds; they spread rapidly between 11,000 and 9,000 years ago, attaining their present range limits approximately 7,000 years ago (Davis 1981). Blue jays (*Cyanocitta cristata*) have been proposed as the postglacial oak dispersers: after the ice age, these birds could have nested in young forest patches lacking oaks and there cached viable acorns that they had collected from trees a few miles to the south. The average rate of Holocene range extension of oaks in eastern North America—approximately 380 yd/year—could readily have been attained and even exceeded by blue jays (Johnson and Adkisson 1986). Hickories, in contrast, reached the northeastern corner of their present range limits only 5,000 years ago, after the warmest part of the Holocene had ended (Davis 1983).

SUMMARY AND CONCLUSIONS

Postglacial pollen analyses of the study area, like others for the north central United States, reveal a succession from a spruce maximum to pine to oak, with the appearance of ragweed pollen marking the onset of white settlement.

Early settlement vegetation (1840-45) consisted of a mosaic of 10 communities, as delineated from the original land surveys. Oak savannas and oak forests accounted for 67% of the land cover of the study area, with wetlands contributing another 22%. In the postsettlement years (after 1845 and into the 1900s), agricultural land became dominant, with oak forest continuing to account for approximately one third of the land cover. Urban and industrial land is most likely to increase significantly in the future.

The distribution of plants and plant associations depends ultimately on climate, but is also determined by such factors as the age of the land, land history, soil and topography, opportunities for migration, biotic relationships, and competition and disturbance. Disturbance has been a major feature of the study area's environment, with white settlement being the newest and most pervasive agent of change. Although climatic control of the landscape continues to be operative, all of today's communities have features imposed by postsettlement land use. Of these features, fragmentation into ever smaller units may prove to have the most far-reaching effects. The modern landscape might more accurately be termed a "manscape."

EPILOGUE

Moses Strong, a historian, congratulated the white settlers of Sauk County:

> The Sauk Indians . . . left no memory of their work but a few broken sticks and a few crumbling rocks. But is it not a glory to the white pioneers that they have made the wilderness to blossom as the rose, that they have converted forests into cultivated fields. . . . (Strong 1885)

Perhaps it is a glory—it depends on your viewpoint. One does suspect that these changes were inevitable.

Another perspective was given by W. H. Canfield, the pioneer surveyor, in reference to the western end of the Baraboo Valley:

> But this natural beauty has already gone, only to be remembered; fences, ploughed ground, domestic animals and implements of husbandry now occupy the landscape. (*Baraboo Republic* 26 May 1859)

Now, the beauty that Canfield referred to is not even remembered.

So the sun no longer flecks the oak openings nor glistens on the "luxuriant grasses" of the Sauk Prairie, and flocks of ducks wheeling in the afterglow amid a medley of sounds in the Baraboo Valley is a historical footnote. The land is leashed and tethered, like some huge domestic animal. One hears the barking of dogs, not the howling of timber wolves. Stephen Vincent Benét (1960:28) expressed it this way:

> When Daniel Boone goes by, at night,
> The phantom deer arise
> And all lost, wild America
> Is burning in their eyes.

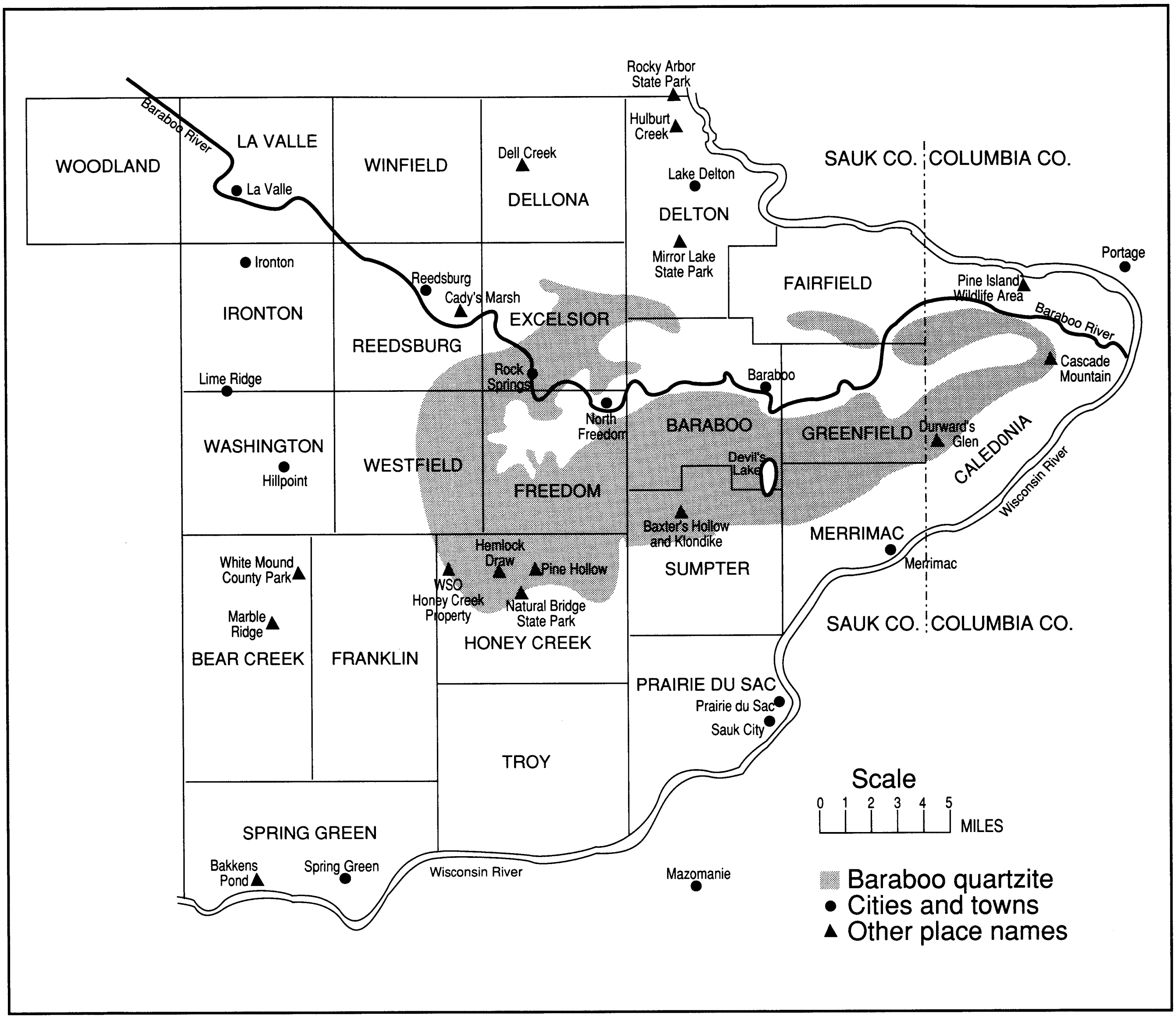
But, as Donald Culross Peattie (1941:156) reminded us, we still can come to what is left of our natural heritage with a patriot's reverence. Perhaps, somehow, the ancient landscapes still exert their influence. At least there is one certainty—the inevitability of change.

APPENDIX

APPENDIX TABLE 1. *Common and scientific names of plants mentioned in the text (after Kartesz and Kartesz 1980).*

Common Name	Scientific Name	Common Name	Scientific Name
Alder (text)	*Alnus rugosa*	Jack pine	*Pinus banksiana*
Alder (pollen diagram)	*Alnus* spp.	Leather-leaf	*Chamaedaphne calyculata*
American elm	*Ulmus americana*	Maple	*Acer* spp.
Ash	*Fraxinus* spp.	Oak	*Quercus* spp.
Aspen	*Populus* spp.	Paper birch	*Betula papyrifera*
Basswood	*Tilia americana*	Pigweed	*Chenopodium album* and/or *Amaranthus retroflexus*
Birch	*Betula* spp.	Pine	*Pinus* spp.
Bitternut hickory	*Carya cordiformis*	Plum	*Prunus* spp.
Black ash	*Fraxinus nigra*	Poplar, popple	*Populus* spp.
Black cherry	*Prunus serotina*	Prickly ash	*Zanthoxylum americanum*
Black locust	*Robinia pseudoacacia*	Prickly gooseberry	*Ribes cynosbati*
Black oak	*Quercus velutina*	Ragweed	*Ambrosia artemisiifolia*
Blueberry	*Vaccinium* spp.	Red cedar	*Juniperus virginiana*
Bluegrass	*Poa* spp.	Red elm	*Ulmus rubra*
Bluejoint grass	*Calamagrostis* spp.	Red maple	*Acer rubrum*
Bog birch	*Betula pumila x sandbergii*	Red oak	*Quercus rubra*
Brambles	*Rubus* spp.	Red pine	*Pinus resinosa*
Bur(r) oak	*Quercus macrocarpa*	Reed canary grass	*Phalaris arundinacea*
Cattail	*Typha* spp.	Sage	*Artemisia* spp.
Composites	Family Asteraceae (Compositae)	Sedges	Family Cyperaceae
Cottonwood	*Populus* sp.	Shagbark hickory	*Carya ovata*
Cranberry	*Vaccinium* spp.	Soft maple	*Acer* spp.
Currant	*Ribes* spp.	Speckled alder	*Alnus rugosa*
Elm	*Ulmus* spp.	Spruce	*Picea* spp.
Fir	*Abies* spp.	Sugar maple	*Acer saccharum*
Gooseberry	*Ribes* spp.	Tamarack	*Larix laricina*
Grape	*Vitis* spp.	Tussock sedge	*Carex stricta*
Grasses	Family Poaceae (Gramineae)	White ash	*Fraxinus americana*
Hazel	*Corylus* spp.	White oak	*Quercus alba*
Hemlock	*Tsuga canadensis*	White pine	*Pinus strobus*
Hickory	*Carya* spp.	Wild crabapple	*Malus ioensis*
Hops	*Humulus lupulus*	Willow	*Salix* spp.
Huckleberry	*Gaylussacia baccata*	Yellow birch	*Betula alleghaniensis*
Ironwood	*Ostrya* and/or *Carpinus*		

APPENDIX FIGURE 1. *Townships of the study area and place names referred to in this report.*



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