Land Use and Vegetational Change on the Aldo Leopold Memorial Reserve

Konrad Liegel

Abstract. This study records land use and vegetational changes on the Aldo Leopold Memorial Reserve in Sauk County, Wisconsin. Vegetation maps were prepared for the early European settlement (1840s) and early Leopold (1930s) eras through interpretation of surveyor’s notes, traveler’s accounts, soils information, aerial photographs, agricultural records, present vegetation, and on-site observations. These maps, compared with each other and with the present vegetation map (1978, rev. 1986), show trends in vegetational change since the time of settlement. Closed communities of shrub-carr and forest have replaced open communities of low prairie, sedge meadow, and oak savanna. The primary factor responsible for this change is the control of fire.

Land-use records indicate that agricultural use helped to delay this succession of communities. Grazing kept the savannas open although it destroyed the natural groundlayer. Therefore, in 1940 more prairie species remained in the minimally grazed black oak forests than in the heavily grazed white oak savannas. The mowing of marsh hay, meanwhile, kept the wet prairie and sedge meadow open. When grazing and mowing stopped, shrubs and trees quickly invaded. Agricultural use peaked in the 1920s, but declined in the 1930s through the 1960s due to meager natural soil fertility, the introduction of modern mechanized farming, and farmer attrition.

The plant communities of southern Wisconsin have changed dramatically in the years since glaciation. European settlement and subsequent land use, in particular, thoroughly modified the plant communities, primarily through the control of fires that resulted from lightning strikes and Indian activities (Dorney 1981). In the absence of fire, the sunny oak openings of southern Wisconsin grew up into the oak woodlots of today, while shrub-carr and aspen invaded the sedge meadows and low prairies. Lumbering and farming transformed most of the remaining expanses of prairie, savanna, marsh, and forest into today’s fields of corn and hay (Curtis 1959).

This study records the changes in land use and vegetation on what is now the Aldo Leopold Memorial Reserve. The Reserve is the “sand country” of Aldo Leopold, where he and his family spent their weekends and vacations in the 1930s and 1940s restoring a worn-out farm north of Baraboo, Wisconsin. Leopold studied the land-use and ecological history of his farm searching for guidance on how to restore it to a healthy state. Leopold’s experiences at the farm also helped in shaping his philosophy of man’s relationship to his environment—the land ethic—which is expressed in A Sand County Almanac (1949):

Conservation is getting nowhere because it is incompatible with our Abrahamic concept of land. We abuse land because we regard it as a commodity belonging to us. When we see land as a community to which we belong, we may begin to use it with love and respect. There is no other way for land to survive the impact of mechanized man, nor for us to reap from it the esthetic harvest it is capable, under science, of contributing to culture.
It seems fitting, therefore, that the ecological story of the Leopold farm and the Reserve surrounding it be told. This land-use and vegetational history illustrates a principle implicit in the writings of Leopold: the pattern and composition of vegetational communities reflect the choices human cultures have made in land use.

Description of the Leopold Memorial Reserve

The Aldo Leopold Memorial Reserve is a private landowner's cooperative tract of approximately 1400 acres dedicated to the memory of Aldo Leopold. Among other properties, it contains Leopold's original farm, which includes "the Shack," now listed in the National Register of Historic Places. A refurbished chicken coop, later memorialized in A Sand County Almanac, the Shack was home to the Leopold family during visits to their farm. The Reserve is located in Fairfield Township, Sauk County, Wisconsin (R7E, T12N, Sec. 2, 3, 4, 5; R7E, T13N, Sec. 32, 33, 34, 35) (Fig. 1) where the Wisconsin River and its floodplain cut a swath through the ground moraine with its wetlands left by the last ice sheet.

Glaciation, subsequent wind erosion, and the fluvial action of the Wisconsin River have molded the Reserve's surface features (Fig. 2). The Reserve is covered with a mantle of supraglacial sediments and till laid down by a series of glacial advances, the last being the Green Bay Lobe of late Woodfordian age (Black and Rubin 1967-1968), which reached its maximum advance into the area about 13,000 years ago (Socha 1984). As the glacier melted, an extension of Glacial Lake Wisconsin formed to the east of the terminal moraine, covering the Reserve. The north-south-trending ridges in the Reserve area were probably fashioned during this time as deltas in the lake at the ice margin. The proglacial lake existed in the Reserve area until the ice margin cleared the east end of the Baraboo range and uncovered a low area near Portage. The proglacial lake drained through this outlet, establishing the present course of the Wisconsin River. Subsequently, the river eroded the north end of the sand and gravel ridges. Eolian processes reworked both the proglacial fluvial and modern fluvial deposits and formed blowouts and dunes, leaving the topography of today (Socha 1984).

Fire stress, fluctuating water levels, and siltation levels have determined the changing pattern and composition of plant communities on the Reserve (Liegel 1982). Presently, about two-thirds of the area is floodplain forest and marshland, dotted with ponds and laced with river sloughs. The remainder is hilly ground moraine covered by a mixed oak-hickory-pine forest and broken by a few fields still under cultivation (Luthin 1980; Bradley 1987). A deep, sandy substrate underlays the entire Reserve and produces an easily eroded soil of low fertility (Sharp and Bowles 1985).
European immigrants settled the area in the 1840s. At that time oak savanna maintained by fires was the dominant ecotype (Liegel 1982). Lumbering, cultivation, drainage of wetlands, overgrazing, mowing, and fire suppression caused rapid changes in the vegetative cover. Farming reached its zenith in the mid-1920s, with farms being abandoned to brush and weeds, wind and weather during the drought and depression of the 1930s. In 1935 Aldo Leopold purchased one of these abandoned farms and started to reverse the process of land deterioration through management and restoration, an activity that continues today under the direction of Frank Terbilcox, Manager, and Charles and Nina Bradley, Co-Directors of Research of the Leopold Memorial Reserve, and through the financial support of the Sand County foundation.

Methods

I based this study of vegetational change on a land-use chronology of the Leopold Memorial Reserve and on a series of vegetation maps of the Reserve during the 1840s (Liegel 1982), 1930s, and 1970s (Luthin 1978, rev. Ferber 1986). Land-use chronologies are an effective tool for generating hypotheses as to the relation between past land-use actions and present ecological effects, for broadly illustrating the significant impact humankind has had on the environment, and for helping to make management decisions (Leopold 1940; Grange 1948; Leopold 1949; Scott 1980). A comparison of vegetation maps for different time periods of the same piece of land, meanwhile, graphically and quantitatively shows the precise changes in percentage land cover by different plant community types over time (Curtis 1959; Vogl 1964).

Land-Use Chronology

This land-use chronology is based on historical documents that covered events within a larger area than the Reserve itself, namely that portion of Wisconsin surrounding the Wisconsin River between Wisconsin Dells and Portage. The historical documents considered include the following: state histories (Smith 1854; Nesbit 1973; Smith 1973; Current 1976); regional histories (Gregory 1932), county histories (Canfield 1861a; Butterfield 1880a and 1880b; Jones 1914; Cole 1918; Lange 1976); the published accounts of early explorers (including Carver [1766] 1838; Nuttall [1810] 1951; Schoolcraft [1820] 1953; Featherstonaugh 1847), pioneers (including Childs 1859; Kinzie 1856), and lumbermen (including Babington 1928); newspaper articles (Baraboo and Portage); and the journals of Reserve inhabitants Melvin Felt (1879-1899), Aldo Leopold (1935-1948), and Charles Bradley (1978-1987).

Written descriptions have their limitations for reconstructing past landscape and land-use patterns. Such historical descriptions are frequently vague, occasionally biased, and almost always very general (Vale 1982). However, for some time periods, especially prior to 1840, they are the only resource a land historian has to reconstruct past vegetation.

Finally, the chronology is based on the 1860-1900 Agricultural Census Schedules for Wisconsin of the U.S. Department of Agriculture (the records for 1910 and 1920 were destroyed in a fire) and the 1923-1972 Annual Enumeration of Farm Statistics by Assessors of the Wisconsin Department of Agriculture, both found in the Archives of the State Historical Society of Wisconsin. The agricultural schedules record, by individual farmer and county, the following statistics: amount of land owned; acreage devoted to various crops, pasture land, marsh hay, woodland, and unplowed land; numbers and kinds of livestock; and use of electricity, centralized heating, tractors, and fertilizers.

Agricultural census records likewise
have their limitations for reconstructing past agricultural-use patterns. Census figures often were conservative estimates from the farmers (Statz 1982, pers. comm.), and occasionally they appeared somewhat incomplete or inconsistent. To minimize these problems, the census figures were closely compared with the other historical documents.

In order to use the records, the land ownership history of the Reserve was determined through a search in the Sauk County Register of Deeds and in individual abstracts for particular properties. Then the agricultural records for each property were tabulated by individual landowner and year. Finally, by comparing the agricultural records with each other, and with the journals of Reserve inhabitants, field observations of the various fence lines, aerial photographs (1937; 1940; 1955; 1968), and various plat maps of Fairfield Township (Canfield 1861b; Tucker 1877; 1906; 1920; 1936; 1947; early 1950s; 1961; 1972; 1976), I was able to determine approximately when individual parcels were cultivated, mowed, or grazed, and for how long.

**Vegetation Maps**

Vegetation maps were prepared for the early European settlement (early 1840s) and early Leopold (late 1930s) eras of the Leopold Reserve for comparison with each other and with the present vegetation map (1978, rev. 1986) to show trends in vegetational change since the time of settlement. These periods were chosen because of their special importance to understanding the ecological history of the Reserve and because of the availability of survey information and/or aerial photographs for making a map of the vegetation during that period. The plant community types were delineated to follow those described by Curtis (1959).

A detailed description of the methods used in preparing the map of the early European settlement vegetation of the Reserve can be found in Liegel (1982).

The vegetation map of the Leopold Reserve in the late 1930s was prepared from the 1940 Agricultural Stabilization and Conservation Service (ASCS) aerial photograph. Community types and boundaries were derived from the following sources used in conjunction with the 1940 ASCS aerial photograph:

1. The Bordner Land Economic Inventory (1938) for Sauk County, the data originally recorded by field workers who traversed each quarter mile of land, noting both vegetational communities and human land use;
2. The ASCS aerial photograph of 1937;
3. The Shack journals of Aldo Leopold (1935–1948);
4. A herbarium collection of Carl Leopold (1938–1940);
5. Recollections of the Leopold family.

In addition, a stereoscopic wetland mapping procedure, developed by the Wisconsin DNR Wetlands Inventory (Wetlands Mapping Staff 1981), was used to delineate boundaries between different wetland community types that otherwise could not have been delineated on the aerial photographs.

Luthin (1978; 1979; 1980) prepared the present vegetation map through field observations while accompanying a baseline survey of the Reserve. Ferber (1986) revised the vegetation map through comparison with the 1976 infrared and 1978 aerial photographs and through additional field checks. This present vegetation map shows the Reserve boundaries of 1986, whereas the 1840s and 1930s vegetation maps show the Reserve boundaries as of 1980 when the maps were compiled.

The relative area coverage for the different community types was determined by counting dots on a grid placed over each map. The 1980 Reserve boundaries were used in making the calculations so
that the relative area coverage for different community types could be quantitatively compared.

**Leopold Reserve Chronology**

**Prehistory (13,000–300 Years Ago)**

The Prehistory era was one of great geologic and climatic change, accompanied by a series of changes in vegetation types from the boreal swamp woodlands of the proglacial period to the mosaic of mesophytic forest, oak savanna, and marsh communities found by the earliest European explorers (Maher 1981; Maher 1982; Winkler 1985). The changes in vegetation, in turn, were accompanied by a change from nomadic tribes of Indians to more sedentary tribes (Quimby 1960; Wittry 1979a; Wittry 1979b).

The first documented aboriginal use of the area surrounding and including the Leopold Reserve was by the Effigy Mound culture of the Woodland Indians about 700 to 1200 years ago (Quimby 1960). Although they still lived by hunting and fishing, the Woodland Indians were the first people in the region to use pottery of fired clay, to raise crops, and to erect mounds over their dead or in the shape of effigies. Several Effigy Mound culture mounds were found near or within the Leopold Reserve, including a possible village site southwest of the Terbilcox residence (Stout 1906; Brown 1924) (Fig. 2). Unfortunately, nothing more is now known about the aboriginal land use of the Reserve area during this period.

**Exploration Era (1660–1836)**

Social upheaval characterized the Exploration Era. The French, the English, and later the Americans fought for control of the region, and Indian tribes displaced one another as European settlers pushed them westward (Smith 1973). Indian tribes exerted an indirect but substantial effect over the composition of plant and animal communities through the use of fire (Day 1953; Martin 1973; Lewis 1980; Dorney 1981). European trappers affected plant community composition to a somewhat lesser, but perhaps still significant, degree through over-exploitation of fur-bearing and large game animal species (Cole 1918; Smith 1973).

The Wisconsin River was the principal means of transportation in the study area prior to settlement. Descriptions of the vegetation and animal life along its banks provide the best evidence of ecological conditions during this period.

When the French explorer and first European visitor Father Marquette paddled his canoe up the Fox, across the Portage, and down the Wisconsin River in 1673, he found a wild land with few Indians and much game. He wrote of the Wisconsin River:

> On the bank one sees fertile land, diversified with woods, prairies, and hills. There are oak, walnut, and basswood trees; and another kind, whose branches are armed with long thorns. We saw there neither feathered game nor fish, but many deer, and a large number of elk. (Kellogg 1917)

Soon after Marquette’s explorations, French trappers pleyed the Fox-Wisconsin route in search of gold, fur, and skins (Smith 1973). The fur trade system, which continued for the next 125 years, altered the relationships between Europeans and Indian tribes by making the Indians dependent upon French-supplied weapons, traps, ammunition, and blankets (Kellogg 1925). The Indians received these supplies on credit, which they paid for by furs.

The cumulative effect of excessive trapping and hunting began to show up in the area around the Reserve soon after the Americans took over the territory after the War of 1812. By this time elk, moose, and beaver were largely eradicated from the region, and deer were significantly
decreased in numbers (Cole 1918; Scholcraft 1953).

The dominant Indian tribe that occupied the area around the Leopold Reserve at the time of the arrival of European explorers was the Winnebago. The Winnebago made their living by farming and hunting and lived in permanent villages. Two of their villages were in Baraboo and Wisconsin Dells. An Indian path from the village in the Dells traversed the Reserve (Brink 1845). The Winnebago used fire to make good pasture for deer, to drive game, to provide for a renewed growth of blueberries and huckleberries, and for communication (Quimby 1960; Peske 1971; Lange 1976; Dorney 1981).

On a journey from Green Bay to St. Louis in 1821, the Green Bay pioneer, Ebenezer Childs, saw "but seven white men in the whole distance, outside the forts" (Childs 1859). Europeans were moving into the area, however, making the local Winnebago Indians restless. To keep the tribe in check, the American government built Fort Winnebago in 1828 near what is now Portage (Prucha 1964). The temporary barracks were constructed of pine logs obtained from an area known as Pine Island about six miles west of Portage (Turner 1898), which was in the close vicinity of the Reserve. In describing the "portage" during a trip through Wisconsin in 1835, the English scientist Featherstonaugh made this prophetic remark:

[The portage was covered with] tall wild grass, no longer kept cropped by roving buffaloes, which had been driven beyond the Mississippi. . . . It could not be long before the Indians will go the way of the buffalo, and cultivated grasses replace the native one. . . . The scythe of what is called "civilization" is in motion, and everything will fall before it. (Featherstonaugh 1847)

Two years later the Winnebago Indians ceded their land to the United States government, thereby allowing permanent settlement of the region (Gregory 1932).

Pioneer Era (1837-1865)

The Pioneer era was a transitional one, during which the first pioneers settled and began to farm what is now the Leopold Memorial Reserve. These pioneer farmers, mostly native-born Yankees (Canfield 1861a; Cole 1918), allowed their livestock to run at large and placed fences around their cropland (Gregory 1932). Wildfires were common, especially in the springtime (Gregory 1932). The frontier was pushing westward, with thousands of immigrants using an early state road (now Levy Road) that traversed the Reserve following the original Indian path (Cole 1918; Davis 1947). The cutting of the Wisconsin Pinery north of Wisconsin Dells was in full swing, with "almost a constant run" of log rafts down the Wisconsin River from early spring till early fall (Wisconsin Power Service Commission v. Federal Power Commission, Transcript of Record, 1944).

At the time of European settlement of the Reserve area in the early 1840s, the vegetation of the Reserve was an open, fire-maintained mosaic of oak savanna (38% by relative area coverage), floodplain forest (33%), marshland (27%), and upland forest (2%) (Table 1).

Traveller, surveyor, and pioneer accounts provide differing pictures of the vegetation of the area. While surveying the Leopold Marsh, John Brink wrote in his field notes: "Land Level wet and sandy (Quick Sand) 3rd Rate—Black & Yellow Oak and not much of that—Marsh bad enough and good for nothing" (Brink 1845). In contrast, a Gazetteer used to attract immigrants to Wisconsin gave the following general description of the area (Hunt 1853):

The openings, which comprise a large portion of the finest land of the state, owe
Table 1. Relative area coverage of the plant community types in what is now the Leopold Memorial Reserve, Sauk County, Wisconsin, during the 1840s, the 1930s, and the 1970s.

<table>
<thead>
<tr>
<th>Plant Community Type</th>
<th>% of total land surface during the 1840s</th>
<th>% of total land surface during the 1930s</th>
<th>% of total land surface during the 1970s</th>
</tr>
</thead>
<tbody>
<tr>
<td>Marsh</td>
<td>27</td>
<td>30</td>
<td>23</td>
</tr>
<tr>
<td>Aquatic</td>
<td>(1)</td>
<td>(1)</td>
<td>(2)</td>
</tr>
<tr>
<td>Emergent Aquatic</td>
<td>(3)</td>
<td>(3)</td>
<td>(2)</td>
</tr>
<tr>
<td>Sedge Meadow</td>
<td>(15)</td>
<td>(10)</td>
<td>(7)</td>
</tr>
<tr>
<td>Wet Meadow</td>
<td>(0)</td>
<td>(3)</td>
<td>(4)</td>
</tr>
<tr>
<td>Low Prairie</td>
<td>(8)</td>
<td>(2)</td>
<td>(0)</td>
</tr>
<tr>
<td>Shrub-carr</td>
<td>(0)</td>
<td>(11)</td>
<td>(8)</td>
</tr>
<tr>
<td>Floodplain Forest</td>
<td>33</td>
<td>24</td>
<td>26</td>
</tr>
<tr>
<td>Mixed F. Forest</td>
<td>(31)</td>
<td>(22)</td>
<td>(24)</td>
</tr>
<tr>
<td>Wet F. Forest</td>
<td>(2)</td>
<td>(2)</td>
<td>(2)</td>
</tr>
<tr>
<td>Savanna</td>
<td>38</td>
<td>10</td>
<td>6</td>
</tr>
<tr>
<td>Oak Opening</td>
<td>(31)</td>
<td>(2)</td>
<td>(0)</td>
</tr>
<tr>
<td>Oak Barrens/Dry Meadow</td>
<td>(7)</td>
<td>(8)</td>
<td>(6)</td>
</tr>
<tr>
<td>Upland Forest</td>
<td>2</td>
<td>19</td>
<td>34</td>
</tr>
<tr>
<td>Mixed Hard. Forest</td>
<td>(1)</td>
<td>(1)</td>
<td>(7)</td>
</tr>
<tr>
<td>Dry Upland Forest</td>
<td>(1)</td>
<td>(18)</td>
<td>(27)</td>
</tr>
<tr>
<td>Disturbed Areas</td>
<td>0</td>
<td>17</td>
<td>11</td>
</tr>
<tr>
<td>Roadsides</td>
<td>(0)</td>
<td>(1)</td>
<td>(1)</td>
</tr>
<tr>
<td>Cultivated Fields</td>
<td>(0)</td>
<td>(16)</td>
<td>(10)</td>
</tr>
</tbody>
</table>

Their present condition to the action of the annual fires which have kept under all other fast growth, except those varieties of oak which can withstand the sweep of that element.

This annual burning of an exuberant growth of grasses and of underbrush, has been adding, perhaps for ages, to the productive power of the soil, and preparing it for the plough-share.

It is the great fact, nature has thus "cleaned" up Wisconsin to the hand of the settler, and enriched it by yearly burnings, and has at the same time left sufficient timber on the ground for fence and firewood, that explains, in a great measure, the capacity it has exhibited, and is now exhibiting for rapid settlement and early maturity.

There is another fact important to be noticed in this connection. The low level prairie, or natural meadow, of moderate extent, is so generally distributed over the face of the county, that the settler on a fine section of arable land, finds on his own farm, or in his immediate neighborhood, abundant pasturage for his stock in summer, on the open range; and hay for the winter, for the cutting—the bounty of nature supplying his need in this behalf, till the cultivated grasses may be introduced and become sufficient for his use.

In 1843, Amos Anderson, a native of Norway, settled on the western end of the Leopold Reserve, preparing the ground that year for crops that gave him profitable returns in the following year.
The Aldo Leopold Memorial Reserve

(Gregory 1932). He was the first settler in Fairfield Township. Although most of the land within the Reserve passed into private hands by the early 1850s, it was not actively farmed but rather was held onto for a year or more, possibly for speculative purposes, and then sold. By 1854, virtually all of the Reserve lands were being actively farmed.

These pioneer farmers only had about 30 acres under the plow, the rest being used as open range for sheep and cattle. The areas put under cultivation included the “Shack” and “Coleman” prairies (Fig. 2). Corn, wheat, and oats were the primary crops, produced in approximately equal quantities. The principal market was the Pinery (Staines 1852).

Wildfires were common during the 1840s and 1850s, especially in the springtime, but diminished thereafter as the area became settled (Gregory 1932). In the early 1860s, after the cessation of wildfires, pines began to germinate in the “Anchor” woods of the floodplain forest (Leopold 1942) (Fig. 2).

Farming Era (1866–1934)

In southcentral Wisconsin, the Farming era began for both man and wildlife as a time of plenty, but ended for both as a time of devastation. Soldiers returning from the Civil War in the late 1860s placed the remaining fertile land under cultivation (Scott 1980). These farmers cultivated the rolling upland savannas, left the ridge savannas to succeed into forest, and burned off the marshlands for mowing of the marsh hay. A 1870 law, forbidding farmers from allowing their livestock to run at large, stopped indiscriminate grazing but intensified grazing in certain areas (Schafer 1922). The resulting mixture of fields, brushlands, and marshlands created excellent conditions for wildlife. Leopold (1934) described it this way:

The optimum conditions for game came after settlers had begun to farm the surrounding hill country. The settlers burned large openings in the tamaracks and used them as hay meadows. Every farmer who owned a quarter-section in the hills also owned a forty in the marsh, where he repaired every August to cut his hay. In winter, when frost had hardened the marsh, he hauled the hay to his farmstead.

The open haymeadows, separated by stringers of grass, oak, and popple, and by occasional remnants of tamarack, were better crane, duck, and sharptail range than the primeval bogs. The grain and weeds on the farms abutting the marsh acted as feeding stations for prairie chickens, which soon became so abundant as to take a considerable part of any grain left in the fields. These were the golden days of wildlife abundance. Fires burned parts of the marsh every winter, but the water table was so high that the horses had to wear “clogs” at mowing time, hence no fire ever “bit” deep enough to do any lasting harm.

However, by 1890, after all the fertile uplands were under cultivation, farmers made attempts to crop the marshland in dry years. The first results were bountiful beyond reason and agriculture started with a rush. The marshland fertility unfortunately quickly disappeared and an added succession of wet years reduced the farmers to desperation. To rehabilitate these farmers Wisconsin passed the Drainage Law of 1894, which provided an incentive to restore wetlands to agriculture through ditching and draining (Wisconsin Regional Planning Committee 1934). Now during dry years the exposed peat itself began to burn, rendering cultivation impossible (Leopold 1934). In addition, the meager natural fertility of the upland sandy meadows was depleted. By the 1930s many farms were abandoned in the “sand counties” to brush and weeds, wind and weather (Wisconsin Regional Planning Committee 1934).
Farming activity on the Leopold Memorial Reserve closely followed this regional scenario (see Fig. 2 for the locations on the Reserve of the parcels discussed in this section). During the late 1860s and 1870s most of the fertile land, now part of the Reserve, was being farmed. For the remainder of the century, the cultivated land included practically all of the rolling uplands with the addition of the “Shack” prairie and the “Coleman” prairie. Most of the marsh, except the wetter portion of the “great marsh” southeast of Chapman Lake, was being mowed for marsh hay, with intermittent fires being set to stimulate production. The oak opening and low prairie around present day Turner Pond and the floodplain forest were grazed, encouraging the spread of thorny shrubs. The ridges succeeded into forest in the absence of fire and grazing, probably remaining undisturbed until intensive cutting for firewood began in the late 1800s. In the mid-1880s, the clearings within the “Anchor” woods and “Susan’s savanna” were brought under cultivation. Around the turn of the century, the “Draba” prairie was brought under cultivation, and the “Coleman” prairie was abandoned. Farms were diversified with the most important crops being corn, oats, spring wheat, and potatoes. Sheep were the most important animal stock.

Equally dramatic changes occurred on the Leopold Reserve lands in the early 1900s. Between 1910 and 1920, farmers dug drainage ditches across the “long marsh” west of Chapman Lake. In the 1920s, cultivation of the riverbottom openings ceased. Grazing of the wetlands east and west of what is now the Terbilecox house began. In the late 1920s, the “island” north of the Shack, currently part of the mainland, was logged. The marsh burned for the last time. In the early 1930s, the “Shack” prairie was abandoned. Unfortunately, the agricultural census records covering much of this period were destroyed in a fire, making it impossible to reconstruct the precise record of cultivation.

**Leopold Era (1935–1949)**

The Leopold era was a transition between older farming practices and modern mechanized agriculture, and the beginning of a land restoration movement. The depression and drought of the 1930s had taken their toll on the Reserve lands, with one farm being abandoned, the house burned down, and the property falling into the hands of the county. Aldo Leopold purchased this property in 1934; his friend Tom Coleman purchased an adjacent farm in 1937 (Fig. 2). With their purchases began a new attitude toward the land, whereby landowners started to reverse the process of land deterioration and to build it back to something like its pre-settlement condition. Toward the end of this era, new farming practices, particularly the use of tractors, made mowing the marsh hay or cultivating the small floodplain openings mechanically difficult and economically unfeasible. This, in turn, presaged the end of farming in the area.

About the time Leopold purchased his land, what is now the Leopold Memorial Reserve was still a relatively open, farming-maintained mixture of marshland (30% by relative area coverage), floodplain forest (24%), upland forest (19%), agricultural fields (17%), and oak savanna (10%) (Table 1). Leopold (1949) provides a description of the area:

> My own farm was selected for its lack of goodness and its lack of highway; indeed my whole neighborhood lies in a backsaw of the River Progress. My road is the original wagon track of the pioneers, innocent of grades or gravel, brushings or bulldozers. My neighbors bring a sigh to the County Agent. Their fencerows go unshaven for years on end. Their marshes are neither
dyked nor drained. As between going fishing and going forward, they are prone to prefer fishing.

During the majority of Leopold’s tenure on the Reserve, the floodplain forests were grazed but the upland forests were not (Leopold 1942; Liegel 1981) (see Fig. 2 for the locations on the Reserve of the parcels discussed in this section). The abandoned fields began to succeed back into prairie. The pines in the “Anchor” woodland were cut. The marsh areas were mowed until the mid-1940s when tractors became common among farmers on the Reserve. Grazing of the wetlands east and west of what is now the Terbilcox residence ended. Grazing of the “Kammerer meadow” began. Shrubs began to slowly invade the wetlands margins when cultivation and mowing ceased, fanning out particularly from the drainage ditch south of “long marsh.”

Almost immediately after purchase of their farm, the Leopold family began the planting of thousands of native trees, particularly pines, and woodland shrubs and wildflowers (Leopold 1935-1949). Virtually all of the plantings from 1936 to 1938 died because of drought (Leopold 1936, 1937), but the family persisted and by the early 1940s the Shack was surrounded by young pine seedlings. In the late 1930s Leopold began to transplant prairie plants into the field in front of the Shack, a process which continued until his death in 1949. However, he did not burn the “Shack” prairie.

**Agricultural Era (1950-1967)**

Commercial farming for all practical purposes ended on the Leopold Memorial Reserve during the Agricultural era. The Reserve farms were simply too small, too infertile, and too varied in their soils and topography to lend themselves to modern farming techniques and the use of tractors and commercial fertilizers. Gentleman farmers, who for the most part rented out the larger and more fertile fields, replaced the older farmers throughout the Reserve. Shrubs and trees quickly invaded the riverbottom forests and marshlands when grazing and mowing ceased.

Farmer attrition occurred throughout the 1950s and 1960s (see Fig. 2 for the locations on the Reserve of the parcels discussed in this section). In 1947 Carl Anchor moved his house out of the Reserve. In 1955 Howard Kammerer purchased a farm, allowing only intermittent grazing of the riverbottom forest and of the “Kammerer meadow” just east of the farmhouse. In 1956 Russ Van Hoosen inherited a farm, ending grazing of his property. In 1957 Frank Terbilcox purchased a farm, ending grazing of his property. In the early 1960s the construction of the interstate highway put an end to the agricultural use of the Sinner Property. In 1961 Charles Anchor inherited a farm and ended all agricultural activity. In 1962 Ray Turner ended grazing of the wetland shrub carr around present day Turner Pond.

The ending of agricultural activity on the Reserve lands began to have a dramatic effect on its character and ecology. The previously cultivated fields continued their succession into prairie. Prickly ash (*Xanthoxylum americanum*) began to fill in the previously open mixed floodplain forest and floodplain oak barrens. The wetland margins continued to succeed into shrub carr. And the shrub carr succeeded on low prairie sites into mixed hardwood forest.

With the death of Aldo Leopold in 1949 and the movement of his family away from Wisconsin, the restoration of the Leopold property ceased. The 1950s and 1960s were quiet times with little visitation and almost no management. In 1967 the Leopold family deeded the property to what is now the Aldo Leopold Shack Foundation. They established this family...
foundation in order to provide for maintenance of the Shack, not only for their own use but as a laboratory for continued ecological and restoration studies.

**Leopold Reserve Era (1968–present)**

The Aldo Leopold Memorial Reserve was created in 1968 as a cooperative private wildlife preserve memorializing Aldo Leopold. In response to a growing threat of recreational development in the Baraboo area, Reed Coleman, the son of Leopold’s good friend and neighbor Tom Coleman, persuaded the other landowners surrounding the Leopold tract to pool their properties under common management funded by what is now the Sand County Foundation. The five landowners who cooperated in this private preserve were Reed Coleman, Franklin Terbilcox, the Leopold family, Russell Van Hoosen, and the Sand County Foundation. Robert Ellarson, one of Leopold’s students, drafted a generalized management plan. Terbilcox accepted the job of Reserve Manager.

During the subsequent years, the Sand County Foundation began purchasing some of the adjoining properties. The Foundation purchased the Sinner Property in 1968, part of the Turner Property and the “island” in 1970, the Anchor Property in 1972, the Kammerer Property in 1977, the Ragan Property in 1982, and another parcel of the Turner Property in 1982 (Fig. 2).

With the creation of the Aldo Leopold Memorial Reserve, Leopold’s land rehabilitation program of the 1930s and 1940s was continued and expanded to include the entire Reserve. The focus of the early to mid-1970s was predominantly on wildlife management. Reserve Manager Terbilcox cleared a network of trails, dug a number of duck ponds (Turner and Van Hoosen ponds, 1969–1970; Center pond, 1971), planted “wildlife patches” around the ponds and in part of the “long marsh” west of Chapman Lake, occasionally mowed the “long marsh,” and burned the “Shack” and “Coleman” prairies (Fig. 2).

In 1976, eight years after the Reserve was established, Charles and Nina Leopold Bradley retired on the Reserve and began a student research program for ecological studies of the area. The Bradleys built the Study Center, with a laboratory and work area in the lower level (Fig. 2). The first Leopold fellows created a working base map and started a comprehensive inventory of the Reserve, including plants and plant communities (Luthin 1978; 1979; 1980), land-use and vegetational history (Liegel 1982; and the present report), palynology (Winkler 1985), glacial geology (Socha 1984), soils (Sharp and Bowles 1985), hydrology (Zolidis 1985), birds (Mossman and Reed 1978), and wildlife (Mossman 1980; Tohulka 1979).

During the late 1970s and up to the present, the focus of management efforts has been more on restoring and maintaining native plant community types once more common on the Reserve. Management efforts have included restoration of old fields into prairie, brush management in the low prairie and oak barrens, and thinning of the Leopold pines.

Today the Leopold Memorial Reserve is a relatively closed combination of upland forest (34% by relative area coverage), floodplain forest (26%), marshland (23%), oak savanna (6%), and cultivated fields (11%) (Table 1).

**Vegetational Change Following European Settlement**

The preceding land-use chronology displays the panorama of vegetational change that has occurred on the Leopold Memorial Reserve during the last 13,000 years. The vegetation maps of the 1840s,
1930s, and 1970s, to be examined in this section, show more graphically the precise changes in percentage land cover by different plant community types since settlement, and the land-use factors responsible for these changes.

Ten natural and three disturbed vegetation types were identified as comprising the vegetation of the Leopold Memorial Reserve in the 1840s, 1930s, and 1970s (Fig. 3–Fig. 5). The relative area covered by each vegetation type for the different time periods is given in Table 1. Successional trends for selected plant community types between 1840 and 1980 are shown in Table 2. The characteristics of each community type are given in Table 3.

As previously discussed elsewhere (Liegel 1982), three interdependent factors seem to have been crucial in influencing the pattern and composition of the pre-settlement vegetation types on the Re-

### Table 2. Successional trends in selected plant community types on what is now the Leopold Memorial Reserve, Sauk County, Wisconsin, between 1840 and 1980.

<table>
<thead>
<tr>
<th>Plant Community Type during the 1840s</th>
<th>% of Original Plant Community Type having succeeded into other types by the 1930s</th>
<th>by the 1970s</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sedge Meadow (100)</td>
<td>Wet Meadow (6)</td>
<td>Wet Meadow (13)</td>
</tr>
<tr>
<td></td>
<td>Sedge Meadow (67)</td>
<td>Sedge Meadow (47)</td>
</tr>
<tr>
<td></td>
<td>Shrub-Carr (27)</td>
<td>Shrub-Carr (40)</td>
</tr>
<tr>
<td>Low Prairie (100)</td>
<td>Low Prairie (25)</td>
<td>Low Prairie (0)</td>
</tr>
<tr>
<td></td>
<td>Wet Meadow (25)</td>
<td>Wet Meadow (25)</td>
</tr>
<tr>
<td></td>
<td>Shrub-Carr (50)</td>
<td>Shrub-Carr (25)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Mixed Hard. F. (50)</td>
</tr>
<tr>
<td>Oak Opening (100)</td>
<td>Shrub-Carr (6)</td>
<td>Mixed Hard. F. (6)</td>
</tr>
<tr>
<td></td>
<td>Oak Opening (6)</td>
<td>Oak Opening (0)</td>
</tr>
<tr>
<td></td>
<td>Oak Barrens (3)</td>
<td>Mixed Flood. F. (6)</td>
</tr>
<tr>
<td></td>
<td>Dry Upland F. (46)</td>
<td>Dry Upland F. (59)</td>
</tr>
<tr>
<td></td>
<td>Cult. Fields (39)</td>
<td>Cult. Fields (32)</td>
</tr>
<tr>
<td>Oak Barrens (100)</td>
<td>Oak Barrens (43)</td>
<td>Oak Barrens (14)</td>
</tr>
<tr>
<td></td>
<td>Dry Upland F. (43)</td>
<td>Dry Upland F. (86)</td>
</tr>
<tr>
<td></td>
<td>Cult. Fields (14)</td>
<td>Cult. Fields (14)</td>
</tr>
</tbody>
</table>
serve: topography, hydrology, and fire. Four land-use factors seem to have been crucial in influencing the pattern and composition of the post-settlement vegetation types on the Reserve: fire control, grazing, mowing, and cultivation. The probable role of these land-use factors in vegetational change on the Reserve will be analyzed by examining successional trends in the following community types: (1) oak opening, (2) oak barrens, (3) sedge meadow, and (4) low prairie.

**Oak Opening to Upland Oak Forest**

Oak opening was the dominant plant community type on the Leopold Reserve at the time of settlement, covering almost one-third of the total land surface (Fig. 3;

**Table 3. Characteristics of the plant community types on the Leopold Memorial Reserve, Sauk County, Wisconsin.**

<table>
<thead>
<tr>
<th>Plant Community Type</th>
<th>Ecological Characteristics</th>
</tr>
</thead>
<tbody>
<tr>
<td>Aquatic</td>
<td>Continuous standing water at least 12&quot; deep, dominated by submerged aquatics</td>
</tr>
<tr>
<td>Emergent Aquatic</td>
<td>Shallow standing water through much or all of the growing season, dominated by cattail (Typha latifolia) and river bulrush (Scirpus fluviatilis)</td>
</tr>
<tr>
<td>Sedge Meadow</td>
<td>Saturated organic soils, dominated by sedges (Carex spp.)</td>
</tr>
<tr>
<td>Low Prairie</td>
<td>Grassland commonly inundated in the spring, dominated by big bluestem (Andropogon gerardii), bluejoint (Calamagrostis canadensis) and cordgrass (Spartina pectinata)</td>
</tr>
<tr>
<td>*Wet Meadow</td>
<td>Disturbed sedge meadow, pastured low prairie, or weed community found on man-made pond spools</td>
</tr>
<tr>
<td>*Shrub Carr</td>
<td>Shrubland dominated by shrubs or early-successional trees, such as aspen (Populus tremuloides)</td>
</tr>
<tr>
<td>Wet Floodplain Forest</td>
<td>Forest found along sloughs and old river channels, dominated by silver maple (Acer saccharinum)</td>
</tr>
<tr>
<td>Mixed Floodplain/Mixed Hardwood Forests</td>
<td>Lowland forest dominated by river birch (Betula nigra), ashes (Fraxinus spp.), prickly ash (Xanthoxylum americanum), (Pinus strobus), and, in mixed hardwood forest, by aspen Populus tremuloides</td>
</tr>
<tr>
<td>Oak Opening</td>
<td>Savanna dominated by bur (Quercus macrocarpa) and white oak (Q. alba)</td>
</tr>
<tr>
<td>Oak Barrens</td>
<td>Savanna dominated by black oaks (Quercus velutina, ellipsoidalis, and rubra), and, in the floodplain, by prickly ash (Xanthoxylum americanum)</td>
</tr>
<tr>
<td>*Dry Meadow</td>
<td>Former savanna disturbed by cultivation and/or grazing, dominated by Eurasian grasses and native prairie species</td>
</tr>
<tr>
<td>Dry Upland Forest</td>
<td>Forest dominated by oaks (Quercus spp.), black cherry (Prunus serotina), and locally white pine (Pinus strobus)</td>
</tr>
<tr>
<td>*Roadsides</td>
<td>Composed primarily of hardy disturbance-resistant perennials, often of Eurasian origin</td>
</tr>
<tr>
<td>*Cultivated Fields</td>
<td>Agricultural fields subject to seasonal disturbance, dominated by annuals</td>
</tr>
</tbody>
</table>

* man-induced plant communities
Table 1). Today dry upland oak forest is the dominant plant community type of the Reserve; oak openings with an intact natural ground layer is no longer present (Table 2).

After settlement, the rolling upland oak openings, which comprised about 40% of the oak openings, were cultivated. Most of the rolling upland oak openings remained under cultivation (Table 2). Meanwhile, virtually all of the ridge oak openings, which comprised about 50% of the oak openings, quickly succeeded into dry upland oak forest, due to the absence of fire and grazing. Thereafter, the oak forests were occasionally but never intensively grazed, and were also selectively cut for firewood. They remain dry upland oak forest today (Table 2). Finally, the lowland oak openings, which comprised about 10% of the oak openings, succeeded into shrub carr or were maintained by grazing until the early 1950s. Grazing may have maintained the lowland oak openings, but it destroyed the natural ground layer. The lowland oak openings are mixed hardwood forest today (Table 2).

Floodplain Oak Barrens to Cultivated Fields to Floodplain Oak Barrens/Upland Oak Barrens to Dry Upland Oak Forest

Oak barrens were scattered on sandy sites throughout the Leopold Reserve at the time of settlement, occupying about 12% of the total land surface (about 5% of which is labelled as mixed floodplain forest in the 1840s map) (Fig. 3; Table 1). Today virtually all of the original floodplain oak barrens remain oak barrens, while 86% of the original upland oak barrens has succeeded into dry/upland forest (Table 2).

The floodplain oak barrens were for the most part cultivated after settlement, but were abandoned several decades later when the meager natural soil fertility ran out (Fig. 4): After abandonment, these “dry meadows” began to succeed back into a dry-mesic prairie, and now are oak barrens again. However, unlike the original floodplain oak barrens, today’s floodplain oak barrens are invaded by prickly ash (Xanthoxylum americanum). The ridge oak barrens, meanwhile, succeeded into dry upland black oak forest, due to the absence of fire and grazing, but at a slower rate than the ridge oak openings (Table 2). Unlike the white oak forest formed from former ridge oak openings, the dry upland black oak forest maintained an intact natural ground layer, presumably because of the relatively open canopy and infertile soils (Curtis 1959; Vogl 1964). Therefore, the dry upland black oak forest on the Reserve easily lends itself to restoration, as demonstrated in the restoration of “Frank’s” prairie (Holtz and Howell 1983) (Fig. 2).

Sedge Meadow to Wet Meadow and Shrub Carr

Sedge Meadow occupied about 15% of the total land surface of the Leopold Reserve at the time of settlement (Fig. 3; Table 1). Today about half of the original sedge meadow remains, the remaining half having succeeded into shrub carr or a disturbed version of the sedge meadow community known as wet meadow (Table 2).

Most of the sedge meadow on the Reserve was maintained from settlement through the mid-1940s by the periodic mowing of marsh hay. The remainder of the sedge meadow succeeded into shrub carr and wet meadow (Fig. 4). When mowing of the sedge meadows ceased in the 1940s, succession into shrub carr accelerated (Fig. 5). Drier hydrologic conditions, resulting from groundwater movement away from the marsh and toward the drainage ditch and from changes in river morphology, most likely also contributed to this successional trend (Bedford et al. 1974).
Stevens (1985) utilized the 1937 to 1975 aerial photographs to analyze the rates of shrub invasion on Reserve sedge meadow over time. Shrub cover increased in "long marsh" from 27% in 1937 to 50% in 1966 with a slight decrease due to mowing in 1955. South of the drainage ditch, the change was even more dramatic, with shrub cover increasing from 35% in 1937 to 83% in 1977.

**Low Prairie to Shrub Carr to Mixed Hardwood Forest**

Low prairie occupied about 8% of the total land surface on the Leopold Reserve at the time of settlement (Fig. 3; Table 1). Today, the low prairie has virtually disappeared as a community type on the Reserve, having been replaced by wet meadow, shrub carr, and mixed hardwood forest (Table 2).

In the absence of fire or mowing, or in the presence of grazing, about half of the original low prairie succeeded into shrub carr by the 1930s (Fig. 4) and ultimately into mixed hardwood forest thereafter (Fig. 5). Mowing delayed this succession in the low prairie near Chapman Lake (Stevens 1985) (Fig. 3–Fig. 5). When mowing ended in the late 1930s, shrubs quickly invaded, increasing from 17% in 1937 to 40% in 1949 but remaining constant until 1975 due to infrequent mowing. In 1975, shrub cover had reached 61% and has continued to increase ever since due to lack of mowing and burning.

**Summary**

The changes in vegetation on the Leopold Memorial Reserve since glaciation have been dramatic. The proglacial boreal forest and sphagnum bog communities of approximately 12,000 years ago have given way to the fire-maintained, relatively open oak savanna, marshland, and floodplain forest communities of pre-European settlement Wisconsin. These aboriginally influenced communities, in turn, have given way to the agriculturally influenced, relatively closed oak forest, shrub carr, cultivated field, and floodplain forest communities of today.

The character and appearance of the landscape of the Leopold Reserve has changed significantly since European settlement. At the time of settlement, two-thirds of the Reserve lands were composed of open communities of savanna and marshland; today, two-thirds of the Reserve is composed of closed communities of upland oak forest, mixed floodplain forest, and shrub carr. The primary factor responsible for this change is the control of fires that resulted from lightning strikes and Indian activities.

Agricultural use of the area helped to delay this succession of open communities into closed ones. Grazing and cultivation kept the savannas open but destroyed the natural groundlayer. The mowing of marsh hay, meanwhile, kept the low prairie and sedge meadow open. Agricultural use probably peaked in the 1920s, dropped throughout the 1930s, 1940s, and 1950s, and then leveled off in the 1960s. This decline in agriculture was due to the meager natural fertility of the soil, the introduction of modern mechanized farming, and farmer attribution.

Reflecting over the immense changes that had occurred since European settlement, an early pioneer of the township lamented in these somewhat florid words:

Fairfield in pioneer days was a veritable flower garden. Wherever the sod was unbroken the ground was literally covered with flowers. It was a delight to look upon them and think that God and not man nor woman planted them and that Solomon in all his glory was not arrayed like one of these. There was one variety for which I looked in vain, the dandelion. The dear home flower, how I missed it and longed for the sight of it. The 2nd or 3rd year my sister, who was always looking for it as well as I, found just one and Mrs. Wing laugh-
ingly tells the story of Mrs. Emily how finding a dandelion and being so overjoyed that she shed tears. Neither was there a stalk of mullein to be seen in all the land. But we said: “with the coming of the sheep the mullein will grow,” which has passed true and the time has come when we could dispense with the everlasting presence of both dandelion and mullein. (Luce 1912)

**Acknowledgments**

Many persons deserve special thanks for helping with this project. In particular, I wish to acknowledge the help the late Walter E. Scott gave in sharing with me his insights about the land-use history of the region and his extensive library of materials on Wisconsin. I also wish to thank Evelyn Howell (Department of Landscape Architecture, University of Wisconsin-Madison) and Kenneth I. Lange (Naturalist, Devil’s Lake State Park) for their advice and editorial suggestions, my wife Karen Atkins for her assistance with producing the maps and figures, and Nina and Charles Bradley for their graciousness and generosity. I am also grateful to the Sand County and Aldo Leopold Shack Foundations; without their financial support during my four years of fellowship studies on the Leopold Reserve, I could not have completed my studies.

**Works Cited**


Brink, J. 1845. GLO survey field notes.


Butterfield, C. W. 1880a. The history of Columbia County, Wisconsin, containing an account of its settlement etc. Western Historical Co., Chicago, Ill. 1095 pp.  

_____ ed. 1880b. The history of Sauk County, Wisconsin. Western Historical Co., Chicago, Ill.

Canfield, W. 1861a. Outline sketches of Sauk Township.

_____ 1861b. Plat map of Fairfield Township, Sauk County, Wisconsin.


Conkey, T. 1845. GLO survey field notes.


Quimby, G. I. 1960. Indian life on the upper


Statz, Roman. 1982. Personal communication. Soil conservation specialist of Sauk County.


Tucker, M. 1877. Plat map of Fairfield Township, Sauk County, Wisconsin.


