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Transformation of a landscape in the upper mid-west, USA: The  
history of the lower St. Croix river valley, 1830 to present

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# LANDSCAPE AND URBAN PLANNING

*An International Journal of Landscape Ecology, Landscape Planning, and Landscape Design*

**Aims and scope.** A journal concerned with conceptual, scientific, and design approaches to land use. By emphasizing ecological understanding and a multi-disciplinary approach to analysis and planning and design, it attempts to draw attention to the interrelated nature of problems posed by nature and human use of land. In addition, papers dealing with ecological processes and interactions within urban areas, and between these areas and the surrounding natural systems which support them, will be considered. Papers in which specific problems are examined are welcome. Topics might include but are not limited to landscape ecology, landscape planning and landscape design. Landscape ecology examines how heterogeneous combinations of ecosystems are structured, how they function and how they change. Landscape planning examines the various ways humans structure their land use changes. Landscape design involves the physical strategies and forms by which land use change is actually directed. *Landscape and Urban Planning* is based on the premise that research linked to practice will ultimately improve the human made landscape.

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# Transformation of a landscape in the upper mid-west, USA: The history of the lower St. Croix river valley, 1830 to present

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## Abstract

Learning the history of a landscape is critical to understanding present land-use patterns. We document the history of landscape change in the lower St. Croix River valley from 1830 to the present. Significant changes in land use and cover have occurred during this time. Because of the convergence of prairie, savanna and forest vegetation in this area, and because of the proximity of the St. Croix River valley to metropolitan Minneapolis/St. Paul (MN), the region is ecologically and culturally very important. A variety of information sources was used to reconstruct the lower St. Croix landscape over time. The primary sources of material were federal census records, records of lumber and agricultural production, descriptive accounts by early settlers and historians, scientific reports, the General Land Office land survey records, maps and photographs. Two periods of rapid change were identified. Change was rapid from 1850 to 1880 as first loggers and then farmers converted a lightly populated landscape of oak savanna, prairie, mixed hardwood and conifer forests and wetlands, maintained by frequent fires, into a largely deforested agricultural landscape. A second period of rapid change was from 1940 to the present as the urban area has expanded outward. Urbanization has further fragmented the remaining areas of natural habitat and has the potential to accelerate soil erosion, stream sediment transport, and oxidation of organic matter. The results of this study illustrate how landscape change can have significant impacts on ecological systems. Understanding the history of landscape change in the lower St. Croix River valley provides an analogue to help understand how other mid-western US landscapes have changed over time.

*Keywords:* Historical ecology; Landscape history; Land-use; Minnesota; St. Croix River; Wisconsin

## 1. Introduction

“Ray,” he said, pointing with his whip, “I shall not live to see the time, but you will, when all this country will be covered with beautiful farms. There will be fine painted houses and great barns and

windmills and good roads and good schools and a rich and contented people.”

I believed it of course if Father said it, but it seemed utterly impossible. On all sides were unbroken forests, great trees, jungles of brushwood, marshy brooks, miles and miles of them: even the road was all but impassable, ruts, mudholes and the remainder of huge stumps and roots. And yet, not so long ago, I drove out that very road with my brother Harry in

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his automobile—a fine pavement all the way. Every word my father said had come true. Great barns and silos, fields overflowing with corn and oats and peas, and herds of cattle as fine as there are to be found in North America. All the things he had dreamed had come to pass and many more that no man, at that time, could have dreamed: an automobile in every garage, radios and telephones and electric lights in every house, and even airplanes whirring overhead. The wilderness we knew as Milltown is now one of the best dairying centers in the state of Wisconsin. And all in fifty or sixty years! (Baker, 1941, p. 18, describing Milltown township, in the St. Croix River valley, Polk County, Wisconsin).

The St. Croix River has long been a significant geographic feature to people in the upper mid-west. Indigenous people used the St. Croix as a major transportation corridor, French explorers and fur-traders used it as a link between Lake Superior and the Mississippi River, and settlers used the St. Croix for transporting their families and supplies into the territory that would soon become Minnesota and Wisconsin. The changes that Ray Baker saw in his lifetime were typical of the changes occurring throughout the St. Croix valley. More recently, the proximity of the St. Croix to the Minneapolis and St. Paul metropolitan area has resulted in intense pressure for recreational use and urban development (Behm, 1994; McDonnell, 1995).

Landscapes consist of patches that differ in composition, size, shape and spatial distribution. The composition and structure of most landscapes reflect the interrelation between the physical environment and land-use history. The human contribution to spatial heterogeneity can be significant; current conditions generally result from 'layers' of past activities, each leaving an imprint on the landscape that persists long after the activity has ceased. To understand current conditions and to predict the impact of future changes in landscape composition and structure, we need to decipher past land use and its relation to ecosystem function. Relating past land-use history to current conditions, however, requires utilizing a variety of information sources, such as federal census records, narrative accounts of settlements, early settlement maps and photographs.

People have long impacted the landscape in the

St. Croix River valley. Although some of these impacts—such as burning the prairies and savannas—may have been significant, the extent, frequency and intensity of early human activities were limited (Curtis, 1959; Whitney, 1994). However, during the past 150 years, the landscapes of the St. Croix River valley have experienced major changes—converting to cutover forest land, farmland and urban land with remnant patches of prairie, oak savanna and mixed coniferous–deciduous forest.

The history and the ecological effects of these changes are not widely known or understood. Landscape history provides analogues of current and possible future conditions, and contexts for understanding how landscapes reached their present state (Wasson, 1994). Our objective in this paper is to document the history of land-use change in the lower St. Croix River valley from the time of European–American settlement. We review the sources and types of information available, the physical characteristics of the valley, and the importance of the area to indigenous people and early European–American settlers in the upper mid-west. We also provide a historical chronology of the events that shaped the landscape, and describe the ecological implications of changes in landscape composition and structure.

## **2. Sources of information**

Many sources tell the history of land-use change in the lower St. Croix River valley. Primary sources include US Census records, records of lumber mill outputs and crop yields, records of land sales, descriptive accounts from some of the early settlers, maps, plat books, photographs, pamphlets to promote the area to immigrants and tourists, and early scientific reports on the geology, botany and forestry of the region. These sources vary in their reliability, data resolution and geographic extent, and few historic records were spatially explicit. The US General Land Office (GLO) Survey, which was conducted for the lower St. Croix area from 1831 until 1865, provides a record of vegetation at the time of European–American settlement. The land surveyors identified witness trees for section corners and quarter section points in each township. Witness trees were

used to locate corner positions as permanently as possible. They were marked by making a blaze or 'small chop' into the tree with an axe and species and diameter were recorded in the field notes. These notes were supplemented by a rough map of the township and information about the vegetation, especially tree cover, land features such as soils, streams and rock outcroppings, and evidence of human habitation. Bourdo (1956), Whitney (1986) and Whitney (1987) discuss the use of GLO surveys for reconstructing presettlement forests, and they identify the limitations of these data. In 1929, the Wisconsin Department of Agriculture began publishing land-cover maps of the state—known as the Bordner Reports or the Land Economic Survey—showing land-use at the township level. The Bordner Reports continued to be published into the 1940s. Viewed collectively, these historic records describe the landscape as perceived at different points in time and in different places within the watershed.

We used the US Census of Agriculture records extensively for compiling data on farm characteristics. Since 1850, the census definition of a farm has been changed nine times, and these changes may account for some differences in the census farm data. In 1860, a farm for census purposes was defined as:

... all considerable nurseries, orchards, and market gardens which are owned by separate parties, which are cultivated for pecuniary profit, and employ as much as the labor of one able-bodied workman during the year. Mere cabbage and potato patches, family vegetable gardens, and ornamental lawns, not constituting a portion of a farm for general agricultural purposes, will be excluded. No farm will be reported of less than 3 acres, unless \$500 worth of produce has been actually sold off from it during the year.... A farm is what is owned or leased by one man and cultivated under his care. A distant wood lot, or sheep pasture, even if in another subdivision or district, is to be treated as a part of the farm;.... (Wright [1900], 1966).

In the 1959 Census of Agriculture, the decrease in the number of farms resulting from the change in the farm definition from the 1954 Census of Agriculture was noted. For the counties in the study area, the numbers of farms were reduced by 28 to 75 farms per county, because of this change in farm definition

(US Bureau of the Census, 1961a; US Bureau of the Census, 1961b). The definition of a farm used since 1974 is "any place from which \$1000 or more of agricultural products were produced and sold, or normally would have been sold, during the census year" (US Bureau of the Census, 1994a).

In evaluating historical statements, we used several criteria to determine their validity. Primary sources based on first- or second-hand observation were sought. In other words, the author of a document either personally made the observations reported or learned of them second-hand from the actual observer. If an event or statement was reported by more than one primary author, it was given more credence than one reported by only one person (Forman and Russell, 1983).

Another source of information is promotional literature and advertisements that were prepared during the time of European–American settlement to attract land buyers and settlers. Such statements sometimes exaggerated the agricultural potential of the soil and other natural resources, and they should be viewed skeptically. The statements from these sources may be true, but we cannot be certain. The impressions of many of the early European–American settlers, as well as the surveyors' field notes, usually focused on the qualities of the land that would make it suitable for lumbering, farming or other economic endeavors. An example is a description by Folsom (1888) of the St. Croix valley:

The southern portion is a rich prairie country, interspersed with groves of hardwood timber. The more northern portion is interspersed with groves of pine, tamarack, cedar, balsam and hardwoods. The whole district, with a small exception, is a cereal country. It abounds in wild meadows, and much of the swampy portion will ultimately be utilized by ditching, which will transform it all into a good stock raising country. About eight-tenths of this entire valley is fitted by nature for agriculture.

Wheat, the leading cereal, averages ten to thirty bushels per acre; the growth of tame grasses can not be excelled; vegetables grow to wonderful size; native wild fruits abound; cultivated fruits are being successfully introduced; cranberries are being cultivated in the northern part. Wheat, stock, and pine

lumber are the principal articles of export.... The soil is, as a general thing, dry and arable. April and May are the seeding months. Crops mature, and are seldom injured by frosts. The whole country adjacent to this valley will answer to this general description.

### 3. Lower St. Croix study area

To compare population and agricultural statistics compiled at the county level with landscape changes over time, we focused our study on the five counties that include most of the watershed of the lower St.

Croix River: Chisago and Washington Counties in Minnesota, and Pierce, St. Croix and Polk Counties in Wisconsin (Fig. 1). Portions of the watershed are in the northwest corner of Barron County, WI, and on the eastern edge of Ramsey County, MN, but because of the small proportions of the total watershed area and the distance from the river, these counties were not included in the analysis. The southeast two-thirds of Barron County is much more agricultural than the other five counties in the study area. Ramsey County includes the city of St. Paul and is one of the most urban counties in Minnesota.

The size of the five counties in the study area has varied with time. In 1851, Chisago County was

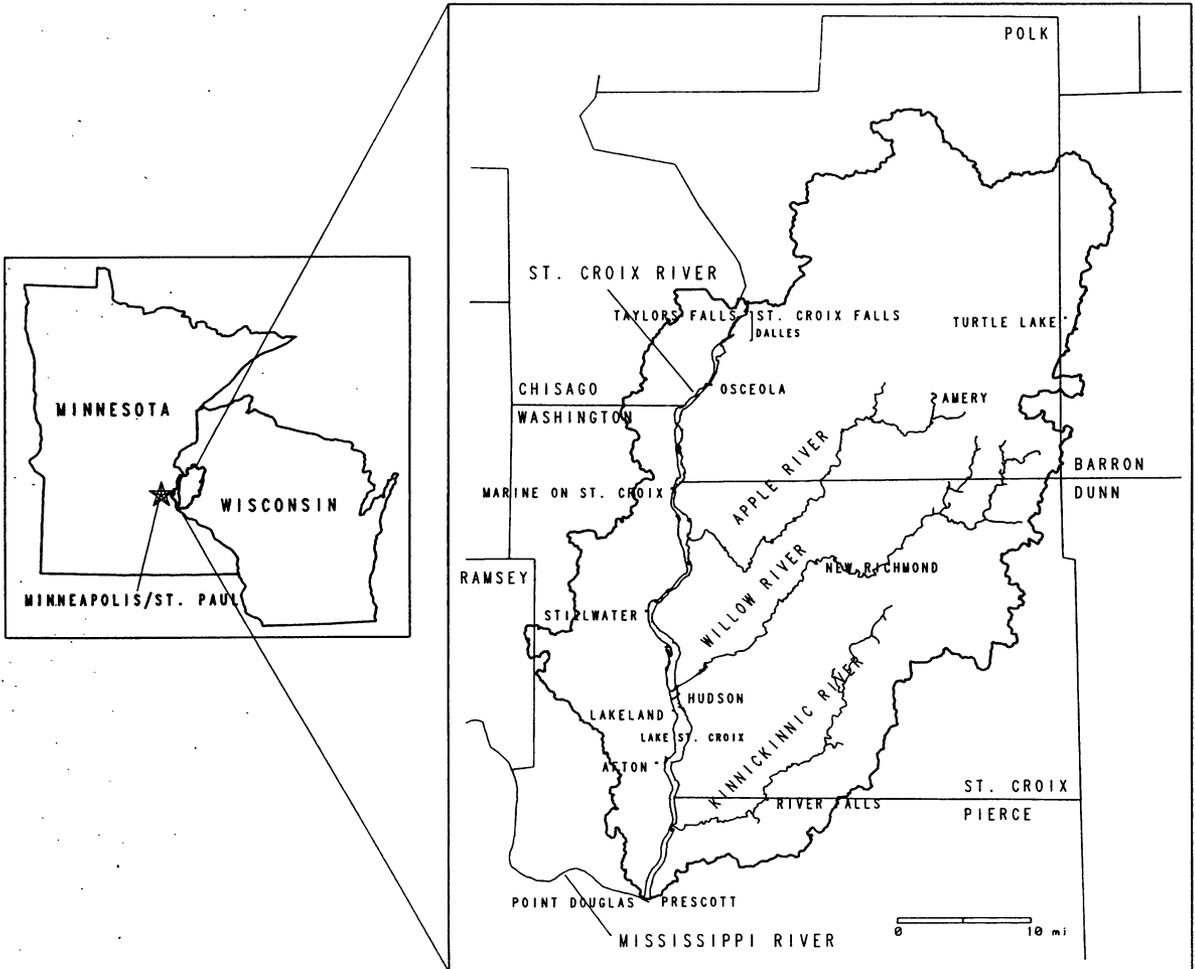


Fig. 1. Location of the lower St. Croix River watershed.

created out of Washington County. The boundaries for Pierce and St. Croix Counties have remained the same since 1853 when Pierce County and Polk County were separated from St. Croix County. In 1853, Polk County extended north of Yellow Lake and Devil's Lake to the south of the present-day town of Danbury. Polk County was reduced in size in 1856 and 1859, and expanded one township eastward in 1863. Polk County's present boundaries have been in effect since 1866, after parts of three townships were transferred to Burnett County (Folsom, 1888; Wisconsin Historical Records Survey, 1941).

The St. Croix River forms the boundary between Minnesota and Wisconsin in our study area. The river originates in northwestern Wisconsin at a spring near Upper St. Croix Lake in Douglas County and joins the Mississippi River at Prescott, Wisconsin. The St. Croix River is 165 miles (266 km) in length with a watershed of 7650 square miles (19813.5 km<sup>2</sup>). The lower St. Croix River watershed (1470 square miles or 3807.3 km<sup>2</sup>) consists of the lower 52 miles (83.7 km) of the drainage basin south of Taylors Falls/St. Croix Falls and is approximately 19% of the drainage basin. Three major tributary streams in Wisconsin, the Kinnickinnic, Willow and Apple Rivers, drain most of the lower St. Croix watershed.

Before European–American settlement, fire was common over much of the prairie and oak savanna and was an important factor in maintaining these ecosystems within the lower St. Croix watershed. Williams (1993, p. 31) stated that most of the prairie openings and perhaps the prairies themselves were a consequence of repeated burning by Indians. From evidence in Wisconsin and Texas, these frequent firings sustained the grassland vegetation against forest encroachment and may have caused a gradual extension of the grassland. Rapid changes occurred after European–American settlement due to the suppression and exclusion of fire from the landscape (Curtis, 1959);

Their small and widely distributed private holdings were guarded against accidental conflagrations and were further protected by the interpolation of roads and plowed fields. As described in earlier chapters, rapid changes took place in the newly protected

communities, often with a nearly complete change in species composition. This was particularly true in the brush prairies, pine barrens, and oak savannas, where a closed forest canopy quickly eliminated most of the light-demanding prairie species of the original groundlayer. Most of the current stands of oak forest in the southern counties and the few remaining white and red pine forests in the north date back to this change in land treatment, with trees remarkably close to one hundred years old on the average.

The lower St. Croix watershed is located in an ecotone between the northern hardwoods province and the prairie–forest province. Curtis (1959) called this ecotone the 'tension zone', since it delineated two major floristic provinces and represented the limits of distribution for many plant and animal species. This regional ecotone extends across the three Lake States and further into the Northeastern United States. Based on the GLO survey, the major vegetation types present in the lower St. Croix valley before European–American settlement were mixed stands of hardwood and conifers dominated by sugar maple (*Acer saccharum* Marsh.) and white pine (*Pinus strobus* L.) in the northern half of the area, sugar maple and basswood (*Tilia americana* L.) on rich sites in areas protected from fire in the Minnesota portion of the study area, and oak openings or savannas dominated by bur oak (*Quercus macrocarpa* Michx.) and perhaps grading into white oak (*Q. alba* L.) where fire was less frequent. Intermixed with the oak openings were prairies, with a patchwork of wet prairies embedded in the upland prairie matrix. Other wetland systems were associated with the rivers, and brushland was commonly identified by the surveyors, probably representing areas where frequent fires maintained thickets of woody vegetation. Areas of recent burns were also noted by the surveyors. Based on reconstruction of the GLO survey information, an estimated half of the lower St. Croix was in closed-canopy forest at the time of the original survey, with 16% covered by oak savanna, and 18% in prairie (S.M. Lietz and T.R. Crow, unpublished report. Stewardship of the Lower St. Croix River. US Department of Agriculture, Forest Service, North Central Forest Experiment Station, Rhinelander, WI 54501, USA, 23 June 1993) (Fig. 2). Various wetland and aquatic systems, including

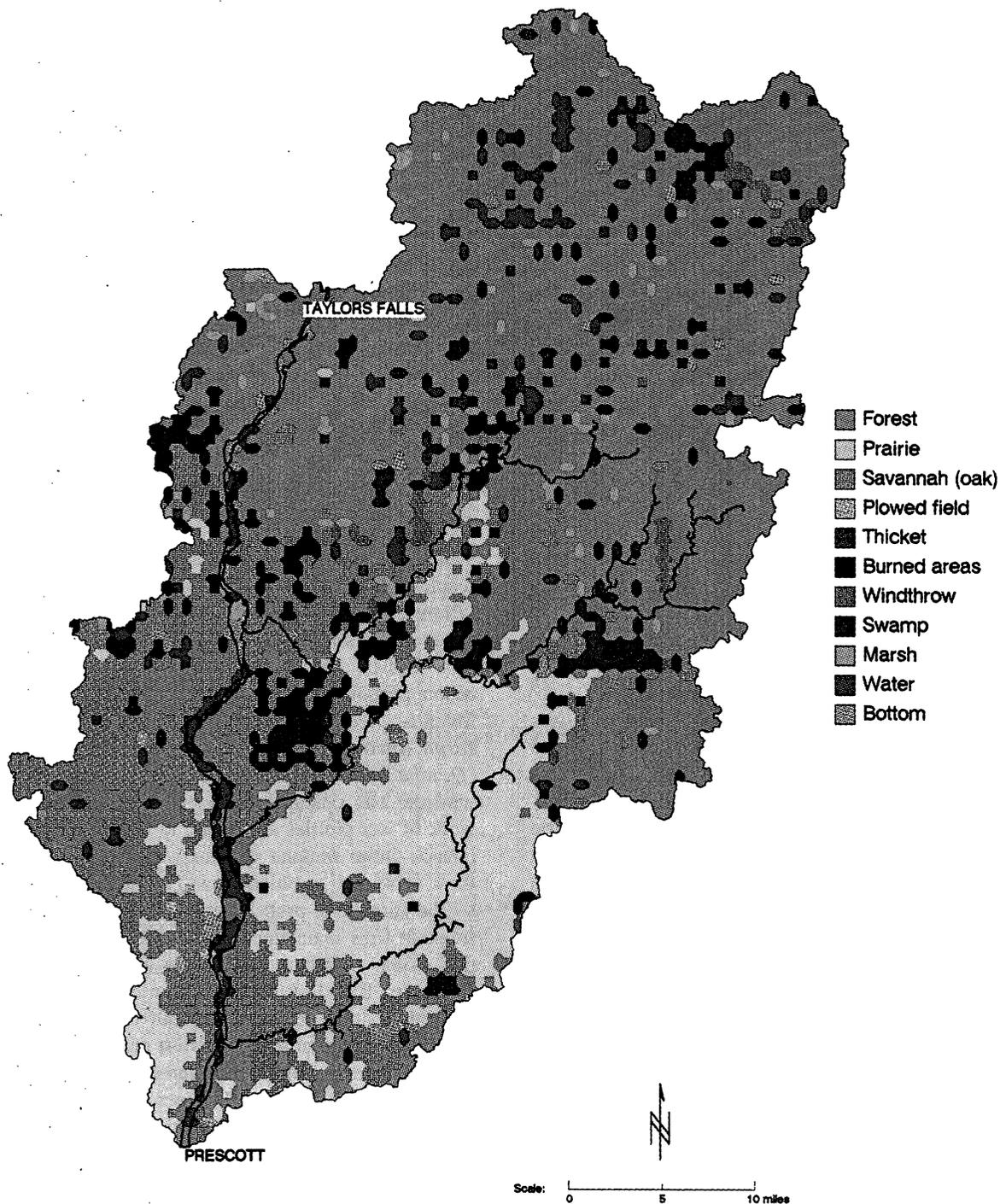


Fig. 2. Vegetation of the lower St. Croix watershed in 1831–1865, based on General Land Office Survey Notes.

lakes, rivers, streams, wet prairie, marshes and wet bottomland, accounted for ~ 10%, and the remaining area was in a disturbed state (e.g. plowed field, burned, windthrow).

Not surprisingly, the major community types reflect broad climatic patterns and regional physiographic features. In northern forest, Precambrian bedrock is generally overlain with glacial drift, and the glacial drift is up to 300 feet (92 m) thick. Kettle lakes are common on the moraines. The growing season is short, 100–120 days, with annual precipitation averaging 30–35 inches (76–89 cm) (Albert, 1995). The oak savanna and prairie portions of the watershed are characterized by loess-covered limestone and dolomite or pre-Illinoian ground moraine (Albert, 1995). Here, the climate is slightly milder than the northern forest, with a 146–160-day growing season, but with annual precipitation averaging only 28–31 inches (71–79 cm). There are few lakes in this portion of the study area.

Wooster (1882) described the vegetation he observed in 1876–1877 in St. Croix County and parts of Dunn and Pierce Counties when he published the first detailed map of the vegetation for any region in Wisconsin. Most of the area was classified as prairie and oak–poplar forest. In the prairie areas, he reported that “many of the deeper hollows are occupied by lakes or ponds with a circling border of marsh vegetation, or the water remains but temporarily, leaving the entire area a hay marsh.” The oak–poplar area was characterized as: “Unlike the oak groves in the limestone and heavy-drift regions, much of the timber is quite light, being composed largely of shrubs and bushes.” Wooster reported species in the oak–poplar group as including northern red oak (*Quercus rubra* L.), black oak (*Q. velutina* L.), aspen (*Populus tremuloides* Michx.) and (*P. grandidenta* Michx.), white oak, and bur oak. “In the northwestern portion of St. Croix county, west of Willow and Apple rivers, dwarf oaks and poplars, with hazel bushes (*Corylus americana*), occupy the surface except over the lower Magnesian limestone in the eastern and western borders of the region” (Wooster, 1882). Parts of the northern area of the district had patches of pine but “... little land covered exclusively by pine exists in the district.” By the time of the GLO survey of Wisconsin, the vegetation had been radically changed by illegal logging

of white pine, especially in the northern part of the watershed. Wooster described the pine areas within the mixed hardwood–conifer forests as areas in which “the bodies of White Pine are frequently skirted by Red Pine (*Pinus resinosa*), wrongly called Norway Pine with a tree termed Black or Jack Pine (*Pinus banksiana*) in the drier situations.” In 1876, “large tracts that were once covered with pine have been stripped of this timber, and a miscellaneous growth of shrubs has succeeded, which, with the hardwood timber that was left standing, make up a forest altogether different from the original one.”

#### 4. Early history

Table 1 lists significant events in the history of the lower St. Croix River valley. In the 1600s and 1700s, many Indian tribes from eastern North America, including the Mascouten, Potawatomi, Sauk, Fox and Ojibwa (Chippewa), migrated into present-day Wisconsin, displaced by social and economic upheaval caused by tribal wars and by European–American settlement in the East (White, 1991). Except for the Mascouten, these were woodland tribes and they often had to change their traditional ways of hunting, food gathering and agriculture to fit the new prairie and savanna environment. The Great Lakes region of the mid-1600s to early 1800s was a world of loose confederations and coalitions in a constant state of flux, rather than there being tribes with distinct territories and chiefs. Refugees from remnants of eastern confederations, like the Hurons and Petuns, lived in contiguous villages or even in mixed villages with relatively intact tribes like the Fox (White, 1991). In the 1700s, the Ojibwas were located in the lands that would become the Upper Peninsula of Michigan, northern Wisconsin, and northern Minnesota. Warren [1885] (1957) reported three thousand Ojibwa living in the State of Wisconsin and five thousand in the Territory of Minnesota in 1852. The Dakota (Sioux) were in the land that would later be called Minnesota, Iowa and the Dakotas. Our study area was historically a conflict zone between the Ojibwa and Dakota peoples (Dunn, 1979). In the 1700s, Ojibwa villages existed near what would later be Webster, Wisconsin and Pine City, Minnesota. In 1830, there was an Ojibwa vil-

lage in the vicinity of present-day St. Croix Falls (Tanner, 1987). In the late 1700s and until about 1830, a Dakota village was located at the mouth of the St. Croix near present-day Prescott, Wisconsin (Tanner, 1987). A map in Durand (1994) shows Dakota and Ojibwa place names on both sides of the St. Croix.

The first European–Americans to see the St. Croix area were the French, who came to the area in the 1600s for economic and religious reasons (Robinson, 1915; Trigger, 1978). French fur traders traveled through the Great Lakes and south into present-day Minnesota and Wisconsin. The St. Croix River was one of the first passageways for French fur traders and explorers who canoed from Lake Superior to the Mississippi (Warner and Foote, 1881). Medard Chouart des Groseilliers and Pierre Esprit Radisson

were reported to have traveled in eastern Minnesota in 1655 and 1659. In 1680, Daniel Greysolon Du Lhut traveled from Lake Superior to the Mississippi River by way of the Bois Brule and St. Croix Rivers (Robinson, 1915). H.R. Schoolcraft, an American geologist and explorer, made an exploratory trip from Prescott to Lake Superior via the St. Croix and Brule Rivers in 1832 (Martin, 1916).

The Indian people who lived in the St. Croix valley were largely forced out by the wave of immigrants who began moving into the area from the eastern United States after the land was ceded in 1837 and 1838. The area was described at the turn of the century: “Adjacent to the Dalles are the ancient battlefields of the Sioux and Ojibway Indians. The rock and hills of the St. Croix Valley, from the source of the river to its mouth, have often been

Table 1  
Lower St. Croix timeline

1500s	Chippewa (Ojibwa) Indians moved into northern and western Wisconsin from the Lake Superior area, pushing the Dakotas westward
1832–1907	US General Land Office Survey conducted for Wisconsin and Minnesota
1837–1838	The area that includes the lower St. Croix valley was acquired through treaties of cession with the Chippewa (Ojibwa) and Sioux (Dakota)
1837	First pine logs cut near Taylors Falls in the St. Croix valley
1838	First steamboat traveled up the St. Croix River to the Dalles
1838	Territory of Wisconsin organized
1839	First sawmills built in the St. Croix valley
1848	Wisconsin became a state
1848	The land office at St. Croix Falls sold the first land in the St. Croix valley, including the townsites of St. Paul, Stillwater and St. Anthony
1849	Territory of Minnesota organized
1850s	Point Douglas and Lake Superior military road built
1851	Ferry established from Point Douglas to Prescott
1856	First bridge across the St. Croix River built at Taylors Falls
1857	The ‘Panic of 1857’ caused an economic depression
1858	Minnesota became a state
1861–1865	US Civil War
1862	The Homestead Act of 1862 passed by the US Congress
1870	First railroad built in St. Croix valley, from St. Paul to Duluth by way of Stillwater and Taylors Falls
1889	Peak number of logs cut in St. Croix valley
1890	Nevers Dam built 11 miles north of Taylors Falls to control log jams on the St. Croix River (this was the largest wooden-pile dam in the world)
1895	Interstate Park established
1905	60-foot-high power dam built at Taylors Falls/St. Croix Falls
1934	First USDA Forest Service forest survey of Minnesota
1935	Peak number of farms in St. Croix valley; Pierce County was 98.9% farmland
1940	First USDA Forest Service forest survey of Wisconsin
1965	Coal-fired power plant built south of Stillwater; Minnesota–Wisconsin Boundary Area Commission formed
1972	Lower St. Croix River added to the National Wild and Scenic Rivers System
1976	Master plans adopted for St. Croix National Scenic Riverway; State Riverway zoning regulations adopted

stained with Indian blood.... But now, with the exception of a few Indians about the head of the river, all have departed; some have gone to homes in the west, but most of them to an unknown land” (Folsom, 1901). Gone were the small, scattered bands of people who depended on hunting and gathering along with the cultivation of small gardens for subsistence. These people changed the land, especially by using fire to aid in hunting, but these impacts were minor compared with changes that would come. When the Sioux and Ojibway surrendered their lands, ‘free land’ quickly passed into the market place, and along with the people who had departed for unknown places, the tallgrass prairie, the wet prairie, the oak savanna, the white pine forest and the sugar maple–basswood forest would soon disappear.

### 5. Lumbering in the lower St. Croix valley: 1820 to the present

Small-scale logging began along the St. Croix in the 1820s, well before the land was ceded to the federal government by the Indians. Commercial logging began in earnest almost immediately after the treaty was ratified. Among the early loggers, J.R. Brown established a camp at the present-day site of Taylors Falls in the winter of 1836–1837, and John Boyce brought 11 men and 6 oxen up the St. Croix from St. Louis in a mackinaw boat, landing at St. Croix Falls in the fall of 1837 (Folsom, 1888).

Pioneer loggers, many from Maine and other north-eastern states (Larson, 1972), were attracted to the St. Croix River valley because of the abundance of white pine. The preferred species for building, white pine is a lightweight, yet strong, durable wood that is easy to work. It could be floated down rivers, and thus could be processed and moved to markets with relative ease.

Timber harvesting increased rapidly from 1837 to 1849 (Fig. 3). The average amount cut each year from 1837 through 1849 was almost 19 million board feet (Easton, 1909). As described by Larson (1972), “they had obtained timber for their mill for almost a decade without being owners of pine land.” The common attitude was that the “timber, the people thought, belonged to them ‘as citizens inheriting an interest in the government’.” From 1837 to 1849, eight sawmills were built in the lower St. Croix valley, and seven communities (Prescott, Hudson - then called Buena Vista) and St. Croix Falls in what is now Wisconsin, and Afton, Lakeland, Stillwater and Taylors Falls in what is now Minnesota) were settled, platted and organized (Fig. 1).

Timber harvesting continued to increase in the 1850s and 1860s. The average annual cut in the St. Croix valley from 1850 through 1869 was 155 million board feet (Easton, 1909). Between 1850 and 1869, 12 additional sawmills were built in the lower St. Croix valley, and 12 new communities were settled, platted and organized (Apple River Falls - now Somerset), River Falls, Cylon, Hammond, Luck,

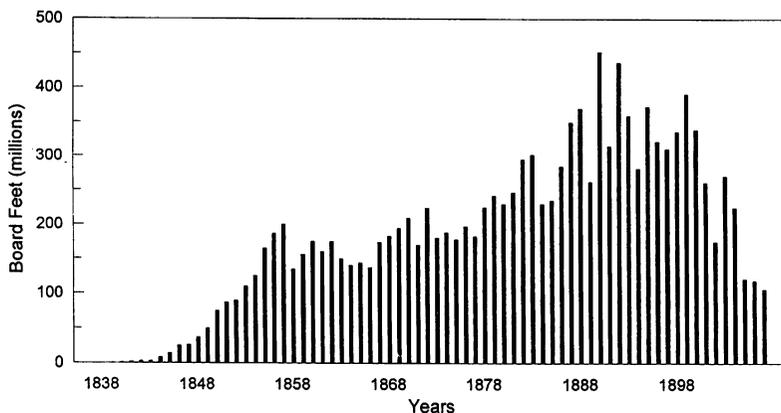


Fig. 3. Logs cut in the lower St. Croix valley, 1838–1907. Source: Easton, 1909.

Balsam Lake, Emerald and Milltown in Wisconsin, and Chisago Lake, Chisago City, Centre City and Franconia in Minnesota).

By 1872, there were 17 sawmills and 2 log booms located on the St. Croix River (Warner and Foote, 1881). Timber production in the St. Croix valley continued its upward trend with an average annual cut amount of 241 million board feet from 1870 through 1889 (Fig. 3).

Until the 1880s, the logging industry depended on water transport to move large pine logs. Robinson (1915) estimated that a third of the logs from the St. Croix valley were rafted downriver to Rock Island and Moline, Illinois, and other towns as far south as St. Louis. Logs were hauled from the forest to the closest navigable stream—usually limited to a distance of 1–4 miles (about 2–7 km), or sometimes up to 6 miles (about 10 km). Small dams, often known as splash dams, were frequently built on feeder streams to back up enough water to assist in the log drives. Log jams were common events during these years. The biggest log jam on the St. Croix occurred in 1886 (Fig. 4). With the building of railroads, this reliance on water for transportation began to diminish. In 1870 a railroad line from St. Paul to Duluth

was completed, and in 1871 branch lines were constructed to Stillwater and Taylors Falls. In 1872 additional railroad lines were built from St. Paul to Stillwater, with branches to Marine, Minnesota, and to Hudson and New Richmond, Wisconsin (Warner and Foote, 1881; Folsom, 1888).

The peak of lumber production for the years 1837 to 1907 in the St. Croix valley occurred in 1890, when 452.4 million board feet of logs were cut (Fig. 3). For 6 years (1898–1903), Wisconsin led the nation in board feet of lumber cut. In 1899, 3.4 billion board feet were cut—the largest amount ever cut in Wisconsin. Of this, 71%, or more than 2.4 billion board feet, was white pine. In 1899, Wisconsin had 1033 operating sawmills, mostly within or on the edge of the southern limit of commercial pine (Ebling et al., 1948). Before 1885–1890, ‘lumbering’ in Michigan, Wisconsin and Minnesota meant almost exclusively the cutting of white pine (Ahlgren and Ahlgren, 1983). During that time, little hardwood was being cut commercially in the Lake States, and other pine species were regarded as of little value as lumber until white pine became less plentiful. Hardwood species and other softwood species, such as cedar and hemlock, were utilized locally as

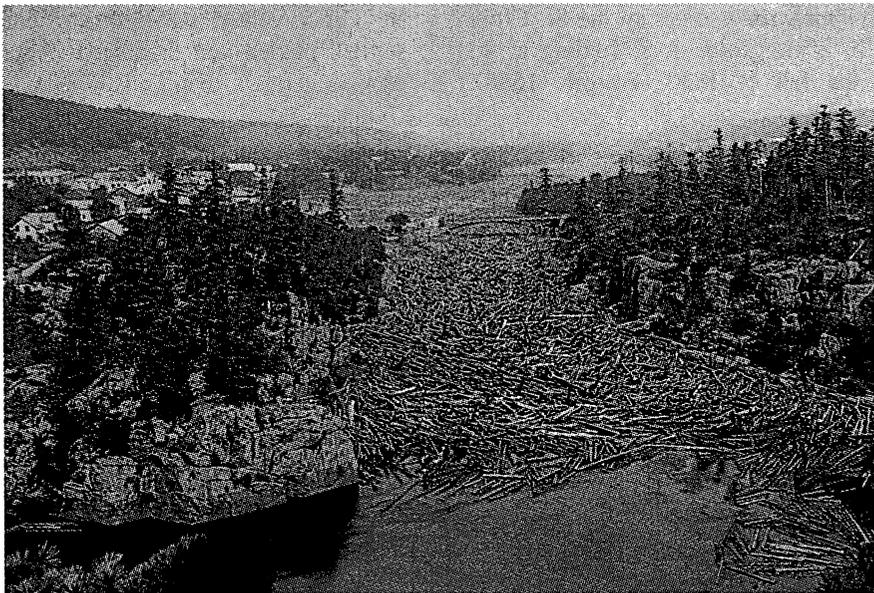


Fig. 4. Log jam on the St. Croix at Taylors Falls, 1886 or 1892. Source: S.C. Sargent, Taylors Falls, Minnesota Historical Society.

shakes, shingles, sheathing and railroad ties. In the early 1890s in the northern part of the St. Croix watershed, especially in Burnett County, jack pine began to be harvested for lumber. Until then, it had been considered 'a worthless commodity' (Easton, 1909).

Seymour (1850) states that "All the tributaries of the St. Croix abound in pine.... There is generally no pine timber on the immediate bank of any of the tributaries. It is mostly obtained from half a mile to two miles from the rivers." Sargent's 1881 map of the cutting history of Wisconsin's forests shows a narrow band of harvested pine, approximately 10 miles wide (about 16 km), along all of the major rivers of Wisconsin, including the St. Croix (Sargent, 1884). By the turn of the century, the white pine forests along the St. Croix River had been logged and fires had burned over much of the cutover forest lands. It was common logging practice to cut only the choicest trees and sometimes to harvest only one or two butt logs from these choice trees. Stumps were cut high and the tops of the trees were not used. The cutover areas were usually burned after being logged, either through fires set deliberately to clear the land, lightning, or fires caused accidentally, e.g. from sparks from trains. Few attempts were made to control the fires. In 1864 the St. Croix pineries, as well as the pineries along the Chippewa, the Black, the Wisconsin and the Wolf Rivers, were "raging seas of flame" (Ebling et al., 1948). These fires killed the remaining trees and left large areas with early successional species such as pin cherry (*Prunus pensylvanica* L.f.), aspen and white birch (*Betula papyrifera* Marsh.). In contrast, the previous forest was dominated by conifers, such as red and white pine, that regenerated originally when fires were less intense and not so widespread, mixed with hardwood species such as sugar maple (Curtis, 1959). No trees were planted in the cutover and burned-over areas. In 1898, "no young growth of pine" was reported in the hardwood districts of northern Wisconsin—more than 80% of the cutover lands were "practically devoid of any valuable forest growth whatever" (Roth, 1898).

Wasteful milling practices were also the norm. 'Scrap' wood pieces, which could have been used for laths, shingles or fuel, were burned or dumped in the river. Sawdust was a waste product. Despite

some published reports on deforestation and the need to conserve forests, such as the *Report on the Disastrous Effects of the Destruction of Forest Trees, Now Going on so Rapidly in the State of Wisconsin* by I.A. Lapham, J.G. Knapp and H. Crocker (Lapham et al., 1867), and Sargent's *Report on the Forests of North America (Exclusive of Mexico)* (Sargent, 1884), the prevailing attitude was that the forests of the 'West' were 'inexhaustible' (Ebling et al., 1948).

Lumbering continued in Wisconsin in the 1920s and 1930s, but at a diminished rate and with different species than during the peak years of 1898–1903. In 1923 hardwood cut in Wisconsin exceeded softwood cut for the first time, and in 1925 the amount of maple and birch cut in Wisconsin was equal to the amount of white pine, balsam, cedar, spruce and tamarack cut (Ebling et al., 1948). In 1928 it was reported that "nearly five-sixths of the forest land in the northern counties of the state [Wisconsin] are either jack pine, popple, or scrub oak land" (Zon, 1928).

Timber harvest in the lower St. Croix watershed continued in the 1970s and 1980s, especially on the Wisconsin side of the St. Croix River. In 1973, Chisago, Washington and St. Croix Counties each produced less than 1 million board feet, while Pierce and Polk Counties produced 1 and 4.99 million board feet, respectively. Saw-log production in 1973 ranged from 71 thousand board feet in Chisago County to almost 4 million board feet in Polk County. Total saw-log production in the lower St. Croix in 1973 was 8 709 000 board feet. The predominant species harvested as saw logs in 1973 were basswood, elm, sugar maple and red oak (Blyth et al., 1976; Blyth et al., 1979). In 1988 and 1990, saw-log production increased in the lower St. Croix valley to more than 15 million board feet each year. Pierce and Polk Counties had the highest levels of saw-log production in 1988 and 1990, with about 5 million board feet harvested each year in each county. The major species harvested as saw logs in 1988 and 1990 were red oak, white oak and aspen. In 1990, sawlog production was 264.6 million board feet in Minnesota and 583 million board feet in Wisconsin (Smith and Whipple, 1990; Smith and Dahlman, 1991; Hackett and Dahlman, 1993; Hackett and Whipple, 1993).

## 6. Agriculture in the lower St. Croix valley: 1830 to the present

Limited farming was practiced at the first lumber camps, where people often cut wild hay and planted potatoes, corn and oats for use the following winter (Robinson, 1915). In the 1840 census for St. Croix County, only 114 persons were reported as employed in agriculture. At that time, St. Croix County included all of Wisconsin west of a line from the mouth of the Porcupine River at Lake Pepin to Lake Superior and the district between the St. Croix and Mississippi Rivers, in what is now Minnesota. The gardens and small fields of corn and potatoes planted by the European–Americans produced insufficient food to support the local population, nor could the produce be transported great distances. In the early years of settlement, most food and supplies were shipped up the St. Croix on steamboats, but shipments were sporadic during the best shipping seasons and did not occur during the winter months (Warner and Foote, 1881; Larson, 1972).

Government land offices first located in Stillwater and at the mouth of the Willow River facilitated land sales for permanent settlement (Fig. 1). In the 1850s, public land was sold to people who could buy it with military bounty land warrants or with cash. These types of land purchases favored people with capital. The Homestead Act, signed into law in 1862, gave more people an opportunity to settle on the frontier, but in reality the land often ended up being owned

by lumber companies. Applicants were given 160 acres (approximately 64.7 ha) under the conditions that they live on it for 5 years and make certain ‘improvements’. According to the 1850 census, ‘improved land’ was defined as “cleared and used for grazing, grass, or tillage, or which is now fallow” (Wright [1900], 1966). Alternatively they could purchase the land early by giving proof of settlement and cultivation for at least 6 months (Larson, 1972).

Population in the lower St. Croix valley increased during the 1850s and 1860s as settlement continued (Fig. 5). The 1850 census recorded 1680 people in St. Croix and Washington Counties, which at that time were much larger than they are now. In the 1850 census, only European–American settlers were counted; the 1860 census was the first to count Native American and African–American people. The population in the lower St. Croix valley increased rapidly in the decade after the Civil War (Fig. 5). The total population in the five counties increased from 19 330 in 1860 to 40 582 in 1870. By 1870, the largest populations in the lower St. Croix valley were in Washington, St. Croix, and Pierce Counties (Androit, 1983).

The St. Croix river was the main travel corridor for European–Americans as they migrated into the area. People and supplies were transported first by canoe, and then by steamboat after the 1840s. Steamboats regularly plied the waters between St. Paul and Minneapolis, and towns and cities along the Mississippi River in Minnesota, Wisconsin, Iowa and Mis-

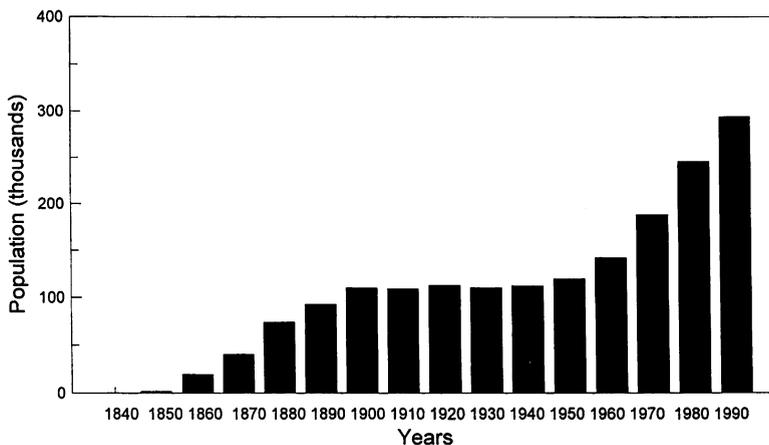


Fig. 5. Population in the lower St. Croix valley, 1840–1980. Source: Androit, 1983.

souri. A land transportation system began to form in the 1850s as trails and paths became roads. Settlement followed the construction of roads, and the roads provided the means for getting produce to markets. In the 1870s, railroads were built in the lower St. Croix River valley and became an important part of the transportation network in the area.

The decade between 1850 and 1860 was one of large increases in the number of farms and the number of acres in farms in the lower St. Croix valley (Fig. 6(A,B)). The acreage of farmland increased dramatically—from 16 918 acres (6846 ha) in 1850 to 219 662 acres (88 885 ha) in 1860. In 1850, Washington County had 58% of the total 'improved' (plowed or enclosed) land in Minnesota. There were 157 farms in Minnesota in 1850, with a total of 28 881 acres (11 686.6 ha) and an average size of 238 acres (96.3 ha) (Fig. 6(C)), of which 40 acres (16.2 ha) were 'improved' (Robinson, 1915).

In the lower St. Croix valley, the 1850s and 1860s were years of transition from a pioneer or subsistence agriculture to a market agriculture. Many early farmers worked in the lumber camps during the winter months, and many farm products were sold to lumber camps. Supplying the logging camps each fall required a large input of oats, hay, beef, pork and flour (Ebling et al., 1948). It was not until after a good harvest in 1859 that farmers began to export crops from the St. Croix valley (Robinson, 1915). Oats and potatoes were shipped downriver from Taylors Falls; wheat, oats and potatoes were shipped from Stillwater; and wheat and oats were shipped from Point Douglas (Robinson, 1915).

Farm numbers and acreages continued to increase in the lower St. Croix valley in the 1870s and 1880s (Fig. 6(A,B)). By 1870 in Pierce County and 1880 in St. Croix County, more than 50% of the land was in farms (Fig. 6(D)). In the northern part of the lower St. Croix watershed, including Polk County, where logging and agricultural production shared dominance, the conversion to agricultural land occurred later. It was not until 1900 that more than 50% of Polk County was in farms.

Settlers first claimed the oak savannas for homesteads because "to have land which could be cropped the first year was a decided advantage in those days of subsistence agriculture" (Ebling et al., 1948). In addition, the trees provided building materials for

cabins, furniture, fences and barns, and even some implements and utensils were made from the oak, ash and black cherry that grew in this region. The relative ease of converting oak savanna into farmland was a major factor in the early prominence of wheat as a crop. At least for the first few years of settlement, wheat production was high on the converted land. According to Ebling et al. (1948), "Wheat was an ideal pioneer crop. Best yields were obtained on virgin soil, especially if it was derived from limestone or limestone drift." During the 1870s, St. Croix County frequently led Wisconsin counties in wheat production. By 1890, however, wheat acreage had decreased substantially in St. Croix and Pierce Counties due to soil depletion and insect and disease damage, and it was replaced by oats, corn, potatoes and dairy products as major crops. Wheat did not become a major crop in Polk County because of a combination of factors, including unsuitable soils and climate, disease and insect damage, and market conditions. On the Minnesota side of the St. Croix, wheat production followed a similar boom and bust cycle as in Wisconsin. Acreages of rye, potatoes and hay increased in all five counties from 1870 to 1890 (Ebling et al., 1948).

In the 1870s and 1880s, the population of the lower St. Croix valley continued to grow rapidly to a total of 92 853 (Fig. 5). As immigrants settled in the area, the population of Pierce, St. Croix, Chisago and Washington Counties doubled from a combined total of 37 160 in 1870 to 79 885 in 1890, while Polk County's population tripled from 3422 in 1870 to 12 968 in 1890. Settlement and the growth of towns continued in the 1870s and 1880s, but at a slower pace as settlement shifted westward.

While the lower St. Croix valley was growing as an agricultural area in the 1870s and 1880s, the expanding urban center 30 miles (48.3 km) away in Minneapolis and St. Paul was beginning to affect the rural landscape. It was the roads, not the rivers, that eventually linked the rural area with the city. Roads made the landscape accessible by facilitating more rapid and more regular exchanges between city and country. Roads were avenues of commerce, and city and country developed together. "The city grew," as Cronon (1991) noted about Chicago, "by drawing to itself the resources of an emerging region," and in turn, "urban markets made rural development possi-

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ble.” Logging and farming continued to be important economic activities, especially with the growing markets for their products in Minneapolis and St. Paul and other mid-western cities, but a shift in population patterns began at the turn of the century

as farm people began moving into the city for jobs (Robinson, 1915). From 1880 through 1910, conversion of forest and oak savanna to agricultural land continued, but not as rapidly as in 1850–1880. In 1910, Pierce County was 96.4% in farms with 58.7%

**A. Thousands of Farms**

Year	Pierce County	Polk County	St. Croix County	Chisago County	Washington County
1850	0.2	0.1	0.3	0.1	0.2
1875	1.2	1.5	1.8	0.5	0.8
1900	2.8	3.2	3.3	1.8	1.9
1925	3.1	4.2	3.3	2.2	2.0
1950	2.8	3.8	3.0	1.8	1.5
1975	1.8	2.2	1.8	1.2	1.0
1992	1.4	1.6	1.5	0.9	0.8

**B. Thousands of Acres**

Year	Pierce County	Polk County	St. Croix County	Chisago County	Washington County
1850	10	5	20	10	15
1875	150	180	250	50	100
1900	320	380	400	220	200
1925	350	450	430	240	220
1950	360	480	450	240	220
1975	320	380	380	180	150
1992	280	300	320	150	120

Fig. 6. (A) Number of farms in the lower St. Croix valley, 1860–1992. (B) Acres in farms in the lower St. Croix valley, 1850–1992. (C) Average farm size in the lower St. Croix valley, 1880–1992. (D) Percentage of land in farms in the lower St. Croix valley, 1860–1992. Sources: Ebling et al., 1948; US Bureau of the Census, 1853; US Bureau of the Census, 1864; US Bureau of the Census, 1872; US Bureau of the Census, 1883; US Bureau of the Census, 1896; US Bureau of the Census, 1902; US Bureau of the Census, 1913a; US Bureau of the Census, 1913b; US Bureau of the Census, 1922; US Bureau of the Census, 1927; US Bureau of the Census, 1932; US Bureau of the Census, 1936a; US Bureau of the Census, 1936b; US Bureau of the Census, 1942a; US Bureau of the Census, 1942b; US Bureau of the Census, 1942c; US Bureau of the Census, 1946a; US Bureau of the Census, 1946b; US Bureau of the Census, 1952a; US Bureau of the Census, 1952b; US Bureau of the Census, 1961a; US Bureau of the Census, 1961b; US Bureau of the Census, 1972a; US Bureau of the Census, 1972b; US Bureau of the Census, 1981a; US Bureau of the Census, 1981b; US Bureau of the Census, 1989a; US Bureau of the Census, 1989b; US Bureau of the Census, 1994a; US Bureau of the Census, 1994b.

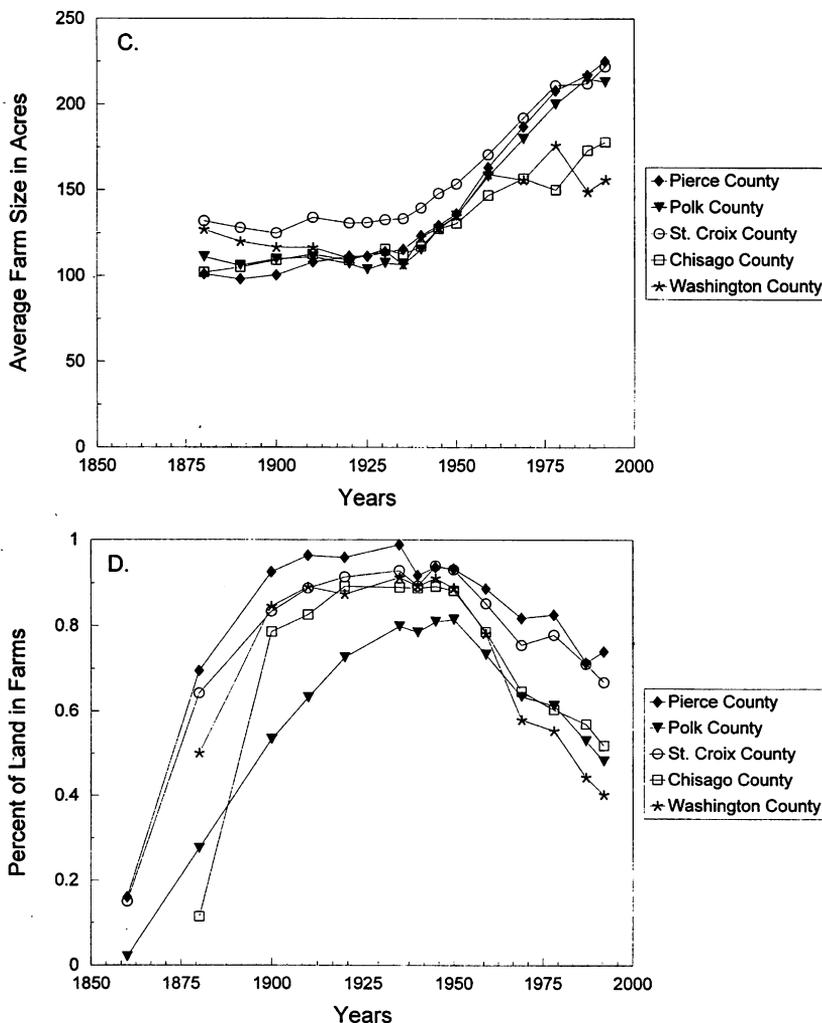


Fig. 6 (continued)

improved, St. Croix County was 88.8% in farms with 71.0% improved, and Polk County was 63.2% in farms with 39.6% improved (US Bureau of the Census, 1913a; US Bureau of the Census, 1913b).

The 1920s and 1930s were a time of stable population in the St. Croix valley (Fig. 5). In 1930 the total population in the five counties along the lower St. Croix was about the same as in 1900. The population of Minneapolis and St. Paul grew by more than 160 000 from 615 280 in 1920 to 780 106 in 1940 (Androit, 1983). During that time, the percentage of land in farms continued to increase in all five counties (Fig. 6(D)). Pierce and Washington

Counties reached their highest percentages of farmland in 1935 with 98.9% and 91.3%, respectively. St. Croix County was 92.9% farmland in 1935, Chisago County was 89%, and Polk County was 79.9%. The number of acres in farms also increased in the 1920s and 1930s (Fig. 6(B)). Pierce and Chisago Counties had their highest number of acres of farmland in 1935. The total number of farms in the lower St. Croix valley peaked in 1935 at 15 220. The principal crops in 1924 (by acreage) were corn, hay and oats in Pierce County, and hay, oats and corn in St. Croix and Polk Counties (US Bureau of the Census, 1927). The conversion of the prairie, savanna and forest to

cropland and pasture was complete. Little more remained to be cropped or grazed. At the peak of this transformation, it is not surprising that 'serious soil erosion' was reported in 1928 on 75% of the farms in southwestern Wisconsin, including St. Croix and Pierce Counties (Zon, 1928).

However, by 1940 the number of farms, the total acres of farmland and the percentage of land in farms began to decrease in all five counties in the valley (Fig. 6(A,B,D)). This trend in agricultural land use continues to the present.

### 7. The urbanization of the lower St. Croix valley: 1940s to the present

As early as 1850, the St. Croix Falls area was being promoted as a beautiful area in which to settle—for its scenic beauty as well as for what was seen as its wealth of timber and fertile soil for farming (Seymour, 1850). In 1881, in a pamphlet called *The Picturesque St. Croix and Other Northwest Sketches*, William H. Dunne described the scenery and history of the Stillwater area from the perspective of being on a steamboat on the St. Croix:

Leaving the bridge far behind, our steamer made her way through large rafts to the landing at Stillwater. The glowing sun was going down behind the Minnesota hills. Reflected in the quiet waters of the river were the trees and mills along its margins, even the surrounding hills were pictured in the water which was aglow with tints from the sky above. (Dunne, 1881)

Although lumbering was still the leading industry of Stillwater at that time, recreational use of the area had already begun. Summer resorts along the St. Croix could be reached by train and steamer. At that time ten trains ran daily between St. Paul and Hudson, Wisconsin, and 13 trains ran daily between St. Paul and Stillwater. At Stillwater, summer visitors could connect with daily steamboats to Taylors Falls and to the Dalles of the St. Croix (Dunne, 1881). The Dalles is an area of the river about 2 miles (about 3 km) long just south of the dam at St. Croix Falls, where the river is confined to a deep, narrow gorge with sheer rock walls. By the 1890s, the area along the St. Croix River from Taylors Falls south to

Stillwater was a popular tourist area, with excursion boats regularly taking people sightseeing in the Dalles of the St. Croix. In 1895, Interstate Park was established (Folsom, 1901). By the early 1900s, a pattern of people commuting between the communities on the lower St. Croix and Minneapolis/St. Paul had developed. An interurban streetcar line traveled between Stillwater and St. Paul every 30 min (Easton, 1909).

Starting in 1940, a second period of rapid population growth began in the lower St. Croix valley (Fig. 5). Washington County's population doubled from 26 430 in 1940 to 52 432 in 1960. St. Croix County and Pierce County had moderate increases in population from 1940 to 1960; Chisago County had a slight increase and Polk County had a moderate decrease. The total population of the five counties increased from 112 064 in 1940 to 142 486 in 1960. Then from the 1960s through the 1980s, the population in the lower St. Croix valley increased more rapidly, with increases in all five counties (Fig. 5). From 1960 to 1990, the total population of the five counties doubled to 294 206 people. With major highways connecting the St. Croix valley with Minneapolis and St. Paul, commuting 40 or 50 miles (about 64–81 km) a day to work became a familiar routine for many people living in rural areas. Relatively cheap fuel prices, the desire to avoid the hassle of urban living, and cheaper housing with increasing distance from the city turned communities such as Stillwater and Hudson into 'bedroom communities' for Minneapolis and St. Paul. The inclusion of these lower St. Croix communities within the commuter ring of Minneapolis and St. Paul since 1940 (Borchert, 1987) has added a new dimension to the linkage between city and countryside.

### 8. A countryside transformed

Our purpose was to gather historical information about the St. Croix River watershed to help us interpret the modern landscape. Aerial photographs, first taken in this area in the 1930s, provided a benchmark for interpreting changes in the landscape. Because significant and dramatic changes in the land surface occurred before this time, we also looked at the period before 1930. A surprising amount of

quantitative information is available in public documents and private collections that provide insight into past human land use and the landscapes created following European–American settlement in North America. This information differs in its quality and reliability, but when it is supplemented with traditional historical documents such as maps, early photographs, drawings, travelers' accounts and oral history, a rich body of eclectic material emerges.

In a sense, landscapes have a 'memory' of past events and perturbations. Past events, such as those listed in Table 1, are still reflected in the composition and structure of the landscape if we are perceptive enough to interpret them. However, the history of a rural landscape may not be as easy to recognize as that of an urban area. Rural landscapes, with their roads, agricultural field patterns, fence rows and forestry practices, are often looked on as 'natural' rather than as human land-use areas (Scott, 1979).

Three significant changes in land use and land cover have occurred in the lower St. Croix River watershed since 1830. The first involved the extensive and rapid conversion of forests, savannas and prairies to an agricultural landscape. In 1840, fur trading was Minnesota's economic backbone. By 1850, lumbering had become the most important economic activity. By the 1860s, however, the lower St. Croix watershed area was being transformed into an agricultural community. In only a few decades, the dominant vegetation—upland prairie, oak woodland and brushland, and maple–basswood forest—was greatly reduced in extent and greatly fragmented (Warren, 1994). The landscape matrix had been converted to agricultural fields, pastures and woodlots. The landscape had taken on the rectangular pattern of the federal land survey. Patches were delineated by ownership boundaries, roads and fence lines. The lower St. Croix watershed is now a human-dominated landscape characterized by straight lines, more uniform patch sizes and rectangular shapes.

The conversion to farming signaled a second defining event in the history of the St. Croix landscape—drainage of wetlands. Although wetlands were not a major landscape element in our study area, a variety of wetland ecosystems—including wet prairies and prairie potholes—did exist and were converted to agricultural uses. These activities were

viewed as 'improving' the land and making it productive for human subsistence. Public policy, such as the Swamp Land Acts of 1849 and 1850, encouraged and supported these conversions. The result was an extensive loss of wetland ecosystems throughout the fertile agricultural region of North America. Whitney (1994) estimates that both Iowa and Illinois have lost more than 85% of their prairie potholes and marshes. More than 80% of the rich elm and ash swamps in Ohio, Indiana and Michigan have met the same fate (Whitney, 1994). In Wisconsin, there were about 10 million acres (4 million ha) of wetlands in the 1830s. According to the Wisconsin Wetland Inventory Program, about 4.7 million acres (almost 2 million ha) of wetlands have been lost (Lois Stoerzer, personal communication. Wisconsin Wetland Inventory Program, Wisconsin Department of Natural Resources, Madison, 1995).

As is the case throughout much of eastern North America, the conversion to farming also resulted in the clearance and fragmentation of forests in the St. Croix valley. This process, documented in detail by Curtis (1956) and Sharpe et al. (1987) for Cadiz Township in southwestern Wisconsin, resulted in smaller, more isolated forest patches with larger edge-to-area ratios immersed in a sea of arable land. Forest edges, with their high light levels and more xeric growing conditions, support a different flora than the low light and mesic conditions in the forest interior (Jacquart et al., 1992). Whitney and Runkle (1981) found greater differences in species composition between the edges and interiors of old-growth beech–sugar maple woodlots in Ohio and between the composition of the interior of old-growth and second-growth woodlots. Small forest patches are more susceptible to external influences from the general matrix (e.g. herbicide drift from agricultural lands), and furthermore, isolated populations are more susceptible to the genetic consequences of inbreeding depression.

Hydrologic processes are also altered with forest clearance. Building on earlier work by Shriner and Copeland (1904), Curtis (1951) related the conversion to farmland to the loss of permanently flowing streams in southern Wisconsin. Curtis attributed the changes to reduced infiltration and decreased water storage in the subsoil associated with cultivation and pasturing. Because of greater overland flows and

more rapid discharges, peak flows from croplands can exceed those from forests by five to ten times in experimental watersheds (Lull and Reinhart, 1972). In addition to changes in water quantity, significant changes in water quality are also likely to occur with agricultural expansion. All major river systems in the mid-west are affected by non-point pollution that originates in large part from agricultural lands.

After World War II, the third major transformation occurred—the urbanization of the landscape. Growth in population provides a surrogate measure for the expansion of urban areas. The agricultural era, 1880–1940, was characterized by relatively stable populations. Starting in the 1940s with Washington County, population levels increased dramatically within the watershed (see Fig. 5). Communities such as Stillwater, Minnesota and Hudson, Wisconsin, grew rapidly, and low-density housing dispersed outward from the large urban centers. Dispersed housing does not occupy much total land area, but this relatively small land base can have disproportionate effects on landscape structure. Rural residential areas perforate the landscape, and the increased infrastructure needed to support this land use dissects the land. Urbanization changes the flows of energy, water and materials on the landscape (Douglas, 1994). Studies in Australia, Northern Ireland and New England (USA) have examined the changes in nutrient cycles when the vegetation was altered from previously conserving systems, such as forests, to systems with increased output of P, N and organic C, such as cities. Increased output of nutrients resulted from soil erosion, stream sediment transport and oxidation of organic matter (Wasson, 1994). With the conversion of rural to urban land use, evapo-transpiration decreases, surface runoff increases, and groundwater storage decreases (Rogers, 1994). Urban areas exist by importing large amounts of energy and materials, and they export large amounts of solid waste along with an abundance of water and air pollutants. St. Croix and Pierce Counties have been identified by the Wisconsin Department of Natural Resources as one of the three areas of most concern in Wisconsin because of the pollution of air and water, and habitat loss caused by urban expansion (Behm, 1994).

The trends that characterize the anthropogenic land use in our study are not unique. Habitat loss and fragmentation are the defining features brought about

by human land use (Meyer and Turner, 1994). In addition to the direct impacts of land use on land cover, there are important indirect effects related to changes in natural disturbance regimes. Fire was an important factor in the St. Croix landscape before settlement by European-Americans (Kline, 1985). Active fire suppression, along with changes in the composition and structure of the landscape, largely eliminated fire from this landscape. Unlike lands in the south and northeast, however, the fertile landscapes in the mid-west will not be allowed to reforest, but will be maintained as a largely agricultural matrix. In this sense, the lower St. Croix River watershed is typical of the mid-western landscape where a mosaic of forest, prairie and savanna once existed. Urban centers have been called key areas for focusing on our global environmental fate (Murphy, 1988). Corridors and surrounding habitats provide a source of biological richness unique in urban areas and can reduce the isolation of surviving ecosystems.

Understanding the history of a landscape is a valuable tool for ecological research. Whitney (1994) defined the basic goal of the historical ecologist as documenting the environmental changes of the past and determining the factors responsible for that change. Showing how landscapes are created over time can help landscape planners and other land managers to guide change in ways that preserve and enhance the desired landscape conditions (Scott, 1979). The changes in the St. Croix valley that Ray Baker's father predicted did indeed occur, and it happened in 'fifty or sixty years.'

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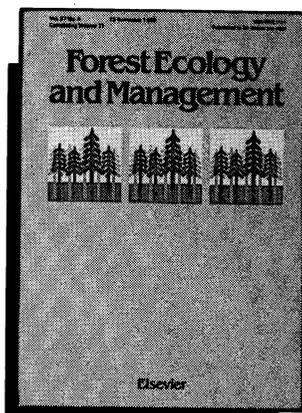
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