THE NATURAL HISTORY OF SPRINGBROOK STATE RECREATION AREA, GUTHRIE COUNTY, IOWA

edited by Raymond R. Anderson and Bill J. Bunker

Geological Society of Iowa

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Cover photograph: GSB geologist and trip leader Brian Witzke examines the exposure of Dakota Formation sandstone at Stop 8, on the west side of the Raccoon River.

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Sunday Field Trip Stop

INTRODUCTION TO THE NATURAL HISTORY OF SPRINGBROOK STATE RECREATION AREA, GUTHRIE COUNTY, IOWA

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Springbrook State Recreation Area is located at the southern edge of the Wisconsinan Des Moines Lobe, partially within the ice-marginal Bemis Moraine. Pleistocene Pre-Illinoian glacial advances between 500,000 and 2,500,000 or more years ago had originally deposited thick layers of till over most of the Springbrook region, however, subsequent erosion removed most of the till from the high bedrock at what is now Springbrook. When the Des Moines Lobe reached the area about 13,000 years ago it stalled, depositing the Bemis Moraine and forming a river that paralleled its margin and carved the valley now occupied by the Middle Raccoon River at Springbrook.

Beneath the glacial deposits, the Springbrook area is underlain by Cretaceous Dakota Formation sandstones and mudstones, deposited in rivers and on floodplains about 100 million years ago. Even older rocks of the Middle Pennsylvanian Cherokee Gp. or Marmaton Gp. (about 300 million years old) are exposed where the Middle Raccoon River has eroded away the Cretaceous strata. Pennsylvanian exposures are rare in the Springbrook area where they are primarily buried by recent river sediments, but a number of underground mines produced Pennsylvanian coal in the late 1800s and early 1900s.

Originally designated as a State Park, Springbrook had grown from an original 132 acres when acquired in 1928 to 796 acres when it was reclassified as a state recreation area in 1994. The addition of 80 acres in the northeast corner in 1995 and about 530 acres tract on the south, including land on both sides of the Middle Raccoon River, completed the over 1325 acre recreation area.

In 1850, much of what is now Springbrook State Recreation Area was prairie, however the region is now mostly dominated by black oak and bur oak forest. However, red and white oak or cottonwood, willow, silver maple, elm, and walnut communities dominate some landscape regions. In addition, several prairie restoration projects and a savanna restoration project are in progress at Springbrook.

The rolling hills of the area abound with deer, red and gray fox, coyote, raccoon, beaver, muskrat, and wild turkey. Almost every kind of bird that visits Iowa can be found there. The abundance of deer in the park and their browsing activities have presented a special challenge to park managers.

Springbrook State Recreation Area is cut by the Middle Raccoon River and several creeks, including Springbrook Creek and Kings Creek, which was dammed in the early 1930s to produce the 17 acre Springbrook Lake, one of several small lakes within Springbrook's boundaries.

Although no comprehensive archaeological investigation has been conducted in the Springbrook area, the presence of several burial mounds in the picnic area are evidence of the early presence of Native Americans in the region. The Sac and Fox (Mesquaki) once lived in Guthrie County. In the 1930s the Civilian Conservation Corps constructed a wide variety of facilities in Springbrook Park, including Springbrook Lake. Today, Springbrook is an important central Iowa outdoor recreation facility. General visitation in 1995 exceeded 235,000, with 16,500 campers recorded.

In 1970 the Iowa Conservation Commission established a Conservation Education Center at Springbrook. The center, with classrooms, a dining hall, and a dormitory building, became the State's primary outdoor education facility with its own staff of educators.

On this field trip, with guidance from staff of the Iowa Department of Natural Resources and the Office of the State Archaeologist, we will have an opportunity to examine many of the natural features of Springbrook State Recreation Area. The trip leaders hope that you will enjoy this visit to one of the most picturesque areas of central Iowa.

Much of the above information was excerpted from the *Springbrook State Recreation Area Ecosystem Management Plan*, IDNR, 1996.

SPRINGBROOK STATE PARK HISTORY

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Introduction

An act of the Thirty-eighth General Assembly in 1917 authorized the establishment of public parks and the creation of a "*State Board of Conservation . . . authorized to establish parks . . . which have by reason of their location become historic or which are of scientific interest, or by reason of their natural beauty or location become adapted therefore, and said Board of Conservation is hereby authorized to improve and beautify such parks.*"

At its first meeting on December 27, 1918, the Board further clarified the reasons for establishing state parks in Iowa. The following excerpts from the meeting report testify to the foresight exhibited by the founders of our state park system:

> *Our examination of the many proposed park sites and preserves has impressed us with the belief that the time has arrived for the great State of Iowa to take a decisive stand to protect and conserve for future generations some of the many beauty spots of the state, as well as preserve in its original form a portion, at least, of what is left that indicates the original natural condition of our prairies, forests and waters with their wealth of varied plant life as well as wild animal and bird life native to them, . . .*
>
> *Let us call attention to the recreational value of such parks as well as the value to the student and scientist . . . Our wooded banks and lake shores are ideal for recreational parks as well as valuable for study of natural history, forest reserve, geology and propagation of wild life, and furnishing splendid fields for the students of plant life also.*
>
> *Summing up our report, we do not hesitate to say that Iowa has within its borders many of the rarest places of historical and scientific interest that might be conserved to the general good of its people, that the opportunity of combining comfort and recreation with the knowledge to be obtained from a study of plant life, natural beauty and resources still exists and that we should avail ourselves of the opportunity of acquiring them for all of the people of our state for all time."*

Early History

Interest in a state park in the Guthrie County area was high in the years following the establishment of the state park system in 1918. In March 1926 a committee of citizens from Guthrie Center addressed the Board of Conservation concerning a proposed state park on the Raccoon River, about seven miles north of the city. Land acquisition efforts began later that year, and on July 9, 1926, an appropriation of $2,000 was used to purchase "*132 and fraction acres*" from the King Estate (and part of the Cramer Estate to be leased) to establish "Kings State Park". The land acquired for the park had been heavily grazed and was dominated by pasture, with only scattered trees and small forested tracks (Figs. 1 & 2). During 1928 - 1932 additional land was acquired (raising the park total to 300 acres – see Fig. 3), and on November 1, 1932 it was renamed "Springbrook State Park". On May 19, 1933, the first park custodian, James Thomas, was hired at $25 per month.

Figure 1. View looking east on the Laub property, north of the Conservation Education Center, ca. 1926.

Coal mining had been an important activity in the area since the late 1800s. Thin seams of coal in and around Springbrook State Park were mined underground. A total of 19 mines are known to have operated in the Springbrook area, This mining activity is discussed in a later section of this guidebook.

CCC Activities at Springbrook

The Iowa Twenty Five Year Conservation Plan of 1933 had envisioned Springbrook as a "Scenic Preserve," with *"great scenic value, but not geographically placed to call for major state park consideration."* This plan called for the development of small dams and ponds for trout fishing and swimming, as well as facilities for picnicking and camping. By late 1933, however, detailed plans had been completed for extensive development at Springbrook State Park with a lake as the focal point. The work was to be accomplished by the Civilian Conservation Corps (CCC), one of the major employment programs developed by the Roosevelt Administration during the Great Depression. At its peak in mid-1935, the CCC operated forty-nine camps in Iowa, one located at Springbrook. On November 11, 1933, National Park Service Company 779, Camp SP7 completed construction of its barracks and other structures in the park. Most of these structures remain functional for public use today as the group camp facility. Camp SP7, assisted by the Civil Works Administration, completed the construction of the dam in November of 1934. National Forest Service CCC Company S100 took over work in the park, between August 1935 and September 1936. Camp SP7 was reestablished in the park on March of 1938 and served until July 17, 1941. By this time the park's size had increased to a total of 727 acres.

Figure 2. View looking west on the Laub property, showing the overlook north of the current Springbrook Conservation Education Center, ca. 1926.

The CCC constructed a wide variety of facilities at Springbrook. According to the 1989 National Register of Historical Places survey, the park contained 46 CCC "properties". The properties consist of a shelter, beach house, dam and spillway, restrooms, pit latrines, trails, roads, culverts, foot bridges, service buildings, ranger residence, and most notably the group camp. In 1990 a National Register of Historic Places District was named in recognition of the historical significance of Springbrook in Iowa's Civilian Conservation Corps heritage.

The CCC shelter house (Fig. 4) was renovated during the summer of 1997 with the replacement of rotten timbers, tuck pointing of the stone work, shingling and other related tasks. The shelter currently serves as the only rental structure available to picnickers in the park. The CCC beach house (Fig. 5) had

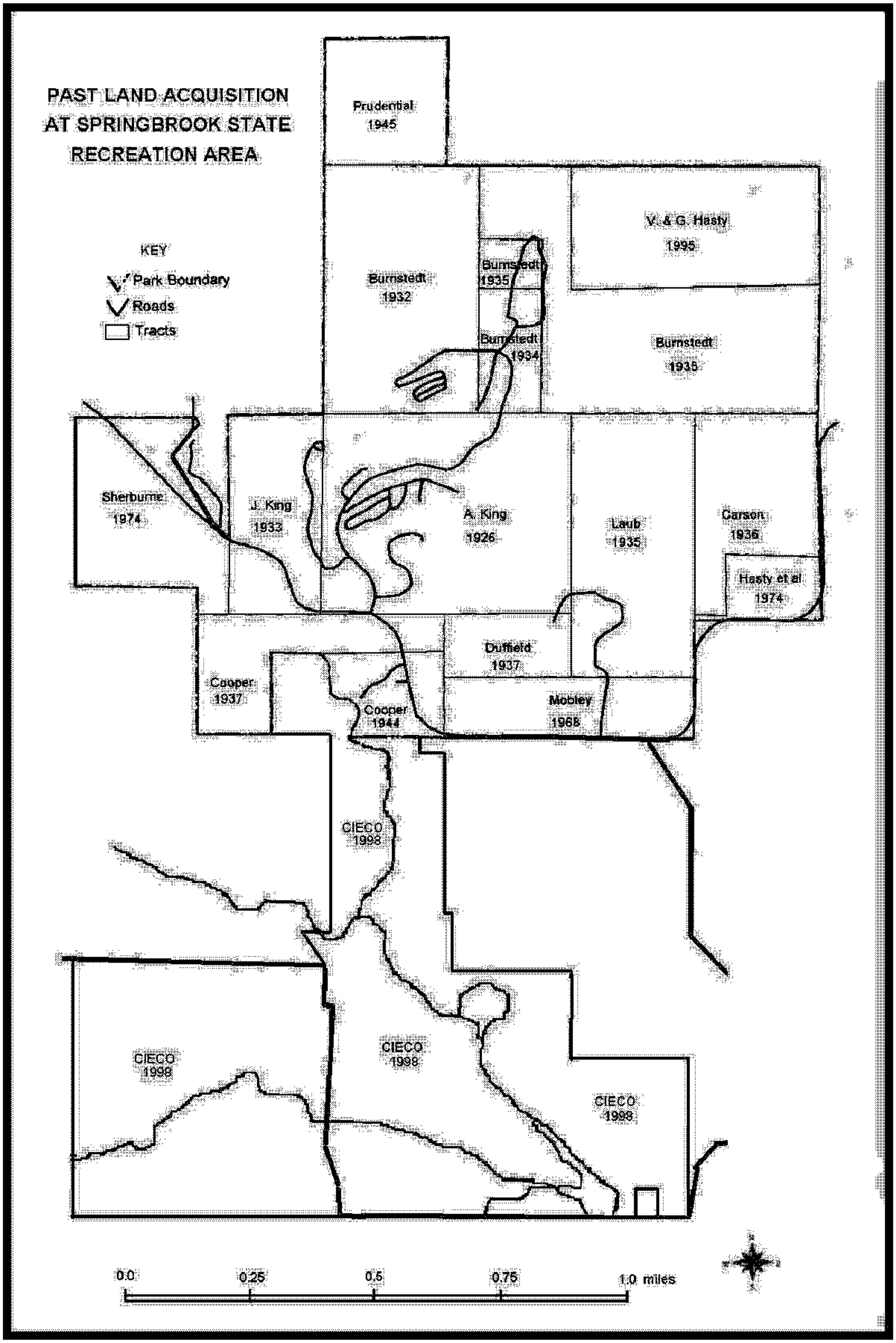

Figure 3. Map of the tracts of land that were acquired to create Springbrook State Recreation Area, showing the tract owners' names and the date that the State acquired the lands.

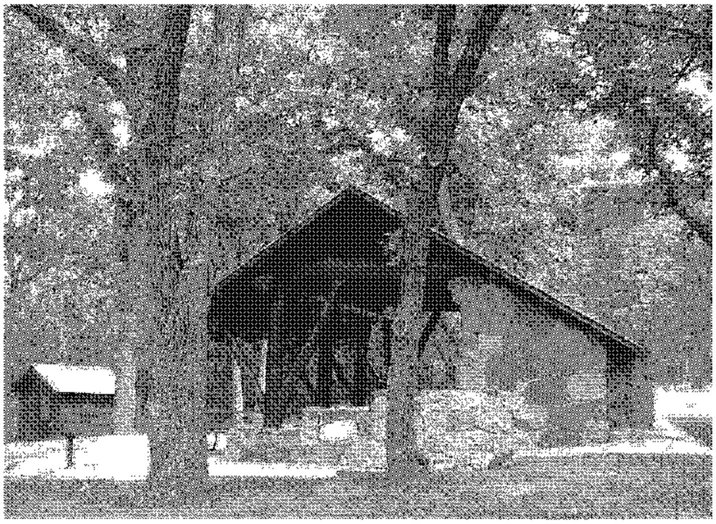

Figure 4. The CCC shelter, renovated in 1997.

been known as the center of recreation on weekends for the park for many years. In the past, the beach and beach house had lifeguards, concessions, boat rental, diving platform and other facilities. However, public utilization of the beach diminished and the function of the beach house changed with the times. The diving platform, life guards, and concessions are no longer present. The beach house underwent a major renovation during the Fall of 1997 and Spring of 1998. It now is utilized more like a shelter with restrooms than a true beach house. The ranger residence was the last of the renovations competed to date. A bedroom was added in September of 1998 to better facilitate the ranger's needs. This facility was originally built by the CCC in 1934 and had changed very little over the years. It had once served as the park office and check-in station for camping. All three structures were renovated with the CCC integrity in mind. The contractors work resembled work done by the CCC to protect the history of each facility.

The former CCC camp went through perhaps the most drastic changes. However, it was the use of the facility and not the facility itself that changed the most. After World War II, the area was used as an important agency training facility. In 1943 it was used by corn detasselers, and December 6 it became known as the youth camp. Starting in April of 1949, the facility was used to train Iowa conservation officers. The following year, it became a camp used by the Teachers Wildlife School and remained so until the Conservation Education Center located outside the park was built in 1969. In 1970, the area became available for public use. There are efforts being made to renovate the facility within the next few years to help carry on the historical importance of the camp.

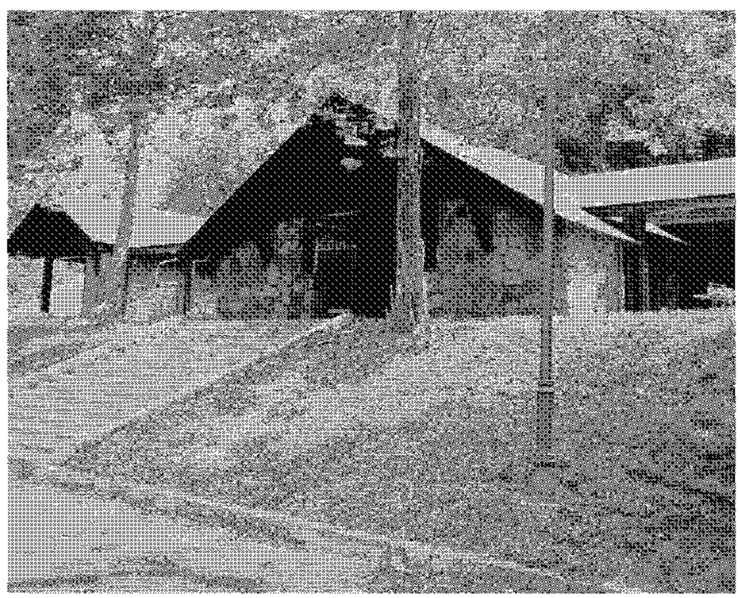

Figure 5. The CCC beach house as viewed today from the beach at Springbrook State Recreation Area.

Perhaps the most important construction project by the CCC at Springbrook was Springbrook Lake. At the time of its completion in 1940 the lake covered 27.7 acres. Siltation slowly filled in much of the original lake until in 1989 a major lake renovation project was begun. The lake was drained, dredged, repairs were made on the spillway, a silt retention impoundment and fishing jettys were constructed, and increased fish habit structures were put in place. In 1991, the lake was allowed to fill again, and it now covers 17 acres (see photo of lake and dam, Fig. 1 on page 35 of this guidebook).

Springbrook Conservation Education Center

The Iowa Department of Natural Resources Springbrook Conservation Education Center (CEC) (Fig. 6) is located within Springbrook State Recreation Area and provides a unique opportunity for integrating resource management with education about natural resources and the environment. Using a watershed systems approach, natural resources issues of concern to Iowans are investigated through hands-on outdoor education activities. Constructed in 1969, this residential facility consists of 104 beds in three dormitories, dining hall/kitchen, classrooms, offices and shop facilities, and provides indoor and outdoor classrooms for nearly 20,000-visitor use days annually. The Center's main priorities are providing a residential educational experience for upper elementary school classes (57% of annual use) and for teacher in-service training (12% of annual use). Fifteen percent of Iowa's school districts use the Center for natural resource education experiences. The DNR's Aquatic Education Program is officed at the CEC. This program utilizes nationally recognized Project WILD, Aquatic Project WILD, Project Learning Tree, in-state developed supplemental materials and "Fish Iowa" to provide teachers with educational materials concerning Iowa's natural resources and recreational fishing. Both in-service and pre-service teacher education programs are provided for educators. Pre-service materials concerning "Fish Iowa", "Project WILD Aquatic", "Project WILD", and "Project Learning Tree" are provided through 15 post-secondary schools in Iowa. (For more information on these projects see the descriptions of the educational programs that are available from the Iowa Department of Natural Resources on the Department's World Wide Web homepage at ***http://www.state.ia.us/government/dnr/educaton.htm#center.***) Students participating in educational methods classes at these school are trained in these materials. In-service educational opportunities are provided at the Conservation Education Center and throughout the state by 60 facilitators for the above programs.

Figure 6. The office and classroom building at the Springbrook Conservation Education Center.

The Newest Addition to Springbrook

Springbrook grew from its original 132 acres to 876 acres by 1997, and this year an additional 530 acres was added to the southern end (Fig. 3) of the recreation area with the purchase of land from the Central Iowa Energy Company (CIECO). CIECO had originally acquired two large tracts of land in northeast Guthrie County in the 1960s. The tracts, one just south of Panora and the other on the northern end of Lake Panorama were a part of a plan to build a nuclear power plant. The plant was to be located at the site south of Panora, and use water from the Middle Raccoon River as coolant. Lake Panorama was to serve as a reservoir to insure that the flow of water past the power plant would always remain sufficient to provide cooling. The land on the northern end of the lake was acquired as an area to dump spoils that would have to be dredged from the lake in order to maintain an adequate volume of water. Planning for the nuclear power plant had actually advanced to the completion of a project environmental impact statement before it was put on hold. With the current regulatory climate for such a facility and the cost of storage and ultimate disposal of spent nuclear fuel, such a plant was no longer practical. Consequently CIECO abandoned the plan and decided to dispose of the properties. The DNR began negotiations to purchase the lands in the Fall of 1997. The purchase proved to be very complex, with the deal finally completed in the late Summer of 1998. The DNR was able to acquire the land due south of Springbrook to the bridge over the lake on county road P-18. Additionally, they were able to acquire the land south of Panora where the power plant was originally to be constructed. The addition to the southern end of Springbrook brings the total area of the Springbrook State Recreation Area to over 1,400 acres.

Springbrook Today

Today, Springbrook remains as an important recreational area for the public's enjoyment. The area has six family cabins, the group camp, and shelter for rent. The campground has seen major improvements in its electrical system and facility improvements. The cabins, group camp and shop facilities are a few years away from renovation. Deer management has become an important aspect with four controlled anterless deer hunts every year. The deer had become a problem in recent years, damaging the crops of local farmers, presenting a hazard to traffic and damaging the forest by heavy browsing. This problem resulted in the need for controlling measures. The Springbrook State Park went through yet another name change in 1994, and is now called "Springbrook State Recreation Area" in order to allow the deer hunt. However, there is movement to change the name back to "Springbrook State Park" to protect the history of the area and the rules and regulations. Visitation in 1936 was 58,893, and today over 200,000.

COAL MINING IN THE SPRINGBROOK AREA

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Erosion by the Middle Raccoon River cut through the Pleistocene and Cretaceous deposits exposing the underlying Pennsylvanian strata along the base of the bluffs near Panora in Guthrie County. Although the Pennsylvanian strata no longer outcrop within the area of the park, they do appear along the bluffs of the Middle Raccoon River to the south. The Pennsylvanian rocks consist primarily of shale with lesser amounts of limestone, siltstone, sandstone, and coal. Stratigraphically, the Pennsylvanian rocks exposed in the area are assigned to the upper portion of the Cherokee Group and may extend upward into the lower part of the Marmaton Group of the Desmoinesian Series (Fig. 2).

The coal seams exposed in the bluffs above the river prompted a small-scale mining industry that lasted from 1894 through 1941, paralleling the development and decline of the coal mining industry in central Iowa. The mines are now abandoned, but potential environmental impacts and historical interest have prompted efforts to collect and organize information about the mines.

Numerous small coal mines operated within what is now the confines of the park and to the south along the Middle Raccoon River valley. The map in Figure 1 shows the locations and names of the mines known to have operated in the area. Symbols and shading are used to represent the type of information used to derive the location and (where available) extent of the mines and to reflect the accuracy and completeness of the location information. Table 1 summarizes other information about the coal

Mine Name	Area (acres)	First known date of operation	Last known date of operation	# Maps	Shaft depth	Mining method	Mine data type
Butler & Graham Coal Co.	unkn	1906	1908	n.a.	62	longwall	Point location, 1/4 section
Decker Coal Mine	unkn	unkn	unkn	n.a.	90	unkn	Point location, w/in section
Eclipse Mine	unkn	unkn	unkn	n.a.	unkn	unkn	Point location, w/in section
J. W. King Coal Company	unkn	1903	1908	n.a.	70	longwall	Point location, 1/4 section
Jack Mansell Coal Mine	2	unkn	1929	1	110	longwall	Surveyed map
John Marshman Mine	unkn	1887	1897	n.a.	86	longwall	Point location, w/in section
M. N. Thomas Coal Co.	0.5	1924	1937	1	unkn	room and pillar	Surveyed map
Mallon Mine	6	1903	1915	1	unkn	room and pillar	Surveyed map,poor location
Mansell & Sweeney Coal Co.	2	unkn	unkn	1	unkn	longwall	Surveyed map
Marchant Mine	unkn	unkn	unkn	n.a.	126	unkn	Point location, w/in section
Ole Oleson Mine No. 1	unkn	unkn	unkn	n.a.	63	unkn	Point location, w/in section
Orillia Coal Co.	6	unkn	1941	3	22	longwall	Surveyed map
Renslow Coal Co.(Lloyd)	2	unkn	1932	1	unkn	longwall	Surveyed map
Renslow Coal Company	unkn	unkn	unkn	n.a.	87	unkn	Point location, 1/4 section
Scott (Brothers) Coal Co.	unkn	1899	1905	n.a.	unkn	unkn	Point location, 1/4 section
Scott Coal Co.	unkn	1905	1948	1	90	longwall	Surveyed map
Scott Mine	3	1894	unkn	n.a.	76	unknwo	Unmapped, extent approx.
Sipe Coal Co.	4	1924	1939	1	unkn	room and pillar	Surveyed map
Thomas Shaft	unkn	1894	1899	n.a.	142	longwall	Point location, w/in section

Table 1. Information on coal mines known to have operated in or near Springbrook.

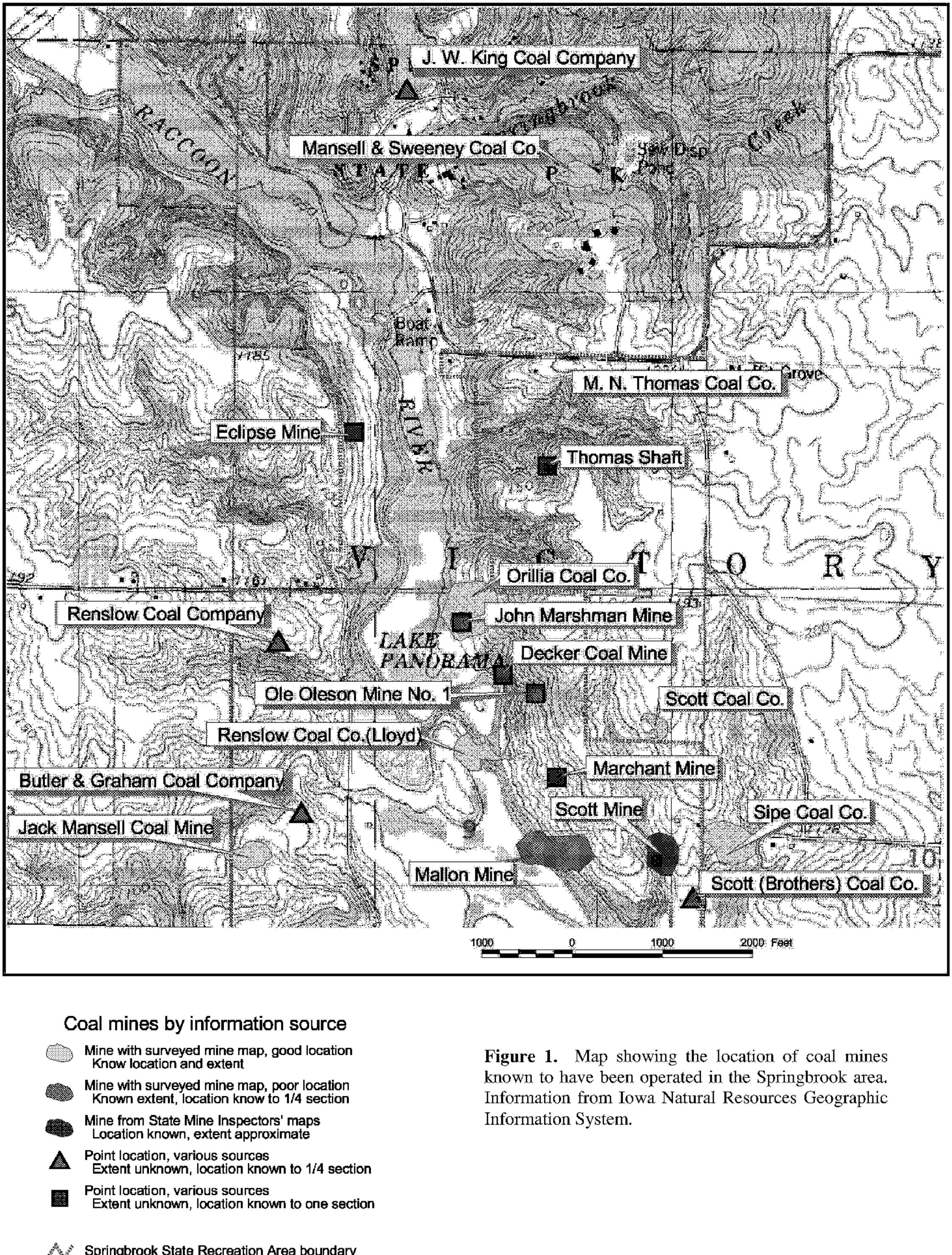

Figure 1. Map showing the location of coal mines known to have been operated in the Springbrook area. Information from Iowa Natural Resources Geographic Information System.

mines such as dates of operation, method of mining, type of geographic information available, etc. The mines in this area, like many small mines in Iowa, operated only during the fall and winter months to provide heating fuel to local consumers. The earliest of the mines were operated by just a few miners and produced only 200 to 500 bushels per day.

All of the coal mines in this area had shaft entrances—a vertical opening from the land surface to the coal seam. Hoisting machinery powered by draft animals or a steam engine would have been required to operate these mines. The depths of the mine shafts range from 22 feet to 142 feet. The thickness of the coal mined ranged from about eighteen inches to about two feet. Room and pillar and longwall extraction was used by mines in the area. In room and pillar mining, as it was practiced at the time, an entry was dug outward from the shaft. Rooms were dug roughly perpendicular to the entry and were about thirty feet wide and up to 300 feet long. The rooms were separated by pillars eight to ten feet wide and as long as the room. Props were used to support the roof especially along entries. In contrast, longwall mining started with entries dug outward from the shaft. A working face was established and coal removed laterally from the entry. The result was a series of fan-shaped mined-out areas with the working face advancing outward from the mine shaft. Cribbing made of wooden timbers and pack walls made of rock were used to support the roof. Often, in longwall mining the coal was undercut, that is, a few inches of the underlying clay were removed. Then the weight of the coal caused it to fall and break into blocks. Longwall mining removed the largest percentage of the coal and was the method of choice for mining a thin coal with a competent roof rock. Room and pillar mining removed less of the coal, but was used where the roof was poor and the coal seam thicker.

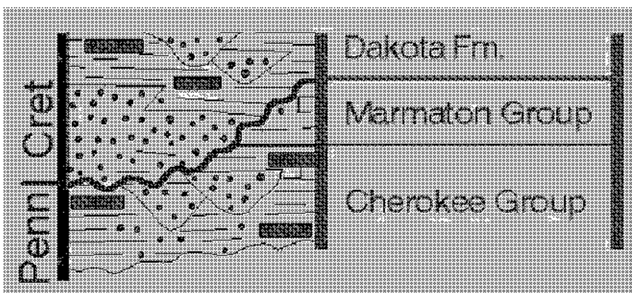

Figure 2. The generalized rock stratigraphy around Springbrook State Recreation Area.

L.M. Cline (unpublished manuscript) identified the coal mined in the area of the park as "Fansler" from the community of Fanslers that existed at the time a few miles east of the present day Springbrook park. "Fansler" was an informal name probably first used by the miners and was never formally adopted for the coal. The coal seam may also have been referred to as "Munterville," although this name was never formally adopted either. Based on Cline's descriptions and notes on the stratigraphy of the area the coal is at about the point where the unnamed coal in the Floris Formation would be expected, but this stratigraphic assignment is not verified. Historic descriptions of the coal report a fairly uniform thickness of about two feet, with "a variation of more than two inches in any one mine rare" (Hinds, 1908). Persistent "sulfur bands", or streaks of impure coal, were characteristic of the coal seam as was a four-inch "draw slate" and carbonaceous shales overlying the coal seam. "Draw slate" is a term used for a compact, calcareous rock often with abundant fragments of brachiopod shells that falls or "draws" with the coal when it is undercut during mining. About seven feet of shale overlie the "draw slate" followed by a thin limestone. This description is consistent with the assignment of the coal seam to the unnamed coal in the Floris Formation, but as noted previously, the correlation is not verified.

The coal seam mined in the area of Springbrook park is slightly higher stratigraphically than the thicker, more productive coal seams that were mined to the east in Des Moines. The deeper thicker coal seams might have been accessible through deeper mine shafts, but the demand created by the railroads and industrialization didn't exist in rural Guthrie County. Consequently, coal mining remained a small, seasonal business.

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Hinds, H., 1908, The coal deposits of Iowa. Iowa Geological Survey Annual Report 19, p. 21-396.

CRETACEOUS BEDROCK GEOLOGY IN THE SPRINGBROOK AREA

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Introduction

The beautiful and deeply-incised valley of the Middle Raccoon River in Springbrook State Recreation Area (Guthrie County, Iowa) reveals an instructive series of bedrock exposures of mid Cretaceous age, the latter part of the so-called "Age of Dinosaurs." These Cretaceous strata, known as the Dakota Formation, were primarily deposited in ancient westward-draining river systems about 100 million years ago. The sequence of sandstone-dominated Dakota rocks lies unconformably (erosionally) above Pennsylvanian-aged strata (about 310 million years old) in the Springbrook area.

The Pennsylvanian bedrock is dominated by shale and mudstone with lesser sandstone, limestone, and coal. However, these Pennsylvanian strata are not readily seen in the Springbrook area, and are largely restricted to elevations at or below the level of the Middle Raccoon River (Pennsylvanian top generally between elevations of 1040-1055 ft). Nevertheless, numerous underground mines once operated in the Springbrook area to extract the coal seams that occur within the Pennsylvanian sequence (see Howes, this guidebook). These historic coal mines aside, the bedrock exposures in the Springbrook area are all of Cretaceous strata.

Exposures of Cretaceous rocks are widespread in the park along the valley walls of the Middle Raccoon River, Springbrook Creek, and the smaller ravines and creeks that adjoin the river. These exposures are restricted to elevations below about 1140 feet (348 m). Natural exposures of Cretaceous rocks are overgrown and slumped to varying degrees, but vertically continuous exposures can be found in parts of the Springbrook area (see Stop 8C discussion). The Cretaceous bedrock is buried across the uplands by more recent Quaternary deposits (less than 2 million years old), primarily pre-Illinoian glacial till deposits and colluvium/alluvium derived from the weathering of these tills. A thin veneer of loess is locally present. Cretaceous rocks are even more deeply buried in the northeastern part of the park, where the Bemis moraine marks the terminus of the geologically recent Wisconsinan glaciation. Both pre-Illinoian and Wisconsin deposits bury the Cretaceous bedrock in that area. The bedrock is also partially to completely covered along the lower valley walls of the Middle Raccoon River. Quaternary (especially Holocene) alluvium has largely infilled the bedrock-incised channel of the Middle Raccoon River and overstepped the modern river channel across the floodplain terraces.

The Dakota Formation in Guthrie County

Background

The prominent sequence of Cretaceous sandstone and shale exposed along the Missouri River Valley in northwest Iowa and northeastern Nebraska was described by Hayden's geological survey during the 1850s and 1860s. That survey named these strata the Dakota Sandstone; the name derives from the bluffs near Dakota City, Nebraska, across the river from Sioux City, Iowa (see summary in Witzke and Ludvigson, 1994). The Dakota Formation has subsequently been applied to an interval of Cretaceous strata throughout much of the Great Plains and Rocky Mountain region of North America, although Witzke and Ludvigson urged usage of the term only for the eastern and central Plains in Iowa, Minnesota, Nebraska, Kansas, and the Dakotas (restricted to include the body of eastern-sourced sandstone and mudstone, contrasted with contemporaneous western-sourced strata of the Rocky Mountain area). Regardless of how its distribution is defined, the Dakota is an extremely widespread and widely recognized Cretaceous stratigraphic unit. Dakota strata in Guthrie County are of special interest as they represent the best exposures in the easternmost area of the Dakota Formation's regional extent. Farther eastward across Iowa, Dakota strata have been largely eroded away.

The Dakota exposures in Guthrie County were first described by Charles White and Orestes St. John (White, 1867, 1870), who recognized that the sandstone-dominated sequence in Guthrie County occupied a lower stratigraphic position than the Dakota strata in the type area near Sioux City. They proposed a two-part subdivision of the Dakota strata in Iowa, a breakdown proven to have great utility in more recent studies (see Witzke and Ludvigson, 1994): a lower Nishnabotna Member (as seen in Guthrie County and southwestern Iowa) and an upper Woodbury Member (as exposed in the Sioux City area). Bain (1897) subsequently studied the Dakota rocks of Guthrie County and made additional observations. Aside from a few minor references to these strata over the years, the Guthrie County exposures did not receive further geologic study until the 1980s and 1990s (Witzke and Ludvigson, 1982, 1994, 1996).

Rock Types

The exposures of the lower Dakota Nishnabotna Member in Guthrie County are typified by poorly-consolidated sandstones, although additional lithologies (rock types) can also be seen. The interval is clearly dominated by sandstone -- across western Iowa the lower Dakota Nishnabotna interval averages 83% sandstone (Munter et al., 1983). The constituent grain sizes represented in these sandstones vary significantly from exposure to exposure as well as stratigraphically (that is, vertically within the stack of sandstone layers). The dominant sandstone lithologies are typically very fine, fine, and medium grained, as seen at most exposures in the Springbrook area. However, coarser-grained sandstones are also common, especially in the lower part of the Nishnabotna Member. These coarser-grained lithologies include medium to coarse-grained sandstones, commonly pebbly to conglomeratic. The coarsest grains are comprised of granules (2-4 mm) and pebbles (>4 mm) of quartz and chert, and mud clasts (pebble and cobble-sized clayey grains) are locally common to abundant. Gravel conglomerates (with chert and quartz grains 1-10 cm) are locally seen near the base of the formation. The coarse pebbly sandstones and conglomerates are used as a prime aggregate resource in Guthrie County, and many roads are covered with this material across the county. These coarse sediments are locally known as "peanut conglomerates," as many of the small pebbles resemble peanuts.

The sandstones and gravelly conglomerates display a number of sedimentary structures that indicate their deposition in the flowing waters of ancient river systems. Small- to large-scale planar crossbeds, trough crossbeds, channel cut-outs, and planar to laminated bedforms are recognized. However, the uniform grain size and poorly consolidated nature of many fine-grained sandstones makes recognition of sedimentary structures difficult at many exposures. The Nishnabotna sandstones of western Iowa are primarily quartzarenites, that is, the sandstones are composed overwhelmingly of silica grains (quartz and chert) (Witzke and Ludvigson, 1994). Minor amounts of other mineral grains are present, especially feldspar, metamorphic lithic grains, and muscovite (mica). The pebbles and granules contained within the conglomeratic units are likewise dominated by quartz and chert.

Mudstone units are secondary in abundance to the sandstones. The term mudstone, as used here, refers to lithologies composed predominantly of clay with a variable component of silt and sand. Mudstone differs from shale in lacking fissility (horizontal bedding), and the mudstones of the Nishnabotna Member are commonly soft and plastic when wet. Because they are so easily weathered, the mudstones are usually only seen where they are capped by more resistant sandstone units. Most mudstones of the Nishnabotna Member are preserved within swales and channel fills in the sandstone-dominated sequence, commonly only a few meters to tens of meters (10-100 ft) in lateral extent. However, some mudstones have much greater lateral extent. The mudstones are most common in the lower half of the Nishnabotna Member, but a few are noted in the upper part (including the Springbrook area, where upper mudstones are seen as very light gray, almost white, exposures scattered along the valley walls of Middle Raccoon River). The mudstones are mostly of light gray color, but some are medium to dark gray with scattered carbonaceous plant debris. Most mudstones appear generally featureless in outcrop, but many show varying degrees of pedogenesis (that is, they show incipient to well-developed soil structure) when examined microscopically. The mudstones are dominantly composed of kaolinitic clays with lesser illite. Clasts of mudstone are scattered to common in the conglomeratic sandstones, and these are lithologically indistinguishable from the mudstone units (and were derived from them).

Siltstone is a minor rock type seen in the Nishnabotna Member, especially associated with mudstones in the basal part. These siltstones are variably argillaceous (clay content), and some are finely laminated to burrow mottled. The bulk of Dakota rocks are poorly consolidated, that is they are quite soft and relatively uncemented and they weather and disintegrate readily on exposure. However, there are some quite hard rocks that are locally present, primarily hard-cemented ledges and clumps of sandstone, conglomerate, and siltstone. The commonest cements are dense red to red-brown iron oxides (hematite and goethite). Individual ledges may be locally cemented, and irregular swirled patterns of alternating cemented bands are apparent in some exposures ("Leisegang" cement patterns). Siltstones and sandstones are occasionally cemented with iron carbonate minerals (siderite), but this mineral commonly oxidizes on exposure. Calcite (calcium carbonate) cements are also seen in some of the Guthrie County sandstones and siltstones -- at Springbrook the fine-grained sandstones locally display calcite-cemented "grapeshot" patterns (small spherical aggregates of calcite cements). Pyrite (iron sulfide) cements and small pyrite nodules are locally noted in the lower Nishnabotna.

Fossils and Age

Fossils in the Dakota Formation of Guthrie County are generally fairly rare, but some important fossil occurrences are noted. Indeterminate plant fossils are the most common fossils seen – the sandstones locally contain woody and carbonaceous plant material, especially near the base or margins of individual sandstone channels. This material represents logs, branches, twigs, and decomposing leaf litter that was transported in the river channels. It is most commonly preserved as black carbonaceous material resembling chunks of coal, rarely as less carbonized woody fibers. However, some logs and branches are represented as molds and impressions now cemented with iron oxides. A few small pieces of petrified wood (silica permineralized) have also been found in the basal Nishnabotna gravels of Guthrie County.

Compressions or impressions of leaf fossils are rarely found in some mudstones or sandstones, and a significant collection of leaf fossils has been secured in Guthrie County (see summary in Witzke and Ludvigson, 1996, p. 51-52). A mudstone near Guthrie Center at the top of the exposed interval has produced numerous large angiosperm leaf fossils, especially large veinated "platinoid" leaves up to 8 inches long (resembling leaves of the modern sycamore). Other angiosperm leaves are also present, including serrated and multi-lobed forms, as well as a grape-sized fossil fruit. These collections include some of the oldest angiosperm fossils in the world. The flowering plants (the angiosperms) comprise most of the plants that we see in the world today, but their rise to prominence was a relatively late development in the history of life on earth. In fact, it was during the middle part of the Cretaceous, the same age as the Dakota strata in Guthrie County, that angiosperms first began their spectacular evolutionary radiation and rise to dominance. The mudstone has also yielded additional plant fossils including several types of ferns, pine needles, and twigs of probable taxodiacean affinities (like cypress trees).

Several gray mudstone units from the Nishnabotna sequence in Guthrie County have already been processed for plant microfossils, but, to date, only one sample has produced any spores or pollen. However, our sample processing is ongoing, and we are hopeful that additional samples will be productive, especially dark mudstones from both Springbrook and the Garst property presently being processed. Our productive sample was recovered from the base of the section in northwestern Guthrie County (Garst North section, Witzke and Ludvigson, 1996). A number of spores and pollen contained in this sample are important for defining the age of the basal Nishnabotna Member, as the time range of several forms do not extend past the middle part of the late Albian (about 100 million years old). Identifications were provided by our colleague Robert Ravn (Æon Biostratigraphic Services). Fern (pterophyte) spores are the most abundant, and a number of species are represented including *Antulosporites distaverrucosus, Cicatricosisporites patapscoensis, C. potomacensis, Concavissimisporites punctatus, Disaltriangulisporites mutabilis, Pilosisporites trichopapillosus, Polycingulatisporites reduncus* (all characteristic Albian taxa). Bryophyte spores are represented by *Couperisporites complexus* (Albian). Finally, gymnosperm pollen includes *Exesipollenites tumulus* and *Equisetasporites concinnus* (Albian). This assemblage of spores and pollen is identical to that found near the base of the Dakota Formation in eastern Nebraska (see listing in Witzke and Ludvigson, 1996), providing strong evidence for the age equivalence of these strata.

Reworked fossils from older strata are incorporated into the Nishnabotna gravels of Guthrie County, and a number of much older Paleozoic fossils have been identified within the chert pebbles (see Witzke and Ludvigson, 1996, p. 46). Brachiopods, corals, and other marine fossils are recognized. These reworked fossils help identify the original sources of the chert grains, which must have included areas of Ordovician, Silurian, Devonian, and Pennsylvanian bedrock exposure. This means that some of the gravel had to have come from at least as far away as the present-day Upper Mississippi Valley (ibid.).

The middle part of the Cretaceous was a time when dinosaurs were the dominant land animals, and there is always the possibility that dinosaur fossils could be found in the Dakota strata of Iowa. In fact, equivalent Dakota strata in nearby eastern Nebraska and Kansas have indeed produced dinosaur fossils, including the remains of a large indeterminate ornithopod dinosaur (probably an early hadrosaur, or duck-billed form) and armored nodosaurid ankylosaur dinosaurs (*Silvisaurus*). Crocodile fossils are also known from Dakota strata of Kansas. Most dinosaur occurrences worldwide are found in ancient river deposits, and the Dakota Formation of western Iowa certainly has good potential for the discovery of additional dinosaur fossils. The only dinosaur material yet described from Iowa has come from Guthrie County, although the specimen is only a small bone fragment of an unidentified dinosaur (see Witzke and Ludvigson, 1996, p. 47). Nevertheless, this fragment shows characteristic dinosaur bone microstructure and provides evidence that dinosaurs indeed roamed the Guthrie County landscape 100 million years ago. Perhaps some future dinosaur fossil discovery awaits the lucky hiker in the Springbrook area.

Nishnabotna Stratigraphy in Guthrie County

The Nishnabotna Member in Guthrie County reaches thicknesses to about 100 feet (30 m). Although each individual exposure reveals unique features and each section shows variations with respect to other sections, there is a general stratigraphic succession (vertical stacking) of units displayed in the county. The best exposed and best studied exposures in Guthrie County are shown in ure 1, which occur in four general areas: 1) the Garst property to the northwest, 2) the Springbrook area, 3) the area south of Guthrie Center, and 4) the South Raccoon Valley. Of course, there are numerous additional exposures in the county (see map in Witzke and Ludvigson, 1996, p. 5), but many of these are more limited in their vertical extent and have not been studied to the same level of detail as the sections portrayed on Figure 1.

The Nishnabotna Member in Guthrie County unconformably (erosionally) overlies Middle Pennsylvanian strata of the Marmaton and upper Cherokee groups. Erosional relief is evident on the sub-Nishnabotna Pennsylvanian surface, with at least 10 to 15 feet (3-4.5 m) of relief locally seen in closely-spaced sections along the Middle Raccoon Valley. The general stratigraphic succession of Nishnabotna strata above this surface begins with a basal mudrock-dominated interval of varying thickness (unit 1 on Fig. 1). This interval ranges from about 0 to 35 feet (11 m) in thickness, and is commonly about 5 to 10 feet (1.5-3 m) thick. Gray mudstones dominate the interval, variably light to medium and dark gray (the darkest colored rocks of the Nishnabotna Member). The mudstones are variably silty to sandy, and interbedded siltstones and minor sandstones are present. The siltstones and mudstones are commonly laminated, in places showing probable thickening and thinning bundles of laminae. Siderite and iron oxide cements are noted, and pyrite occurs locally as cements or small nodules. The mudstones and siltstones are locally burrowed, and large vertical and subvertical burrow mottles (to about 2 inches, 5 cm, long) are prominent at the Long Creek sections (Fig. 1; see also Phillips and White, this guidebook). Smaller sub-horizontal burrows (1 mm diameter) are also recognized. A probable bentonite near the top of the thick mudstone interval in the Long Creek section needs to be more fully evaluated, but the occurrence of a bentonite in the sequence would provide an opportunity to establish a time-significant correlation independent of the biostratigraphy. The basal mudstones have thus far been the only portion of the Nishnabotna sequence in Guthrie County to produce spores and pollen.

The basal mudstone units are overlain and crosscut by a complex sandstone-dominated interval (general unit 2, Fig. 1). The sandstones, especially in the lower part, are commonly coarse and pebbly to conglomeratic. The coarsest facies of the member are represented by gravel units, best seen in the South Raccoon Valley (Fig. 1). Complex crosscutting channel geometries characterize the interval, and some of

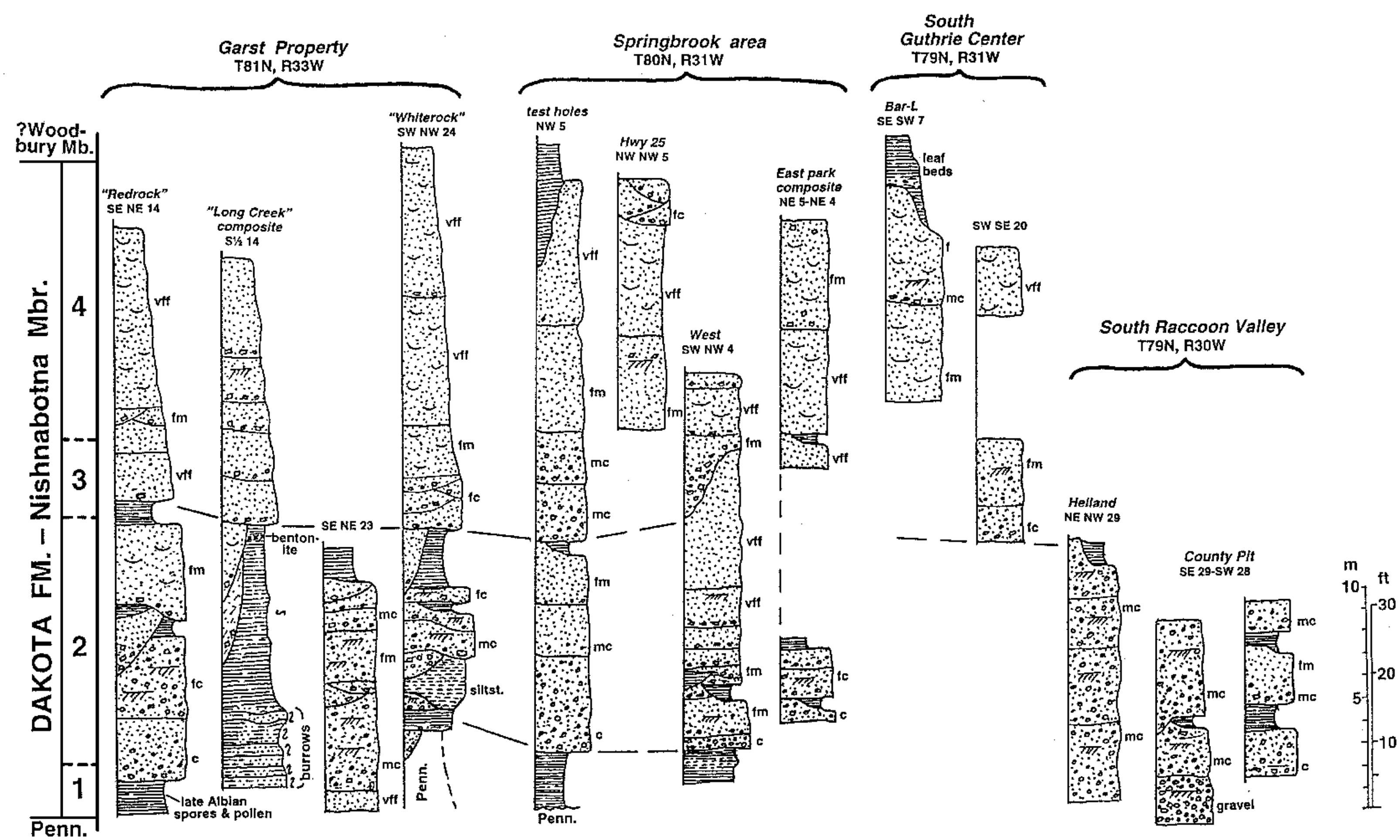

Figure 1. Graphic stratigraphic sections of important Cretaceous exposures in Guthrie County, Iowa, arranged in a general northwest to southeast transect. Symbols as in figure for Stop 8C. Most sections are adapted from Witzke and Ludvigson (1982, 1994, 1996). Dominant grain sizes for various sandstone units are noted: vff (very fine to fine), fm (fine to medium), fc (fine to coarse), mc (medium to coarse), c (coarse). Penn. marks top of Pennsylvanian strata.

within the complex channeled braidplain of these river systems. Mudstones associated with these coarse deposits were deposited in overbank and floodplain settings, locally infilling the sites of former channels. Extensive migration of the braided channels led to the aggradation of Nishnabotna channel sands across virtually the entire region of western Iowa and eastern Nebraska. The Nishnabotna sandstones regionally form a "sheet sand" that blankets the older surface of eroded Paleozoic rocks and comprises the main body of the economically important "Dakota Aquifer."

Although the bulk of the Nishnabotna Member was deposited in nonmarine fluvial (river) environments, studies of Nishnabotna strata in the lower Platte River Valley of eastern Nebraska during the mid 1990s resulted in the recognition of marine-related sedimentation in the lower Nishnabotna sequence of that area. The evidence for marine-influenced deposition in that area was two-fold: occurrences of marine organic-walled microfossils and the discovery of well-preserved tidal rhythmites (finely laminated mudrocks modulated by semimonthly tidal cycles) (see summary in Witzke and Ludvigson, 1996). These discoveries clearly showed that marine waters (seawater) intruded far up the low-lying valleys along the eastern edge of the Western Interior Sea. Sediments deposited in tidal estuaries and tidally-influenced river systems were part of the regional picture of lower Nishnabotna sedimentation. As of 1996, it seemed remarkable that tidal influences were present so far up the lower Dakota valleys, at least 190 miles (300 km) from the shoreline of the Western Interior sea (the margin of the age-equivalent upper Albian Kiowa-Skull Creek marine shales stretches across western Kansas to central Nebraska and South Dakota). The limits of marine influence in most modern estuary-tidal river systems rarely exceeds 100 to 150 miles from the open sea, and so the discoveries in the lower Platte Valley seemed remarkable in the extent to which the estuaries penetrated into the eastern landmass. By 1998, discoveries in Guthrie County pushed the limits of marine-influenced lower Nishnabotna sedimentation even further eastward, defining some of the largest estuarine systems yet known from the geologic record.

Marine-influenced deposits are not seen at all localities in the lower Nishnabotna Member of Guthrie County, but the newly described sections along Long Creek on the Garst property display the best evidence for marine-influenced sedimentation to be seen in the county (see Phillips and White, this guidebook). Although additional study is underway, the presence of a number of features at these sections is suggestive of marine-influenced sedimentation, including fossil burrows (whose forms are similar to those seen in many marine facies), laminated silty mudrocks (some laminae may show tidal modulation), and pyritic cements. The laminated pale siltstone seen at the Garst property Whiterock section (Witzke and Ludvigson, 1996, p. 63) may also show possible tidal influence (Dale Leckie, 1998, personal communication). Finally, the basal part of the Nishnabotna section at the Springbrook West section (units 1-3, see descriptive section in this guidebook) may also represent marine-influenced facies, displaying pyrite cements and possible burrow mottles.

The upstream reaches of tidally-influenced estuarine sedimentation appears to have extended eastward as far as Guthrie County, Iowa, a remarkably long distance, approximately 280 miles (450 km) from the open sea. These distances are so great as to encourage skepticism. Further studies of the basal Nishnabotna sediments are needed to confirm our present interpretations, but we remain confident and intrigued by the possibilities. The eastward incursion of estuarine facies up the broad Nishnabotna valleys likely corresponded to a time of maximum expansion of the Western Interior Seaway during the late Albian (the Kiowa-Skull Creek marine cycle). These estuaries penetrated eastward into the relatively flat-lying coastal lowlands along the eastern side of the seaway, and it was probably the extreme low relief and low gradients across this landscape that allowed minor changes in sea level to be seen so far inland up the major river valleys. The aggradation of fluvial (river) sediments during subsequent Nishnabotna sedimentation marked the infilling of the valleys and the extensive lateral migration of the rivers' braidplains. An episode of downcutting and erosion likely occurred at the close of Nishnabotna sedimentation as regional base levels fell coincident with the withdrawal of the late Albian seaway.

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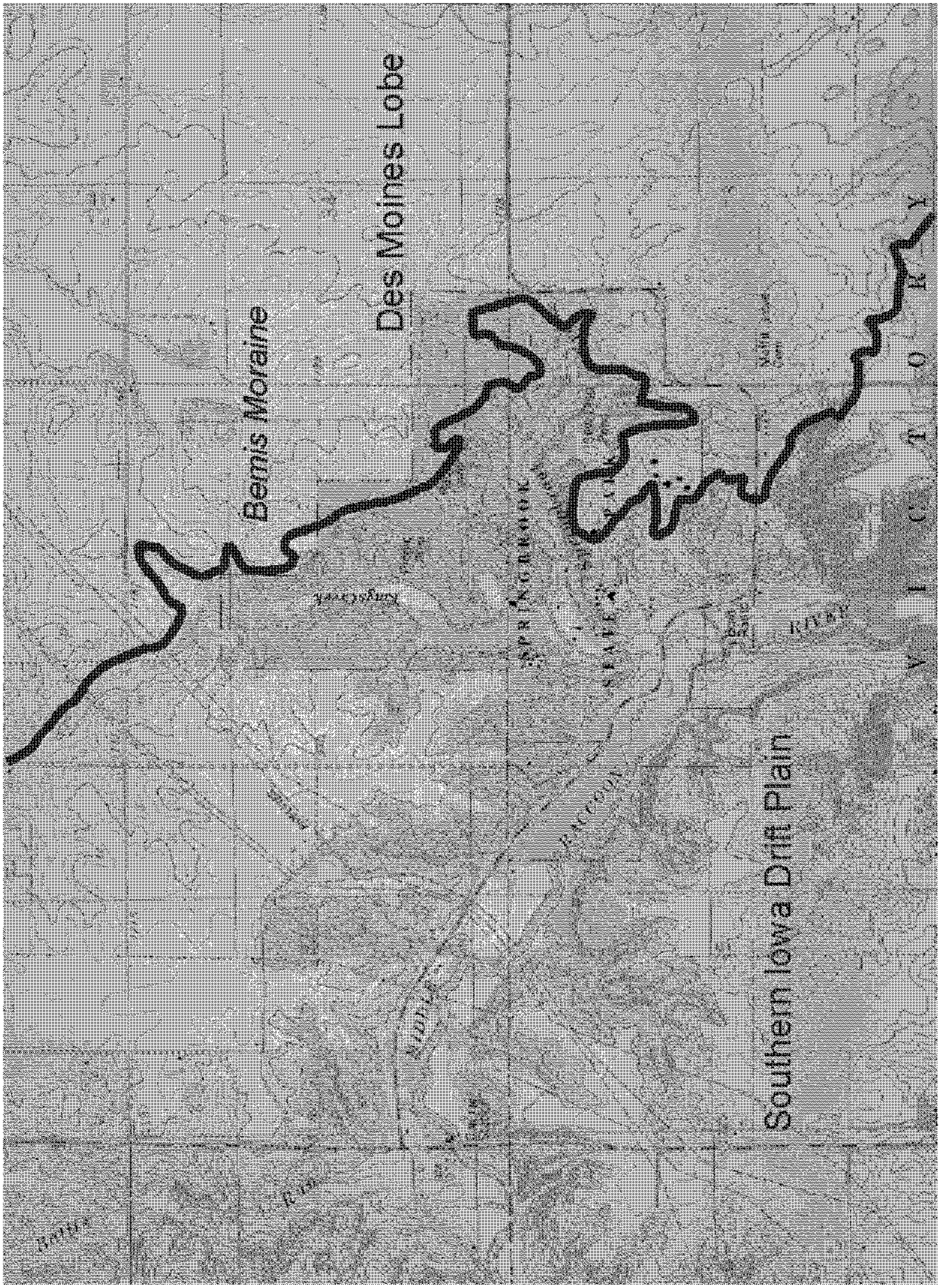

Figure 1. Location of Springbrook State Recreation Area. Black line delineates the former ice margin of the Des Moines Lobe ice sheet and the boundary with the Southern Iowa Drift Plain. Base from U.S.G.S. Bagley 7.5' quadrangle, 1982.

AN OVERVIEW OF THE QUATERNARY HISTORY OF THE SPRINGBROOK AREA

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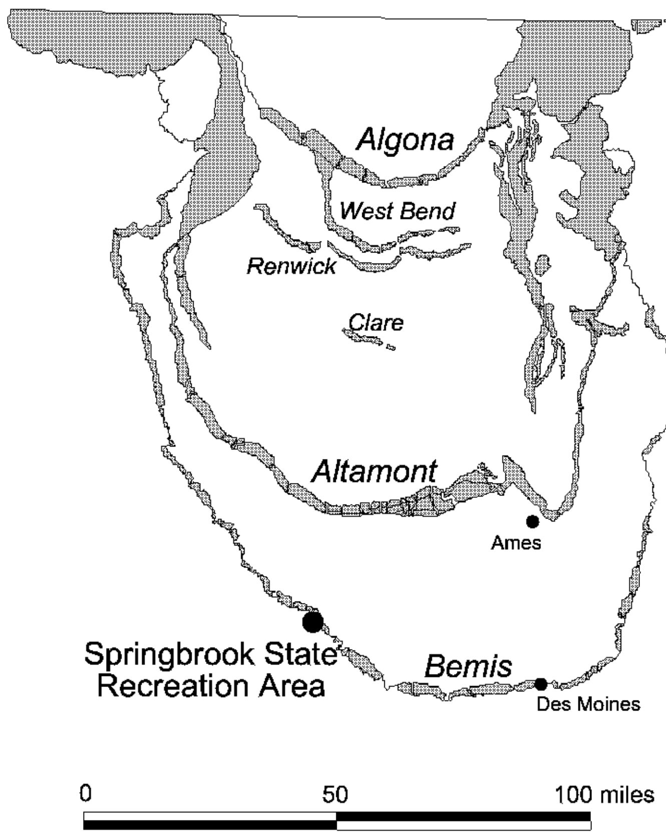

Figure 2. Map showing the Des Moines Lobe landform region and former ice margins associated with this glacial advance into north-central Iowa.

Geomorphic Setting

Springbrook State Recreation Area and the adjacent Conservation Education Center are located in Guthrie County just east of the Middle Raccoon River. The course of this river through Guthrie County generally marks the boundary between two major topographic regions of Iowa – the Des Moines Lobe and the Southern Iowa Drift Plain. Landscapes northeast of the river are characteristic of terrain directly affected by Late-Wisconsinan glacial processes about 14,000 years ago. The land southwest of the Middle Raccoon is strikingly different, the result of long-term erosion on glacial materials that were deposited during numerous Pre-Illinoian glaciations between 2.2 million and 500,000 years ago (Hallberg et al., 1980). This landscape was mantled with several meters of Wisconsinan loess between 55,000 and 12,000 years ago (Bettis, 1997). The Middle Raccoon, which separates these two regions, has excavated a steep sided valley that contains sediments and features resulting from Wisconsin and Holocene alluvial processes (Fig. 1.).

The Bemis Moraine

The first field trip stop of the afternoon, Stop 5, will be just north of the trail that leads east from the picnic area where we have lunch. This stop provides one of the best overviews of the Bemis Moraine in the Springbrook area. This moraine marks the southwestern edge of the Bemis ice advance, and the maximum reach of Late-Wisconsinan Des Moines Lobe (DML) ice into Iowa (Fig. 2).

The Pre-Illinoian Landscape at Springbrook

The landscape within Springbrook State Recreation Area itself is more characteristic of the older weathered Pre-Illinoian deposits that typically lie west of the Middle Raccoon. Here at the park, the course of the Middle Raccoon River diverges from its usual ice-marginal position. Most likely this segment of the Middle Raccoon existed here prior to the advance of the DML, whereas most of its length reflects diversion by the DML ice advance. The park's relatively steep slopes and rugged topography result from erosion and dissection along Springbrook Creek and Kings Creek, which are tributaries of the Raccoon. To our knowledge there are no exposures of Pre-Illinoian tills within the park, as they are covered with colluvial deposits. Probing of the steep ridge crests upslope from Stop 2 revealed that the ridges are cored with weathered Pre-Illinoian till and mantled by loamy colluvium. The colluvium most likely was derived from the erosion of Pre-Illinoian till and younger Wisconsinan sediments during Holocene time. It is also possible that these creeks, eroding headward into the toe of the Bemis Moraine, may have carried some colluvial materials off the Lobe. We will have an opportunity to examine this colluvium at Stop 2, just northeast of Springbrook Lake.

The Late-Wisconsinan Des Moines Lobe

The Des Moines Lobe (Fig. 2) advanced into Iowa approximately 15,000 years ago and reached its terminal position, at Des Moines about 14,000 years ago. The DML was active in Iowa until approximately 12,000 years ago, which is 5,000 to 8,000 years later than major glacial lobes to the east (Johnson, 1986; Fullerton, 1986). Kemmis and others (1994) concluded that the DML advance occurred during a period of regional warming and therefore was a surging glacier, lubricated by meltwater at its base. Plant macrofossil data provides further evidence for warming. Bettis et al. (1985) found abundant wood and plant macrofossils in Late-Wisconsinan sediments at the Saylorville Emergency Spillway exposures located 9 miles north of the southern terminus of the DML in Polk County, approximately 45 miles east of Springbrook. Baker (1985) studied plant macrofossil data from the Saylorville site and found substantial data showing a lack of tundra elements and the presence of a spruce-larch forest. These extensive investigations of exposures at the Saylorville Spillway provide the bulk of detailed stratigraphic, sedimentologic, and paleoenvironmental data accumulated on the southern terminus of the DML. Much of the Saylorville information can be extrapolated here to the Springbrook area.

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SPRINGBROOK STATE RECREATION AREA ARCHAEOLOGICAL RESOURCES

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The archaeology of Springbrook State Park, and Guthrie County in general, is poorly known. Most of the archaeological sites that have been recorded in the county are prehistoric campsites whose cultural affiliations have not been determined. However, several Archaic and Woodland sites have been identified in the region, indicating at least periodic use of the area over the past ca. 10,000 years. The sites of several farmsteads from the late 1800s and early 1900s have also been recorded as locations of archaeological interest.

Figure 1. Two Woodland mounds located near the southern end of the picnic area at Springbrook State Recreational Area.

One recorded archaeological site exists within Springbrook State Park. Site 13GT47 consists of four mounds in the northeast portion of the park. These mounds (Fig. 1) are conical shaped and suggestive of those constructed during the Woodland period (ca. 500 B.C. - 1000 A.D.). Although the mounds within the park have not been subjected to intensive archaeological study, they are considered to be burial sites because such mounds throughout the Midwest contain human remains. Two similar mounds (13GT46) are located immediately outside the park boundaries, at Moffit Grove Cemetery. All burial mounds are protected under Iowa's burial site protection law.

Based on the presence of the mounds, the locality's dissected landscape, the proximity to the Middle Raccoon River, and the campsites elsewhere in the county, it is likely that people resided in the Springbrook State Park area at various times throughout the prehistoric era. Campsites and other evidence of at least temporary occupation probably exist in the park. An intensive archaeological survey would be needed in order to detect these sites. Undisturbed archaeological sites might be rare because of erosion that has affected many of the upland soils. Upland areas not significantly eroded include those around 13GT47 and a small area west of these mounds across Kings Creek. These two places are the most likely locations for undisturbed upland archaeological sites. The flood plain areas surrounding the Middle Raccoon River, Springbrook Creek, and Kings Creek also may contain archaeological deposits. The sandy foot slope positions bordering these creeks may have been especially desirable habitation sites.

THE FAUNA OF SPRINGBROOK STATE RECREATION AREA; LIFE ON THE EDGE

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Introduction

The fauna of Springbrook State Recreation Area is truly a product of the land. Historic geologic activities, climatic conditions, prairie fires, and vegetation changes have helped mold the site into its present day condition. Springbrook is located on the edge of two unique landforms, the Des Moines Lobe and the Southern Iowa Drift Plain. One of the best opportunities for viewing large numbers of wildlife species is found on the edge of two habitat types. When this edge lies in conjunction with the edge of two major landform regions the edge effect is greatly exemplified.

People have helped play an important role in preparing Springbrook for its current wildlife resources. The areas Ecosystem Management Plan, developed in 1996, identifies the historic vegetation of Springbrook as being prairie, "scattering trees", and a small tract of timber. Land acquisition records identify 17 separate parcels of land lying within Springbrook's current boundary that were acquired over the past 72 years (see map on page 5 of this guidebook). How these areas were managed by previous owners serves as an indicator of the future vegetation types found on those parcels.

Figure 1. View looking east in the east-central portion of the Carson property which was acquired by the State and added to Springbrook State Park in 1936. Photo ca. 1926.

As each of these areas was acquired, cultivation and grazing practices (see Figs. 1 & 2) were eliminated. Lacking specific management practices, plant succession and browsing by deer have helped maintain the total area as a large community of edges. The land acquisitions are slowly developing over time allowing the advancement of a mosaic of vegetation types currently present at Springbrook.

Songbirds

Many visitors come for opportunities to view songbirds and white-tailed deer throughout the year. Since 1979 educators at the Conservation Education Center have been developing a species list of birds in conjunction with bird banding programs. Birds are captured using mist nets and banded with bands supplied by the U.S. Geological Survey's Bird Banding Laboratory. Banding efforts are currently restricted to areas near bird feeders and trails at the Conservation Education Center.

Fifty-eight species of near-passerines (doves through woodpeckers) or passerines (songbirds) have been banded to date. Although waterfowl, hawks and owls, and other groups of birds are commonly seen at Springbrook, banding is limited to near-passerine and passerine species. The 10 most common species captured to date are:

Black-capped Chickadee
American Goldfinch
White-breasted Nuthatch
Purple Finch
Rose-breasted Grosbeak
Dark-eyed Junco
Red-headed Woodpecker
Gray Catbird
Downy Woodpecker
Blue Jay

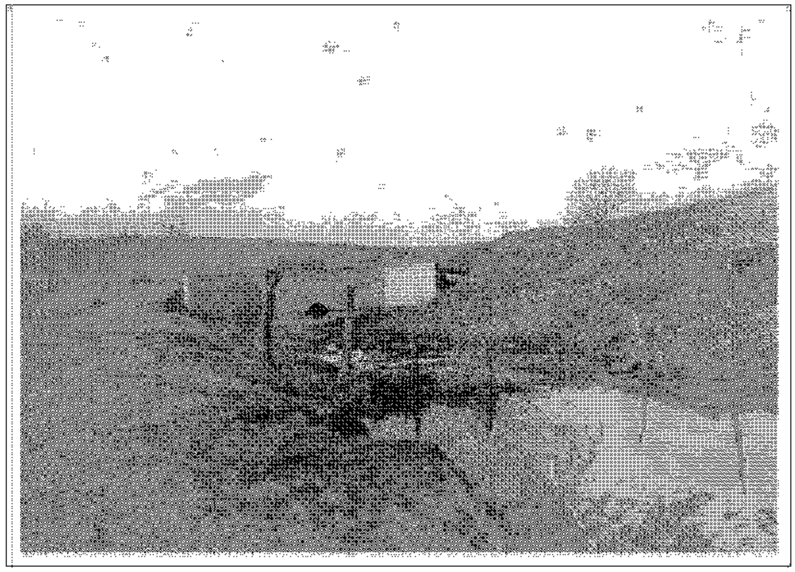

Figure 2. The head of Springbrook Creek as it emerges from a culvert at the north end of the Carlson property, added to Springbrook in 1936. Photo ca. 1926.

While many of these can be identified as common attractants to bird-feeders, the capture of 11 warbler species along trails at the Education Center indicate Springbrook may at the least be an important component of migration routes for these and other neotropical migrants and deserves continued study. The following warblers have been banded at Springbrook.

Tennessee Warbler
Orange-crowned Warbler
Nashville Warbler (Fig. 3)
Yellow Warbler
Yellow-throated Warbler
Black-and-white Warbler
American Redstart
Ovenbird
Mourning Warbler
Wilson's Warbler
Canada Warbler

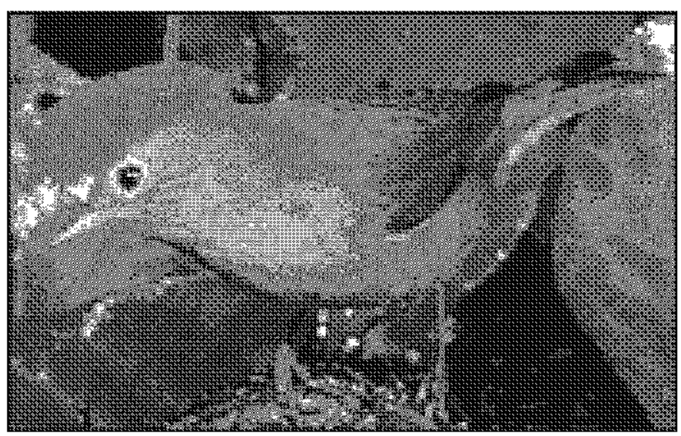

Figure 3. The Nashville Warbler is one of the birds that is seen at Springbrook State Recreation area.

White-tailed Deer

Without discussing the white-tailed deer, a look at Springbrook's present day flora and fauna would be very incomplete. They are the dominant "managers" of the plant communities found here. A definite browse line is apparent throughout Springbrook. While deer densities are recommended to be kept below 20/sq. mi. in "forested areas", the mosaic of vegetation types within Springbrook provides a large edge habitat that these animals simply browse through.

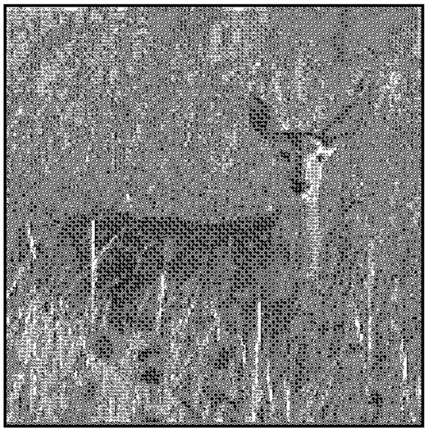

Figure 4. White tailed deer are currently stressing the floral environment at Springbrook.

White-tailed deer (Fig. 4) populations were thought to be approximately 1-3 deer/sq. mi. before settlement of North America by Europeans. Estimates of the adult deer population in Springbrook were approximately 130 deer/sq. mi. in early summer of 1989. Aerial counts during the winters of 1983-1995 averaged 236 deer/sq. mi. Winter, after the removal of Iowa's "forests of corn", best represents the time period when deer most actively seek out woodland areas similar to Springbrook for cover.

To better assess the effects deer were having on Springbrook's woody vegetation, five 1/10 acre control plots and five 1/10 acre enclosures were established in 1986. The controls had a total of 9 woody species represented by 123 stems sized >1' in height to a 4.1" dbh. Ten years later, in 1995, a recount of these same controls revealed 4 woody species and a stem count of 9 stems.

The enclosures in 1986 had 14 woody species represented by 408 stems sized >1' in height to a 4.1" dbh. Recounts in 1995 yielded 13 woody species and 275 stems.

Landowners were concerned about the loss of crops to the local deer herd. A deer hunting season was established in 1994 to assist in managing the deer population. Because hunting is prohibited in State Parks, the name of the area was changed to Springbrook State Recreation Area. One hundred licenses were issued each year during 1994 and 1995 while 50 licenses were issued each year during 1996 and 1997. Hunters attended a mandatory training session to familiarize them with the area and rules pertaining to the hunt.

Efforts were made to reduce the reproductive potential of the Springbrook deer herd by restricting licenses to antlerless deer only. Of the 300 licenses issued during the four year period, only seven hunters did not hunt. Two hundred seventy deer were harvested on the area during the four year time period for a 92% success rate.

One hundred ninety-five does (72% of the harvest) were removed. Because young bucks could not be distinguished from does, due to lack of noticeable antler growth during their first summer and fall, 75 (28% of the harvest) were also removed as antlerless deer. Adult does represented 65% (126 animals) of the females harvested.

The average age of adult females harvested has declined from 4.2 to 2.9 years during the four year hunting period. The reproductive potential for Iowa deer is quite substantial with approximately 70% of one-year-old does producing one fawn and over 90% of two-year-old does producing two fawns annually. Triplets and even quadruplets are not uncommon.

During 1998, 50 licenses will again be issued for hunting deer within the Recreation Area's boundaries. Winter aerial counts indicate that the number of deer per square mile is remaining fairly constant, with the numbers increasing in the Lake Panorama area adjacent to Springbrook.

Future Management

The 1996 Springbrook State Recreation Area Ecosystem Management Plan identifies specific management zones within the Area. Many of the sites now dominated by specific species (i.e. Bur and

Black Oak, White and Red Oak) have been identified to be managed as zones (i.e. bottomland, old forest, savanna, etc.).

Of major concern in managing the woodland components is the understanding that each of the small land areas acquired in the past will develop independently over an extended period of time unless active management occurs. The current size of the Recreation Area greatly limits opportunities for wildlife.

Additional land acquisition would allow options for management of the Area as a larger ecosystem. Burning and removal of trees in specific areas would allow oak seedlings to acquire full sunlight for growth and survival. With the implementation of active management, the future for songbirds looks promising in that we can provide larger corridors of similar habitat types for neotropical migrants. Because of the mosaic of roads, trails, and on-site development, Springbrook will always have species associated with edges.

White-tail deer populations are expanding throughout their range. Controlled hunting will not in itself greatly reduce deer populations in Springbrook. As deer are removed others will move into the available habitat. Hunting is helping to control extensive damage to adjacent cropfields.

Springbrook has an opportunity to play a vital role in the future of many wildlife species. The completed acquisition of 530 acres adjoining Springbrook on the south will increase opportunities for wildlife management, education, and recreation.

References

Iowa Department of Natural Resources. 1996. Springbrook State Recreation Area Ecosystem Management Plan. Iowa Department of Natural Resources, Des Moines, IA. 55 pp.

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THE VEGETATION OF SPRINGBROOK STATE RECREATION AREA

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Springbrook State Recreation Area is located in Guthrie County in the west-central part of Iowa. Biogeographically, this location is in a transitional area between the extensive deciduous forests of eastern North America and the open grasslands of the Great Plains. As one moves from east to west across this transition, forested land becomes rare and restricted to stream valleys. Compositionally, although the forests remain dominated by oaks (*Quercus* spp.), the leading tree species shift from white and red oaks (*Q. alba* and *Q. rubra*) to bur oak (*Q. macrocarpa*). The original grasslands in this transitional area were tallgrass prairies dominated by big bluestem (*Andropogon gerardii*) on the expansive rolling uplands between forested stream valleys. Numerous small patches of prairie dominated by little bluestem (*Schizachyrium scoparium*) also occurred within the forested portions of the landscape on droughty soils such as on escarpments, sandy soils, and on narrow ridges.

Compilation of the township plat maps drawn by General Land Office (GLO) surveyors in the 1850's (Fig. 1) confirms that prairie was the most extensive vegetation in Guthrie County prior to modern settlement. Although several parties of surveyors independently mapped different township in the county, all used the term "prairie" to label the extensive grasslands. In sharp contrast, the surveyors used up to five separate names for wooded areas (none of which were formally defined or documented), including:

- **Timber**, probably a dense mature forest with potential for cutting of logs, roughly equivalent to modern use of the term,
- **Grove**, probably a small patch of timber, consistent with contemporary use of the term,
- **Scattering trees**, evidently a grassland area with scattered trees, perhaps what would now be termed "savanna",
- **Barrens**, an enigmatic type possibly with no modern counterpart in the present landscape, but evidently intermediate between forest and grassland in the 1850's,
- **A mosaic of Timber, Scattering Trees, and Prairie Openings**, a complex mapping unit whose individual elements were too finely intermeshed to distinguish given the scope of the original maps (36 square miles) and the surveyor's instructions to provide only general descriptions of the country through which they passed.

Different parties of GLO surveyors often applied different names to the portions of single forested areas that crossed township lines. As a result, the GLO township maps aggregated at a county or state scale are an intriguing and frustrating mixture of natural diversity and taxonomic confusion.

Springbrook State Park is a microcosm of the regional vegetation pattern and also illustrates the contrasting approaches to classification of forest vegetation by GLO surveyors. The park is located along the Middle Raccoon River, a heavily forested corridor in the midst of an overall landscape formerly dominated by tallgrass prairie. The GLO surveyors mapped prairie on rolling uplands in the roughly northeast half of the park and various forested communities in the roughly southwest part along the stream valley. An east-west township line through the park separates forested land mapped as "timber" by one surveyor and as "scattering trees" by another. The original map also shows a linear escarpment, possibly the site of a prairie opening, where today the Sandstone Prairie is located on a low sandstone bluff along the park's west entrance.

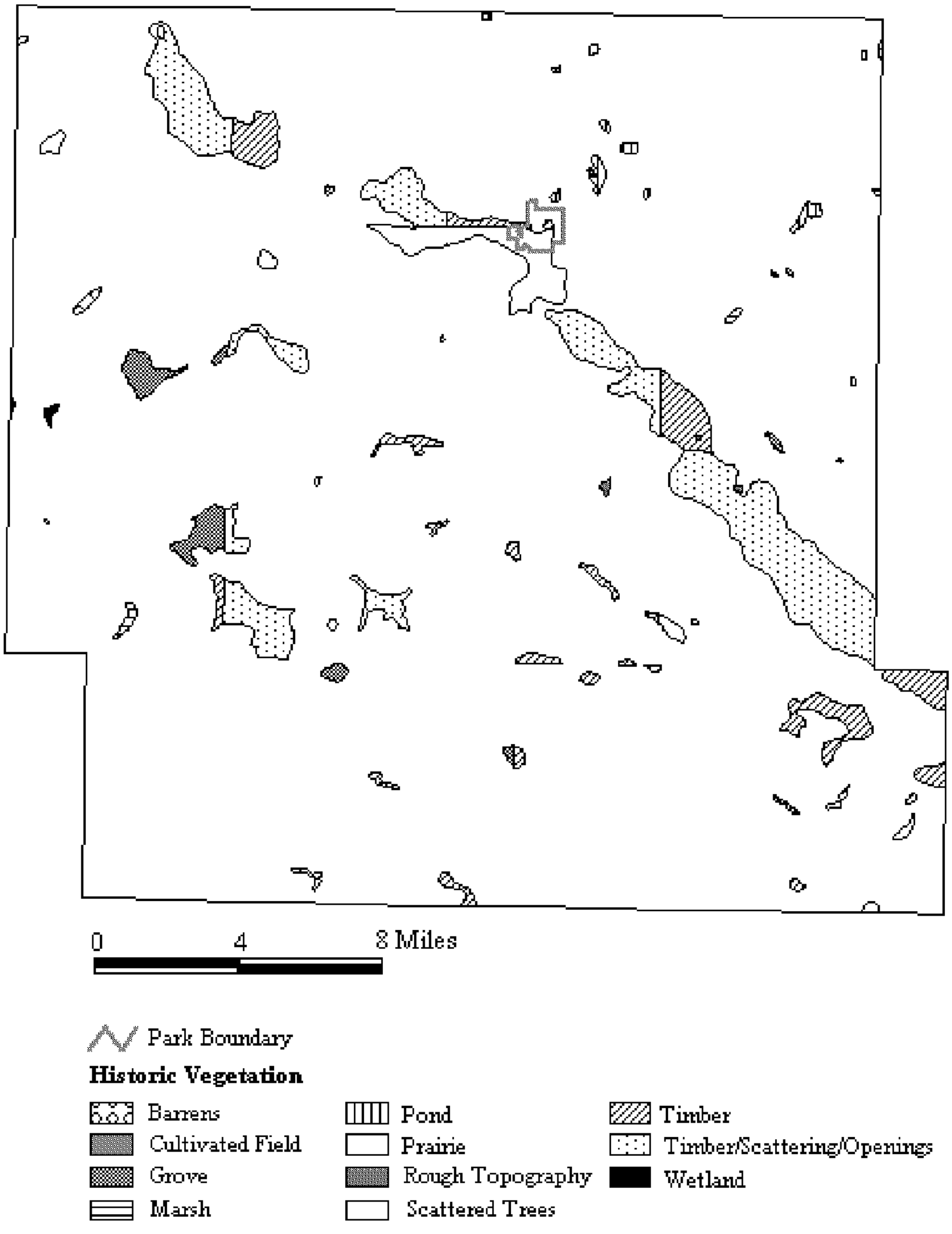

Figure 1. Historic vegetation in Guthrie County, drawn by General Land Office surveyors in the 1850's

Although modified from pre-settlement conditions, the present vegetation of the park reflects the two main elements of the historic vegetation mapped by the GLO surveyors. The "timber/scattering trees" portion of the park along the corridor of the Middle Raccoon River and the lower reaches of its tributaries in the southwest part of the park are primarily forested today, with scattered, small prairie openings where the tree canopy is thin or absent. The "prairie" portion of the park (at least its far northeastern corner) is still open land today, although planted with tame grasses and crops. Other parts of the "prairie" portion of the park are today appear to be occupied by forested or semi-forested communities. However, literal interpretation of fine-scale vegetation patterns on the GLO maps is risky of the coarse scale of the original maps.

The present vegetation in the park (as mapped at a finer scale than the GLO surveys) is a complex of communities, both natural and cultural, influenced by topography and substrate (Fig. 2). The majority of

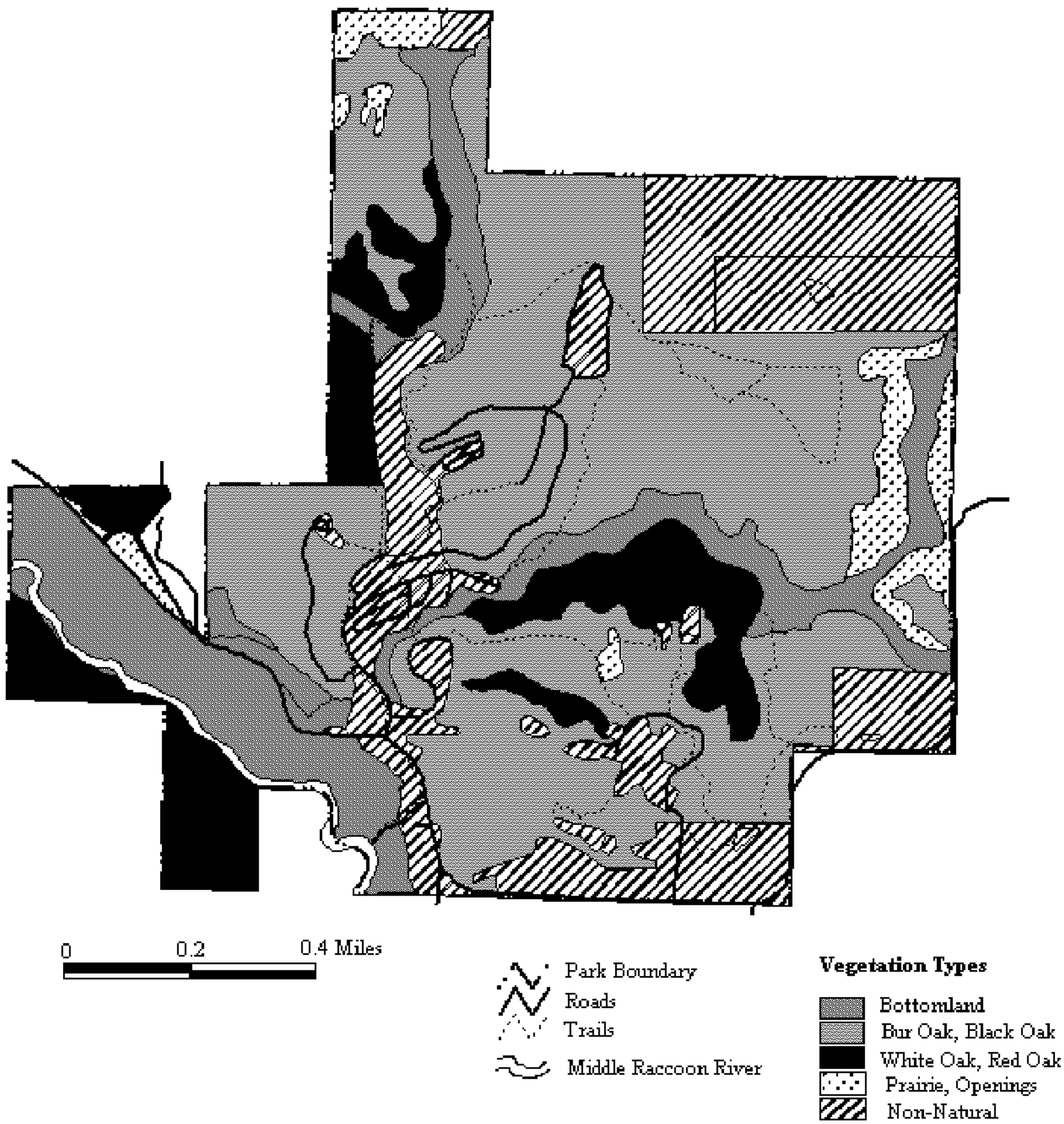

Figure 2. Historic vegetation in Guthrie County, drawn by General Land Office surveyors in the 1850s.

the park contains natural vegetation, although non-natural clearings associated with visitor facilities (lake, campground, picnic area, Education Center) or wildlife management (old fields, prairie plantings, crop field, ponds) are conspicuous in certain places. The major natural vegetation types are:

- **Bottomland forests**, located on alluvium along stream valleys,
- **Upland forests**, further divided into **White Oak-Red Oak** Forests on steep slopes and **Bur Oak-Black Oak Forests** on rolling uplands, and
- **Prairie Openings** on droughty soils surrounded by forest.

Each of these natural vegetation types are briefly described below.

Bottomland forests occupy the narrow bands of alluvium along the Middle Raccoon River, Springbrook Creek, and Kings Creek. Although forested in general aspect, the bottomlands of these streams are more accurately described as a mosaic of forested and open patches. The forested areas are dominated by silver maple (*Acer saccharinum*), cottonwood (*Populus deltoides*), willow (*Salix nigra*), and elms (*Ulmus rubra* and *U. americana*). Walnut (*Juglans nigra*) is also common in the bottomlands, especially on terraces. The open areas are strongly dominated by Reed canarygrass (*Phalaris arundinacea*), a species that aggressively invades low-lying lands subject to siltation. The "native" or "exotic" status of canarygrass is confused by the facts that it is a native, circumboreal species and that cultivars from have been widely introduced throughout the state and the nation. The structure of pre-settlement bottomland forests in the area cannot be known with certainty, but it seems likely that openings dominated by canarygrass are more common today due to siltation resulting from high sediment loads delivered from the modern agricultural landscape.

Upland forests dominated by **white oak (*Quercus alba*) and red oak (*Q. rubra*)** are found on steep slopes above the Middle Raccoon River (especially south of the river), along Springbrook Creek (north of the Conservation Education Center), and along Kings Creek (especially west of the lake). Other common species in this forest community are shagbark hickory (*Carya ovata*), ironwood (*Ostrya virginiana*), Pennsylvania sedge (*Carex pensylvanica*), and elm-leafed goldenrod (*Solidago ulmifolia*).

The geographic range limit of white oak is encountered only a few miles west of the park, although red oak extends to the Nebraska border. Thus the white oak-red oak forest in Springbrook State Park represents one of the westernmost occurrences of an upland forest community which is widespread in eastern Iowa and over much of the Midwest. Within the park, this forest type is entirely confined to soils of the Monteith series, which are developed on sandy residuum weathered from the underlying sandstone bedrock.

Most of the unquestionably natural forest in the park (not obviously heavily grazed or permanently cleared in the past) is concentrated within this type, probably due to its relatively unusable location on steep slopes. Although relatively free of the effects of past heavy grazing, the white oak-red oak forests were evidently cut in the past. The oldest white oak trees in the park (whose ages were determined by dendrochronologist Dan Duvick of Iowa State University) date to about 1880. Thus the white oaks currently dominating this community evidently regrew from a forest which was cut not long after settlement and are approximately 120 years old today (1998), a characteristic that typifies many oak forests in parks and preserves throughout Iowa.

In contrast to the prevalence of highly natural white oak and red oak on steep slopes in the park, **bur oak-black oak forests** are found extensively on flat to gently sloping uplands, which have been obviously grazed in the past. The substrate of the uplands occupied by this forest community is glacial till (Lindley soils), often capped with loess (Lester soils). This is the most widespread vegetation type in the park, comprising nearly half of its total acreage. The principal tree species, bur oak (*Quercus macrocarpa*) and black oak (*Q. velutina* or *Q. ellipsoidalis*), are known for their ability to withstand dry conditions and to rapidly colonize open areas; bur oak can also endure in heavily grazed pastures. Both species generally co-occur on the same site, but may also dominate in the near-absence of the other species in various places in the park.

As relatively flat areas with loamy soil, the land now supporting the bur oak-black oak forest were used more intensively than the steep, rocky ground occupied by the white oak-red oak forest. Pasturing, possibly accompanied by clearing of trees, was a traditional use of the forest until its acquisition by the park, when grazing was halted. The oldest trees in this community are generally about 65 years old today, about 50 years younger than comparable trees in the white oak-red oak forest. The younger age of the bur oak-black oak forest thus reflects its beginning as a grassland or open woods released from grazing and clearing pressures in the mid-1930's. Another possible interpretation is that the area now supporting the bur oak-black oak forest was originally prairie which has since been encroached by trees due to lack of fire and grazing. A literal interpretation of the GLO map supports this view, at least for the area north of Springbrook Creek (see Figure 1).

The understory of the bur oak-black oak forest is depauperate, both in terms of its low floristic diversity and a general lack of tree seedlings and small saplings. Dense shade and heavy browsing by deer have suppressed regeneration of young trees. Prickly-ash (*Zanthoxylem americanum*) and prickly gooseberry (*Ribes cynos-bati*) are thorny, grazing-tolerant shrubs that are common throughout this community due to its past use as a wooded pasture. Exclusion of deer browsing in small fenced plots indicates that regrowth can occur, but is almost entirely of shade-tolerant species.

Prairie openings are present in the predominantly forested landscape of the park where droughty soils limit the growth of trees. The single largest prairie opening (about 2 acres) is the Sandstone Prairie by the west entrance to the park. A complex of several small prairie openings interspersed with forest patches (together comprising about 10 acres) is found in the "savanna" along Springbrook Creek by the east entrance. Both of these areas are located on sloping areas of sandy Monteith soil, where the sandstone bedrock is exposed or only shallowly buried.

Many other tiny prairie openings (each measuring only a few tenths of an acre or less in size) are found otherwise forested areas throughout the park on convex slopes, possibly on exposures of glacial till (stratigraphically beneath the loess cap on the rolling uplands). Droughty soil conditions due to excessive internal and external drainage appears to be a common aspect of the Monteith (sandstone residuum) and Lindley (glacial till?) sites. Little bluestem is the dominant grass species in all of these locations, co-occurring with a low to moderate diversity of other prairie plants.

One prairie opening north of the Conservation Education Center is located on the flat topography of the Lester soil series (on loess) in the midst of a bur oak-black oak forest. It is strongly dominated by big bluestem and Indiangrass (*Sorghastrum nutans*) and may be an old field which has become naturally dominated by native grasses, as stimulated by numerous prescribed burns. It was not planted or seeded with the grasses that are so evident today. The significance of this opening is that it suggests that prairie grasses are present in a suppressed condition throughout the bur oak-black oak uplands, needing only a release from shade and stimulation by fire to become abundant.

SATURDAY

FIELD TRIP STOPS

STOP 1: SPRINGBROOK STATE PARK HISTORY

Rod Nelsen and Tammy Domonoske
Iowa Department of Natural Resources
Parks, Recreation and Preserves Division
Springbrook State Recreation Area
Guthrie Center, Iowa

Figure 1. A view of Springbrook lake, dam, and the edge of the beach house from Stop 1.

The first stop on the Geological Society of Iowa (GSI) Fall 1998 field trip will be at the Beach House on Springbrook Lake (Fig. 1). The beach house was originally constructed by the Civilian Conservation Corps in the 1930s, and had been known as the center of recreation on weekends for the park for many years. In the past, the beach and beach house had life guards, concessions, boat rental, diving platform, and other facilities. However, public utilization of the beach diminished and the function of the beach house changed with the times. The diving platform, life guards, and concessions are no longer present. The beach house underwent a major renovation during the Fall of 1997 and Spring of 1998. It now is utilized more like a shelter with restrooms than a true beach house. To learn more about the Springbrook history see the discussion of Springbrook State Park History beginning on page 3 of this guidebook.

At this stop, trip leaders will present a brief overview of today's field trip and Park Ranger Rod Nelsen will discuss the history of Springbrook State Recreation Area.

The Iowa Department of Natural Resources (DNR) discusses the preservation of CCC structures in the Springbrook State Recreation Area Ecosystem Management Plan. They state that:

> *The DNR places a high priority on the maintenance of the integrity of the Civilian Conservation Corps facilities and other historic resources present in the state area. These facilities have been subject to a comprehensive survey in recent years as well as diverse renovation efforts. National Register of Historic Places recognition has been granted to Springbrook in recognition of the historic significance of many of its CCC facilities. Accordingly, a high priority has been placed on the renovation of key CCC structures in such a manner that their historic integrity will be maintained. In some cases, the renovation effort will also focus on adaptive re-use of facilities to better serve park visitors of today and the future, for example, the conversion of portions of the beach building to semi-open picnic areas versus restoring of the no longer needed formal concession/kitchen and open air mens' and womens', changing rooms. The program of renovation will continue, at Springbrook State Recreation Area and elsewhere in the state park system.*

References

Iowa Department of Natural Resources, 1996, Springbrook State Recreation Area Ecosystem Management Plan, 55 p.

STOP 2: TRAILSIDE EXPOSURES OF DAKOTA FM. SANDSTONE AND QUATERNARY MATERIALS NORTH OF SPRINGBROOK LAKE

Brian J. Witzke, Greg A. Ludvigson, and Deborah E. Quade
Iowa Department Natural Resources
Geological Survey Bureau
Iowa City, Iowa 52242-1319

To reach Stop 2 we will proceed north from the Beach House along the trail that runs along Springbrook Lake (Fig. 1). At this stop we will see one of the few exposures of bedrock in this area, the Cretaceous Dakota Sandstone, and Holocene-age colluvium associated with erosion of the surrounding steep slopes.

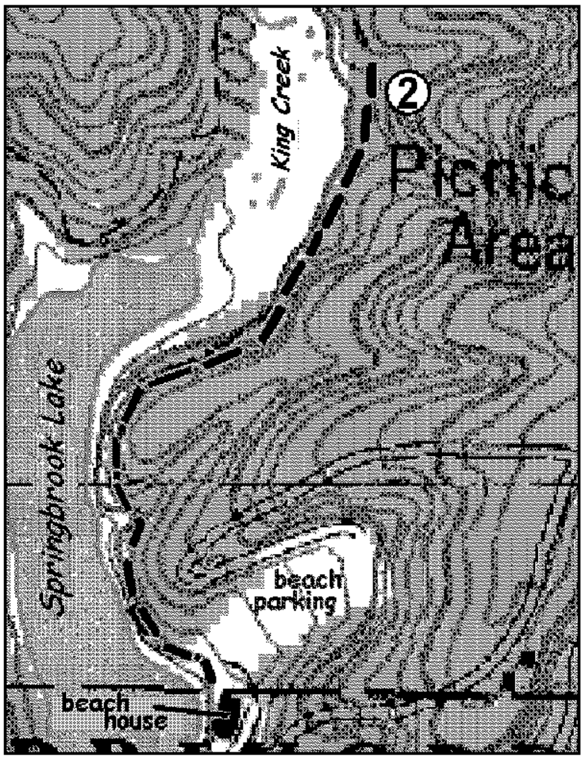

Figure 1. Route along Springbrook Lake from Stop 1 at the beach house to Dakota Fm. and Quaternary exposures at Stop 2.

Quaternary Materials

Deborah E. Quade

Various cuts within the ravine reveal several cycles of slope movement, probably during Holocene time. Colluvial sequences exposed near the mouth of the ravine are characterized by erosional lags consisting of coarse cobbly gravel that is overlain with fine-textured loamy colluvium. As you move headward up the ravine numerous large boulders carpet the channel. Most likely these boulders were weathered out of the surrounding landscape which is composed of Pre-Illinoian till. The age and timing of the colluvial sequence is problematic but most likely is related to intense rainfall events.

Cretaceous Sandstone Exposure

Brian J. Witzke and Greg A. Ludvigson

An instructive trailside sandstone exposure can be seen following a short walk north of the beach. Ledges of sandstone are actually seen within the trail, rising upward to a small vertical exposure to the east. The poorly-indurated very fine to fine-grained sandstone is characteristic of many exposures of Cretaceous bedrock in the Springbrook area. This particular exposure belongs within the upper part of the Nishnabotna Member, the lower interval of the Dakota Formation, a widespread Cretaceous rock unit in western Iowa and elsewhere across much of the American Great Plains. These sandstones were deposited in westward-flowing river systems about 100 million years ago, during the latter part of the "Age of Dinosaurs." The relatively homogeneous grain size of the sandstone layers at this stop makes recognition of sedimentary structures within the sandstone difficult, although small-scale cross-bedding is faintly visible. Of special note is a thin mudstone unit that fills a small channel near the top of the exposure. The soft mudstone is a silty clay-rich rock. Such mudstone units were probably deposited outside of the main river channels in overbank and floodplain settings.

STOP 3: STREAMSIDE EXPOSURES IN SPRINGBROOK CAMPGROUND, LOWER STRATA OF THE CRETACEOUS NISHNABOTNA MEMBER

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The only exposure of Dakota conglomerates in Springbrook State Recreation Area are found along Springbrook Creek in the campground area. To reach this exposure, Stop 3, we backtrack south along Springbrook Lake, past the beach house, then continue south across the dam and into the campground area (Fig. 1).

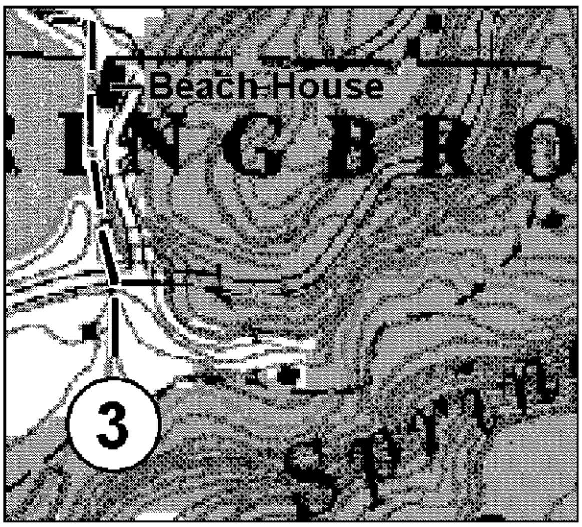

Figure 1. Route soutn along Springbrook Lake, across the dam, and into the campground area where Dakota Fm. conglomerates are exposed at Stop 3.

Cutbank erosion along Springbrook Creek in the campground area has revealed a series of small Cretaceous bedrock exposures of coarse-grained sandstones, pebbly conglomerates, and other rocks. These strata are found near the base of the Nishnabotna Member of the Dakota Formation, and they typify the general rock types seen in the lower part of the member in the county and elsewhere in western Iowa. A variety of rock types are seen along this short stretch of the creek: 1) coarse-grained sandstone; 2) fine to medium-grained sandstone; 3) pebbly and conglomeratic sandstone; and 4) light gray mudstone. The pebbly lithologies contain peanut-sized grains of quartz and chert as well as mudstone clasts derived from erosion of overbank muds. These various rock types are mutually crosscutting in complex channel forms. These sediments were deposited in a westward-draining braided river system during the Early Cretaceous period (late Albian Stage).

STOP 4: SPRINGBROOK STATE RECREATION AREA ARCHAEOLOGICAL RESOURCES

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Iowa City, Iowa 52242-1030

To reach Stop 4 of the GSI field trip, return to the cars in the beach parking area and drive northeast to the picnic area in the north-central part of Springbrook State Recreation Area (Fig. 1).

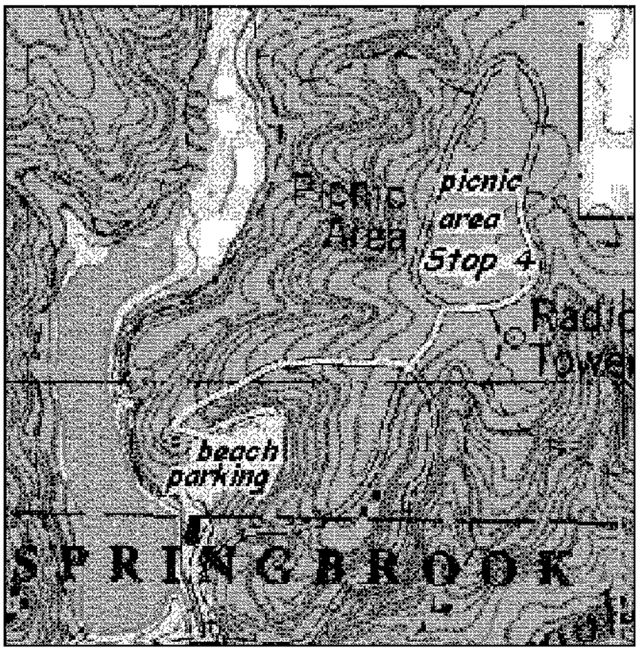

Figure 1. Map showing the route from the beach parking area to Stop 4 at the Springbrook Picnic Area.

As was noted in the discussion of Springbrook's archaeological resources beginning on page 25 of this guidebook, no overall archaeological survey of the Springbrook State Recreation Area has yet been conducted. Because of cost, such efforts have primarily been restricted in recent years to area master plans for new State recreation areas or for existing State Park redevelopment efforts. However, the DNR does schedule archaeological studies as appropriate, in conjunction with site specific capital improvement, facility renovation, or resource management efforts. The Ecosystem Management Plan for Springbrook does include the statement that "*Efforts should be made to seek innovative methods of securing more wide spread archaeological investigations at Springbrook and other State areas.*"

The Springbrook State Recreation Area Ecosystem Management Plan also includes recommendations for the management of the archaeological resources of the area. It states:

> *"The presence of documented burial mounds at Springbrook mandates careful attention so that these significant archaeological features are not damaged by either management activities or public usage. Within the mown picnic area, the seven oaks and hickories (varying in size from 12" to 24" diameter) on the two mounds will be monitored. As long as they are sound, they will be allowed to remain. The possibility of a tree falling and damaging the mound through uprooting of soil mandates ongoing attention. The 16" elm, a short-lived species, on one of the mounds will be removed. Further tree growth on the two mounds will be controlled through mowing. Weighing the woodland, the mound has 12 oaks under 14" in diameter and ten elms under 6". Oaks under 10" in diameter will be removed and the remaining oaks monitored. All elms will be removed from the mound and further tree development discouraged"*

References

Iowa Department of Natural Resources, 1996, Springbrook State Recreation Area Ecosystem Management Plan, 55 p.

STOP 5: THE DES MOINES LOBE ICE MARGIN

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Iowa City, Iowa 52242-1319

We are located just outside the northeastern boundary of Springbrook State Recreation Area and along the southwestern margin of the Des Moines Lobe (DML) ice advance (see figure 1, page 20). As you look across the fields to the northeast, there is an excellent vista of the relatively low-relief landscape of the Des Moines Lobe, specifically the Bemis Moraine, the outermost or "terminal" moraine of the DML. Bettis et al. (1985) theorized that overall, the DML ice was relatively thin, perhaps hundreds of feet thick, and that it thinned more toward these outer margins. Also, radiocarbon dates indicate that the ice occupied these marginal positions for a fairly short period of time, about 500 years or less. These conditions contributed to a thinner package of DML sediments, with a less uniform, variably textured till, and the presence of greater relief on the sub-Des Moines Lobe surface. Looking opposite the DML ice margin, back to the southwest, notice the sharp contrast in topography and landuse. The steeply dissected terrain is characteristic of the Southern Iowa Drift Plain, a region that is underlain by much older, Pre-Illinoian glacial deposits. Note the change from agricultural landuse on the Lobe to woodlands on the steeper sloping terrain.

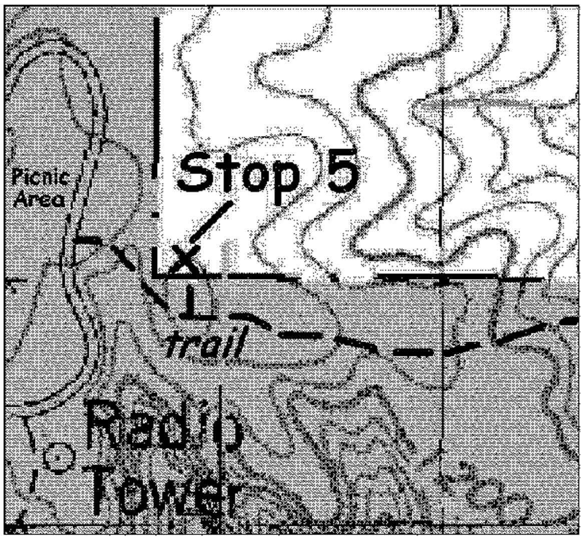

Figure 1. Map showing the location of Stop 5, just north of the trail that heads east out of the Springbrook Picnic Area.

A LATE-WISCONSINAN CORE SITE

With a Giddings drill rig, and the help of Joe Krieg of the University of Iowa Geology Department, a core was taken at this site, located at the toe of the Bemis Moraine. We extracted a 24-foot core that consisted entirely of Late Wisconsinan, Dows Formation diamicton (till) with a modern soil developed in the top. The upper 3.6 feet of the core was comprised of an oxidized, leached, sandy loam to loamy sand unit. The underlying unit from 3.6 to 5.8 feet consisted of a reduced, unleached diamicton with silty clay loam to loam textures. The upper 5.8 feet of the core is interpreted as the Morgan Member (a supraglacial till) of the Dows Formation, which is characterized by diamicton interbedded with silt, silty clay, and sand stringers. The contact with the underlying Alden Member (a basal till) is gradational and is noted by an increase in both density and silt content with depth. The lower 5.8 to 21 feet of the core is fairly typical of the Alden Member as described elsewhere near the terminus of the Lobe. From 5.8 to 17.7 feet, the core showed a reduced, jointed, unleached loam diamicton with higher silt content and interbedded thin stringers of medium sand. From 17.7 to 20.4 feet, the core contained what appeared to be a silt inclusion in the diamicton. The interval from 20.4 to 24 feet was described as a reduced, jointed, unleached loam to silt loam diamicton with the bottom 2 feet exhibiting a platy structure, possibly related to compression and shearing within the ice.

This core profile is quite similar to descriptions by Bettis and others (1985) from exposures at the Saylorville Emergency Spillway in Polk County. Also, Kemmis and Lutenegger (unpublished) have found a systematic increase in silt content in the massive DML basal tills southward toward the DML terminus, especially south of Ames. It is likely that this increased silt content is the result of local

Wisconsinan loess becoming incorporated and mixed with the debris-rich ice during the basal pressure melting processes.

Additionally, here near the ice terminus, localized areas of shearing and deformation caused by compressive flows may have occurred, which could account for the emplaced inclusion of silt and the platy structures observed in this core. Ice thrusting is known to occur elsewhere along the lateral ice margins in Iowa. (It rarely appears in interior positions within the Des Moines Lobe.) Ice compression, overriding, and thrusting at this particular marginal position in Guthrie County could be caused by increased friction with the ground as less lubrication was produced by basal pressure melting because of the thinner ice, and also perhaps by a rising bedrock or Pre-Illinoian landscape surface.

Unfortunately, we did not reach the base of the Dows Formation with this core. If this landscape is similar to the Saylorville area, we anticipate that the Dows Formation is underlain by at least 6 to 8 feet of Late-Wisconsinan Peoria loess, which is in turn underlain by Pre-Illinoian age glacial sediments.

References

Bettis, E.A. III, Kemmis, T.J, Quade, D.J. and Littke, J.P., 1985, Part 2. Quaternary Deposits of Saylorville Emergency Spillway, in After the Great Flood Exposures in the Emergency Spillway, Saylorville Dam. Edited by: E.A. Bettis III, T.J. Kemmis and B.J. Witzke. Geologic Society of Iowa, Guidebook 43, p.2-1 - 2-42.

Kemmis, T.J., and Lutenegger, A.J., unpublished, Systematic changes in the matrix texture of massive basal tills near the southern terminus of the Des Moines Lobe.

STOP 6: ASPECTS OF THE FLORA AND FAUNA OF SPRINGBROOK STATE RECREATION AREA

Fauna

Don Sievers
Iowa Department of Natural Resources
Information and Education Bureau
Conservation Education Center
Guthrie Center, IA

Flora

John Pearson
Iowa Department of Natural Resources
Parks, Recreation & Preserves Division
Des Moines, IA 50319-0034

From Stop 5 we will return to the trail and continue east to Stop 6 (see Fig.1). At this stop John Pearson, DNR Environmental Specialist, will discuss the vegetation of the park, particularly the Bur and Black Oak savanna in this portion of the park. Don Seivers of the DNR Springbrook Conservation Education Center will discuss the animals of Springbrook, particularly the white-tailed deer and the problems that their numbers have produced.

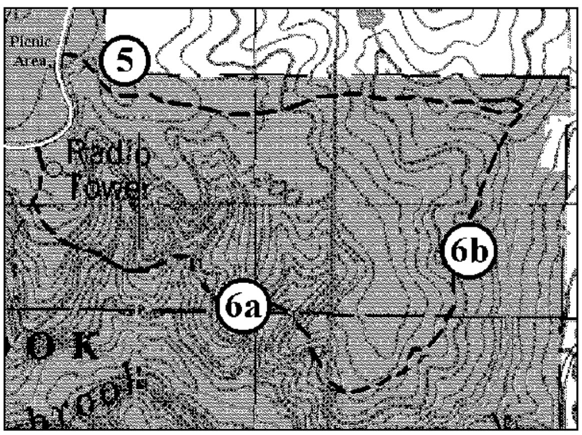

Figure 1. Map showing the trail that circles east our the the Springbrook Picnic area and includes field trip Stop 6, .

STOP 6A. PROBLEMS WITH WHITE-TAIL DEER IN SPRINGBROOK

Don Sievers

White-tailed deer present one of the greatest stresses on the modern flora of Springbrook. They are the dominant "managers" of the plant communities found here. A definite browse line is apparent throughout Springbrook. While deer densities are recommended to be kept below 20/sq. mi. in "forested areas", the mosaic of vegetation types within Springbrook provides a large edge habitat that these animals simply browse through.

To assess the effects deer were having on Springbrook's woody vegetation, a series of control plots and enclosures were established in 1986. At this stop we will discuss the results of this assessment. A written discussion of this study is printed, beginning on page 25 of this guidebook.

STOP 6B. SAVANNA ON TRAIL EAST OF PICNIC AREA

John Pearson

The loop trail east of the picnic area is almost entirely confined to a flat upland occupied by young, formerly grazed, and depauperate bur oak-black oak forest. The southern side of the loop provides glimpses of small prairie openings on the gentle side-slopes above Springbrook Creek, possibly developed on exposures of glacial till. At the easternmost end of the loop, a larger savanna-like complex of prairie openings in the forest are found on a belt of sandy Monteith soils. The prairie openings occur on convex slopes while the forest areas occur on the intervening concave slopes. Little bluestem is the dominant grass in the openings. Other prairie species observed here include:

Big bluestem (*Andropogon gerardii*)
Bicknell's sedge (*Carex bickenellii*)
Birdsfoot violet (*Viola pedatifida*)
Horsemint (*Monarda fistulosa*)
Thimbleweed (*Anemone cylindrica*)
Round-headed bushclover (*Lespedeza capitata*)
Germander (*Teucrinum canadense*)
Ironweed (*Vernonia* sp.)
Indian-plantain (*Cacalia plantaginea*)

STOP 7: THE SPRINGBROOK SANDSTONE PRAIRIE RESTORATION PROJECT

The Prairie

John Pearson
Iowa Department of Natural Resources
Parks, Recreation & Preserves Division
Des Moines, IA 50319-0034

Geology

Brian J. Witzke and Greg A. Ludbigson
Iowa Department Natural Resources
Geological Survey Bureau
Iowa City, Iowa 52242-1319

After leaving field trip Stop 6 we will return to the Picnic Area, board our vehicles, and drive to the park entrance where we will head northwest on Highway 348. About ½ mile from the entrance we will pull over on the shoulder of the road for a look at an area where prairie is being restored in an area of thin, sandy soil and Cretaceous Dakota Fm. exposures on the east side of the road.

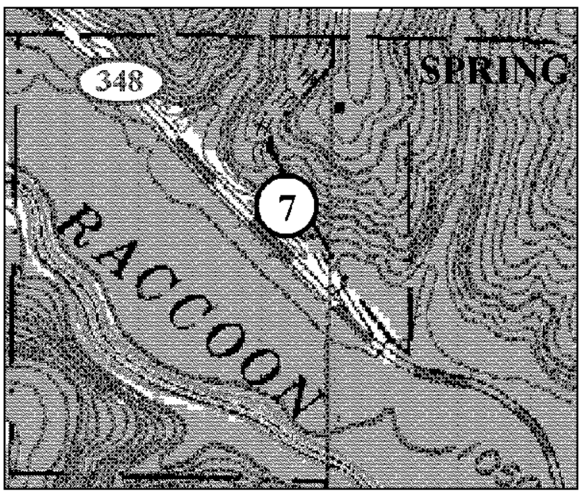

Figure 1. Map showing Stop 7, a sandstone prairie restoration project and exposures of Cretaceous Dakota Fm. sandstone.

Vegetation of the Sandstone Prairie

John Pearson

An south-facing escarpment of sandstone along the Middle Raccoon River at the park's west entrance is the site of a small natural prairie (Fig. 2) occurring as an opening in an otherwise forested landscape. Although modified by road construction, this escarpment was depicted on a township plat map prepared by GLO surveyors in 1850. The dominant grass is little bluestem (*Schizachyrium scoparium*); additionally, species indicative of sandy soils observed here are yellow puccoon (*Lithospermum caroliniense*) and wormwood (*Artemisia caudata*). Other, more typical prairie species at this site include:

Big bluestem (*Andropogon gerardii*)
Panic-grass (*Dichanthelium oligosanthes*)
Bicknell's sedge (*Carex bicknellii*)
Leadplant (*Amorpha canescens*)
Hoary puccoon (*Lithospermum canescens*)
Purple coneflower (*Echinacea pallida*)
Rough blazingstar (*Liatris aspera*)
Prairie cinquefoil (*Potentilla arguta*)
Flowering spurge (*Euphorbia corallata*)
Round-headed bushclover (*Lespedeza capitata*)
Blue-eyed grass (*Sisyrinchium campestre*)
Spiderwort (*Tradescantia bracteata*)
Prairie larkspur (*Delphinium virescens*)
Oldfield goldenrod (*Solidago nemoralis*)
White sage (*Artemisia ludoviciana)*

Since 1987, management activities on this prairie have included prescribed burning and manual brush cutting. Although most woody plants (especially sumac, black cherry, elm, and mulberry) were targeted for removal, scattered individuals of bur oak and black oak were deliberately spared from cutting to promote a "savanna" character.

Figure 2. Photo of Stop 2, the sandstone prairie on the north-west edge of Spring brook State Rec. Area. The light colored area near the top of the hill is exposures of Cretaceous Dakota Fm. sandstone

STOP 8: DAKOTA FM. EXPOSURES, A VEGETATED SLUMP, AND MODERN SEDIMENTATION, MIDDLE RACCOON RIVER

Slump Vegetation

John Pearson
Iowa Department Natural Resources
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Geology and Hydrology

Brian J. Witzke and Greg A. Ludvigson
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University of Iowa
Iowa City IA 52242

To get to field trip Stop 8 we will have to drive northeast on Highway 348 to its intersection with Highway 25 (see map insert on back cover of this guidebook). We head south on Hwy 25 for a little over one mile and then take the first road left (east). Continue east for a little over one mile, until just before the road curves right (south). At this point we turn left (north) into a farm lane and drive north along the lane for about ½ mile and park at the tree line as directed by trip leaders. We will divide into three groups in order to reduce the number of people present at each stop at any one time. We will rotate the groups, so everyone will have an opportunity to see all three areas of interest (Fig.1).

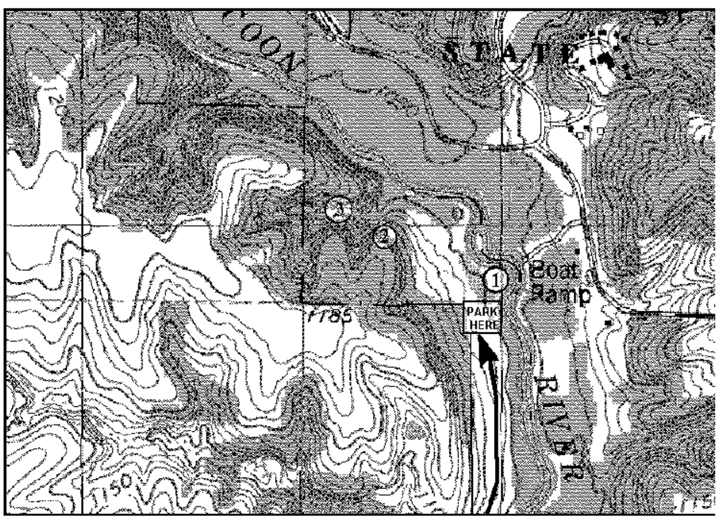

Figure 1. Map showing Stop 8, a and the three areas of interest at the stop.

Group 1 will walk along the Middle Raccoon River and view the sedimentary structures, especially the point bar that is developing near the parking area. Group 2 will look at an area of slope failure and the interesting vegetation that has developed on the slump material. Group 3 will advance up the steep, narrow drainage northeast of the parking area to view the best exposures of Dakota Formation rocks known in the Springbrook area..

STOP 8A: MODERN SEDIMENTATION ALONG THE MIDDLE RACCOON RIVER

Brian J. Witzke, Tim S. White, and Greg A. Ludvigson

Like all rivers in Iowa, the Middle Raccoon River (Fig. 2) in the Springbrook area displays a number of modern sedimentary features that formed in response to changes in the river's flow over time. These are expressed by both erosional and depositional features along and within the river channel and its floodplain and tributaries. We will examine some typical sedimentary structures along a small stretch of the river, and contrast features along the inside and outside of the channel meanders. A well developed point bar can be seen along the inside bend of the channel meander. The point bar is a crescent-shaped sand and gravel body that slopes into the channel. Because the river's flow is slowest along the inside of the meander, the transported sediments tend to accumulate by lateral accretion at this position. The sands are commonly crossbedded, and ripples are locally evident. During times of waning flow, finer muddy sediments may accumulate across portions of the point bar. Dune-like sand bedforms migrate within the river channel itself, and the movement of these sand bodies is most prominent during times of active flooding when the river's current is at a maximum.

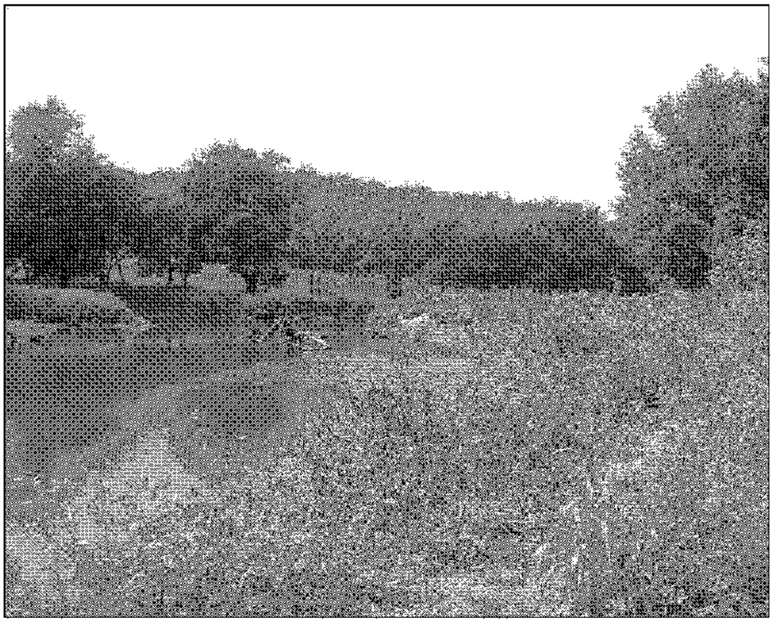

Figure 2. View of Middle Raccoon River and Stop 8 from east bank of river.

The river's flow is swiftest along the outside bend of the meander, and this region is characterized by active erosion expressed along steep-faced cut banks. The cut banks reveal older river sediments, primarily finer-grained muds and sands deposited on the floodplain. Undercutting along the cut bank exhumes tree roots, resulting in the collapse of trees into the river channel. The river's floodplain contains the bulk of the sediment contained within the valley. The floodplain terraces are episodically inundated during flood stage when fine sediments are deposited across the flooded surfaces. Flood channels may cut across the convex bank of the meander forming chutes. A well displayed chute can be seen behind the point bar at this stop. Rivers are dynamic systems, and active river channels change their positions repeatedly within the valley, resulting in shifting bed forms and sandbars, migrating meanders and cut banks, and changing patterns of sedimentation and erosion along the channel margins. Small tributary streams deliver locally derived sediment to the river, and small-scale deltas can be seen at the mouth of these tributaries along the river's edge.

The Middle Raccoon River, like all of Iowa's rivers, flowed unimpeded across the landscape for many thousands of years, shifting its channel and depositing and transporting sediment in response to waxing and waning flows. However, like many of Iowa's rivers, human engineering and other activities have modified the dynamics of the Middle Raccoon River. First, a significant increase in the sediment load of the river accompanied the spread of farming across Iowa's landscape from the mid 1800s to the present day, primarily a result of the increase in erosion caused by the expansion of row crop agriculture. Second, the effects of recent engineering a short distance downstream from the Springbrook area has changed the nature of the river's dynamic system, and a general increase in the amount of sedimentation that is presently occurring along this stretch of the river, over that seen further upstream, is evident. This change is likely the result of damming the river at Panora during the 1930s and the creation of the Lake Panorama reservoir, whose upstream edge reaches to the southern portion of the Springbrook Recreation Area. The river's flow begins to decrease substantially as it enters the upstream reaches of the reservoir, thereby diminishing the ability of the river to carry sediment. This results in increased sediment deposition, creating a prograding delta in that area. Of course, the ultimate fate of all reservoirs is siltation, the infilling of the reservoir with sediment. Sediment dredging can help forestall the inevitable.

STOP 8B: UNUSUAL VEGETATION ON SLUMP

John Pearson

The steep, dissected, north-facing Monteith slopes on the south side of the Middle Raccoon River support a highly natural white oak-red oak forest. At some unknown time in the past (perhaps decades ago), a portion of the sandstone bedrock within this forest slumped and created a bare, sandy area. A distinctive plant community comprised of cushion mosses and other "psammophilic" (sand-loving) plants has developed on this unusual site. The moss species include:

Leucobryum glaucum
Dicranum scoparium
Polytrichum commune
Thuidium recognitum
Pleurozium schreberi
Bartramia pomiformis
Aulocomnium heterostichum
Anomodon attenuata
Tetraphis pellucida

Shining clubmoss (*Lycopodium lucidulum*), a rare vascular plant known mainly from sandy forested areas in the Paleozoic Plateau, also occurs here. Another outlying population is associated with the sandstone bluffs of Dolliver State Park.

STOP 8C: NATURAL RAVINE EXPOSURES OF THE CRETACEOUS DAKOTA FORMATION

Brian J. Witzke, Greg A. Ludvigson, and Tim S. White

The most complete succession of Cretaceous strata in the Springbrook area is found in a deeply ravined drainage that incises the west valley wall of the Middle Raccoon River (SW SW NW section 4)(see Fig. 1 map and photograph on front cover of this guidebook). The succession of strata, dominantly sandstone, is shown in a graphic representation (Fig. 3), and the units are described in the accompanying descriptive text. The vertical succession of units was measured using a hand level and metric tape. The modern environment in which these exposures are found is remarkably unspoiled by human activity, with rare plant communities and picturesque sandstone ledges. Please be careful not to disturb this natural setting. Travel may be difficult up the ravine, and wading in the small creek is necessary at several points. For those unaccustomed to traversing such environments, please be advised of potential difficulties. Most of the sandstone succession is only weakly indurated, and the sandstones commonly crumble and disaggregate upon weathering. The sandstones were

Figure 3. A view of the Cretaceous exposure at Stop 8.

deposited in westward-flowing river systems during the latter part of the Early Cretaceous (late Albian Stage).

The basal strata (units 1-3) of the Cretaceous succession are found along the lowest reaches of the stream drainage. These are dominated by soft clayey light to dark gray mudrock with an intervening ledge of siltstone. The relatively impervious nature of these strata results in a series of wet seeps along the contact with the overlying conglomeratic sandstones. As discussed earlier in this guidebook, the basal mudrock-dominated strata may show evidence of marine influences during deposition, and pyrite cements and possible burrow mottles are recognized here.

A series of fine to coarse sandstones, pebbly and conglomeratic to varying degrees, overlies the basal mudrocks. This succession is coarsest at the base (unit 4), and mudclasts, quartz pebbles, and granules are found near the base of channel reactivation surfaces that are seen at several positions within the lower interval (units 5-8). The sandstones are locally cemented by iron oxides. Several lensatic light gray mudstone bodies are seen to locally infill small channels (unit 6). Sedimentary structures are generally difficult to discern, but tabular crossbeds are seen in most of the sandstone layers.

The upper succession of sandstone is dominated by finer-grained sandstones. These are best represented along a picturesque cliff-forming section (units 8-9). As seen at the hard cemented ledge within the floor of the ravine, these sandstones are locally well indurated. However, the bulk of the sandstone succession is soft and easily weathered. Part of the upper sandstone (units 9-10) shows fine horizontal laminations, a very different sedimentary structure than seen in the lower sandstones. This sandstone interval can also seen at the top of the prominent slump (Stop 8B).

The highest exposed part of the upper sandstone succession is marked by coarser sandstones (unit 11), including pebbly and conglomeratic lithologies in the lower parts of channel-filling bedforms. The base of the upper unit shows erosional incision into the underlying strata which is infilled by sandstones containing an abundance of mudclasts. A ledge in the floor of the ravine shows fossil wood and log impressions. The left fork of the ravine contains pebbly and conglomeratic sandstone at an elevation significantly lower than seen in the main ravine section, and it is possible that this conglomerate represents even lower downcutting of the unit 11 channel. Uppermost strata are primarily very fine-grained and display trough crossbedding. The succession of Cretaceous strata is capped by Quaternary sediments in the highest reaches of the ravine, including stratified clayey colluvium.

SPRINGBROOK WEST, BEDROCK SECTION

SW SW NWsec. 4, T80N, R31W, Guthrie County, Iowa
Main ravine drainage, west of Middle Raccoon River
Measured by Brian Witzke, Greg Ludvigson, Tim White; Sept. 2, 1998.

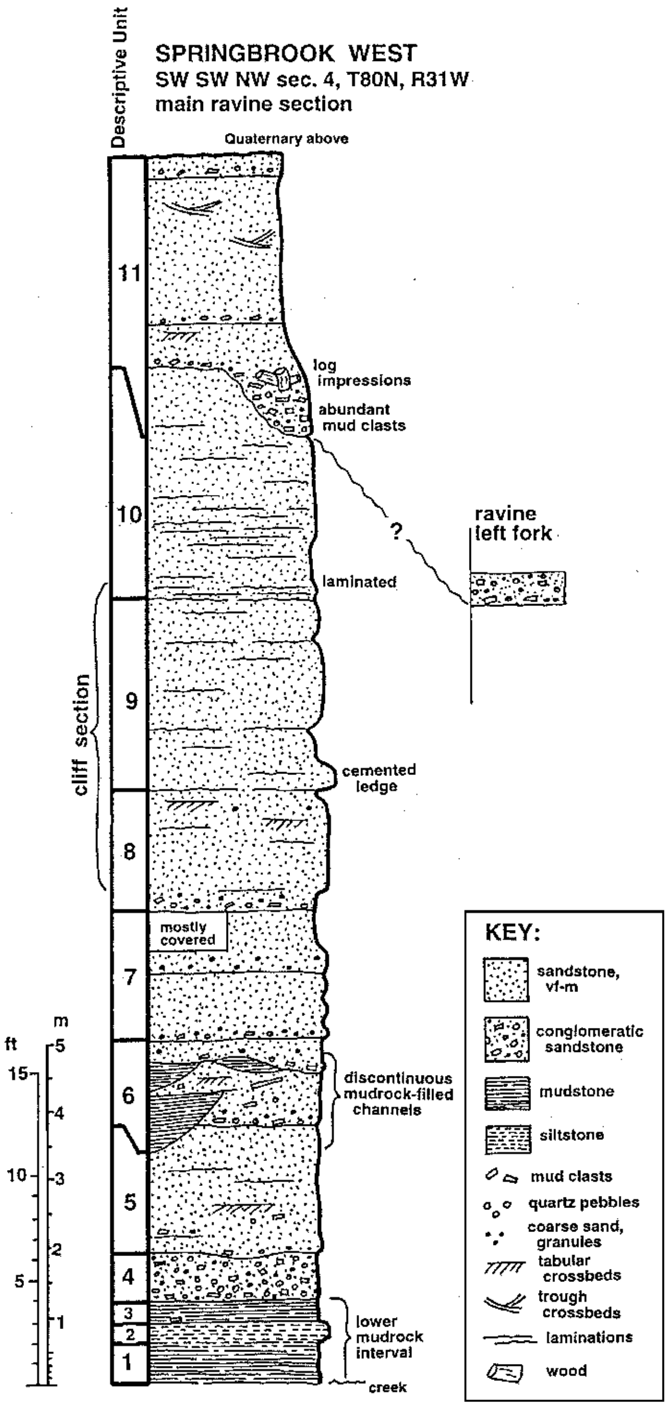

Figure 3. Graphic section of the Cretaceous Dakota Formation rocks exposed at Stop 8. See associated text for detailed description.

CRETACEOUS
DAKOTA FM., NISHNABOTNA MBR.

UNIT 11. Sandstone, vf-f, f-m, part conglomeratic, **Basal part**: basal 20 cm is pebbly conglomeratic sandstone with mudclasts (to 2 cm) and scattered quartz/chert pebbles (to 1.5 cm), basal interval incises laterally up to 1.0 m into Unit 10 sandstone moving up the ravine where is contains abundant light gray mudclasts (up to 6 cm, many deformed and compressed up to 25 cm long), upper part of basal incision displays ferruginous-cemented wood and log casts (to 20 cm diameter); basal conglomerate grades upward into sandstone, f-m, crossbedded, 45 cm thick. **Middle part**: reactivation surface at base with 10-cm thick conglomeratic sandstone above, scattered coarse sand and pebbles; grades upward to sandstone (2.1 m thick), vf-f, small-scale trough festoons (10 cm amplitude) in upper part. **Upper part**: top 25 cm of unit is ferruginous cemented conglomeratic sandstone, mudclasts, scattered quartz/chert pebbles. Thickness total interval: 3.1-4.1 m. **Note**: hand-leveling up the left fork of ravine (south) revealed a 50-cm thick conglomerate at a lower elevation (9.4 m above base of unit 5), conglomeratic sandstone, f-c, argillaceous to silty, poorly sorted, mudclasts and quartz/chert pebbles (to 3 cm); this conglomerate could mark deeper incision of unit 11 to the south.

UNIT 10. Sandstone, vf-f; mm-scale horizontal laminations common through most of unit, accentuated by ferruginous cements (especially lower 1.25 m), laminations resemble clay drapes (but no clay observed); irregular sharp contact at top, laterally incised by Unit 11. Thickness: 2.3-3.3 m.

UNIT 9. Sandstone, vf-f, homogeneous, cliff-former, scattered faint horizontal laminations; basal bed in floor of ravine is a ferruginous-cemented bed; unit forms upper part of prominent vertical cliff face downstream; minor re-entrants along bedding surfaces at base, 95 cm up, 2.15 m up. Thickness: 2.8 m.

UNIT 8. Sandstone, vf-f, scattered coarse sand and granules noted in upper part; massive cliff-former; basal 30 cm is pebbly conglomeratic sandstone, poorly exposed; scattered small-scale tabular crossbeds in upper part; some faint horizontal laminations; planar surface at top. Thickness: 1.75 m.

UNIT 7. Sandstone, mostly vf-f, part f-c and conglomeratic; locally displayed as ferruginous-cemented ledges; basal part is f-c sandstone, granules, scattered mudclasts; top 30 cm is f-c sandstone, granules; upper 65 cm is mostly covered, appears to be sandstone. Thickness: 1.9 m.

UNIT 6. Sandstone, mostly f-m, and mudstone, light gray; sandstone includes scattered quartz pebbles (to 1 cm) and mudclasts at base, scattered small mudclasts (most 2-5 mm) above, 60 cm above base is deformed elongate mudclast or clay streak, middle sandstone with tabular crossbeds in sets 10-20 cm thick; laterally discontinuous mudstone-filled channels, lowest mudstone to 95 cm thick (part incised into Unit 5), additional discontinuous mudstone-filled channels above up to 70 cm thick (incised into lower Unit 6). Thickness of total interval: 1.35-1.8 m.

UNIT 5. Sandstone, mostly f-m, scattered quartz pebbles and coarse sand; scattered mudclasts in lower part; low-angle southward-dipping cross-laminae noted; part shows planar bedding; may incise laterally into Unit 4; locally incised by Unit 6 mudstones at top. Thickness: 1.8 m.

UNIT 4. Gravel and sandstone, f-vc, abundant granules and quartz pebbles (to 1.5 cm, most < 1 cm); scattered mudclasts in lower part (to 3-4 cm); sharp contact at base. Thickness: 77 cm.

UNIT 3. Mudstone to claystone; light to medium gray; lower part is pale gray mudstone, very silty, with scattered mudclasts (1-2 cm); grades upward to light to medium gray claystone (darkest 10 cm below top; palynology sample SLW-2). Thickness: 32 cm.

UNIT 2. Siltstone, weakly calcite-cemented; light gray with irregular medium gray mottles (may be burrows); becomes clayey and pale gray near top; scattered pyrite nodules (1 cm), may be pyritized wood fragments. Thickness: 23 cm.

UNIT 1. Claystone, silty, plastic when wet, medium to dark gray lower 30 cm, pale gray upper 20 cm; palynology sample SLW-1 near base. Maximum measured thickness: 50 cm.

STOP 9: NATURAL FEATURES NORTH OF THE SPRINGBROOK CONSERVATION EDUCATION CENTER

The final stop of the day, Stop 9, will be at the DNR Springbrook Conservation Education Center. To get to the stop we will return back to the Springbrook State Recreation Area, retracing the same route that brought us to Stop 8 from Stop 7 (see map on back of this guidebook). Instead of turning into the entrance to Springbrook Park we will continue south on Hwy 438 passed the entrance and follow the road as it curves east. Just after the road curves south again we will turn left (east) into the Education Center and park in their parking lot. Following the trip leaders, we will hike north along the west-most of the trails, taking the first branch in the trail to the right (east).

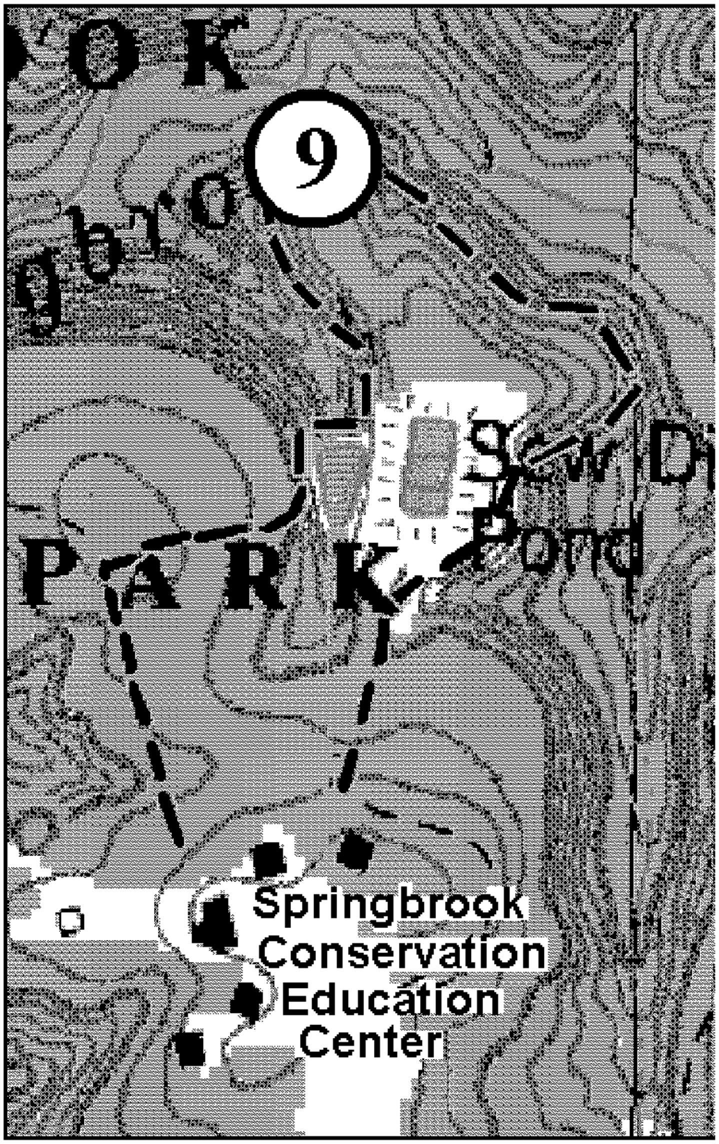

Figure 1. Topographc map showing field trip Stop 9, the Springbrook Conservation Education Center and the trial north from the center.

TRAIL TO CANYON OVERLOOK

John Pearson

The trail from the Conservation Education Center to the canyon overlook above Springbrook Creek passes an old field which has naturally revegetated with prairie grasses under the influence of repeated burning. Upon entering the woods, the trail first passes through bur oak-black oak forest on gently rolling, loess-covered uplands and past a vegetated pond (Fig. 2), then encounters white oak-red oak forest on steeper topography associated with the sandstone bedrock. From the overlook atop the sandstone bluff, there is a good view of the alluvial bottomland along Springbrook Creek with its characteristic mosaic of floodplain forest and open stands of canarygrass.

Several small prairie openings in an overall forest matrix may be viewed on a longer returning route to the Conservation Education Center by turning left at the first and second forks. These openings occur on the upper parts of convex slopes, possibly underlain by glacial till.

Figure 2. Photograph of the pond along the trail from the Conservation Education Center to the overlook, Stop 9, the final stop of the field trip.

SPRINGBROOK CREEK OVERLOOK SECTION

Brian J. Witzke and Greg A. Ludvigson

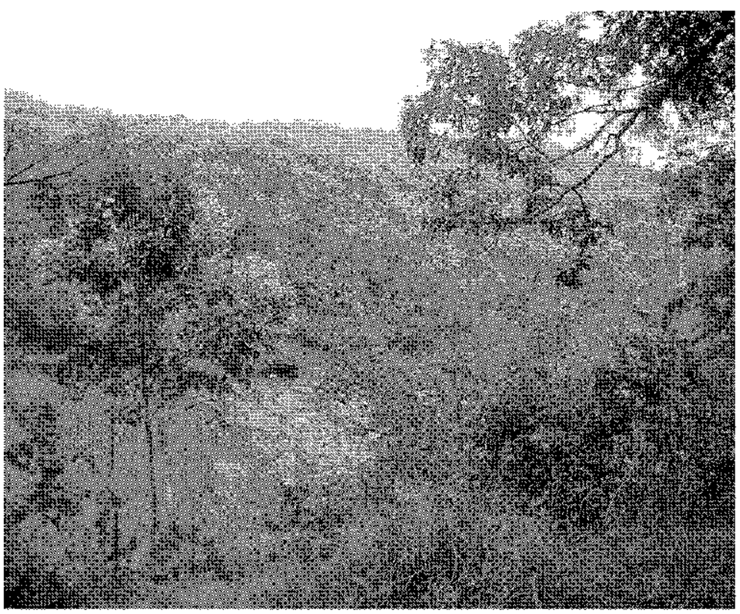

Figure 3. Photograph from Stop 9, overlook north of Conservation Education Center. Compare the vegetation to a photo of the area from 1926 (Figs. 1 & 2 on page 4).

The valley walls of Springbrook Creek are underlain in part by Cretaceous sandstone strata, although exposures of these strata are typically poorly represented. This scenic overlook (Fig. 3) lies immediately above one of the better natural sandstone exposures of Cretaceous sandstone along the creek, although, even here it is difficult to see the sedimentary character in the sandstone ledges due to moss and other vegetative overgrowth. The sandstone ledges are composed dominantly of poorly indurated fine-grained sandstone, but some weak iron oxide cements are locally evident. Some faint trough crossbeds are seen in the exposure. About 15 feet (4.5 m) below the overlook, a recessive layer containing common mudclasts marks the base of one of the many channels that internally crosscuts the

Cretaceous succession at Springbrook. Scattered mudclasts are also seen in the sandstone beds above this layer.

Additional discontinuous exposures of Cretaceous sandstones are seen along the same side of the valley a short distance upstream. Some of these exposures extend a bit lower in elevation, where scattered quartz pebbles and granules are seen in the weathering sandstones. Some of these exposures also reveal tabular and trough crossbeds. The strata seen in this segment of Springbrook Creek, as typified by the overlook exposure, occupy a position in the upper half of the Nishnabotna Member, overlapping in part with the upper strata seen at Stop 8C.

SUNDAY

FIELD TRIP STOPS

PRELIMINARY DESCRIPTION AND DISCUSSION OF FACIES OF THE NISHNABOTNA MEMBER OF THE DAKOTA FORMATION, GUTHRIE COUNTY, IOWA.

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Department of Geology
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Introduction

Four outcrops along "Long Creek" (LC-1 through LC-4) and one on the Middle Raccoon River (Bluff Section) (Figs. 1 & 2) provide new insights into the depositional processes which affected Guthrie County, Iowa during the Albian Stage of the Early Cretaceous. "Long Creek" is a tributary of the Middle Raccoon River in the E ½, SW ¼, SE ¼, Sec. 14, T 81N, R 33W in Guthrie County. Outcrops along this creek include lithologies of the Nishnabotna Member of the Dakota Formation which are distinctively different from any others that have been described in the Guthrie Co. area. We interpret some of the strata as deposits of a tidally-influenced estuary along the eastern margin of the Cretaceous Western Interior Seaway. These strata may record the easternmost exposures of marine influence within the lower Dakota Fm. For simplicity the strata observed along "Long Creek" and at the Bluff Section will be described as lower, middle and upper units based on their relative positions at the LC-1 site. Note that all three units are exposed only at the LC-1 and LC-2 sites.

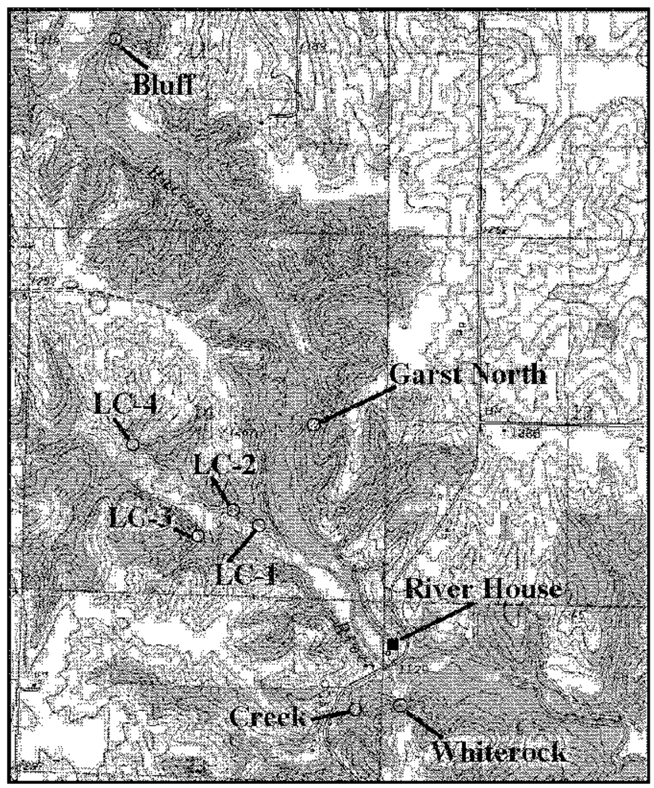

Figure 1. Enlargement of topographic map (Coon Rapids South Quadrangle) showing location of Dakota Fm. exposures on and near the Garst Farm Property in the Middle Raccoon River Valley, Guthrie County, Iowa. Contour interval = 20-feet..

Long Creek Sections of the Garst Property, Guthrie County, Iowa

The lowermost strata at LC-1 (Fig. 3) and LC-2 (Fig. 4) consist of very fine sandstone and siltstone interlaminated with mudstone. Both outcrops display an overall westward fining, i.e. they become mud dominated with sand lenses to the west. Sandstone and mudstone planar cross-laminae range from 2 mm to 5 cm in thickness (Fig. 3b), and contain pyrite nodules (< 1 cm). The unit is moderately bioturbated in the eastern, relatively coarser portion of the section; bioturbation intensity decreases to the west at LC-1 and LC-2. Subvertical burrows average 1 cm wide and 3.5 cm long and are commonly lined with pyrite. Gypsum is also noted lining the burrows likely as a pyrite oxidation residue. Smaller, mm-scale subhorizontal to subvertical burrows are common

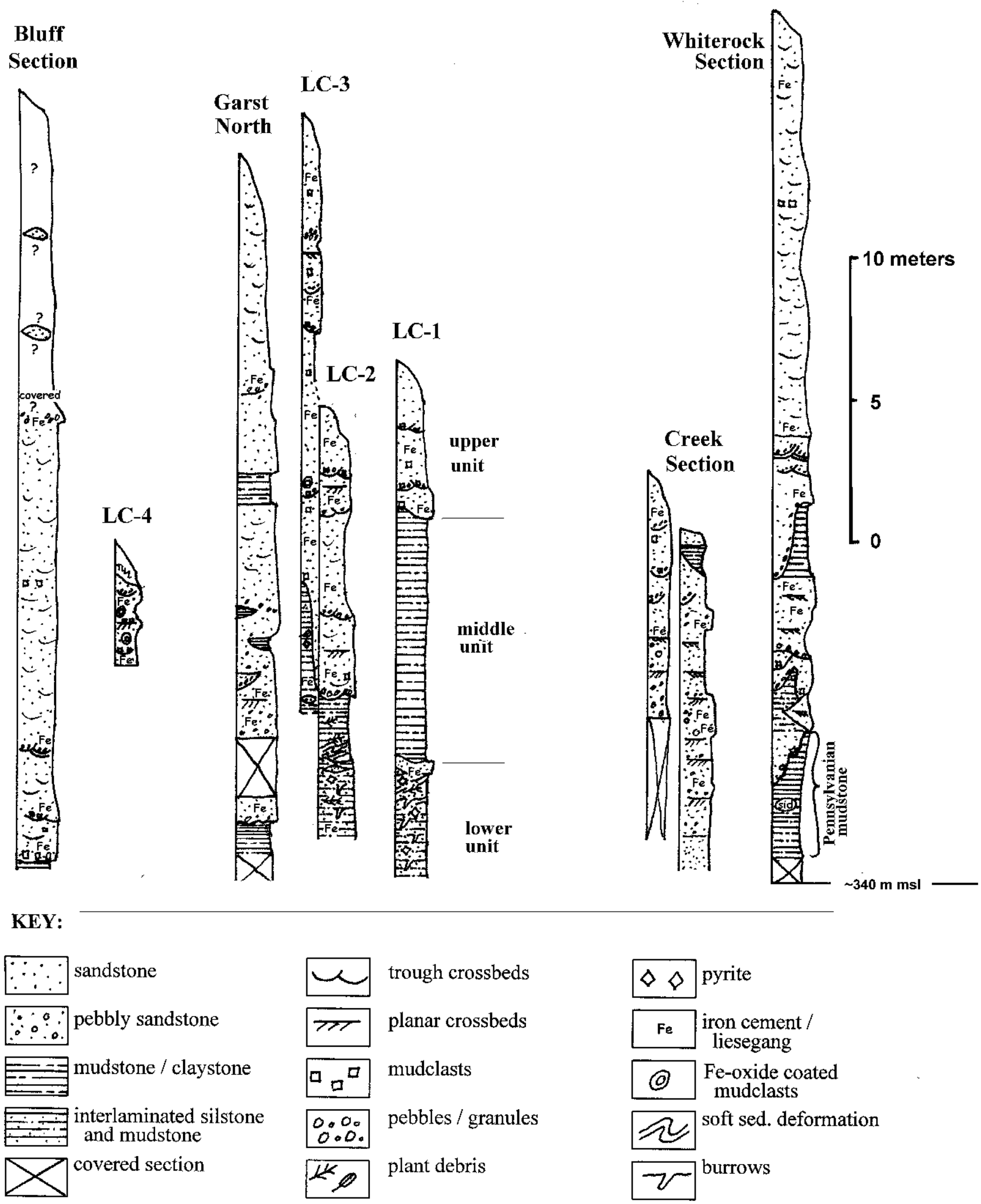

Figure 2. Graphic sections of Nishnabotna Mbr. exposures in the Middle Raccoon River Valley, northwest Guthrie County, Iowa. See Figure 1 for location of sections. Note that LC-1 and LC-2 contain lower, middle, and upper units described in the text.

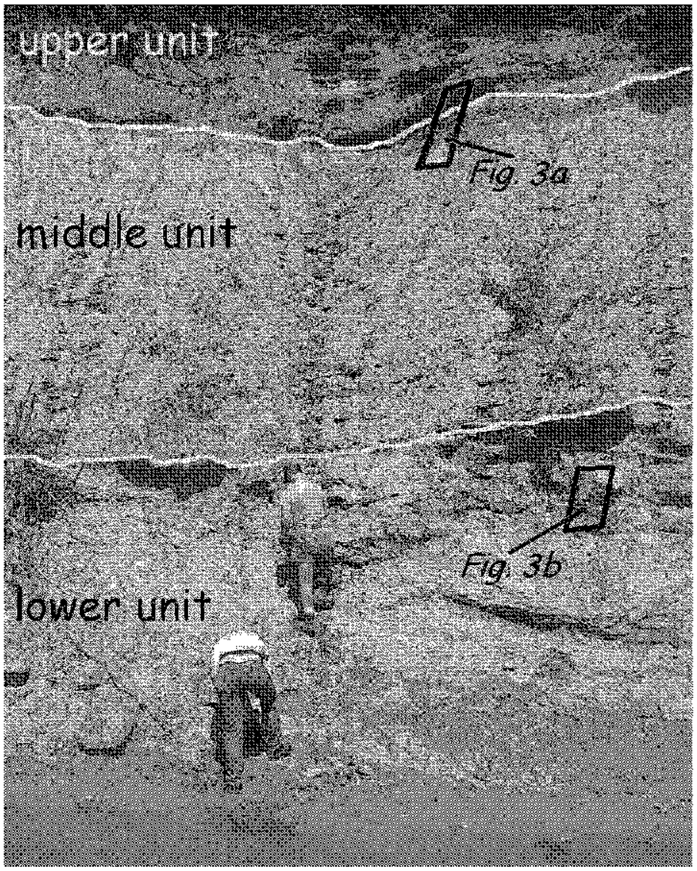

Figure 3. Photograph of lower Nishnabotna Mbr. units in the Dakota Fm. at the LC-1 exposure, Garst Farm properties, northwest Guthrie County, Iowa. Lines identify approximate locations of unit contacts. Locations of photographs shown in Figures 3a and 3b are delineated. **Figure 3a** is photograph of upper kaolinitic clay portion of the middle unit overlain by upper unit mudclast conglomerate. **Figure 3b** is photograph of heterolithic laminated strata with subvertical, pyrite-lined burrows within lower unit.

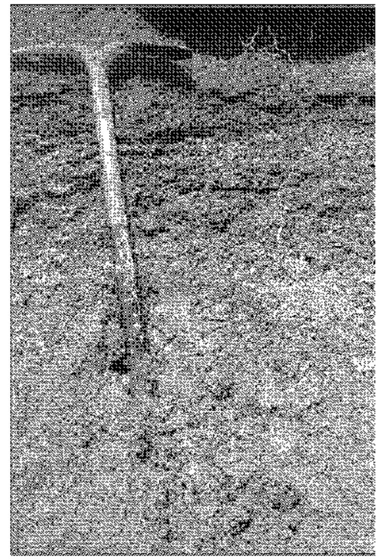

Figure 3a

Figure 3b

in the upper portion of this unit. Plant debris is also common in some horizons. This lowermost unit is capped, at LC-1, by an iron cemented (possibly siderite), fine to medium grained quartz sandstone bed which thickens to the east across the outcrop.

The middle strata (at LC-1, LC-2, and LC-3) consists primarily of light to dark gray mudstone. This mudstone unit is darker gray toward the west, which we surmise is an indication of greater organic content. The unit contains more iron oxide toward the top. Silt and sand lenses and laminae of iron stained quartz sand are common throughout the unit. Subhorizontal mm-scale burrows and plant debris are common. A very light gray claystone in the upper portion of this middle unit at LC-1 may be a bentonite (Fig. 3a).

The uppermost strata (at LC-1, LC-2, LC-3, and LC-4) is primarily an iron-stained, trough cross-bedded, medium grained quartz sandstone. Mudclast, quartz and chert granule to pebble conglomerates are common at the base of the unit and at the base of many troughs throughout the unit (Fig. 3a). Mudclasts and quartz granules are also dispersed throughout the sandstone. Planar laminated beds of fine to medium quartz sandstone are found near the top of the upper unit at LC-3; iron cemented layers and

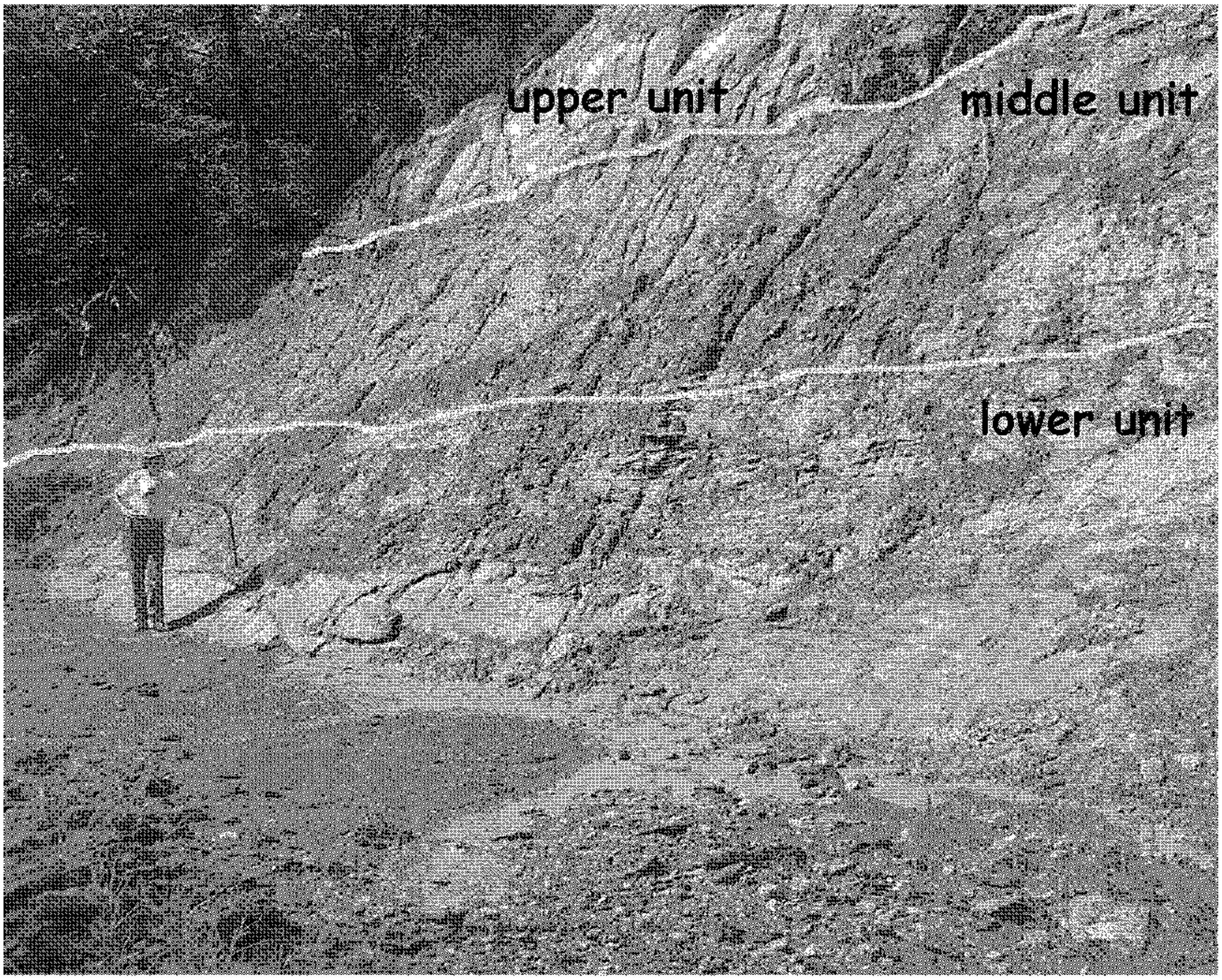

Figure 4. Photograph of lower Nishnabotna Mbr. units in the Dakota Fm. at the LC-2 exposure, Garst Farm properties, northwest Guthrie County, Iowa. Lines identify approximate locations of unit contacts.

liesegang banding are common throughout this uppermost unit. Mudclasts with iron oxide coatings are found in this unit at LC-3 and LC-4.

Bluff Section along the Middle Raccoon River

(SE ¼, SE14, SW ¼, NW ¼, Sec. 11, T 81N, R 33W)

The Bluff Section is a very steep outcrop at river level on the east side of the Middle Raccoon River. A light gray claystone at the base of the section is truncated by sandstones of the upper unit which rises above the river level at least 16 m, where much of the section is covered. We suggest the light gray claystone correlates to the light gray claystone at LC-1 and LC-2 and is the top of the middle unit, therefore the sandstone is equal to the upper unit of the region. Overlying iron cemented medium to coarse grained quartz sands of the upper unit contain abundant mudclasts at the base. Mudclasts become less abundant upsection, though they line trough crossbeds. The majority of the upper unit is a fine to medium grained quartz sandstone with quartz, chert and mudclast granules to pebbles common along troughs and along some bedding planes. The sandstone is iron-stained and has extensive liesegang banding near the base.

Discussion

The bulk of Dakota Fm. strata along the eastern margin of the Cretaceous Western Interior Seaway have been previously interpreted as deposited in braided to meander belt fluvial systems draining the Precambrian/ Paleozoic craton to the east (Witzke et al., 1983). In the Sioux City, Iowa region and at the Dakota Fm. type locale in northeast Nebraska the formation is interpreted as marginal marine to deltaic (Witzke and Ludvigson, 1987). In a basinward direction, lower Dakota strata correlative to the Guthrie Co. sections are dominated by marine mudrock of the Kiowa Fm. Mudrock interbedded with coarse-grained Nishnabotna facies are interpreted as an eastward incursion of estuarine facies along the late Albian coastal lowlands bordering the Kiowa-Skull Creek seaway (Witzke et al., 1996c).

The Albian Dakota Fm. units described for the "Long Creek" and Bluff sections in conjunction with those described by Witzke and Ludvigson (1996b) for the Garst Property in Guthrie County provide a three dimensional architecture for this region (Fig. 2). The presence of rhythmic laminae of siltstone to very fine sandstone with mudstone interbeds (or drapes in some locales) combined with abundant pyrite within the lower unit are suggestive of a tidally-influenced marine environment of deposition. Within the regional framework, the lower unit at the Garst Property is preliminarily interpreted to have been deposited within the most basinward reaches of a late Albian estuary. The middle unit is finer and displays less bioturbation than the lower unit, which we interpret as an indication of a less oxygenated setting in a deeper water or more distal regime. Based on stratigraphic position and high visual percentage of organic material, the middle unit is interpreted as deposited within the central basin portion of the estuary. The deeper water, distal, less oxygenated interpretation for the middle unit is compatible with the central basin setting. The sandstones and conglomerates of the upper unit were deposited within a fluvial setting; the absence of paleosols and rooting suggests an entirely subaqueous environment. The upper unit truncates the middle unit by cut and fill scour and is interpreted to equate to the more proximal river-dominated portion of the estuary.

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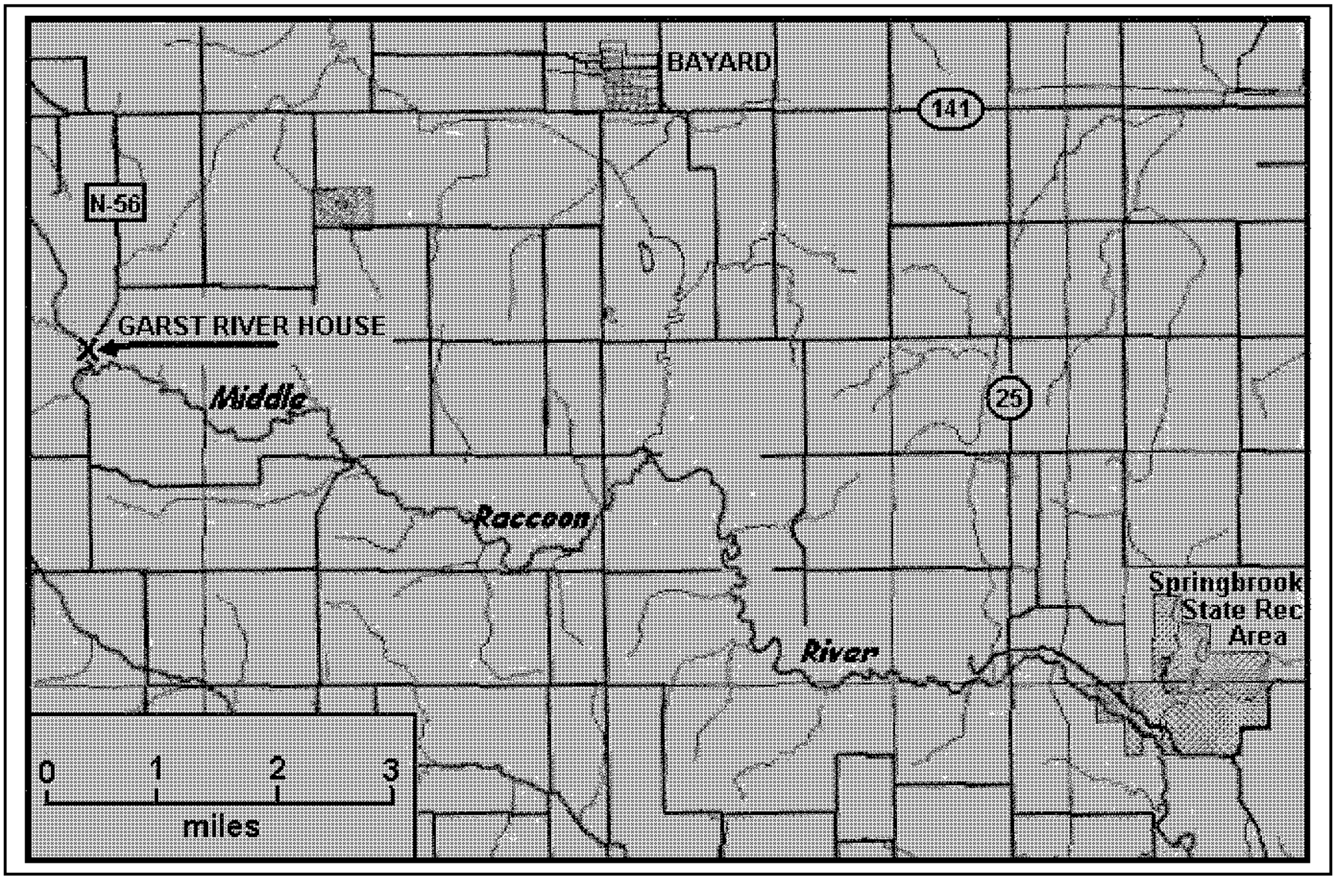
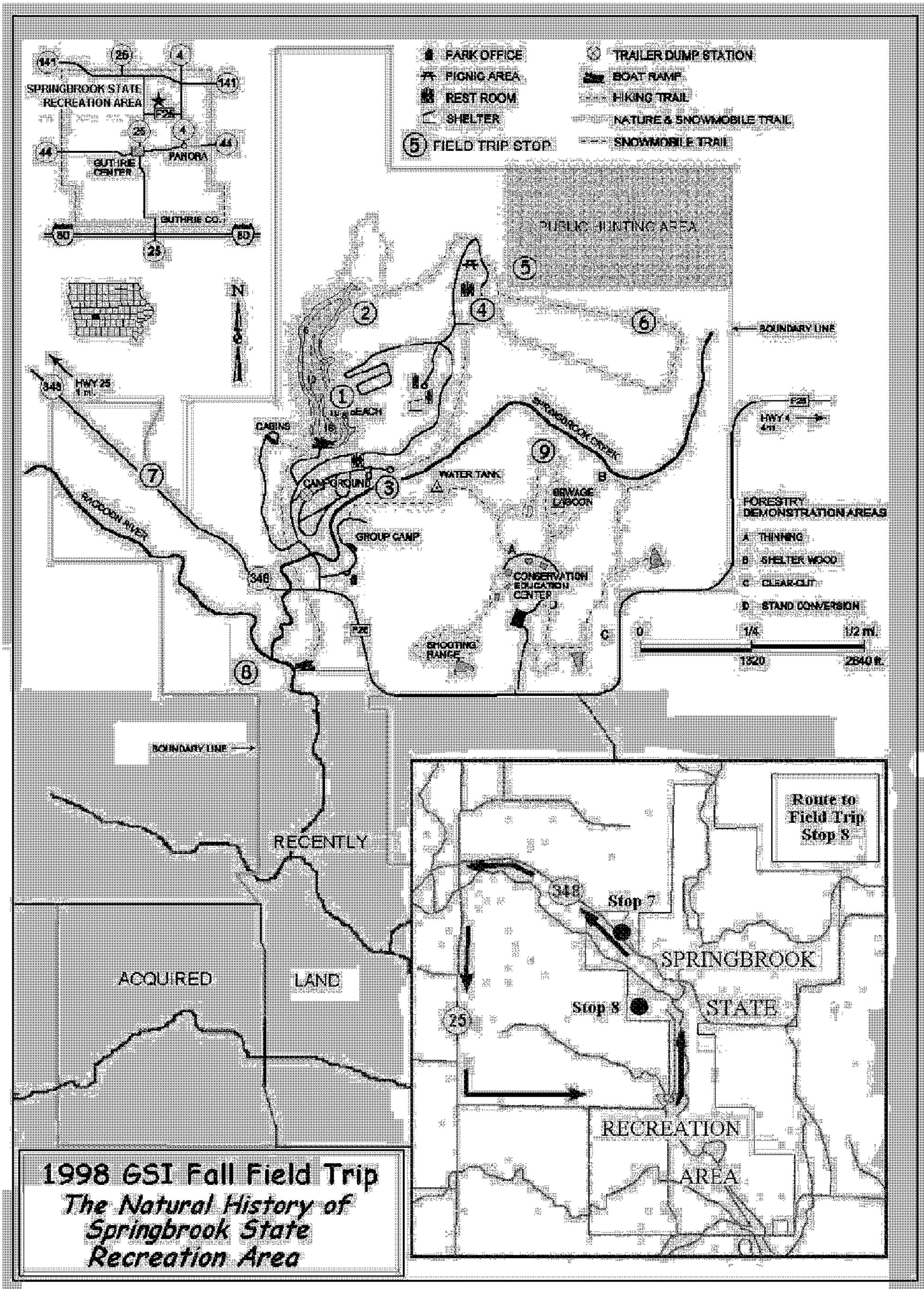


ROUTE TO SUNDAY MORNING STOP AT GARST RIVER HOUSE

Geological Society of Iowa
109 Trowbridge Hall
Iowa City, Iowa 52242-1319



1998 GSI Fall Field Trip

The Natural History of Springbrook State Recreation Area