Further Reading

Goldthwait, R.P., 1959, Scenes in Ohio during the Last Ice Age: Ohio Journal of Science, v. 59, p. 193–216.

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Hansen, M.C., 2008 (revised), The Ice Age in Ohio: Ohio Department of Natural Resources, Division of Geological Survey Educational Leaflet No. 7.

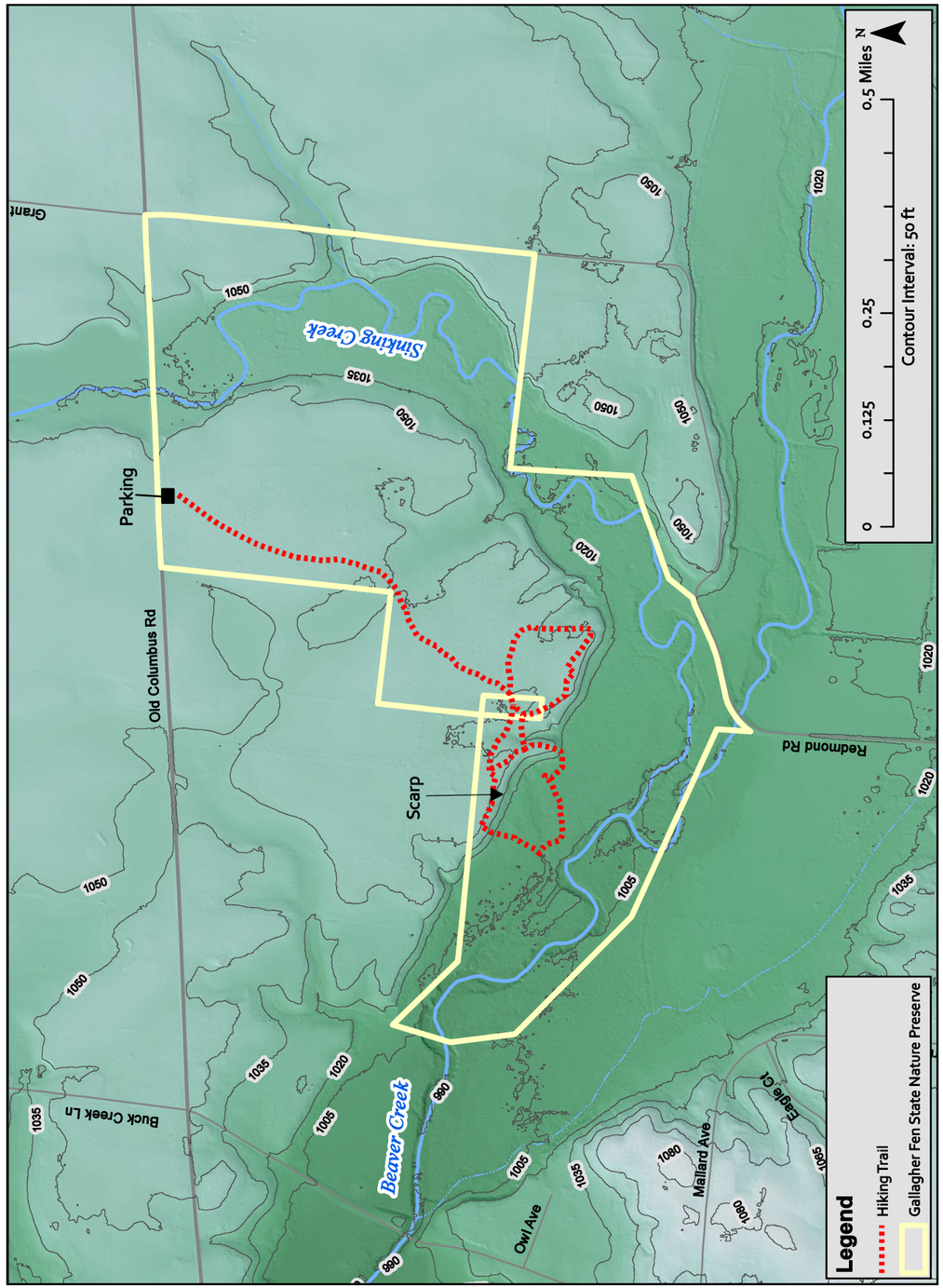

Figure 5. Gallagher Fen SNP trail map showing topography of the area and geologic sites discussed in the text.

THE GEOLOGY OF GALLAGHER FEN STATE NATURE PRESERVE

by Nate Erber

STATE OF OHIO
DEPARTMENT OF NATURAL RESOURCES
DIVISION OF GEOLOGICAL SURVEY

OhioGeology.com

Introduction

The Pleistocene Epoch (2.6 million years ago [m.y.a.]–11,700 years ago [y.a.]) in Ohio was dominated by glacial activity. During this time, glaciers originated in Canada and flowed southward, covering much of Ohio. In Ohio and throughout the Midwest, the glaciers had several major advances and retreats based on climatic shifts during the Pleistocene. Evidence of a very early glaciation, known as the Pre-Illinoian, also is found in Ohio. However, subsequent glaciations reworked and wiped away most of the Pre-Ilinoian deposits. Glacial landforms and sediments present in Ohio today were made by the two most recent glaciations, the Illinoian (about 300,000–130,000 y.a.) and the Wisconsinan (about 24,000–18,000 y.a.). These glaciations shaped the current landscape of Ohio and created the unique setting of Gallagher Fen.

Bedrock Geology

Although Gallagher Fen has no bedrock exposed at the surface, the bedrock surface played a major role in developing the preserve we see today. Underlying the glacial sediment is interbedded limestone, dolomite, and shale. These rocks range in age from Ordovician (about 485–445 m.y.a.) to Silurian (about 445–420 m.y.a.). During these periods, a warm shallow sea covered most of Ohio, including the area surrounding the fen. The rocks underlying Gallagher Fen were deposited as sediments in this shallow sea and later lithified.

During the Pleistocene Epoch, glacial ice and meltwater eroded the bedrock and incorporated it into glacial sediments deposited in western Ohio. In some areas, where large amounts of meltwater were channeled, large gorges were cut into the bedrock. One example of this is nearby Clifton Gorge near Yellow Springs.

Ancestral Drainage Modification & Early Glaciation

Prior to the Pleistocene Epoch, southern and western Ohio was drained by a major river system known as the Teays River (fig. 1). The Teays River flowed in a generally northwest direction with its headwaters in West Virginia. The drainage of the Teays River system eventually was dammed by advancing ice and began to pond, creating networks of large lakes. The largest of these lakes, Lake Tight (fig. 1), is located in southern Ohio. The ice dam that caused Lake Tight to form was located at the furthest extent of glaciers.

Just north of Gallagher Fen, evidence of the Teays River remains as a buried bedrock valley (fig. 2). This section of the Teays became flooded as the advancing ice dammed the river.

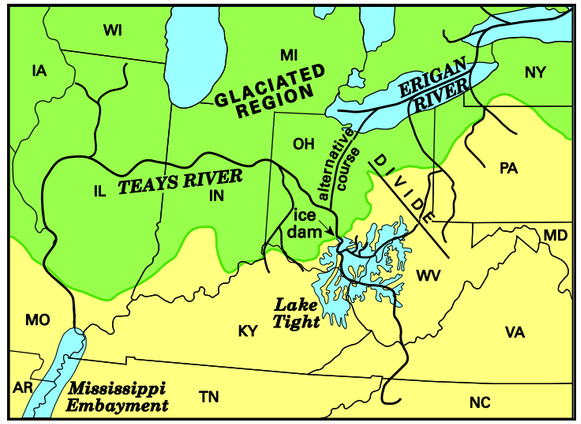

Figure 1. Preglacial Teays River in north-central United States.

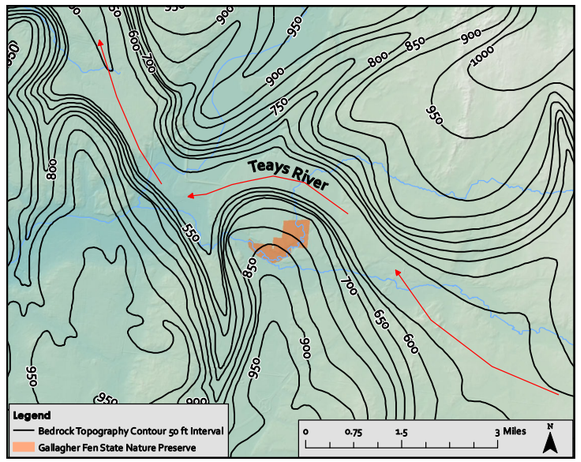

Figure 2. Bedrock topography of the area surrounding Gallagher Fen SNP showing the location and original direction of flow (red arrows) of the ancestral Teays River buried valley.

During this time, fine-grained silts and clays accumulated on the lake bottom in relatively calm waters. As the lake filled with water, it began to overflow and eventually caused the river to reverse flow toward the southeast.

Subsequently, the ice advanced southward and covered the entire Teays River Valley near Gallagher Fen. When covered by ice, the valley began to fill with glacial till. Glacial till is unsorted glacial sediments deposited directly by ice; the deposits range in size from boulders to clay particles. When the ice retreated from the area, meltwater from this episode of glaciation deposited outwash, as sand and gravel, in the valley and surrounding area.

Cover image: *Prairie dock* (Silphium terebinthinaceum)*, a tall-grass prairie plant in a marl flat at Gallagher Fen SNP. The water in the stream is artesian, flowing naturally from the base of the gravel hills in the background. Photo: Tom Arbour.*

Wisconsinan Glaciation

During the Wisconsinan glaciation, ice again advanced into Ohio. As the ice advanced into what is now Logan County, it split into distinct lobes as it flowed around bedrock highs. Gallagher Fen is located directly south of one of these bedrock highs, the **Bellfontaine Outlier**, causing the ice to split into the **Miami Lobe** to the west and the **Scioto Lobe** to the east (fig. 3).

The Wisconsinan glaciation wiped away much of the evidence of previous glaciations and deposited the majority of glacial sediments observed today. As the ice advanced, it deposited more till into the now partially buried Teays River Valley and the surrounding area. Later as the ice retreated, an end moraine developed to the east of Gallagher Fen (figs. 3 and 4). As the ice margin paused over the area, the end moraine developed, causing the accumulation of large amounts of sediment. The stagnating ice margin caused the formation of many diverse landforms. Large blocks of ice falling from the ice margin caused kettles to form. Kames developed as sediment rich ice melted. Eskers also formed due to streams developing underneath the ice. Also, significant amounts of meltwater flowed from the glacier across the landscape, depositing outwash consisting of mostly sand and gravel. The water flowing from the glacier front created a complicated network of channels and terraces.

Today, many of the channels developed from glacial meltwater contain streams that carry significantly less water compared to the amount of water coming off the ice during the Wisconsinan glaciation. Total thickness of glacial sediments deposited in the area surrounding Gallagher Fen range from about 110 ft to 550 ft. The thickest deposits of glacial sediments accumulated from the infilling of the Teays River Valley.

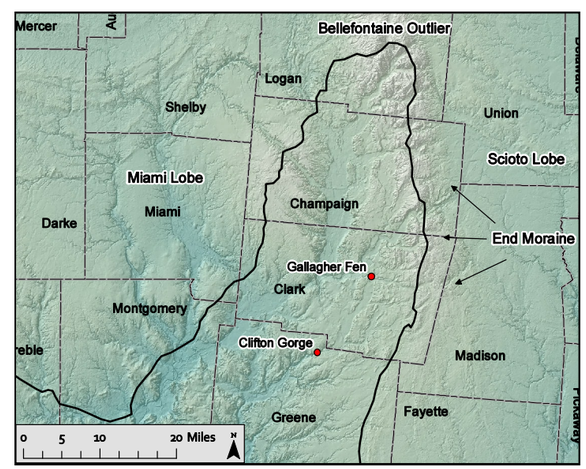

Figure 3. Map showing how the Wisconsinan glaciers were split into the Scioto and Miami Lobes by the Bellefontaine Outlier.

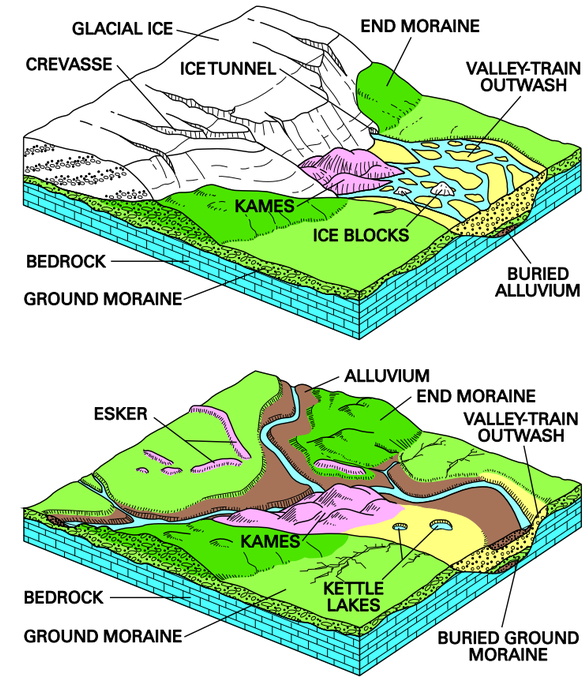

Figure 4. Conceptual diagram showing landscape during maximum advance (top) and after retreat (bottom) of a glacier.

Gallagher Fen Today

Three major units of glacial sediments underlie Gallagher Fen. The uppermost unit consists of about 10 ft of organic deposits, which are decaying plant materials collected in low areas. Beneath the organic material lie approximately 40 ft of glacial outwash, consisting mostly of sand and gravel. Under the outwash is about 200 ft of glacial till consisting of dense, unsorted sediments.

A prominent *scarp*—a cliff or ridge produced by erosion—runs along the western bank of Sinking Creek and the northern bank of Beaver Creek (fig. 5). In several areas along this scarp, natural springs flow out of the ridge toward the creeks. Springs are present along this ridge because of the stacking of outwash over till. Outwash is relatively porous, which means that water can easily flow through it, whereas the till is unsorted and dense so water cannot easily penetrate it. Therefore, as groundwater passes down through the outwash and contacts the till, it is forced to flow horizontally to the edge of the scarp, forming a spring.

These springs differentiate Gallagher Fen from a bog. Unlike bogs, fens receive their water and nutrients from groundwater and not solely from precipitation. The groundwater source creates a less acidic environment and higher nutrient level, which fosters plant diversity.