

Welcome to the Iowa Academy of Science's National Wildlife Refuge Audio Series. In this segment, Academy member Lynn Brant, Emeritus Professor of Geology at the University of Northern Iowa will discuss the geology of the Driftless Area National Wildlife Refuge.

The northeast corner of Iowa is a broad upland dissected by streams that cut deeply into the underlying bedrock on their way to the Mississippi River. Being rather short streams that begin at around 1200 to 1300 feet above sea level and end at the level of the Mississippi River, they are relatively steep in their gradient. For instance, the Yellow River running across the southern portion of the Winneshiek and Allamakee Counties drops from an elevation of 1240 feet above sea level to near Ossian to about 640 feet where it joins the Mississippi River; a gradient of about 20 feet per mile in places. Even though they are small rivers, streams with such a high gradient can erode very effectively as shown by the deep valleys these streams now occupy. In addition to cutting deeply into the bedrock, these streams have also removed most of the glacial drift that once mantled the landscape in this part of Iowa.

Glacial drift is clay, sand, gravel, and boulders deposited directly by a glacier, called till, as well as material that is redistributed by the meltwater coming from the glacier. All of Iowa was once glaciated but only the central part of the state was covered by ice in the last advance of glaciers ending about 12,000 years ago. Most of the rest of Iowa, including the northeast corner, was last glaciated in the order of a half million years ago. Drift from these older glaciers – and there may have been seven or more going back in time some two and a half million years – covers most of the bedrock in Iowa except for what has been called the “driftless area” in the northeast corner of the state. But even here there are boulders brought to Iowa by the glaciers, called glacial erratics, and areas of drift that have avoided the erosive processes of the steep-gradient tributaries of the Mississippi. What is sometimes called the “driftless area” in Iowa is not truly driftless.

A better term for this northeast part of the state, and the one now used by geologists in Iowa, is the “Paleozoic Plateau”. The Paleozoic Era is that part of geologic time starting about 520 million years ago and ending about 250 million years ago. This is the time of trilobites, the first fish, and extensive forests of strange plants that formed much of the county's coal deposits. It was before the age of dinosaurs, flowering plants, and mammals. During much of the early Paleozoic Era, Iowa was covered by warm, shallow seas and was south of the equator. Continental drift, now explained in the theory of plate tectonics has moved North America (including Iowa) into the place it now has in the temperate portion of the northern hemisphere. But during those warm, tropical times in the south, the seas laid down deposits of sandstone, limestone, dolomite (a rock very similar to limestone), and shale which now form the bedrock of northeast Iowa. The Mississippi and its tributaries in northeast Iowa have cut their valleys into the upland plateau underlain by the old, Paleozoic rock forming the distinctive landscape we see there today.

The rare plants and animals protected by the Driftless Area National Wildlife Refuge owe their existence to a group of unusual geologic features found almost entirely in Iowa; algific slopes. Limestone and dolomite are somewhat soluble in underground water, and over long periods of time caves and other solution features can develop. A cave near the surface may collapse and form a depression or hole on the land called a sinkhole. Streams may disappear into sinkholes, flow under ground, and emerge as large springs, such as Big Springs Fish Hatchery near Elkader. Sinkholes also may allow cold, winter air to enter, chilling the rock and freezing water in the cave system. Algific slopes occur where steep stream valleys cut across cave systems tapping into the source of cold air in the caves. Most algific slopes are on north-facing sides of the valley where the cold air in the bedrock caves can flow out over the ground surface forming an area with an unusually cool climate on that slope. Very locally, usually only a few acres in size, the climate is similar to what is found many hundreds of miles farther north – or similar to the climate during the Pleistocene when glaciers covered large parts of North America.

As we can see, the conditions imparting special value to the Driftless Area National Wildlife Refuge with its rare plants and animals have their origins in the processes and history of geology going back to times of warm seas, cold glaciers, and freely-running streams. These processes continue today to shape the world in which we and all other living organisms exist.

Next, Academy member Chad Heinzl, Assistant Professor of Earth Sciences and Science Education at the University of Northern Iowa will address the conservation efforts past and present at the Driftless Area National Wildlife Refuge.

In 1980 Terry Frest, a geology graduate of the University of Iowa, discovered rare Pleistocene snails in the sensitive algific talus slope environments of Clayton County. After that initial discovery, other rare snail and plant species were identified. These species and their environmentally sensitive ecosystems are vulnerable to extinction and some are listed as threatened or endangered. Human-caused disturbances including overgrazing, logging, road construction, and quarrying have reduced and compromised the remaining algific ecosystems of the Iowa Pleistocene land sail. This snail species has existed for approximately the past 400,000 years. Conservation efforts are not just determined to protect this small snail they are striving to maintain and perhaps improve the overall quality of our natural world. Algific slopes function by air flowing down through upland sinkholes created by cracks and fissures in limestone and dolostone bedrock. Air flows over frozen groundwater and out small vents on talus covered slopes creating a cold microenvironment. Temperatures on these slopes in the summer can be as low as 30°F.

The Driftless Area National Wildlife Refuge was established in 1989 to defend these ecosystems under the protection of the 1973 Endangered Species Act. Many individuals and organizations worked tirelessly to conserve this special ecosystem. Aided by the Nature Conservancy, the first Driftless Area Refuge land purchase acquired 207 acres along Howard Creek, with the hope of adding more land.

As the great Aldo Leopold once said "A land ethic ... reflects the existence of an ecological conscience, and this in turn reflects a conviction of individual responsibility for the health of the land. Health is the capacity of the land for self-renewal. Conservation is our effort to understand and preserve this capacity." Conserving our remaining natural ecosystems is vital to the health and well being of not only the landscapes themselves but to human race as well. These wild and natural areas provide a fundamental link between the natural world and the human race in the midst of our increasingly altered landscapes. Since 1989, the Driftless Area National Wildlife Refuge has expanded to include 810 acres of algific slopes in Allamakee, Clayton, Dubuque, and Jackson counties throughout northeast Iowa. In 2005, Cathy Henry (U.S. Fish and Wildlife Service) developed two important documents that helped to characterize and protect the Driftless Area National Wildlife Refuge. These documents were an Environmental Impact Statement and a Comprehensive Conservation Plan.

Current efforts led by Tim Yager (U.S. Fish and Wildlife Service) seek to expand and protect up to 2500 acres of algific slopes in Iowa, Illinois, Minnesota, and Wisconsin. Managing these localized land segments throughout the upper Midwest is challenging. Most of the slopes are so sensitive that the only way to protect them is to keep them locally isolated from human contact and other disturbance factors such as grazing. Even this may not be enough in the face of our planet's continued warming trend. Algific slopes thrive on the upwelling of cool moist air as a result of contact with underground ice. As the Earth's temperature continues to warm these areas become increasingly threatened.

There is a plan that will carefully construct a trail through the Howard Creek Unit (Clayton County, IA) to facilitate and enhance educational opportunities of algific ecosystems. Protecting algific slopes should also include safeguarding their associated sinkholes. Sinkholes can at times be far away from the slope and it is not always

known where the sinkholes are or which ones connect the cool air flow. Cathy Henry has mapped many of these sinkhole locations to gain a better understanding their geologic processes and environmental sensitivity. Sinkholes and their associated algific slopes are vulnerable to runoff and erosion in steep karst terrain. Therefore, protection of the algific slopes includes protecting scattered sinkholes through set aside programs, conservation farming practices, and land acquisition. The Refuge seeks to manage and protect algific slopes and provide forest and prairie habitat for other species as well. Partnerships to manage adjacent lands will be important for addressing management issues such as minimizing the adverse effects of invasive species. Thus, local citizens (landowners, hunters, anglers, photographers) are a critical component to successfully preserving our natural resources. Without citizen participation and cooperation, preserving Iowa's remaining natural ecosystems would not be possible.

Thank you for joining us in discovering a portion of Iowa's amazing natural resources. Please explore the entire Iowa Academy of Science's National Wildlife Refuge Audio Series. The best way to help preserve our environment is to become active in your local area. For more information please contact the Iowa Academy of Science at www.scienceiniowa.org and your local, state and federal conservation departments.