

Welcome to the Iowa Academy of Science's National Wildlife Refuge Audio Series. In this segment, Academy member Jim Pease, Iowa State University Extension Wildlife Specialist will share the ecological story of Neal Smith National Wildlife Refuge.

"There be buffalos there!" Yes, buffalo--and elk and deer, too! Those three mega fauna, also known as "big critters", were once gone from Iowa, but now they're back. They might be right in front of you at the Neal Smith National Wildlife Refuge. The goal of this refuge is to put back a small piece of what Iowa once looked like. On the refuge's 5,800 acres, the U.S. Fish and Wildlife Service and a host of volunteers is bringing back a piece of the tallgrass prairie and savannas that covered over $\frac{3}{4}$ of Iowa just 170 years ago--and with it, many of the wild critters that once lived here, too.

Back in the mid-1800s when new Iowans were just establishing this state, the idea was to turn the prairies and wetlands and woodlands that were here into... productive agriculture. Of course, those habitats were already mighty productive. Pothole wetlands dotted this land by the thousands, especially in the north-central part of the state, a gift from the glaciers that retreated about 12,000 years before. Large forests dominated northeast and southeast Iowa and the wetter lands along rivers and streams throughout the state. Oak savannas, park-like groves of oaks--especially bur oaks--with special grasses and other flowering plants growing beneath them gave relief to the landscape and to the wild critters that sought their shade. The prairies, well prairies filled in all the spaces between. Prairies grew from and helped produce the deep and rich prairie soils with over 200 species of plants in a single square mile. The dominant tall grasses like big bluestem, Indiangrass, and switchgrass, along with the Compass Plant sometimes grew to spectacular heights of 8 feet or more. But this, this was more than a "sea of grass". Openings created by pocket gophers, Franklins ground squirrels, woodchucks, and badgers, made room and fresh ground for legumes, composites, sedges, and scores of other plant species as well.

And wild animals? We were rich in them! Some 70 species of mammals once wandered here, including the bison, elk, and deer you can see on this refuge. So, too, did wolves, mountain lions, and bears,--big predators of course for big prey species. Over half the mammal species are gone from the Iowa landscape today. About 76 species of reptiles and amphibians also called Iowa home and nearly half are now in danger of being extirpated or gone from the state. And birds, well with birds we had about 170 species breeding here--some of them by the thousands! Savannas housed red-headed woodpecker and kestrels, bluebirds and shrikes. Prairies hosted short-eared owls and harriers, and several dozen species of sparrows and other songbirds. Insects? They were, quite simply, abundant. We have no idea how many insect species were here but with the abundance of plant species, you can be sure the insects followed suit in both diversity and abundance.

What happened? Iowa happened. We turned these rich and deep prairie soils into one of the most productive agricultural systems the world has ever known. Where once was prairie, today there is corn and beans. But for that productivity, there is a price to pay. Original prairie--unsprayed and unplowed--today occupies less than 1/10 of 1% of our land. None of us living today know what it looked and felt like. But we feel the loss, the absence of that vast landscape. So, we've tried to recreate a little bit of that here. To date, about 3,000 acres of prairie is reconstructed on the 5,800 acres that are part of this refuge.

With careful planning, seeding, and burning they are bringing it back, little by little. With it, some of the animals, too: like the bison and elk in the large enclosure. Others have come back on their own: white-tailed deer, badgers, butterflies, bobolinks, meadowlarks, and others. They are responding. You may have heard the phrase "if you build it they will come" from a famous movie filmed here in Iowa. Where wildlife are concerned, it should be "if you plant it and they will come"! Because if the habitat is good enough, the wild character big enough, and the wildlife species portable enough, indeed, wildlife will come back. For some, however, it is just too late: there

are none left in Iowa. That's why elk and bison were reintroduced to the refuge and are managed inside a large fenced area. Plants, too, have to be mostly reintroduced. Sure, a few have seeds that travel on the wind or on the coats of animals, but most have been so isolated or so rare for so long, they couldn't get here on their own. So, restoration ecologists have collected seeds from native prairie remnants and brought them here. Still, other species are so rare or so far from this place that they may never be here again.

Will it ever look and feel like that vast tallgrass prairie of the 1840s? Maybe—already it feels pretty wild. We'll certainly never have the incredible diversity of plants and animals that were once here. It's just too difficult and too expensive to reconstruct such a diverse ecosystem. What we've learned from this is that it's always easier and less expensive to save an existing ecosystem now than it is to try to reconstruct it later.

Still, this is incredibly neat: getting to see habitats and species long gone from our state come back. Who knows? Maybe this will catch on! After all, "there be buffalos there!"

And now Academy member, Kathy McKee, Science Consultant at Iowa Department of Education will share some information about conservation efforts at the Neal Smith National Wildlife Refuge.

Eighty-five percent of Iowa was once tallgrass prairie. Prairie extended from western Indiana to Rockies, from Canada to Texas – tallgrass to the east, becoming increasingly shorter traveling west. Sometimes grasses in the tallgrass prairie would grow to a height above a person on horseback. Bells were tied to children so they wouldn't get lost. People traveling from the wooded eastern United States were frightened of the seemingly endless prairie. Early settlers saw the land that is now Iowa as something to cross to get somewhere else – if trees didn't grow here, nothing would. In 1837, John Deere invented the steel plow, making it easier to cut through the deep roots of the native plants, some of which extend 10-20 feet beneath the soil, which was discovered to be among the richest in the world.

The tallgrass prairie also provided a diversity of wildlife – besides the hundreds of plant species, there were over 350 species of birds; nearly 100 species of mammals; scores of amphibians, reptiles, and fish; and thousands of insect species.

Savannas, communities of bur oak, hickory, and walnut trees resistant to fires, grew among the tall grasses, surrounded by shorter grasses and wildflowers.

There is now only 1/10th of 1% of Iowa's tallgrass prairie remaining mostly found in isolated remnants, along railroad right of ways, or old cemeteries. The savannas are as rare. Neal Smith National Wildlife Refuge and Prairie Learning Center exists to bring back some of the plants and animals that were the tallgrass prairie.

In 1990, Congress approved a prairie restoration project with the support of Iowa congressman Neal Smith. The land being considered had been earmarked for a nuclear facility. The first parcel was purchased in April of 1991, and 3,600 more acres purchased in September of that year. To date, over 5,000 of the anticipated 8,654 acres have been acquired. The task of reconstructing thousands of acres of these highly degraded ecosystems is unprecedented. The Refuge is attempting to restore as many functions of the ecosystems as possible, including bringing back major grasses, wildflowers, and wildlife. Refuge staff works with volunteers, school groups, scientists, and prairie enthusiasts to preserve these pieces of Iowa's natural heritage. Rare prairie and savanna seeds are collected, studied, sown, and tended. Existing prairie and savanna remnants are protected. Management of these existing sites and those being reconstructed include mowing, brush cutting, and controlled burns. The refuge restoration process has already seen success with the hundreds of plant species, birds, mammals, reptiles, amphibians and countless insect species that have found homes on the Refuge. Bison and

elk have been reintroduced to demonstrate the role of large herbivores in the ecosystem. The endangered Indiana bat and Henslow's sparrow have been found on the Refuge.

Research is a key component at the Refuge, guiding the process of restoration and ensuring its success as well as creating valuable data to be used in other restoration efforts. Besides the acres of prairie and savanna on which this research is conducted, the Refuge houses a laboratory and greenhouse and employs a Geographic Information System for soils, vegetation, and topography. Some of the research being conducted includes restoring the endangered Regal Fritillary butterfly and its host plant, the bird's foot violet; the effects of seeding method and early mowing management; and a carbon sequestration study. Seed collection and propagation take place in several areas on the Refuge.

Public education and recreation are also among the goals of Neal Smith National Wildlife Refuge. About 200,000 people visit the Refuge annually. Hiking trails and an auto tour route have been established, and opportunities for volunteers to help with restoration and management are numerous. A K-12 curriculum was developed for teachers to use before, during, and after trips to the Prairie Learning Center, which opened in 1997. The Learning Center includes classrooms, an exhibit area, theater, and bookstore.

In 1993 a friends group was formed to increase public awareness and participation and help fund projects not funded by the government. Information about joining the friends group can be found in the bookstore.

A visit to Neal Smith National Wildlife Refuge and Prairie Learning Center will provide a rare peek at the incredible ecosystems that are the tallgrass prairie and savanna, and a connection of people and nature, past and future. Next, Academy member Tom Fenton, Professor Emeritus in the Agronomy Department at Iowa State University will describe the unique geology of Neal Smith National Wildlife Refuge.

The Neal Smith Wildlife Refuge is located about 18 miles east of the Des Moines metropolitan area in the southwestern part of Jasper County. It is in the Southern Iowa Drift Plain land form regions of Iowa. The landscape is gently rolling with a well integrated drainage net. The major drainage in the area is Walnut Creek and its tributaries. On stable landscape positions in the refuge, the upper material is Peoria loess and many of the soils in the area are formed in this material. The area lies within two major soil association areas--Tama-Killduff-Muscatine and the Otley-Mahaska.

Loess is an eolian deposit which means that wind is the transporting agency. The properties of which vary with distance from the source area. Two of these properties are thickness and particle size. Farther from the source, loess thickness decreases, clay content increases, and sand content decreases. The major source area for the refuge is the Missouri River floodplains with minor contributions from the Iowan Erosion Surface. Peoria loess is the upper increment of the Wisconsinian eolian deposits that range in age from about 30,000 to 14,000 radio carbon years before present to 14,000 years. Beneath the Peoria Loess is the Farndale paleosol, also formed in loess, characterized by organic carbon accumulation or flakes of organic carbon that indicate a slower rate of loess deposition than the bulk of the Peoria Loess.

Beneath the loess is a pre-Wisconsinian deposit of till, classically called Kansan but now called the Wolf Creek Formation in this area. Prior to the more recent loess deposition, the surface of this till was exposed to weathering and soil formation with properties of the soils varying much as they do today on the present landscapes. This interglacial period is referred to as Yarmouth. On stable landscape positions on this old surface, soils formed during two interglacial periods--the Yarmouth and Sangamon--resulting in soils with highly differentiated profiles. Sangamon is the interglacial period following the Illinoian glaciation. However, the Illinoian Glaciation did not cover this part of the state, thus allowing geomorphic surfaces in this area to be exposed to

weathering and soil forming processes during both the Yarmouth and Sangamon interglacial periods.

In the older geological literature, these soils are referred to as gumbotil, described in the earliest literature as a “gray to dark colored, thoroughly leached, non-laminated deoxidized clay, very sticky and breaking with a starch like fracture when wet, very hard and tenacious when dry, and which is chiefly the result of weathering of till”. Today, the material originally called gumbotil is recognized as Yarmouth-Sangamon paleosols when described in a stratigraphic section. Because of the high clay content, the downward movement of air and water is severely restricted and these paleosols are described as having very slowly permeability. The very slow permeability of the paleosol, in contrast to the more permeable overlying loess, results in perching of downward percolating water. Accumulation of the water above the paleosol causes the lateral movement of water which results in side hill seeps at the loess-paleosol contact.

The terms “Yarmouth” and “Sangamon” are used to denote interglacial periods during which weathering and soil formation occur. Classically Yarmouth has been used to identify the interglacial period between the Kansan and Illinoian glaciation while Sangamon identifies the interglacial period between the Illinoian and the Wisconsinan. The use of these two terms in combination indicates the surface was exposed to weathering and soil forming processes during both interglacial periods. Where the Yarmouth-Sangamon paleosols are exposed on the present day landscape due to erosional processes, they are recognized as the Clarinda soil series if the native vegetation is prairie. If the paleosol is partially truncated, the Lamoni series is mapped.

On less stable, sloping parts of the old landscape, soils also formed but with much different characteristics. In the old literature, these soils were grouped under the term ferrotill and today are recognized as Late Sangamon paleosols which are usually reddish in color. This term “Late Sangamon” refers to the age of the surface on which these soils formed and so time wise they formed on more recent geomorphic surfaces than the Yarmouth-Sangamon paleosols. When the Late Sangamon paleosols are exposed on the present-day landscape due to erosional processes, they are recognized as the Adair soil series if they formed under prairie vegetation. The cause of the red color is widely debated but many soil scientists agree that it is most likely related to a warmer environment and amount of time the surface was exposed to soil forming processes.

The loess in all of Iowa has a distinct weathering profile, depending on the part of the landscape on which it is located. On well-drained sites in the refuge area the soil solum is underlain by an oxidized and leached (OL) weathering zone. This zone is characterized by yellowish-brown colors but may have a few gray mottles. The term “leached” indicates the absence of carbonates as indicated by a lack of effervescence when dilute hydrochloric acid is applied. Underlying this zone is the oxidized and unleached (OU) zone, which has colors similar to the zone above but does effervesce when dilute hydrochloric acid is applied, indicating the presence of carbonates.

The deoxidized and unleached (DU) zone underlies this zone and is characterized by light gray colors and much iron segregation. The reddish-brown iron may be in the form of mottles or tubules commonly called “pipestems” because of their unique shapes. Carbonates are present in this zone. On more poorly drained areas in the refuge, the soil solum grades into a deoxidized and leached (DL) zone. It has the color characteristics of the deoxidized and unleached zone but lacks carbonates.

An examination of soil maps of the area shows the relationship between geology, stratigraphy, geomorphology, and soils. The major loess-derived soils in the area are Tama, Muscatine, Otley, and Mahaska and they are formed in the OL zone of the loess.

On short, convex to straight side slopes and coves at the head of drainage ways erosion has truncated the upper

weathering zones and the Kilduff and Nira soils are formed in the deoxidized and leached weathering zone. Lower on the landscape, Clarinda and Lamoni soils mark the outcrop of the relict Yarmouth-Sangamon surface. Adair soils indicate the outcropping of the Late Sangamon surface. On the younger till surfaces, below the elevations of the paleosols, the Shelby soil is mapped.

The restoration of the prairie ecosystem at the Neal Smith Refuge Center should provide an environment that will allow the landscape and soils to regain many of their lost properties that resulted from intensive agricultural use.

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.