Welcome to the Iowa Academy of Science's National Wildlife Refuge Audio Series. In this segment, Academy member Mark L. Anderson, Project Archeologist at the Office of the State Archeologist at the University of Iowa will discuss the geology of Union Slough National Wildlife Refuge and the archeological discoveries that have been made there.

Union Slough is a large tract of conservation ground located along Buffalo Creek in Kossuth County, Iowa. It is located within the Interior Lowland physiographic province, which encompasses all of the state of Iowa. Its geological and archaeological history of Union Slough is varied and unique, representing an interesting aspect of this national wildlife refuge.

The most deeply buried rocks just southeast of Union Slough date to the Pre-Cambrian, about 1 billion years old. These rocks are part of an ancient Midcontinental rift system that once extended from the Lake Superior region, southwestward through Iowa, to northeast Kansas. The rocks contained within the rift system include sandstones, shales, mudstone and siltstone. They are interpreted as being deposited by ancient fluvial, or river systems, and represent sediments derived from weathering of the original continental crustal rocks to the north and east. These fluvial sediments were laid down in environments such as rivers, stream, floodplains, lakes, and ponds. While rocks of this ancient Midcontinental rift are exposed at the surface in the Lake Superior region, they lie too deeply buried in Iowa and are not exposed at the surface in the Union Slough area.

Immediately above these rocks, and underlying all of the Union Slough area, are Cretaceous-aged Dakota Formation rocks. This was the age of the dinosaurs when the western half of what was to become Iowa was located near the eastern margin an expanding inland sea. The Dakota Formation contains rocks composed of sandstone, mudstone, shale, siltstone, and conglomerate, with minor deposits of lignite coal and limestone. Rocks laid down during the early and middle stages of the Dakota Formation are fluvially derived as drainage ways flowed across Iowa and emptied into the inland sea. Rocks laid down during the later Dakota Formation are derived from coastal environments representing near shore and estuary settings. Fossils have been recovered from Dakota Formations rocks, mainly preserving altered plant material in the lignite coals. Plant leaf and branch compressions, petrified wood, and occasional tree trunk casts are known from these rocks along with microfossils of plant pollen and spores providing an image of the plant communities that once inhabited the continental coastal lowlands of the Late Cretaceous period in Iowa.

Both of these bedrock units are relatively deeply buried beneath 25 to 150 feet of gravel, sand, silt, and muck laid down during the Ice Age. This geologic period, known as the Quaternary, includes the past 2 million years when a succession of ice sheets advanced and retreated from the north across the landscape. Earlier advances are difficult to detail since each successive advance removed evidence of the previous ones. These advances and retreats likely occurred at least four times with the most recent being called the Wisconsinan glacial advance. The specific area of Iowa impacted by this most recent advance is known as the Des Moines Lobe. The landscape of Union Slough is within the north-central portion of the Des Moines Lobe. Geologic study of this area has shown several individual advances and retreats during this time. The nature of ice advance creating the Des Moines Lobe appears to have been a complex system of quickly moving ice sheets able to advance in surges over the ground surface. The first of these, known as the Bemis advance, reached the Minnesota-Iowa border approximately 15,000 years ago and by 13,800 years ago had reached the present day location of the city of Des Moines. The ice then stagnated and melted, or wasted in place, leaving relatively level, hummocky topography called a till plain bordered by the characteristic ridge known as an end moraine marking the furthest ice extent. The next advance, known as the Altamont, moved south by about 13,500 years ago stopping in northern

Greene, Boone, and Story counties. Several minor surges are present within the Altamont, occurring between 13,500 and 12,600 years ago, and are known as the Clare, Renwick and West Bend moraines but they are discontinuous and not well expressed. The third advance, known as the Algona, covered all of Kossuth County and Union Slough. It is largely responsible for the modern landscape seen in the area. This advance occurred about 12,300 years ago followed by stagnation and rapid wasting of the ice. It was during this advance that Buffalo Creek, containing Union Slough, and the upper Des Moines River valleys formed. They represent outwash channels that carried away glacial melt waters during and after stagnation and wasting. These advances of ice during the Wisconsinan glacial advance created what are known as prairie potholes that dot the landscape. The result of surging ice, rapid stopping, and in place wasting created the relatively level, hummocky topography featuring the characteristic wetland landscape seen today at Union Slough. This region developed richly varied plant and animal communities, which in turn became considerably attractive to human occupation.

Prehistoric human occupation of the Union Slough area is ancient but poorly understood. The earliest recognized culture period in Iowa is the Paleo-Indian Period, dating earlier than 10,500 years ago. Because of the Algona advance, human occupation of the Union Slough area was not possible until after the ice had stagnated and melted, consequently we do not have a record of humans in the area during the Paleo-Indian period. Human occupation of the Union Slough area dates back to at least 10,500 years ago based on artifact collections held by local landowners in the surrounding area. The time from 10,500 to 2,800 is called the Archaic Period and represents a time when humans were extending their range and taking advantage of increasing resources. The Early Archaic period is characterized by rapidly changing environments including the development of Union Slough. Peoples were hunting a variety of game from large to small as well as gathering a wide variety of plants and other resources. During the Middle Archaic, climatic conditions became increasingly warm and dry which may have resulted in shrinking of the slough and perhaps decreased human occupation. The Late Archaic period sees a return of moister conditions and an overall population increase. From other areas of the Des Moines Lobe, the Late Archaic peoples appear to be focused on spring-summer-fall resource extraction then perhaps leaving during the harsh winter months.

The time from roughly 2,800 to 1,000 years ago is called the Woodland Period, again divided into Early, Middle and Late. The Woodland Period is well represented in the artifact collections of local residents. The climate and landforms stabilized to resemble those of today with the development of the forest-prairie mix similar to that seen at the slough. This period saw major technological, economic, and social change including the development of pottery, the use of the bow and arrow, domestication and cultivation of plants, and burial complexes. Prehistoric settlements became larger and more sedentary and social interactions became much broader across the landscape and much more complex. The time from 1,000 to 300 years ago is called the Late Prehistoric period where several groups developed distinct cultures based on agriculture, permanent villages, and even greater social and political organization. One of those groups known as the Oneota, who came to be known as the historic Ioway, was near Union Slough around the early 1700s and most likely used the abundant resources of the area. Currently, there are eleven archaeological sites recorded within Union Slough. Two are historic farmstead dating to the 19th and 20th centuries, one is a multicomponent site composed of a historic farmstead and a prehistoric occupation of unknown cultural period, and eight are prehistoric occupations of unknown culture period. As more research is conducted in the future, our understanding of prehistoric human occupation of the Union Slough will improve.

Next, Academy member Jane Shuttleworth, Executive Director of the Friends of Lakeside Lab will tell us the conservation story of Union Slough National Wildlife Refuge.

Union Slough National Wildlife Refuge was established in 1938 to provide a refuge and breeding ground for waterfowl and other migratory birds. It is managed by the US Fish and Wildlife Service, who work to conserve, protect and enhance fish, wildlife and plants for the continuing benefit of the American people.

For thousands of years prior to its establishment, the landscape of what would become the Union Slough National Wildlife Refuge was part of a continuous, vast system of prairie and wetland habitat known today as the prairie pothole region, and extended from Canada to Texas. This mixed ecosystem of tall grass prairie and wetlands was home to ducks, geese, shorebirds, songbirds, prairie chickens, buffalo, beaver, muskrats and many other animal species. By the beginning of the 20th century, however, habitat alterations and over hunting had severely reduced wildlife populations. Several species had already become extinct or nearly exterminated, including the passenger pigeon, prairie chicken, and bison. The Refuge was created during this time period when the American public realized if they did not act to conserve what little remained of the once vast prairie pothole region, its animal and plant life could vanish forever.

But human activity had not always been so detrimental to wildlife and their habitat. For thousands of years, Union Slough and the surrounding region was also home to American Indian populations including the earliest Paleo-Indian and archaic hunters through the more recent and early historic periods when north central Iowa was home to Ioway, Winnebago, Dakota, Sac and Fox peoples. These people hunted deer, elk, bison and other animals. They harvested waterfowl for their meat, eggs and feathers. From animal hides and bones, they manufactured tools, clothing and shelter. From the marshlands they gathered wild rice, cattails, arrowheads and other plants for food, medicine and fiber. Some native peoples also planted corn, beans and squash. They all engaged in wide ranging trade networks with other American Indian peoples. Some of these trade routes ranged at least as far south as Cahokia, the modern day location of St. Louis, Missouri.

By the 1700s, American Indians had to enter into fur trade with French and other European explorers. They traded the pelts of beaver, muskrat and other fur bearing animals in exchange for pots, pans, rifles, beads and other European goods. This system of trade between Indian and Europeans developed over a century and a half, but over time it lead to increased European expansion, the demise of the fur trade and the dispossession of Indian lands, ushering in a new phase in the region's ecological and social history: the arrival of Euro-American settlers and the introduction of market oriented agriculture.

The prairie pothole landscape, once a source of livelihood to Native Americans and Euro-American traders and trappers, now became viewed as an impediment to the new inhabitants who depended upon agriculture for survival. The breaking of prairie soils and draining of wetlands for agriculture was both symbol and fulfillment of the settlers' American dreams of land, liberty and freedom.

Arriving from more populated centers, these early settles were unaccustomed to what seemed to be an endless abundance of fish and wildlife. The practice of harvesting wildlife for economic exchange that had begun with the fur trade centuries before now took on a new form: the era of market hunting. As the railroads expanded west bringing needed supplies and carrying grain and livestock east, market hunters joined in the growing economy, shooting, trapping and shipping hundreds of thousands of prairie chicken, ducks, geese as well a frogs, fish and clam shells and other wildlife to ship to markets in urban centers as far east as Philadelphia and New York City. Sport hunters also took enormous bounties. The land was viewed as an endless source of wealth and commoditization, and it seemed inconceivable that their numbers could ever be threatened.

By the twentieth century, the development of railroads, grain and livestock markets increasingly connected city and countryside, integrating the United States economy as never before. Iowa had become one of the most productive agricultural landscapes in the world – and also become one of the most physically and ecologically altered states in the union. By 1906, after barely fifty years of statehood, Iowa had lost over 75% of its original wetland acres and the prairie was being swallowed up by the plow. Not until wildlife and habitat became so scarce did policies and scientific practice come into place to protect them.

In Iowa and nation wide, a conservation movement was growing. By the 1900s, Iowa had already passed some of its first game laws, but it was the signing of the federal Migratory Bird Treaty that provided recognition and funding for protection for ducks, geese and other waterfowl. The severe drought of the early 1930 also brought further attention to the plight of waterfowl.

Kossuth County, the home of Union Slough, was a microcosm of these landscape transformations, and became focus for new federal programs to develop a nationwide system of wildlife refuges to protect migratory and nesting habitat for waterfowl. Much of the region had stubbornly resisted efforts to drain it and remained too wet to farm. It still continued to continue to provide nesting and migratory habitat for such as mallards, teal, canvasbacks, redheads, and other birds.

In 1934, Ding Darling, one of Iowa's most prominent conservationists, visited the county and surveyed the Union Slough region as a potential site for a wildlife refuge. In 1938, President Franklin D. Roosevelt signed into law Executive Order 7976 establishing the Union Slough Wildlife Refuge.

Today, management activities on the refuge are designed to provide quality grassland and wetland habitat for waterfowl and other migratory birds. Water levels are varied to provide appropriate habitat for different groups of birds. Shorebirds, for example, prefer shallow wetlands and mudflats, while mallards, teal and other ducks require a complex of temporary, seasonal and semi-permanent wetlands. A variety of vegetation is required to proved critical food, brood cover and loafing areas for birds. Water levels are frequently manipulated in winter months to control carp and other rough fish populations.

Mowing, tree removal and prescribed burns are the main method of managing and restoring the tall grass prairie and controlling the advance of woody vegetation. By releasing nitrogen into the soil, fires maintain the vigor and dominance of prairie grasses and forbs. The refuge staff also restores newly acquired ground to tallgrass prairie by planting a diverse mixture of local ecotype grasses and forbs. Most of the species are harvested from remnant and restored prairies on the refuge, while hard to get species are purchased from local seed vendors. Wetlands are restored by breaking or rerouting drainage tile or plugging surface ditches. Because the refuge is surrounded by intensive agriculture, neighboring farmers are encouraged to participate in conservation practices such as siltation ponds, buffer strips and grassed water ways to control soil erosion and nutrient runoff into Refuge waters.

Several public events are held at the Refuge each year. On Prairie Rescue Day, volunteers help cut back invasive woody vegetation, learn about and admire prairie grasses and forbs. The public is also invited to visit the Refuge in the spring to see large concentrations of migrating ducks, geese and swans. A 4.5 mile self guided auto tour, open yearly on August first, is accessible form the Refuge headquarters, and gives the public an opportunity to view waterfowl and a variety of shorebirds, herons, and egrets while using the car as a blind. Multiple species of wildflowers are in their height of bloom while grasses are beginning to cure and turn deep shades of browns and reds at this time. Hunting, fishing, photography, wildlife observation, environmental education and interpretation activates are offered during

different times throughout the year and are scheduled to avoid disturbing waterfowl and other birds during the nesting season. An overlook trail and observation platform with scopes is accessible year round from the headquarters. The south unit of the refuge is open year round to hiking and snowshoeing in the winter months. A Friends group meets quarterly to help with public events and management activities, such as collecting prairie seed for prairie restorations, and removal of invasive species.

And now, Academy member Rick Lampe, Ecology Professor at Buena Vista University will introduce us to the wildlife of Union Slough National Wildlife Refuge.

At first glance, it appears to be a wasteland, lost in a tangle of vegetation, mud, and smelly water. But look closer! The Union Slough National Wildlife Refuge is an intricately balanced community of organisms depending closely upon each other for their existence. Set amidst the rolling countryside of north-central Iowa, this pre-glacial riverbed is a protected region of 3300 acres plus and an additional 19, 800 acres of managed wetlands. The name slough is used in the Midwest for a marsh, or what today is often called a wetland. Where once a mighty river flowed, pools of varying depth now provide a home for aquatic plants and animals. Surrounding the wetlands, you'll also see low banks covered with prairie grasses that are used by a myriad birds and small mammals.

Each spring flocks of migratory birds return to the Refuge. Some use it as a rest stop before continuing their journey to northern breeding grounds. Others will nest on the ponds and pools whose depth is carefully controlled throughout the year in order to provide protection from predators that stalk the grassy banks. Breeding pairs of various species of waterfowl and songbirds can be seen in spring going through their species specific behavioral displays. Such actions and sounds are intricately timed to bring a male and female through the steps of identifying that each is of the same species. If a duck makes the wrong grunt whistle, the courtship stops thus preventing the exchange of gametes between members of different species.

Spring is also a time when you may see smoke curling up from portions of the grasslands as the refuge staff uses controlled burning as a tool for prairie management and restoration. Done at a time prior to construction of nests for many birds, fire sweeps across selected portions of the refuge removing the old standing crop of dried stems and leaves. Ash falls to the ground releasing minerals back into the soil where it can be utilized quickly by other plants. The blacken ground warms in the spring sun and within several weeks there will be a fresh green carpet of new growth. Once a natural part of the grasslands ecology, fire today ensures the survival and growth of many native forbs and grasses.

Although a primary purpose of Union Slough is the management of migratory waterfowl, its habitat is also immensely important to many other species. Several species of small mammals can be seen if one sits patiently watching for their movement. Ground squirrels, meadow voles, white-footed mice, deer mice, jumping mice, harvest mice, several species of weasel, red fox and badger claim these grassy banks as their home. Mink, muskrat, beaver and otter occupy the wet meadows and marshes. Snapping turtles lie in wait for a meal as an unsuspecting fish or duckling approaches its unmoving form. Coyotes stalk the banks and attempt to capture an unwary mallard. Ermine slip through small grassy tunnels in search of mice or nesting birds. In the past, the interplay of life and death was not well understood and some misguided actions attempted to remove predators because their means of surviving….that is the capture and death of another creature….was seen as cruel. Today however, we understand the vital role that predators and prey have in the flow of energy that starts with chlorophyll in green plants utilizing sunlight to build chemical molecules. Every creature not having chlorophyll must gain its nourishment by eating plants (which are called primary consumers) or by eating animals that eat plants (the secondary

consumers). Tinkering with the assortment of consumers and the complexity of the feeding webs within this community becomes evident. Try to remove the predators and prey populations grow without constraint.

Refuges like Union Slough provide places where many creatures can find a place to live as they have in the past. This certainly is true for Trumpeter Swan that now can be seen flying across the wetlands with magnificent beats of its long broad wings. Once a species in decline, Trumpeter Swans have returned to Iowa because of breeding programs across the state and places where they can raise their young safely. Look for this beautiful bird as it sticks its long white neck above the marsh grasses to peer across the ponds.

Seasonal changes will sweep across Union Slough. Within its wetlands, many species of aquatic insects mark the change in day length and thus are cued as to the proper time for them to emerge from their watery lives and molt into a body bearing wings. Some of them, such as mayflies, last a mere day of life out of water during which they must find a mate and then lay eggs back into the water from which hours before they had emerged. Then, having spent their energy completely, they drop back into the water to become food for fish and frogs.

As summer draws to a close, ducks and geese once again splash into the Refuge's ponds but this time they are headed south to avoid the wintry storms only staying here briefly to rest before continuing their journey. Though ice will seal the surface of the ponds, life continues beneath until the warmth of spring returns.

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.