

Spirit Mound Trust News

P.O. Box 603, Vermillion, SD 57069 • info@spiritmound.org • www.spiritmound.org • Norma C. Wilson, Editor • December 2014

Spirit Mound's Connection to an Ancient Sea

By Tim Cowman
SD Geological Survey

Introduction

Spirit Mound's rise above the surrounding terrain in Clay County, South Dakota, has been attracting attention ever since this area was first inhabited by humans. Interpretations that have been made about the geologic origin of Spirit Mound generally describe the Mound's formation during the last glacial age. However, in a way the Mound owes its existence not just to the work of the glaciers, but to its bedrock foundation. Let's take a step back in geologic time to when that bedrock foundation was formed.

Cretaceous Period

The Cretaceous Period ended about 65 million years ago and was an interesting time from both biological and geological perspectives. The supercontinents were breaking up into smaller land masses, plants and animals were evolving into more modern forms, and dinosaurs and other marine reptiles dominated the landscape. *Triceratops* and *Tyrannosaurus rex* were roaming the earth, as were marine reptiles such as *mosasaurs* and *plesiosaurs* that can be found as fossils in the rock layers today (figure 1). The Museum of Geology at the SD School of Mines and Technology has excellent exhibits of some of these fossils.



Figure 1. Mosasaur from the Cretaceous Period
(image credit: Dan Varner)

Western Interior Seaway

A significant inland sea existed during the latter part of the Cretaceous Period. It is known as the Western Interior

Seaway and covered an area from Mexico to northern Canada in length and Utah to Iowa in width (figure 2). Sediment from rivers and shells from small animals were deposited at the bottom of this sea and formed rock layers of sandstone, limestone, and shale. Fossils of animals that died and became buried in these sediments are occasionally discovered today. Eventually the sea dried up and these rock layers became the land surface.

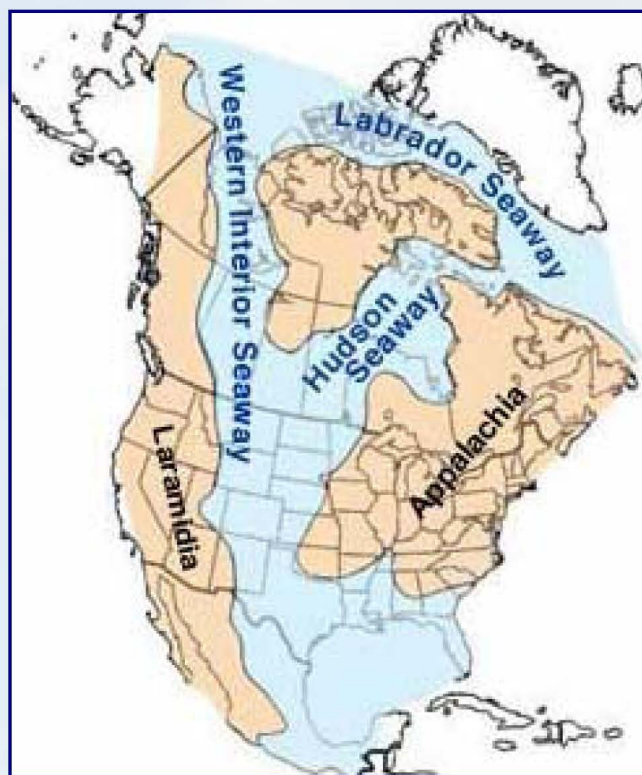


Figure 2. Western Interior Seaway
(source: U.S. Geological Survey)

The Niobrara Formation was formed within a relatively deep sea in part from the calcium carbonate shells of animals that settled to the bottom of the sea after they died. Although it resembles limestone, it is considered to be chalkstone. This rock layer is especially important to Spirit Mound as it forms the core around which the Mound was created.

continued page two

The Last Ice Age

During the last ice age, large ice sheets originating in the Hudson Bay region advanced southward. These "Late Wisconsin" glaciers covered parts of the northern United States, including what is now eastern South Dakota (figure 3).



Figure 3. Maximum extent of Late Wisconsin glaciers

As these ice sheets advanced, they eroded the bedrock underneath them. The ice sheets then re-deposited the eroded material as glacial sediments. Although the ice sheets retreated from this area about 15,000 years ago, their work still defines our landscape today.

Formation of Spirit Mound

As the ice sheets moved through what is now Clay County, they eroded some of the rock layers that were left behind by the ancient sea. Most of the Niobrara Formation in Clay County was removed by the ice and prior erosion; but in the area that is now Spirit Mound, a

knob of Niobrara Formation remained. Sediment from the glacier was deposited around this knob, and the resulting feature is the oblong shaped earth structure we see today. Thus, Spirit Mound was built from a Niobrara Formation core surrounded by glacial sediments and is known in geologic terms as a rock-cored drumlin (figure 4).

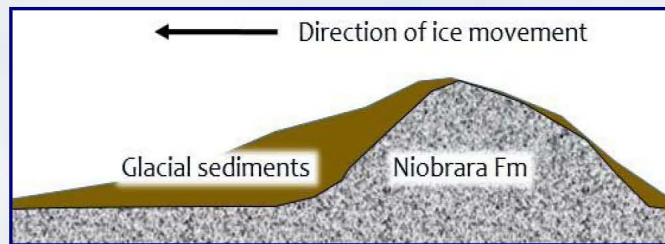


Figure 4. Cross-section view of Spirit Mound

This is the relation of Spirit Mound to an ancient sea that covered this area millions of years ago. The Niobrara Formation was deposited at the bottom of the sea. Later, when the glaciers carved out the landscape we see today, a knob in the Niobrara Formation helped shaped the sediment deposition that formed Spirit Mound (figure 5).



Figure 5. Spirit Mound today

The Enduring Feedlot

By Eric Vander Stouwe,
District Supervisor, South Dakota Game, Fish & Parks

Spirit Mound Historic Prairie has seen many changes since its establishment in 2000. One area of the prairie, however, has been slow to change. It has been very difficult to establish prairie species on the former farm and feedlot on the east side of the Mound. High soil nutrient levels and high salt concentrations in this area have likely prevented prairie species from establishing because either the soil condition is too extreme for the prairie plants or because the prairie plants are being outcompeted by agricultural weeds with higher initial growth rates. We have tried many nutrient mining strategies to reduce the amount of nutrients. Alfalfa was seeded in 2006; however, the crop did not grow and therefore could not be harvested to mine the nutrients. In 2012, the area was planted with radishes, sugar beets and sorghum Sudan grass with the same



soil mining strategy in mind. However, the cover crop was not successful as it was outcompeted by annual weeds. Therefore, beginning in 2013, the area was seeded with glyphosate-resistant corn with the intention of removing nutrients from the soil when the grain was harvested and the corn stalks baled. The glyphosate used to manage the corn crop was also expected to reduce the agricultural weed seed bank in the area. The cornfield will be maintained again in 2015.

Then we will reseed the area, and hopefully tall grass prairie species will again flourish.

Spirit Mound, a Sparrow Haven

By David Swanson,
Department of Biology, University of South Dakota

Grassland and prairie birds are, perhaps, the most at-risk bird group in North America from a conservation perspective, and prominent among this group are the New World sparrows. Loss of grassland and prairie habitat is thought to be the primary cause of population declines for these birds. This habitat loss problem in South Dakota has recently been exacerbated by high corn and soybean prices, which have resulted in the conversion of more and more native prairie and grassland habitats to agricultural row crops. Prairie restoration efforts, such as those at Spirit Mound, can help mitigate population declines in grassland and prairie birds by providing suitable habitat for nesting and migration.

Most research relating to sparrow use of grassland and prairie habitats has focused on the breeding season, and these studies generally demonstrate the positive consequences of grasslands (including Conservation Reserve Program (CRP) grasslands for breeding sparrows. The recent dramatic reductions in acreages enrolled in the CRP program in the Dakotas is likely to have a negative impact on sparrow populations. This highlights the positive role that prairie restoration efforts can play for supporting sparrow populations.

Some work on breeding bird populations has been conducted at Spirit Mound. Jay Carlisle, a former graduate student at the University of South Dakota, and colleagues conducted breeding-season bird surveys at Spirit Mound in 2003. This study was later published in *South Dakota Bird Notes* (2004, Volume 56, Pages 32-41). These authors found six species of sparrows and buntings breeding on the grasslands of the property, with Dickcissels (*Spiza americana*) and Grasshopper Sparrows (*Ammodramus savannarum*) occurring in particularly high abundance. The surveys that Carlisle and colleagues conducted were repeated in 2013 by Eva Soluk, an undergraduate student at USD, and Meghann Jarchow, an Assistant Professor of Biology at USD, who found three of the same six breeding species of sparrows and buntings present. The three missing species in the 2013 study were Field (*Spizella pusilla*), Vesper (*Pooecetes gramineus*) and Lark (*Chondestes grammacus*) sparrows, which occurred in low numbers in 2003; so they could have been missed on surveys in 2013. In addition to the regular breeding species, some rare (for eastern South Dakota) sparrows and buntings have also been documented during the breeding season at Spirit Mound, including Lark Bunting (*Calamospiza melanocorys*) and Henslow's Sparrow (*Ammodramus henslowii*).

Much less research attention has been devoted to



Le Conte's Sparrow.
(Photo by Roger Dietrich)

birds using grasslands and prairies as stopover habitat during migration. Most birds migrate in relatively short hops to cover the distance between breeding and wintering grounds, which for some grassland sparrows and buntings can occur as close as the southern U.S., but for others such as Dickcissels, can extend all the way to northern South America. Between migratory hops, birds stop to rest and refuel before completing the next leg of the migratory journey. Thus, these migration stopovers can be critical habitats for successful completion of migration in a timely manner, and can influence survival and reproductive success, and thereby the population dynamics of these birds. As I mentioned previously, there have been fewer studies of the importance of grassland habitats as stopover sites for migrating sparrows than there have been of woodland and wetland habitats as stopover sites, but it is likely that grasslands are just as critical to maintaining stable populations as are woodlands and wetlands for these migrants.

Little formal research has been conducted on migratory sparrow populations using the restored prairie habitat at Spirit Mound, but bird observation data suggest that Spirit Mound is an important habitat for fall migrating sparrows. Eighteen species of sparrows and buntings have been recorded on the grasslands at Spirit Mound during fall migration, including one of my all-time favorites, the uncommon and striking Le Conte's Sparrow (*Ammodramus lecontei*).

The Le Conte's Sparrow is a small, short-tailed, streaked sparrow with a bright, orange-yellow face and, in my opinion, is one of the most beautiful sparrows. A breeding-season denizen of wet grasslands

continued on page four

and sedge marshes from northeastern South Dakota through the prairie provinces of Canada, it winters in grassland patches along the Gulf Coast of the southern U.S. According to Breeding Bird Survey data from the U.S. Fish & Wildlife Service, Le Conte's Sparrows in the central region of North America appear to be maintaining stable populations. However, work by Larry Igl and Doug Johnson from the Northern Prairie Wildlife Research Center out of Jamestown, North Dakota, shows that local populations in the Dakotas may be quite variable, with higher numbers of breeding birds during wet years. Their research has also demonstrated that CRP grasslands are a real boon to Le Conte's Sparrows; so the marked decline in CRP acreage is likely to have a negative effect on populations, making preservation of suitable stopover habitat during migration even more important for the conservation of this species.

The Le Conte's Sparrow is an uncommon to sometimes common migrant in grasslands with native grasses in southeastern South Dakota. It stops in this area from mid-September to mid-October, and Spirit Mound is one

of the best places to find this species during migration. On one memorable outing of the South Dakota Ornithologists' Union to Spirit Mound in early October, we were surrounded by hundreds of Le Conte's Sparrows clinging to stalks of native prairie grasses and bulrushes. While you can typically find a number of Le Conte's Sparrows at Spirit Mound during most fall migration periods, especially in the wetter areas along the creek, the sheer number of birds present on this outing was something not likely to be experienced again. Very little research has been conducted on migration and stopover biology of Le Conte's Sparrows, but because of the regular occurrence of this species during migration, the restored prairie at Spirit Mound seems like high quality stopover habitat. In any event, Spirit Mound seems to be a popular stopover location for Le Conte's and many other sparrows, so I encourage you to take your binoculars out for a stroll up the trail during the fall migration period. You are likely to be rewarded with a beautiful variety of sparrows.

Prairie Progress at Spirit Mound

By Meghann Jarchow,
Department of Biology, University of South Dakota

Tallgrass prairie restoration has been ongoing for more than a decade at Spirit Mound with the initial seeding of the site occurring in the fall of 2001 and in spring of 2002. Management efforts at Spirit Mound have included both prairie restoration and prairie reconstruction. Restoring a prairie refers to facilitating the re-establishment of prairie plants within an existing prairie that has been taken over by another plant community, which in the case of Spirit Mound is primarily smooth brome (*Bromus inermis*), a non-native species. Reconstructing a prairie refers to establishing a prairie on land where former grasses have been removed, generally by agricultural use. Seventy per cent of Spirit Mound is reconstructed prairie on land that was formerly used for row-crop agriculture, and 23% of Spirit Mound is restored prairie that was formerly used for intensive livestock grazing. The restored prairie is primarily on the Mound and along Spirit Mound Creek (Figure 1).

Most of the former cropland was seeded with a 28-species tall grass prairie mix; however, the area immediately surrounding the trail was seeded with a 36-species mix which contained more forbs. Initial restoration efforts on the mound included seeding over the existing vegetation with a 34-species mix of dry-adapted prairie plants and planting plugs along the eastern slope of the mound. The areas around the creek were not

initially seeded. Additional restoration efforts, including multiple seed additions, have occurred around the creek since 2002.

In order to assess the early establishment of the prairie plants, Rustan Vote (now Rustan Krentz), a former graduate student at USD, and her advisor Karen Olmstead conducted vegetation surveys in 2003 and 2004 at Spirit Mound. Ten years after Vote and Olmstead's work, Alice Millikin, a former graduate student working with me, conducted a follow-up vegetation survey. Both Vote and Millikin found that most of the variability in plant community composition was between restored versus reconstructed areas. But there were also differences within restored and reconstructed areas of the prairie.

In the restored areas of Spirit Mound, smooth brome was dominant in 2004 (57% cover) and remained dominant in 2013 (59% cover). Whereas, in the reconstructed areas, the plant community was dominated in 2004 by early-establishing prairie species especially Canada wild rye (*Elymus canadensis*; 50% cover) and weedy annual species including prickly lettuce (*Lactuca serriola*; 8% cover) and yellow foxtail (*Setaria pumila*; 5% cover). By 2013 the plant community had transitioned to species more common in established tallgrass prairies. These included Indiangrass (*Sorghastrum nutans*; 25% cover), Bergamot (*Monarda fistulosa*; 15% cover), and Little Bluestem (*Shizachryium scoparium*; 14% cover). Overall plant diversity and species richness were higher in the

reconstructed areas than in the restored areas, with diversity and richness increasing in the reconstructed areas between 2004 and 2013 (Figure 2). The reconstructed areas also have a much lower proportion of non-native species (seven times lower) than the restored prairie areas (Figure 2).

By 2013 most of the prairie at Spirit Mound was composed of tallgrass prairie species with low abundances (< 10% cover) of non-native species. Yet, restoration challenges remain in the former grazed areas where the

previous non-native vegetation, primarily smooth brome, has remained throughout the restoration efforts. This research highlights the difficulty of bringing prairie back on former agricultural land and the long-term impact that previous land use can have on the success of prairie restoration. Fortunately, the South Dakota Department of Game, Fish and Parks and the Spirit Mound Trust continue to work hard to convert all of Spirit Mound back to native prairie plants.

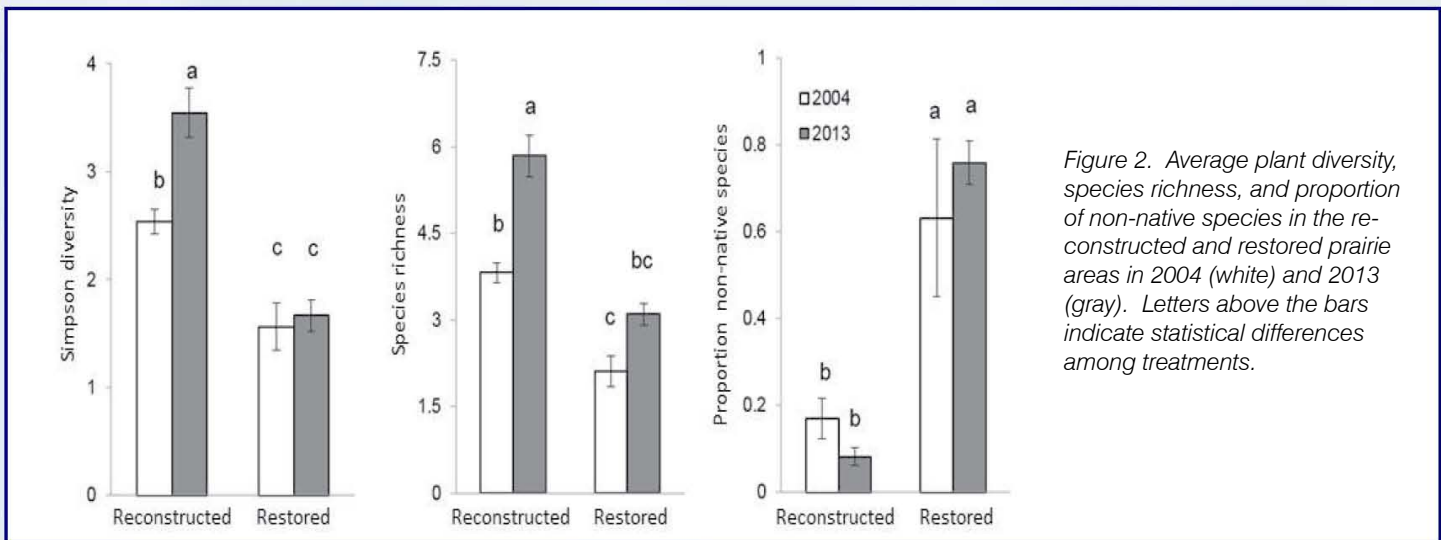
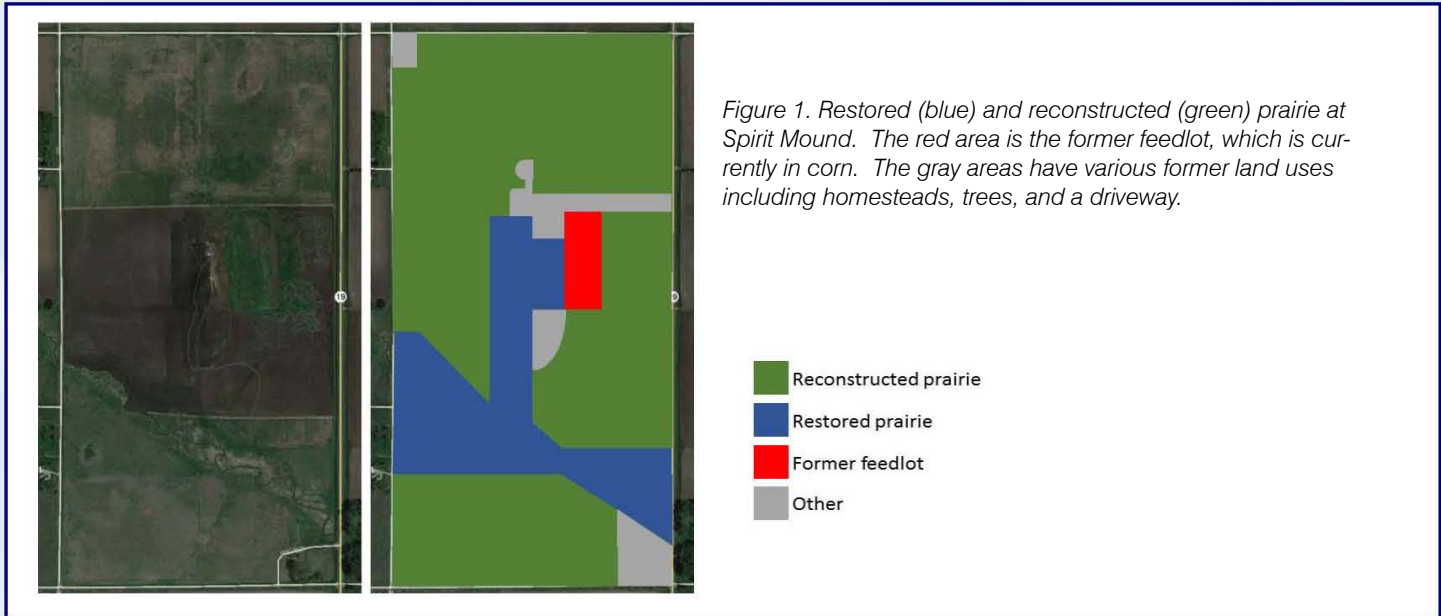


Figure 2. Average plant diversity, species richness, and proportion of non-native species in the reconstructed and restored prairie areas in 2004 (white) and 2013 (gray). Letters above the bars indicate statistical differences among treatments.

Editor's note: For more information about the vegetation surveys, see Alice Millikin's Master's thesis titled "Assessment of tall grass prairie vegetation at Spirit Mound 12 years post-restoration," available at the I.D. Weeks Library on the USD campus.

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Spirit Mound Trust

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