

Heritage Farm's Karst Topography and Algific Talus Slopes Convention Walking Tour with Jeff Nekola

We're looking at something that's unique to north-eastern Iowa: vertical surfaces. They exist elsewhere in Iowa, certainly, along some of the rivers, but you really have to get up in this northeastern corner to see this kind of rugged topography. For a long time (100-120 years) this region – because of its ruggedness and because of these cliffs and the bedrock outcrops – was referred to as “the driftless area.” The myth was that there was no glacial drift; in other words, the glaciers were thought to have missed this area.

For the last two and a half million years, there have been something like 24 different ice age events that we know about by looking at sediment cores from the deep ocean and the ice pack in Greenland and other places. The thought was that during that whole time none of those 24 glaciers ever made it to this area. It turns out that's just simply wrong. In fact, this area was covered with glaciers as recently as 300,000 years ago, just two ice ages ago.

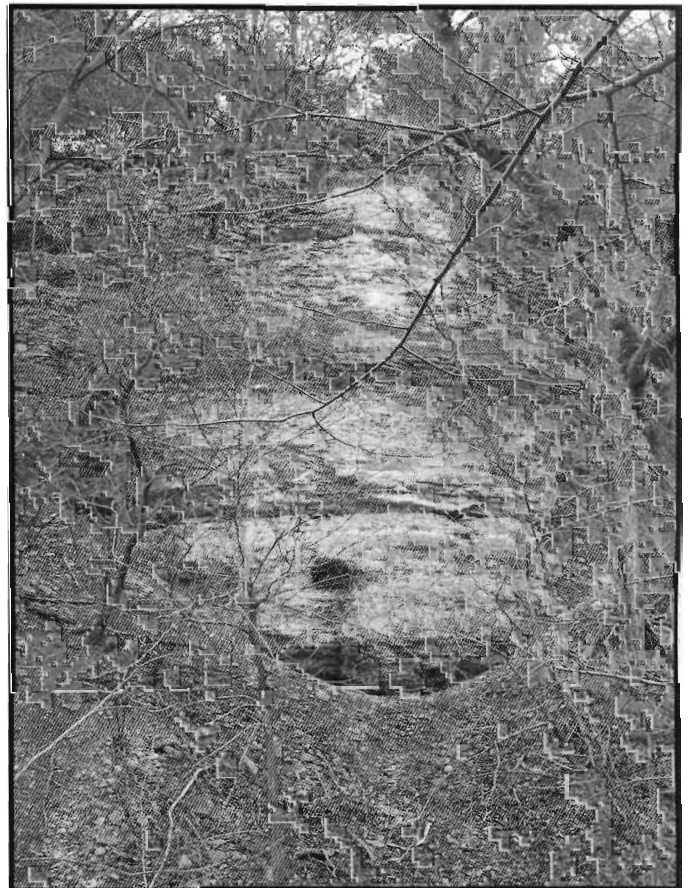
This area would have looked like the rest of Iowa half a million years ago. Where did all of these steep cliffs come from? What the folks at the Iowa Geological Survey have been finding out is a much more interesting story that relates to what was going on in this area during the last ice age. Where is the closest that the ice sheet got to right here at Heritage Farm? You'd have to go up north by the Twin Cities, and to Madison, Wisconsin, and then way into Illinois. It also dipped down a little bit into northwestern Iowa. Twenty thousand years ago, Heritage Farm was surrounded on three sides by glacial ice.

You have to remember what a continental-size glacier looks like. If you've been to the Rockies and if you've seen those ice sheets, you were looking at a glacier maybe 100 feet tall. If you have an ice sheet that is forming on a continent – taking over a continent – they become much bigger. In fact, the ice sheet in this part of the world was at least two miles thick. That's the size of the Tibetan plateau – if you think about it – made of ice, surrounding this area. You can imagine – if there's that much frozen stuff surrounding us – the climate here was really different. In fact, this area was covered in tundra, underlain by permafrost. By the time you get to Iowa City, you begin to see evidence of there being trees as well as tundra mixed together.

In the summer, when things would melt a little bit, water would run down into the cracks in the rocks and then it would freeze again in the winter. Then the next summer more warm water would come in from the

surface, would melt in, and when it froze would expand a little bit more. And slowly, like a crowbar, it wedged apart the rock and broke it into pieces. If we take a look up on this slope, we can see fissures and cracks and all sorts of little things here that were all caused by ice wedge. If you look in back of this tree – I think that's a butternut tree – you'll see there's a little narrow cleft that runs right back into the hill. Well, that's caused by ice wedge and is an example of the permafrost that was here a long, long, long time ago.

I still haven't explained why these cliffs are here. What we know is that about 15,000 years ago the bedrock in this area was completely frozen with permafrost. The next part of the story is a really surprising one; it's one that we've only known for about ten years. It's information that comes from folks who have been studying the ice cap in Greenland and Antarctica, retrieving trapped air bubbles inside of that ice that tell us what the atmosphere was like at times in the past. What's nice about these ice cores is that every year a



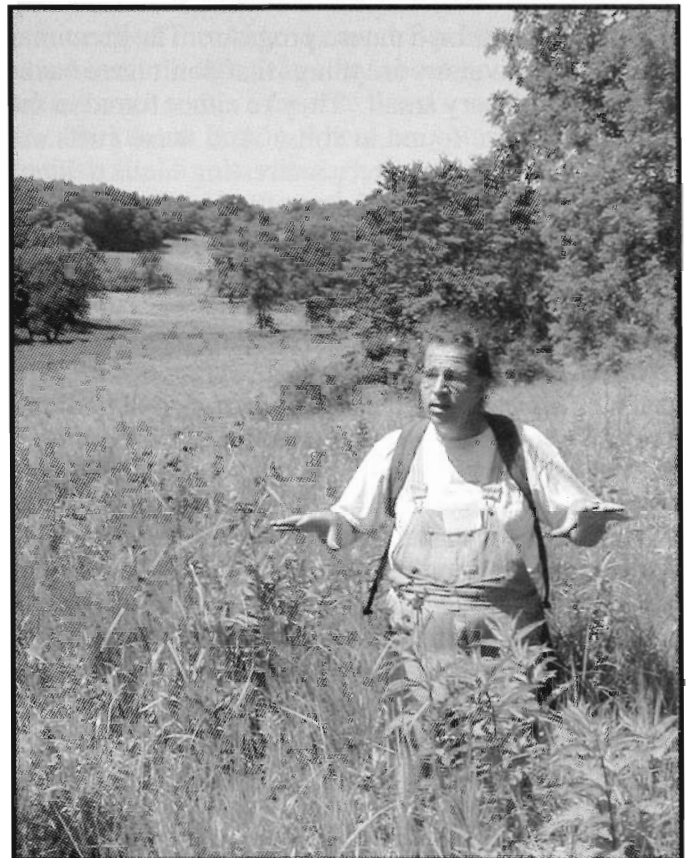
Limestone Bluff with Talus Slope (below)
(Photo by Kent Whealy)

new layer of snow is deposited like rings on a tree, and you can actually count back the number of years to when a particular air bubble was trapped. By doing that, by looking at the ratios of different types of atmospheric chemicals, scientists have discovered that the ice age did not gradually end. Up until 15,000 years ago, the climate had for the most part been as cold as it had been for the last 30,000 years.

Then, in just 10 years the climate changed to one like we're experiencing today. It took another 8,000 years for the Hudson's Bay ice cap to catastrophically fail, with all the remaining ice getting washed out into the North Atlantic and into the Arctic Ocean. What happens when you catastrophically warm an area that has a lot of limestone and also has permafrost? That ice melts out, leaving a fractured rock area that just collapses, and washes down the streams and rivers into the Mississippi. And so it turns out that these cliffs here in northeastern Iowa are in fact some of the youngest geological features in the state. This cliff right here was formed probably between 15,000 and 13,000 years ago as the permafrost melted out. This little creek began to form and began to drain the permafrost, and the rock just collapsed and created this cliff. There was probably always a creek here, but I'm guessing that at least 50 feet of this cliff is of very recent origin, meaning 10,000-12,000 years old.

So everything we're going to be looking at during the remainder of today's hike, remember, is not ancient. Forget what you've been told about the Midwest and the Driftless Area and how ancient the hills of northeastern Iowa are – it's all wrong. This is a new landscape that was formed by a catastrophic climate change 15,000 years ago that converted this area from tundra, overnight, into canyons and hills. Below these cliffs are very steep, rocky talus slopes. "Talus" just means loose rock. It turns out that the steepness of these slopes has a lot to do with the climate. How do you think that shallow slope of rock over there was formed? Given the amount of rainfall we have and given the length of our summers, you wouldn't expect that steep of a piece of loose rock at the base of a cliff here in Iowa. The only climate that can produce such a steep talus slope is one much colder than our own, helping demonstrate that permafrost actions were very important in forming the northeastern Iowa topography.

Let's walk on down through the campground to another special area. What happened right here where the talus slope erodes away? There's a gully up above us and during heavy rains it will spill over right here and has removed part of that talus slope. So we have a chance here to look into one of these talus slopes. What you'll notice is that generally these cliffs will continue all the way down to the ground level, but probably



Jeff Nekola's Tour of Heritage Farm and Twin Valleys
(Photo Courtesy of Bruce Kennett Studios)

90% of the cliffs are covered with loose rock like we were viewing before. That will make more sense in a few minutes when we take a look at another example of one of these talus slopes, one that has an ice cave in back of it. So just remember that even though we may be seeing a steep slope and some loose rock on the surface, remember that it's an apron that's hiding a solid limestone cliff.

You can see that these cliffs are just alive with various plants. In some places you'd see Northern Wild Monkshood, a little plant called *Sullivantia*, and any number of another dozen really rare plants. In fact, if you cross the state line just up into Minnesota along the Root River, there are some places where you get clusters of a plant called *Draba arabascens* growing on cliff faces just like this, and the closest place you'd see them are on the north shore of Lake Superior. Nearby, you might also see Leedy's Roseroot, which is known from only three places in the world: two in Minnesota and Seneca Lake in New York. The closest relative to it grows above the tree line in the Rockies in Colorado. The remnants of this tundra still cling to existence, tens of thousands of years later.

Another especially interesting group living on these cliffs are land snails. Of the 40-50 million species of life on earth, probably only about 1 in 20 is a big tree

or a big wildflower or a bird or a buffalo or something we normally see on a nature program. The great majority of the diversity are things that don't have backbones and are very small. They're either found in the ocean or they're found in soils. And these cliffs are perfect places for very, very interesting snails to live.

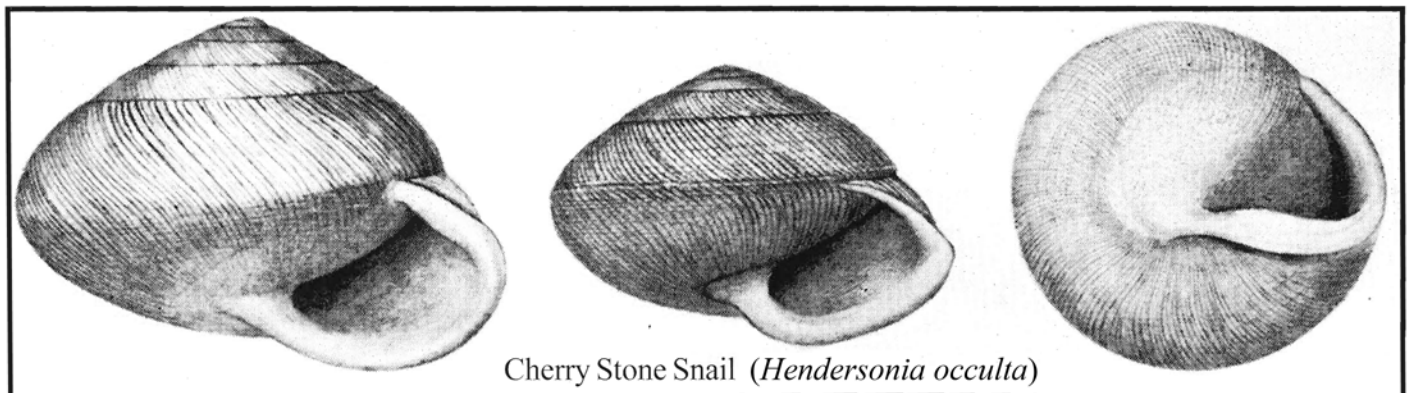
We're going to look for one that's pretty common on this cliff, and is actually an ice age relict, even though it needs only damp, cool conditions in order to thrive. It's called the Cherry Stone snail and it likes to live on these talus slopes. My guess is that if we all turn over some rocks, each of us will be able to find one of these snails. This little snail, about a quarter-inch in diameter, is red and looks like a cherry pit. I'm going to carefully turn over some of these rocks and ferns and see if we can find one or two. Well, there's a big snail; that's the largest snail that we get in this area. Very few snails have common names, by the way. That one is called *Anguispira* and it's found everywhere. And here's a Cherry Stone; that didn't take too long. I'll try to get some more so you can all have a look before we put them back. There's another Cherry Stone. It's fortunate for these snails that it's been so rainy here. Often during the summer these snails will dig down into the rock and go to sleep, and it's hard to find anything other than dead shells. They're pretty easy to find, though, on a morning like this when it's kind of misty.

Here's a little history of the Cherry Stone snail. It's fairly common in northeastern Iowa, and you can find them on many north-facing, moist, fern-covered cliffs like this. The only other places in the world where you see this snail are along the Lake Michigan shoreline in Wisconsin, and then you have to go to the Shenandoah Valley, where it's found from Tennessee all the way up into Pennsylvania. During the last ice age, this snail would frequently get fossilized, so we know what its distribution was. It used to be found all along the Ohio and the Missouri River valleys, from western Kansas and Nebraska to West Virginia and then south all the way to New Orleans. But today it's only found in these little lime-rich, cool, moist habitats, and it's been able to survive simply because it is so small. In a way, holding one is like putting a miniature mastadon in your hand.

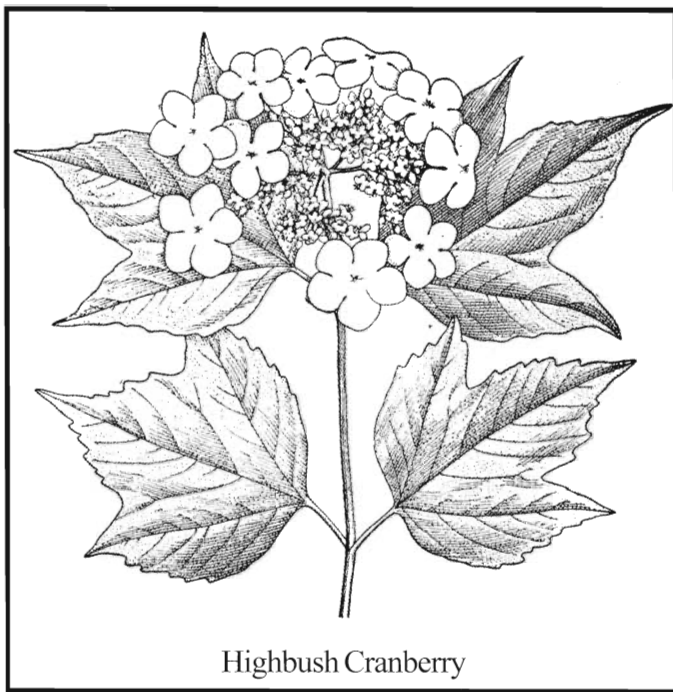
There are about 25 different land snails that live on this cliff, about a quarter of Iowa's entire land snail fauna. They live up on these soil-covered ledges and up on the cliff itself. What you can do is get some soil and you'd sieve it and you'd look for little shells. We'll do that later. I have a soil sample I took off a site further down the way. The problem is that the best stuff is up there about 10 feet, and I would probably ruin the habitat for the snails if I took it off during the three field trips today. So I'll show you a bit of soil that I picked up yesterday and I'll sieve some and show you what these little guys look like.

One thing to notice, though, is that there is no cold air coming out of the ground here. It's cool, but it's not refrigerated. If you go back 15 feet into that rock, the average temperature in Iowa is about 51 degrees. Now, take a look straight ahead. You may notice that the trees are gone. What's going on? You'll notice above this patch that there's a cliff and it's almost vertical all the way up to the top of the ridge. And then at the very base there's another 5-6 feet of rock ledges. This is an area where an ice cave occurs, and it is called an algific talus slope. The name was coined by a geologist at the University of Iowa back in 1980. He invented a word out of ancient Greek, "algific," which means cold-producing, and is based on the the Greek word 'algos.' The treeless area in front of us covers a series of fissures, maybe 1-2 feet wide, where there is still ice. The ice stays there year-round in places. On the top of the ridge, underneath those pines, there's a sinkhole that feeds this cave, and you can feel air being sucked into it like a vacuum cleaner. That air is brought down through the cave system, gets cooled down to near freezing by the ice, and the humidity is brought up. As this cold air and water vapor tries to exit, it almost gets stopped by all the limestone talus at the base of the cliff. So, this naturally refrigerated air ends up seeping out over an area here that's at least 150 yards long.

Why are there no trees on this little algific slope? Partly because it's a bit too cold and also because it's very unstable. If a tree grows in there, the roots don't develop well and it doesn't take too long before it gets top-heavy and falls over. And why am I not taking you



Cherry Stone Snail (*Hendersonia occulta*)

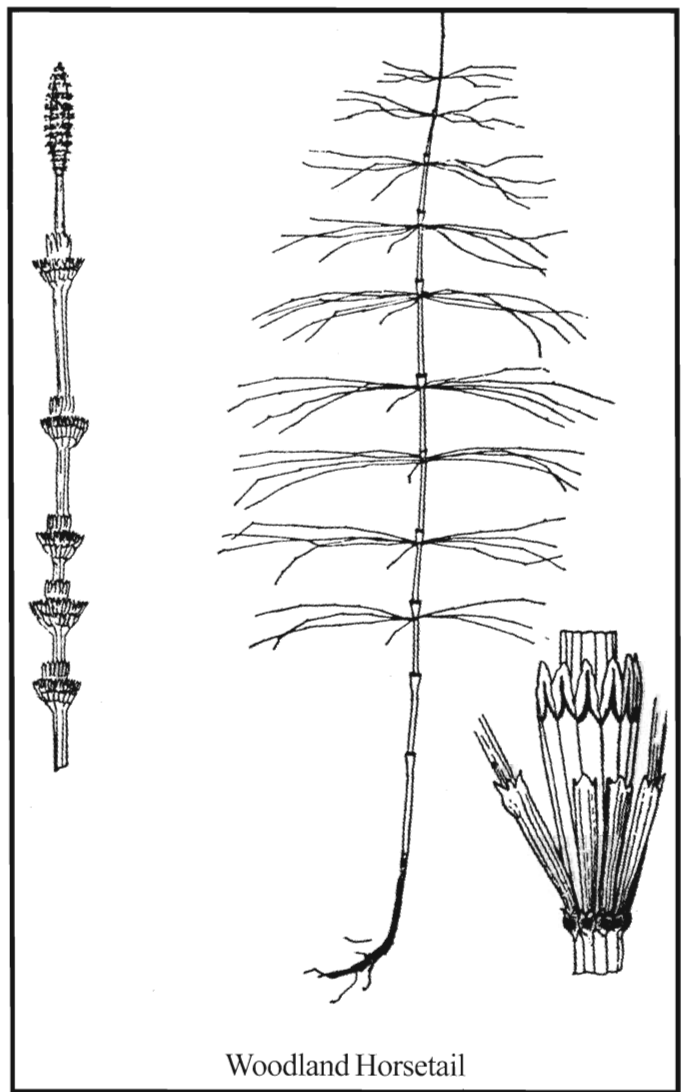


Highbush Cranberry

up there? Well, it's awful small, for one thing, and it's very fragile. I hadn't been up there for two years, but I wanted to get these samples for you folks, so now I don't need to go back for a while. Just walking up there I made a nice little trail and a couple of slip marks (which I'm glad you can't see from here), but it'll recover. But a whole bunch of people would do some serious damage, and there's that five-foot cliff we'd have to climb at the bottom.

I want to talk to you about some of the interesting plants that grow on these sites. These should not be living in northeastern Iowa at all. On the little cliff overhanging the top of this algal slope is the native form of Highbush Cranberry, which ought to be growing in the boreal forest. There's also a special Horsetail that is much more delicate than the the normal weedy one we usually see. This is a special one called Woodland Horsetail. In Iowa it's found in two distinct types of habitats: cold-air slopes and sandy woodlands in east-central Iowa. Here is one of my favorites; it's called Dwarf Enchanters Nightshade. You might walk through forests and see big Enchanters Nightshade that gets about two feet tall. But this northern version only gets a few inches tall. You have to get up along the north shore of Lake Superior and, better yet, in the boreal forest to see it growing everywhere. Another really cool thing that we observe in this habitat is the Parsley Fern. I actually saw a little bit of Parsley Fern on the cliff where we were talking before, but I figured I'd hold off showing it to you because there was only one plant. Here the Parsley Fern becomes dominant, particularly in the areas where the cold air is seeping out. Although it's not that rare in northeastern Iowa – you can see it on many of the cold north-facing cliffs – it really comes into its own on these cold-air slopes.

I'm saving the best two plants for last. This is a plant called the Alder-Leaved Buckthorn. Some of you heard me talk yesterday about how buckthorn is taking over and is a terrible weed – well, this is a native buckthorn. Again, where are you going to find it? In the boreal forest, although it can occur in spring-fed peatlands all the way south to Peoria, Illinois and east to New Jersey. The last plant I want to show you is Northern Lungwort, a relative to the common Virginia Bluebells. It's common in the boreal forest from Alaska to Manitoba, Canada and barely reaches the upper part of Michigan and northern Wisconsin. In fact, in Wisconsin it's considered a threatened species. In Iowa, Northern Lungwort has a really interesting distribution. There's one patch of it down by Arlington in the Brush Creek Canyon State Preserve. There may be one site for it over by Postville, although I suspect that report was made in error, as is another from Farmersburg near Elkader. The remaining Iowa populations are limited to a small band running from Decorah to Cresco. In this area it's common, and I'd expect to see this on every cold-air slope. Why is it so frequent here, and found nowhere else in Iowa? Who knows? This cold-



Woodland Horsetail

air slope is essentially the same as ones down by Dubuque. It may just be that when the climate warmed up 15,000 years ago, this plant was restricted in Iowa to this small area.

Before we leave, I also want to show you what is living in the soil on this algific slope. I'll use my sieve to look for some of the little snails that are found here. Of the snails in the Great Lakes region, over half are less than 5 millimeters in size. That means they're about the size of Lincoln's nose on a penny; they're tiny, tiny things. And it turns out that on these algific slopes, we have not only remnants of the ice age from the plant world but also from the animal world. Here are some big snails – a common woodland snail – that eat nettles, so it's not surprising that it's all nettle banks around here. That's actually something you'd see further to the south; this is actually at the very northern edge of its range. And there's a baby of our Cherry Stone snail, a couple of them, in fact. And there's an adult Cherry Stone like we were seeing before. There are lots of Cherry Stone snails up in there.

What's really interesting is in the next sieve size down there are a couple of species that I'm looking for. One of them is a snail that looks a little bit like a French horn, something you'd normally see in the aspen forests of the Rockies. The other one is a snail that was first identified from fossils from the last ice age and was assumed to have gone extinct, until 1980 when a geologist at the University of Iowa began finding them alive. And it turns out that there's a really good colony of them up here. There's one, right there. This snail lived with mastadons, and it died with mastadons, so it is a true living fossil of the last ice age. And absolutely the only reason that it can live here is because the ground right up there on that slope is about 38 degrees F. Any more than that, or much less, and it couldn't exist. Just 20 feet down the slope and it will be absent.

Concerning the life span of these snails, one of the problems is that most of the people who have done research on these snails are mainly interested in taxonomically naming them. They're not ecologists. Because of that, many basic ecological questions about these snails remain unanswered. For instance, how long do they live? I suspect that most of these live for multiple years, because I can find individuals of all ages at the same time. There are places where this does not happen, though. For instance, in the North Carolina coastal plain, you can only look for this group of snails for about one month, from mid-May to mid-June, because that is the only time that adults will be present. Later in the summer, the climate will become too hot, and they can survive this time only as eggs.

These cold-air slopes become a refuge for many,

many, many different species of life. It's not just these pretty wildflowers that make them special. In fact, it's the ground itself and things that are living in the soil. One thing I want to send off with all of you as a parting thought is to remember that probably only half (if that) of the species that live in soil in North America have yet to even be named. In fact, soils are among the most diverse ecosystems in the world, and we know virtually nothing about them. I could easily find 1,500 different species in a square foot of ground. Soil is every bit as species-rich as the rain forest, and in many ways is assembled in the same way.

[Question: What would be the difference between a square foot here and a square foot in a corn field?]

Jeff: The square foot in a cornfield has been turned over so much that you've lost a lot of what was once present. If you cut a forest down and cut it down again and again, eventually only the strongest survivors will remain. Yet, when you have an undisturbed place like this, the soil fauna will be extraordinarily rich. I guarantee that in this sample there are probably two or three dozen species that have never been described. One of the sad things right now in North America is that all the funding is being used to send people to the tropics in the belief that we know everything about the North, when we know almost nothing about the species found in undisturbed soils in Iowa or Colorado or California or anywhere else.

One of the estimates I've read is that in a prairie there's probably 10 times as many invertebrate species, particularly soil invertebrates, as there are plants. If we are interested in conserving prairie biodiversity, we need to quit thinking just about plants. The problem is that if we manage prairies in a way to make plants happy, that doesn't necessarily mean that the soil fauna will also be healthy. And until we know more about this hidden diversity that's literally under our feet, until we see soil as a habitat that is alive and vital and every bit as complex as the tropical rain forest and every bit as undescribed – rather than just something we grow plants in – until that happens, we're going to keep losing this really important part of our diversity.

We got lucky in Iowa because 20 years ago a scientist realized that in the soil of these cold-air slopes were ice age snails. If it were not for that work, these places would not be understood, or protected. And, I'm sure that there are many other ice age relict species found in algific slope soils, such as mites, nematodes, worms, spiders, and heaven knows what-all else. Because of this earlier researcher, we know the snail story, but that's just the tip of a big iceberg. It's up to others to continue telling this story.