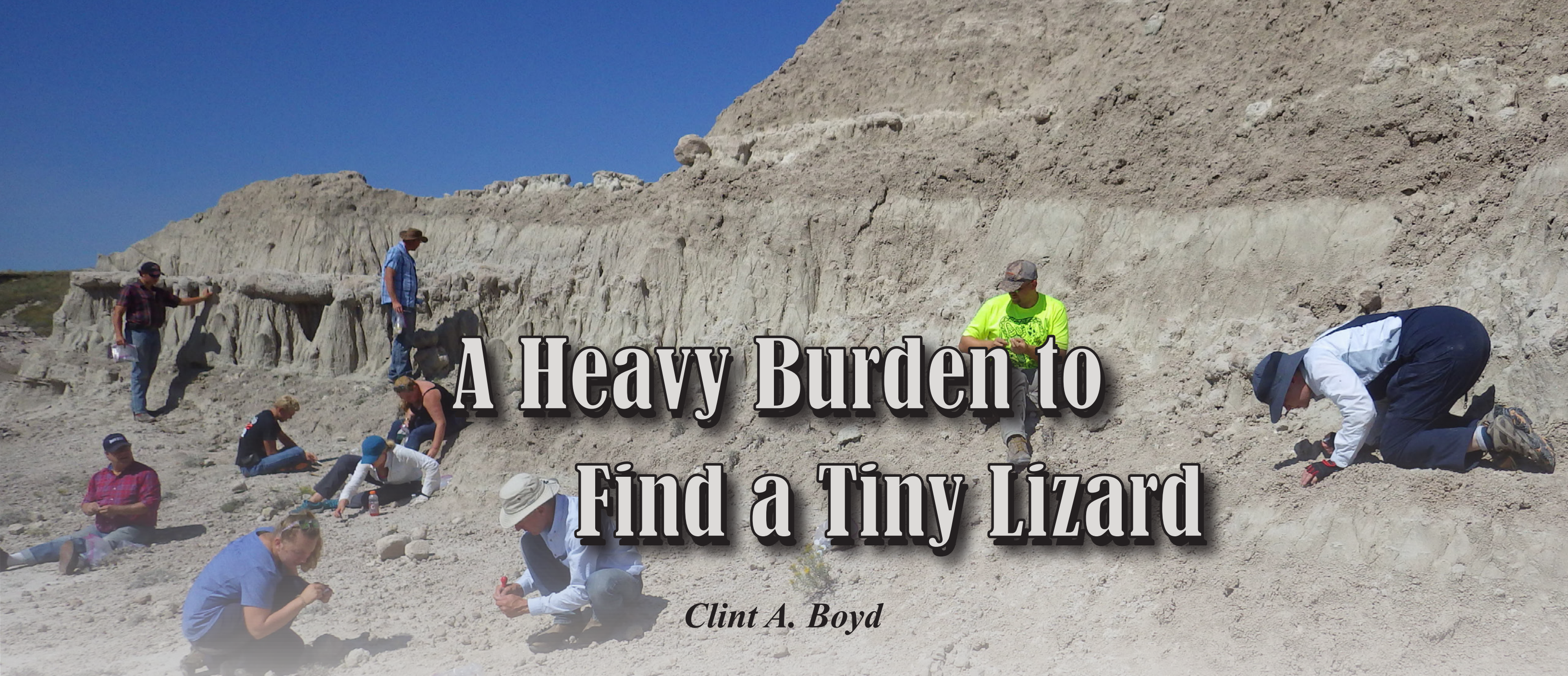

A Heavy Burden to Find a Tiny Lizard

Clint A. Boyd

Fellow NDGS paleontologist Jeff Person and I have been working with several other researchers over the past few years to get a better understanding of the mammal species preserved in rocks of the Brule Formation in the Little Badlands region of Stark County, North Dakota (Czaplewski et al., 2019; Korth et al., 2019a, 2019b, 2020). Those rocks range in age from 32 to 30 million years old, spanning the middle portion of the Oligocene Epoch. That work includes efforts to understand exactly how long each mammal species was present in North Dakota by identifying the lowest (oldest) and highest (youngest) occurrence of each species. That information allows us to identify any large turnovers of species in these rocks, which may indicate a major change in environment or climate in North Dakota at that time. The more precisely we can document the distribution of the species, the better we can pinpoint exactly when such changes occurred.

In order to properly study that question, we collect rocks from specific layers within the Brule Formation so we know exactly what elevation within the formation they came from. We then take those rocks back to our lab and soak them in water, which slowly breaks down the rock, leaving behind the fossils preserved inside. This process is called screen washing and was discussed in more detail in a previous newsletter article (Person, 2015). If we repeat this process multiple times at different stratigraphic positions within the formation, we can build a very detailed record of what animal species were present at different times while that rock was deposited. Over the years we have built up a pretty good record for the lower half of the Brule Formation using this technique (fig. 1); however, the upper portion of the formation is typically exposed in more vertically weathered profiles, making it harder to get to and sample using this method.

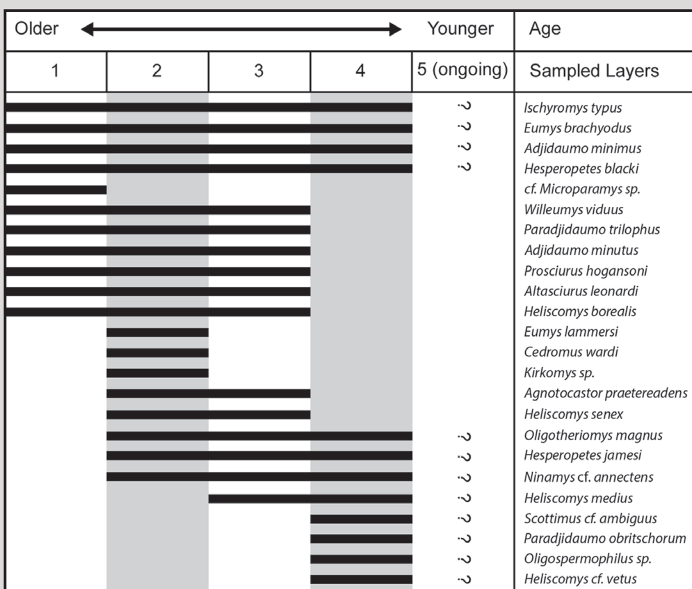

Figure 1. Distribution of different rodent species within the rocks of the Brule Formation in the Little Badlands area of North Dakota. Black bars indicate layers where each species is present. The uppermost layer (5) represents the rock layer currently under study and discussed in this article. Abbreviations: cf. conforms with (looks most similar to); sp. unidentified species within the identified genus.

Taking Sampling to New Heights

In the fall of 2020, the NDGS Paleontology team returned to the Little Badlands area with the goal of sampling a higher layer within the Brule Formation. During some exploration work the previous spring our team had identified a muddy siltstone layer with many small fossils exposed on the surface. On that trip we had collected a gallon Ziploc bag of rock as a test sample and screen washed it over the summer. The test confirmed our suspicions. The rocks in that layer broke down easily in water and contained enough fossils to make it worth the effort to collect them. And it took quite a bit of effort. The layer was best exposed high up on a rather steep, crumbly slope (fig. 2). We hiked up to the site, bringing 20 five-gallon

Figure 2. Sampling location within the upper portion of the Brule Formation discussed in this article. Photograph taken prior to sampling. The blue arrow indicates the rock layer that was sampled in this study. Photograph by C.A. Boyd.

lidded buckets with us. We removed the outer-most few inches of rock from the surface of the layer to make sure there would be no contamination of fossils that had washed down from higher up and then proceeded to chop out blocks of rock with our pickaxes and load them into the buckets. Once the buckets were completely full and the lids were secured, we had to carefully carry each bucket back down the slope to the prairie level and then hike back to our vehicle to load them up. In total, we collected and brought back to the lab that day 875 pounds of rock from that layer.

Over the course of the next six months that rock was screen washed (about 10 pounds at a time) in our indoor screen washing setup. Of the original 875 pounds of rock, only 67.5 pounds (~8%) was left over after screen washing, which is a really good result. Over two-thirds of the remaining rock is in pieces that are smaller than two millimeters in size, and over ninety percent is under five millimeters in size, which are the sizes most likely to contain the small fossils we are searching for. All 67.5 pounds of the remaining rock must now be examined under a microscope so that the fossils can be identified and separated, a slow process that is largely completed by a dedicated set of volunteers who help speed up the process. When we decided to sample these rocks, our goal was to recover around 100 identifiable mammal jaws or isolated teeth, which works out to around one tooth for every nine pounds of rock washed. We've only examined a little over half of the leftover rock, but so far 95 mammal teeth and jaws have been recovered. This means we'll certainly meet our original goal and will have a good set of fossils for comparing to those collected from other rock layers in the Little Badlands area, allowing us to assign an age to this layer and assess any changes in the mammalian fauna between the lower layers and this layer. However, as is often the case in paleontology, our work on this material has produced an unexpected result: a nice sample of fossilized lizard bones.

A New Find

The fact that we recovered fossilized lizard bones from these rocks was not surprising, several lizard species are known from this time period, and we have recovered a few small lizard bones from all the rock layers of the Brule Formation in the Little Badlands area we have screen washed so far. What was surprising was how abundant the lizard bones were, seeming to indicate that something about the environment had changed compared to the lower layers, making the habitat better suited for these animals. Most of the lizard fossils we found consist of what are called osteoderms, or 'skin bones,' that some lizards (and other animals) have embedded in their skin to help protect them from predators. In this case, these osteoderms are all from the anguid lizard *Peltosaurus granulosus* (fig. 3), which is an extinct lizard closely related to modern alligator lizards. This is unsurprising given that a single individual of *Peltosaurus* was covered with hundreds of these osteoderms in life, increasing their odds of being recorded in the fossil record once they died. However, we also recovered several dozen jaws with teeth from other lizard species that allow us to identify which other, less commonly preserved lizard species were living in North Dakota at this time.

The most common lizard jaws in the collection were from a unique group of lizards called amphisbaenians, or worm lizards. As their name implies, these are highly specialized lizards whose overall

Figure 3. A well-preserved specimen of the anguid lizard *Peltosaurus granulosus* collected from the Brule Formation of Nebraska. The head is on the lower right (nose facing left) and a portion of the body covered with osteoderms is on the upper left. Specimen is housed in the collections of The University of Nebraska Natural History Museum. Photograph by M. Jones.

Figure 4. Photograph of the living amphisbaenian *Rhineura floridana* taken in Orange County, Florida. The head is to the lower left. Photograph by M. Keim (CC BY-NC-SA).

Figure 5. A right lower jaw (dentary: NDGS 10164) from the new species of amphisbaenian from the Little Badlands area of North Dakota (Stark County) sitting on a dime for scale. Note the enlarged teeth relative to the size of the jaw when compared to *Peltosaurus* shown in figure 3. Photograph by C.A. Boyd.

body structure resembles that of a worm or a snake. They are elongate, ribbon-shaped animals, and most living species lack legs, increasing their superficial resemblance to snakes. Only one amphisbaenian species still lives in the United States today, *Rhineura floridana*, and it only lives in the southeastern corner of the country, largely restricted to Florida (fig. 4). These animals reach only about a foot in length and are highly adapted for burrowing, with their heads modified into a shovel shape for pushing through dirt and their eyes reduced in size to the point where they are impossible to see on the outside of their head. They feed on invertebrates, like worms and insects, that they encounter while burrowing and they typically only come to the surface during heavy rains when flooding prevents them from staying in their burrows. Amphisbaenian jaws are very distinctive, in part because their teeth are very large compared to other lizards of similar body size, making it easy to identify their fossils despite their extremely small size (fig. 5).

Prior to this work, amphisbaenian fossils had not been reported from the Brule Formation in North Dakota, making this an exciting discovery. The next step was to figure out exactly what species of amphisbaenian these fossils represented. We only had fossils of the upper jaw (maxilla), lower jaw (dentary), and the tip of the upper snout (premaxilla), but those bones are very informative and were enough to tell that we were looking at a species closely related to the modern *Rhineura floridana*. That discovery was not especially surprising because most amphisbaenian fossils from North America during this time period are from species that are more closely related to *R. floridana* than to any other living amphisbaenian species. However, as we examined the fossils in more detail, the excitement increased as we realized that they did not look like any other known amphisbaenian species, living or extinct. It turns out that we have discovered an entirely new species that is unique to North Dakota!

I will be presenting information about this new amphisbaenian species this fall at the annual meeting of the Society of Vertebrate Paleontology so that I can receive feedback from other paleontologists that work on these animals. Assuming their feedback is favorable, and the identification is not contradicted, I will move forward with describing this new species. This discovery is yet another piece of evidence that highlights the importance of the NDGS Paleontology Program's efforts to focus on screen washing rocks in search of fossils from some of the smallest animals that once lived in this area. Moving forward, I expect we'll continue to regularly make exciting discoveries like this one for years to come given how poorly studied the fossil record of small-bodied animals is. Whereas oftentimes the larger animals receive the most attention, sometimes the smallest fossils lead to some of the biggest discoveries, including new species that expand our knowledge of what prehistoric life was like in North Dakota.

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