

Discovery Pool Grant 17-03-BLM
Final Report

“Continued Excavation of the Grey Hills Site: a Rich Small Vertebrate Locality in the Upper
Jurassic Morrison Formation”

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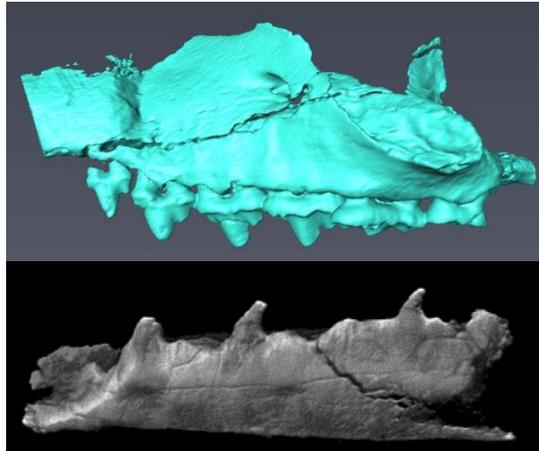
During the summer of 2017, a team of students and research personnel from the University of Oklahoma and the University of Louisville continued work at a new microvertebrate fossil site in the Upper Jurassic Morrison Formation near Cisco in eastern Grand County, Utah. Originally named the Grey Hills Site, the locality was rechristened the Cisco Mammal Quarry (CMQ) to more accurately reflect the importance (and relative abundance) of early mammals from this site. The CMQ was discovered on the final day of the 2015 field season, and after two subsequent seasons of work I am delighted to report that our collecting efforts to date have yielded several dozen specimens across a range of taxonomic groups: fish, frogs, lizards, snakes, crocodylians, dinosaurs, and mammals, with mammals unusually abundant in the sample. While our general research agenda centers on terrestrial ecosystem evolution during the Jurassic, our particular focus is on the evolution of early mammals. Fossils of early mammals are extremely rare, and the quality and quantity of the specimens we have recovered from this site are truly extraordinary. Excavation of the site must still be considered preliminary, as the potential is very high that the quarry will yield a large number of new specimens next season and for many seasons beyond, especially as collection techniques are fine-tuned based on our experience with the site. With persistent effort, this site will undoubtedly become one of the most important early mammal sites in the Morrison Formation and among the most informative Jurassic mammal sites in North America, with major impacts also on our understanding of the evolution of other small vertebrate groups, such as snakes.

Quarry work was physically difficult as anticipated. The site is completely exposed, and while a shade canopy was helpful for much of the time the relentless wind (clocked at 64mph one afternoon) made it occasionally unmanageable. The silt- and mudstones which entomb the fossils are extremely hard and do not split easily along bedding planes; in past seasons, we relied on picks and chisels to remove large blocks from the hilltop, which were then struck with small hand sledges until they fractured.

This season, we employed an electric jackhammer to reduce the surface of the quarry into workable blocks. The exposed surfaces were examined under magnification for bone which, fortunately, stands out prominently as black against the pale blue-grey of the rock. Smaller rocks which contained fossils were carefully wrapped for transport back to the Sam Noble Museum or University of Louisville, where they are currently being prepared for study.



Additionally, tailings from the quarry work were collected in burlap sacks to be processed through underwater screenwashing, which will remove sediment and concentrate any small, isolated fossils that may have been missed during quarrying. Preparation of several mammal fossils is already complete, and more formal study is already underway. A preliminary survey of the mammal fauna from the site has been submitted for publication in a special volume of *Geology of the Intermountain West* (the publication of the Utah Geological Survey), arising from a symposium at the 2016 meeting of the Society of Vertebrate Paleontology. The discovery of several snake fossils from the CMQ created much buzz when presented at the 2017 SVP meeting in Calgary; these are among the oldest and best-preserved fossil snakes in the world. Additionally, one specimen from the site, a partial skull of a small dinosaur (a primitive ancestor of duck-billed dinosaurs), is a potential Master thesis topic for a graduate student at the University of Oklahoma.



Micro-CT rendering of a partial mammal skull, and SEM image of a snake jaw

In addition to excavation work at the CMQ, the field party explored other nearby exposures of the Morrison Formation in search of new vertebrate fossil sites. Of particular interest was a site discovered in 2016 that appeared to preserve part of a small theropod dinosaur. In addition to the isolated remains collected last season, we recovered an articulated partial hindlimb of the individual as well as portions of a small turtle; these specimens were field jacketed and are currently being prepared at the Sam Noble Museum. There are expansive outcroppings of Morrison Formation near this theropod site that will be the focus of future exploration.



Articulated lower limb bones of a small theropod dinosaur, recovered from a new site on BLM land

At the beginning of the season, I had the opportunity to speak to the Gastonia Chapter of the Utah Friends of Paleontology at their May meeting about the mammals from the Cisco Mammal Quarry and their role in our growing understanding of early mammal evolution. The talk was

well received, and I hope to speak again to the group as this project progresses. I also gave a public lecture at the Moab Information Center on Mesozoic mammals, and spoke to KZMUs Kristina Young for her Science Moab program. These outreach opportunities are essential to build science literacy and community support for research on public lands.

The 2017 excavation of the Cisco Mammal Quarry was a major success, and I am grateful for the support of the Canyonlands Natural History Association through Discovery Pool Grants. I intend to seek support for continued work at the site for the 2018 summer field season. Methodology will generally remain the same, as our efforts proved effective at recovering relatively complete fossils, but the number and quality of specimens recovered in 2017 as compared to 2016 suggests the hill is not close to being played out. As preparation of specimens progresses, several will be CT scanned to explore their internal structure. After they have been formally described, 3D surface data can be scaled up and printed to produce durable models of important specimens that can be worked into interpretive exhibits to teach about the small vertebrate fauna of the site and the broader Morrison Formation. The specimens recovered from the CMQ thus far are all from small vertebrate species (nothing larger than a house cat). As a rule, small vertebrates are underrepresented in the fossil record; the mammals now known from the CMQ are nearly all unique to this locality, and the recovery of a diverse assemblage, including some articulated specimens, will greatly improve our understanding of the Morrison paleoecosystem.

Publications and Presentations Resulting Directly from this Grant

Davis, B.M., Cifelli, R.L., and Rougier, G.W. submitted. A preliminary report of the fossil mammals from a new microvertebrate locality in the Upper Jurassic Morrison Formation, Grand County, Utah. *Geology of the Intermountain West*.

Nydam, R. L., Caldwell, M. W., Simões, T. R., Palci, A., and Davis, B. M. 2017. The devil is in the details: new evidence of the primitive snake *Diablophis* from the Jurassic of Utah, U.S.A. *Journal of Vertebrate Paleontology* 37, supplement to no. 3. 77th annual meeting of the Society of Vertebrate Paleontology, Calgary, AB.