

Discovery Pool Grant 16-03-2016-BLM
Final Report

“Excavation of a New Small Vertebrate Locality in the Upper Jurassic Morrison Formation”

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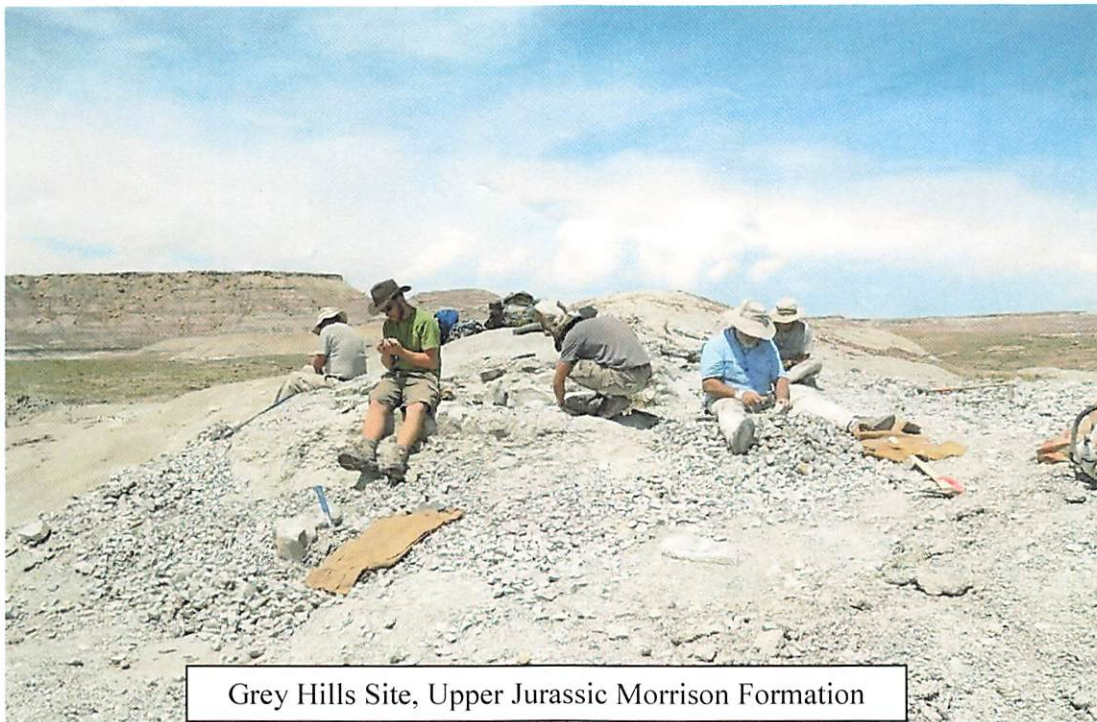
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Research question addressed: What will new, well-preserved specimens of small vertebrates (e.g., dinosaurs, squamates, mammals) tell us about terrestrial ecosystem evolution at the end of the Jurassic in western North America?

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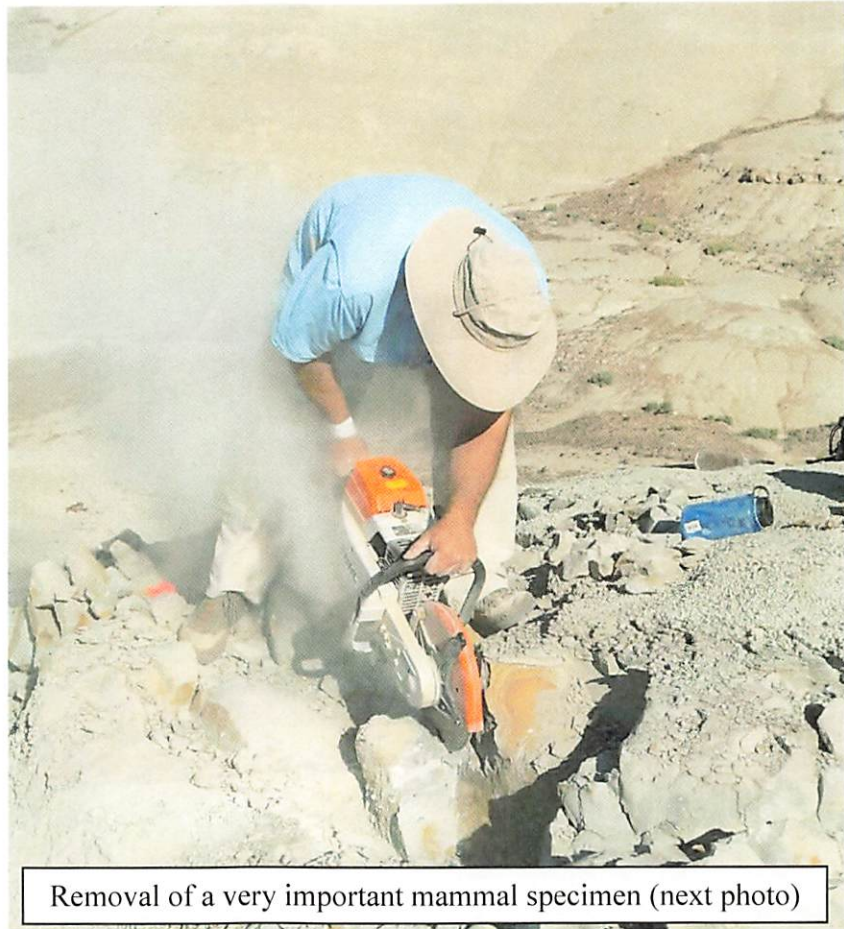
During the summer of 2016, a team of students and research personnel from the University of Oklahoma and the University of Louisville excavated a new microvertebrate fossil site in the Upper Jurassic Morrison Formation near Cisco in eastern Grand County, Utah. The Grey Hills Site was discovered on the final day of the 2015 field season, but only a few specimens were collected that year (of note was a partial skull of a small dinosaur). I am delighted to report that our collecting efforts this season can only be characterized as extremely successful, with several dozen specimens recovered including what appears to be an articulated partial skeleton of a very small crocodilian, and several mammals. 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 discovered in this single field season 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 quickly become one of the most important early mammal sites in

the Morrison Formation and among the most informative Jurassic mammal sites in North America.

Quarry work was physically difficult as anticipated. The site is completely exposed, and the relentless wind made erecting a canopy for shade impractical. The silt- and mudstones which entomb the fossils are extremely hard and do not split easily along bedding planes; picks and chisels were used to remove large blocks from the hilltop, which were then struck with small hand sledges until they fractured. The exposed surfaces were examined under magnification for bone which, fortunately, stands out prominently as black against the pale blue-grey of the rock. In a few instances, specimens were discovered in-situ in the hill and were deemed too fragile or important to risk removal; these were given protective plaster jackets and cut from the hillside using a gas-powered rock saw.

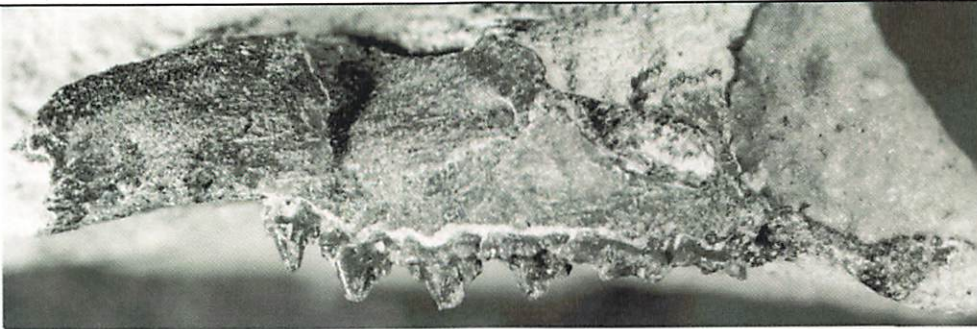


Removal of a very important mammal specimen (next photo)

Smaller rocks which contained fossils were carefully wrapped for transport back to the Oklahoma Museum of Natural History or University of Louisville, where they are currently being prepared for study. Preparation of some mammal fossils is already complete, and more formal study is already underway. Several important scientific projects are possible based solely on the results of the 2016 field season, and some preliminary results are being included in a presentation at the 2016 meeting of the Society of Vertebrate Paleontology in Salt Lake City in late October. 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.

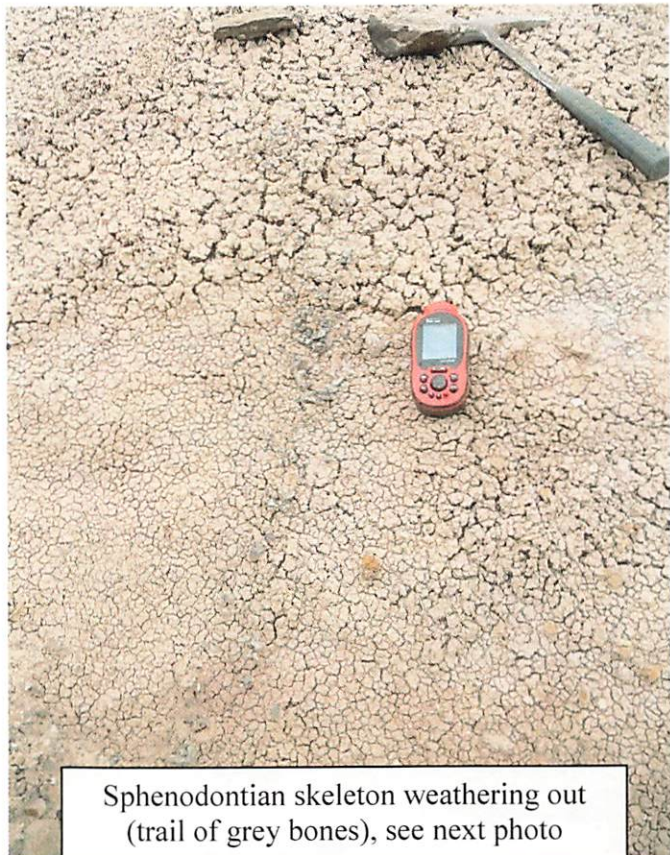


Partial skull of a new, primitive mammal with nearly complete dentition (after preparation)



5 mm

For a change in the routine of quarry work, the field party also explored other nearby exposures of the Morrison Formation and discovered several new vertebrate fossil sites. Preservation and abundance of bone ranged from poor to excellent: one site yielded only fragments of heavily weathered bone, but is noteworthy in that it is positioned very low in the Morrison Formation, where sites are rare; others yielded beautifully-preserved pieces of small turtle shell, or in one case several theropod teeth and partial limb bones. Beyond the main quarry, the most exciting discovery was a disarticulated skeleton of a large sphenodontian (a primitive lizard-like animal), weathering out of a low, red hill. Sphenodontians are not particularly rare in the Morrison Formation, but much of the skeleton of this individual is present and may preserve previously unknown anatomical information.



Sphenodontian skeleton weathering out (trail of grey bones), see next photo



Partial sphenodontian skeleton (jaws, vertebrae, limb bones)

The 2016 excavation of the Grey Hills Site was a major success, and I am grateful for the support of the Canyonlands Natural History Association through a Discovery Pool Grant. I intend to seek support for additional excavation in the 2017 summer field season. Methodology will generally remain the same, as our efforts proved effective at recovering relatively complete fossils. However, it is evident that isolated teeth and other very small fossils may be evading detection, so we will employ an additional recovery technique next season. We plan on collecting the quarry tailings and reducing the rock in water. We have experimented on rock from the site by placing it in screened boxes, and have discovered that after soaking in plain water the muds and silts disaggregate completely, leaving behind only tiny rocks, mineral crystals, and fossils. This method, coupled with laborious but productive hand quarrying, will greatly increase our yield of fossils next season. Most of the required materials and equipment are already available from the Sam Noble Museum (Univ. of Oklahoma), so the impact on the project budget should be minor.

As preparation of the specimens collected in 2016 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 Grey Hills Site during the 2016 field season are all from very small vertebrate species. As a rule, small vertebrates are underrepresented in the fossil record; the mammals now known from the Grey Hills Site 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.