Excavation of Dinosaurs at the Hanksville-Burpee Quarry

Federal Partner: Bureau of Land Management

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Statement of Research and Questions Addressed

The Hanksville-Burpee Quarry (HBQ) represents one of the largest dinosaur accumulations discovered in the world in the last 30 years. The site preserves the remains of at least 15 individual animals representing 8 different species of dinosaurs and possibly more. While the dinosaur fossils are unquestionably what draws visitors to the site every summer, petrified wood fragments along with large intact petrified logs can be found as well as freshwater clams, crocodile teeth, and potential mammal burrows effectively preserving an intact ecosystem in one locality. Funds provided by the Canyonlands Natural History Association were requested to continue excavation of the HBQ and conduct educational programs at the site by providing public tours to visitors during the time the quarry was open. Specific goals of the project were to 1) continue excavation of the dinosaur bonebed, 2) explore other areas in the Hanksville region for other dinosaur fossil localities, 3) radiometrically date the HBQ, and 4) expand the educational programs at the site.

Methodology and Personnel

We arrived at the HBQ on May 22, 2017 and began unburying the site to uncover fossils discovered the previous summer. Once fully uncovered, the excavation techniques employed at the quarry followed standard paleontological protocol for this type of quarry. Because the enclosing rock matrix at the quarry tends to have bedding planes of heavily cemented sandstones, pneumatic air scribes running off of gas powered air compressors were needed. While many other quarries in other locations excavated by the Burpee Museum and other institutions can be worked with traditional hand tools such as picks and hand awls, the HBQ does not afford such luxuries. The rock matrix was slowly worked with the air scribes while carefully monitoring the rock in search of bone. There is typically good separation of the rock from the bone surface so the matrix will flake off of the surface of the bone before the tool hits it in most cases. Once the surface of a bone was exposed, it directed the individual working the fossil where to go. Upon fully

exposing the extent of the fossils, the bones were then covered with either tin foil or several layers of wet paper towel followed by several layers of burlap soaked in Plaster of Paris. Once the plaster "top cap" hardens, excavation continued around and underneath the bone until it was pedestaled and could be flipped and a final plaster cap applied, completely enveloping the fossil in a plaster jacket. This jacket is applied to protect the fossils during transport back to the museum for final preparation in the Jay & Barbara Brost Paleo Viewing Lab located on the lower level of the Burpee Museum. As new bones were discovered, mapping of the site continued on both hills with surveying equipment, measuring the distance to each bone from a fixed point in the quarry, the depth of each bone, azimuthal location along the horizon and the trend and plunge of each element where applicable.

The original proposal listed Dr. Michael D'Emic (PI), Scott Williams, Katie Tremaine, and Joshua Mathews as principal investigator and research staff. Due to the departure of Scott Williams and Katie Tremaine from the Burpee Museum in April of 2017, Joshua Mathews was hired as Scott Williams's replacement and took over the field operations for the summer expeditions. Two other individuals were brought onboard to assist at the field site; Daniel Large and Diana Boudreau. Daniel Large was a volunteer, now part-time fossil preparator at the Burpee Museum and Diana Boudreau had just finished her Master's degree in Biology and had accompanied the Burpee Museum on several past expeditions. Diana was hired to conduct the public tours of the HBQ during the expedition since she had past experience and knowledge of the site. Michael D'Emic brought one graduate and two undergraduate students to the site to assist in excavation.

Projected and Actual Results

Because the goal of the project is to bridge the gap between the general public and the science happening at the quarry, it was our hope to provide educational tours to anyone interested in seeing a working, active dinosaur quarry in "real-time" where they can speak directly with the paleontologists working at the site. As we continued to expand the quarry and uncover new bones, we wanted to

disseminate that information to the public as we worked the site, but also in the form of educational programing and presentations once the field season had wrapped up and we had returned to our respective institutions. In addition to the educational tours and programing, prospecting in the area around the HBQ and areas around Hanksville, UT would hopefully lead to the discovery of new fossil localities that could be excavated and sample during future expeditions. Radiometric dating of the site was projected to yield dates similar to other Late Jurassic dinosaur quarries such as Dinosaur National Monument, Cleveland-Lloyd Dinosaur Quarry, and the Mygatt-Moore Quarry.

The 2017 field season was very successful and we accomplished most of what was set forth in our original proposal. The expedition began on May 22, 2017 and wrapped up on June 7, 2017 providing 3½ weeks of excavation in the quarry. During this time, over 30 volunteers and staff from across the country participated in the dig. These varied from Burpee Museum "veterans" who have been involved since the beginning in 2008, to new individuals and park rangers from Dinosaur National Park and Capitol Reef National Park who volunteered their time on their days off. In addition to the volunteers, a geology class of 7 students from Highland Community College in Freeport, Illinois led by Steve Simpson joined the crew. Mr. Simpson has been bringing students on expeditions to Montana and Utah for over 10 years and his class was vital to the initial excavation of the HBQ in 2008, discovering the first large bones on what has become known as "Limb Bone Ridge" due to the presence of many limb elements from multiple different dinosaurs.

This season was particularly productive as we were able to remove many specimens that have been in the ground for nearly 10 years. In the portion of the quarry referred to as "Middle Quarry", a large mound of bones have been awaiting removal, however we had continually expanded the quarry laterally away from the main pile in search of more bones. This season we made a concentrated effort to whittle away at the jumble of bones before excavating new areas of the quarry. This proved highly successful and as we removed the bones from the pile, new ones were lying in wait below. A beautifully preserved sauropod ilium had been partially exposed for several years, however unidentified until this time. Removal of the

overlying specimens allowed us to carefully remove it and apply a jacket for transport back to the museum. By the end of the season, we had completely removed the bone pile in “Middle Quarry” and discovered several new vertebrae, another sauropod ilium, and a well-preserved set of fused sauropod ischia in addition to multiple other new bones.

Work continued on “Limb Bone Ridge” (LBR) as a major accumulation of exposed bones were worked on as was done in “Middle Quarry” (MQ). A similar situation has been ongoing on this hill as well, with many bones remaining in the ground for many years. While a similar strategy was used to remove previously unearthed bones, it proved more difficult due to the density of bones in this part of the quarry. As one bone was excavated, multiple more were typically found next to it, making removal more problematic. At the end of the season, multiple new bones including a femur, *Allosaurus* vertebrae, a large sauropod scapula (shoulder blade), and a massive sacrum (pelvis) were found on LBR. One large jacket containing the partial hips to our juvenile *Diplodocus* nicknamed “Jimmy” was finally removed after 3 years of excavation. In all, when the field season concluded, 44 bones had been removed from the quarry and multiple new ones had been discovered. To date, more than 1,000 specimens have been removed from the HBQ representing at least 8 different species and it is safe to say that just as many bones likely remain to be discovered.

As stated above, Diana Boudreau was hired as our educational site manager in charge of conducting public tours at the site. The public tours ran from May 25, 2017- June 3, 2015 with Sundays being the only days that the quarry was not open for tours. The volunteers worked the quarry all day Monday-Friday, however a handful of staff, including Diana Boudreau were all that worked the quarry and led tours on Saturdays. The tours were run three times a day and lasted at least 45 minutes depending on the size of the crowd and questions they may have had. After the tour had concluded, visitors were asked to fill out a survey car listing how many were in their group, number of children, where they were from and how they heard about the site. While most of the visitors filled out the cards, there were many that chose not to, thus those numbers are not reflected in the total number of visitors to

the site. Throughout the two weeks of tours, 222 people had visited the site and filled out survey cards (spreadsheet attached). To our surprise, the vast majority of the visitors to the site were adults (194) with only 28 children. This is likely due to the timing of the tours where several schools in Utah were still in session or just finishing up the school year. The tours brought in people from all over the country representing 16 states plus Washington D.C. At the same time that the tours were occurring, the University Mars Rover Challenge was occurring in the same area near the quarry. This event pulls in teams from all over the world for 3 days. At the end of their competition, many of the teams visited the quarry for a tour. Several of those teams are represented in the visitor count, however many were not, likely due to a language barrier. Nonetheless, the tours for the summer of 2017 were very successful and we hope to continue these tours and increase total visitorship in the future with more advertising and possibly shifting the dates to coincide with summer recess for K-12 schools. While in Hanksville, the team posted daily to semi-weekly updates on progress in the quarry via social media when internet service was available. These posts generally were in the form of a series of photographs with captions and updates to the individual crewmembers social media (Facebook) pages. Upon return, presentations were given to several local area societies and schools detailing the Burpee expeditions to Hanksville and how it would contribute to the current field of paleontology. Presentations were given to the local Northern Illinois gem and mineral societies, the Lions Club, and to several grade school classes in southern Wisconsin.

We were able to spend some time during the field season to prospect areas around the quarry for potential new fossil sites. The region around the HBQ contains vast exposures of the Morrison Formation and several new localities were located or relocated and explored further during this time. A total of four new fossil localities were found off of the county road that leads to the Hanksville quarry. Two of these sites (exact coordinates on file with the Hanksville, Bureau of Land Management Field Office) could easily be worked in the future and are relatively accessible from the road. At these localities, a considerable number of bones are slightly exposed at the surface and show little to no weathering at this point. We have covered some of

them up to prevent further degradation and potential poaching. The other two localities are located well off the "beaten path" and carry significant difficulties if anyone had hopes to excavate them. One has a depositional setting similar to the HBQ, however transporting the necessary equipment to the location would prove very problematic. The other locality is rich in large dinosaur bones. The bedding plane in which these bones occur, however, is high on a cliff face in a matrix that would be unworkable with hand-tools and can only be compared to "concrete". Several boulders have fallen from the cliff side and contain numerous large bones or cross-sections of bones (see attached pictures). While the site is very interesting and exciting to see, the dangers associated with attempting an excavation exceed any need to do so.

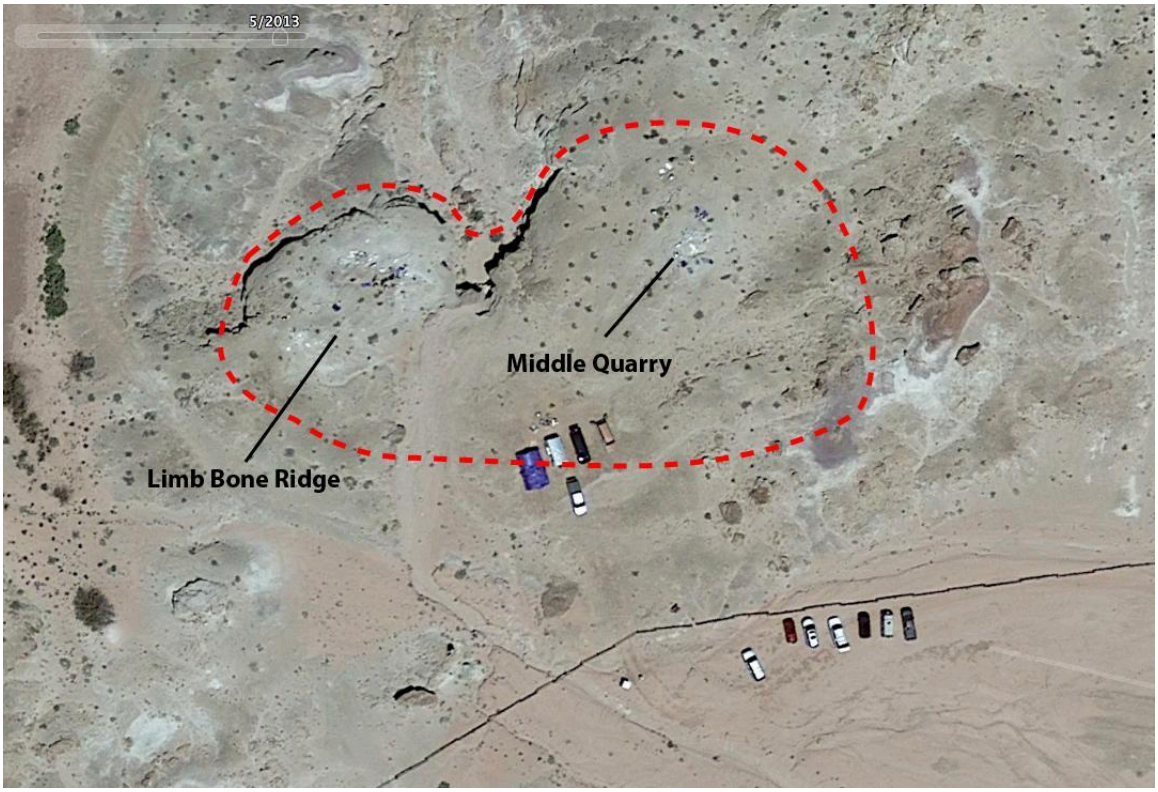
One of the goals of this project was to radiometrically date the site to see where it lies stratigraphically. While we can say generally where the quarry is located within the Morrison Formation, radiometric dating gives us higher resolution and can give us age dates down to ±75,000 years. Unfortunately, the schedule for when we were working the quarry and for those who we were going to have sample the site for radiometric dating did not coincide with one another and it is with regret that we were not able to accomplish this goal. The budgeted funds for this component of the project were $2,300.00, which we will have to forgo. It is unfortunate that this did not work out, however because it is an important part of the overall project, we will certainly revisit it in the future, hopefully sooner than later.

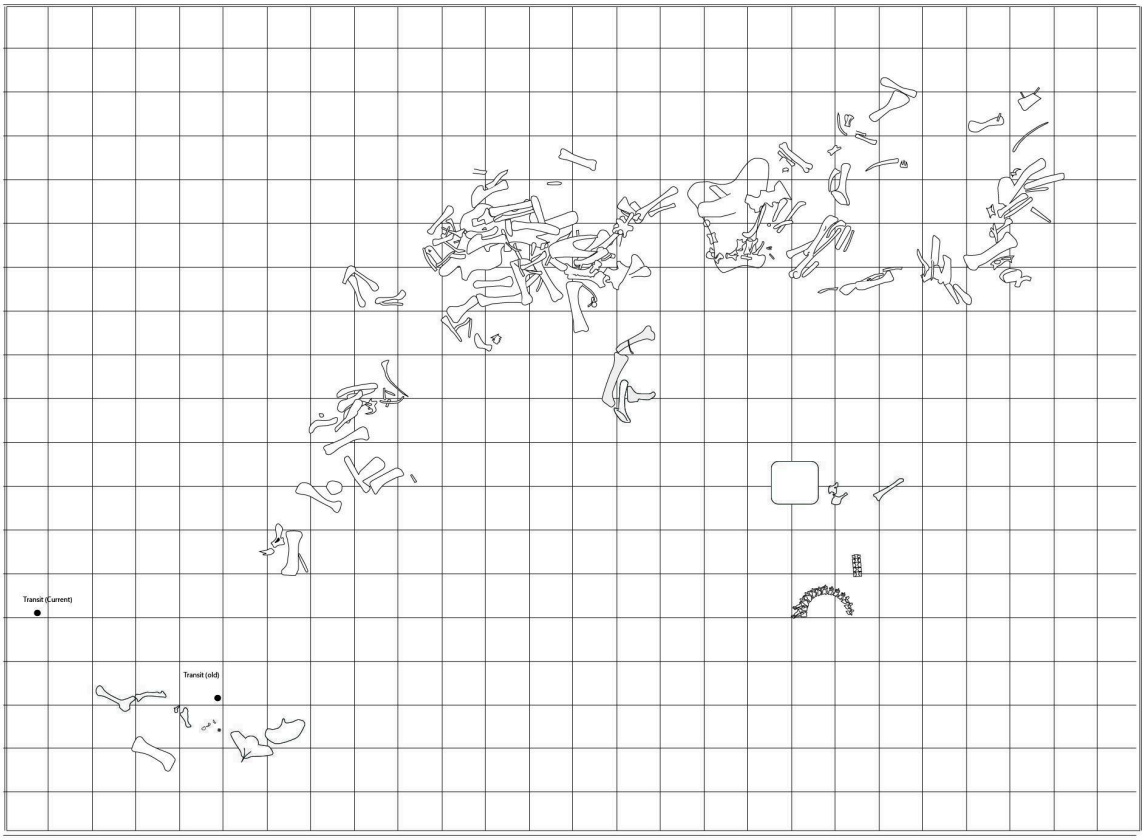
Upon return from the field, much of the material collected over the field season began immediate preparation in the fossil prep lab back at the Burpee Museum. The sauropod ilium found within the bone jumble of MQ was one of the first elements to be prepared. Preparation of the specimen by Daniel Large was relatively quick and the fossil was very well preserved and in nearly complete and revealed that it likely belongs to a juvenile *Diplodocus*, although histological sampling to determine this has yet to occur. Preparation is typically a slow process and is dependent upon the enclosing rock matrix. While some fossils clean up rather

quickly, others take months to complete, sometimes longer. Many of the fossils collected during the summer of 2017 have been prepared or are currently under preparation. Those that have been prepared include pelvic elements including the ilium previously mentioned, numerous osteoderms and ribs to the rare armored dinosaur *Mymoorapelta*, and two *Allosaurus* caudal vertebrae. Currently a second ilium, caudal vertebra, fused ischia, and a large sauropod scapula are under preparation along with numerous other specimens collected in previous years.

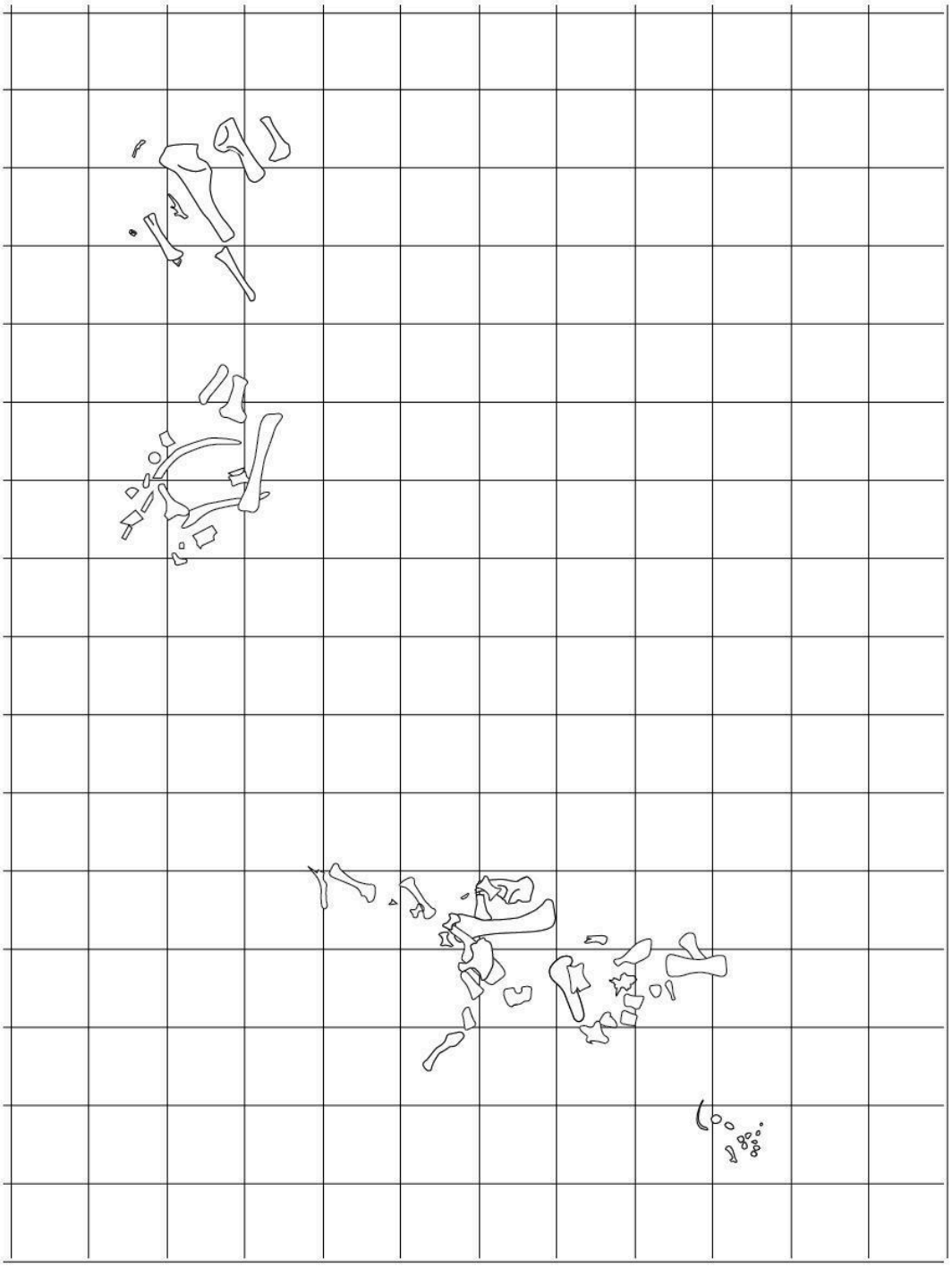
Conclusions

The project proved to be very successful with a large turnout of visitors to the HBQ. Although we were unable to radiometrically date the site, the continued interest in the quarry at the local and regional level has galvanized our intentions to continue promoting our educational tours of the Hanksville-Burpee Quarry and to focus on developing our programming further. Due to the proximity to Hanksville and relative ease of access to the site, the HBQ remains an invaluable resource to educating the public on this unique period of time. While most other paleontological excavations lie far beyond the reach of the general pubic, the HBQ has a lot of potential to reach a greater number of people with some minor adjustments of the program, particularly the timing. While we will likely continue to return in late May of each year, extending the field season for a further one to two weeks would provide more of an opportunity for school age children to visit the quarry while it is still open. Looking toward the future, we envision erecting a couple of canvas tents for equipment storage and to use as a mobile field prep lab.


5/2013
Middle Quarry
Limb Bone Ridge


Transit (Current)
Transit (old)

Hanksville-Burpee Quarry: Bone map of Limb Bone Ridge. 1 square=1 meter.



Hanksville-Burpee Quarry: Bone map of Middle Quarry. 1 square= 1 meter

Uncovering Limb Bone Ridge. Daniel Large (L), Diana Boudreau (R).

Jacketed bone pile on Limb Bone Ridge.

Limb Bone Ridge with Henry Mountains in the background.

Limb Bone Ridge with Factory Butte in the background.

Volunteers working the bone pile at Middle Quarry.

Field staff and volunteers working Middle Quarry.

Diana Boudreau (L) and Daniel Large (R) excavating a near complete *Diplodocus* left ilium from Middle Quarry.

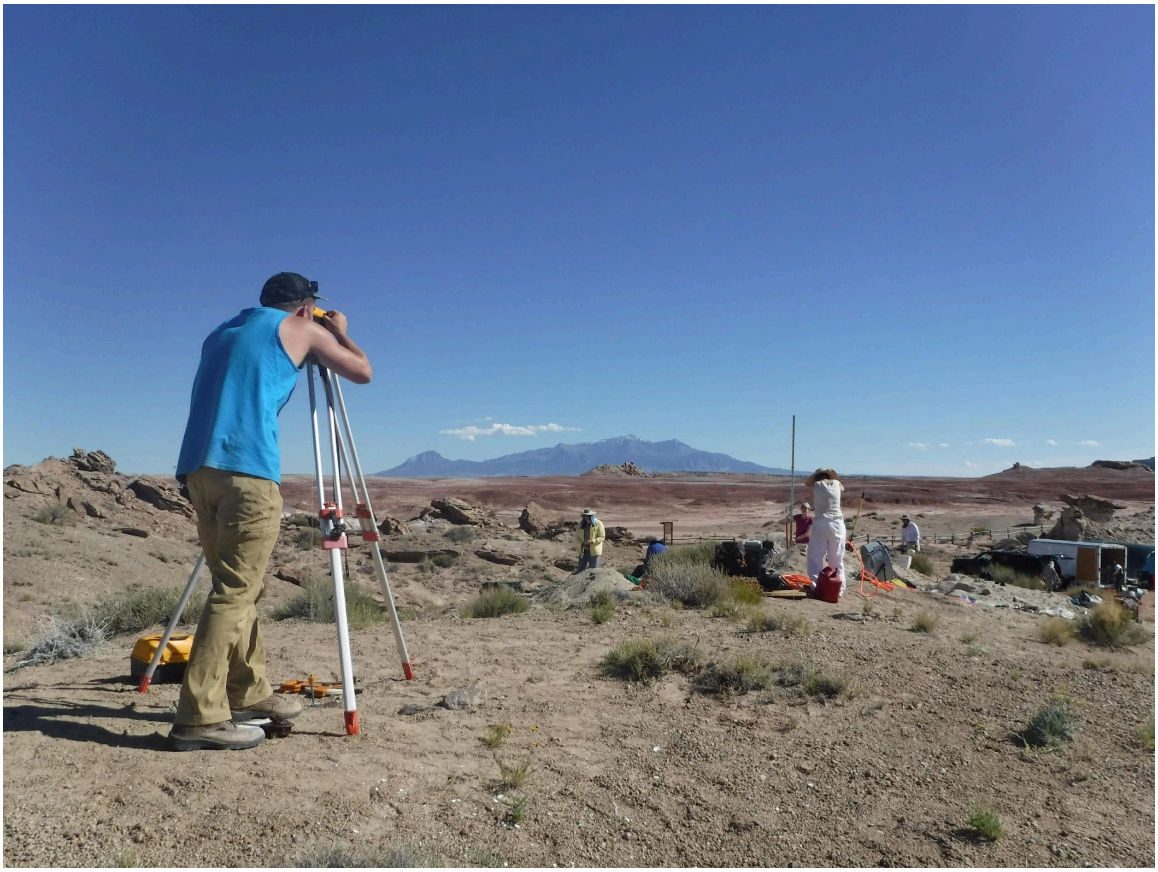
Volunteer John Heller excavates a pair of sauropod fused ischia (pelvic bones) in Middle Quarry.

Beautifully preserved sauropod tail vertebra in Middle Quarry.

Sauropod dorsal vertebra from Middle Quarry.

Dr. Michael D'Emic and Adelphi University students excavating in the Middle Quarry.

Dr. Michael D’Emic and Adelphi University students at Middle Quarry.



Daniel Large (front) and Diana Boudreau (back, pink shirt) measuring and mapping new bones discovered in the Middle Quarry.

Diana Boudreau leading a tour to a group from Madison, Wisconsin.

Dr. Michael D'Emic (blue) and Diana Boudreau (Red) leading a tour group through the HBQ.

Diana Boudreau leads a tour of the HBQ.

Diana Boudreau pointing to a bone in the rock at a newly discovered fossil locality.

Large boulder containing the cross section of more than 8 dinosaur bones from a newly discovered dinosaur locality.

Leaving the HBQ with Henry Mountains in the background.