

Paleontological Survey of the Jurassic Morrison Formation In Dinosaur National Monument

By George F. Engelman

Many NPS units contain important paleontological resources. In some cases, as at Dinosaur National Monument (DINO) they are a major feature of the park. Yet these resources have been little utilized; their extent and scientific significance often is unknown and even more often, undocumented. With paleontological materials, a hands-off approach to protection of fossils results in destruction of the resource. The information that is contained in fossils and the context of their occurrence is a scientific resource that can only be conserved by active investigation.

The Carnegie Quarry at DINO has been a site of great paleontological importance since its discovery in 1909. It is well studied and accessible for continuing study. But the reason Earl Douglass came to the Uintah basin looking for a dinosaur in the first place was the extensive exposures of the Jurassic Morrison Formation (Fm) in which the Quarry is located. The Morrison was known, even then, to contain a remarkable sample of fossil vertebrates. Important localities had been found in this formation in the years before, and continue to be discovered.

Although the Morrison is exposed beyond the Carnegie Quarry within DINO, throughout most of the monument's history no systematic survey of these exposures had been undertaken to determine if they might produce additional sites of scientific importance. In 1984, a preliminary survey of the Morrison Fm. within the monument was conducted. Although most of the field party consisted of volunteers with little experience, more than 100 localities were recorded. Two of these sites have been quarried since then; hand quarrying and screen washing have revealed a diverse fauna of microvertebrates previously unknown from this area (Chure and Engelman, 1989).

Beginning in 1989, we have undertaken a more thorough survey of the Morrison to clarify the picture of the nature and extent of the paleontological resources at DINO. The survey objectives were to examine all Morrison Fm. exposures within DINO for all fossil occurrences, to document any localities found in such a way that they could be relocated, and to evaluate the resource as we found it and make recommendations for its management.

Methods

The methods we used are standard paleontological practice. Geological mappings in DINO have delineated the areas where the Morrison occurs at the surface. Discussion with field geologists Christine Turner and Fred Peterson of the USGS, who are conducting a stratigraphic and sedimentologic study of the Morrison at DINO (Turner and Peterson, 1990), have helped develop recognition criteria whereby we can locate ourselves stratigraphically in the field.

With this information as a guide, we (a student assistant and I) identify and walk over the Morrison Fm. exposures. We cover areas systematically in a pattern determined by the terrain, but typically as a series of closely-spaced traverses. In this way, we are able to inspect the surface visually from a dis-

tance of no more than several feet. Occasionally, exposures deemed promising by virtue of sediment type or association are examined more closely. Shallow excavations may even be made.

When fossil material is found, we first attempt to determine whether it represents a specimen (or specimens) in place. This is done by tracing the fossil material to its source in the bedrock and making shallow, localized excavations if necessary, to reveal the source and discover the nature and extent of the deposit. If possible, a tentative identification of the fossil(s) is made. As a rule, fossils are not completely exposed or collected, but when a scientifically useful specimen is in imminent danger of loss or destruction, it may be collected where feasible.

Whether a specimen is collected or not, the occurrence is documented in the field. Field notes of all work are kept. They include verbal description of the location, nature of the occurrence, nature of the material present (including a taxonomic and anatomical description), stratigraphic position, and other information judged useful. Sketches may supplement any of these items. Photographs including the site are taken and referenced by a field number in the notes as are any specimens or samples collected. Each locality is assigned a field number in the notes and is plotted on a topographic map where it is identified by the same number.

In the lab, all this information is transferred to the DINO archival locality files, where a unique locality number is assigned and specimens are catalogued into the collections. Field data are entered into a computerized locality data base that cross references all the various types of materials. Samples have been collected by this project and the stratigraphic project in DINO for radiometric dating and for analysis for palynomorphs.

Results

Two seasons of field work have allowed us to survey about 75 percent of the exposures of the Morrison Fm. within DINO. Within this area we have identified more than 260 distinct localities. The majority of these sites (well over half) are occurrences of dinosaur bone. Dinosaur bone could be said to be virtually ubiquitous within the Morrison. In most cases, the occurrence consists of little more than bone scraps, but as a rule I only recognized a "locality" at an occurrence when there was some reason to conclude that the specimen(s) was in place or close to the horizon of its origin. Such indications might be: a specimen still partly imbedded in the unweathered rock of the outcrop, a concentration of related fragments in a small area, discovery of additional fragments on digging into the weathered sediment around a fragment found loose at the surface, or other such information. A surface occurrence was not regarded as a locality if it was reasonable to suppose it had been transported from its source.

In many cases, bone specimens were poorly preserved. Some of those in place in unweathered rock had been abraded to little more than bone pebbles prior to burial; however, a few were well preserved.

One site revealed articulated tail and foot bones at the surface and further excavation has exposed more of the skeleton. Most sites fall into a category that could be described as of unproven potential. It may be that a significant fraction of these sites contain incomplete but identifiable specimens that could be useful in a comprehensive study of dinosaurs or paleoecology, and some may yield much more complete material.

After dinosaur bone, the next most common fossil is silicified wood, which occurs as specimens ranging from small fragments to logs a meter or more in diameter. Preservation type and quality is variable but is excellent in some cases. One specimen preserves what appears to be insect borings. Others preserve clearly the structure of the woody tissues and could provide taxonomic identifications. A specimen that appears to be a cone from one of the trees was collected by this survey. None of the logs is upright or rooted, but some are quite large; one unusual specimen appears to be more than 20 m long as preserved.

A small fraction of the localities preserve other elements of the biota. Freshwater gastropods and bivalves occur at a few sites, as do charophytes. Invertebrate trace fossils have been found. There are the two microvertebrate sites noted above and a handful of sites that have produced a few microvertebrates, suggesting a potential for further development.

All the fossil localities found so far have been within the Salt Wash Member and the Brushy Basin Member of the Morrison Fm. The Salt Wash is dominated by thick sandstone bodies and the fossils seem to be confined to the sandstones within this member; surprisingly, they are quite fossiliferous for dinosaur bone and silicified wood. The sandstones in the middle and upper part of the Salt Wash seem most consistently fossiliferous.

The Brushy Basin, on the other hand, is dominated by fine sediments with occasional prominent sandstones. Both lithologies contain fossil localities. Dinosaur bone and silicified wood are abundant in this member, as they are in the Salt Wash, but virtually all the fossils other than dinosaur bone or wood occur within the Brushy Basin.

Discussion

This survey is not yet complete, but based on results to this point I expect that by its conclusion we will have documented well over 300 Morrison Fm. fossil localities at DINO. This record may be used in various ways. Some of the sites reported should be excavated as opportunity permits; indeed, some already are being developed. I think a majority of the sites might be worth examining more thoroughly. Some may yield useful identifications or even good specimens. This would be especially important for the Salt Wash localities, as fossils from that part of the section are not well known.

It also appears possible to get a good sample of the biotic diversity of the Morrison from these localities if some of the less studied groups of organisms, such as plants, are examined. The locality records should make it easier to recover such a sample.

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Finally, the record of distribution of localities within the Morrison is itself data that may be useful in interpreting Morrison environments.

Engelmann, a vertebrate paleontologist, is a professor at U/NE, Omaha; he is under contract to DINO for baseline inventorying of fossils from the Morrison Formation.

Literature Cited

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