

Tracking Dinosaurs and Other Extinct Animals at Lake Powell

By Martin Lockley, Adrian Hunt, Kelly Conrad, and John Robinson

The Glen Canyon National Recreation Area (GCNRA) is one of the largest preserves in the National Park System and one of the most spectacular in terms of geological exposures. It is therefore not surprising to discover that, like other national parks and public lands in the Colorado Plateau region, it is rich in fossil resources - particularly fossil footprints. A recent exploratory survey of known tracksites in this area reveals a wealth of interesting sites and suggests considerable potential for future discovery and research.

Fossil footprint sites in GCNRA fall into several categories including those that were known before dam construction and the filling of Lake Powell, those that were studied, collected or rescued as Lake Powell filled up, and those that have been discovered since. Tracksites in this region can also be classified according to age ranging from Early Permian (about 280 million years) before the Age of Dinosaurs, through the Late Jurassic Epoch (about 140 million years) by which time dinosaurs were well-established. Our preliminary surveys suggest that there are at least a dozen tracksites known in GCNRA and that several are of considerable scientific significance.

It is convenient to follow the geological convention of a trail through time and describe selected sites in chronological order. It is also appropriate to distinguish between sites that are still accessible and available for future study, and those that are now submerged or in danger of damage or destruction by rising water levels and erosion. For purposes of this report we have focused attention on sites that have been documented as the result of rescue missions.

Permian Footprints

To date we know of only one Permian Age tracksite from the Cedar Mesa sandstone in the Dirty Devil River. In 1973 former Utah State Paleontologist Jim Madsen made a rubber mold of a track-bearing slab in order to preserve a record before it was inundated by the lake. The trackways are remarkable because they show what Madsen suggests is a "Permian Murder: (Fig.1) - where a large animal snapped up or swallowed a smaller victim. Such direct evidence for predator-prey interaction is rare in the fossil-footprint record.

Triassic Tracks

So far we know of only one indisputably Triassic Age tracksite in GCNRA. This is a Late Triassic, Chinle Formation site in the vicinity of Four Mile Canyon. Here several specimens of distinctive track *Atreipus* (Fig.2) were recently discovered and moved from a vulnerable location to preserve them in the Park collections. These are the first *Atreipus* tracks ever reported from the western United States. They are also a controversial trackway type because they have hind footprints that are similar to those of bipedal theropod dinosaurs but also display unique tulip-shaped front footprints. *Atreipus* tracks also are known from Late Triassic beds in Europe and eastern North America. They probably were made by slender, long limbed dinosaurs or

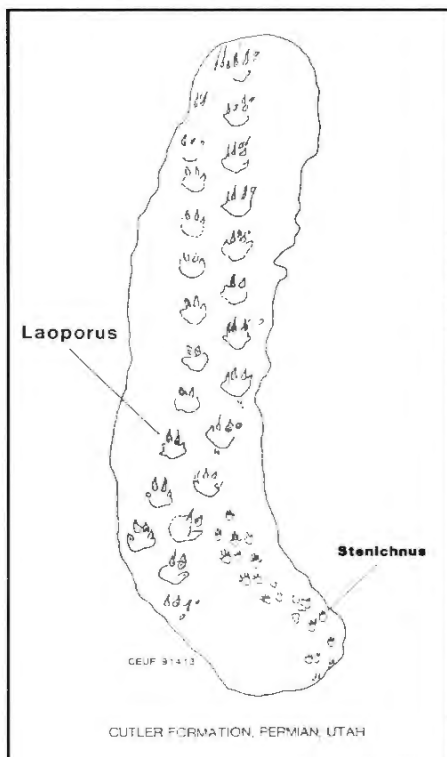


Figure 1. Trackways from the Permian Cedar Mesa Sandstone provide evidence of predator prey interactions.

dinosaur-like archosaurs, but authorities have reached no firm consensus on the trackmaker's identity.

Jurassic Tracks

Tracksites have been reported from three Early Jurassic Formations in the GCNRA. These are, in ascending order, the Wingate, Kayenta and Navajo Formations that collectively comprise the greater part of the Glen Canyon Group.

Tracks are known from three sites in the Wingate Formation in the vicinities of Lee's Ferry, North Wash and the Rincon. The former site was the first ever documented from the area that is now GCNRA, and a specimen of a three toed theropod track known as *Grallator* was described in 1904 by Elmer Riggs and curated in the Chicago Field Museum collections (Riggs, 1904). The other two sites also yield typical *Grallator* tracks, made by turkey- to Emu-sized theropod dinosaurs. The Rincon site is easily accessible and is referred to in Kelsey's Boaters Guide to Lake Powell.

Two tracksites are known from the Kayenta Formation including a large site in Explorer's Canyon that was featured in National Geographic (Edwards, 1967). Several large slabs were collected from this site including the specimen that is on display at the Wahweap Visitors Center. The tracks are known as *Eubrontes* (meaning "true thunder") and represent some of the first of the large theropod dinosaurs (Fig. 3). Based on foot lengths of up to 18 inches these animals were about 7 feet at the hips and

measured between 20 and 25 feet from snout to tail. Several paleontologists have suggested that the carnivore *Dilophosaurus* was a probable candidate for the trackmaker.

At least three tracksites are known from the Navajo Formation including one, now lost, that was discovered during blasting in the early phases of dam construction. The other two sites, at the west end of Lake Powell include one that has been underwater for most of the last 10 years (Fig. 4). Both the latter sites are associated with the upper part of the Navajo Formation, and both reveal a large four-toed trackmaker *Otozoum* (means "giant animal") along with diminutive three-toed *Grallator*-like tracks. Although there is some debate about *Otozoum* tracks, many paleontologists interpret them as the footprints of prosauropods, forerunners of the well-known sauropods or brontosaurs.

It is interesting to note that *Grallator*, *Eubrontes*, and *Otozoum* tracks were all described from early Jurassic deposits in the eastern United States early in the 19th Century when the science of ichnology (the study of tracks and traces) was in its infancy. Although there has been little serious study of Early Jurassic tracks in the western United States until recently, it is now becoming clear that the same trackmakers were present, and relatively abundant at that time (Lockley, 1991). This means the tracks are useful for biostratigraphic correlation (age determination) of strata on a regional and global scale. This is particularly important in the Glen Canyon Group which consists largely of desert sandstone

Continued on page 17

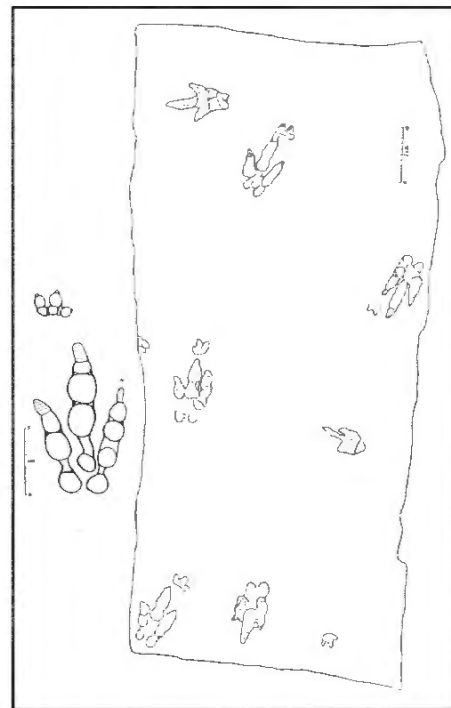


Figure 2. *Atreipus* tracks from the Chinle Formation are the first reported from the western USA.

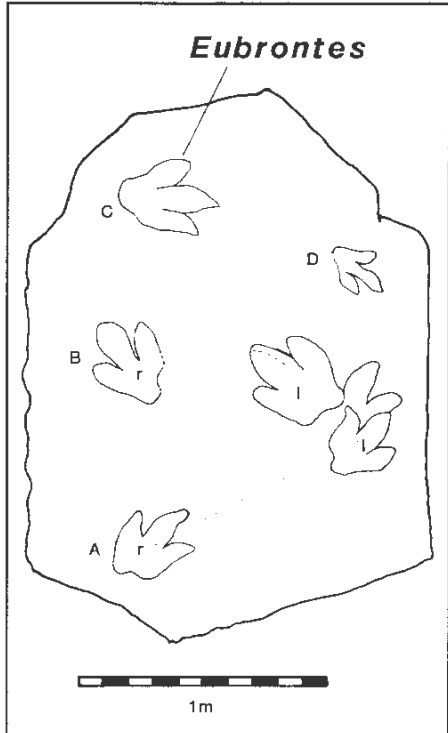


Figure 3. *Eubrontes* tracks were rescued from Explorer's Canyon in the 1960-s.

deposits that are mainly devoid of fossils. Tracks help show that these early Jurassic desert environments did support animal communities.

Last, but by no means least, we report on a very interesting discovery of a brontosaurus front footprint that is so well-preserved that it reveals skin impressions (Fig. 5). The track was discovered in the Morrison Formation near Bullfrog and is the first example of skin impressions ever reported from a brontosaurus track.

Our preliminary survey at Lake Powell indicates that tracksites are distributed throughout the GCNRA and occur in most of the exposed formations. We therefore anticipate that a systematic

search is likely to reveal many more fossil footprint sites in future.

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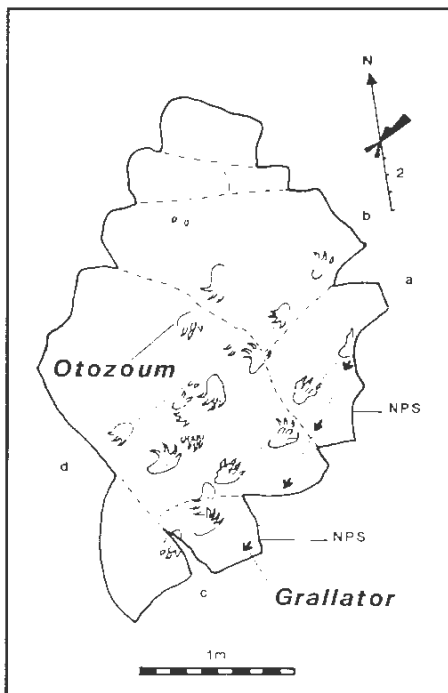


Figure 4. *Otozoum* and *Grallator* tracks were rescued from West Canyon in 1992. NPS = specimens in Park Service collections.

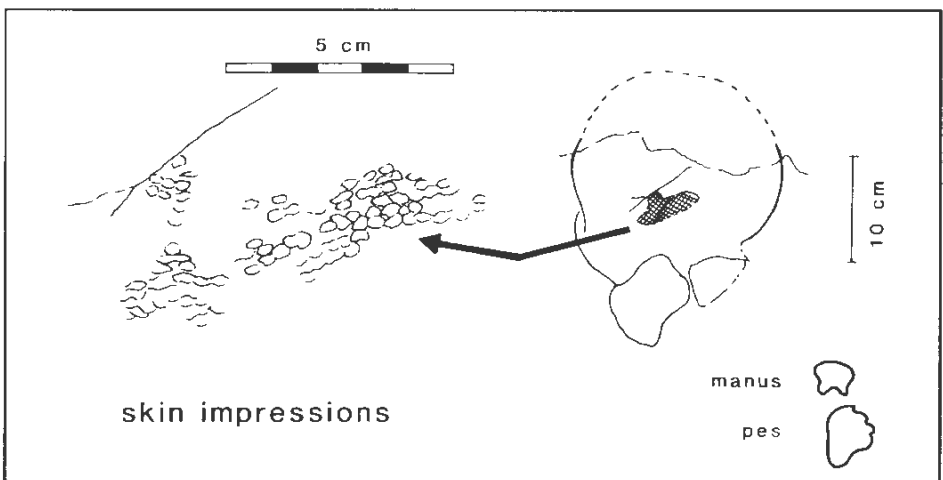


Figure 5. A brontosaurus front foot cast with skin impressions.