

The Prehistoric Trackways National Monument, Permian of Southern New Mexico, U.S.A.

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The Prehistoric Trackways National Monument (PTNM) is ~5000 acres of land administered by the Bureau of Land Management (BLM, an agency of the U.S. Government) in the Robledo Mountains of Doña Ana County, southern New Mexico, USA. In 2008, the U.S. Congress created the national monument, primarily because of the world-class Early Permian trace-fossil assemblages preserved in the Robledo Mountains. One of us (JPM) discovered these assemblages in the 1980s and brought them to scientific attention.

The Robledo Mountains are a horst block along the western margin of the southern Rio Grande rift that exposes a 500-m-thick section of upper Paleozoic, carbonate-dominated strata (Fig. 1). Near the top of this section, red-bed siliciclastic strata of the Robledo Mountains Formation of the Hueco Group (late Wolfcampian, Artinskian) contain extensive trace fossil

assemblages made by invertebrates and vertebrates that lived on and near tidal flats of the Early Permian Hueco seaway. Nearly two decades of scientific research have identified the Robledo trace fossils as one of the most scientifically significant ichnofossil records known, a true trace-fossil Lagerstätte. This significance derives from documentation by Robledo traces of the: (1) presence of many organisms, especially arthropods, not known from coeval strata in New Mexico; (2) new ichnotaxa, not previously known from the ichnofossil record; (3) complex apterygote insect behaviors, including some of the oldest records of jumping; (4) diversity, inferred trophic dynamics and paleoecology of the Early Permian tidal flat biota; (5) extramorphological variation in tetrapod footprint morphologies, allowing comprehensive ichnotaxonomic revisions; and, (6) composition of ichnofossil assemblages, ichnocoenoses and ichnofacies that are a pivotal part of modeling spatial variation in Early Permian red-bed terrestrial communities.

The degree of scientific study of the Robledo ichnofossils is reflected by two volumes of collected scientific articles, one monograph, dozens of articles in scientific journals and numerous abstracts of presentations at scientific meetings (see bibliography below). Despite intensive collecting and study, much new information about Robledo ichnofossils continues to be discovered. Recent discoveries include the identification of a new assemblage that preserves limulid and anemone traces together with chondrophorine body impressions, and demonstrate that ongoing research and collecting of the Robledo ichnofossils will continue to advance our understanding of the Early Permian tidal flat communities documented by ichnofossils in the PTNM.

The PTNM tetrapod tracks have served as a “Rosetta Stone” for rewriting global Permian tetrapod footprint ichnotaxonomy, particularly of the ichnogenera *Batrachichnus* and *Dromopus* and *Dimetropus* and their various synonyms. The large sample sizes

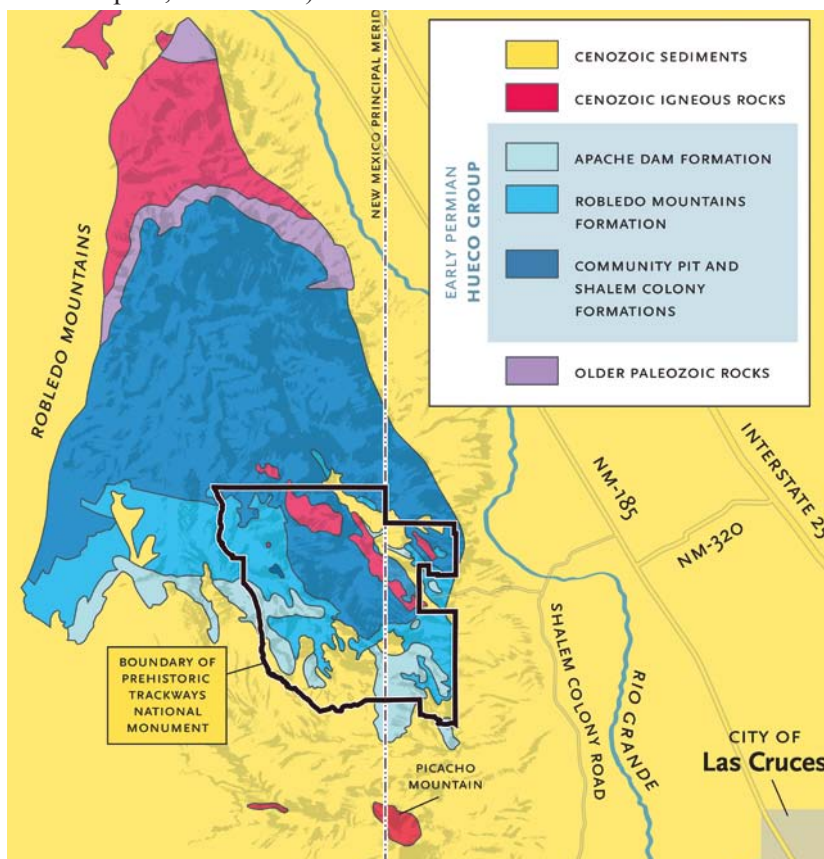


Figure 1 - Simplified geological map of the Robledo Mountains of southern New Mexico, USA, showing the location of the Prehistoric Trackways National Monument (Fig. 2), *Dromopus* and *Dimetropus* and their various synonyms. The large sample sizes



Figure 2 - Temnospondyl amphibian making *Batrachichnus* tracks.

allowed extensive documentation of extramorphological variation in Permian tetrapod footprints that made it clear that numerous named ichnotaxa are based on such variants and thus are useless “phantom taxa.” Among invertebrate traces, the PTNM sites have provided several new ichnotaxa (such as *Augerinoichnus*, Fig. 3) as well as a better understanding of variation in several known ichnotaxa. Trace fossil assemblages from the PTNM were central to new concepts of tetrapod footprint ichnofacies. Indeed, the tetrapod footprints from the PTNM are the archetypal example of the *Batrachichnus* Ichnofacies, known from a wide range of trace-fossil assemblages of Carboniferous-Triassic age (Fig. 2).

The PTNM trace fossils are integral to interpretation of the tidal flat paleoenvironments in which they were preserved. Particularly significant are questions regarding the amount of salinity of the Early Permian tidal flats. Presumably, several of the tracemakers were animals that could not tolerate much salinity, such as terrestrial insects.

Local paleogeography of the Early Permian shoreline can also be better interpreted with the aid of the PTNM trace fossils.

The PTNM trace fossil assemblages are preserved as part of a national monument administered by the BLM. This guarantees protection of the fossil sites from vandalism, unauthorized collection or other human-induced damage/destruction. It also guarantees future opportunities for research and interpretation of the trace fossil sites.

Beginning in the 1990s, the results of scientific research on the trace fossils began to be published. Since then, at least 65 scientific books, articles and abstracts have been dedicated primarily to the paleontology of the Lower Permian strata in the southern Robledo Mountains. Here, we compile these publications through 2010, as well as some articles published on the paleontology of the Lower Permian of the Robledo Mountains prior to the 1990s.



Figure 3 - *Augerinoichnus* (scale bar = 1 cm).

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