

## Dinosaur footprints from Dinosaur State Park (East Berlin Formation, Lower Jurassic, Rocky Hill, Connecticut, USA)

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### Abstract:

Dinosaur State Park (DSP) in Connecticut preserves a spectacular occurrence of tridactyl dinosaur footprints from the Lower Jurassic East Berlin Formation. The tracks are impressed in sediments that accumulated in a rift valley created during the early stages of separation of North America from Africa that led to creation of the Atlantic Ocean (McDONALD 2010). These footprints have repeatedly received brief attention in the literature (e.g. FARLOW & GALTON 2003; GALTON & FARLOW 2003). Using maps and photographs created by GALTON when the track occurrences were initially discovered, subsequent on-site examinations of the trackways by FARLOW, and laser-scanning and digital modeling by HYATT, we embarked on a project of full-scale documentation of the DSP footprints, part of which is presented here.

There are two occurrences of footprints at DSP, a larger East Tracksite that was re-buried after GALTON's fieldwork, and a smaller West Tracksite (Fig. 1; informally known as the "Trackway") that is presently protected by a surrounding building. Most of the footprints accessible to study are in the West Tracksite. Footprints occur in two beds, the uppermost of which (Tier 1) immediately overlies the other (Tier 0). Some trackways in Tier 1 can be traced beyond the limits of Tier 1 onto Tier 0, and some footprints truncated by the edge of Tier 1 can also be seen in Tier 0, indicating that the Tier 0 prints are undertracks. Prints in Tier 1 vary in depth and clarity, some of them being clearly impressed (Fig. 1 insert), and others very faint. Although some trackways may parallel each other, for the site as a whole there is little indication of preferred direction of travel by the dinosaurs.

Clearly registered West Tracksite Tier 1 footprints are longer than broad, sometimes show acuminate toetips, and sometimes a slight sigmoid curvature of digit III. With increasing size among footprints attributed to theropods, there is a tendency for prints to become relatively broader, and for the portion of the print distal to the tips of digits II and IV to become shorter relative to the portion of the print proximal to the terminal ends of digits II and IV (Fig. 2). DSP footprints are generally similar in size and shape to such named theropod ichnotaxa as *Eubrontes*, *Kayentapus*, and larger forms of *Anchisauripus*.

The mean length ("heel" to toetip III) across Tier 1 trackways is 35.9 cm (range 31-41; maximum/minimum = 1.3; CV = 7.4 %; N = 35). This is a rather small range of sizes (the East Tracksite, in contrast, had a few trackways made by considerably smaller animals). This could be consistent with trackmakers having been a single species, but does not require that interpretation; many dinosaur skeletal faunas have more than one large theropod species of comparable size (cf. FARLOW & PIANKA 2002). Considerations of overall footprint shape in fact suggest that more than one kind of large trackmaker may have been present at the site.

**Keywords:** vertebrate ichnology, Theropoda, Newark Supergroup, digital imaging

## References

FARLOW, J.O. & GALTON, P.M. (2003): Dinosaur trackways of Dinosaur State Park, Rocky Hill, Connecticut; p. 248-263. In: LETOURNEAU, P.M., & OLSEN, P.E. (eds.), *The Great Rift Valleys of Pangea in Eastern North America, Volume two: Sedimentology, Stratigraphy, and Paleontology*; New York, Columbia University Press.

FARLOW, J.O., & PIANKA, E.R. (2002): Body size overlap, habitat partitioning and living space requirements of terrestrial vertebrate predators: implications for the paleoecology of large theropod dinosaurs. *Historical Biology* 16: 21-40.

FARLOW, J.O., COROIAN, D., & CURRIE, P.J. (2018): *Noah's Ravens: Interpreting the Makers of Tridactyl Dinosaur Footprints*. 643 p., Indiana University Press, Bloomington, Indiana.

GALTON, P.M., & FARLOW, J.O. (2003): Dinosaur State Park, Connecticut, USA: history, footprints, trackways, exhibits. *Zubia* 21: 129-173.

MCDONALD, N.G. (2010): *Window into the Jurassic World: Dinosaur State Park, Rocky Hill, Connecticut*. 106 p., Friends of Dinosaur State Park and Arboretum, Rocky Hill, Connecticut.

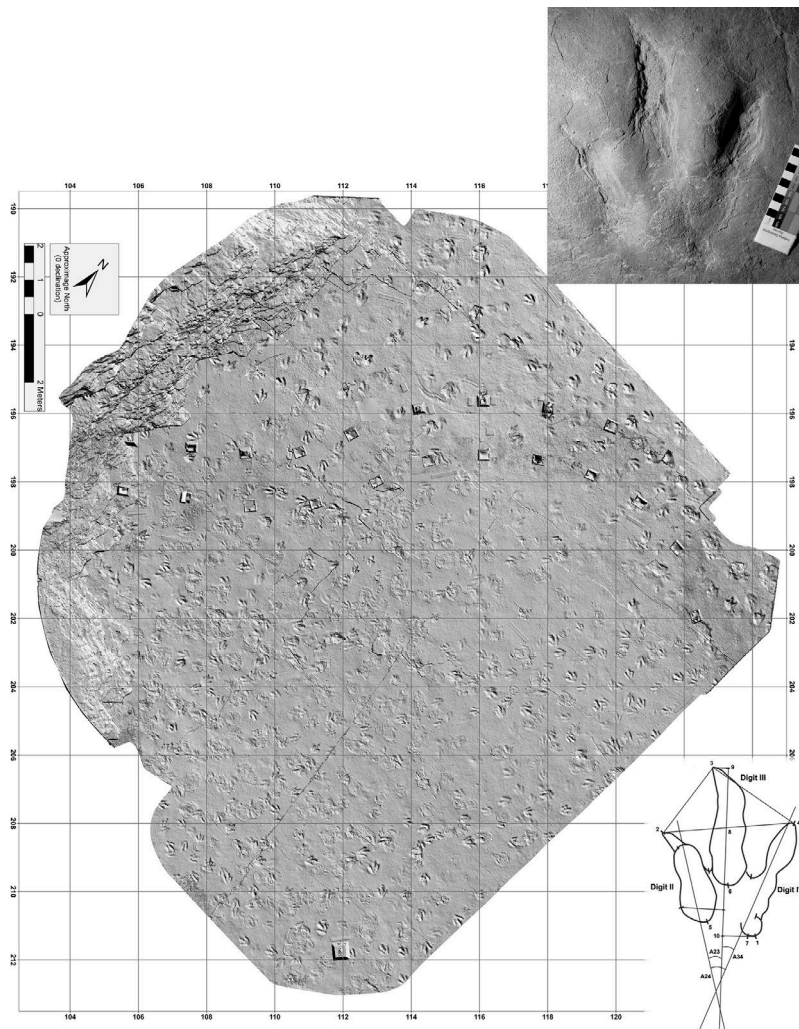


Fig. 1. Digital model of the West Tracksite, Dinosaur State Park (DSP). Top right insert: Footprint 7 (a right) of trackway G in Tier 1, one of the more clearly registered footprints at the site; scale bar in cm. Lower right insert: Landmarks on DSP footprints: 1 = "heel"; 2 = toetip II; 3 = toetip III; 4 = toetip IV; 5 = proximal end of digit II; 6 = proximal end of digit III; 7 = proximal end of digit IV (sometimes, but not always, the same point as the "heel"); 8 = intersection of long axis of digit III (as seen on a 3D model of the footprint, which may not always be the same as a midline through the toemark as seen in a 2D drawing) with line connecting toetips II and IV; 9 = projection of toetip III onto the long axis of digit III; 10 = projection of "heel" onto long axis of digit III. Other, unlabeled landmarks drawn on the footprint were not used in the present analysis.

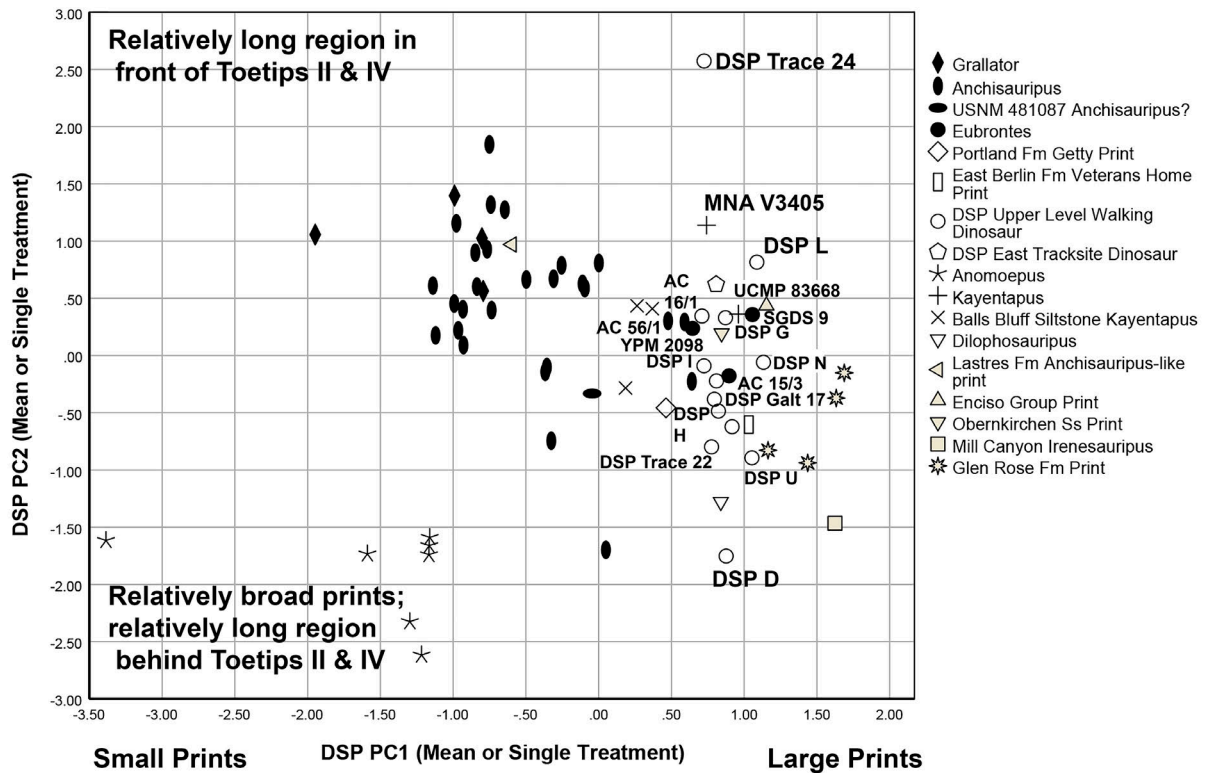


Fig. 2. Principal components analysis (PCA) of measurements of DSP footprints, along with those from other Newark Supergroup sites (data from FARLOW et al. 2018), from Early Jurassic sites in the western USA, and from later Mesozoic tracksites from around the world. Measurements of toetip distances (II-III [landmarks 2-3], III-IV [landmarks 3-4], and II-IV [landmarks 2-4; = toetip width]), projection of digit III beyond the distal limits of digits II and IV [landmarks 8-9], length of the print behind toetips II and IV [landmarks 8-10], distances between the proximal ends of digits II-III [landmarks 5-6], and III-IV [landmarks 6-7], and distances from the “heel” to toetips II [landmarks 1-2] and IV [landmarks 1-4], were made on actual footprints, casts of footprints, or digital models of footprints; where measurements for more than one footprint in a trackway were available, mean values were used. Measurements were log-transformed before PCA. PC1 is mainly associated with overall print size. PC2 is a contrast between parameters associated with the length of the print ahead of digits II and IV (more positive values), and parameters associated with broad prints and a relatively long region behind the tips of II and IV (more negative values). *Anomoepus* is a likely ornithischian print, while all others are interpreted as made by theropods. Note tendency for prints attributed to theropods to take lower values of PC2 with increasing size. Where possible without clutter, selected individual points of interest are labeled. Although there is considerable scatter along PC2 in the DSP prints, they mostly plot close to values for *Eubrontes*, *Kayentapus*, and larger forms of *Anchisauripus*. AC = Amherst College, DSP = Dinosaur State Park, MNA = Museum of Northern Arizona, SGDS = St. George Dinosaur Site (Utah), UCMP = University of California Museum of Paleontology.