# A social species? Newly discovered fossils show early dinosaurs lived in herds

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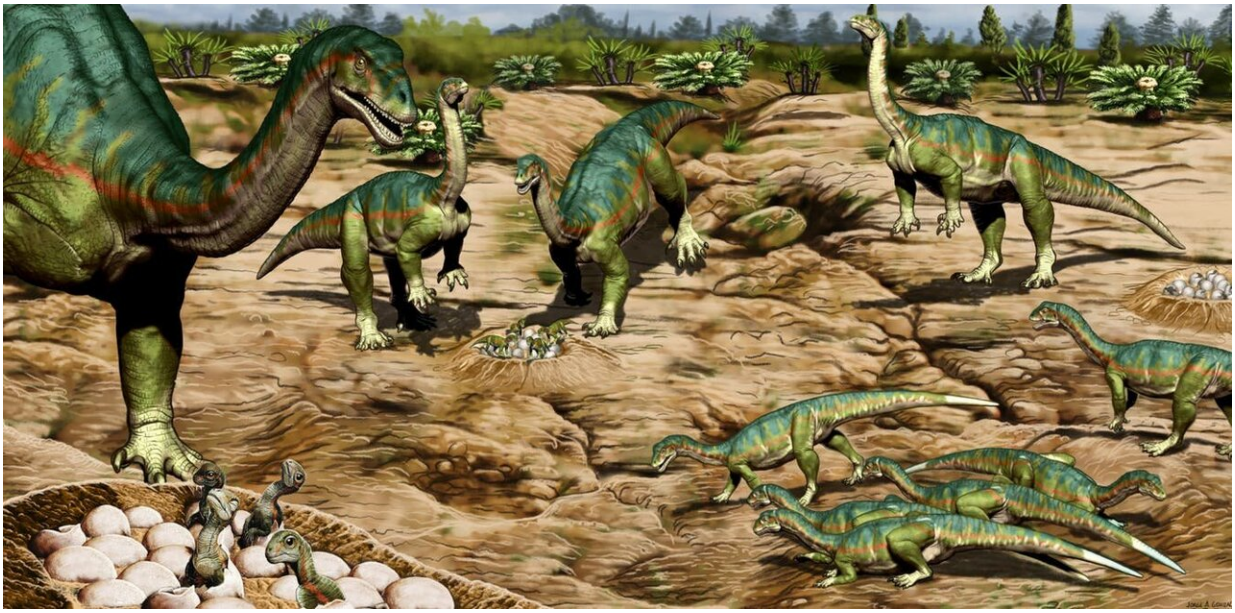

Credit: Jorge Gonzalez

Were dinosaurs unfeeling scaly brutes or caring, well behaved and intelligent? This debate has continued since dinosaurs were first discovered 200 years ago, and has spilled over into the movies and popular consciousness.

In seeking to answer questions like this, paleontologists generally look at the nearest living relatives, in this case crocodilians and birds. Do we see

dinosaurs as exhibiting complex social behavior like modern birds, or perhaps more rudimentary habits, as seen in crocodiles and alligators?

Dinosaurs were originally perceived as brutish, perhaps cannibalistic, and certainly lacking the brain power or inclination to care for their young. Then, in the 1970s and 1980s, Jack Horner and his colleagues pioneered a new view in their studies of *Maiasaura*, a plant-eating dinosaur from the Late Cretaceous (77 million years ago) of Montana.

Horner and colleagues found evidence that the adult *Maiasaura* dinosaurs returned to the same nesting spot year after year, showing enough intelligence to remember the place and appreciate its favorable character, whether access to food or safety. Their nests in the ground were spaced about seven meters (or one dinosaur length) apart, suggesting that like modern communally nesting birds, they liked to be close—but not so close that they would bite and bicker. This research saw dinosaurs redeemed as loving parents with advanced social behavior (the name *Maiasaura* means "good mother reptile").

In a new study published in *Scientific Reports*, Diego Pol from the Egidio Feruglio Paleontological Museum in Trelew, Argentina, together with international colleagues, argue that this kind of behavior can be traced back to the origin of dinosaurs, or at least to the early Jurassic period, 193 million years ago.

At an early Jurassic site in Patagonia, Argentina, the team studied fossils of a dinosaur species called Mussaurus patagonicus which, according to their new dating analysis, lived at the site about 193 million years ago. *Mussaurus* is a sauropodomorph dinosaur—an early relative of later giants such as *Brontosaurus* and *Diplodocus*—but already showing evidence of large size.

The researchers identified 80 individual dinosaur skeletons, as well as

nests and about 100 eggs. The nests were shallow trenches in the ground containing eight to 30 spherical eggs arranged in rows and piled in layers, as we've seen with other sauropod dinosaurs. The researchers used CT scanning to find that some of the eggs had tiny bones of the unhatched embryos inside.

The research team studied fossils at an early Jurassic site in Patagonia, Argentina. Credit: Alejandro OTero

The researchers measured the skeletons and counted growth rings in their bones to ascertain the dinosaurs' approximate sizes and ages. The skeletons included fully grown adults, maybe ten years old, subadults (equivalent to teenagers), juveniles and babies. Sizes ranged from babies

weighing 70 grams, like a little songbird, to adults weighing an estimated 1.5 tons, confirming a relatively fast growth rate for these long-necked herbivores.

The nests, eggs and skeletons occurred at three levels in the rock through a total thickness of three meters. The researchers interpreted the configuration of their nests layer upon layer through the rock as evidence the dinosaurs kept returning to the same place (called nest-site fidelity).

It appears juvenile dinosaurs traveled with the adults, and the whole herd migrated to the nesting site each year, and stayed together, perhaps for mutual protection and even to help the egg-laying mothers and their hatchlings.

These kinds of nesting sites have been reported before from several localities through the Jurassic and Cretaceous, in North America, South America, Africa and China. This suggests complex herd behavior was widespread across all major dinosaur groups. But this new discovery predates any earlier identification of this behavior by 40 million years, and is closer to the origin of dinosaurs about 250 million years ago.

Can we be sure these accumulations of skeletons say anything about social behavior? If you find a pile of dinosaur skeletons, it doesn't mean they were living together. They could have been brought together by a river or a storm. The same happens today when sudden monsoon rains may flood the landscape and concentrate dead trees, animal carcasses and other debris in fast-flowing streams that then dump their load as the current slows.

However, in the case of the new Patagonian discovery, certain characteristics of the ancient soils in which the skeletons, nests and eggs were found—such as traces of roots of plants that grew in the

soil—suggest some permanence. Further, the nests were in place and some were undisturbed, containing a full complement of unbroken eggs, some with embryos inside. This suggests a crisis struck, such as a drought and dust storm, causing the eggs to be buried or prevented from hatching. Complete skeletons also indicate limited transport by water or wind from the place the dinosaurs died.

The complex social behavior in early dinosaurs observed in this research lines up with other fossil evidence that dinosaurs were more bird-like than crocodilian-like. It's likely they all had feathers from the start, while evidence shows dinosaurs and their relatives were warm-blooded creatures. The first dinosaurs were small, with upright posture, and adapted for sustained running. Bird- or mammal-like social behavior from their origins seems acceptable. This view has been controversial for years, but the evidence is piling up: dinosaurs were warm-blooded, feathered, fast-moving and had sophisticated behavior.

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