PALEO SCIENCE JOURNAL FOR KIDS

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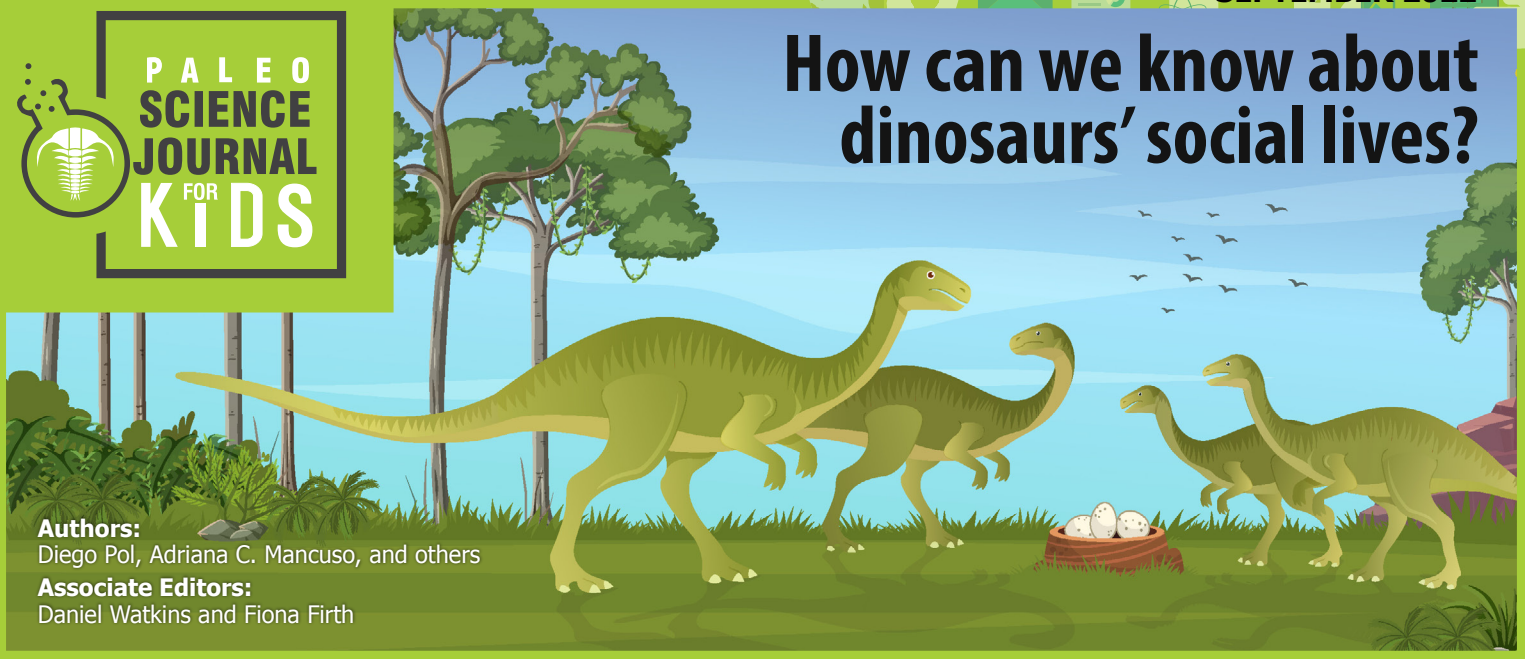
How can we know about dinosaurs' social lives?



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Abstract

Fossils tell us a lot about how dinosaur shapes changed over time. But learning how dinosaur behavior changed over time is a lot harder to do! That's why we were so excited to find a treasure trove of *Mussaurus patagonicus* fossils in Patagonia in southern Argentina. We found fossils of eggs, hatchlings, juveniles, and adults. *Mussaurus* lived in the early Jurassic, about 193 million years ago. It is an early cousin of the giant sauropods like *Diplodocus*. Clues from our fossil find tell us about *Mussaurus*' social lives. They lived in herds, nested in colonies, and spent time in age-separated groups. This is the oldest fossil evidence of dinosaur social behavior ever found!

Introduction

How do your friends and family make your life better? Humans are **social animals**. We take care of family members. We teach each other how to live and how to be happy. Many animals have complicated social lives, too! Have you ever seen ants working together to build a nest or carry food? Or birds flocking together? Other examples are wolves hunting together and beaver colonies building dams and mounds. Social behavior is an **adaptation** that helps us and other animals thrive.

Evolution is the gradual changes in living things over many generations. Little differences between parents and children can add up to big changes over thousands of generations. Adaptations are changes that make organisms more likely to survive. An adaptation could be a change in an organism's body, like camouflage helping animals avoid predators. It could also be a change in the organism's behavior. Scientists learn about animals, plants, and other living things from the past through **fossils**. By comparing fossils of

It takes a lot of work to unearth a fossil without damaging it! This is a photo of our dig site in Patagonia, in Southern Argentina (see the marker on the map). You can see that we took careful notes as we dug up the fossils.

Photo: Alejandro Otero

organisms from different times, scientists can learn how they evolved over millions of years. Fossils are really useful for seeing how the shapes of plants and animals evolved. But it's really hard to see from fossils how animal behavior evolved!

Sauropodomorphs are a group of dinosaur species that first appeared in the early **Triassic period** (about 230 million years ago). They were **herbivores** (plant eaters). By the end of the Triassic, they were the most common kind of herbivore. At the end of the Triassic many plant and animal species went extinct, but the sauropodomorphs survived! The descendants of these survivors include *Mussaurus* and other species. These later evolved into the giant and long-necked sauropods such as *Supersaurus* and *Diplodocus*.

Why did the sauropodomorphs survive and flourish when so many other dinosaurs didn't? Was it that they were bigger than other herbivores? Was it because they grew quickly to adulthood? Or could it be that the social lives of sauropodomorphs gave them an advantage? That's what we wanted to find out!

Methods

We looked for fossils in **sedimentary rocks** called the Laguna Colorada Formation. A few fossils of *Mussaurus patagonicus* were found there in the 1970s. We used a technique called **X-ray tomography** to make 3D models of the fossilized **embryos** inside of the eggs without breaking the eggs apart (Fig. 1). We then used a computer program to estimate the weight of the dinosaurs based on the thickness of the **femur** bone (Fig. 2). We also used a technique called uranium-lead dating to measure the age of the rocks.

Figure 1:
1. We recorded the size and shape of the nests in our notebooks. 2. A *Mussaurus* egg is about as big as a baseball. 3. We brought the eggs to a lab where we could X-ray it. 4. With the X-rays, we could see inside the egg!

Photos (clockwise from top left): Roger Smith, Roger Smith, Vincent Fernandez, Argoud ESRF.

Why is it important for the paleontologists to take notes on how the fossils were arranged in the ground?

Results

We found 69 new *Mussaurus* specimens and over 100 eggs. We found fossils of many different sizes, from hatchlings to adults. We estimate that the babies weighed only 70 grams (2.5 ounces) when they were born, but a year later they weighed about 10 kg (22 lb) and the adults grew up to 1500 kg (3300 lb). Small skeletons tended to be next to other small skeletons, and large skeletons tended to be next to other large skeletons. The eggs were in groups of 8 to 30. The eggs were in trenches, piled up in two or three layers. Some of the eggs had fossilized embryos inside that we could see in the X-rays! We expected the fossils to be from the late Triassic (about 210 million years ago). Our measurements show that the fossils are from the early **Jurassic** instead – 193 million years ago.

For the curious: An adult *Mussaurus patagonicus* would have weighed 1500 kg (3300 lb), which is about the same as a rhinoceros!

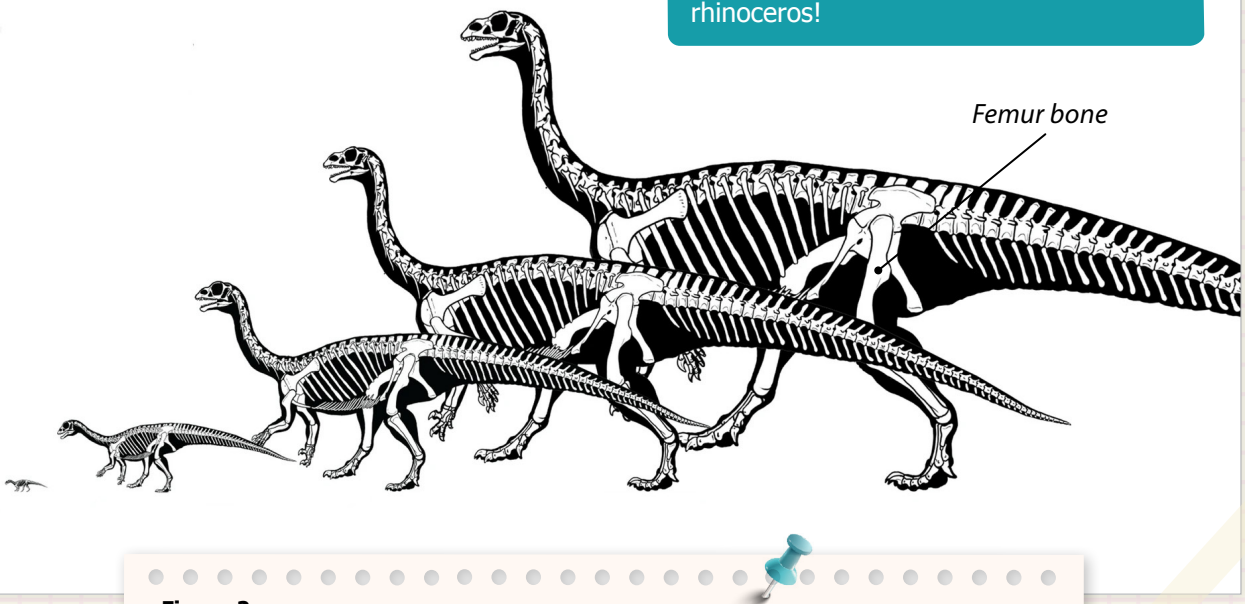

Figure 2:
By measuring the femur bone, we can estimate the weight of *Mussaurus patagonicus* at each age. Hatchlings would have only been about 60-70 grams (2-3 ounces, about the weight of a plum). The juveniles we found would have been about 10 kg, and our adult dinosaurs would have weighed up to 1500 kg.

Discussion

Learning from fossils isn't just about finding the full skeleton. We learn a lot from carefully paying attention to where we find the fossils and what position the fossils are in. That's why it's exciting that we found so many fossils in one spot!

Since we found infants, juveniles, and adults in the same place, we think that *Mussaurus* spent time together throughout their lives. The way the nests and eggs were laid out makes us think *Mussaurus* nested in **colonies**. Because fossils of juveniles were mostly

next to other fossils of juveniles, we think that groups of the same age hung out with each other. Modern animals that go through large changes in size from birth to adulthood do this, too. This is because animals have different needs while they are growing up than when they are adults.

Our fossil find isn't the only sign that dinosaurs had social lives. Fossilized footprints show that some sauropods in the Jurassic and Cretaceous periods traveled in herds. Other fossil finds from those periods also show age-grouping. Our find is 40 million years older than any other evidence for dinosaur social behavior!

Conclusion

Dinosaurs and birds evolved from primitive reptiles. Birds living today can have complicated social lives. Many care for their young. Some hunt and forage in groups. Others mate for life. Those behaviors evolved at some point in the past. It is amazing to find signs of these social behaviors in such an old fossil site.

Family and friends are important to you, too. Can you think of something you learned from an older relative? What about your friends? Spending time with others is important for our well-being, and we can achieve more when we work together.

Glossary of Key Terms

Adaptation – traits or behaviors that help a living thing survive

Colony – a group of animals that live and work together.

Embryo – an animal in the early stages of development that has not yet hatched or been born

Evolution – continuous development of already existing features into new ones over time from generation to generation. Characteristics that help the species to survive are more likely to be passed on.

Femur – the upper leg bone.

Fossils – preserved remains or imprints of living things from long ago.

Herbivore – an animal that eats only plants for food

Jurassic – the period from 201 million to 145 million years ago.

Sedimentary rock – rock formed from sand, silt, gravel, shells, or other small particles.

Social animals – animals that interact in some significant way with others of their species.

Triassic – the period from 252 million to 201 million years ago. The first dinosaurs are from the Triassic period.

X-ray tomography – a technique where many X-ray pictures are combined to form a 3D image.

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Check your understanding

1. Why is it harder to learn about dinosaur behavior than about dinosaur shapes?

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2. How did the researchers figure out the weight of the dinosaurs?

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3. How did the researchers learn about dinosaur behavior from the fossils?

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4. Imagine you are a paleontologist from 10,000 years in the future. What human behaviors from today do you think you would see evidence for? What kind of evidence would it be?

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