



ScienceWatch – My Father Was a Dinosaur

“... the authors show that fatherhood in theropods was about more than just looking macho and gnashing teeth.” – R. Prum

Birds are unusual in many respects. For example, most birds exhibit biparental care and provisioning of young. This contrasts with most mammals and virtually all reptiles, which exhibit maternal care or none at all. Even more striking is that in one ancient avian lineage of living birds—the Paleognathes, which includes flightless, ground-dwelling birds like the ostrich, kiwi, and the flying tinamous, males exclusively build the nest, incubate the eggs and raise the chicks.

Scientists have long wondered about the origins of paternal care in birds and a study published in the December 19, 2008 issue of *Science* now has the answer. Paternal care in birds originated with dinosaurs.

The research team headed by paleontologist David Varicchio, Montana State University, Bozeman, MT, found that the parental behavior of theropods, those fierce, fast-running, bipedal dinosaurs, was like the ostrich group; they practiced paternal care exclusively. Most scientists now agree that theropods like *Velociraptor* and *Deinonychus* gave rise to modern birds, and “... it’s more interesting than the authors know. This answers all sorts of questions about bird behavior,” says Richard Prum, an ornithologist at Yale University.

Of course, no one has ever seen a living theropod so the scientists used data derived from modern birds and reptiles whose behaviors they do know to help them reach their conclusions about dinosaur behavior.



In birds the volume (mass) of a clutch of eggs increases as the average adult size (mass) goes up. In modern-day Paleognathes the male, who is polygamous, collects eggs from several females. Consequently, the volume of eggs in the nest is much larger than any single female could produce based on adult size. Varicchio compared the ratio of clutch volume to adult volume for the paternal Paleognathes with three other groups: other birds that are biparental, birds that are maternal and maternal reptiles (crocodiles). The ratio was much higher for the Paleognathes than any of the other groups.

Fossils of adult theropods like *Oviraptor philoceratops**, *Troodon formosus* and *Citipati osmolskae* have been discovered on eggs clutches. Accordingly, Varicchio assessed the parental care system of these dinosaurs by calculating the ratio of clutch volume to adult

size. He found that it most closely matches that of the paternal Prognathes. As team member Gregory M. Erickson, a paleobiologist from Florida State University, Tallahassee, FL put it, "... where adult dinosaurs have been found on top of nests, we found that the volume or mass of the egg clutch ... is very large relative to the size of the nesting animals. This suggests multiple females contributed the eggs and the male guarded them. Notably, the ratio of egg volumes to the nesting animal's size is consistent with those in living birds where the male is the sole or primary nest attendant."

How did the researchers know the brooding dinosaurs were males? Erickson knew that in order to lay down eggshells female dinosaurs had to extract calcium and phosphorus from their bones, leaving telltale cavities. So he examined the microstructure of the fossilized long bones. Also, in modern birds females deposit irregular bone tissue inside the long bones, known as medullary bone, which is mostly resorbed during egg formation, but traces remain weeks after ovulation. Paleontologists had already reported the presence of such bone in other dinosaurs.

Erickson saw no medullary bone or evidence of bone resorption in adult dinosaurs found on egg clutches. "This is consistent with the brooding dinosaurs being males", said Erickson. The finding severely weakens the argument from scientists who believe the female-only pattern of care found in some birds and in crocodiles was the original breeding system.



Inferring dinosaur parental care behavior from the behavior of modern birds is exciting, and these results give us another link to further strengthen the dinosaur →bird theory of bird origin. However, it's still hard for me to imagine some fierce dinosaur dad softly cooing to his brood.

Saul Scheinbach

* "Oviraptor" means "egg seizer", so named by the famous fossil hunter Roy Chapman Andrews, Director of the American Museum of Natural History, and the real-life model for "Indiana Jones". In 1923 Andrews discovered an adult next to a clutch of eggs and assumed it was fossilized in the very act of robbing the eggs. In fact the "thief" was incubating its own eggs (see the last figure).