
STRANGE PREDATORY DINOSAUR FROM EUROPE'S LATE CRETACEOUS DESCRIBED BY ROMANIAN AND U.S. PALEONTOLOGISTS

NEW *VELOCIRAPTOR* RELATIVE HAD STOCKY LIMBS AND TWO CLAWS ON ITS FEET

By describing a new double-clawed and highly-unusual relative of *Velociraptor*, paleontologists have answered a long-standing question: what did the Late Cretaceous predatory dinosaurs in Europe look like? *Balaur bondoc*, described this week in *Proceedings of the National Academy of Sciences*, is the first reasonably complete skeleton of a meat-eating dinosaur from the final 60 million years of the Age of Dinosaurs in Europe and provides insight into an ecosystem very different from that of today. Europe at the end of the Cretaceous was awash in higher seas and was an island archipelago dominated by animals smaller and more primitive than their relatives living on larger landmasses.

“We’ve all been waiting for something like this, and the wait has yielded an interesting surprise,” says Mark Norell, chair of the Division of Paleontology at the American Museum of Natural History and one of the authors of the research paper describing the fossil. “*B. bondoc* is heavy, with unexpectedly stocky limbs and fused bones. It shows just how unusual the fauna of the area was during the waning years of the dinosaur era.”

“*Balaur* might be one of the largest predators in this ecosystem because not even a big tooth has been found in Romania after over a hundred years of research,” says co-author Zoltán Csiki of the University of Bucharest. “Fragmentary remains of *Balaur* were already known for more than 10 years, but the morphology of it is so weird we didn’t have any idea where to fit them.”

Balaur bondoc, which means “stocky dragon,” was unearthed in Romania by geologist and co-author Mátyás Vremir of the Transylvanian Museum Society. Higher

sea levels at the end of the Cretaceous flooded much of present-day continental Europe, so Romania, which was an island, is now one of the best windows into Europe at the end of the Age of Dinosaurs. Other fossils have been discovered in these deposits include dwarf sauropods that were the size of cows and tiny duck-billed dinosaurs. These herbivorous dinosaurs had features not unexpected in island inhabitants: the so-called “island effect” postulates that island dwellers tend to be stranger and smaller than close relatives on continental land masses. Also, animals endemic to islands are often more primitive than their mainland relatives.

The new theropod fossil, the type specimen, is a partial skeleton that includes leg, hip, backbone, arms, hand, rib, and tail bones. But *B. bondoc* has 20 unique features when compared to its nearest relatives, including a re-evolved functional big toe with a large claw that can be hyperextended, presumably used to slash prey. Because there is also a large claw on the second toe, as is typical of the group of dinosaurs to which *B. bondoc* belongs, the new species has unusual double-clawed feet. Unique features are also found in other parts of the foot, leg, and pelvis. The feet and legs are short and stocky, with bones fused together, and the pelvis has enormous muscle attachment areas, indicating that this species was adapted for strength over speed. Finally, the hand is atrophied and some of the bones are fused, features that would have made grasping difficult. This, in combination with the leg and foot traits, indicates that the lower limbs rather than hands were used to grasp and disembowel prey.

“*Balaur* is a new breed of predatory dinosaur, very different from anything we have ever known,” says Stephen Brusatte, a graduate student at Columbia University who is affiliated with the Museum. “Its anatomy shows that it probably hunted in a different way than its less stocky relatives. Compared to *Velociraptor*, *Balaur* was probably more of a kickboxer than a sprinter, and it might have been able to take down larger animals than itself, as many carnivores do today.”

“Nevertheless, *Balaur* is the size of an oversized turkey and unlike what we know of the large predators from other parts of the world at the same time period, like *Tyrannosaurus* or *Carnotaurus*,” says Csiki. “As European dinosaur faunas were known to be peculiar, we half-expected to find peculiar predators as well. But, as the first good record of these, *Balaur* surely exceeds our most daring expectations.”

But while *B. bondoc* has unique features expected from the “island effect,” its relationship with other dromaeosaurs shows that there was some faunal exchange between the Romanian island that the mainland—at least among the carnivorous dinosaurs.

“Because *Balaur* is related to dinosaurs like *Velociraptor*, it indicates that the European island archipelago had a faunal connection with other parts of Europe, Asia and North America where this group of dinosaurs has also been found in similarly aged rocks,” says Norell. “It also shows how pervasive island effects can be in producing truly unusual animals.”

The new fossil is described in and pictured on the cover of the *Proceedings of the National Academy of Sciences*. The include Csiki, Vremir, Brusatte, and Norell. The research was funded in part by the American Museum of Natural History, the National Science Foundation, Columbia University Department of Earth and Environmental Sciences, the Romanian National University Research Council, Richard and Lynn Jaffe.

Science at the American Museum of Natural History

Founded in 1869, the American Museum of Natural History is one of the world's preeminent scientific and cultural institutions. The Museum supports research programs in anthropology, paleontology, zoology, astrophysics, molecular biology, and conservation with a scientific staff of more than 200. The Museum's research scientists work with the exhibition team to develop award-winning, topical exhibitions and are supported in their work by the Museum's state-of-the-art research laboratories, the largest independent natural history library in the world, and a world-renowned collection of more than 32 million specimens and cultural artifacts. The Museum became the first American museum with the authority to grant the Ph.D. degree with the launch of the Richard Gilder Graduate School in 2006.

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