The Kem Kem Beds: A Paradise For Predators?

Ninety-five million years ago, in what is now southeastern Morocco, giant predators ruled the land known today as the Kem Kem fossil beds

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Ninety-five million years ago, in what is now southeastern Morocco, giant predators ruled the land. The reddish Cretaceous rock of these arid localities—called the Kem Kem Beds—has yielded the remains of the theropods *Deltadromeus*, *Carcharodontosaurus* (seen in Mark Hallett's exquisite painting " [Thunder Across the Delta](http://www.hallettpaleoart.com/gallery/pages/thunder.htm)"), *[Spinosaurus](http://blogs.smithsonianmag.com/dinosaur/2010/12/14/what-do-we-know-about-spinosaurs/" \o "Dinosaur Tracking Spinosaurs" \t "_blank)* and several other, [poorly-known species](http://en.wikipedia.org/wiki/Kem_Kem_Beds#Dinosaurs). In fact, based on the described fossils, there would appear to be a greater abundance and diversity of predatory dinosaurs than herbivorous ones (!), but was there really such a surplus of carnivores at just one time?   
  
As Charles Darwin aptly recognized over a century and a half ago, the fossil record is an archive "imperfectly kept." Geological processes and the capricious nature of fossilization have obscured the windows into the past that fossil-bearing rocks present, and one of these confounding factors is called time averaging. Simply put, fossils from different times can be mixed together to make it look as if all those organisms lived alongside one another when they may have actually lived hundreds, thousands, or even millions of years apart. Hence, when paleontologists try to reconstruct an area's prehistoric ecology, they must always investigate how the fossil-bearing deposits formed and how long a time period they represent.   
  
In the case of the Kem Kem Beds, Queen's University paleontologist Gareth Dyke has recently argued that the richness of theropod dinosaurs is likely the result of time-averaging and not an indication of there truly being more predators than herbivores. In an short article just published in *Current Biology*, which draws from a *Geology* study published with Alistair McGowan last year, Dyke argues that both the nature of fossilization in this place and the way in which those fossils have been collected have skewed our perspective of prehistoric ecology. Since many of the Kem Kem fossils are fragmentary, most are never collected, and it is the sturdier teeth which often get picked up. Given that theropod teeth are abundant and can fetch a good price for local fossil hunters, this leads to an over-representation of predatory dinosaurs in Morocco's rock shops.   
  
The collecting bias of the local fossil hunters has trickled through the scientific community. Many of the Kem Kem theropod fossils were not collected in the field by professional paleontologists but purchased from rock shops—without detailed geological information—and then later deposited in museums. The Kem Kem dinosaur specimens in many museums, therefore, represent only a snippet of the actual diversity of the prehistoric ecosystem, and the lack of geological data makes it difficult to figure out which species actually lived alongside one another. Indeed, thorough fieldwork in the Kem Kem beds is rarely carried out, and therefore it has been easy to create the impression that these fossil sites represent a strange ecosystem in which hordes of predatory dinosaurs feasted on each other.   
  
The prehistoric ecology of the Kem Kem beds has yet to be fully worked out. Among the questions that remain: How many species of predatory dinosaur were there? Were they all present at one time, or does the formation represent a succession of different assemblages predators over time? What species of herbivorous dinosaurs were present, and how abundant were they? How did these fossil beds accumulate, and how long did it take? Answering these questions will take years of difficult work, both in the lab and the field, but in the process of doing so we will be better able to restore this lost world of Mesozoic Morocco.   
  
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