

# Dinosaurs grew to outpace their young

Ancient reptiles owed huge size more to their eggs than to a benign environment.

Matt Kaplan

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Some dinosaurs grew to gigantic sizes to avoid competition from their own young, rather than to take advantage of abundant oxygen, high temperatures and large territorial ranges, say two studies. But their largeness may also have proved their undoing.

Some have argued that dinosaurs were able to grow quickly and fuel large bodies when temperatures were warm, oxygen levels were high, and land masses such as the supercontinent Gondwana provided abundant living space.

But although the idea that certain environmental conditions favoured the growth of enormous dinosaurs has been popular among palaeontologists, there is little evidence for it.

## Friendly environment

To see whether the link could be supported, Roland Sookias, a biologist at the Ludwig Maximilian University of Munich in Germany, and his colleagues examined whether changes in body size followed changes in environmental factors. Their findings are published in *Biology Letters* today<sup>1</sup>.

The team used thigh-bone lengths to work out the body sizes of more than 400 species alive during the Permian, Triassic and Jurassic periods (299 million to 145 million years ago). This included dinosaurs and their predecessors, as well as contemporaries such as flying pterosaurs and the ancestors of mammals.

The researchers compared body sizes with records of atmospheric oxygen levels, temperatures and the available area of dry land when these animals were alive, and found no correlation. To check their results, they also compared the same environmental variables with the sizes of mammals living between the Palaeocene and Pleistocene epochs (65 million to 0.01 million years ago). Again, there was no connection.

"Our results support the idea that biological factors, such as growth rates, were more important in governing maximum body size" than were environmental factors, says Richard Butler, a palaeontologist at the Ludwig Maximilian University of Munich and a co-author of the study.

"The model is good and the findings are probably right but we must remember this is very broad-brush stuff," says Paul Barrett, a palaeontologist at the Natural History Museum in London. "We mustn't take this to mean we can start entirely ignoring the interactions that exist between environmental factors and physiology."

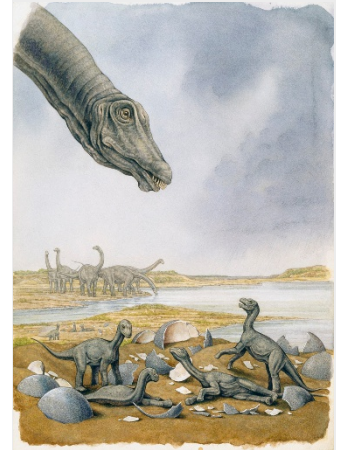
## Bigger and bigger

In another study published in *Biology Letters* today<sup>2</sup>, Daryl Codron, a zoologist at the University of Zurich in Switzerland, and his colleagues argue that the key to some dinosaurs' vast size lies in the limitations of egg laying.

Large eggs must have thick shells, which make it difficult for the developing embryo to 'breathe' by exchanging gases with the outside world. This places an upper limit on egg size.

So, even though they grew into giants as adults, dinosaurs were forced to produce relatively tiny young. Titanosaur hatchlings, for example, were nearly 2,500 times smaller than the 4-tonne adults. By contrast, the live-born calf of an Asian elephant (*Elephas maximus*) is about 25 times smaller than its mother.

When the young of large animals start out small, they must grow through a large size range before reaching adulthood, and compete with species of many different sizes as they do so.



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A newborn titanosaur had to get 2,500 times bigger before it reached adulthood.

Codron and his colleagues developed a model that suggests that there was intense competition among small and medium-sized dinosaurs, so that it was difficult for medium-sized adults to make a living, and adults had to keep growing until they reached very large sizes to gain a competitive edge. In comparison to mammals, relatively few dinosaurs are known with adult sizes between 1 kilogram and 1,000 kilograms.

But being big also has drawbacks. When an asteroid impact at the end of the Cretaceous period (65 million years ago) wiped out most large-bodied animals, there were so few small dinosaur species that the group was almost obliterated, with only the birds surviving. However, the many small mammals alive at the time were well suited to a world that favoured diminutive species.

“I love the idea that egg-laying led dinosaurs to engage in such different niche occupation from mammals and that this played a part in their eventual extinction,” says John Hutchinson, an evolutionary biologist at the Royal Veterinary College in Hatfield, UK. “But we are going to see a lot of debate over how accurate these models really are,” he adds.

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## References

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1. Sookias, R. B., Benson, R. B. J. & Butler, R. J. *Biol. Lett.* <http://dx.doi.org/10.1098/rsbl.2012.0060> (2012).
2. Codron, D., Carbone, C., Müller, D. W. H. & Clauss, M. *Biol. Lett.* <http://dx.doi.org/10.1098/rsbl.2012.0240> (2012).