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A Tail of Two Critters: Royal BC Museum research reveals surprising connections in tail weapon evolution

VICTORIA, BC—Why would two species, separated by millennia, evolve similar-looking weapons—not teeth, talons, horns or venom, but tails?

This was the question Royal BC Museum paleontologist Victoria Arbour and Lindsay Zanno at the North Carolina Museum of Natural Sciences/North Carolina State University set out to answer in the journal *The Anatomical Record*, available at <https://onlinelibrary.wiley.com/doi/full/10.1002/ar.24093>, in a special issue dedicated to research on the paleobiology of dinosaurs.

Their research reveals striking similarities in the development of the tail as a weapon in ankylosaurs (a group of dinosaurs) and glyptodonts (a group of extinct mammals), two groups of animals separated by more than 300 million years of evolution.

Although separated by millennia, the two groups of animals share some similarities. While ankylosaurs were huge dinosaurs and glyptodonts were huge armadillos, both were herbivorous animals covered in bony plates. And both evolved sledgehammer-like tail weapons.

“The term ‘**convergent evolution**’ refers to the process when unrelated groups of animals evolve similar-looking body shapes,” **said Arbour, Curator of Paleontology at the Royal BC Museum.** “It usually means similar selective pressures have shaped their bodies over time.”

Arbour and Zanno wanted to know whether ankylosaurs and glyptodonts had undergone convergent evolution, or if they evolved similar body shapes by coincidence. They were also curious if the two species evolved their unique features in the same order and pattern.

The researchers collected data about the animals’ anatomy, including the amount of their bodies covered by armour, how much of their tails was stiff, and how large they were, and used statistical models to test the hypothesis of convergent evolution.

Arbour and Zanno found evidence for strong convergent evolution in ankylosaurs and glyptodonts; they also found, in both groups, that certain features appeared before others in their evolutionary history.

Specifically, the two animals became large and herbivorous *before* evolving tail weapons, and developed stiff tails *before* the tip of the tail was enlarged into a wrecking-ball-like structure.



When adaptations are rare, like tail weapons, it means that there must be constraints that prevent those sorts of structures from evolving repeatedly. In this case, Arbour and Zanno speculate that stiffening the backbone and tail might be necessary for the structural requirements of swinging a heavy tail, and this feature might constrain the repeated evolution of tail weapons in other groups of animals.

About the Royal BC Museum

The Royal BC Museum explores the province's human history and natural history, advances new knowledge and understanding of BC, and provides a dynamic forum for discussion and a place for reflection. The museum and archives celebrate culture and history, telling the stories of BC in ways that enlighten, stimulate and inspire. Located in Victoria on the traditional territory of the Lekwungen (Songhees and Xwsepsum Nations), we are a hub of community connections in BC—onsite, offsite and online—taking pride in our collective histories.

- 30 -

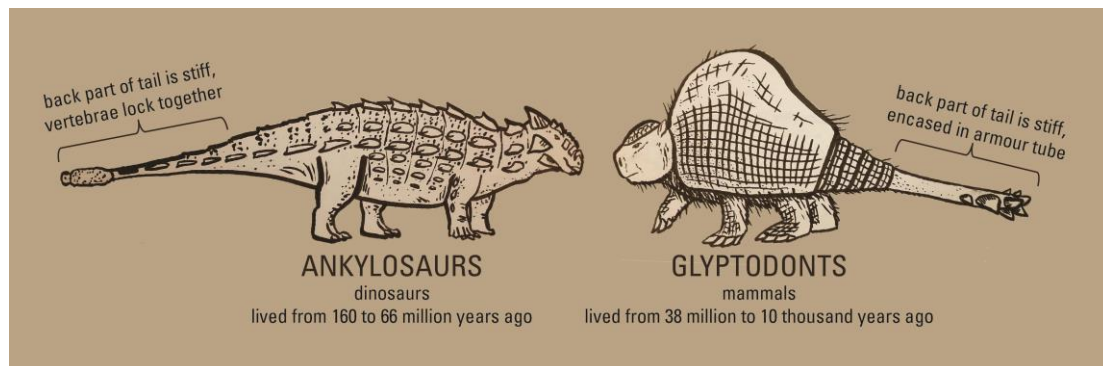
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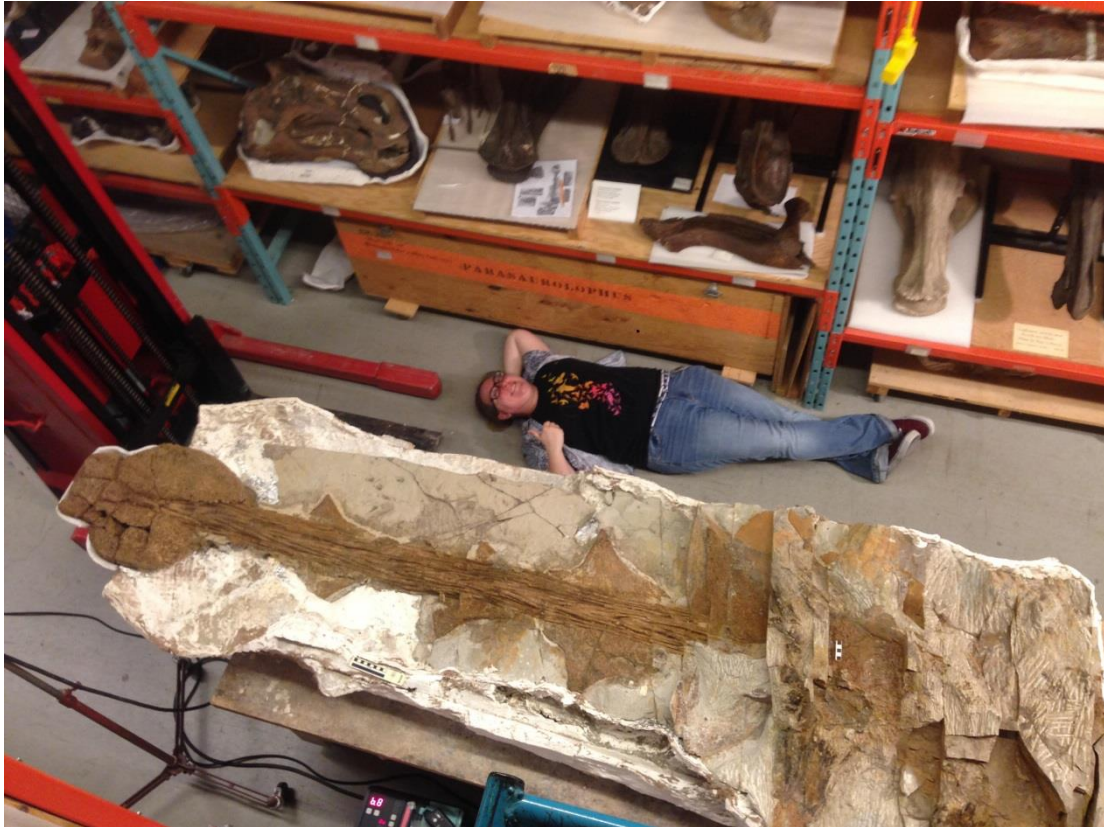
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Ankylosaurs and glyptodonts both evolved similar armoured bodies with weaponized tails, but they weren't closely related to each other.

Image credit: Victoria Arbour/Royal BC Museum



Victoria Arbour, lead author on the new study, lies next to the massive tail club of the ankylosaur *Zuul crurivastator*. Ankylosaurs like *Zuul* had tail clubs with stiff, modified vertebrae and huge bony plates at the tip of the tail.
Image credit: David Evans/Royal Ontario Museum



Modern armadillos (like the nine-banded armadillo shown here) have flexible tails covered in bony rings, but some of their extinct relatives, the glyptodonts, had stiff tail clubs that might have been used as weapons.
Image credit: Victoria Arbour