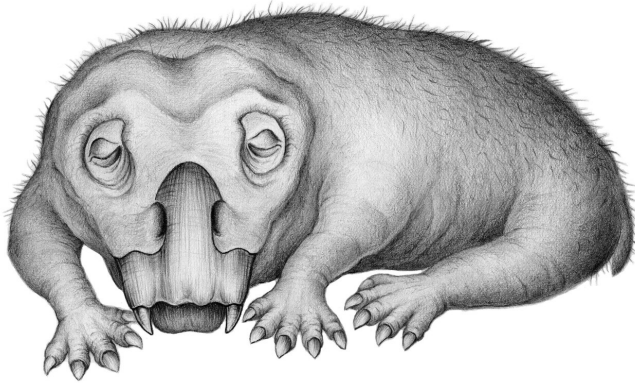


# Fossil evidence of 'hibernation-like' state in 250-million-year-old Antarctic animal

27 August 2020



Life restoration of Lystrosaurus in a state of torpor.  
Credit: Crystal Shin

Hibernation is a familiar feature on Earth today. Many animals—especially those that live close to or within polar regions—hibernate to get through the tough winter months when food is scarce, temperatures drop and days are dark.

According to new research, this type of adaptation has a long history. In a paper published Aug. 27 in the journal *Communications Biology*, scientists at the University of Washington and its Burke Museum of Natural History and Culture report evidence of a hibernation-like state in an animal that lived in Antarctica during the Early Triassic, some 250 million years ago.

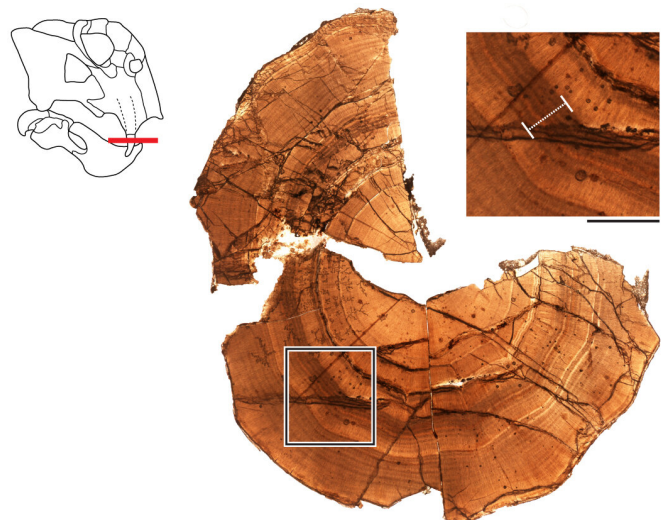
The creature, a member of the genus *Lystrosaurus*, was a distant relative of mammals. Antarctica during *Lystrosaurus*' time lay largely within the Antarctic Circle, like today, and experienced extended periods without sunlight each winter.

The fossils are the oldest evidence of a hibernation-like state in a [vertebrate animal](#), and indicates that

torpor—a general term for hibernation and similar states in which [animals](#) temporarily lower their [metabolic rate](#) to get through a tough season—arose in vertebrates even before mammals and dinosaurs evolved.

"Animals that live at or near the poles have always had to cope with the more extreme environments present there," said lead author Megan Whitney, a postdoctoral researcher at Harvard University who conducted this study as a UW doctoral student in biology. "These preliminary findings indicate that entering into a hibernation-like state is not a relatively new type of adaptation. It is an ancient one."

*Lystrosaurus* lived during a dynamic period of our planet's history, arising just before Earth's largest mass extinction at the end of the Permian Period—which wiped out about 70% of vertebrate species on land—and somehow surviving it. The stout, four-legged foragers lived another 5 million years into the subsequent Triassic Period and spread across swathes of Earth's then-single continent, Pangea, which included what is now Antarctica.

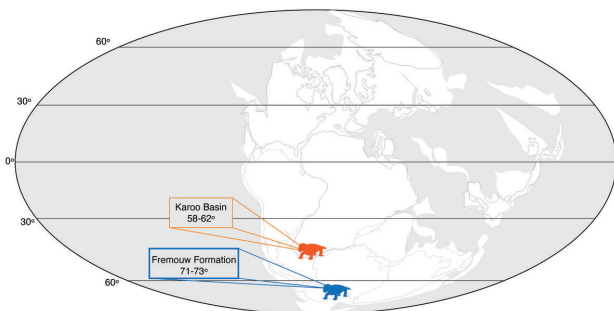


This thin-section of the fossilized tusk from an Antarctic *Lystrosaurus* shows layers of dentine deposited in rings of growth. The tusk grew inward, with the oldest layers at the edge and the youngest layers near the center, where the pulp cavity would have been. At the top right is a close-up view of the layers, with a white bar highlighting a zone indicative of a hibernation-like state. Scale bar is 1 millimeter. Credit: Megan Whitney/Christian Sidor

"The fact that *Lystrosaurus* survived the end-Permian mass extinction and had such a wide range in the early Triassic has made them a very well-studied group of animals for understanding survival and adaptation," said co-author Christian Sidor, a UW professor of biology and curator of vertebrate paleontology at the Burke Museum.

Paleontologists today find *Lystrosaurus* fossils in India, China, Russia, parts of Africa and Antarctica. These squat, stubby, creatures—most were roughly pig-sized, but some grew 6 to 8 feet long—had no teeth but bore a pair of tusks in the upper jaw, which they likely employed to forage among ground vegetation and dig for roots and tubers, according to Whitney.

Those tusks made Whitney and Sidor's study possible. Like elephants, *Lystrosaurus* tusks grew continuously throughout their lives. The cross-sections of fossilized tusks can harbor life-history information about metabolism, growth and stress or strain. Whitney and Sidor compared cross-sections of tusks from six Antarctic *Lystrosaurus* to cross-sections of four *Lystrosaurus* from South Africa.



A map of Pangea during the Early Triassic, showing the

locations of the Antarctic (blue) and South African (orange) *Lystrosaurus* populations compared in this study. Credit: Megan Whitney/Christian Sidor

Back in the Triassic, the collection sites in Antarctica were at about 72 degrees south latitude—well within the Antarctic Circle, at 66.3 degrees south. The collection sites in South Africa were more than 550 miles north during the Triassic at 58-61 degrees south latitude, far outside the Antarctic Circle.

The tusks from the two regions showed similar growth patterns, with layers of dentine deposited in concentric circles like tree rings. But the Antarctic fossils harbored an additional feature that was rare or absent in tusks farther north: closely-spaced, thick rings, which likely indicate periods of less deposition due to prolonged stress, according to the researchers.

"The closest analog we can find to the 'stress marks' that we observed in Antarctic *Lystrosaurus* tusks are stress marks in teeth associated with hibernation in certain modern animals," said Whitney.



In this image of the thin-section of a fossilized tusk from a South African *Lystrosaurus*, black arrowheads show layers of dentine deposited in layers of growth, with no signs of a hibernation-like state. Scale bar is 0.1

millimeters. Credit: Megan Whitney/Christian Sidor

The researchers cannot definitively conclude that *Lystrosaurus* underwent true hibernation—which is a specific, weeks-long reduction in metabolism, body temperature and activity. The stress could have been caused by another hibernation-like form of torpor, such as a more short-term reduction in metabolism, according to Sidor.

*Lystrosaurus* in Antarctica likely needed some form of hibernation-like adaptation to cope with life near the South Pole, said Whitney. Though Earth was much warmer during the Triassic than today—and parts of Antarctica may have been forested—plants and animals below the Antarctic Circle would still experience extreme annual variations in the amount of daylight, with the sun absent for long periods in winter.

Many other ancient vertebrates at high latitudes may also have used torpor, including hibernation, to cope with the strains of winter, Whitney said. But many famous extinct animals, including the dinosaurs that evolved and spread after *Lystrosaurus* died out, don't have teeth that grow continuously.

"To see the specific signs of stress and strain brought on by hibernation, you need to look at something that can fossilize and was growing continuously during the animal's life," said Sidor. "Many animals don't have that, but luckily *Lystrosaurus* did."

If analysis of additional Antarctic and South African *Lystrosaurus* fossils confirms this discovery, it may also settle another debate about these ancient, hearty animals.

"Cold-blooded animals often shut down their metabolism entirely during a tough season, but many endothermic or 'warm-blooded' animals that hibernate frequently reactivate their metabolism during the hibernation period," said Whitney. "What we observed in the Antarctic *Lystrosaurus* tusks fits a pattern of small metabolic 'reactivation events' during a period of stress, which is most similar to

what we see in warm-blooded hibernators today."

If so, this distant cousin of mammals isn't just an example of a hearty creature. It is also a reminder that many features of life today may have been around for hundreds of millions of years before humans evolved to observe them.

**More information:** Megan R. Whitney et al, Evidence of torpor in the tusks of *Lystrosaurus* from the Early Triassic of Antarctica, *Communications Biology* (2020). DOI: [10.1038/s42003-020-01207-6](https://doi.org/10.1038/s42003-020-01207-6)

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