



Evidence suggests that an asteroid impact that killed most dinosaurs happened in spring.

FOSSIL FISH REVEAL TIMING OF ASTEROID THAT KILLED DINOSAURS

The discovery is likely to reignite controversy over the US site where the fossils were found.

By Colin Barras

Winter began in spring for many animals during the final year of the age of dinosaurs. Palaeontologists studying fossilized fish suggest that spring was in full bloom in the Northern Hemisphere when an asteroid slammed into Earth, triggering a devastating global winter and mass extinction.

But the conclusions are likely to stir controversy among some researchers, partly because the fossils come from Tanis, an extraordinary yet contentious geological site in North Dakota. Some were puzzled by the results, published in *Nature* on 23 February¹, which are essentially identical to those of a study published in *Scientific Reports* last December² by another research group working at Tanis. Neither paper cites the other.

News of Tanis' discovery first hit the headlines in *The New Yorker* magazine in 2019. The team behind the discovery, led by Robert DePalma, now a PhD student at the University of Manchester, UK, then published a description of the site in a scientific journal³. The researchers said Tanis captured what happened just minutes to hours after the asteroid struck Mexico's Yucatán Peninsula about 66 million years ago.

According to the 2019 paper, the impact generated 10-metre-tall waves in a shallow sea that stretched across what is now the southern and eastern United States. As one of these waves surged up a river valley in what is now North Dakota, it swept up the organisms in its path, along with plenty of mud and sand. The wave then retreated and dumped the material, forming the Tanis site.

The research came under intense scrutiny because no other site on Earth is thought to preserve a detailed record of the day of impact. But many researchers note that the 2019 paper did not include a detailed description of the site's geology, making it difficult to assess whether the geology can be tied to the impact or another unknown catastrophe that occurred perhaps thousands of years earlier. "For a site of such potential importance, I'd really like to see a long-format paper that dives deep into the sedimentology and stratigraphy of the site, and supports it with lots of imagery and data," says Thomas Tobin, a geologist at the University of Alabama in Tuscaloosa. He says this is particularly important given that few researchers have had an opportunity to visit Tanis.

DePalma says that an upcoming study will expand on the description of the site given in 2019. He also acknowledges there is a "misconception" that he is restricting access to the site,

but he insists this is not the case.

One researcher who has had access is Melanie During, who is now pursuing a PhD in palaeontology at Uppsala University in Sweden. In August 2017, while she was at the Free University of Amsterdam, she had an opportunity to visit Tanis because her instructor, geologist Jan Smit, had previously worked with DePalma at the site. "It looks like a car wreck frozen in time. It's insane," says During. "There are fishes folded around tree branches – you can tell that this wave displaced everything."

Fossil record

During wondered whether a geological record formed on the day of impact would preserve evidence that could pinpoint the event to a particular season. She says the growth patterns of certain fossilized fish bones at Tanis can reveal the season in which the fish died. The bones grow rapidly in spring when food is abundant, but slowly in winter when food is scarce – creating a microscopic 'line of arrested growth' (LAG) in the bone tissue.

During collected fossilized fish from Tanis and then, working with Smit and other colleagues, produced high-resolution micro-computerized-tomography models of three paddlefish jawbones and three sturgeon pectoral fin spines. The researchers say it was possible to identify LAGs in the six bones and show that all six fish had died shortly after beginning a new period of growth. This suggests their deaths – and, by implication, the asteroid impact – occurred during the Northern Hemisphere's spring.

The findings from During's work could offer clues about why the impact-triggered extinction wiped out some animals, including all non-avian dinosaurs, but not others. She speculates that the impact's timing might have been devastating for species in the Northern Hemisphere that had young to care for.

"I think their argument [about the season of death] is convincing," says Michael Newbrey, a biologist at Columbus State University in Georgia who is familiar with using LAGs to study fish. He says he would have liked to see a larger sample size, but acknowledges the difficulty in accessing samples from the fossil record.

But LAGs are contentious, says a postdoctoral researcher who understands bone analysis and the geology of the Tanis region. They have requested anonymity given the controversy of the site. "There is no uniform, agreed-upon definition of what a LAG is or how you identify one," they say – and neither is there agreement on how often and why LAGs form. As such, the researcher questions the strength of the spring-impact hypothesis.

1. During, M. A. D. et al. *Nature* <https://doi.org/10.1038/s41586-022-04446-1> (2022).

2. DePalma, R. A. et al. *Sci. Rep.* **11**, 23704 (2021).

3. DePalma, R. A. et al. *Proc. Natl. Acad. Sci. USA* **116**, 8190–8199 (2019).