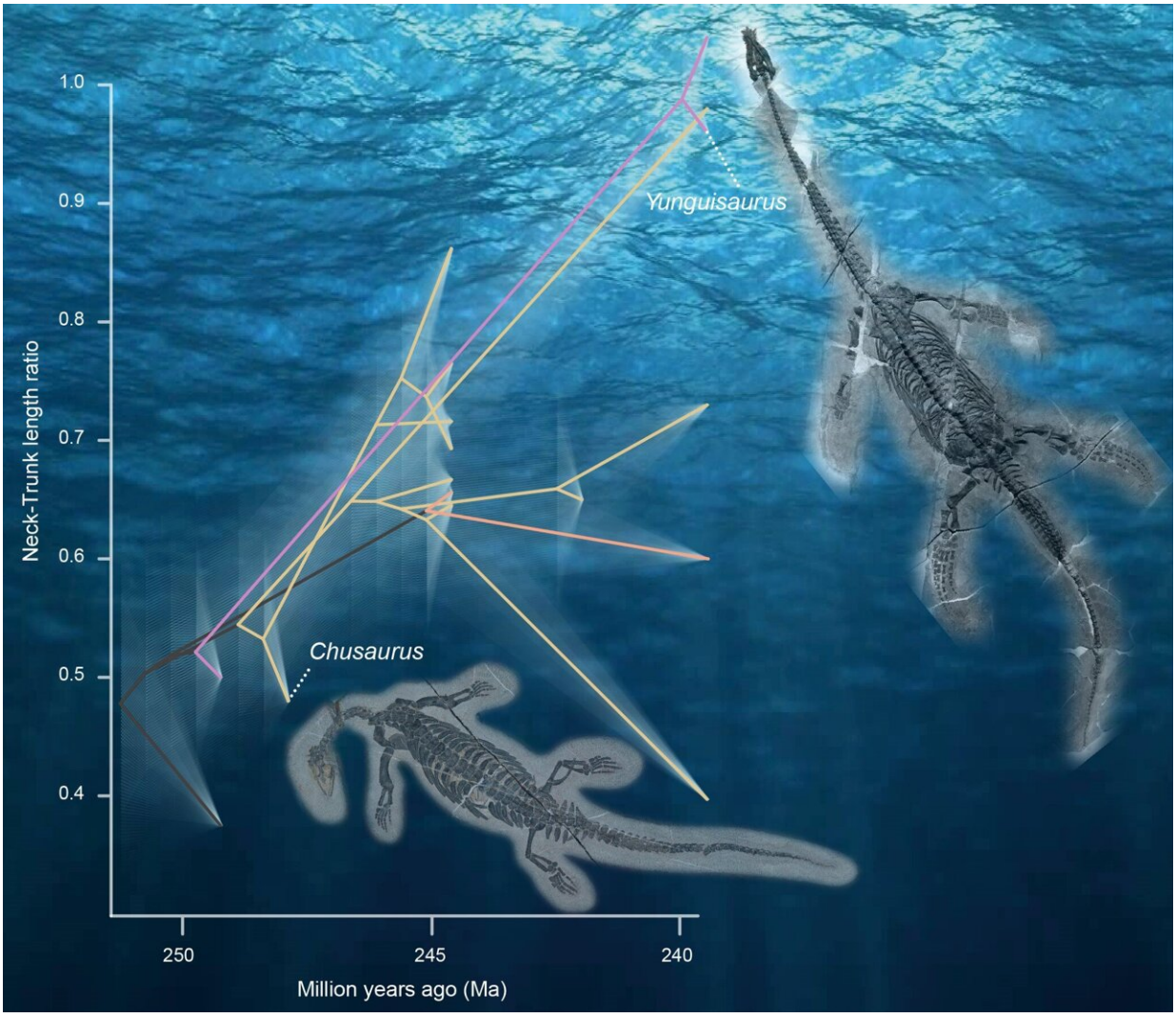
Plesiosaurs doubled their neck-length by gaining new vertebrae, research shows

September 4 2023



Fast rates of evolution and the specimens. Credit: University of Bristol

Plesiosaurs gained their famous long necks rapidly, researchers have shown.

Their lengthy necks, used for chasing fast-moving fishes, developed quickly over a five million year period around 250 million years ago.

The findings, published today in *BMC Ecology and Evolution*, and carried out by scientists in China and the UK, show that a species known as pachypleurosaur lengthened their necks mainly by adding new vertebrae. One species had 25 vertebrae, while some Late Cretaceous plesiosaurs such as Elasmosaurus had as many as 72, and its neck was five times the length of its trunk.

The animals originated in the Early Triassic, four million years after the end-Permian mass extinction wiped out around 90% of Earth's species and during a time of rapid change following the disaster.

In the study, the researchers describe a new, short-necked plesiosaur ancestor called Chusaurus xiangensis from the Early Triassic of Hubei Province, China. Its neck has begun to lengthen, but it is only half the length of the trunk of its body compared to 80% or higher in its later relatives.

"We were lucky enough to find two complete skeletons of this new beast," said Qi-Ling Liu from the China University of Geosciences in Wuhan, who led the project. "It's small, less than half a meter long, but this was close to the ancestry of the important group of marine reptiles called Sauropterygia."

"Our new reptile, Chusaurus, is a pachypleurosaur, one of a group of small marine predators that were very important in the Triassic. I wasn't sure at first whether it was a pachypleurosaur though because the neck seemed to be too short."

"The fossils come from the Nanzhang-Yuan'an Fauna of Hubei," said Dr. Li Tian, also of China University of Geosciences Wuhan, who co-supervised the project. "This has been very heavily studied in recent years as one of the oldest assemblages of marine reptiles from the Triassic. We have good quality radiometric dates showing the fauna is dated at 248 million years ago."

Collaborator Professor Michael Benton of the University of Bristol's School of Earth Sciences said, "The end-Permian mass extinction had been the biggest mass extinction of all time and only one in twenty species survived."

"The Early Triassic was a time of recovery and marine reptiles evolved very fast at that time, most of them predators on the shrimps, fishes and other sea creatures. They had originated right after the extinction, so we know their rates of change were extremely rapid in the new world after the crisis."

"The pachypleurosaurs lengthened their necks mainly by adding new vertebrae," said Professor Cheng Long, of the Wuhan Centre of China Geological Survey, a co-supervisor.

"Normally, vertebrates like reptiles and mammals (and us) have seven neck vertebrae. Chusaurus already had 17, whereas later pachypleurosaur had 25. Some Late Cretaceous plesiosaurs such as Elasmosaurus even had 72, and its neck was five times the length of its trunk. With so many vertebrae, these long necks must have been super-snakey and they presumably whipped the neck around to grab fishy prey while keeping the body steady."

Dr. Tom Stubbs of the Open University UK added, "Not all long-necked animals do it in the same way. Giraffes for example keep the standard seven neck vertebrae, but each one is very long, so they can reach high

into the trees. Flamingos also have long necks so they can reach the water to feed, because of their long legs, and they have extra vertebrae, up to twenty, but each one is also long."

"Our study shows that pachypleurosaur doubled the lengths of their necks in five million years, and the rate of increase then slowed down," added Dr. Ben Moon, also of the University of Bristol. "They had presumably reached some kind of perfect neck length for their mode of life."

"We think, as small predators, they were probably mainly feeding on shrimps and small fish, so their ability to sneak up on a small shoal, and then hover in the water, darting their head after the fast-swimming prey was a great survival tool. But there might have been additional costs in having a much longer neck, so it stabilized at a length just equal to the length of the trunk."

More information: Qi-Ling Liu et al, Rapid neck elongation in Sauropterygia (Reptilia: Diapsida) revealed by a new basal pachypleurosaur from the Lower Triassic of China, *BMC Ecology and Evolution* (2023). DOI: 10.1186/s12862-023-02150-w

Provided by University of Bristol