



PRESS RELEASE – State Museum of Natural History Stuttgart

In the Age of Dinosaurs, long-necked marine reptiles were decapitated by their predators.

Palaeontologists at the State Museum of Natural History Stuttgart find first fossil evidence of deadly predator attacks targeting the long necks of *Tanystropheus*.

Stuttgart, Germany, June 19, 2023. Many different lineages of prehistoric marine reptiles that lived before and during the Age of Dinosaurs possessed extremely long necks that were often more than twice the length of their body. This famous body type even inspired the legend of "Nessie", the Loch Ness monster. For more than 200 years, palaeontologists have speculated that these long necks of marine reptiles were vulnerable to attack by large predators, but they have been unable to find any fossils to support this idea. Now, a team from the State Museum of Natural History Stuttgart, Germany has succeeded in confirming this assumption. Dr. Stephan Spiekman and Dr. Eudald Mujal, palaeontologists at the State Museum of Natural History Stuttgart, examined two fossils of the 242-million-year-old Triassic marine reptile *Tanystropheus*. The necks in both of these reptiles are completely separated from the body and show bite marks from predators. This is the first clear evidence that these elongate necks, despite their evolutionary success in marine reptiles, were vulnerable. The scientists' research is published today in the journal "Current Biology".

An important piece of the puzzle in reconstructing past ecosystems

Until their extinction, long-necked marine reptiles swam the oceans for more than 175 million years. That is more than twice as long as the time span between humans and *Tyrannosaurus rex*. An extremely long neck was therefore a highly successful evolutionary adaptation for prehistoric marine reptiles for a very long time. Despite this, palaeontologists since the days of Charles Darwin suspected that such a long neck also represented a weakness against potential predators. However, because fossil evidence of predator-prey interactions among marine reptiles is very rarely preserved, no clear evidence to support this interpretation was ever found, until now. The research results of the Stuttgart palaeontologists are therefore an important piece of the puzzle for scientists with regard to the evolution and interaction of ancient marine reptiles in their prehistoric ecosystems.

***Tanystropheus*, a very bizarre reptile**

"Of the various forms of marine reptiles, *Tanystropheus* was perhaps one of the most bizarre examples: It had a neck three times as long as its torso, but only 13 extremely elongate vertebrae. This made its neck particularly long, slender, and stiff. It most likely served to catch prey through an ambush strategy", said Dr. Stephan Spiekman, an expert on Triassic reptiles who has studied *Tanystropheus* in detail during his PhD research. 242 million years ago, two species of *Tanystropheus* lived together in a shallow sea on the border between what is now Switzerland and Italy. One species was only up to 1.5 metres long and probably fed on shrimp and other invertebrates. The other species could grow up to 6 metres long and ate fish as well as squid.



"Our most important research finding is direct evidence of decapitation in extinct long-necked marine reptiles by predators. In the two studied specimens of *Tanystropheus*, representing both species, the neck was completely severed. The presence of bite marks is also truly remarkable. In addition, the repeated occurrence of severed necks shows us that the elongated neck was indeed a functional weakness of the animals," said Dr. Stephan Spiekman.

Bite marks, sequence of events, prime suspects

By examining the fossils in detail, the palaeontologists found indications that both specimens of *Tanystropheus* were deliberately hunted. The type of breaking of the bones, as well as the close association of clear bite marks, suggests that the necks were severed with a single bite. Researchers suspect that the fatal attack occurred around the time the animal in question died, due to the way the bones are broken, which is similar to that seen in fresh cadavers of recent animals. Because in both specimens the head and neck are almost perfectly preserved, but no sign of the body can be found, the predator probably fed on the body of its victim, leaving the lean head and neck behind. The excellent preservation of the neck, and lack of bite marks makes it unlikely that the animals were scavenged.

"Because of its small size, many different predators could have decapitated the small species of *Tanystropheus*. From a large predatory fish to another marine reptile. In the case of the large species, the list of suspects is smaller. Only a very large marine reptile was capable of biting the neck off in a 4 metre long *Tanystropheus*. An ancestor of the plesiosaurs, *Nothosaurus giganteus* is one of the main suspects here", said Dr. Eudald Mujal. The palaeontologist at the Stuttgart Museum, also research associate at Institut Català de Paleontologia Miquel Crusafont, Spain, is a specialist in bite marks, decay processes and trophic interactions, feeding relationships, that can be inferred based on fossils.

Inferences about the evolution of prehistoric marine fauna

Tanystropheus was evolutionarily quite successful, living for at least 10 million years and occurring in Europe, the Middle East, China, North America and possibly South America. "In the broadest sense, our research shows that evolution is a game of trade-offs. The advantage of having a long neck nevertheless seems to have outweighed the risk of being attacked by a predator," says Dr. Stephan Spiekman.

The *Tanystropheus* fossils studied are from the Monte San Giorgio site and are in the collection of the University of Zurich. Monte San Giorgio is one of the most important sites for Middle Triassic marine fossils and has been designated a UNESCO World Heritage Site for this reason.

For the editors

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State Museum of Natural History Stuttgart:

The State Museum of Natural History Stuttgart is a forward-looking research and communication institute. Its research collections, the archives of diversity, contain over 12 million objects. The museum researches the evolution of life and analyses the biodiversity of different ecosystems and communicates research findings to the general public.

www.naturkundemuseum-bw.de



The Monte San Giorgio Fossil Site:

The specimens of *Tanystropheus* studied come from a fossil deposit particularly well known among palaeontologists, Monte San Giorgio, on the border between Switzerland and Italy. The fossils are in the collection of the University of Zurich, Switzerland. Monte San Giorgio is one of the most important sites for Triassic marine fossils and has been designated a UNESCO World Heritage Site. It represents a shallow marine ecosystem from the Middle Triassic period 242 million years ago, just before the appearance of the first dinosaurs, and has yielded fossils of exceptional preservation. The site is therefore referred to as a fossilagerstätte. Such exceptional fossil deposits are very important because they provide specific snapshots of past ecosystems. This helps scientists to reconstruct and understand what life looked like, evolved, and how different organisms interacted with each other in Earth's history.

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Image material:

Picture 1: Picture1-Tanystropheus-Illustration-Copyright-Roc Olivé.jpg

Description: Reconstruction and illustration of *Tanystropheus* being attacked by one of the suspected predators, *Nothosaurus giganteus*, in the prehistoric sea.

Copyright notice: Roc Olivé (Institut Català de Paleontologia Miquel Crusafont) / FECYT

Picture 2: Picture2-Tanystropheus-Illustration-Fossil-Copyright-Olivé, Spiekman, Mujal.jpg

Description: Reconstruction and illustration of *Tanystropheus* and pictures of one of the examined fossils of *Tanystropheus* with bite marks.

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Picture 3: Picture3-Collection-SMNS-Spiekman, Mujal-Copyright SMNS, L.Reinoehl.jpg

Description: The palaeontologists, Dr. Eudald Mujal (left) and Dr. Stephan Spiekman, in the palaeontological research collection of the Natural History Museum Stuttgart.

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Picture 4: Picture4-Diorama-Tanystropheus-Spiekman, Mujal-Copyright SMNS, L.Reinoehl.jpg

Description: Dr. Eudald Mujal (left) and Dr. Stephan Spiekman in front of a reconstruction of a prehistoric marine habitat with *Tanystropheus*.

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Picture 5: Picture5-Nothosaurus-Exhibition-SMNS-Copyright, SMNS, M.Rech.jpg

Description: Example of the skull of a 242 million year old *Nothosaurus giganteus*, in the exhibition of the Natural History Museum Stuttgart. The fossil was found in Baden-Württemberg.

Picture 6: Fossil-Tanystropheus hydroides-Copyright, S.Spiekman.jpg

Description: The large specimen of *Tanystropheus* (*Tanystropheus hydroides*) decapitated by a large predator. The specimen is housed in the Palaeontological Institute of the University of Zurich, Switzerland.

Copyright notice: Stephan Spiekmann

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