Earth's first-known giant was as big as a sperm whale

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The skull of the first giant creature to ever inhabit the Earth, the ichthyosaur Cymbospondylus youngorum, currently on display at the Natural History Museum of Los Angeles County. Credit: Natalja Kent / Natural History Museum of Los Angeles County

The two-meter skull of a newly discovered species of giant ichthyosaur, the earliest known, is shedding new light on the marine reptiles' rapid growth into behemoths of the Dinosaurian oceans, and helping us better understand the journey of modern cetaceans (whales and dolphins) to becoming the largest animals to ever inhabit the Earth.

While dinosaurs ruled the land, ichthyosaurs and other aquatic reptiles (that were emphatically not dinosaurs) ruled the waves, reaching similarly gargantuan sizes and species diversity. Evolving fins and hydrodynamic body-shapes seen in both fish and whales, ichthyosaurs swam the ancient oceans for nearly the entirety of the Age of Dinosaurs.

"Ichthyosaurs derive from an as yet unknown group of land-living reptiles and were air-breathing themselves," says lead author Dr. Martin Sander, paleontologist at the University of Bonn and Research Associate with the Dinosaur Institute at the Natural History Museum of Los Angeles County (NHM). "From the first skeleton discoveries in southern England and Germany over 250 years ago, these 'fish-saurians' were among the first large fossil reptiles known to science, long before the dinosaurs, and they have captured the popular imagination ever since."

A life recreation of C. youngorum stalking the Nevadan oceans of the Late

Triassic 246 million years ago. Credit: Stephanie Abramowicz / Natural History Museum of Los Angeles County

Excavated from a rock unit called the Fossil Hill Member in the Augusta Mountains of Nevada, the well-preserved skull, along with part of the backbone, shoulder, and forefin, date back to the Middle Triassic (247.2-237 million years ago), representing the earliest case of an ichthyosaur reaching epic proportions. As big as a large sperm whale at more than 17 meters (55.78 feet) long, the newly named Cymbospondylus youngorum is the largest animal yet discovered from that time period, on land or in the sea. In fact, it was the first giant creature to ever inhabit the Earth that we know of.

"The importance of the find was not immediately apparent," notes Dr. Sander, "because only a few vertebrae were exposed on the side of the canyon. However, the anatomy of the vertebrae suggested that the front end of the animal might still be hidden in the rocks. Then, one cold September day in 2011, the crew needed a warm-up and tested this suggestion by excavation, finding the skull, forelimbs, and chest region."

The new name for the species, C. youngorum, honors a happy coincidence, the sponsoring of the fieldwork by Great Basin Brewery of Reno, owned and operated by Tom and Bonda Young, the inventors of the locally famous Icky beer which features an ichthyosaur on its label.

In other mountain ranges of Nevada, paleontologists have been recovering fossils from the Fossil Hill Member's limestone, shale, and siltstone since 1902, opening a window into the Triassic. The mountains connect our present to ancient oceans and have produced many species of ammonites, shelled ancestors of modern cephalopods like cuttlefish and octopuses, as well as marine reptiles. All these animal specimens are

collectively known as the Fossil Hill Fauna, representing many of C. youngorum's prey and competitors.

Owing to their remote location, fossils have only recently been discovered in the Augusta Mountains. An international team of scientists led by Dr. Sander began collecting on public lands there 30 years ago, with fossil finds being accessioned to the Natural History Museum of Los Angeles County since 2008. Credit: Lars Schmitz

C. youngorum stalked the oceans some 246 million years ago, or only about three million years after the first ichthyosaurs got their fins wet, an amazingly short time to get this big. The elongated snout and conical teeth suggest that C. youngorum preyed on squid and fish, but its size

meant that it could have hunted smaller and juvenile marine reptiles as well.

The giant predator probably had some hefty competition. Through sophisticated computational modeling, the authors examined the likely energy running through the Fossil Hill Fauna's food web, recreating the ancient environment through data, finding that marine food webs were able to support a few more colossal meat-eating ichthyosaurs. Ichthyosaurs of different sizes and survival strategies proliferated, comparable to modern cetaceans'— from relatively small dolphins to massive filter-feeding baleen whales, and giant squid-hunting sperm whales.

Co-author and ecological modeler Dr. Eva Maria Griebeler from the University of Mainz in Germany, notes, "Due to their large size and resulting energy demands, the densities of the largest ichthyosaurs from the Fossil Hill Fauna including C. youngourum must have been substantially lower than suggested by our field census. The ecological functioning of this food web from ecological modeling was very exciting as modern highly productive primary producers were absent in Mesozoic food webs and were an important driver in the size evolution of whales."

Natural History Museum of Los Angeles County Dinosaur Institute volunteer Viji Shook lying next to the skull of Cymbospondylus youngorum for scale, during the preparation of the specimen. Credit: Martin Sander / Natural History Museum of Los Angeles County

Whales and ichthyosaurs share more than a size range. They have similar body plans, and both initially arose after mass extinctions. These similarities make them scientifically valuable for comparative study. The authors combined computer modeling and traditional paleontology to study how these marine animals reached record-setting sizes independently.

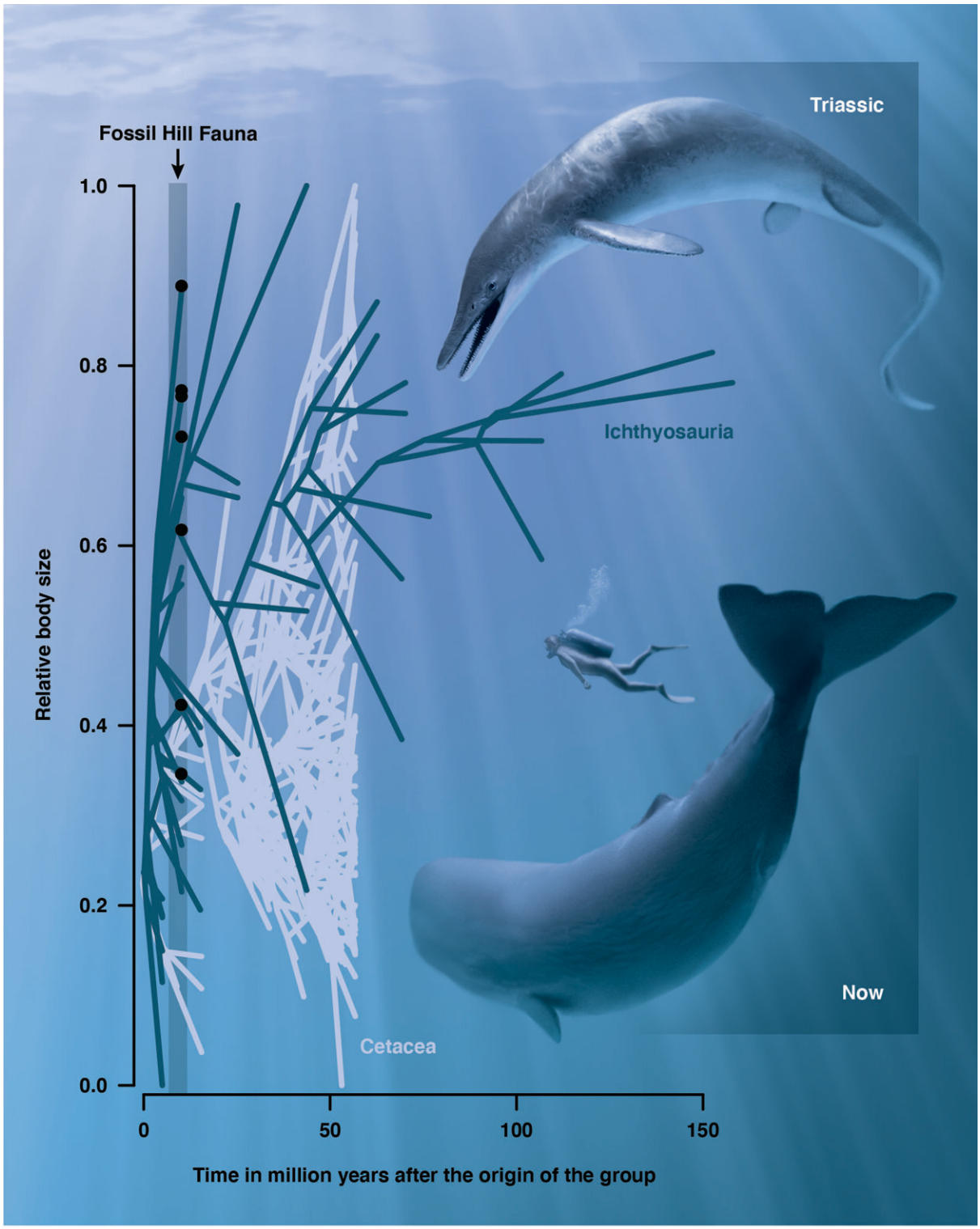
"One rather unique aspect of this project is the integrative nature of our approach. We first had to describe the anatomy of the giant skull in detail and determine how this animal is related to other ichthyosaurs," says senior author Dr. Lars Schmitz, Associate Professor of Biology at

Scripps College and Dinosaur Institute Research Associate. "We did not stop there, as we wanted to understand the significance of the new discovery in the context of the large-scale evolutionary pattern of ichthyosaur and whale body sizes, and how the fossil ecosystem of the Fossil Hill Fauna may have functioned. Both the evolutionary and ecological analyses required a substantial amount of computation, ultimately leading to a confluence of modeling with traditional paleontology."

An ichthyosaur fossil surrounded by the shells of ammonites, the food source that possibly fueled their growth to huge. Credit: Georg Oleschinski / University of Bonn, Germany.

They found that while both cetaceans and ichthyosaurs evolved very large body sizes, their respective evolutionary trajectories toward gigantism were different. Ichthyosaurs had an initial boom in size, becoming giants early on in their evolutionary history, while whales took much longer to reach the outer limits of huge. They found a connection between large size and raptorial hunting—think of a sperm whale diving down to hunt giant squid—and a connection between large size and a loss of teeth—think of the giant filter-feeding whales that are the largest animals ever to live on Earth.

Ichthyosaurs' initial foray into gigantism was likely thanks to the boom in ammonites and jawless eel-like conodonts filling the ecological void following the end-Permian mass extinction. While their evolutionary routes were different, both whales and ichthyosaurs relied on exploiting niches in the food chain to make it really big.



A figure from the text comparing C. youngorum to a modern sperm whale as well as rates of body size evolution over time between ichthyosaurs and

cetaceans. The lines trending towards the top indicate larger body sizes whereas those towards the bottom are smaller sizes. Time is displayed as starting from the point of origin of the group until their extinction (for ichthyosaurs) or present (for whales). Credit: Stephanie Abramowicz / Natural History Museum of Los Angeles County

"As researchers, we often talk about similarities between ichthyosaurs and cetaceans, but rarely dive into the details. That's one way this study stands out, as it allowed us to explore and gain some additional insight into body size evolution within these groups of marine tetrapods," says NHM's Associate Curator of Mammalogy (Marine Mammals), Dr. Jorge Velez-Juarbe. "Another interesting aspect is that Cymbospondylus youngorum and the rest of the Fossil Hill Fauna are a testament to the resilience of life in the oceans after the worst mass extinction in Earth's history. You can say this is the first big splash for tetrapods in the oceans."

C. youngorum will be permanently housed at the Natural History Museum of Los Angeles County, where it is currently on view.

More information: P. Martin Sander et al, Early giant reveals faster evolution of large size in ichthyosaurs than in cetaceans, *Science* (2021). DOI: 10.1126/science.abf5787

Lene Liebe Delsett et al, Early and fast rise of Mesozoic ocean giants, *Science* (2021). DOI: 10.1126/science.abm3751 , www.science.org/doi/10.1126/science.abm3751

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