

The New York Times

TRILOBITES

Where Did Fish First Evolve? The Answer May Be Shallow

Some had armor and spikes. Many lacked jaws. They evolved in the shallow coasts around supercontinents and they were some of our earliest ancestors with spines.



By **Nicholas St. Fleur**

Oct. 25, 2018

More than 400 million years ago, ancient oceans were teeming with many fish that might seem alien in today's seas.

Back then some wore plates of bony armor and lacked jaws, like the arandaspids, which looked like a clam with a tail. The heterostracans sometimes resembled underwater armadillos with spikes. There were also galeaspids, some of which sported swordlike helmets, and the osteostracans, which had horseshoe-shaped heads.

Not all jawless fish were heavily armored. The thelodonts, for example, had torpedo-shaped bodies and bony scales that looked like shark skin. Some anaspids had scales and a leaf-shaped body. And then came the first jawed fishes like armored placoderms, some of which used their tanklike exterior and razor-sharp teeth to dominate the water world.



An artist's rendering of a heterostracan. Nobumichi Tamura

Thelodont Nobumichi Tamura

Osteostracan Nobumichi Tamura

Scientists have long wondered where in the sea these extinct fish groups and their living relatives first evolved. Was it the open ocean? Perhaps on coral reefs? Or maybe in the depths of the abyss?

Figuring out the answer has been difficult. While there's an abundance of fish fossils from about 420 million years ago, the ancient fossil record gets scarce farther back at about 480 million years ago, when fish are believed to have first appeared.

Now, a new study suggests that fish first swam in the shallows around the coasts of supercontinents before they diversified and conquered the world's waters. The findings, which were published Thursday in the journal *Science*, also provide insight into the origins of the vertebrates that became the forebears of our ancestors who first ventured onto land.

[Like the Science Times page on Facebook. | Sign up for the Science Times newsletter.]

To better understand the ancient evolutionary history of fish, the researchers trawled through the scientific literature and created a database with more than 2,700 fossil records of jawed and jawless fish from every continent that stretched from 480 million to 360 million years ago. The database allowed the team to determine where in the ocean the ancient fish groups lived and evolved.

"All of the groups kept originating in the shallow water over the whole 100-million-year period, which was completely unexpected," said Lauren Sallan, a paleontologist at the University of Pennsylvania and lead author of the study. "This is an unexpected diversity hot spot that persists for a long time."

The finding changes what scientists previously assumed about where the earliest fish evolved, said Michael Coates, a vertebrate paleontologist at the University of Chicago, who was not involved in the study.

“Previously we thought the early reef systems would be the cradle of diversification,” said Dr. Coates. “But no, it seems that these early armored forms were in much nearer shore environments. That explains why our early record is so cryptic.”

Placoderm Nobumichi Tamura

Galeaspid Nobumichi Tamura

Anaspid Nobumichi Tamura

The team is not exactly sure why fish evolved near the coast in clear, shallow lagoons and intertidal zones that were typically no deeper than about 100 feet. They think it may have to do with the waves, sea level changes, runoffs, rainfalls and other environmental factors of shallow water habitats.

“We’ve come to the suspicion that there’s something going on with water chemistry and potentially with oxygen levels in these active and dynamic environments,” said Ivan Sansom, a paleobiologist from the University of Birmingham, in England and an author on the paper.

The team also found that as the fish evolved in the shallow water, the more flexible swimmers, like the thelodonts, eventually left and invaded deeper areas like coral reefs and the deep sea. There, they may have encountered mollusks, trilobites and fearsome sea scorpions.

Over time, many of the hunkering, armored fish evolved into bottom dwellers and might have stayed in the waters near shore and moved to freshwater rivers and lakes.

Today, evolution has left us with two main fish groups. Bony fish like salmon, marlin and some 28,000 other species make up the osteichthyes. And the chondrichthyes are cartilaginous fish like sharks, rays and skates.

But a couple oddball jawless fish still lurk in the seas, like goopy hagfish and the bloodsucking lampreys. They may not be armored, but they’re a reminder of the evolutionary footsteps and missteps that eventually led to all vertebrates, underwater and up here on dry land.

Interesting reporting about creatures that live underwater

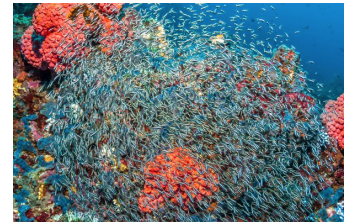
On Ecstasy, Octopuses Reached Out for a Hug Sept. 20, 2018



Fish Depression Is Not a Joke Oct. 16, 2017



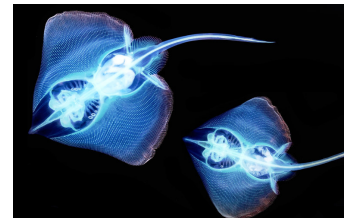
Why Southeast Asia and Australia's Coral Reefs Became So Rich in Species Oct. 17, 2018



This Mutant Crayfish Clones Itself, and It's Taking Over Europe Feb. 5, 2018



These Skates Are Made for Walking Feb. 8, 2018



Nicholas St. Fleur is a science reporter who writes about archaeology, paleontology, space and other topics. He joined The Times in 2015. Before that, he was an assistant editor at The Atlantic. @scifleur • Facebook

READ 6 COMMENTS