Deep-sea fish use hydrothermal vents to incubate eggs

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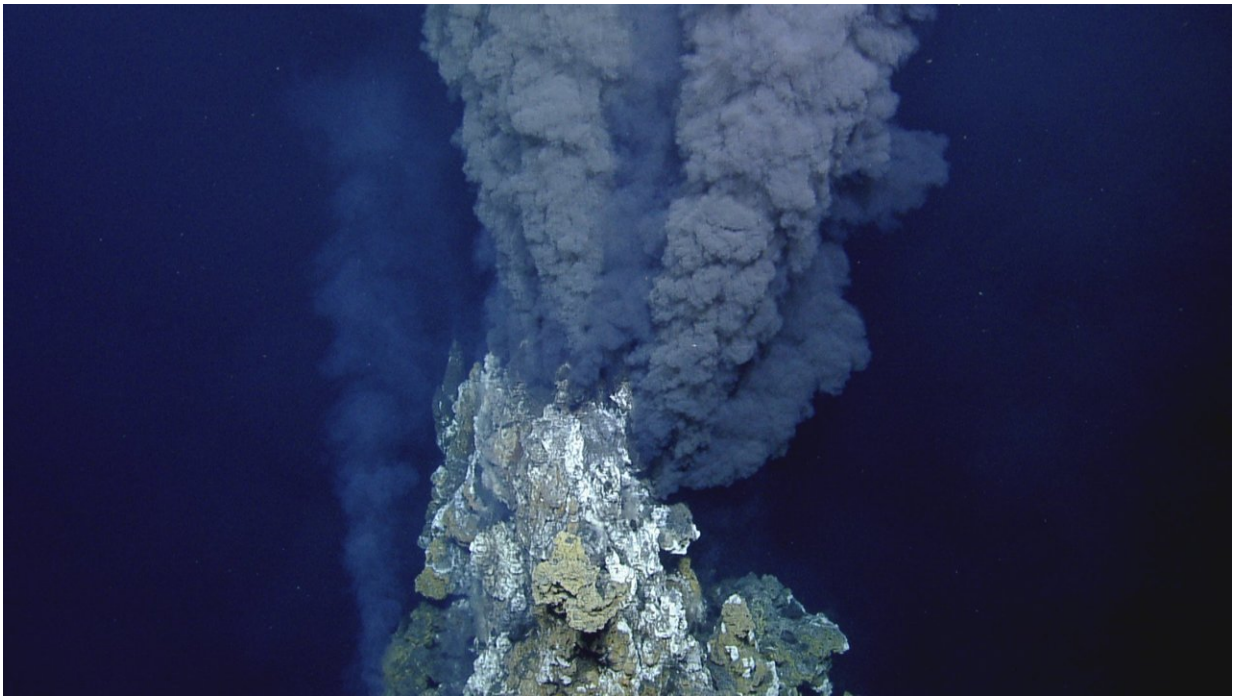


Eggs of deep-sea skates have been discovered near the hottest type of hydrothermal vents, where super-heated water emerges out of the sea floor. These vents, called black smokers, emit dark, sulphurous plumes. Credit: Ocean Exploration Trust

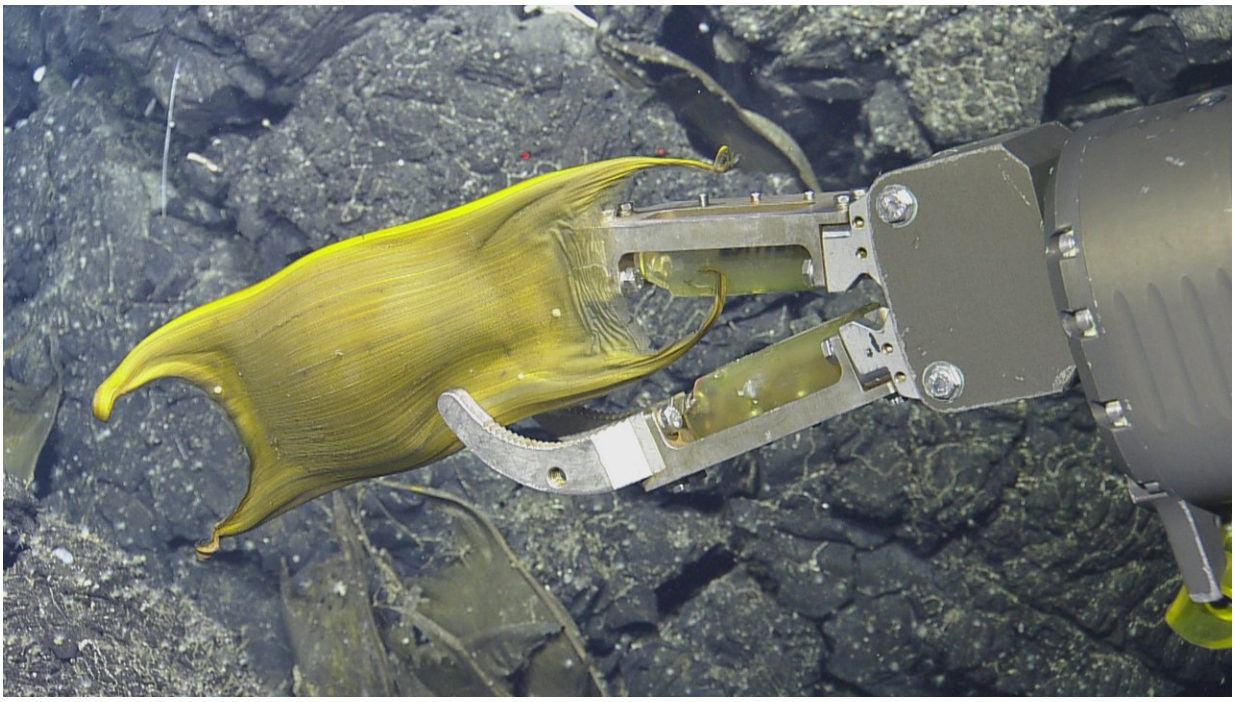
Some deep-sea skates—cartilaginous fish related to rays and sharks—use volcanic heat emitted at hydrothermal vents to incubate their eggs, according to a new study in the journal *Scientific Reports*.

Because deep-sea skates have some of the longest egg incubation times, estimated to last more than four years, the researchers believe the fish are using the hot vents to accelerate embryo development. This the first time such behavior has been seen in marine animals.

"Hydrothermal vents are extreme environments, and most animals that live there are highly evolved to live in this environment," said Charles Fisher, Professor and Distinguished Senior Scholar of Biology at Penn State and an author of the paper. "This study is one of the few that demonstrates a direct link between the vent environment and animals that live most of their life elsewhere."

Among the least explored and unique ecosystems, deep-sea hydrothermal fields are regions on the sea floor where hot water emerges after being heated in the ocean crust. In their study, an international team of researchers, led by Pelayo Salinas-de-León of the Charles Darwin Research Station, used a remotely operated underwater vehicle (ROV) to survey in and around an active hydrothermal field located in the Galapagos archipelago, 28 miles north of Darwin Island.

"The first place the ROV landed on the sea floor was on a ridge, in the plume of a nearby hydrothermal vent that we had specifically come to investigate - a black smoker," said Fisher. "When we panned the camera down, we found something we did not expect: These giant egg cases, also known as mermaid purses. And we found several layers of them, indicating that whatever was laying these eggs had been coming back to this spot for many years to lay them. As the dive progressed, we saw more and more of these egg cases and realized that this was not the result of a single animal, but rather a behavior shared by many individuals. "



Over 150 egg cases were discovered near a black smoker in the deep waters near the Galápagos Islands. The research team collected four egg cases using a remotely operated underwater vehicle for DNA analysis. Credit: Ocean Exploration Trust

The researchers found 157 egg cases in the area and collected four with the ROV's robotic arm. DNA analysis revealed that the egg cases belonged to the skate species Bathyraja spinosissima, one of the deepest-living species of skates that is not typically thought to occur near the vents. The majority—58 percent—of the observed egg cases were found within about 65 feet of the chimney-like black smokers, the hottest kind of hydrothermal vents, and over 89 percent had been laid in places where the water was hotter than average. The researchers believe that the warmer temperatures in the area could reduce the typically years-long incubation time of the eggs.

While several species of reptiles and birds lay their eggs in locations that optimize soil temperatures, only two other groups of animals are known to use volcanically heated soils: the modern-day Polynesian megapode—a rare bird native to Tonga—and a group of nest-building neosauropod dinosaurs from the Cretaceous Period.

DNA analysis revealed that the egg cases found near the black smoker belong to the skate species Bathyraja spinosissima, commonly known as deep-sea skates. The researchers believe the fish use the volcanic heat emitted from the hydrothermal vents to accelerate the typically years-long incubation time of the eggs. Credit: Julye Newlin, Ocean Exploration Trust

Because of their long lifespan and slow rate of development, deep-water skates may be particularly sensitive to threats to their environment, including fisheries expanding into deeper waters and sea-floor mining. Understanding the development and habitat of the skates is vital for developing effective conservation strategies for this poorly understood species.

"The deep sea is full of surprises," said Fisher. "I've made hundreds of dives, both in person and virtually, to deep sea hydrothermal vents and have never seen anything like this."

More information: Pelayo Salinas-de-León et al, Deep-sea hydrothermal vents as natural egg-case incubators at the Galapagos Rift, *Scientific Reports* (2018). DOI: 10.1038/s41598-018-20046-4

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