

Hammerhead Shark Gave "Virgin Birth" in Omaha Zoo

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A hammerhead shark born in a Nebraska zoo in 2001 was the result of a so-called virgin birth, new DNA evidence shows.

The finding marks the first confirmed case of a female shark fertilizing her own eggs and giving birth without sperm from a male, a process known as parthenogenesis.

"We were very surprised to find parthenogenesis in a shark," said Mahmood Shivji, director of the Guy Harvey Research Institute at Florida's Nova Southeastern University.

"It has been found in other vertebrates, birds, snakes, reptiles, even some bony fishes, but it has never been described in sharks and rays or in mammals," he added.

Shivji is the co-author of a study detailing the findings that was published yesterday in the journal *Biology Letters*.

Shark Mystery

The baby bonnethead shark, a type of hammerhead, was born at the Henry Doorly Zoo in Omaha, Nebraska.

It was killed within hours of its birth by a stingray in the same tank.

Scientists were able to match the baby's DNA with one of three potential mothers in the tank.

But none of these females had had any contact with a male for more than three years.

Scientists at first believed the birth had come about as a result of a female shark's well-documented ability to store sperm for months.

"But that assumed the mother had actually copulated in the wild when she was a baby," before being taken to the tank in 1998, Shivji said. "That was not likely."

Previous studies had also shown that sharks are able to store sperm for only about five months.

The virgin birth was confirmed when an analysis of the baby shark's DNA found that it contained no paternal genetic material.

"That nailed down the fact that this was a case of parthenogenesis," Shivji said.

"The female's eggs had developed into a fully formed, live [shark] without actually being fertilized by a male."

No Sex Required

Parthenogenesis has been seen in about 70 species, mainly insects but also several lizards, for example.

Until now it was thought that all shark species used internal fertilization through copulation to produce their young.



This baby bonnethead shark, born in a Nebraska zoo in 2001, was recently found to have been the product of "virgin birth," the first time the phenomenon has been confirmed in a shark. The baby was killed soon after birth by a stingray kept in the same tank.

Photograph courtesy Henry Doorly Zoo

However, in 2002, the eggs of a female white spotted bamboo shark at the Belle Isle Aquarium in Detroit produced two live babies, even though the female had not been near a male for six years.

The DNA of those offspring are now being tested by Shivji and his colleagues.

"We have two cases now of female sharks giving birth without males," he said.

"What is clear is that sharks at the very least have an alternative reproductive pathway available to them in the absence of males."

The big question is whether this behavior occurs in the wild and, if so, how often, experts note.

"Since parthenogenesis in sharks has only been documented in individuals maintained in captivity, one wonders if the phenomenon is an artifact of artificial conditions imposed by the aquarium environment," said George Burgess, the director of shark research at the Florida Museum of Natural History in Gainesville.

Genetic Disadvantage

The results could also be of interest to shark biologists because of potential implications for fishery management.

Sharks are being overfished worldwide, and many populations have been decimated.

"We now know that if females in the wild are having difficulty encountering males they have this capability of triggering this alternative pathway for reproduction," Shivji said.

But, he warned, while more baby sharks may be produced in the absence of males, baby sharks produced only by the mother suffer considerable genetic setbacks.

"For one, there is no father to provide genetic diversity," Shivji said.

Reduced genetic diversity makes living creatures less able to cope with threats, such as disease and climate change.

"The fitness of the parthenogenesis-produced individuals [is] much lower than would come from normal sexual reproduction, and eventually that will catch up with the population," Shivji said.
