

# Female Shark Reproduced Without Male DNA, Scientists Say

By Henry Fountain

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A hammerhead shark that gave birth in a Nebraska aquarium reproduced without mating, a genetic analysis shows.

This form of asexual reproduction, called parthenogenesis, has been found in other vertebrate species, including some snakes and lizards. But this is the first time it has been documented in a shark.

Researchers from the Guy Harvey Research Institute at Nova Southeastern University in Florida and Queen's University Belfast in Northern Ireland found no male DNA in the female baby shark, which was born in December 2001 and died shortly after birth, apparently killed by another fish. The mother was one of three female bonnetheads, a small hammerhead species, that had been captured in Florida and kept without male sharks for three years in the Henry Doorly Zoo in Omaha.

At the time of the birth, many scientists thought that the female had mated with another species, or that it had used sperm obtained years before. Female sharks are capable of storing sperm, although none have been known to store it as long as these sharks had been isolated.

But through the analysis "it was pretty clear that there was no male contribution," said Mahmood S. Shivji, director of the Guy Harvey Research Institute and author of a paper on the finding being published online today by the journal *Biology Letters*.

Instead, the female shark's own genetic material combined during the process of cell division that produces an egg. A cell called the secondary oocyte, which contains half the female chromosomes and normally becomes the egg, fused with another cell called the secondary polar body, which contains the identical genetic material.

Robert E. Hueter, director of the Center for Shark Research at the Mote Marine Laboratory in Sarasota, Fla., said the finding helped fill a gap in understanding of parthenogenesis, which has been found to occur in most vertebrate lines except mammals and, until now, cartilaginous fishes like sharks.

"These guys have proven their case," Dr. Hueter said of the researchers.

Dr. Shivji said that after the bonnethead birth was reported, keepers at the Belle Isle Aquarium in Detroit reported similar virgin births by white spotted bamboo sharks. While those births have not been proved to result from parthenogenesis, Dr. Shivji said, it is reasonable to assume they did. And if it is found in these two species, "it seems not unreasonable to think this is probably more widespread in different shark lineages," he said.

Gordon W. Schuett, an adjunct professor at Georgia State University who discovered parthenogenesis in a snake in 1997, said it would probably be discovered in more species "because we know to look for it."

Previously, Dr. Schuett said, zookeepers and others tended to discount evidence of virgin births precisely because they were so out of the ordinary. But in recent years it has been found in Komodo dragons, other lizards and snake species.

"It's all over the place," Dr. Schuett said.



*This shark's mother is said to have had no contact with male sharks.*

*( Photo courtesy Henry Doorly Zoo)*

Still, parthenogenesis among vertebrates tends to be rare, and, while it may occur in the wild, has been documented only in captivity.

“It’s a last-resort tactic that animals use when they absolutely can’t find another mate,” Dr. Hueter said.

While it has the advantage of ensuring the survival of a species in the absence of males, it also comes at a cost: a loss of genetic diversity. And that, Dr. Shivji said, may spell conservation problems for some shark species whose populations are declining. If it becomes more difficult for female sharks in the wild to find a mate and instead they reproduce through parthenogenesis, then the offspring will be less genetically diverse, making the species more susceptible to diseases and other problems.

But Dr. Hueter said he thought it unlikely that most sharks, which are highly mobile, would end up so isolated that parthenogenesis would be much of a factor. Sharks have plenty of other problems that are of potentially greater impact.

“I would be concerned about a lot of other things than whether or not a female shark can get a date for an evening,” he said.

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