Female Sharks Reproduce Without Dad

By Jennifer Viegas, Discovery News

May 23, 2007 — Virgin births are possible in female sharks, according to a new study that determined a captive female bonnethead shark reproduced without having been near a male in three years.

Lee G. Simmons

No Need for Dad?
A bonnethead shark, born in a virgin birth six years ago, is shown swimming. Analysis of the shark confirmed it had no father. Research also confirmed it carried only half the genes of its mother, placing it at a genetic disadvantage.

Since other captive females — including a white spotted bamboo shark — have anecdotally accomplished the same feat, researchers conclude it is likely all shark species possess the ability.

The recent determination, made possible through DNA analysis, actually applies to the birth of a bonnethead shark (of the hammerhead family) that occurred six years ago at the Henry Doorly Zoo in Nebraska.

"It was a big surprise for us," zoo director Lee Simmons told Discovery News.

Simmons added, "We brought in three female bonnetheads on December 15, 1998, and on December 14, 2001, bang! One of them gave birth to an 8-inch-long offspring."

The pup unfortunately died the same day from internal injuries likely caused by a stingray in the same exhibit that munched the wiry infant and then spit it out. Puzzled by the birth, Simmons and his team put the offspring on ice and handed it over to the Guy Harvey Research Institute at Nova Southeastern University.

At this point Simmons said he considered all possibilities, including a delayed pregnancy, which is possible in some insects that can store sperm and then give birth much later.

Mahmood Shivji, director of the institute, and his team collected tissue samples from all of the zoo's female bonnetheads. DNA analysis, which took several years, identified one female as the mother.

Research on the perished pup found that it had no paternal DNA. Additionally, it possessed half of its mother's genetic diversity. Combined, the data indicates the mother gave birth through a non-sexual mode of reproduction known as automatic parthenogenesis.

Shivji explained to Discovery News that this process involves the female creating an egg that contains fifty percent of the mother's genes. It is induced to behave as though it has been fertilized by a tiny, genetically similar cell called a sister polar body.

The resulting offspring therefore is doubly genetically disadvantaged.

"It had no father to provide genetic diversity, and it even lacks its mother's full genetic makeup," Shivji said.

He speculates that such births can only occur when females do not have access to males, such as in a captive setting, or in the wild when overfishing depletes shark populations.

"We now are concerned, because if conditions prompt asexual reproduction in the wild, the species could be at an evolutionary disadvantage," he said.
While the new research, published in today's Royal Society Biology Letters, represents a rare, documented case of an asexual birth in a shark, it's already known that certain birds, reptiles and amphibians also possess the ability.

Shivji said it is significant that sharks can now be added to the list, since they are the world's oldest living vertebrates, a group of backboned animals that also includes humans.

Since humans and mammals lack the ability, he suspects it evolved early on in the vertebrate lineage, but was lost in some groups when they diverged from their common ancestor with sharks about 450 million years ago.