

## Sex-free shark birth startles scientists, and worries them

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Scientists say a female hammerhead shark gave birth without having sex—the first scientific report that an ancient lineage of vertebrates can reproduce asexually, or without sex. The development startled scientists, and worried them. Asexual reproduction, especially of the type involved in this case, leaves babies at a genetic disadvantage—due to lack of genetic diversity, one said. This would place extra burdens on already threatened shark populations.

Among vertebrates, asexual reproduction is known only in very few species: some reptiles, birds and amphibians, and a few members of a relatively modern lineage of fish known as teleosts. Asexual reproduction was found in a type of hammerhead shark species known as the bonnethead, or *Sphyrna tiburo*. (Image courtesy D. Chapman)

The shark surprise leaves mammals as the only major vertebrate group where this form of reproduction has not been seen, said Paul O'Rourke of Queen's University Belfast, one of the researchers. Its occurrence in sharks also suggests asexual reproduction evolved early in the vertebrate lineage, said co-researcher Mahamood Shivji, director of the Guy Harvey Research Institute in Daytona Beach, Fla. "As far as anyone knew, all sharks reproduced only sexually by a male and female mating, requiring the embryo to get DNA from both parents—as in mammals," O'Rourke said. Sharks, rays and skates are members of the ancient line of cartilaginous fish, descended almost directly from some of the first animals with jaws. A surprise hammerhead birth in 2001 at an aquarium at Henry Doorly Zoo in Omaha, Neb. prompted the shark study. None of three possible mother hammerheads in the tank, of the species *Sphyrna tiburo*, had encountered any male hammerheads since being caught off Florida three years earlier as babies. Scientists initially guessed a mother had mated before capture, and then somehow stored the sperm; or possibly mated with a male shark of another species in the tank. But after identifying the mother through genetic tests, they found the baby's DNA matched only hers; no paternal DNA was found.

Asexual reproduction—or parthenogenesis, as it's called in vertebrates—is "the likely explanation behind the anecdotal but increasing observations of other species of female sharks reproducing successfully in captivity—without male contact," said Shivji. Researchers don't think parthenogenesis takes place in mammals due to a mechanism called genomic imprinting that occurs in them, Shivji said.

In sharks, he added, it seems at least some females can switch from sexual to asexual reproduction in the absence of males—which is "a good" thing, since the offspring lack helpful genetic variation that would come from a father's DNA contribution. Worse, the researchers found that the parthenogenesis in this case was probably of a specific type called "autotomic" in which half the mother's genetic diversity also gets lost. The baby "gets a double dose of genetic disadvantage," said Demian Chapman, lead author of a study on the finding to be

published May 23 in the research journal *Biology Letters*. In this process the unfertilized egg, which contains about half of the mother's genetic diversity, is activated to behave as a normal fertilized egg by a small, genetically nearly-identical cell known as the polar body. The finding raises concerns about the genetic and reproductive health of dwindling shark populations, added Chapman. He is now head of shark research at the New York-based Pew Institute for Ocean Science but took part in the study as a graduate student at Guy Harvey. "Female sharks might reproduce like this more often when they have difficulty finding mates" in under populated zones, he said. "This could hasten the erosion of genetic diversity and perpetuate the production of genetically disadvantaged offspring."

Courtesy Queen's University Belfast and World Science staff

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