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Girl Power: No Male? No Problem for Female Boa Constrictor

In a finding that upends decades of scientific theory on reptile reproduction, researchers at North Carolina State University have discovered that female boa constrictors can squeeze out babies without mating with a male snake.

More strikingly, the finding shows that the babies produced from this asexual reproduction have attributes previously not considered possible.

Large litters of all-female babies produced by the "super mom" boa constrictor show absolutely no male influence – no genetic fingerprint that a male was involved in the reproductive process. All the female babies also retained their mother's rare recessive color mutation.

This is the first time asexual reproduction, known in the scientific world as parthenogenesis, has been attributed to boa constrictors, says Dr. Warren Booth, an NC State research associate in entomology and the lead author of a paper describing the study. He adds that the results may force scientists to re-examine reptile reproduction, especially among more primitive snake species like boa constrictors.

The study is published online in *Biology Letters*, a Royal Society journal.

Snake sex chromosomes are a bit different from those in mammals – male snakes' cells have two Z chromosomes, while female snakes' cells have a Z and a W chromosome. Yet in the study, all the female babies produced by asexual reproduction had WW chromosomes, a phenomenon Booth says had not been seen before and was believed to be impossible. Only through complex manipulation in lab settings could such WW females be produced – and even then it has only happened in two or three fish and amphibians species, Booth says.

Adding to the oddity is the fact that within two years, the same boa mother produced not one but two different snake broods of all-female, WW-chromosome babies that had the mother's rare color mutation. One brood contained 12 babies and the second contained 10 babies. And it wasn't because she lacked options: Male snakes were present and courted the female before she gave birth to the rare babies. And the versatile super-mom had previously had babies the "old-fashioned way" by mating with a male well before her two asexual reproduction experiences.

Booth doubts that the rare births were caused by environmental changes. He notes

that while environmental stresses have been associated with asexual reproduction in some fish and other animals, no changes occurred in the mother boa's environment or routine.

It's possible that this one snake is some sort of genetic freak of nature, but Booth says that asexual reproduction in snakes could be more common than people think.

"Reproducing both ways could be an evolutionary 'get-out-of-jail-free card' for snakes," Booth says. "If suitable males are absent, why waste those expensive eggs when you have the potential to put out some half-clones of yourself? Then, when a suitable mate is available, revert back to sexual reproduction".

A reptile keeper and snake breeder, Booth now owns one of the young females from the study. When the all-female snake babies reach sexual maturity in a few years, Booth will be interested to see if they mate with a male, produce babies without a mate, or – like their mother – do both. In any case, these WW-chromosomed females will continue their version of "girl power," as any baby they produce will also be female.

Drs. Coby Schal and Ed Vargo co-authored the paper. Co-author Sharon Moore raised the snakes in the study. Co-author and veterinarian Daniel Johnson provided surgical sexing on the snakes. NC State's Department of Entomology is part of the university's College of Agriculture and Life Sciences.

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"Evidence for viable, non-clonal but fatherless Boa constrictors"

Authors: Warren Booth, Coby Schal and Edward L. Vargo, North Carolina State University; Daniel H. Johnson, Avian and Exotic Animal Care; Sharon Moore, The Boastore
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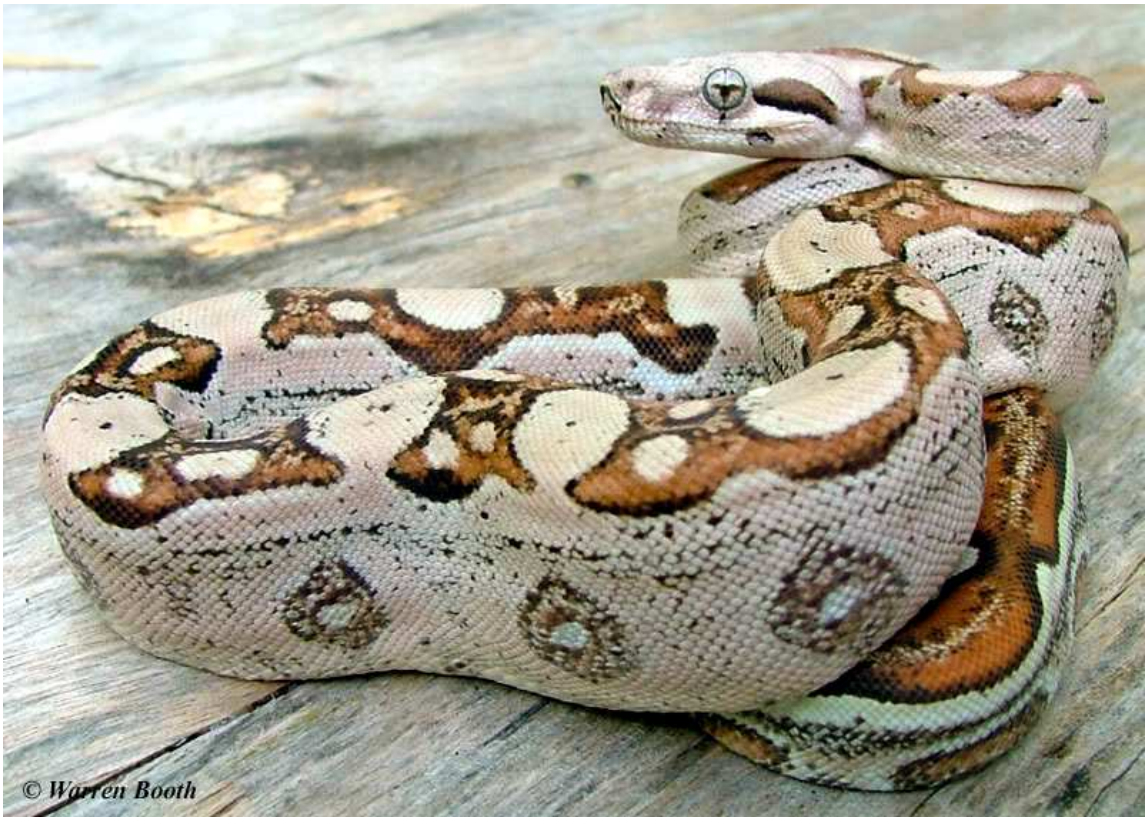
Abstract: Parthenogenesis in vertebrates is considered an evolutionary novelty. In snakes, all of which exhibit genetic sex determination with ZZ:ZW sex chromosomes, this rare form of asexual reproduction has failed to yield viable female WW offspring. Only through complex experimental manipulations have WW females been produced, and only in fish and amphibians. Through microsatellite DNA fingerprinting, we provide the first evidence of facultative parthenogenesis in a Boa constrictor, identifying multiple, viable, non-experimentally induced females for the first time in any vertebrate lineage. Although the elevated homozygosity of the offspring in relation to the mother suggests that the mechanism responsible may be terminal fusion automixis, no males were produced, potentially indicating maternal sex chromosome hemizygosity (WO). These findings provide the first evidence of parthenogenesis in the family Boidae (Boas), and suggest that WW females may be more common within basal reptilian lineages than previously assumed.

Female parthenogenetic offspring exhibiting the caramel color trait. One of twelve produced in 2001. Photo credits: Dr. Warren Booth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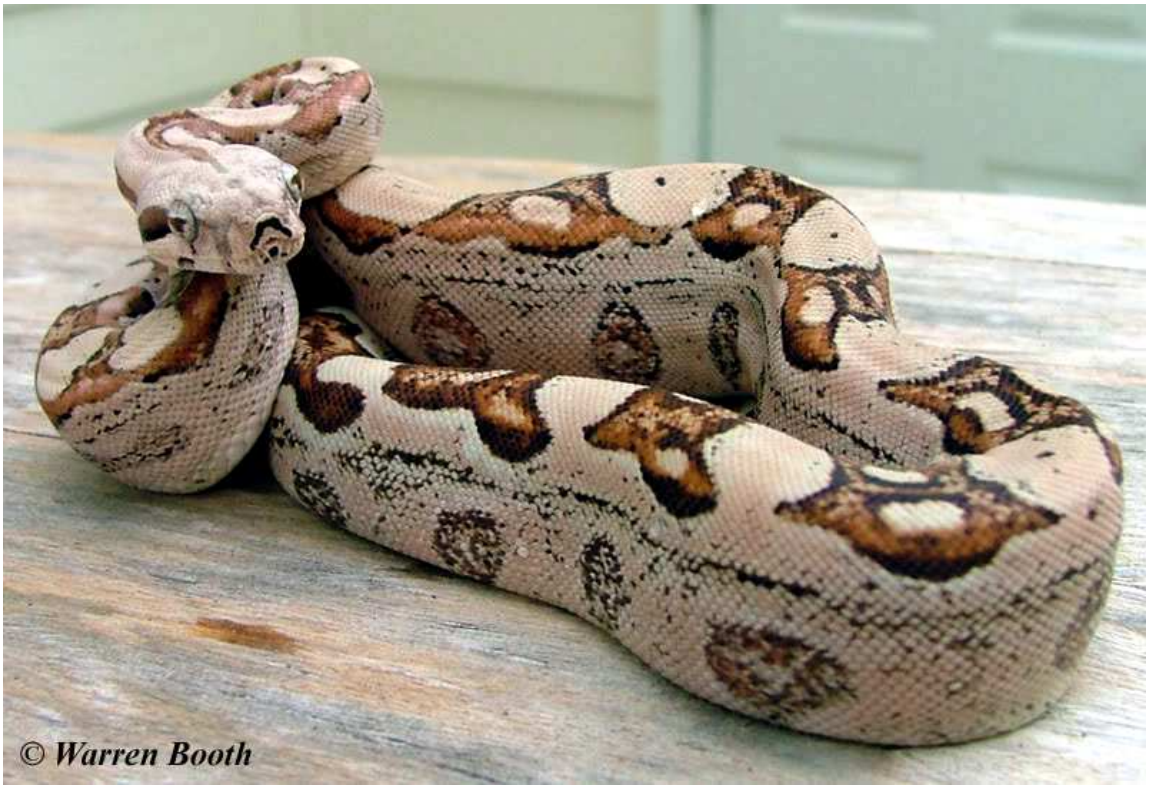
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