ScienceWatch – A Vulture "Virgin Birth"

"This is truly an amazing discovery. We were not exactly looking for evidence of parthenogenesis, it just hit us in the face." – O. Ryder

Parthenogenesis is Greek for "virgin birth." It is the development of a new individual from an unfertilized egg. Normally, as eggs and sperm mature, they undergo meiosis, which cuts the chromosome number in half. Fusion of egg and sperm at fertilization restores the chromosomal number and initiates egg cell division. But sometimes a mature egg cell will divide on its own and the two cells will then fuse. Alternately, after meiosis an egg may double its chromosomes in preparation for cell division, but not divide. Either process can produce a "parthenote," or unfertilized embryo, which has two identical sets of chromosomes from its mother, rather than one maternal and one paternal set.

Parthenogenesis is rare for vertebrates but cases exist where female Komodo dragons and sharks and rays in captivity have produced offspring without males. In the wild parthenogenesis occurs in fishes and lizards, but has never been observed in mammals. Some birds, notably domestic turkeys and chickens housed without males have produced parthenotes. Now a study in the October 28, 2021 issue of the *Journal of Heredity*, led by Oliver Ryder and Leona Chemnick from the San Diego Zoo Wildlife Alliance, Escondido, CA, shows that parthenogenesis has occurred in the critically endangered California condor (*Gymnogyps californianus*).

With a wingspan of almost ten feet, California condors are the largest flying birds in North America. The birds live up to 60 years and begin breeding at about age six. Once they roamed across the American southwest and west coast, but by 1982 only 22 birds existed in the wild. In a controversial action at the time, the US Fish and Wildlife Service caught all the wild birds in 1987 and began a captive breeding program, which has produced more than 1,000 chicks. Reintroduction into the wild began in 1992, and despite the continuing danger of lead poisoning from bullet fragments in carcasses left by hunters, their number in the wild has increased to over 500.

To avoid inbreeding, Ryder, Chemnick and their team sequence the DNA of all the captive birds at 21 highly variable sites throughout the 40 chromosome pairs comprising the condor genome in order to mate those that are sufficiently genetically different.

Chemnick was reviewing the parentage of each chick hatched since the program began when she discovered two, produced about a decade apart by two different females, that had no DNA

sequences matching the birds listed as their fathers. Indeed, none of the 467 males used as sires provided a match. Normally, the paired chromosomes show differences with respect to each other, reflecting the genetic differences stemming from each parent. Instead, they were identical to each other and they matched the mother's DNA, indicating they were parthenotes. The clincher was that both birds were males.

In humans, females have the same two sex chromosomes (XX), and males have two different ones (XY). In birds that is reversed, females have two different ones (ZW) and males have the same (ZZ). If a female reproduces by parthenogenesis, she can only create ZZ progeny because WW embryos never survive. So, in birds, parthenogenesis can only produce males.

In captivity, bird parthenotes have only occurred when females were housed without males, leading many scientists to speculate that it happens when females have no other way to reproduce. But the two instances documented by Chemnick and Ryder cast doubt on that idea. Both female condors had been housed with males and had normal chicks. Condors only lay one egg per nesting attempt. One female had 11 chicks with the same male before laying the parthenote egg. The other had 23 normal chicks with the same male before producing her parthenote offspring and had two more normal chicks after that.

Both parthenotes died before they reached sexual maturity, perhaps because they lacked genetic diversity. One died at two years from malnourishment after being in the wild for five months. The other never reached normal body size and died after eight years in captivity.

Now that the scientists know parthenogenesis occurs in condors, they will be watching for it. "Previously, parthenogenesis was really identified by seeing females who weren't housed with males have offspring. But now we know the condor can have offspring while being housed with males and it begs the question, 'Is this going on more than we know?' We only now have the tools to look at this in detail," said Dr. Ryder.

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