

Cheetah Countdown

Does inbreeding — or zoo life — hinder this feline's fecundity?

By ELIZABETH PENNISI

Time was when zookeepers didn't think much about their animals' genes. Now they may think too much about them.

About 15 years ago, researchers at the National Zoological Park in Washington, D.C., showed that inbred zoo animals, like inbred livestock, produce fewer healthy young than their noninbred counterparts. A few years later, molecular biologists drove that point home with compelling data showing that wild as well as zoo-bound cheetahs have no more genetic variability than highly inbred strains of laboratory mice. "It pointed out to conservationists that there were things going on that they couldn't tell by looking through a pair of binoculars from a Land Rover," recalls Stephen J. O'Brien, who led the genetic analyses in his Frederick, Md.-based lab, part of the National Cancer Institute. He suggested this genetic homogeneity also made this species unusually susceptible to disease.

As a result, many zoos hired geneticists, who used their molecular techniques to assess the genetic health of threatened species. Zookeepers developed family trees, worked out species-survival plans, and began trying to mate unrelated individuals, sometimes importing animals from across the world to achieve genetic diversity.

But cheetahs in U.S. zoos remained notoriously unproductive, failing to bear enough young to maintain their numbers. So four years ago, Jack Grisham, a zoologist at the Oklahoma City Zoological Park and coordinator of the cheetah species-survival plan, went one step further, recruiting scientists to study possible infertility problems in these swift cats.

This in-depth look at the cheetah has convinced some scientists that zoo husbandry practices, not inbreeding per se, account for the poor reproductive success of cheetahs. These scientists worry that the focus on genetics has caused zoologists to downplay or overlook other issues, such as living conditions. "All these more glamorous [molecular techniques] took more of a spotlight, but these other problems didn't go away," says Katherine Ralls, a research zoologist at the National Zoo.

Others interpret the new data differently, and they warn that inbreeding problems still threaten to cause the cheetah to become as infertile and unhealthy as the Florida panther, another endangered species. "It's possible for populations to do quite well without genetic diversity, at least on the short term," says Jonathan Ballou, a population biologist at the National Zoo. "But we certainly have enough data to say that, in general, the lack of genetic diversity puts a population at risk."

Out of 266 cheetahs living in North America, only 26 males and 27 females have parented cubs at least once between 1987 and 1991, Grisham and Laurie Marker-Kraus of the National Zoo reported in the January *ZOO BIOLOGY*.

To begin to figure out why, David E. Wildt of the National Zoo and his colleagues traveled across the United States, assessing the reproductive status of 128 cheetahs. They expected to find low sperm counts, high percentages of abnormal sperm, and other problems. The

researchers confirmed that more than 75 percent of cheetah sperm are abnormal — a trait generally attributed to too much inbreeding. Yet, surprisingly, they found that the zoos varied widely in average sperm counts of male cheetahs — ranging from about 10 million to almost 66 million in a single ejaculate. Also, neither sperm count nor other reproductive traits distinguished virile from non-virile individuals. "Cheetah who breed have the same reproductive [characteristics] as cheetah who don't breed," says Wildt.

Moreover, other researchers have noted that 19 of 20 free-roaming female cheetahs watched closely in their native Africa proved quite prolific; yet these animals show no more genetic diversity than captive cheetahs, Wildt reports.

"There are circumstances in the wild where [cheetah] numbers are increasing," says Oliver A. Ryder, a geneticist at the Zoological Society of San Diego. There, predators, not genes, may determine the fate of cheetahs: In regions where lions are



expanding their ranges, cheetahs are decreasing in number. Also, cheetahs cease to thrive when habitat for their chief food source—gazelles—disappears, notes Timothy M. Caro, a wildlife biologist at the University of California, Davis, in the January *ZOO BIOLOGY*.

The argument that inbreeding has lowered cub fitness and reduced the survival of cheetahs also warrants a closer look, says Donald G. Lindburg of the Zoological Society of San Diego. His breeding records indicate that newborn cheetahs survive as well as other felines, such as snow or clouded leopards or Sumatran tigers, he reported at a June meeting of the Society for Conservation Biology in Tempe, Ariz. When he and colleagues reviewed the outcome of 1,500 captive cheetah births, they found only 11 congenital anomalies, and nine of those resulted from births to one female or her daughters. Lindburg does not view that statistic as indicative of a population in jeopardy

from inbreeding.

"The simpler explanation is that we don't know how to breed cheetahs well," says Ryder.

"There has been a greater attention to the use of high-tech approaches to problem-solving when commonsense approaches may be much more effective and cheaper," adds Devra G. Kleiman, a zoologist at the National Zoo. "You have to look at the [species'] natural history."

For decades, zoos kept cheetahs in wild-cat houses. But as they learned more about how cheetahs act in their native habitat, zoologists began to advocate moving these felines far from lions. "We started getting increases in reproduction," says Grisham. "[Before], they were being intimidated by other large cats."

Zoo managers also typically pair one male with one female cheetah to encourage them to mate. But actually, males tend to work together, breeding in small groups often established early in life, says Caro, who draws on years of experience observing these animals in the wild. That kind of knowledge has already proved quite useful for gorillas, who now breed better because zoos keep them in large groups, and for golden lion tamarins—once housed in large colonies—who now thrive in pairs or small family units.

A few zoos even boast of great success producing cheetah young. Even with high levels of abnormal sperm, among a dozen males at the San Diego Zoo, 21 of 23 matings resulted in pregnancy, says Lindburg. He thinks genetic homogeneity will probably prove less of an impediment once researchers home in on these breeding-success secrets.

O'Brien is not so sure. He says the San Diego data do not counter his results because they are based on small sample compared to the thousands considered in his analyses. "It's anecdotal," he told *SCIENCE NEWS*.

Even if the cheetah can overcome the reproductive liabilities of inbreeding, O'Brien worries that genetic homogeneity leads to another, more insidious threat. "The peril that is still there is a virus or [other] pathogen, an epidemic," he says.

O'Brien thought that was what happened in 1983, when 18 cheetahs at the Wildlife Safari in Winston, Ore., died of complications from a coronavirus infection. "[The] catastrophic sensitivity of this genetically uniform species [provides] a graphic natural example of the protection afforded to biological species by genetic variability," O'Brien wrote in his evaluation of the status of cheetahs in the March 22, 1985 *SCIENCE*.

Yet today, other researchers see that fatal outbreak a little differently. "We have

to assume that the [Oregon] population was also naive [previously unexposed to the virus]," says James F. Evermann, a microbiologist at Washington State University in Pullman. If so, then these animals were like American Indians who succumbed to measles and smallpox brought over by European newcomers. "Nobody says that was from inbreeding," Ryder notes.

Fewer cheetahs now die from this coronavirus. According to data summarized by Marker-Kraus and Grisham, infection with the virus accounted for just three deaths between 1987 and 1991. Also, the number of cheetahs with antibodies to this pathogen jumped from 35 percent in 1989 to 60 percent a year later.

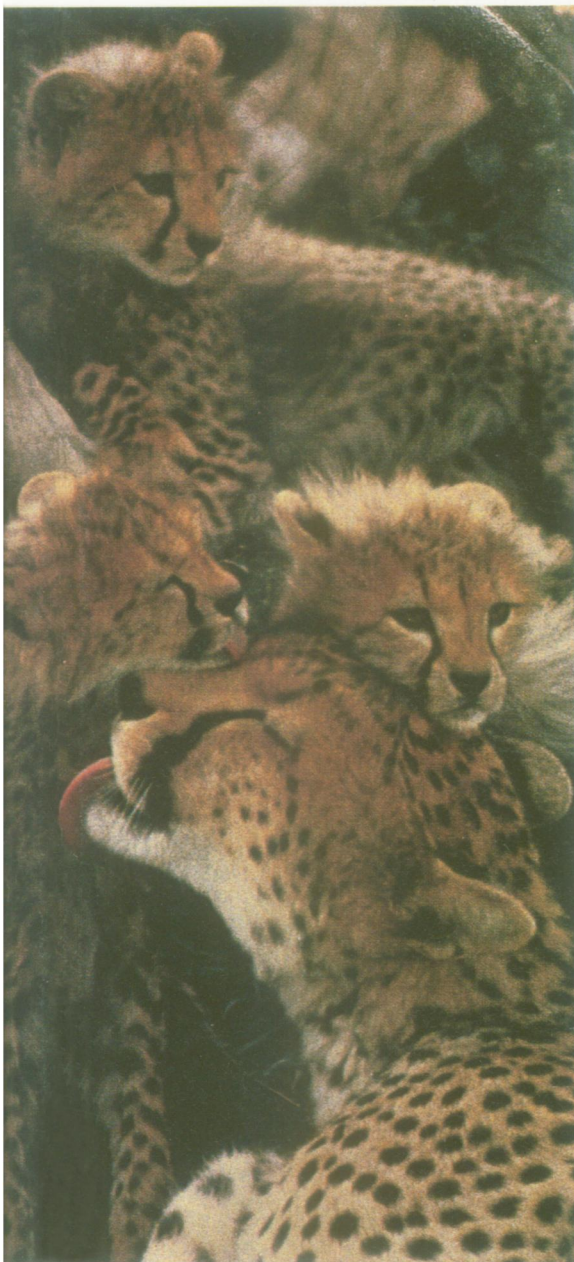
Evermann still cautions that inbreeding has compromised the cheetah's defenses, but he adds that better management has helped compensate for the species' shortfalls. The Oregon outbreak illustrated the importance of "not just shipping animals willy-nilly," he says, but of comparing medical histories before allowing animals to mingle. Many zoos now keep their cheetah populations small as a further precaution against epidemics.

As is typical of science, the data gathered these past four years paint a more complicated picture than researchers envisioned a decade ago. "The impact of inbreeding depression on any species depends on the species, the degree of genetic diversity it started out with, and the degree to which it can tolerate inbreeding," says Kleiman. "The cheetah may well be one of the species that just doesn't show a lot of diversity."

Recent genetic results support the idea that cheetahs do all right, even with their homogeneity. An analysis conducted by O'Brien found that these animals have lacked genetic diversity for about 10,000 years. "If that's the case, the cheetah has gone through a number of generations—several thousand, actually—without dying [out]," O'Brien says. "It's very encouraging."

The cheetah's story contrasts with the continuing decline of the Florida panther, whose numbers have fallen drastically and whose males have even higher percentages of abnormal sperm than cheetahs. In some male panthers, the testicles do not descend, and even when they do, the males can still be incapable of fertilizing their mate's eggs. "There's very good evidence that genetics is having an effect," Wildt says, adding that perhaps in the cheetah the percentage of bad sperm could eventually become high enough to really impede reproduction.

That worry lingers, even among people such as Lindburg who think cheetahs would increase their numbers if they were managed correctly. "We'd like to say that cheetahs are just fine and we can relax," Lindburg says. "But we don't feel we can." □



Grisham/Oklahoma City Zoological Park