

David Wildt's Domestic Cat and Cheetah Experiments (1978 - 1983)

David Wildt's research on cheetahs (*Acinonyx jubatus*) from 1978 to 1983 helped to establish the use of embryological techniques in endangered species breeding programs. The cheetah is a member of the cat family (Felidae), which includes thirty-seven species. According to the Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES) all Felidae species are currently threatened or endangered, with the exception of the domestic cat (*Felinus catus*). Cheetahs are an internationally recognized charismatic megafauna species, prized zoo specimens, difficult to breed, and are the basis of many conservation campaigns. Like most species, cheetahs are less well studied than are model organisms in laboratory settings. Wildt's research revealed that the difficulty with breeding cheetahs in captivity is due to their lack of genetic diversity.

From 1978 to 1980, Wildt worked at the Houston Zoo in Houston, Texas. There he studied the effects of reproductive hormones, including follicle stimulating hormone (FSH-P) and human chorionic gonadotropin (hCG), on ovarian activity in domestic cats. Wildt manipulated female cats to produce large numbers of oocytes, a production termed superovulation. The cats also showed behavioral signs of estrous, a reproductive period found in some mammals. Estrous, similar to menstruation in primates, is a period of hormonal changes in females that makes them fertile and ready to conceive. Superovulation improves oocyte collection and in vitro fertilization (IVF), because there are more oocytes available during superovulation than produced during regular ovulation. Both superovulation and estrous increase the likelihood of successful artificial insemination (AI).

Wildt experimented with the domestic cat because it is a model organism, and by 1978 biologists well understood its reproductive biology. When Wildt began experimenting with cheetahs in 1981, the domestic cat would be deemed a suitable model for cheetahs. Cheetahs are an endangered species, therefore researchers must demonstrate the efficacy and safety of a research technique before they are permitted to subject cheetah research subjects to experimental risk.

From 1980 to 1982, While Wildt was working at National Institutes of Health (NIH) in Bethesda, Maryland, he collaborated with Carrol Platz, a reproductive biologist with an emphasis in spermatology at Texas A&M University in College Station, Texas; Mitchell Bush, a veterinary scientist at the National Zoo in Washington, DC; and Stephen Seager, a specialist in the reproductive biology of the cheetah at NIH. Together, they sought to ascertain normal ovarian activity in cheetahs. To induce the cheetahs to ovulate, Wildt and his colleagues used the superovulation techniques Wildt had developed at the Houston Zoo. They supplemented those techniques with research from Seager's 1978 of the cheetah's reproductive characteristics. The researchers administered to some cheetahs a series of hCG and FSH-P injections, and they monitored the cheetahs' ovarian activities with a laparoscope. Mature ovary follicles developed, but unlike the domestic cats, the cheetahs did not superovulate nor did they exhibit behavioral signs of estrous. This experiment provided evidence for the use of hormonal induction methods to develop ovarian follicles and demonstrated the potential of laparoscopy for embryo collection and transfer. Wildt and his colleagues concluded that their results may indicate the need to induce ovulation hormonally when attempting to breed captive cheetahs. They published their results in their 1981 paper "Induction of Ovarian Activity in the Cheetah."

In 1981, Wildt and Bush also began collecting data on cheetah genetic diversity with Stephen O'Brien, a geneticist at the NIH's National Cancer Institute. To investigate why cheetahs were difficult to breed in captivity and why cheetah populations were rapidly declining in Africa, Wildt and his colleagues collected blood samples from geographically isolated cheetahs throughout Africa

and North America and used population genetics to model the data. In 1983's "The Cheetah is Depauperate in Genetic Variation," the authors concluded that cheetahs have remarkably low genetic diversity. The study compared average genetic diversity in the sampled cheetahs with average genetic diversity in other species. Cheetahs had significantly lower, if any, genetic diversity in the compared DNA regions than did other species. Wildt and his colleagues hypothesized that such low diversity could arise from inbreeding following a population bottleneck, citing contemporary ecological evidence of drastic climate change in the Pleistocene for support. They suggested that the cheetah's genetic diversity was so low that reproduction was difficult, causing cheetah populations—and their genetic diversity—to decline even further.

At the same time, Wildt, O'Brien, and Bush joined researchers from the Smithsonian's National Zoological Park in Washington, DC, and reproductive biologists in South Africa to investigate cheetah sperm. The researchers gathered sperm from two geographically isolated South African cheetah populations in 1981. They molecularly analyzed the samples and observed the sperm under microscopes. They discovered that cheetah sperm had a significantly high percentage of abnormally formed cells. For comparison, the team also collected sperm from geographically isolated American domestic cat populations. Whereas domestic cats had an average of twenty-six percent abnormal sperm cells, cheetahs averaged seventy percent. Abnormal sperm may have a bent or coiled tail (flagellum), or a defectively shaped head. The researchers published their results in 1983's "Unique Seminal Quality in the South African Cheetah and a Comparative Evaluation in the Domestic Cat."

The research indicating that cheetahs have an abnormally high percentage of malformed sperm played a key role in the hypothesis that the cheetah population had bottlenecked. The hypothesis states that low genetic diversity observed in cheetahs was caused by one or more population bottlenecks, leading to inbreeding and higher rates of abnormally formed and dysfunctional sperm. As dysfunctional sperm cannot fertilize ova, fewer male cheetahs were able to reproduce, contributing to an increase in inbreeding and higher rates of abnormal sperm. According to this theory, the cheetah's poor genetic character and sperm quality result in low rates of reproduction. Those results led to questions concerning the ethics of charismatic megafauna species conservation, because in the case of the cheetah, the scientific data show that cheetahs may have been naturally approaching extinction before human intervention.

In 1983 Wildt, joined the Smithsonian National Zoological Park where he continued to study the interactions of cheetah embryology, endocrinology, spermatology, genetics and cryopreservation on cheetah reproduction success. Though Wildt's cheetah experiments continue to have a strong basic research component, his views about the roles and ethics of reproductive science for conservation have influenced his research. Wildt's cheetah research, represents some of the earliest experiments combining embryology, population genetics, spermatology, endocrinology and cryopreservation of gametes.

Sources

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