SCIENTIFIC DETECTIVE WORK IN PRACTICE: SOLVING THE MYSTERY OF WHITE RHINO REPRODUCTION

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At the Hluhluwe-iMfolozi Park, white rhinos breed like fleas. When brought into captivity, they still breed well, but their captive-born offspring do not.

What would you say if I were to tell you that we have a breeding problem with rhinos? In this day and age when there seems to be a high-tech solution for most of society's ills, one would think that it would be rather simple to get animals "to do what comes naturally." Indeed the San Diego Zoo and the Wild Animal Park have remarkable track records for establishing successful captive breeding programs, and the Beckman Center for Conservation and Research for Endangered Species (CRES) has played an integral role in these programs for "problem" species, seeking answers about their behavior, genetics, physiology, and health. Rhinos are a prominent symbol at the Wild Animal Park, and visitors will hear about the many successes we have had—more than 50 Indian rhinos and nearly 100 white rhinos born at the Park alone. Yet despite this remarkable success, the white rhinos are heading for a population crash in facilities worldwide if we don't solve a major problem soon.

With so many births, what problem could there be? Neither the European nor North American captive white rhinoceros population is self-sustaining. Many of the founding population, given appropriate husbandry and management, reproduced well, but reproduction among captive-born females has been extremely sluggish. Most of the wild-caught females that formerly drove population growth have died or become nonreproductive in the past decade. Why don't the captive-born females reproduce? This is one of the great unsolved mysteries of animal reproduction in zoological institutions, a problem that has remained intractable despite considerable scientific effort.

Significant headway has been made in determining what factors cause reproductive failure in captive-born white rhino females, and much of the work has been done here at CRES. Working with CRES endocrinologists, I have investigated the pattern of reproductive behavior and hormones across the reproductive cycle. Some females have long cycles and some have short ones. Data from the wild suggest that the short ones are normal. In captivity, the long cycles are associated with chronic uterine infections, which may interfere with conception or pregnancy. Although we found some anomalies in the reproductive cycle, they are no more common in captive-born than wild-caught females, and so do not explain why more captive-born females fail to reproduce.

We also circulated a questionnaire worldwide, interviewing rhino keepers about their rhinos. Both data from the Wild Animal Park and the questionnaire indicate that captive-born females show normal signs of behavioral estrus and reproductive behavior, comparable to wild-caught females, indicating that the problem arises after the animals have copulated. Thus, the problem must occur during conception or pregnancy, taking us one step closer to understanding it.

But even if we know where in the chain of events the weak link occurs, that doesn't mean that we understand why captive-born females have this problem and wild-caught females don't. A widely accepted hypothesis was that the mothers—or other older, wild-caught females—were dominant and suppressing reproduction in the younger, captive-born females (a phenomenon that usually occurs in species more social than rhinos). But in fact, reproduction was significantly higher when captive-born females were housed with their mothers.

Another key finding is that the problem must have its roots in the development of rhinos in captivity. In our studies, captive-born and wild-caught females were kept at the same facilities and exposed to the same social, environmental, and management circumstances, yet the birth rate for captive-

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A southern white rhino in semi-nature, a small private game reserve in South Africa. Managers of reserves have a wealth of untapped information on how rhinos were managed and how successful breeding has been.

born females was significantly less than that observed in wild-caught females. Since all factors were constant, our results point strongly toward the effects of environment during the early development of captive-born females. The circumstances of these rhinos differed only during their early years, with some females developing in the wild and some in captivity. Thus, the question that needs answering is, "Why is captivity having a different effect on captive-born and wild-caught females?"

Our next step was to move our studies to the wild, where we could learn more about what takes place in a natural rhinoceros community—reproductive behavior and hormones, courtship and social interaction, and all aspects of development. We spent three years radiotracking wild rhinos at the Hluhluwe-iMfolozi Park in South Africa, literally the cradle of all southern white rhinos alive on the planet today. Among other important findings, these data helped us pose new hypotheses for why white rhino females fail to reproduce in captivity.

Step by step we get closer to an answer. At times frustrating, at times fascinating, this is the way that conservation science often moves forward. We are tantalizingly close but still can't quite identify the critical factor(s). After chatting with colleagues, I've come up with a number of new hypotheses. Some of these involve the more intense social environment in captivity compared to the wild. In captivity, males can shadow females—even young ones—and harass them, whereas in the wild, a male has to cover more territory and can only afford to court females that are likely to be fertile soon. Captive white rhino females also appear to copulate for the first time at an earlier age than their wild counterparts. Do these precocious copulations damage the reproductive tract and cause many of the chronic uterine infections that are common in these females in captivity? Or maybe it has something to do with differences in nutrition or infectious agents?

In the next—and hopefully final—phase of this work, there is a new plan of attack, focusing on development and where on the captive-wild continuum of reproduction starts to break down. Clearly, with the reproduction crisis looming as aging females die, we do not have the time to conduct a longitudinal study of development. So a new and improved questionnaire is in order. With funds from the International Rhino Foundation, I have hired two assistants, Shannon Chapman and Dale Airton (both experienced rhino researchers involved in our previous studies), to spend the year interviewing managers of small private game reserves in South Africa.

There are hundreds of these reserves, and they are sitting on a goldmine of information. These reserves vary from similar to zoos to almost wild, making them the perfect place to address our question. First, we contact them by phone to ensure that they have all records available, and then we schedule an in-person interview lasting an hour or more. We are using a systematic questionnaire format to get information on social, nutritional, ecological, and reproductive histories, during development and as adults. It is designed so that we can test specific hypotheses, which can be supported or ruled out by the data. We are finding that these managers really enjoy talking about their experiences with rhinos on their properties. We are also tackling these same issues by re-surveying the world-wide zoo rhino populations, using the new questionnaire focused on developmental questions. Dr. Lisa Nordstrom, funded by donations from the Heller Foundation of San Diego, joined our team in June 2006 to perform this aspect of the research.

White rhinos at the Wild Animal Park enjoy a more social life than their wild counterparts.

In a year's time, I hope to report a more definitive answer, and that our new data will pinpoint the factors in captivity responsible for the captive-born white rhino reproduction crisis. More importantly, I hope to begin to apply these findings by making recommendations on how to change white rhino management to address this problem. If this crisis can be averted, we will be able to continue to enjoy our white rhinos at the Wild Animal Park and elsewhere for the foreseeable future. The captive rhino populations, of course, are here for more than our enjoyment. These populations are also important to safeguard against their extinction, should their situation in the wild take a turn for the worse.

Author Ron Swaisgood collects behavioral data on wild white rhinos at Hluhluwe-iMfolozi Park in South Africa.