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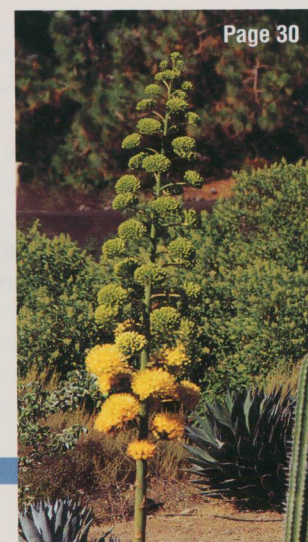
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COVER

Does she or doesn't she? Only her researcher knows for sure! The reproductive cycles of southern white rhinoceroses *Ceratotherium simum simum*—and how they correspond to the rhinos' behavior—are a puzzle and a challenge that scientists at the Zoological Society's Center for Reproduction of Endangered Species (CRES) are hoping to solve. Successful breeding among southern white rhinos in captivity has been inconsistent, and while studies have indicated some possible reasons for this, researchers are now turning to wild rhinos to make comparisons and test their theories. But getting hormone samples from a two-ton animal with horns is no easy task. See how they manage it, starting on page 8.



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Rhino Research in the HYPOTHESIS TESTING

STOOPING LOW to avoid detection, not to mention the dense bramble of acacia thorns, we stealthily inch toward our quarry: a female southern white rhinoceros. From this distance we can barely make out her form in the dense thicket—only occasional glimpses of smooth, gray pachyderm skin, an ear, the silhouette of a three-foot horn. We are creeping through the bush of the Hluhluwe-Umfolozi Game Reserve, a South African reserve that almost single-handedly staved off the extinction of this awe-inspiring animal.

One whiff of human scent, even from more than 100 yards away, and the only view of a rhino you'll get is its colossal rear end crashing off into the bush, leaving thundering little earthquakes in its wake.

It is only after an hour of painstaking effort that we have arrived here, just as dawn begins to break. The lions have just begun to settle in from their night of hunting, making it safe for two-legged pursuers of rhinos to venture out. We listen to the beep emitted from a small radio transmitter that we've implanted in the horn of the rhino. A strong signal seems to indicate that she's at the base of Mantiyane, the mountain that dominates the landscape. But an ever-so-slightly stronger signal

points us in the opposite direction. The weaker false signal is probably a "bounce" off of Mantiyane, conspiring to lead us several miles astray.

We set off at almost a right angle to our destination and gradually turn back toward where we think the rhino

we can observe a rhino without being detected from only 15 or 20 yards away. But much to our dismay, rhinos respond to the alarm calls of other sharper-eyed inhabitants of the "thornveld" (the local thorny version of the African bush dominated by acacia



is. Why such a circuitous path? The first and most important principle when tracking rhinos is to always, always approach them from downwind. One whiff of human scent, even from more than 100 yards away, and the only view of a rhino you'll get is its colossal rear end crashing off into the bush, leaving thundering little earthquakes in its wake.

As we approach the female cautiously, the wind direction has changed and we've had to circle back around to the other side. Lucky for us, rhino vision is notoriously poor. As long as we move slowly and stay downwind,

So we must also avoid detection by wildebeeste, giraffes, impalas, and other denizens of the reserve. But the bane of our existence is the oxpecker, a small bird that lives in a mutual arrangement with rhinos. The birds hop around plucking delectable ticks and other parasites off the rhino's skin, even entering the ears and nostrils to extract those hard-to-get morsels. The oxpeckers get a full belly, and the rhinos get rid of some irritating bugs. The birds also raise a horrible ruckus whenever they spot one of the rhino's enemies, most notably humankind.

Story and Field Photography by Ron Swaisgood, Ph.D.,

Office of Giant Panda Conservation/Center for Reproduction of Endangered Species (CRES)

African Bush: TICKS, AND BIG SCARY ANIMALS

Having successfully avoided detection, we creep out of the bush to watch our rhino grazing peacefully on a rich carpet of green grass. She is accompanied by her calf of about a year and an unrelated three-year-old male that has joined up with her for the past few months. We spend the next three hours following blissfully behind her, recording her behavior in a small notebook. Today is rather uneventful. She

an adult male today, suggesting that her estrous period is not approaching. This is our most important piece of behavioral data for the day. Shortly before nightfall, we are rewarded with our other crucial piece of data when the female visits a communal dung heap and makes a deposit of her own. We rush over and scoop up a small sample of her feces. The sun is setting now and the lions will soon come out

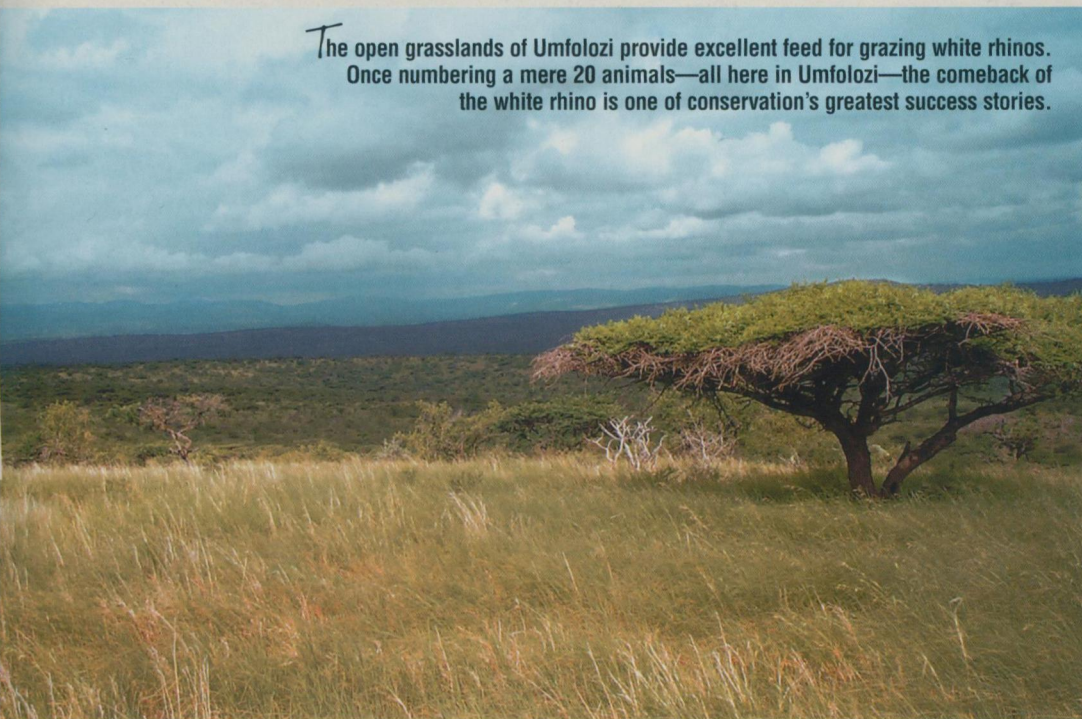
We began this study in September 2000, when CRES endocrinologist Nancy Czekala, research assistant Angela White, and I flew to South Africa to set up the project in Hluhluwe-Umfolozi Game Reserve. Nancy and I are just visitors here, but Angela will make the reserve home for a year. Renowned for its unusual abundance of all varieties of wildlife, Hluhluwe-Umfolozi has a teeming rhino population, along with a history of excellent rhino research, most notably by ecologist Dr. Norman Owen-Smith of the University of Witwatersrand in Johannesburg. In fact, our first order of business was to meet with Professor Owen-Smith, as he is collaborating with us on the project.

Our interests in the rhino's reproductive biology are not merely academic. We're trying to find some pieces to a puzzle that we discovered during several years of research with white rhinos at the San Diego Wild Animal Park and other zoos in the United States. As a behaviorist, I collaborated with Lynn Patton, Nancy Czekala, and others from the CRES endocrinology team

in a long-term study of white rhino endocrinology and behavior. Behaviorist Angela White joined the project in 1995. Several years later, we'd raised more questions than answers.

We were trying to understand why so many white rhinos raised in captivity failed to reproduce. The Wild Animal Park has had remarkable success, with more than 80 births since wild-caught

The open grasslands of Umfolozi provide excellent feed for grazing white rhinos. Once numbering a mere 20 animals—all here in Umfolozi—the comeback of the white rhino is one of conservation's greatest success stories.



spends the bulk of her time grazing, eating a small swath through the grass. Occasionally, the young male strays too far away, gets excited, and trots back to the mother and calf, making an exaggerated panting sound. The calf never lags too far behind her mother. At one point the calf begins to whine and the mother stops to let her nurse. The mother is not accompanied by

to hunt, so we hurry back to camp and place our precious sample in the freezer. Back in San Diego it will be analyzed to determine the level of the reproductive hormone progesterone. By following several females for two years, we hope to gain a better understanding of the species' reproductive cycle, particularly the connection between hormones and behavior.

rhinos were brought there in the 1970s. But many rhinos at other facilities, and some at the Wild Animal Park, were not reproducing. Another crisis facing the captive population is that many of the white rhinos born in captivity do not reproduce. As the rhinos captured in the wild in the 1970s age and begin to die out, we are becoming increasingly

mating. These troughs indicate that the female is fertile.

What surprised us was the incredible variability in the length of these cycles from one fertile period until the next, from 29 to 75 days. At first all we saw was "noise": a lot of variation with no apparent pattern. But on closer inspection we noticed that the cycles seemed to fall into two distinct types.

Some lasted about a month and others lasted about two months. Interestingly, some females went back and forth between long and short cycles. In all, short cycles were just a

progesterone levels increase dramatically throughout the pregnancy. Thus, some of these females might be getting pregnant, and the "long cycles" might just be the result of short pregnancies followed by early death of the embryo. This could create the pattern of progesterone levels we found. In other cases, the uterine infection itself might produce these abnormal patterns of progesterone production.

Unfortunately, this insight has not yet produced tangible results, because treatment of this condition has so far proven difficult. Also, these cycle irregularities do not seem to explain all cases of reproductive failure. Indeed, we don't even know with certainty that these



alarmed about the future viability of the captive population.

Discoveries during our studies were intriguing. Several females appeared to be shut down reproductively. Mostly older females, these rhinos did not display any reproductive behavior. Their progesterone levels were consistently low, suggesting that the ovaries were

Having successfully avoided detection, we creep out of the bush to watch our rhino grazing peacefully on a rich carpet of green grass.

not working. Other females had episodes of mating behavior that corresponded nicely with "troughs" in progesterone levels. As with other mammalian species studied, progesterone levels rose between mating periods before falling back just before

Rhinos have notoriously bad eyesight, so researchers can observe them if they stay downwind of the rhinos. But other animals are always on the lookout and might sound the alarm, including the oxpeckers that perch on the rhinos' backs (above left) and long-sighted giraffes.

little more common than long cycles. What struck us as most profound was that females with only short cycles seemed more likely to give birth.

Compelled by the data, we began to suspect that these long cycles may be related to reproductive failure. Inspection of the reproductive tract revealed that at least two long-cycling rhinos suffered from chronic uterine infections; and two were even pregnant but lost the embryo after about two months. When a female becomes pregnant, her

long cycles are abnormal. In a similar study, a group of European researchers concluded that the long cycles were the normal ones! So it seems clear that we still have a lot of work to do if we want to understand white rhino reproduction—particularly, finding out what a regular cycle looks like in a healthily reproducing group of wild rhinos.

In spending time with wild rhinos, we can also study other aspects of

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How to track a rhino: Researchers find their rhino study subjects with the help of radio signals. Left: Park conservator Pete Hartley drills a hole in one of the rhino's horns for a transmitter and antenna. The transmitter is placed near the base, and the antenna is threaded through a narrow channel the length of the horn. A rhino's horn is made of keratin, dead tissue that contains no nerves, so the procedure is painless for the rhino. Middle: After the transmitter and antenna are installed, the hole is filled with dental acrylic, resulting in a horn every bit as strong as it was before the procedure. Below: Research assistant Angela White uses the radio-tracking equipment. The transmitter in the rhino's horn emits a signal that can be detected by the receiver from several miles away. The direction of the loudest signal is the way to the rhino.

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their behavior. White rhinoceroses have a fascinating social system. The dominant bull occupies a small, exclusive territory, allowing only one or two subordinate males to share the territory with him. Neighboring dominant bulls show unusual respect for the territory boundaries and rarely trespass except to obtain water during the dry season. They won't even follow an estrous female into another bull's territory. Dominant bulls invest a great deal of time and energy just patrolling the territory, marking it with urine and defecating in dung heaps that serve as a "community bulletin board" for olfactory communication. Subordinate bulls put



As the rhinos captured in the wild in the 1970s age and begin to die out, we are becoming increasingly alarmed about the future viability of the captive population.

little effort into such communication with scent, always deferring to the dominant bull when they meet up. Females are not territorial and move through large home ranges that overlap with many other females. Several male territories lie within a single

female home range. To choose a male, all a female has to do is show up in his territory when she's ready to mate.

So we have a good idea what rhinoceros behavior is like in the wild but hope to fill in some of the gaps in our knowledge. For example, in captivity we've noted that males will often "shadow" females, following them everywhere they go. Does this happen in the wild? Could this excessive attention by males be part of the problem with captive-breeding programs? Another possibility is that females, especially dominant ones, may suppress reproduction in other females in captivity. How do female-female relations in the wild compare to what we observe in captivity? Another problem encountered at some zoos is that males appear too aggressive during courtship. How aggressive are wild males when courting females? Adult males are rarely kept together in zoos,



so we know little about how the presence of several males may affect the courtship process. Perhaps male-male competition is good for rhino reproduction, and perhaps females need to have a choice between different males. We do know that if a single male and a single female are raised and kept

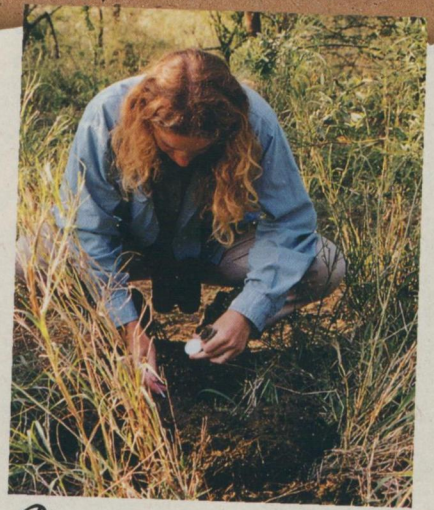
Below us stretch miles of gently rolling woodlands interspersed with lush green pastures, disappearing on the horizon at the base of a small mountain range.

together, they almost never mate. The Noah's ark approach, two by two, does not appear to work with the white rhinoceros!

The answers to these questions will have to await analysis of the data that we're now collecting. The next day, we're back out on the trail of our rhinos again. We locate one of our females

accompanied by a dominant bull rhino. We recognize this male because of his distinctively torn right ear. He is courting the female, following her, smelling her urine, and trying to rest his chin on her flanks, a sure sign that he thinks she's coming into estrus. The male is shadowing the female's every move and "hic-panting" almost continuously, a breathy inhalation followed by a hiccup. The female is still not quite ready, and she turns abruptly at his approach and gives a loud snort, followed by a snarl display—a loud roar with ears laid back. The male backs off, regroups, and tries again. This scene plays out repeatedly over the next several hours. A couple of subadult males are lingering in the background, and the dominant bull doesn't like that and gives chase. Much to our excitement, he chases them right toward us! It's a tremendous feeling to be standing there on the savanna with a couple of two-ton beasts thundering toward you like steam trains!

The next morning the courtship has heated up. The bull approaches the



Angela collects a fecal sample from a rhino dung pile. The sample will be sent to the laboratories at CRES in San Diego for analysis of the reproductive hormone progesterone.

female with a series of confident hic-pants and rests his chin on her flanks. She is tolerant and remains still. "Chin resting" probably tests whether the female will tolerate mounting, for the male quickly transitions from chin resting to mounting. The female holds for a moment, then walks off. She passes through a dung heap and we run



White rhino calves usually remain with the mother until she gives birth to another calf. Just before birth, the mother chases the older calf off to force its independence. The older calf will then join up with another group of rhinos.


over to collect a very valuable sample, one that will undoubtedly indicate that she is reaching her fertile period. The bull catches up with the female in a small clearing and mounts her again. After a few attempts, he succeeds, and they mate for the next 15 minutes. Afterwards, the female walks off and begins to graze. The male follows behind, grazing intermittently. We, on the other hand, are ecstatic and can barely contain our excitement. We have just joined one of the world's most exclusive clubs, for few people have witnessed white rhinos mating in the wild!

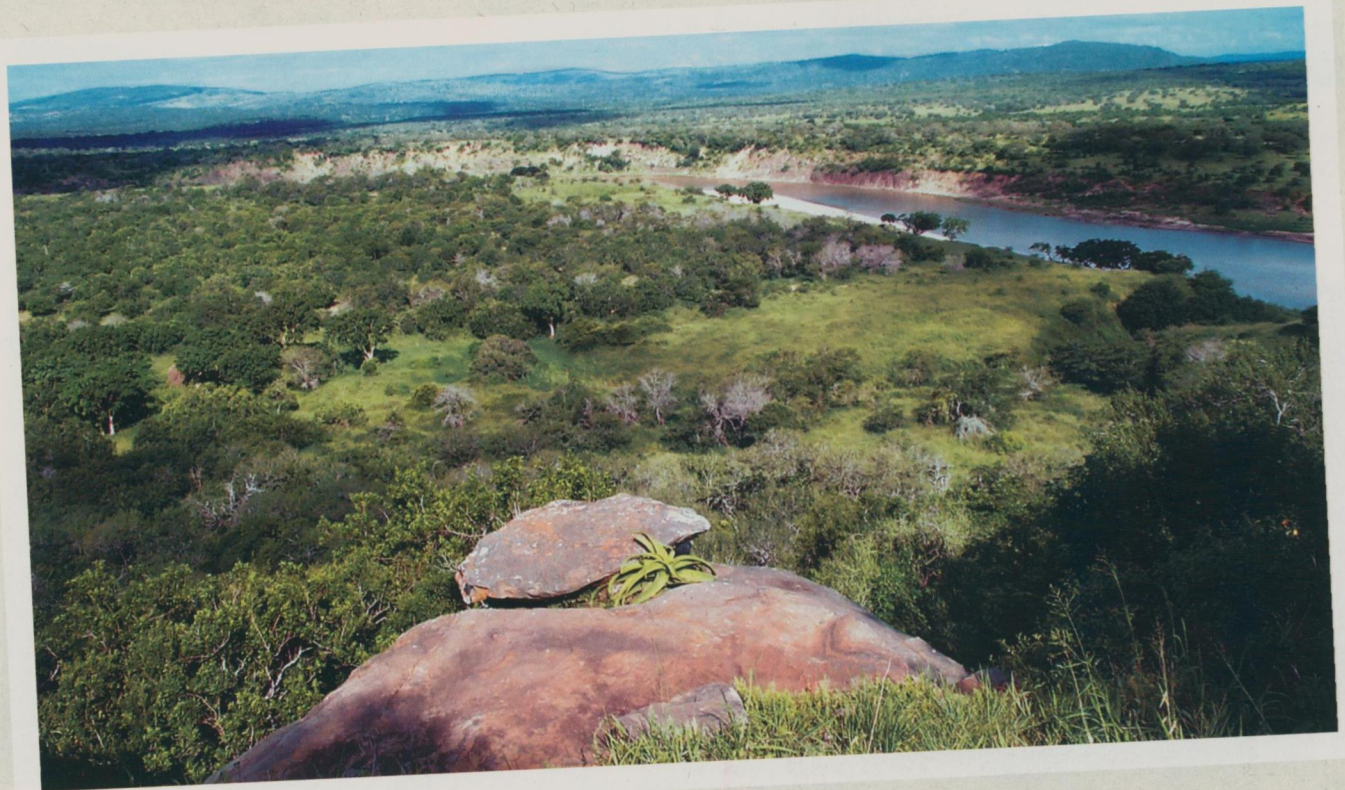
Back at camp we relax and take it all in. Hot and tired, we stroll down the path to our favorite place to pick off the dozens of pinhead-sized "pepper ticks" and acacia thorns that have accumulated on our legs. We call it simply "the rock," and it affords stunning, surreal, cinematic views of the African savanna. Below us stretch miles of gently rolling woodlands interspersed with lush green pastures, disappearing on the horizon at the base of a small mountain range. At the foot



It's an exhilarating feeling to be close to a rhino. White rhinos rarely attack humans—instead, they usually kick up dust trying to get away as fast as possible. Black rhinos, in contrast, have been known to keep unlucky visitors up a tree for several hours. But the researchers aren't exactly safe from white rhinos. They have been charged several times, usually by males trying to track the same female they're tracking. The best strategy seems to be to remain still, look big, and make noise so they know you're human. A good thing, since most of the trees in the thornveld are bush-sized with long painful spines, offering little refuge from 4,000 pounds of angry pachyderm!

of our hill the Black Umfolozi River winds gently like a ribbon through the savanna. Cape buffalo graze on the shores, huge cranes and ibises wade in the shallows, and herds of elephants forge the river, trumpeting their arrival. Above the river, giraffes crane their necks to feed off the tops of acacia trees, and black rhinos and

lions can be seen ambling along the network of bush paths. As night falls we notice a white rhino mother and calf settling down for the night in a sandy bed on the far shore of the river. By the shape of her horn we can tell that she's one of ours. We'll look for her tomorrow. 



"The rock" at Mbuzane field camp offers a sweeping view of the Black Umfolozi River and the bushveld. From this restful spot, researchers can enjoy views of elephants crossing the river, zebras and Cape buffalo grazing on the shore, and lions ambling along the network of bush paths.