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Abstract: In 1973, a 4-year study on the ecology and behaviour of cheetahs in the Serengeti plains in Tanzania was started. Half to three-quarters of the cubs died during the first three months of life. A male coalition of three animals was observed to have killed an intruder.

Cheetahs: *In a Race for Survival*

Secure in a Tanzania wildlife park, this

swiftest mammal eyes prey. Elsewhere encroaching civilization nips at its heels.

THE CHEETAH DIED without resistance. With two companions he had entered the territory of three other male cheetahs and had been instantly attacked.

The victim's response surprised us, for he barely tried to defend himself. While his companions kept their distance, he was repeatedly savaged (pages 724-5).

From my Land Cruiser 15 yards away I could see the three attackers tear mouthfuls of fur from their opponent and hear the horrible cracking of his bones.

In half an hour it was over. The victim lay dead, scarcely a square inch of his hide untouched, and the two other invaders routed. Peace returned to the Serengeti Plain, East Africa's great natural wildlife region.

To me the fate of that one cheetah typifies the plight of his species. Cheetahs today are outnumbered by their enemies, they are largely defenseless, and, where unprotected, they are likely headed for extinction.

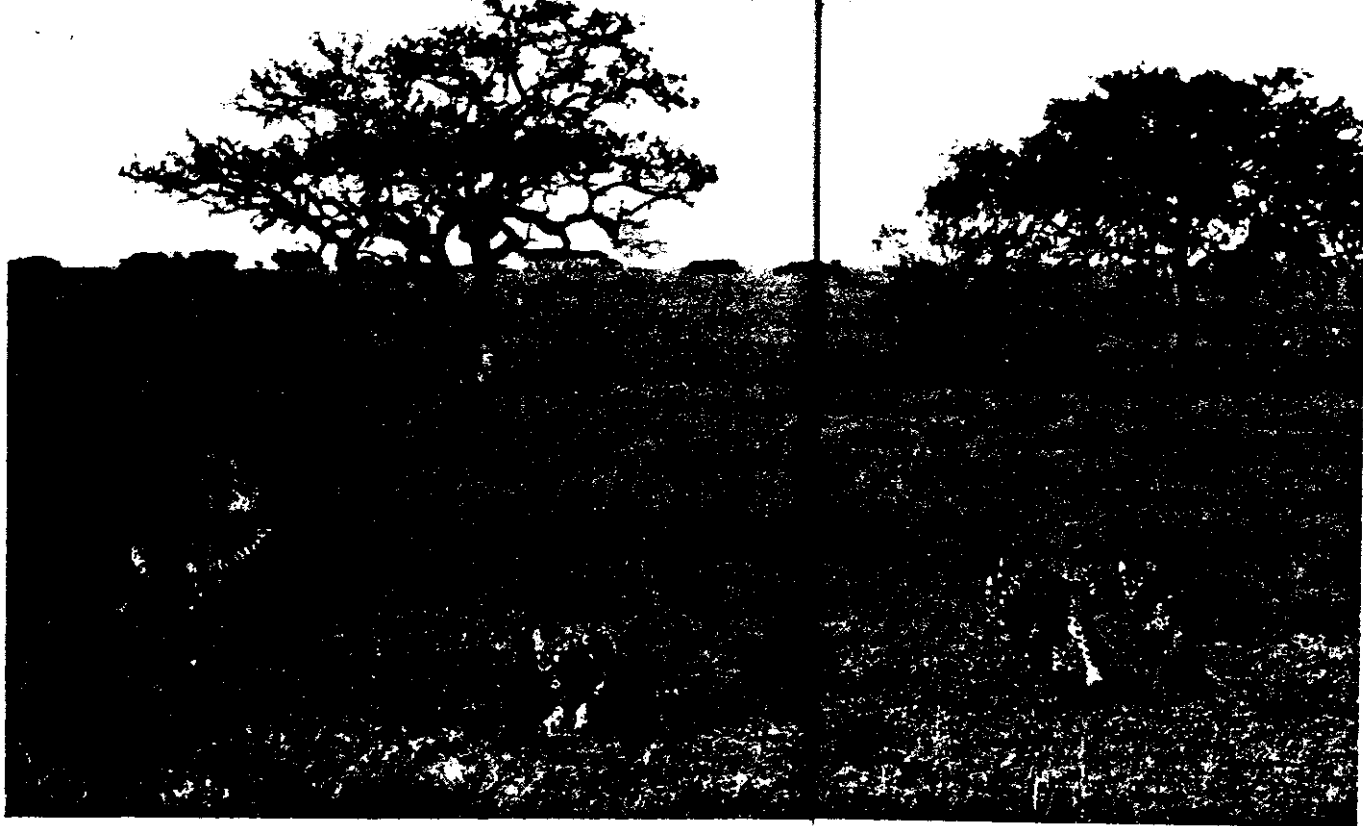
Slowly, inexorably, cheetahs have been exterminated from large portions of their former range in Africa and the Middle East. Once also plentiful in India, cheetahs have totally disappeared there, the victims of hunters and loss of habitat.

Only careful study and protection of remaining cheetah populations can ensure the species' survival. Research is vital, for in order to guarantee cheetahs' survival, one must know their habitat requirements, feeding habits, mating patterns, family structure, life expectancy—in short, every possible aspect of cheetah life.

Little was known about cheetah ecology and behavior in the wild when my wife, Lory, and I began our observations in 1973. At the same time we were studying African wild dogs in Tanzania's Serengeti National Park (map, page 717), we undertook research on cheetahs.

Our study extended over more than four





A flurry of cheetahs—cubs just 6 months old—converge on a hapless hare that they flushed in the Serengeti grasslands (left). Their mother (below, far right) looks on as the cubs finish off the quarry.

On the chase, a cheetah can accelerate, in a brief burst, to a top speed of about seventy miles an hour; average speed is usually less than forty mph. Because even that pace can quickly cause overheating, the cheetah's hunting success depends on a careful stalk of the prey that culminates in a pursuit of only 200 to 300 yards.

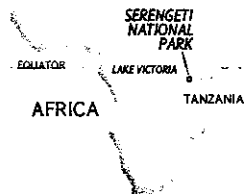
Tracking cheetahs in the sprawling Serengeti National Park and its environs during a four-year study, the authors found them in surprising numbers—at least a thousand animals. But beyond such refuges the cheetah is losing its race with man, whose intrusive presence reduces its habitat and food supply and threatens its survival.





Vehicle-wise cats regard the park's population of cars and trucks as just part of a familiar landscape. Cubs appear to view themselves in a windshield (left). A hunting animal may even commandeer a roof to sight prey.

Driving more than 50,000 miles throughout the Serengeti (right) during their study, the authors found thorn-punctured tires an almost daily occurrence. Here George repairs yet another flat (below).



years and encompassed an area of 2,000 square miles in the Serengeti Plain and neighboring woodlands. Roughly speaking, the Serengeti forms the center of the cheetah's range, which stretches across Africa south of the Sahara and extends toward the Cape of Good Hope. The project helped form the basis of my doctoral dissertation at Utah State University.

Valuable support for the study came from African, American, and European institutions concerned with wildlife conservation. Among these, the Serengeti Research Institute provided us with a base of operations, and the East African Wildlife Society generously provided a Toyota Land Cruiser.

Despite our common devotion to the project, Lory and I occasionally differed in our approach to the subject. One morning on the Serengeti Plain we were studying a mother

cheetah and her cubs through binoculars. Presently one of the female cubs climbed into the branches of a tree and became stranded some eight feet above the ground. The mother cheetah simply walked away as the cub frantically chirped in distress.

"Let's lend a hand," I suggested, but Lory shook her head. "That cub got herself up there, she'll get herself down," my wife assured me. Lory grew up in a household with pet cats, and she is an old hand at such minor crises. I, on the other hand, am a fire chief's son, and a cat in trouble still evokes memories of extension ladders and heroic rescues. After a while, the cub climbed down.

Our early observations refuted popular notions about cheetahs' hunting methods and their speed. Nearly every schoolchild learns that cheetahs are the world's fastest mammals, capable of sprinting at speeds as

high as seventy miles an hour. The *average* speed for most chases, however, is rarely more than forty miles an hour—still a crucial advantage over their favorite prey, the smaller types of antelope.

Despite their speed and killing efficiency, cheetahs are in the bottom ranks of large African predators. Among carnivores of the Serengeti, only the lowly jackal gives way to the cheetah. Lions, leopards, and even spotted hyenas not only challenge adult cheetahs for prey but also sometimes attack and devour their cubs.

After careful study Lory and I estimate that between half and three-quarters of all cheetah cubs in the Serengeti die before the age of 3 months. Those that survive reach sexual maturity around the age of 18 months, averaging 100 to 120 pounds in weight and standing roughly thirty inches

high at the shoulder. Once past the critical three-month period, cheetahs in the wild may live as long as 12 or 14 years.

From the beginning of our study we kept detailed records on each cheetah we observed. In every case we snapped mug shots of the animals so that we could identify them later. We gave each one a name, borrowing from English, German, Swahili, and several other languages to accommodate a list that eventually grew to more than three hundred individuals representing four successive generations of cheetahs in the Serengeti.

The three male cheetahs whose killing of the intruder I had witnessed were known to Lory and me by the Swahili names we had given them—Tisa, Tatu, and Tano. Tatu and Tano were brothers who had teamed up with Tisa to establish a territory around the

Naabi Hill area in the middle of the Serengeti Plain.

To our knowledge, such a killing had been observed only once before. After much discussion Lory and I speculated that the intruder had hoped to join the resident males as a partner and had therefore chosen not to resist their challenge. If so, the choice had cost him his life.

Old Friend Reveals New Family

Such violence was rare in our day-to-day observations. Our subjects more often were females engaged in rearing cubs. Among those one of our favorites was Brigitta, a female (right) with a unique sickle-shaped scar across the top of her muzzle.

On our first encounter with Brigitta she had five nearly grown cubs with her. Thereafter she again became solitary, traveling and hunting on her own. After a time she disappeared, presumably to follow the herds of gazelles that migrate fifty miles or more across the Serengeti. One morning months later we were observing a female and her five new cubs through binoculars.

"Know her?" Lory asked.

"Not sure," I replied, studying the pattern of spots on the female's cheeks. I didn't recognize the pattern, and then my eye suddenly shifted to the animal's muzzle. There was the distinctive sickle-shaped scar.

"Brigitta!" I exclaimed, surveying the five silver-blue-and-black balls of fur gamboling along beside her. "So that's what she's been up to all these months."

Brigitta and her cubs proved ideal subjects for observation. Moving fairly slowly during the day and settling down together at night, the group offered excellent opportunities for round-the-clock study, a vital element in our research project.

From the beginning we had determined to study cheetahs on a 24-hour basis, something no one had ever done over extended periods. We equipped the Land Cruiser with a mattress, portable stove, jerry cans of water, and an assortment of canned goods, so that we could remain in the field for as long as nine days at a time. Working shifts with binoculars and taking advantage of the bright East African moonlight, we were able to record nocturnal behavior (pages 722-3).

During the many weeks that followed our



Catnapping cubs find mother's back a fine pillow for a noontime snooze (above). The mother, dubbed Brigitta, was one of more than three hundred cheetahs the authors grew to recognize from facial-spot patterns. Brigitta's cubs will wear their silver-blue mantles and blackish underside fur—visible on the animal at left—until they are about 10 weeks old. Scientists are as yet uncertain about the purpose of such distinctive markings.

At 4 months (right), cubs bear their mature coats and engage in the playful sparring familiar in cats of all kinds.

Cheetahs in areas frequented by tourists adapt to man's presence. Their morning hunts disrupted by sightseers, the Serengeti animals frequently kill during midday when people are at the lodge eating lunch.





Deadly teamwork enables two males to down a yearling wildebeest (above). One cheetah grabs its haunches; the other lunges for the throat to inflict a suffocating bite, the standard method of

dispatching a victim. Yet the animals sometimes kill in less efficient fashion. Immobilized, a Thomson's gazelle gasps as three hunters feed on its vitals (below).



BOTH BY REINHARD AUMKEL

reintroduction to Brigitta, Lory and I shared everyday life with her and her cubs. We watched her nurse the cubs, hunt, and share her kills with them.

After watching Brigitta hunt for several weeks, we concluded that a single Thomson's gazelle (left), an animal weighing roughly forty pounds, will sustain a mother cheetah and five small cubs for a day. Larger animals such as Grant's gazelles, wildebeests, hartebeests, and zebras require teamwork by two or more cheetahs to bring down (above). The usual method of killing is strangulation—the cheetah clamping its jaws onto the victim's windpipe.

When we had our second encounter with Brigitta as a parent, her new cubs were about 5 or 6 weeks old, and were beginning to follow their mother. Their fur was black, with silver mantling along the neck and spine. Although Brigitta still nursed the cubs, they were gradually being weaned. In

following weeks they ate larger and larger portions of their mother's kills.

Occasionally during her travels Brigitta would climb into the branches of a thorn tree or to the top of a termite mound. She was searching for prey but often used the opportunity to mark the spot with urine or feces. Cheetahs space themselves out over relatively wide areas and use these scent marks on trees, bushes, and points of high ground to indicate their whereabouts or their territorial boundaries.

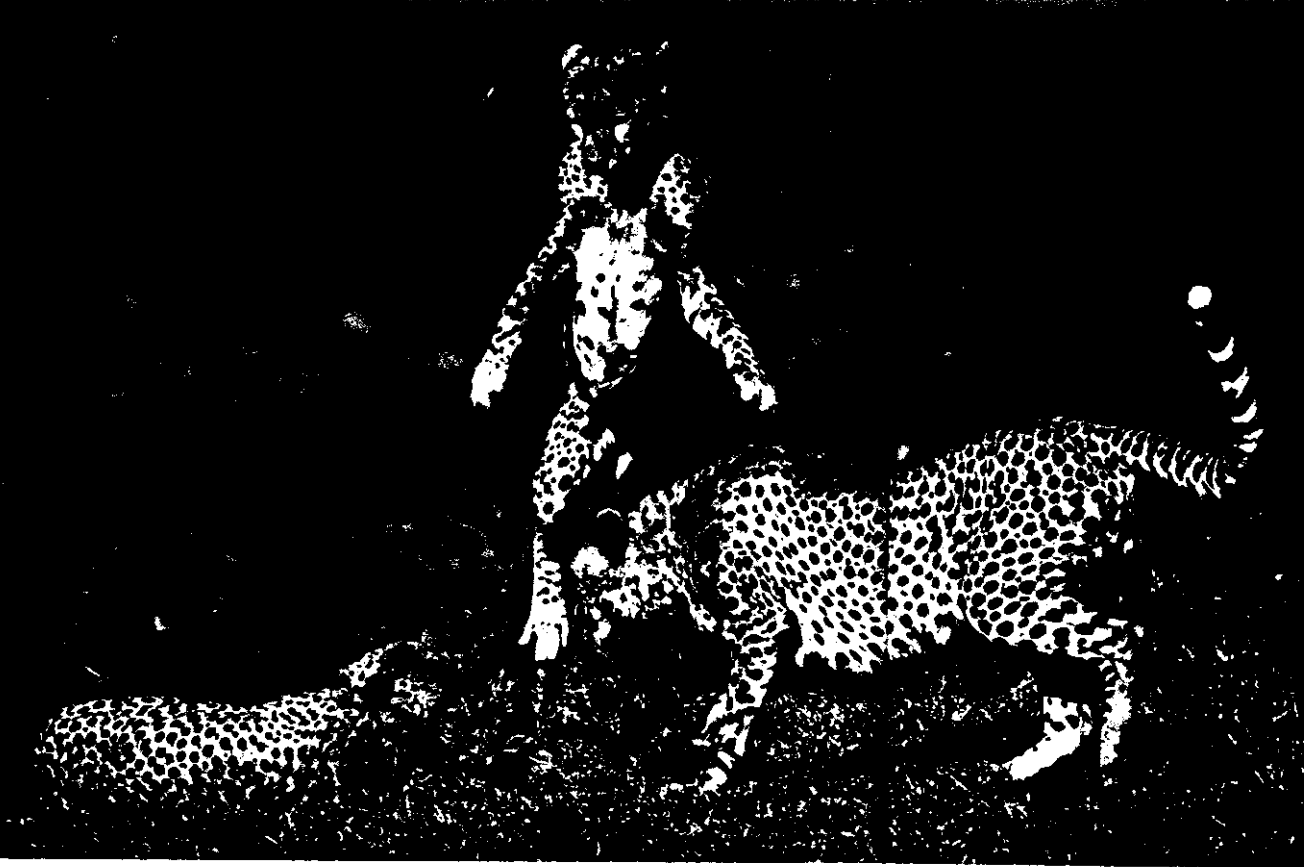
In time our study extended from one generation to succeeding ones. On a very hot afternoon in the fourth year of our study, one of Brigitta's daughters that we had named Tomoko suddenly appeared after a long absence. Tomoko emerged from a stand of high grass, her face blood smeared and her belly plainly full.

Cheetahs normally remain inactive during the heat of midday, so Lory and I,



Lovelorn Paka sits attentively as morning breaks on the day after mating with Solitaire, who lolls on the grass. "Solitaire was merely tolerating him at this point," say

the authors, first scientists to fully document wild cheetahs courting and mating. "When Paka fell asleep later in the day, she sneaked away, practically on tiptoe."



Leaping to the fray, a male in defense of territory pounces on an intruder (above). The attacker's cohort slinks in from the side. Curiously enough, the intruder lies submissively and does not try to fight back. "He was probably trying to be accepted into the group," say the authors.

The assailants continue for twenty minutes, tearing out mouthfuls of fur and biting so savagely (left) that the crunch of bone can be heard. Even when they stop to rest, the victim makes no attempt to flee. The denouement comes almost as an afterthought. One attacker ambles over and administers a choking, fatal bite.

curious, drove closer to see why Tomoko was so active.

"She's nursing," Lory announced after a second look. "She seems swollen, and she's got dirt smudges around her nipples. She's obviously made a kill, and she's on her way back to her litter; maybe we can follow her and get a look at them."

For several miles Tomoko led us without a pause, finally stopping at Loliondo Kopjes, a scattering of huge boulders fringed with thornbushes. Here Tomoko began inspecting seemingly random bushes, glancing under each as she passed.

"Has she forgotten where she left the cubs?" Lory asked. "Or maybe she's checking for lions and hyenas?"

Neither, it seemed. Finally Tomoko paused and looked slowly around. She gave the soft churring noise of a female cheetah calling to her cubs, then vanished beneath a tangle of grass and thorn branches.

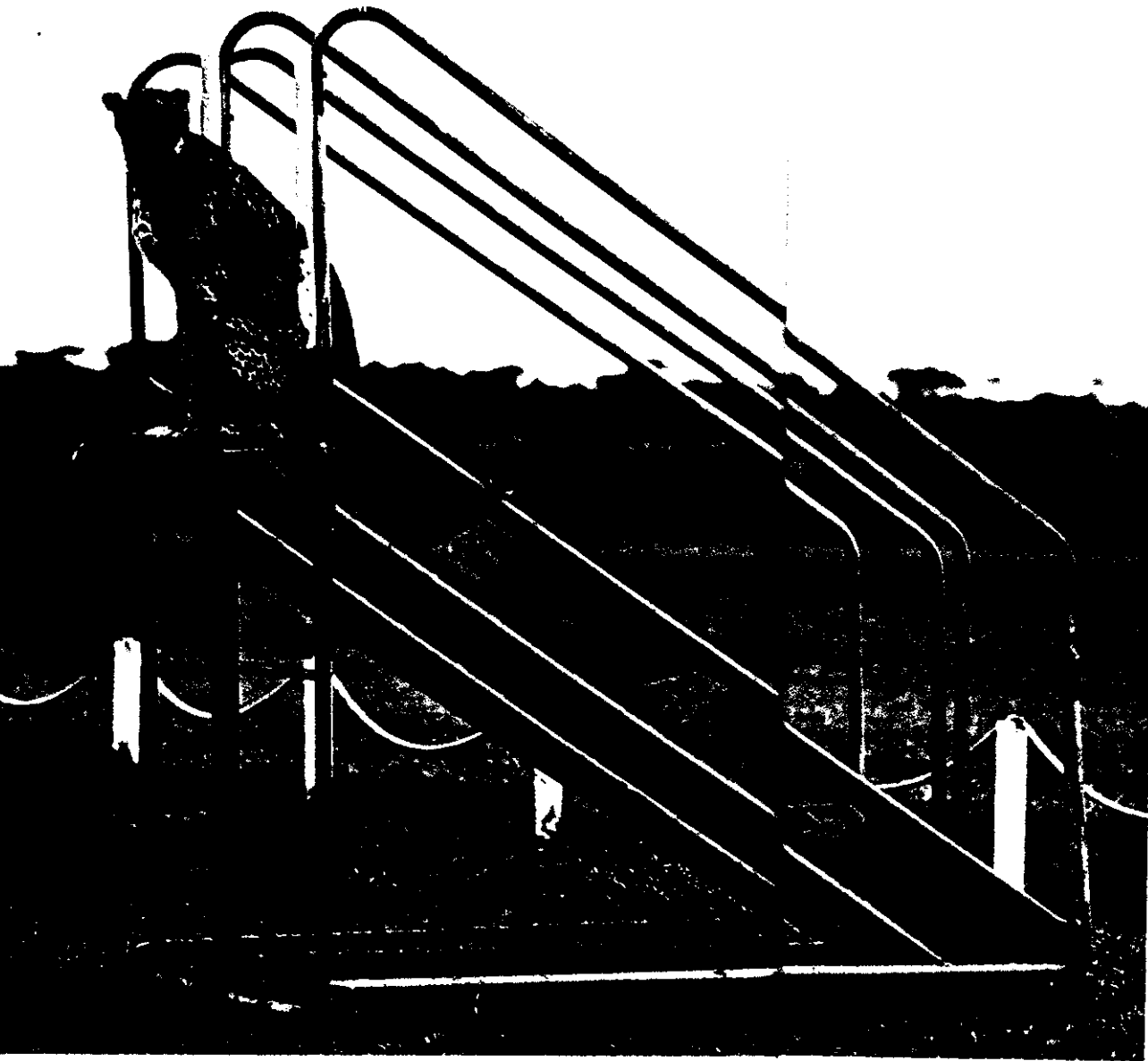
We waited in silence for half an hour. At length Tomoko emerged and stretched on her side in the grass. Five tiny balls of fur emerged from their hiding place and crawled toward her. When they reached her, they began nursing. Lory and I estimated the cubs' age at no more than 10 days.

Mother's Absence Brings Tragedy

For several weeks after that we followed Tomoko and her cubs, but kept a proper distance. With instinctive caution she moved her family to a new lair at least every other day, probably to hide them from predators. The technique worked, but only for a while. One day, with our colleague Reinhard "Leo" Künkel trailing her, Tomoko left the cubs for several hours in order to hunt. When Leo followed her home, the cubs had simply vanished. Although Tomoko searched a wide area around the lair for two whole days, no trace of the cubs remained. Most likely a hyena or lion had found them; such is the fragility of life in the Serengeti.

Unlike Tomoko's cubs, Jade's offspring survived the critical first three months and probably roam the Serengeti today as adults. Jade was a handsome mother with six cubs that we kept track of for 15 months.

Around the age of 10 weeks the cubs' black coloration and silver mantles began to give way to the adults' tawny fur and dark



spots. By the time Jade's cubs were a third grown, they were playing among themselves in ways increasingly suggestive of adult behavior. The play was so fast and varied that we couldn't watch and take notes at the same time. We finally had to concentrate on a single cub at a time, recording every possible detail on tape.

The most common type of play was stalking, chasing, and pouncing. The sequence bore close resemblance to actual hunting by adults. One cub would chase another to the point of capture, then swipe at its rump or hind leg with a paw in the same manner that an adult cheetah knocks its victim to the ground. Among cubs, however, the usual final stage was simply a wrestling match instead of the fatal strangling bite.

Jade was remarkably tolerant of the cubs' play, even when it was directed at her. Now and then a cub would rear up beside her as she walked, bracing its forepaws against her neck and vigorously chewing her nape. Often Jade merely continued to walk, forcing the cub to keep pace on its hind legs. Before long the attacker would weary of the effort.

Cub Rearing Is No Easy Task

Despite their growing independence, the cubs remained a constant burden on their mother. When Jade went on the hunt, the cubs tagged along, sometimes wrestling, pouncing, and snarling among themselves, frequently scaring off the quarry Jade had so painstakingly stalked.

Yet when Jade *did* make a kill and paused briefly to catch her breath, the cubs became a ravening mob, growling and shoving past their mother to get at the meat.

One fact we learned from our tracking of Jade and her cubs is that cheetahs can go long periods without water. Even in the hottest season the family regularly passed up water holes for four or five days at a time.

Jade and her cubs parted company when the young ones were 16 months old and

Panic erupted at Seronera airport when travelers spied Solitaire sitting on a ramp. But the estrous female was just passing through, marking the spot—and other high points—with urine to broadcast her eligibility to prospective males.

weighed roughly a hundred pounds each. At that stage young cheetahs are nearly full grown and are fairly competent hunters, though they still have much to learn. Perhaps partly for that reason littermates tend to remain together for at least several more months before going their separate ways.

As with many other mammal species, it is the males that disperse. We found that young female cheetahs continue to occupy virtually the same range as their mothers. In nearly every case the young males eventually emigrate, sometimes together, as did Tatu and Tano, to establish new territories.

Although male and female cheetahs are born in roughly equal numbers, we found that in the Serengeti adult females outnumber males. The reasons seem to be that young males are forced by the older, resident males to emigrate out of our study area into less favorable habitats. Some males are also killed in fights.

Curiously, although it is the males who emigrate, the females usually travel farther during the course of a year. Whereas a male's established territory encompasses 15 to 30 square miles, a female's range covers about 600 square miles. It is not uncommon when following migratory herds of gazelles for female cheetahs to travel more than forty miles.

The females are normally solitary creatures. The largest number of cheetahs we ever saw together in four years was nine—two mothers, with three and four cubs respectively. I suspect the females were young sisters who still had a sibling bond.

Perhaps the single most exciting observation in our four years of study involved the courtship and mating of cheetahs. The full sequence had never been studied in the wild, for cheetahs are not only solitary but also very secretive animals.

We had an indication that mating was soon to occur when we encountered Solitaire, another of Brigitta's grown daughters. Solitaire was clearly in estrus, for as she traveled, she paused to sniff at virtually every tree, bush, termite mound, and clump of grass she came to. In addition, she left urine marks at an unusually high rate—at least once every ten minutes.

Studies of mammals show that the urine of females in estrus contains hormones that

advertise the condition to males. We knew it was only a matter of time before Solitaire's trail would be picked up by a prospective suitor, and we stayed close to her round the clock for five days.

Early on the morning of the sixth day a male we knew as Paka discovered Solitaire's scent marks. He broke into a fast walk, alternately yelping and emitting staccato purrs as he followed her trail. Shortly before sunrise Solitaire heard Paka's call and immediately trotted in his direction.

The moment the two animals saw each other Solitaire lay in the grass. Paka almost immediately mated with her, grasping the back of her neck in his mouth in typical cat fashion. The courtship ritual just before mating was surprisingly brief.

Afterward Solitaire rolled in the grass, groomed her legs and face, and seemed to ignore Paka. He growled and hissed whenever she moved, following her and sniffing the grass wherever she lay.

The pair rested through the day, mated again at dusk, and remained together until the next afternoon, when Solitaire cautiously crept away as Paka slept. The entire process was in marked contrast to those other large African cats, the lions, who mate frequently over a period of several days, sometimes as often as four times in an hour.

Preserves May Promise Only Haven

The major conclusion of our study is that the protected Serengeti cheetah population is doing well. Elsewhere in Africa, however, cheetahs are declining in number at a frightening rate. One survey jointly sponsored by two wildlife-conservation groups indicates that the cheetah population is being halved every decade. The reasons are simple: illegal hunting for pelts, encroachment on habitat by farms and settlements, loss of natural prey, and deliberate extermination.

Only in vast designated preserves such as the Serengeti National Park can the cheetah hope to survive. Lory and I estimate that there are at least a thousand cheetahs in the Serengeti, a living monument to the continuing efforts of Tanzania's government.

A similar conservation effort on the part of other African nations is the cheetahs', and our own, best hope. □



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