

Coping with a Lion Killer

Epidemiologists in the Serengeti battle to protect the king of beasts from man's best friend

Text and photographs by Craig Packer

The rains have come early to Mugumu, Tanzania, this wet season. When I arrive in December, the landscape is already lush and the roads unnervingly slick. I am less than ten miles from the boundary of the Serengeti National Park, but the eighty-mile drive from the park headquarters at Seronera has taken more than three hours. Parking my Land-Rover beside the village post office, I stretch my legs and contemplate the satellite dish that connects Mugumu to the outside world via an ancient windup telephone in its colonial era booth. Nearby, a boy sells mangoes from a wooden table; his dog sleeps fitfully in the heat. I am greeted by the regional veterinary officer, Magai Kaare, who offers me a cup of tea, then excuses himself to collect vaccine, syringes, and members of his staff before leading me to the nearby village of Maranga.

Driving through herds of cattle and goats, past hand-tilled cassava and maize fields and huts made from mud and thatch, we wind up a hill to the village square. We are swept toward town-hall by a tide of about 500 dogs and their owners. Dr. Kaare's staff open their bags in the shade of the veranda, pull out their ledgers, and start filling their syringes.

The dogs are leashed, some attached to bicycle chains, others tethered by woven strands of grass, and still others held by chains that could secure a treasure chest.



Twitching facial muscles and forepaws are among the many distressing signs of canine distemper in lions, above. Right: Tens of thousands of domestic dogs live in the Serengeti region. Scientists hope that vaccinating as many as possible will halt the spread of this devastating disease to lions and other wildlife.

The owners come in all ages and sizes: small boys, teen-agers, old men. Many of the dogs are called Simba—someone explains to me that the fiercest dogs are always given the Swahili name for lion. Others answer to Rambo, Khomeini, Saddam, Scud, or Mandela. The vets restrain each dog with a makeshift muzzle of cotton gauze. Dr. Kaare asks if I can bring him some leather muzzles from the United States; most of these animals aren't used to much physical contact, and a good portion of them could be carrying rabies.

Dr. Kaare is hoping to control rabies in this remote part of Tanzania, but my presence here is inspired by another scourge: canine distemper. And my principal motivation is to protect a different carnivore: the Serengeti lion, which I have been studying for the past eighteen years.

The period leading up to this intensive effort to vaccinate as many dogs as possible against distemper was fast paced and emotional. It all began on February 3, 1994, as a group of tourists glided over the heart of the Serengeti in a hot-air balloon. In the morning light, the scene below looked idyllic. Wildebeests, zebras, and other wild ungulates grazed as birds flew nearby; the savanna stretched unspoiled to the horizon. But not far from the banks of the Seronera River, the tourists saw something else, something disturbing: a male lion flailing and jerking and unable to stand.

After landing nearby, the balloon pilot sent an urgent message to the chief veterinary officer of Tanzania National Parks, Melody Roelke. When Roelke drove up to the dark-maned male later that day, he was disoriented and apparently oblivious to his surroundings. Within a few minutes he started working his mouth, lifting his chin, and stretching his neck. His limbs began to tremble, then jerk. He tried to stand, but his legs failed to support his weight, and he collapsed on his side, thrashing helplessly, unable to breathe. A few minutes later, the seizures ceased, and he lay flat out: panting and exhausted.

The pattern of convulsions alternating with exhaustion repeated itself every half hour or so for the rest of the day, and the animal died during the night. By the next morning, only his head remained. The rest of the body had been eaten by hyenas.



Over the next few weeks, Roelke and my field assistants, Sarah Legge and Pamela Bell (I was away teaching at the University of Minnesota at the time), encountered seven more lions suffering from the same symptoms and recovered the bodies of another dozen. Part of my research program involves regularly monitoring the 250 lions living in the southeastern sector of the Serengeti National Park. By May, more than a third of these study animals had died or disappeared. Many of the survivors were left with neurological damage, manifested by a permanent twitch in their forepaws or upper lip. By August, the disease had spread to the far western part of the Serengeti; by October, it had reached Kenya's Masai Mara Reserve, where it likewise killed more than a third of the lions. Assuming comparable mortality over the entire Serengeti ecosystem, I estimated that the overall lion population dropped from 3,000 to 2,000 in less than a year.

As the disease raged throughout the region, Roelke autopsied as many of the victims as she could, and I flew out to the Serengeti to help her veterinary team collect blood samples from fifty-seven of the surviving lions. We sent tissue samples to Linda Munson, a pathologist at the University of Tennessee, who immediately recognized the damaging signs of canine distemper, a viral disease that causes encephalitis and pneumonia.

Virologist Max Appel, of Cornell University, soon confirmed Munson's diagnosis using monoclonal antibodies, which seek out the biochemical fingerprints of a specific virus. Appel's serological analysis revealed that more than 90 percent of the Serengeti lions had been exposed to the virus in 1994. In contrast, his analysis of samples we had routinely collected over the previous decade showed that no lion had been infected between 1981 and 1993. (The samples showed that some lions born before 1981 had been infected with canine distemper; whether that earlier strain was the same or different, more or less virulent than the latest one cannot be definitively determined at this time.)

With the diagnosis in hand, the next step was to find out the source of the infection. This too was quickly determined by Sarah Cleaveland, who has been conducting doctoral research on rabies for the London Zoological Society. Blood samples in her collection revealed that distemper had struck domestic dogs around Mugumu in each of the four preceding years. Margaret Carpenter, a molecular geneticist working at the National Cancer Institute, examined virus extracted from the dogs and found that the sequence of nucleotide bases matched the virus that had killed the lions.

Canine distemper is an airborne disease spread mostly by sneezing. We don't know how the first lions became infected, but since they seldom venture into towns or villages, the virus is unlikely to have traveled directly to lions from domestic dogs. More likely, lions caught the virus from some of the other carnivores affected by the disease: bat-eared foxes, spotted hyenas, jackals, and leopards. Hyenas and jackals, for example, often scavenge near village compounds; leopards eat domestic dogs. Lions come in contact with these species at kills. Once one lion was infected, the virus would have spread quickly to others in the animal's pride. Sick lions sometimes become nomadic and follow the wildebeest migration throughout the Serengeti, spreading the virus to other prides.

The pathogen responsible for canine distemper belongs to a class of RNA viruses - the morbilliviruses - that often demonstrate an alarming ability to hop from one species to another. The morbilliviruses include measles, rinderpest (a disease of cattle and other cud-chewing ungulates), and a recently discovered virus that suddenly infected a stable of Australian horses in 1991. Most of the infected horses died, as did two of their handlers. The canine distemper virus itself is well known for infecting a wide range of hosts, including black-footed ferrets, seals, and dolphins.

Several "new" viruses have made headlines in the past few years. One, the Ebola virus, captured the world's attention in 1995 when it killed several hundred people in Kikwit, Zaire. An Ebola-like virus even became the subject of a Hollywood movie, *Outbreak*. But the Ebola virus may pose less of a long-term threat to humans

and animals than do the morbilliviruses, for it is relatively hard to catch; most victims are health-care workers who have come in direct contact with the body fluids of infected patients. The morbilliviruses, in contrast, are easy to catch. They have evolved aggressive means of transmission: violent sneezing in the case of distemper; severe dysentery in the case of rinderpest.

Morbilliviruses can be deadly, sometimes killing up to 80 percent of their vic-

A recent epidemic of canine distemper wiped out a third of the Serengeti's lions. Among the many other carnivores felled by the virus were leopards, jackals, bat-eared foxes, and spotted hyenas.

tims. Even measles, which we have largely forgotten in the West, still kills more children in the Third World than any other infectious disease. Survivors of a morbillivirus, however, typically enjoy lifelong protection against further infection. Consequently, these diseases can persist only in a very large population of susceptible animals. Epidemiologists calculate that measles requires a human population with at least 200,000 susceptible hosts.

Such a dependence on population size is a definite drawback for any pathogen, but many morbilliviruses surmount this difficulty by attacking more than one species at a time. The tens of thousands of wild carnivores in the Serengeti, for example, would not have provided enough susceptible hosts to sustain a "hot" strain of canine distemper. But domestic dogs are another

story. Sarah Cleaveland estimates that more than 30,000 domestic dogs live within ten miles of the park boundaries, and millions more populate the rest of the country. By far the most abundant carnivore in the region, the domestic dog is the critical link in the cycle of infection.

The recent spread of distemper from the dogs to wild carnivores has similarities to, and, ironically, is the indirect result of, the great rinderpest outbreaks in Africa in the 1890s, the most famous epizootic in history. Rinderpest spreads itself by causing uncontrolled diarrhea. When a healthy animal grazes on contaminated grass, it picks up the virus and carries it elsewhere. Stories differ as to precisely how rinderpest first reached Africa. It may have been when Italians brought an infected herd of cattle to Ethiopia or when the British attempted to relieve General Gordon at Khartoum. At any rate, the first recorded cases on the continent occurred in the Horn of Africa in the late 1880s. Less than ten years later, rinderpest had swept its way to the Cape of Good Hope.

Millions of animals died, including nearly 80 percent of all domestic livestock. Pastoralist tribes were devastated; one Masai elder reported that so many people starved that "the vultures forgot how to fly." Populations of many wild ungulates - buffaloes, wildebeests, gazelles, giraffes, wart hogs - were decimated. In several areas, lions no longer had enough wild prey to eat and turned to human flesh. When early settlers wrote about close encounters with man-eating lions, they were unwittingly writing about the far-reaching consequences of human activity.

Rinderpest raged across Africa until the 1930s, when it subsided everywhere except in the Serengeti. Repeated outbreaks of the disease greatly reduced the Serengeti's once vast ungulate populations, but the many cattle left in the region, together with the surviving wildlife, provided the necessary pool of susceptible hosts for the virus to persist. Various techniques were employed in an attempt to protect the cattle from the disease. Fences were built; livestock movements were restricted. Nothing worked.

Finally, in 1962, the colonial veterinary service initiated a large-scale vaccination

program for the cattle around the Serengeti. No longer able to infect livestock around the park, the virus died out in the wild animals as well. After 1963, there were no further infections. In the absence of the disease, wildlife populations rebounded. Wildebeest numbers went from 250,000 to more than 1.5 million by 1978. The number of buffaloes and other ruminants likewise increased several-fold. As Canadian ecologist Tony Sinclair has pointed out, the story of the Serengeti is the story of rinderpest.

In the last several decades, the human population around the Serengeti has grown at more than 4 percent a year. With a doubling time of only eighteen years, the number of people in the villages of Mugumu and Maranga, for example, has almost quadrupled since rinderpest was brought under control.

In a sense, solving the rinderpest problem paved the way for canine distemper, for more people means more dogs. The local people rely on dogs to watch their cattle; they also use them to drive wild game while poaching inside the park. There may now be enough dogs named Scud, Simba, and Saddam to constitute a potentially permanent reservoir for the canine distemper virus that so devastated the lions in 1994.

Today, the remnants of the colonial veterinary service provide the foundation for Project Life Lion, our program for vaccinating the burgeoning domestic dog population against distemper and rabies. For the villagers, this is one of the few tangible benefits of living next to a well-protected national park. Revenue from tourism rarely makes its way down to the local villages, and the law prohibits villagers from using their traditional hunting grounds inside the Serengeti.

Everyone in Maranga knows we've come to vaccinate their dogs because of the lions. It seems odd to talk to someone who may have lost a cow - or even a child - to a lion and then explain that our ultimate goal is to protect the wildlife. But even here, in this impoverished town on the front lines of the battle for the future of the wild, people are pleased to think that there might still be lions in the next century and proud to be able to help.
