PRIMATOLOGY

Human Diseases Threaten Great Apes

Researchers are uncovering disturbing evidence that scientists and tourists are infecting wild primates with human pathogens

High in the misty mountains of Rwanda, hundreds of international tourists flock each year to view the endangered mountain gorilla. The visitors come not only to admire these animals but also to support their protection. But the tourists' presence, as well as that of the scientists who study the gorillas, puts the animals at risk.

In 1988, the animals were sneezing, coughing—and dropping like flies. At first, nobody knew the cause, but then blood and tissue samples from one gorilla showed telltale signs of measles infection. No one ever identified the source of that outbreak, which killed six animals and sickened 27 more. Nor did anyone isolate human measles virus from any gorilla. But "from all outward signs, it appeared to be measles, and it was most probably of human origin," says Annette Lanjouw, director of the International Gorilla Conservation Program in Nairobi, Kenya. Because the loss of a single population could have been catastrophic to the species, the veterinarians who monitored the animals suspended their usual hands-off policy and gave the remaining 65 healthy gorillas in that social group a measles vaccine to ward off the disease. The epidemic stopped as suddenly as it had started.

That outbreak seemed like an isolated occurrence, but looking back, experts see it as an early sign of an emerging threat. Just as deadly viruses like Ebola and HIV have jumped from primates to people, increasing evidence suggests that human diseases have infected wild primates, perhaps with fatal consequences. As primate populations dwindle and people press ever closer to the animals' forest homes, experts say that the threat of human disease is rising—particularly to populations, such as the Rwandan mountain gorillas, that have become accustomed to people.

"We're just starting to appreciate … how devastating pathogen transmission could really be," says primatologist Randy Kyes of the University of Washington, Seattle. In response, ape specialists, including the American Society of Primatologists, are now calling for stricter health standards for researchers and tourists. They are also urging researchers to learn how to diagnose disease in their study animals.

These efforts may provide a crucial safeguard as wildlife veterinarians and epidemiologists work to determine the extent of the problem. Although anecdotal accounts abound about recent outbreaks, so far, hard data are lacking to finger human exposure as the true culprit. Even so, "there's emerging evidence that there is an impact," says veterinarian and epidemiologist Jonathan Sleeman, former director of the Mountain Gorilla Veterinary Center in Rwanda. Studies have documented that infections do occur, as antibodies to human diseases such as influenza, measles, and tuberculosis have been detected in some wild macaques and orangutans. Also, gorillas and chimps that live close to humans have more parasites than animals in remote areas.

Close encounters. Field researchers are being urged to don masks and gloves to avoid infecting primates *(above)*. Below, a researcher keeps a respectful distance.

For example, last year in the *International Journal of Primatology*, Janette Wallis of Oklahoma University Health Sciences Center in Oklahoma City and D. Rick Lee of the M. D. Anderson Cancer Center in Houston described more than a dozen outbreaks of what may have been human diseases in gorillas, chimpanzees, baboons, and monkeys from five different field sites. Several of the outbreaks had never before been reported. The animals had come down with a diverse range of diseases, including measles, polio, and scabies, Wallis says.

During one outbreak in 1996, 11 chimpanzees, including a mother and her twin infants, succumbed to respiratory infections at Gombe National Park in Tanzania. The chimps were all members of a group that were handed food every day by a field worker in an effort to habituate them. When the rains came that spring, many of the workers contracted colds or flu, which can kill a chimpanzee. Wallis, who coordinated chimpanzee field research at Gombe from 1989 to 1994, speculates that sick workers may have infected the chimps.

Studies at other sites show a similar trend. Parasitologist Thaddeus Graczyk of Johns Hopkins School of Public Health, John Bosco Nizeyi of Makerere University in Kampala, Uganda, and their colleagues have found that the number of mountain gorillas in the Bwindi Impenetrable National Park carrying the common human gut bacteria *Salmonella* or *Campylobacter* has doubled in the past decade. This team already reported last year in the *Journal of Parasitology* that the protozoan *Cryptosporidium* and the roundworm liver parasite *Capillaria hepatica*, which infects humans and is spread via contaminated water, were widespread in the feces of mountain gorillas that have frequent contact with tourists. And in unpublished work from Gombe National Park, Felicia Nutter and Chris Whittier of North Carolina State University in Raleigh have shown that fecal samples from a chimpanzee group at Gombe that kept their distance from humans had just six species of parasites, whereas samples from a habituated group had 13 species.

Researchers don't really know, however, whether animals typically carry these parasites. "We're missing what's normal," says wildlife veterinarian Billy Karesh of the Wildlife Conservation Society in the Bronx, New York. A growing number of researchers are trying to collect those baseline data. Primatologists Alecia Lilly and Patrick Mehlman of the State University of New York, Stony Brook, for example, are comparing parasite levels in fecal samples from wild western lowland gorillas in remote areas of central African forest with those near human settlements. On the other side of the world in Saba, Malaysia, a team led by Annelisa Kilbourn of the Shedd Aquarium in Chicago has assessed pathogen and parasite levels in

CREDITS: (TOP TO BOTTOM) M. CRANFIELD/MOUNTAIN GORILLA VETERINARY PROJECT; COURTESY J. WALLIS/UNIVERSITY OF OKLAHOMA HEALTH SCIENCES CENTER

Victim? A sick chimp at Gombe.

orangutans from pristine forests.

At the same time, primatologists are urging field workers and ecotourists to adopt the strict precautions already in place in primate centers. Workers at U.S. zoos and primate facilities don masks and gloves to handle the animals and must also undergo vaccinations, parasite screens, and annual tuberculosis tests. But some field sites have been slow to adopt similar measures. "It's easier for me to go up within 5 meters of one of the rarest animals in the world [mountain gorillas] with no health restrictions than it is for me to travel to Cincinnati or UC [the University of California] Davis and go behind the scenes in their primate house," says Michael Cranfield, director of the Mountain Gorilla Veterinary Project.

In an effort to change that, Wallis led a working group at an international conference of ape researchers and zookeepers last May to discuss improved monitoring of primate diseases and better health care for people living near primate reserves. In July, the American Society of Primatologists asked its members to tighten safety standards, further underscoring the urgency of these issues. And that same month, a team of field researchers and wildlife veterinarians held a workshop in Africa to teach field workers how to recognize signs of illness in chimps, take samples, and conduct a necropsy—all of which will help them diagnose sick animals and catch outbreaks early. For Wallis, who has witnessed several outbreaks at Gombe, these efforts can't come a moment too soon. Says Wallis, "I just want to know we've done what we can."

–DAN FERBER

Dan Ferber is a writer in Urbana, Illinois.

AIDS RESEARCH

The Odd Intersection of HIV and Scrub Typhus

Can contracting another disease help suppress HIV? Researchers report intriguing new findings

Sometimes the most intriguing ideas come out of left field. Take the peculiar discovery in a new study from Thailand suggesting that a disease called scrub typhus may offer novel leads to developing anti-HIV treatments and vaccines.

Typically, when HIV-infected people become infected with other pathogens, the level of the AIDS virus in their blood skyrockets. But in the 5 August issue of *The Lancet*, researchers report that AIDS patients infected with the bacillus that causes scrub typhus—a mite-borne disease that produces fever but usually isn't fatal—have precisely the opposite reaction: Their HIV levels plummet. "It's very intriguing," says Peggy Johnston, head of the AIDS vaccine branch at the U.S. National Institute of Allergy and Infectious Diseases (NIAID). "It's clear that there's something interesting going on here, and it does appear to be some kind of suppressive factor."

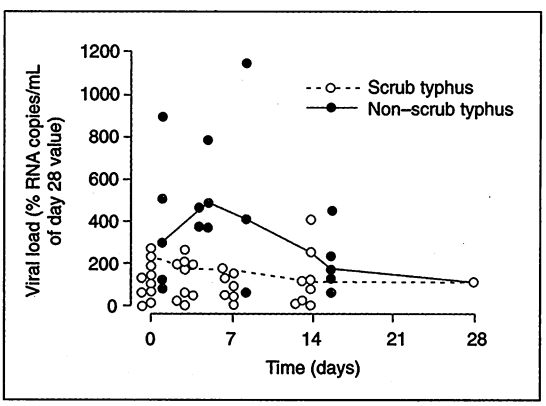
The idea for the study began 2 years ago, when George Watt, a tropical disease specialist at the United States Armed Forces Research Institute of Medical Sciences in Bangkok, became intrigued by one HIV-infected patient who developed scrub typhus. Caused by *Orientia tsutsugamushi* (formerly *Rickettsia*), scrub typhus is transmitted by chiggers that fall off rodents and then live in the scrub bush. Surprised that this one patient's HIV level—or "viral load"—dropped coincident with an acute case of scrub typhus, Watt, Pacharee Kantipong of Chiangrai Regional Hospital, and their colleagues began systematically hunting for HIV-infected people who also had acute cases of scrub typhus.

As the researchers report in *The Lancet*, their massive, yearlong screening program in Thailand uncovered 10 people who clearly had both infections and no others. First, the Thai team compared viral loads in these patients to a control group of five HIV-infected people who did not have scrub typhus but did have either malaria or leptospirosis. Over the 28-day study, the investigators found that the patients with scrub typhus had significantly lower HIV viral loads than those with the other diseases. In two of these people, in fact, the levels fell so low that the most sensitive tests could not detect HIV. In another curious twist, the scrub typhus patients happened to have more damaged immune systems, with an average of only 117 CD4 white blood cells, as opposed to an average of 255 CD4s in the control group. (By definition, an HIV-infected person has AIDS when CD4 counts drop below 200.) The new findings are "an absolutely fascinating example of how one infection ameliorates the effect of another," says Sanjeev Krishna, a malaria specialist at St. George's Hospital Medical School in London and an author of the paper.

More evidence that scrub typhus somehow suppresses HIV came from a second experiment, a comparison of viral variants in the same 10 scrub typhus patients and another control group whose CD4 counts were more closely matched. As HIV disease progresses, several researchers have shown that the virus typically evolves to a form more adept at destroying immune system cells. Specifically, once these nastier HIV variants infect cells, they can readily fuse with other cells to form clumps called "syncytia," an efficient means of transmitting the virus and speeding the course of disease. None of the 10 patients with scrub typhus had a syncytia-inducing HIV variant, whereas five of the seven controls did.

Watt and his co-workers attempted to tease out how *O. tsutsugamushi* might thwart HIV. Preliminary data in both mouse and test tube experiments with human sera point to antibodies against scrub, which for some unknown reason seem also to bind HIV. "This is an opportunity to examine very seriously what scrub typhus is telling us about HIV," says Krishna, who suspects that these new insights might provide clues for developing both AIDS treatments and vaccines.

NIAID's Johnston particularly enjoys the oddity of the finding. "I like surprises," she says. "It keeps us thinking." **–JON COHEN**



Surprising suppression. Scrub typhus lowers HIV levels.

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