

Pattern of Human Ebola Outbreaks Linked to Wildlife and Climate

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Bush Pig. Credit: S. Lahm, UCSD

A visiting biologist at the University of California, San Diego and her colleagues in Africa and Britain have shown that there are close linkages between outbreaks of Ebola hemorrhagic fever in human and wildlife populations, and that climate may influence the spread of the disease.

The decade-long study, published this month (with a cover date of January) in the journal *Transactions of the Royal Society of Tropical Medicine and Hygiene*, tracked animal disease outbreaks and human exposure to the Ebola virus in Gabon and adjoining northwestern Republic of the Congo (RoC). The researchers found that many additional wildlife and human populations within and outside of known epidemic zones have been exposed to the virus. When they considered

disease outbreaks in all mammals, not just humans, the spread of Ebola no longer seemed erratic and inexplicable.

“Some researchers have hypothesized that outbreaks of Ebola are randomly-spaced periodic outbursts, while others have suggested that Ebola has spread like a wave surging over the Central African landscape,” said Sally Lahm, a visiting scholar in UCSD’s Division of Biological Sciences and the primary investigator of the study. “Our results are intermediate between these two views. There is a perceived pattern to the way the virus spreads, but it is not simply a wave affecting everything in its path, since apparently healthy mammal communities thrived in close proximity to Ebola epidemic sites.”

Lahm has been a research associate at the Institute for Research in Tropical Ecology in Makokou, Gabon since 1982. She was conducting unrelated ecological studies when outbreaks of Ebola virus in humans prompted her to explore how the disease was affecting animal populations in the region. Between 1994 and 2003, she collected reports of animal illness and deaths from wildlife survey teams, villagers, hunters, fishers, loggers, miners, Ebola survivors and families of victims from across Gabon and into northwestern RoC.

Despite the low probability of finding dead animals in the humid forests that cover most of the region, due to the scavenging by animals and insects and rapid decomposition, Lahm received and verified reports of 397 dead animals. The carcasses, which were found at 35 different sites in Gabon and RoC, included gorillas, chimpanzees, mandrills, bush pigs, porcupines and four species of antelope. Tests on 14 samples from the decomposed carcasses did not detect the Ebola virus, but at 12 sites, observers also saw sick or dying animals with symptoms consistent with Ebola infection. In addition, 16 reported wildlife mortality incidents coincided with known Ebola epidemics.

“The transmission of Ebola within animal populations is much more widespread than previously believed,” explained Lahm. “Ebola appears to spread both within species and between different species of animals.”

To determine the extent of human exposure to Ebola within Gabon, Lahm collaborated with Maryvonne Kombila, the director of the Department of Tropical Medicine and Parasitology at the University of Health Sciences in Libreville, Gabon and with Robert Swanepoel, the director of the Special Pathogens Branch of the National Institute of Communicable Diseases in Sandringham, South Africa. Swanepoel tested for antibodies to the Ebola virus in more than one-thousand human blood samples that had been collected by Kombila and her colleagues for other research in Gabon between 1981 and 1997.

Fourteen of the blood samples tested positive for antibodies to Ebola. Some people had been exposed at least three years before the first known Ebola outbreak in Gabon, while others lived in regions where no known epidemics had occurred. In 2003, Lahm was able to track down six of the people whose blood samples indicated that they had been exposed to the Ebola virus. Life history interviews revealed that some of the antibody-positive people had never visited a region where known Ebola outbreaks occurred in humans. Therefore people have been exposed to the Ebola virus where it has not been recognized.

Based on their findings, the researchers were able to identify relationships among previously documented Ebola outbreaks in humans and wildlife in Gabon and RoC that initially seemed disparate and unrelated. They proposed that the virus first spread southwest across Gabon. It then looped back toward the northeast from sites in western or central Gabon and caused the most recent outbreaks in RoC.

“If the spread of the Ebola virus follows its current northeastward path, the next outbreak would be expected to occur in northern Republic of

the Congo towards Cameroon and the Central African Republic,” predicted Lahm.

However, according to the findings, the spread of Ebola also depends on climate factors. Illness and deaths among animals were most prevalent during periods of prolonged drought-like conditions in the rainforest, which indicates that severe environmental stress may facilitate disease transmission.

In the study, the researchers urge that public education is needed to decrease human contact with potentially infected wildlife by discouraging people from scavenging dead animals and by promoting safe hunting and trapping practices, especially because the results show that outbreaks in wildlife populations have been much more frequent than previously believed. They emphasize that monitoring wildlife in collaboration with rural African residents could provide information essential for protecting public health as well as comprehending the ecology of the disease.

Lahm points out that there remain many unanswered questions about Ebola including how the virus spreads within and between mammal species.

“Our study provides more pieces of the puzzle, but at the same time it is enlarging the puzzle,” she noted.

Richard Barnes from the Environmental Sciences Research Center at Anglia Ruskin University, Cambridge, England, who is currently a visiting scholar in UCSD’s Division of Biological Sciences, also contributed to the study.

Source: University of California, San Diego

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