Scientists Search for Human Hand Behind Outbreak of Jungle Virus

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IPOH, Malaysia -- Thick jungle vegetation has taken over the concrete pens that once held thousands of pigs at the Leong Seng Nam farm. Rusting tractors bake in their tracks under a blistering sun. Only the lush mango and jackfruit trees appear unchanged from four years ago, when the farm and most everything on it were abandoned in terrific haste.

At the main gate, a sign bearing the silhouette of a man shooting a trespasser warns that no one should return: "We accept no visitors in view of the outbreak of swine disease."
But an ambitious group of outsiders has come back -- to ground zero of a frightening viral outbreak in 1998 and 1999. The previously unknown "Nipah" virus, named for the Malaysian village where it was first isolated, leapt from beast to man and killed both at a torrid rate. Then it disappeared back into the surrounding forests and limestone cliffs. The virus decimated Malaysia's fast-growing pork industry and killed 40% of the 257 people who caught it. So deadly is Nipah that the U.S. lists it among potential bioterrorism agents.

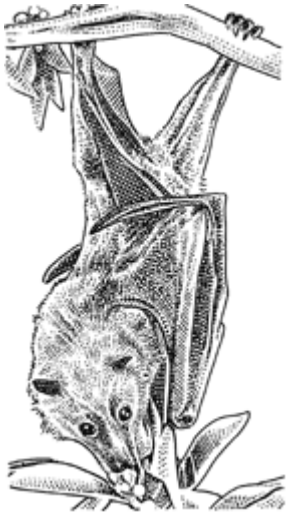
As governments begin to declare cautious victory over severe acute respiratory syndrome -- a disease that, like HIV, Ebola and Nipah is believed to have jumped from an animal host to humans -- some scientists are turning their attention to a question asked all too infrequently once deadly viral outbreaks have been contained: Where did that come from?

One such group of investigators is digging in at Ipoh, with an unconventional, multidisciplinary approach involving virologists, ecologists, zoologists, botanists and even agronomists familiar with pig-farming techniques.

Organized by the Consortium for Conservation Medicine in Palisades, N.Y., and equipped with a $1.4 million grant from the National Institutes of Health, the team of scientists will test over the next four years a compelling, if complex, theory of Nipah's emergence. It goes like this: The burning of over 12 million acres of virgin forest in Borneo and Sumatra in the fall of 1997 cast an extreme haze over a huge swath of Southeast Asia for months. That haze blocked sunlight, reducing the ability of trees to flower and bear fruit. This caused giant bats to travel great distances in search of sustenance. They settled on fruit trees fertilized with the manure of pigs on huge Malaysian farms cut out of the forests where the so-called flying foxes roost.
Somehow, the theory goes, the bats then passed the virus to the pigs who -- because of physiological and genetic similarities to humans -- amplified its potency and began infecting people in contact with them.

To some conservationists and scientists, there would be a dark poetic justice in a disease passed to man from an animal endangered by man's encroachment on its treetop environment. **"In the case of almost every emerging disease, complex human changes to the environment drive emergence," says Dr. Peter Daszak, a parasitologist and executive director of the consortium that organized the study. "Nipah appears to be a case of the bats getting some payback."**

The results of the Nipah investigation could be a key to understanding the many variables involved in sudden viral outbreaks.They could also have implications for environmental policy. If human intervention in nature is shown to have triggered the deadly epidemics, then the arguments for protecting fragile ecology suddenly become much more palpable than the desire to preserve rare landscapes or endangered species.



Pteropus vampyrus

It's far from certain that man brought on Nipah, or any of the other sudden viral scourges of recent years. And determining conclusively how a virus progresses among different species is extraordinarily difficult.

"There is always a massive knowledge gap in understanding what drives a virus that evolved over thousands of years and co-exists peacefully with one animal to jump and eventually come into contact with man," says Malaysian scientist Dr. Chua Kaw Bing, the first researcher to trace the Nipah virus to enormous endangered fruit bats, known locally as flying foxes.

In the case of SARS, researchers in Hong Kong have identified the civet cat, a relative of the raccoon, as one animal player in the spread of the virus. But they have also found SARS coronavirus antibodies in a Chinese ferret badger and a raccoon, meaning researchers are still a long way from establishing whether the civet is the virus's natural "reservoir" or just one link in a much more complex ecological chain.

Pinning down the animal source of the terrifying Ebola virus has also been difficult. In 1994, the first appearance of Ebola in 15 years occurred in a Swiss researcher on the Ivory Coast. Investigators quick to the scene thought they could trace the virus from chimpanzees dying of the disease to their prey, red colobus monkeys, which also die of the virus. World Health Organization researchers armed with a $250,000 grant undertook an ambitious study to find Ebola's natural host.

But even after collecting thousands of insects, birds and mammals that interact with the monkeys, the Ebola reservoir was as elusive as ever. "After four years, our agencies got fed up and our funding disappeared," says Francois Meslin, the WHO's top expert on diseases acquired from animals.

Determining the role of the flying foxes -- known scientifically as pteropus vampyrus -- will be critical to charting the origins of the Nipah virus. The bats are the world's largest, with the Malayan variety boasting a five-foot wingspan. Local hunters shoot and eat them. In Cambodia, they are prized as aphrodisiacs, and the bats are used as good-luck talismans in Filipino wedding ceremonies.

The bats are also Nipah's most likely natural host, since they have natural antibodies that protect them from the virus. As flying mammals common across the region, they also -- at least in theory -- make a highly mobile carrier of disease that could cross over to human populations.

The scientific team organized by the **Consortium for Conservation Medicine**, a joint venture between the Harvard Medical School's Center for Health and the Global Environment, Tufts University's School of Veterinary Medicine, the **Wildlife Trust** and the U.S. government's National Wildlife Health Center, starts with a working theory that the Nipah virus transmitted from bat to pig as a result of the flying foxes' messy eating habits.

After sucking the juice from fruit, they spit out pulp and drop half-eaten fruit to the ground. Scientists believe this is what they did while feeding in trees overhanging the pig pens at the Leong Seng Nam farm and other farms in Ipoh, delivering a lethal dose of virus-laden saliva to voracious hogs.

Pigs can pick up pathogens from a natural host and render them more infectious before passing them on to humans. In the case of Nipah, pigs developed encephalitis and a "one-mile cough" -- so called because their violent hacking could be heard at great distances -- before quickly dying. Men working with the swine then picked up the disease. More than 100 people died in Malaysia. Humans apparently don't infect each other with Nipah, so a massive culling of 1.1 million pigs stopped its spread. The linchpin of the theory is that virus-carrying flying foxes can migrate great distances -- something that has never been studied due to the nocturnal animal's remote and vast range.

The scientists hope to outfit a handful of flying foxes with solar-powered radio collars that can last four years -- if the bats don't shake the $5,000 devices. Such radio-tracking in Australia has shown that some bats will periodically travel up to 375 miles. But the Malaysian team first has to catch them. "Very difficult," says Azizi bin Mohammed Yatim, a bat catcher with Malaysia's Veterinary Research Institute in Ipoh. On a recent nighttime trip into the jungle, Mr. Azizi and his crew struggled to apprehend even small bats in fishing nets set up around fruit trees. One small cave-dwelling bat the size of a chipmunk let out a series of terrific squeals while biting repeatedly at a handler's welding gloves.

"You can imagine the time we'll have with vampyrus," says Kevin Olival, a 27-year-old working on his Ph.D. at Columbia University. Mr. Olival is on hand to perform sophisticated genetic tracing of the bats. He hopes this will prove that flying foxes migrate over great distances and across water.

Mr. Olival hopes to take "wing punches" from captured flying foxes -- 3-millimeter holes cut from the bat's wing (they grow back). Then, he will use satellite location technology and genetic data extracted from those punches to track the movement of bats from Thailand down through Sumatra. If a "marker" in the DNA sequence of a bat in Malaysia, for instance, matches that of a bat in Sumatra, one can assume the bat populations move and mix -- or that flying foxes are all part of one huge population.

To prove the thesis of an environmental trigger to the Nipah virus, the team must also establish whether the forest fires of 1997 could really have caused atmospheric conditions disruptive enough to so alter the migratory movements of the giant bats.
As the dry, summer haze season approaches in Southeast Asia, another member of the team, 26-year-old Malaysian graduate student Chong Kwai Hoe, will use satellite images to track and map smoke from forest fires. He will then criss-cross Malaysia's ubiquitous oil palm plantations, taking readings on the effect of smoke on the fruit production of palm trees -- a proxy for all species of fruiting trees.

Other scientists will study flying-fox blood and urine -- even the ticks and fleas they carry. Then they will collate and compare what they find with studies under way in Australia of bats bearing the Hendra virus -- another killer closely related to Nipah. They also will go to India to study a recent outbreak of a deadly virus in Uttar Pradesh state similarly thought to have come from fruit bats. That virus responds to the same antibody test as Nipah.

A separate Japanese team, meanwhile, is in Malaysia analyzing pig tissue samples from as far back as 1994. If they find the Nipah virus, the thesis that extreme haze in 1997 ignited the outbreak will have to be reconsidered.