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Keep All the Parts

In fighting infectious diseases, conservation is the best medicine

THE PALM CIVET, an Asia native that resembles a mix of housecat, mongoose, and opossum, would merit a spot on anyone's threatened-wildlife calendar. While civets are farmed as meat animals in China, the wild palm civet is protected by Chinese wildlife laws, and it has made the Red List of the International Union for Conservation of Nature as a species at risk of extinction. Habitat loss is its primary threat, although poaching may also take a toll.

But in January 2004, World Health Organization representatives agreed with Chinese officials that the palm civet could have transmitted the SARS coronavirus to humans. And so the government proceeded to authorize the drowning, in water and vats of detergent, of approximately ten thousand civets, including some that had undoubtedly been poached from the wild.

In the end, they killed the wrong culprit. Subsequent testing indicated that at least three other species had a higher prevalence of SARS antibodies than did civets. And on a listserve of the International Society for Infectious Disease, scientists voiced suspicions that humans may have passed SARS on to the civets, not the other way around. Officials had acted hastily, with limited information, to kill a perceived host of an infectious disease.

But what if the palm civet had in fact been the primary transmitter of SARS, and the government could actually succeed in killing every civet that might expose humans (an almost impossible feat)? Surely in that case the slaughter could be justified, right? Surely then conservationists—who would otherwise advocate saving the species—should give ground? Quite the contrary, according to a new field of science called conservation medicine, which is finding that good old-fashioned preservation of biodiversity is the best way to save us from new infectious diseases.

According to the World Health Organization, at least thirty previously unknown diseases emerged from 1976 to 1996, and experts say the number has only increased since then. Meanwhile, known diseases have also expanded their ranges. Since about 70 percent of all diseases are always animal-borne, governments have often resorted to killing the hosts of diseases, from rodents (plague) to mosquitoes (West Nile virus). And that solution may only gain in appeal as new and re-emerging diseases spread.

But from the array of studies conducted under the rubric of conservation medicine, which promotes an ecological understanding of infectious disease, such slaughter turns out to be a bad idea. The killing of wild hosts has rarely controlled a disease vector in the short term; and in the long term, diseases—not humans—ultimately benefit from any mass killing of wildlife.

Palm civets provide a textbook example. In China, all the civets were killed after officials confiscated them from dealers without determining their origin. At least some had been wild caught. A wild civet's diet, like that of many small mammals, relies heavily on rodents and insects. Although insects carry their share of pathogens, rodents transmit the most diseases to humans. At least two rodent species in the affected area carry SARS, and may transmit it to humans. And that's the rub: Kill the civets and you may be helping the rodents to thrive, along with the diseases they harbor, which may include the one you're trying to eradicate.

Rick Ostfeld, a scientist at the Millbrook, New York–based Institute of Ecosystem Studies, has modeled how predator removals have contributed to disease outbreaks. He points out that a study of the 1993 hantavirus—a rodent-borne disease that broke out in the southwestern U.S.—suggested that crashes in predator populations likely allowed rodents, and the disease, to proliferate. Trying to eliminate the rodents themselves might also have backfired. "Who would have thought that decimating urban rats would exacerbate bubonic plague?" asks Ostfeld, referring to evidence that the extirpation of rats at just the wrong time in fourteenth-century Europe probably caused more fleas, the plague vector, to jump from rats to people.

In the end, killing the civets—or even rats or other unpopular pests—would only

A Chinese health worker inspects palm civets after they were confiscated during the 2004 SARS virus outbreak.

invite trouble, illustrating Aldo Leopold's first rule of conservation: Keep all the parts.

It's a rule that applies even to mosquitoes. When the mosquito-borne West Nile virus emerged in the U.S. in 1999, health officials authorized widespread spraying of several pesticides to wipe them out. The effort relied on the commonly used Malathion, which is toxic to birds, including those that consume insects. Thus, paradoxically, though results haven't been measured, spraying could be increasing mosquito numbers, and indirectly furthering the spread of infectious diseases.

But what if the spraying—or some as-yet unknown silver bullet—could kill off mosquitoes in the short term? Although no studies have formally modeled the scenario, it is plausible that removing large numbers of mosquitoes from the food web could have a cascading effect on the ecosystem as a whole. For one thing, mosquitoes feed some fish and many amphibian species. These species in turn feed predators like weasels, raptors, raccoons, and even bears. Studies have shown that if those predators decline, disease-carriers like rodents and deer can explode.

Researchers now familiar with the disease ecology of the West Nile virus have advocated a tried-and-true remedy: apply mosquito repellent. But that has not stopped the spraying.

Luckily, measures that are more ecologically friendly have prevailed in other countries. In Malaysia, researchers hypothesized that a Nipah virus outbreak in 1997 was fueled by deforestation, which forced flying foxes, a type of fruit bat, to flock to orchards for food. The orchards were next to pig farms, and the virus passed from bats to farmers by way of the pigs. Nipah killed 105 farmers within a few weeks.

Flying foxes, some of the world's largest bats, resemble Chihuahuas with wings. But it wasn't their looks that prompted practitioners of conservation medicine to take steps to preempt any calls to slaughter them.

"A flying-fox decline could have serious consequences for [tropical] forest health and viability," notes Raina Plowright, an Australian scientist who studies bats in their role as reservoirs of Nipah and related viruses. "Flying foxes spread seeds and pollen. [They are] one of the few remaining long-range dispersers in the region, helping forests regenerate and maintain genetic diversity." Declines in pollinating bats could contribute to deforestation, with its potentially devastating medical consequences. Not only would disease hosts increase their contact with humans, but the loss of CO_2-trapping plants would exacerbate global warming—inviting the kind of ecological disruption that diseases can exploit.

In collaboration with the Palisades, New York–based Consortium for Conservation Medicine, the Malaysian government instead had pig enclosures fenced off and fruiting trees cut down around pig farms. These preventive measures are likely one reason that the Nipah virus has not been seen in Malaysia since the 1997 outbreak.

Perhaps a bigger challenge for conservation medicine will be in Bangladesh, where from January to April 2004 several outbreaks of a closely related virus—presumably also originating with flying foxes—killed as many as fifty people in three districts, a lot of them children. Apparently several boys died after eating fruit from a tree where bats had fed. For the first time, researchers could identify no intermediate host for a Nipah-like virus—bad news for bats and humans.

Should a more sustained outbreak occur with many more deaths, flying foxes may very well be targeted for slaughter. So conservation medicine researchers, in concert with scientists and health officials in Bangladesh, are racing to test exactly how the virus spreads (possibly via droppings, saliva on fruit, and/or person to person) and to investigate whether there might be an as-yet-undiscovered intermediate host such as a rodent. In the end, recommended measures might include education campaigns against eating unwashed fruit, or teaching family members how to protect themselves when caring for ill relatives.

Through these kinds of efforts, conservation medicine might save wildlife, help control the spread of infectious diseases, and perhaps eventually transform fear of pathogens into appreciation of biodiversity—reminding us that plans to protect healthy ecosystems, including unpopular species, are ultimately plans to protect humanity.

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