Using Parasite Inventories to Predict Emerging Diseases

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More than half of all species on Earth are parasites and pathogens, yet most remain unknown. Parasites often emerge from obscurity, however, when humans destroy or encroach on wildlife habitat, move animals to new regions, or drive changes in climate. Then parasites can become "evolutionary land mines," jumping to new hosts and threatening human health. "Because we have no idea what's out there and what's coming, we treat each emerging disease as a crisis," parasite systematist Dan Brooks of the University of Toronto told a panel at the annual meeting of the American Association for the Advancement of Science (AAAS), held 17–21 February in Washington, DC. He believes good systematics can pave the way for predicting and heading off emerging diseases.

Since 1996, Brooks and the Taxonomic Working Group he coordinates have been developing a prototype for efficient and relatively inexpensive parasite inventories as part of the All Taxa Biodiversity Inventory in Costa Rica's Guanacaste Conservation Area. By scouring the carcasses of birds, frogs, deer, and others of the 950 vertebrate species in the region, he has identified more than 5000 parasites, two-thirds of them new to science. He and collaborators are now developing protocols for molecular bar coding of parasites, that is, using selected DNA sequences to identify species—a tool that can be used to uncover their life cycles and transmission patterns and monitor parasite loads.

To illustrate potential uses of the inventory, Brooks turned to parasites he has culled from the native white-tailed deer of Guanacaste. The deer, for example, host six native tick species, and phylogenetic work shows some are close relatives of North American deer ticks, which are known to host the Lyme disease pathogen *Borrelia burgdorferi*. Although no case of Lyme disease has been reported from Costa Rica, if *Borrelia* were to move into Central America, public health officials could quickly test the Guanacaste ticks for their ability to host it.

Brooks also found that the Guanacaste deer, like white-tailed deer from Canada to Texas, harbor a brain worm—the nematode *Parelaphostrongylus tenuis*—that causes deadly neurological disorders in moose (so-called "drunken moose" disease) and in farmed llamas and alpacas. If conservation authorities decide to attempt reintroduction of native red brocket deer (*Mazama americana*), it would be important to test them for susceptibility to the brain worm, he said. It's possible that this parasite once kept brocket deer at such low numbers in Guanacaste that the population was unable to survive hunting pressure.

PROTECTING HAWAII FROM WEST NILE VIRUS

West Nile virus (WNV) appeared in New York in 1999 and swept across North America in four years, killing 500 people and hundreds of thousands of birds. In Hawaii, which harbors one-third of the nation's endangered bird species, both conservation and public health agencies fear severe impacts if the virus reaches the islands.

To help target prevention efforts, Marm Kilpatrick of the Consortium for Conservation Medicine at the Wildlife Trust in Palisades, New York, and colleagues assessed the risk of infectious individuals—human, bird, or mosquito—arriving through natural or human-assisted pathways (*EcoHealth* 1: 205–209). Although some 4 million people fly from North America to Hawaii each year, peak viral titers in humans infected with WNV are considered too low to infect any mosquitoes that could bite them in Hawaii. The researchers also discounted the threat of infected mosquitoes blowing to Hawaii on the wind, since mosquitoes had failed to colonize the islands naturally for millions of years before humans arrived in ships. As for the thousands of birds that migrate to Hawaii each year, researchers consider it unlikely that many birds infected with WNV could survive a 2500-mile migration across open seas.

The greatest known risk, the team concluded, comes from mosquitoes that arrive on airplanes. Peter Daszak, executive director of the consortium, said at an AAAS session that 18 percent of airplanes carry mosquitoes, most of them in the cargo hold. By estimating the fraction of these that are likely to be infectious and able to transmit WNV with a bite, the team found that Hawaii is exposed to 70 to 700 "infectious mosquito days" per year. Since most planes arrive in Hawaii from California, where WNV is not yet fully established, the risk is expected to become greater. The most effective way to reduce the risk: spray cargo holds of Hawaii-bound planes with insecticides.

The team also identified a second risk, this one from live bird imports. Five bird species, including chickens, are currently exempt from quarantine regulations—seven days in a mosquito-proof facility prior to import for most other birds—a threat that could be reduced by ending the exemption.

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