Quarantine the Caves

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The fungal disease that has killed millions of bats in the United States since its discovery 6 years ago, white-nose syndrome, continues its destructive spread and threatens the extinction of some species. Originally identified in a cave in northern New York, the disease has moved across much of the eastern half of the country and into eastern Canada. The parallels to the worldwide spread of chytridiomycosis in amphibians are hard to ignore. That fungal infection likewise infects multiple species, has a very high mortality rate, and may also come to be identified as the principal cause of some extinctions. Both may yet also be blamed as the cause of disappearing ecosystem services—pollination and insectivory, mainly, in the case of white-nose syndrome, water quality in the case of chytridiomycosis.

The identification in recent years of specific fungal species responsible for both conditions, at least in most cases, is a scientific triumph. But broader questions about the causation of the two diseases remain frustrating mysteries. "Why now?" is the obvious inquiry. And for both diseases, there are as yet no clear answers.

Key parts of these sad stories are still missing. For example, it would be tempting to jump to the conclusion that *Geomyces destructans* (the white-nose agent) and *Batrachochytrium dendrobatidis* (implicated in chytridiomycosis) are invasive species, but firm evidence of that is lacking. In fact, the pathogens seem to have been present in regions without disease—or possibly with low, unnoticed levels of disease—for decades; *G. destructans* is certainly found widely in Europe, and there was no evidence of associated disease until recently. In any event, the *invasive* label would only push back the mystery, not solve it. The question would then be, "Why have these fungi suddenly become invasive?"

It is tempting to turn to climate change as a possible culprit, but the simplest form of that explanation—more warmth leads to more fungal spread—must reckon with the fact that both pathogens are adapted to cold conditions. More specific effects of warming, including increased humidity or warmth at critical points, are, however, not so easily excluded. The recent appearance of a more virulent strain, perhaps through a mutation, is likewise plausible.

Research on white-nose syndrome is yielding insights into how the disease is spreading. Recently, close contact between hibernating bats has been implicated as an avenue for the spread of white-nose syndrome (doi:10.1111/j.1461-0248.2012.01829.x). Given the social nature of many bats, this is hardly good news, although, encouragingly, one species seems to be adapting by becoming less social.

The Overview of *Geomyces* fungi by Mark Hayes that appears on p. 819 provides valuable background: The genus is widespread on land, in the sea, and in the air. Notably, its spores appear to be spread easily by humans. The potential of humans to spread white-nose syndrome is now widely recognized, and measures are being taken to quarantine some caves. Testing of more heroic interventions should continue, but until and if it is ruled out as a contributing factor, preventing human contamination of vulnerable environments should now be a priority.

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