

## Editorial

# Emerging Infectious Diseases: Bridging the Divide between Biomedical and Bioecological Science

A recent international meeting showed how ecosystem scientists and medical researchers/practitioners can work together, despite coming from quite distinct research communities. The meeting, a relatively small but intense 3-day Cary Conference in New York on the ecology of infectious diseases, opened with a statement presenting this challenge. A quote from the review panel (the U.S. National Institutes of Health [NIH]) that declined a request to support the meeting was presented in the opening Power-Point slide by the conveners. To paraphrase the quote, the NIH panel concluded that research focused on diseases and ecosystems would contribute little to understanding human infectious diseases and their prevention—at least not enough to warrant NIH funding at that time. The conveners graciously expressed their response, in terms of rising to the challenge and “throwing down the gauntlet” (their words), by committing themselves to demonstrating the significance of the research fostered by the meeting.

The NIH and the biomedical research establishment in general obviously do not eschew research addressing the ecological underpinnings of infectious diseases as a matter of policy. In fact, innovative research programs have begun to emerge that bridge biomedical and bioecological research in many countries. The Ecology of Infectious Diseases grant program, jointly funded by the U.S. National Science Foundation and the NIH, is exemplary in this regard. Yet the above-mentioned incident was a provocative reminder of the significant gap that exists within a community of research professionals sharing what, ultimately, is the same goal: understanding and quelling the present global upsurge in new and previously controlled infectious diseases.

*Community* is the operative word here, the standard dictionary definition of which is “a social group with a

common interest.” Thus, for example, the commonly used term *scientific community*, although hardly reflecting a cohesive social group, nonetheless refers to the sharing of the common goal of advancing knowledge. Ironically, the overarching common interest too often is eclipsed by subsidiary interests not shared—i.e., in the research paradigms, approaches, and methods used. Researchers and practitioners focus on humans, and those focused on ecosystems generally come from and operate in entirely different research cultures. They generally see the world differently and use distinctly different paradigms, models, and methods. Fortunately, an increasing number of exceptions exist, as evidenced by many of the articles in this journal and, indeed, the recent establishment of the journal itself and the growing association behind it.

The cultural gap between these two anthropocentric/ecocentric schools of infectious disease research nonetheless remains substantial. This can have significant consequences for disease research policy, as well as for disease control and prevention policy. A good illustration of this is the series of reports generated by the U.S. National Academy of Science’s Institute of Medicine addressing emerging infectious diseases. The most recent synthesis (Institute of Medicine, 2003) capped the decade-long series of studies and reports. In it, “ecological factors” and related mechanisms implicitly and explicitly dominate the list “Factors in Emergence” identified (Institute of Medicine, 2003, p 54). Remarkably, the conclusions and recommendations at the end of the volume are virtually bereft of any recognition of the need to incorporate approaches, theory, models, and methods from ecological and allied ecological/evolutionary fields in the research agenda. Instead, the recommended research agenda focuses on fundamentally important, yet

conventional, biomedical and epidemiological approaches: surveillance, diagnostics, vaccines, antimicrobials, and so on. Ecology as a discipline is given brief mention in the recommendations for the establishment of interdisciplinary infectious disease research centers.

This gap in the agenda seems even more problematic considering that the emergence factors (host switching and range expansion, spillover from natural hosts to accidental hosts, adaptation, and so on) responsible for most of the diseases listed in the report are attributable to particular ecosystems (human modified and natural) and associated ecological and evolutionary processes. In fact, upwards of 80% of those historically making it to the Centers for Disease Control and World Health Organization emerging infectious disease rosters are environmentally acquired or zoonotic or are suspected of having originated relatively recently as pathogens in wild populations inhabiting natural ecosystems (e.g., influenza, human immunodeficiency virus/acquired immunodeficiency syndrome, and severe acute respiratory syndrome). Clearly, an integrated biomedical and bioecological research agenda is required if we are to understand how the interaction of pathogens, people, wildlife, and ecosystems contributes to new diseases and causes preexisting ones to reemerge. As amply demonstrated in the seminal works by Anderson and May (1991), Stearns (1999), and Frank (2002), lurking behind the epidemiology, pathogenesis, and molecular genetics of infectious diseases are processes largely explicable by ecological/evolutionary models and theory. The equivalent synthesis, scaling up to the level of ecosystems, although incomparably complex, remains to be accomplished. The onus is on not only ecosystem scientists and their allies in biological ecology (e.g., population ecology, community ecology, and evolutionary ecology), but also biomedical researchers (e.g., clinical and epidemiological). Together, individuals from both schools must build a single, integrated community of researchers and practitioners. Here I extend the meaning of *community* by drawing on the notion of informal networks of relationships based on trust, reciprocity, and collective action.

Of course, infectious disease is but one of many examples within the domain of ecohealth that presents profoundly important opportunities for forging transdisciplinary communities of researchers working at the interface of the ecological and health sciences. In general, this will require the collective action of individuals committed to taking at least three steps. Individuals must communicate across disciplinary divides. They must establish and cultivate ongoing dialogues, if not formal research relationships. Also, the relationships formed must involve a give and take that allows new ideas to emerge that transcend the confines of one's own discipline. In the context of emerging infectious diseases in particular, each of these three steps will be critical if we are going to respond to the challenge—not just to forge a better theoretical understanding, but also to develop better prevention and management of the ongoing and evolving threat of disease faced by both humans and the ecosystems of which they are a part.

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