



"Infectious disease is one of the few genuine adventures left in the world. The dragons are all dead and the lance grows rusty in the chimney corner."

- Hans Zesser ("Rats, Lice and History," 1935)

In 1998, in northern Malaysia, a new biological threat was born. Pig farmers were suddenly becoming ill with flu-like symptoms. Unsuccessfully treated as Japanese encephalitis, the outbreak signaled the emergence of a previously unknown virus, now named Nipah.

The Nipah virus spread through peninsular Malaysia. By the next year it had sickened 265 pig farmers, killed 105 more, and led to the slaughter of more than 1 million pigs. Animals and humans in Bangladesh and India were also infected – the result of pigs imported from Malaysia – causing encephalitis, or brain inflammation. Nipah killed up to 70 percent of patients – a danger level equal to the Ebola virus.

An investigation of the Malaysian pig farms exposed an overlap between fruit bat habitats and the farms. Attracted to the area due to nearby fruit orchards, spillage from the bats' feces, urine and from partially eaten fruit infected the pigs, then the humans.

Like other recent viruses such as SARS and Ebola, Nipah is a "zoonotic" disease as it can transfer between animals and from animals to humans. Zoonotic diseases evolve from a convergence of species such as bats and humans, sometimes involving intermediary hosts such as pigs. Environmental changes such as the encroachment of humans into animals' territory and animals' relocation due to changes in food availability and a loss of habitat increase the potential for disease transfer.

Humans' role as stewards of the Earth, as well as beneficiaries of its resources, has created a symbiosis between humans, animals, environmental conditions and disease. Scientific revelations of the delicate balance of this relationship recognize rising "bio-distress." In the balance hangs the impact of the outcomes of biodistress upon humans by self-created rapid urbanization and population growth, extreme climate variability, a declining species biodiversity, and the consequent ability for "super diseases" to start local and go global.

POPULATION AND URBANIZATION

Around the time of Columbus' arrival in the new world, the global population totaled 500 million. It now tops 6.6 billion with the greatest increase coming after World War II. By 2050, more than 9 billion humans will inhabit the Earth, drawing upon its water and food

supplies. Countries least able to support this growth – those facing political, economic and environmental crisis – will host 80 percent of the 9 billion. The United Nations Population Division reports that by 2050, nearly half of the world's population will reside in nine countries. Only one (U.S.) is in the developed world.

The number of us living in cities is growing. As of 2007, more than half the world's population live in cities – a figure that will reach 60 percent by 2030. The rise in urban populations is impacting the Earth in ways that defy simple measures or models, adding to changes in the planet's surface and atmosphere thermal properties. In addition, though cities in the developed world may hold conveniences, 40 percent of urban dwellers are in the developing world, many in packed conditions, lacking clean water and adequate sanitation.

The interplay of population and urban growth and rising standards of living in heavily populated countries such as India and China is creating a depletion of resources never before seen. Water will become one of the most critically sought-after resources by 2025, impacting four billion people in an estimated 54 countries who will face serious water shortages. A lack of safe water could claim more lives than the HIV/AIDS pandemic. Water is also a needed component for food and animal production, and its scarcity and quality will weigh heavily upon expanding current food production.

MICROBES AND CLIMATE CHANGE

Microbes reflect the environmental niches where they reside. Warmer conditions, unhealthy water supplies, and growing and more transient populations upon which germs can hitchhike all foster the conditions for a "disease perfect storm" – a public health, animal health and emerging disease convergence.

MIGRATION OF SPECIES TO NEW PLACES

Animal and plant species not previously seen in northern climates are becoming evident in increasing numbers.

Originally from South America, the nine-banded armadillo is common in Mexico and the southern United States. More recently, however, armadillos have been spotted moving north toward Canada through states in which they are had not previously appeared. Researchers believe this is a pre-cursor to the animals' movement further north. Some believe that the northeastern and northwestern U.S. coasts are its next destinations as winter weather conditions throughout the U.S. become more mild.



- Journal of Biogeography
- National Wildlife Federation

Fear is growing of the potential for a warmer and more populous Earth to cause tropical diseases such as malaria to invade temperate zones. This fear is supported by the recording of 3,000 cases of infections in Russia in April 2007 caused by hantavirus. Responsible for hemorrhagic fever and renal syndrome, the virus typically dies off in Russia's consistent below-zero temperatures. Temperatures in the winter of 2006, however, were well above normal, marked by a record 46 degree F day in Moscow on December 7th. It was comparable to a warm spell in 1997 when 20,000 cases of hantavirus were recorded.

Seen as a growing problem in historically colder climates, hantavirus is transmitted to humans through the air from the droppings of infected mice. Their survival requires warmer winters, and Russia's current rodent population is 10 times as high in 2007 as in previous years. One of every three mice infected with the virus. With changing climates and the emergence of food sources such as specific trees and flowers in northern regions, the impact could be hantavirus cases that reach into the tens of thousands.

INTERDISCIPLINARY SOLUTIONS FOR COMPLEX CHALLENGES

Recognizing mechanisms underlying emerging and reemerging infectious diseases is vital to protecting animal and public health. Knowledge gaps exist for even the most studied diseases, reflected by a currently simplistic view of pathogens as disconnected from social and ecological contexts.

The reality is that the ecosystem shared by humans, animals and emerging infectious diseases undergoes natural environmental change, such as seasonality or meteorological events. Man-made changes, however, are creating events spawning a unique era of emerging infectious diseases. It demands an unprecedented approach for understanding and solutions.

The notion of biocomplexity offers a holistic and realistic view. The complex interplay of life and environment is sustained, affected and modified by living organisms' behavioral and social, biological and chemical, and physical interactions. Biocomplexity captures this depth and richness of the interactions of human and natural systems.

Employing the biocomplexity paradigm can enhance the understanding of infectious diseases, yet requires a synthesis of interdisciplinary perspectives. It sparks the need to view biological processes from molecular levels up through communities and regions, linking public health infrastructure with an understanding of the impact of climate conditions.

This effort must work at the convergence of human, animal and ecological health to achieve healthier people, places and a healthier world. Health is now an outcome shaped by a wide range of social, economic, natural and political factors. This forms a

complex and ever-changing dynamic that needs to be reflected by new scientific, medical, and research teams.

This view also suggests that people and citizens not previously involved in science and from a much wider array of disciplines can help frame our agricultural and biomedical agendas and become more influential in determining future agendas. The task is addressing the complex, contemporary microbial threats and their ecologies.

Dr. Rita Colwell, past director of the National Science Foundation stated, "Public health is no longer the domain of any one boundary or discipline; instead it is the work of clinicians, epidemiologists, climate scientists, oceanographers, and even space scientists working together to provide a new perspective using many tools, including remote sensing. Tracking, treating and preventing disease are truly global in their scope and require the richness of interdisciplinary research."

SUMMARY

The agent - host - environment relationship is changing in ways never before seen. Rising human, animal and exotic species populations, packed into concentrated geographic settings, contribute to externalities such as the depletion of resources. In a complexity and magnitude yet to be fully understood, the rearrangement of these components can facilitate a greater spread of disease marking the need for new approaches and thinking in the realm of animal and public health.

MAN-MADE BIODISTRESS THREATENS ANIMAL AND PUBLIC HEALTH IN SOUTHERN CHINA

Man-made biodistress is also playing out at southern China's Dongting lake. An operation that began in 1994 and completed in 2006, the construction of the Three Gorges Dam across the Yangtze River is changing the ecology of the Dongting. One of its native species is the zoonotic parasitic disease, *Schistosomiasis japonica*. It infects freshwater snails and can be transmitted to other mammals, notably water buffaloes, when they are exposed to infected water.

Schistosomiasis is a major health risk. A consequence of the Three Gorges project is the relocation of 2 million persons and domestic animals. Not only are population movements linked to extreme vulnerability to disease due to malnutrition and lack of clean water and appropriate sanitation, but officials also warn that these water management projects will aid the transmission of Schistosomiasis as the range of snail habitats will be extended. Around Dongting, occupational groups, notably, farmers and fishermen are at risk thus having substantial effects on the local economy and agricultural development of the area.