



“The term ‘climate change’ conjures images of melting ice caps and rising sea levels that threaten coastal cities and nations. But just as important is how increasing temperatures and fluctuating precipitation levels will change the distribution of dangerous pathogens. The health of wild animals is tightly linked to the ecosystems in which they live and influenced by the environment surrounding them. Even minor disturbances can have far reaching consequences on what diseases they might encounter and transmit as climate changes.”

Dr. Steven E. Sanderson
President and CEO of the
Wildlife Conservation Society

One World, One Health

The Wildlife Conservation Society’s “One World, One Health™” program is a holistic initiative that manages human, wildlife, and domestic animal health issues according to a fundamental truth—the “one health” that affects all is the health of the planet’s ecosystems.

Protection of the environment is often treated as a low-priority issue when compared with more immediate concerns, such as domestic security or the economy. But a healthy environment is not a luxury—it is a prerequisite for human health.

The rise of emerging and resurging infectious diseases threatens not only humans—and their food supplies and economies—but also the wildlife comprising the biodiversity that supports the living infrastructure of our world.

Winning the disease battles of this century and ensuring the biological integrity of the Earth for future generations require interdisciplinary, crosscutting approaches to disease prevention, surveillance, monitoring, control, and mitigation as well as to environmental conservation.

Outbreaks of West Nile virus, Ebola hemorrhagic fever, SARS, monkeypox, mad cow disease, and avian influenza remind us that human and animal health are intimately connected. A broader understanding of health and disease demands a unified approach achievable only through a consilience of human, domestic animal, and wildlife health.

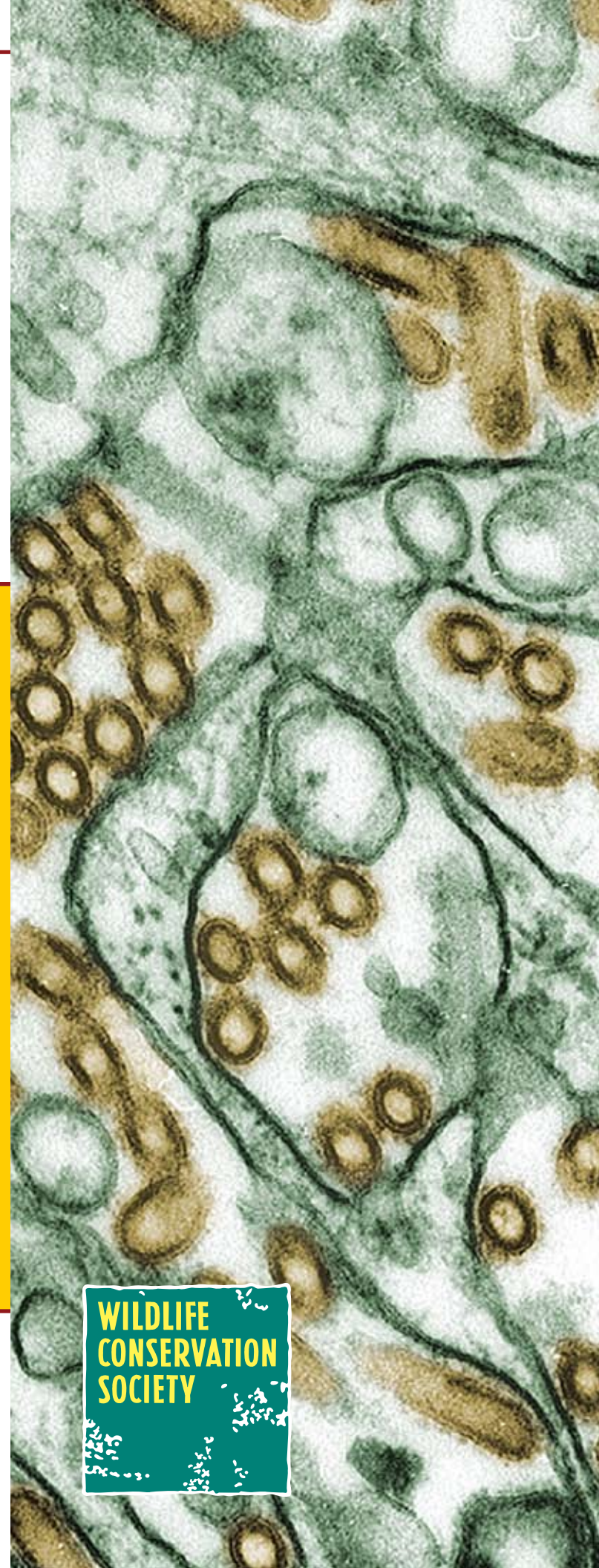
“The monitoring of wildlife health provides us with a sensitive and quantitative means of detecting changes in the environment. Without wildlife, we may not see what’s coming until a crisis has occurred. Wildlife monitoring provides a new lens to see what is changing around us to help governments, world health agencies, and regional communities detect threats and mitigate them before they become health crises.” Dr. William Karesh, Vice President and Director, WCS–Global Health.



The Wildlife Conservation Society saves wildlife and wild places worldwide. We do so through science, global conservation, education, and the management of the world’s largest system of urban wildlife parks, led by the flagship Bronx Zoo. Together, these activities change attitudes toward nature and help people imagine wildlife and humans living in harmony. WCS is committed to this mission because it is essential to the integrity of life on Earth. Visit: www.wcs.org.



PHOTOS BY JULIE LARSEN MAHER@WCS; DENNIS DEMELLO@WCS; SUZANNE BOLDU@WCS; W.B. KARESH, AND U.S. CENTERS FOR DISEASE CONTROL



the DEADLY DOZEN

THE WILDLIFE CONSERVATION SOCIETY
Sounds the Alarm on
WILDLIFE-HUMAN DISEASE THREATS
in the Age of Climate Change



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Health experts from the Wildlife Conservation Society have identified 12 pathogens that could spread into new regions as a result of climate change, with potential impacts to human and wildlife health as well as to global economies.

Called **The Deadly Dozen: Wildlife Diseases in the Age of Climate Change**, the new report provides examples of diseases that could spread as a result of climate-induced changes in temperatures and precipitation levels. The best defense, according to the report, is a good offense—monitoring wildlife to detect how these diseases move so health professionals can prepare to mitigate their impact.

In addition to the health threats that diseases pose to human and wildlife populations, the pathogens that affect wildlife have, in many cases, destabilized trade and caused significant economic damage. For example, several diseases that have emerged since the mid-1990s—including avian influenza and SARS—have caused an estimated \$100 billion in losses to the global economy. Monitoring wildlife health will help us predict where trouble spots will occur and plan how to prepare for them.

The “Deadly Dozen” report builds upon the recommendations included in a recently published paper, “Wildlife Health as an Indicator of Climate Change,” which appears in the newly released book, *Global Climate Change and Extreme Weather Events*, published by the National Academy of Sciences/Institute of Medicine.

AVIAN INFLUENZA A highly pathogenic strain of avian influenza—H5N1—has proven deadly to domestic and wild birds as well as humans. It has the potential to mutate into a strain that can spread from human to human. Current data indicate that the movement of H5N1 from region to region is largely driven by the poultry trade, but changes in climate, such as severe winter storms and drought, can disrupt normal movements of wild birds and bring wild and domestic bird populations into greater contact at water sources.



BABESIA These tick-borne diseases affect domestic animals and wildlife, but are being recognized as emerging diseases in humans. When infections are severe due to large numbers of tick bites, the host becomes more susceptible to other infectious diseases. This has been seen in large die-offs of lions in East Africa due to canine

distemper. In Europe and North America, the disease is becoming more common in humans, also linked with tick distributions.

CHOLERA Cholera is a water-borne diarrheal disease affecting humans mainly in the developing world. It is caused by the bacterium *Vibrio cholerae*, which survives in small organisms in contaminated water sources. Cholera is highly temperature dependent, and rising global temperatures due to climate change are expected to increase incidence of this disease.

EBOLA Ebola hemorrhagic fever virus and its closely related cousin—Marburg fever virus—easily kill humans, gorillas, and chimpanzees, and there is no known cure. There is significant evidence that outbreaks of both diseases are related to unusual variations in rainfall/dry season patterns. As climate change disrupts and exaggerates seasonal patterns, we may see more frequent outbreaks of these diseases in new locations.



INTESTINAL AND EXTERNAL PARASITES

Parasites are widespread in terrestrial and aquatic environments. As temperatures and precipitation levels shift, survival of parasites will increase in many places, affecting more humans and animals. Many species of parasites are zoonotic—spread between wildlife and humans. Monitoring of parasite species and loads in wildlife and livestock helps us identify transmission modes of these infections among domestic and wild animals and humans.

PLAGUE Plague, *Yersinia pestis*, is one of the oldest infectious diseases known, and it still causes significant death rates in wildlife, domestic animals, and humans in certain areas of the world. Plague is spread by rodents and their fleas. Alterations in temperatures and rainfall are expected to change the distribution of rodent populations around the globe, which would impact the range of plague and other rodent-borne diseases.

RED TIDES Harmful algal blooms off global coasts create toxins that are deadly to both humans and wildlife. These occurrences—commonly called “red tides”—cause mass fish kills, marine mammal strandings, penguin and seabird mortalities, and human illness and death. Similar events in freshwater have resulted in animal die-offs in Africa. Altered temperatures or food-web dynamics resulting from climate change will have unpredictable impacts on the occurrences of these worldwide phenomena.



RIFT VALLEY FEVER Rift Valley fever virus (RVFV) is an emerging zoonotic disease of public health, food security, and overall economic importance, particularly in Africa and the Middle East. It commonly causes abortions and high death rates in cattle, sheep, goats, and camels. In people (who can contract the virus from butchering infected animals), the disease can be fatal. The role of wildlife in the epidemiology of this extremely devastating disease could be a significant piece of the RVFV puzzle.

SLEEPING SICKNESS Also known as trypanosomiasis, this disease affects people and animals. Caused by a protozoan and transmitted by the tsetse fly, the disease is endemic in regions of sub-Saharan Africa—an area covering 36 countries, with estimates of 300,000 new cases and the deaths of 40,000 people each year in eastern Africa. Direct and indirect effects of climate change on tsetse fly distributions could play a role in the distribution of this disease.



TUBERCULOSIS As humans have moved cattle around the world, bovine tuberculosis has spread. It now has a global distribution and is especially problematic in Africa, where it infects vital wildlife populations such as buffalo and lion in Kruger

National Park in South Africa. The disease also infects humans in southern Africa through the consumption of un-pasteurized milk. Human forms of tuberculosis can also infect wild animals. Climate change impact on water availability due to drought is likely to increase the contact of wildlife and livestock at limited water sources, resulting in increased transmission of the disease.

YELLOW FEVER Found in the tropical regions of Africa and parts of Central and South America, this virus is carried by mosquitoes that may spread into new areas as temperature and rain levels change. One type of yellow fever—jungle yellow fever—can spread from primates to humans and vice-versa via mosquitoes. Recent outbreaks in Brazil and Argentina have had devastating impacts on wild primate populations.

the DEADLY DOZEN

Many wildlife pathogens have been the focus of monitoring efforts, but little information exists on how diseases will spread in response to climate change. This list is not a comprehensive one but includes pathogens that may spread as a result of changing temperature and precipitation levels. Monitoring efforts for these diseases need to be examined in tandem with meteorological data to uncover climate-related trends.



LYME DISEASE Caused by a bacterium, Lyme disease is transmitted to humans through tick bites. Tick distributions will shift as a result of climate change, bringing this disease into new regions to infect more animals and people. Human-induced changes in the environment and on wildlife population patterns of the species that can carry the ticks—such as white-tailed deer and white-footed mice—have large-scale effects on the distribution of this disease.