

# Early detection and response to climate change related emergence of infectious disease

## OVERVIEW

Sixty percent of emerging infectious diseases spillover from animals to people, posing a major threat to global health and the world's economy, and thereby making animal surveillance a crucial component of pandemic preparedness. Many of these pathogens circulate in wildlife populations whose home ranges are expected to shift in response to climate change, increasing the risk of novel viral transmission and spillover to humans and their animals. Surveillance systems that link wildlife and livestock to veterinary services in remote, rural areas of the tropics where species shifts are likely to be most pronounced, are required to monitor and respond spillover of novel diseases at their source and collect valuable long-term datasets that can be used to relate animal health to climatic change.

## IMPORTANCE

Conducting disease surveillance of animal populations in regions of high animal-to-human spillover risk, where a critical window of opportunity exists to prevent outbreaks from propagating, is of high global health and economic importance. One such area is Africa's drylands where an estimated 50-200 million pastoralists and their livestock move between water sources and seasonal grazing areas in biodiverse landscapes that are known to harbor emerging pathogens and at high risk of the effects of climate change. Climate change also places increased stress on wildlife, be it extreme heat, drought, or other weather events, which in turn results in higher susceptibility to emerging infectious diseases, increased viral shedding, and more frequent sharing of limited resources with other native animals, where these pathogens can jump species. Remoteness and the mobility necessitated by livestock management practices that frequently cross national borders, have led to the inadequate integration of people, their animals and the wildlife they coexist with into health services. As such, most wildlife and livestock that exist on the front lines of climate change and spillover risk in sub-Saharan Africa are unaccounted for in disease surveillance and outbreak response efforts.

To address this gap, the Smithsonian's Global Health Program and partners are working with partners in Kenya (where consultations with the Government have identified wildlife surveillance as a critical blind spot in Kenya's zoonotic disease surveillance strategy) to develop a syndromic surveillance and response system ([EarthRanger Health](#)) that can rapidly detect and respond to unusual disease presentations in difficult-to-reach pastoral livestock and wild animal populations, and build a national dataset that can link animal health to environmental change. Because the majority (~70%) of Kenya's wildlife exist outside formally protected areas, this system will operate extensively within community-managed rangelands, with reporting being conducted by rangers who are members of local communities.

EarthRanger Health has been developed on the [EarthRanger platform](#), which puts real-time reporting into the hands of wildlife rangers who are tasked with patrolling biodiverse, geographically remote landscapes, thus connecting them to centralized disease surveillance efforts. Because the EarthRanger platform is currently being used for protected area management across Africa, EarthRanger Health has the potential to equip an army of rangers working in Africa's most biodiverse and remote landscapes to collect real-time information on the health status of wildlife and pastoralist livestock populations.

Funds have been acquired to pilot the system on 10 pilot community conservancies in central, northern and southern Kenya, which are already using the Earth Ranger system over the next two years. This is taking place in close partnership with Kenya Wildlife Service (KWS), the Wildlife Research and Training Institute (WRTI) and the Directorate of Veterinary Services (DVS). During this pilot phase, the module will be incorporated into the workflow of rangers (through quarterly training activities), protected area managers, veterinarians, and epidemiologists to guide clinical decision-making, coordination of One Health responses to disease outbreaks, and a centralized database integrating animal health and environmental

data. After the pilot, the EarthRanger Health module will be transitioned to become the primary wildlife health monitoring system in Kenya, with data feeding into the Government's own centralized zoonotic disease surveillance system. KWS and WRTI have recently adopted EarthRanger as their centralized wildlife monitoring system (with data feeding in from national parks, community, and private conservancies across the country), and through consultations they have indicated their desire to integrate the health module into this if piloting is successful.

### **POTENTIAL RESEARCH THEMES**

The Smithsonian's Global Health Program and partners in Kenya seek a postdoctoral fellow to leverage an expansive dataset on animal health and environmental conditions currently being generated during the EarthRanger Health pilot, to evaluate and refine the system's performance and study the biogeography of wildlife disease outbreaks in relation to changing environmental conditions across the pilot study area. We especially encourage proposals that use innovative modeling approaches to evaluate the system's useability and sensitivity and specificity to detecting disease outbreaks, investigate spatial and temporal patterns of wildlife disease in relation to local landscape features and environmental conditions, and automate detection and flagging of local epidemiological and ecological patterns, to provide professionals working on the ground to support in-field decision-making with real-time 'epidemiological intelligence'.

### **ADVISORS**

The following Smithsonian staff scientists and associates commit to respond to queries from prospective fellows, facilitate access to project assets, and provide guidance throughout the fellowships: Suzan Murray, James Hassell, Lasey Hughes, Jared Stabach, Katherine Worsley-Tonks, Michael Von Fricken, and Dino Martins. Fellows will also have the opportunity to seek additional expertise and collaboration from partners on the EarthRanger Health project in Kenya, including Kenya Wildlife Service (KWS) and Wildlife Research and Training Institute (WRTI), Kenya Wildlife Trust, Government of Kenya Directorate of Veterinary Services (DVS)/Zoonotic Disease Unit (ZDU), Institute of Primate Research, International Livestock Research Institute (ILRI), Space for Giants, San Diego Zoo Global and Big Life.