International Systems for Monitoring Viral Chatter

The interface of human and animal health: Identifying threats before they emerge.

Brad S. Schneider, Ph.D.
Metabiota
(formerly Global Viral Forecasting, Inc.)

Where is the frontline in the battle against infectious diseases?

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Scanning for fever in response to swine flu, Singapore

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HIV screening and counseling activities
Cameroon

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Taiwanese hospital during SARS outbreak

Centers for Disease Control and Prevention

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Gorilla found dead

bushmeat

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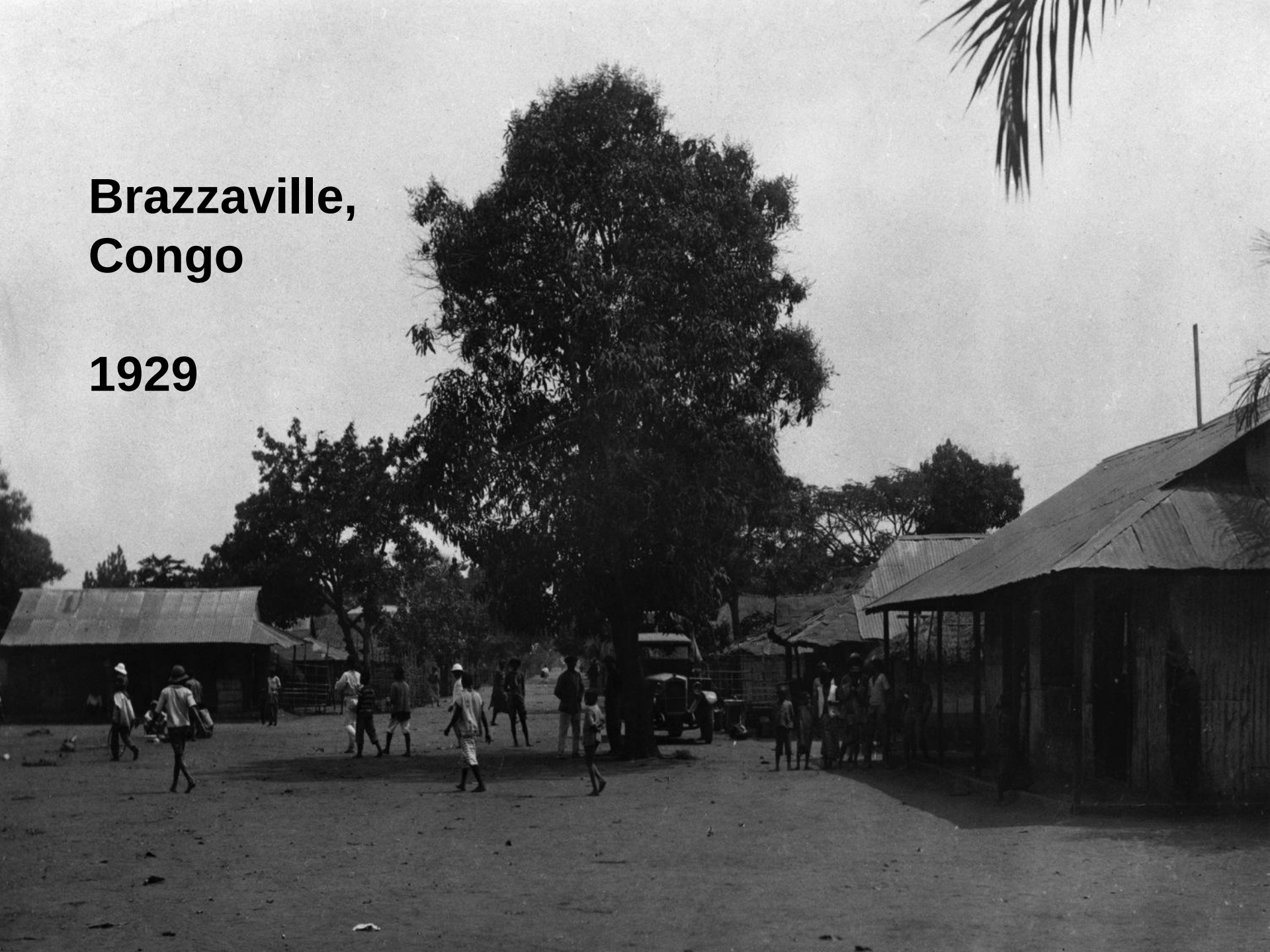
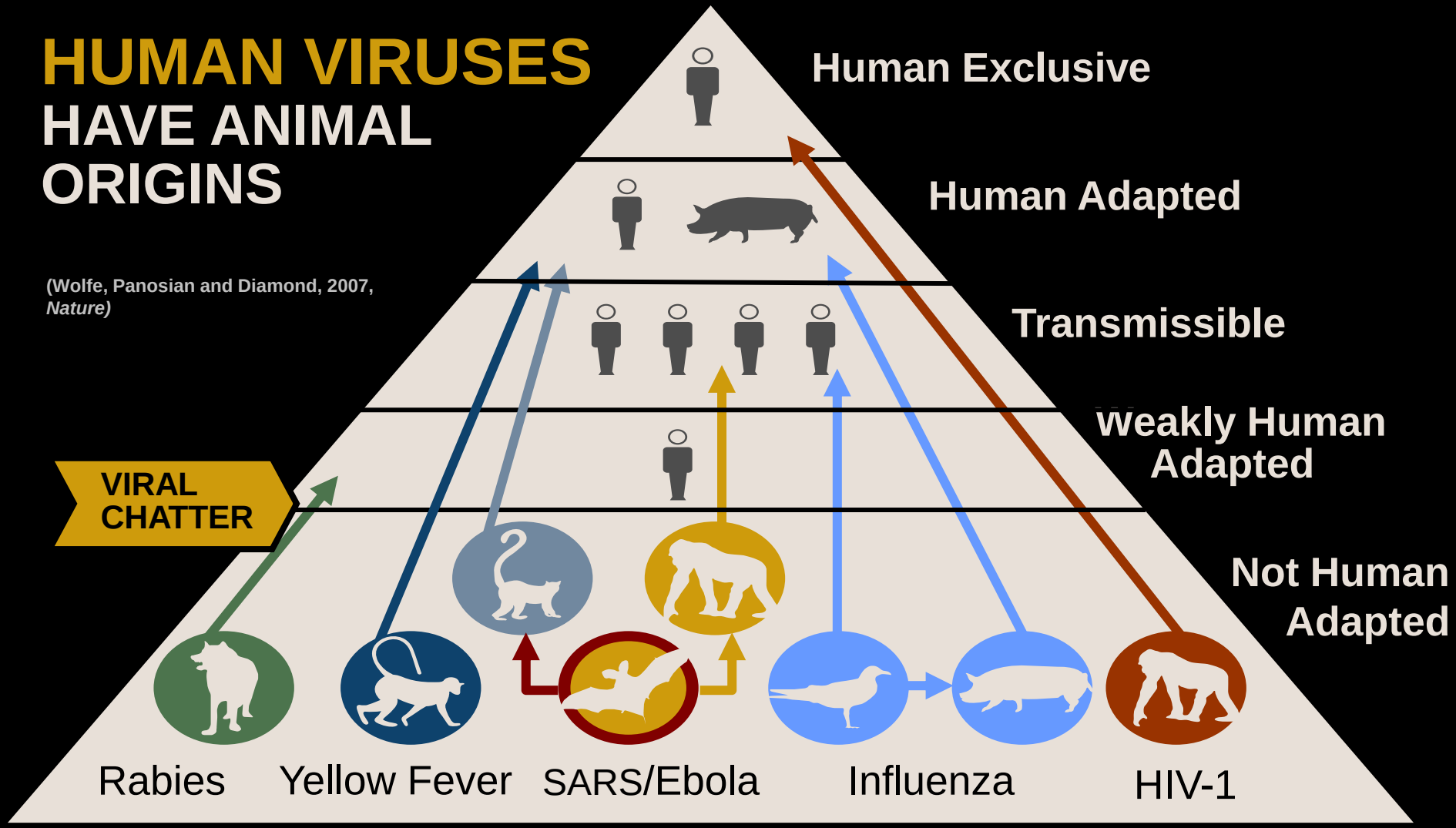

Brazzaville,
Congo
1929

HUMAN VIRUSES HAVE ANIMAL ORIGINS

(Wolfe, Panosian and Diamond, 2007, *Nature)*



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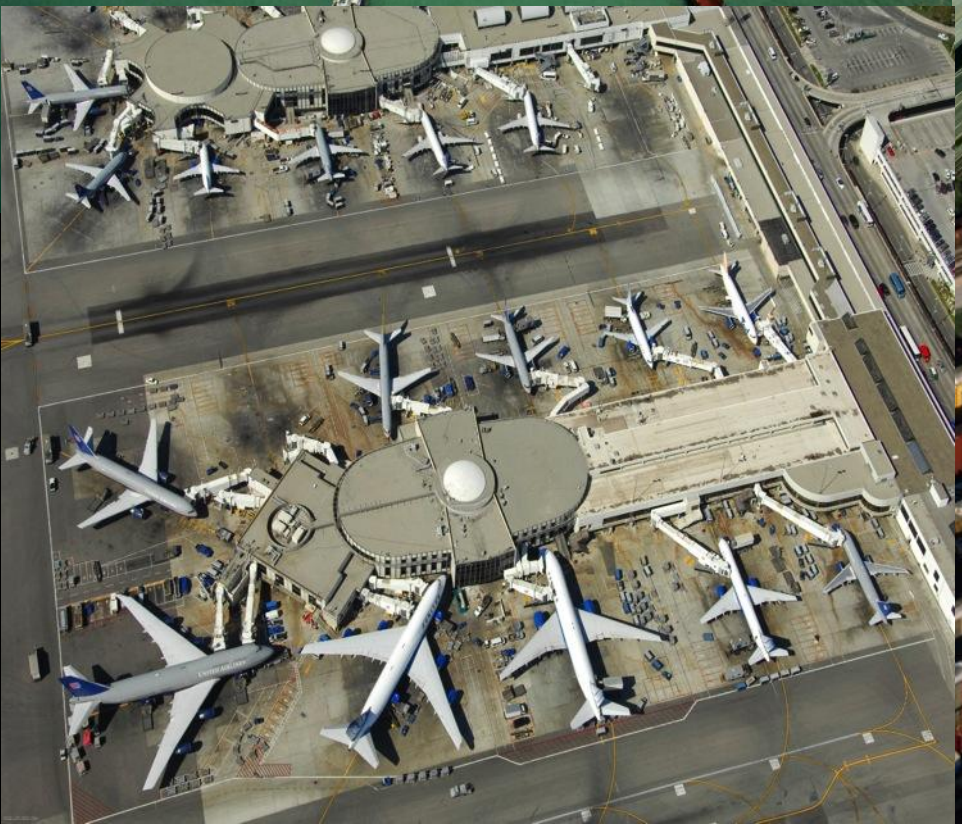
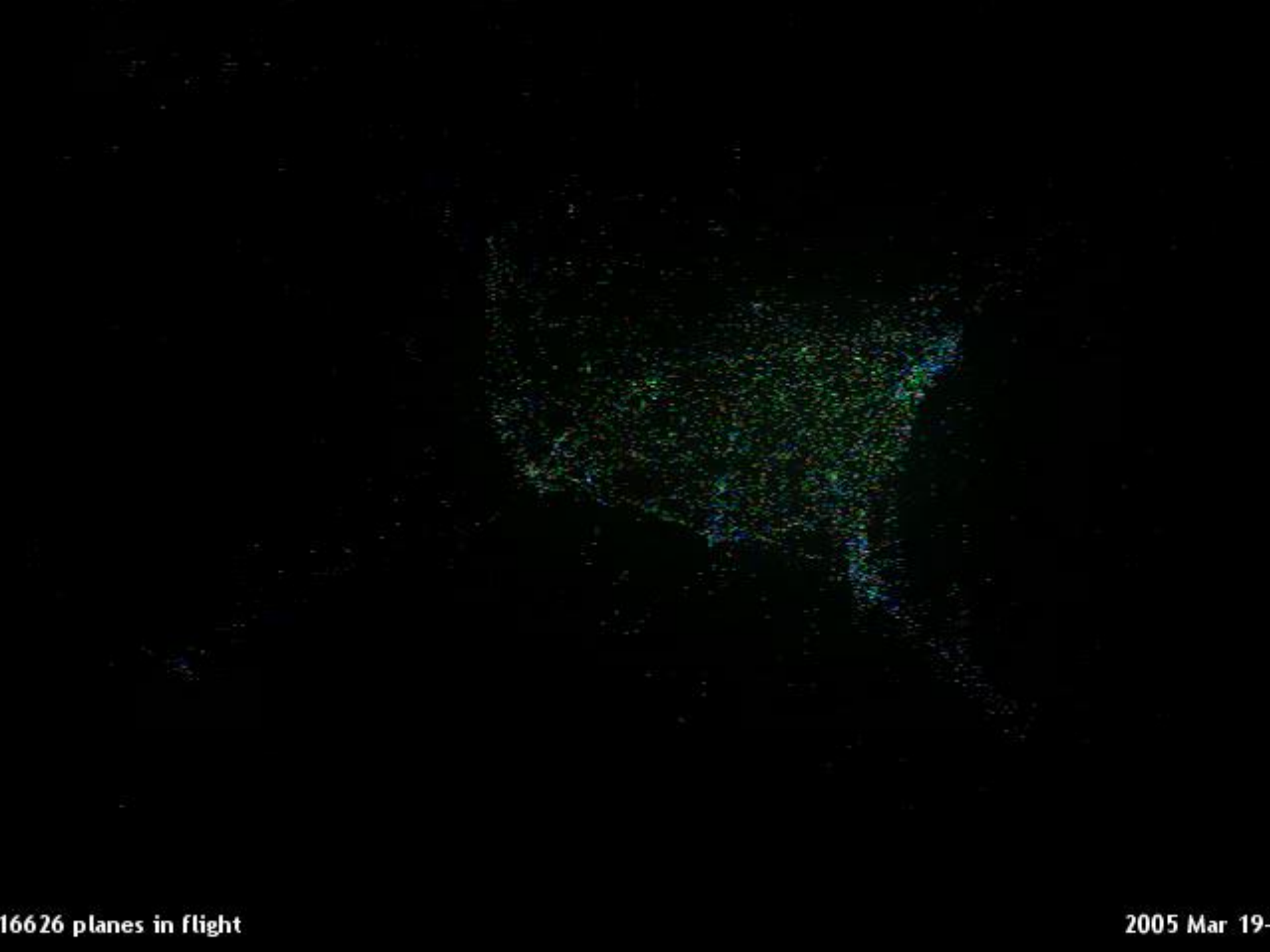
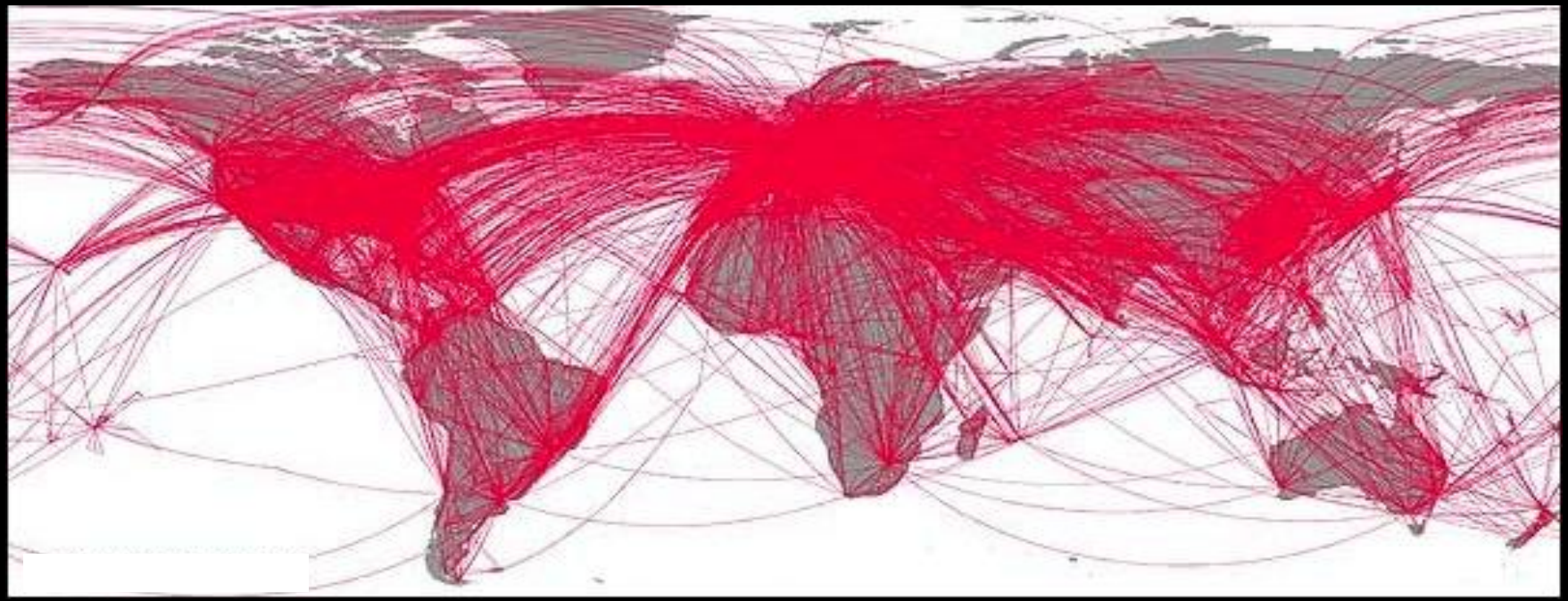


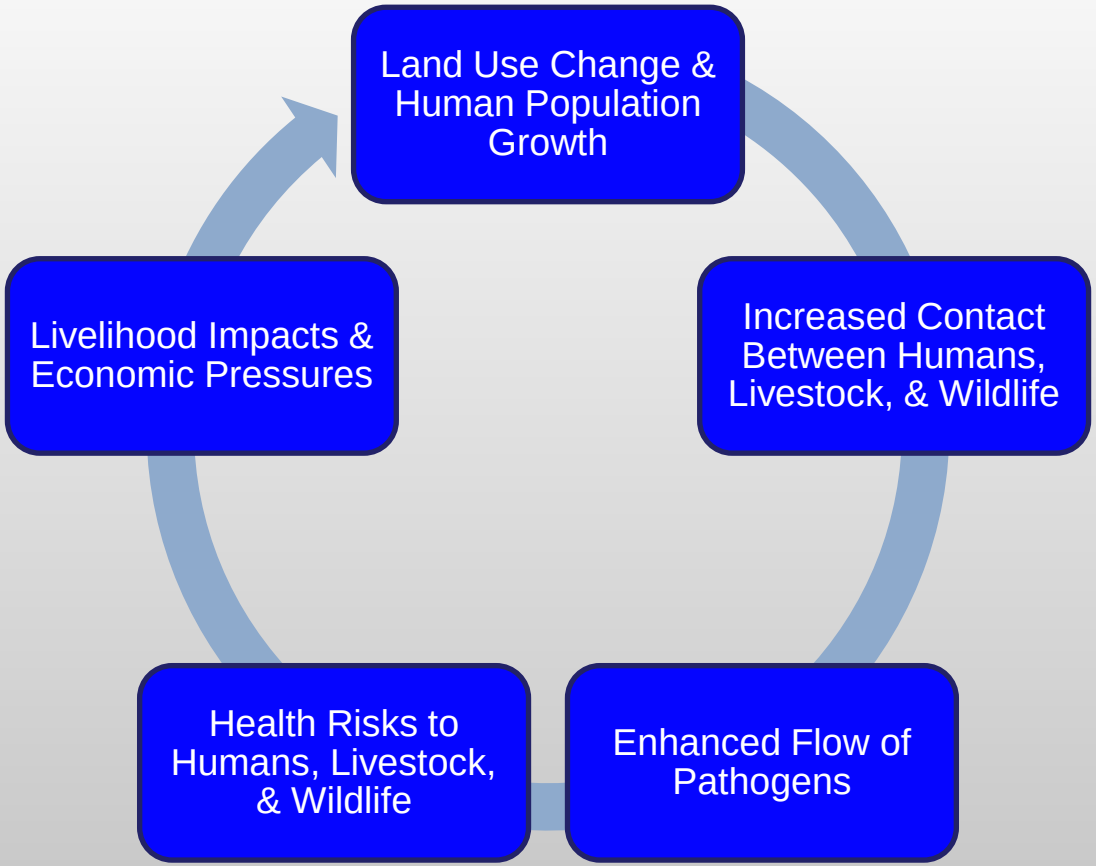

16626 planes in flight
2005 Mar 19-

AIR NETWORKS IN 1933

AIR NETWORKS IN 2005

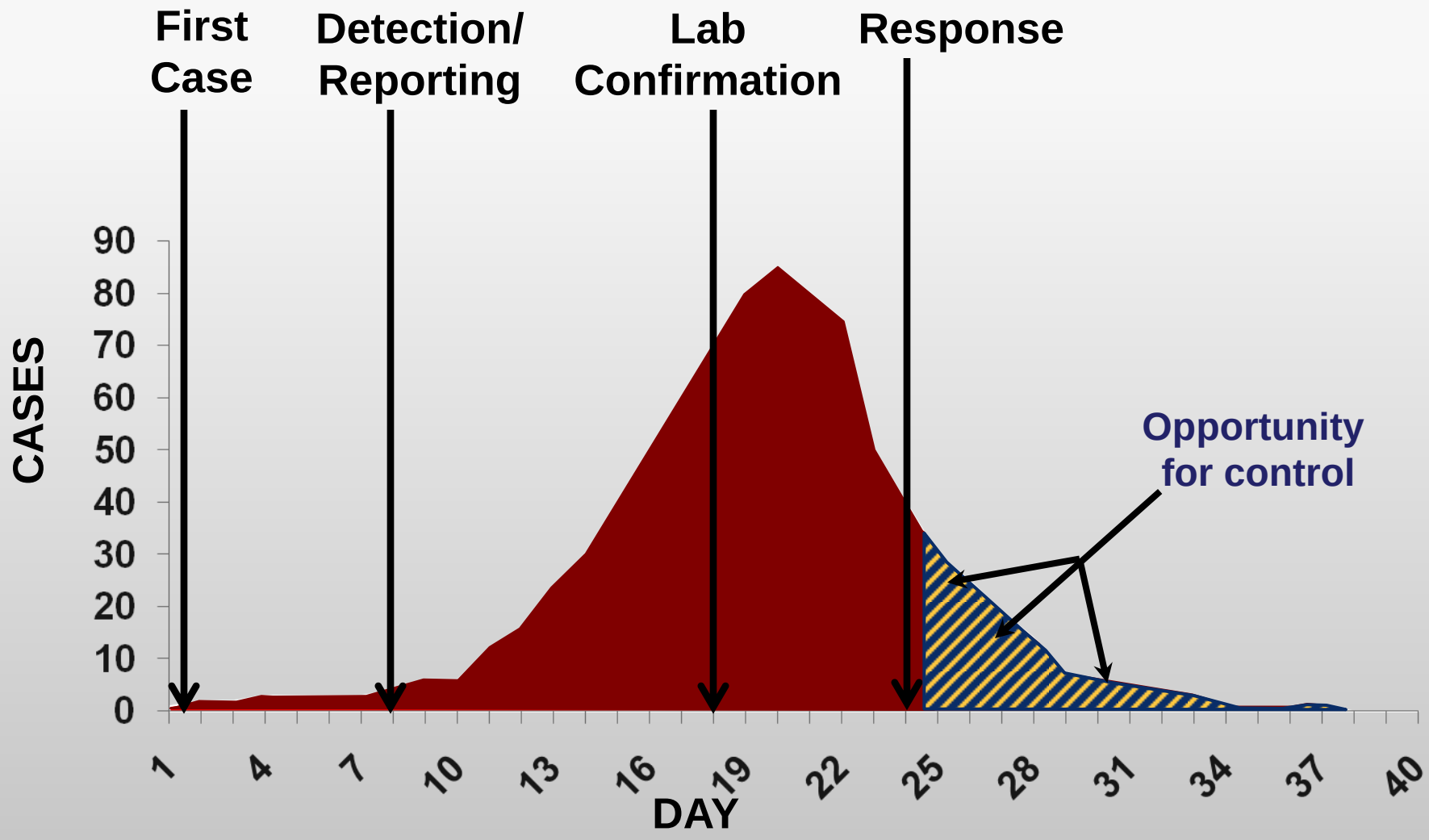


Human-Livestock-Wildlife Interface



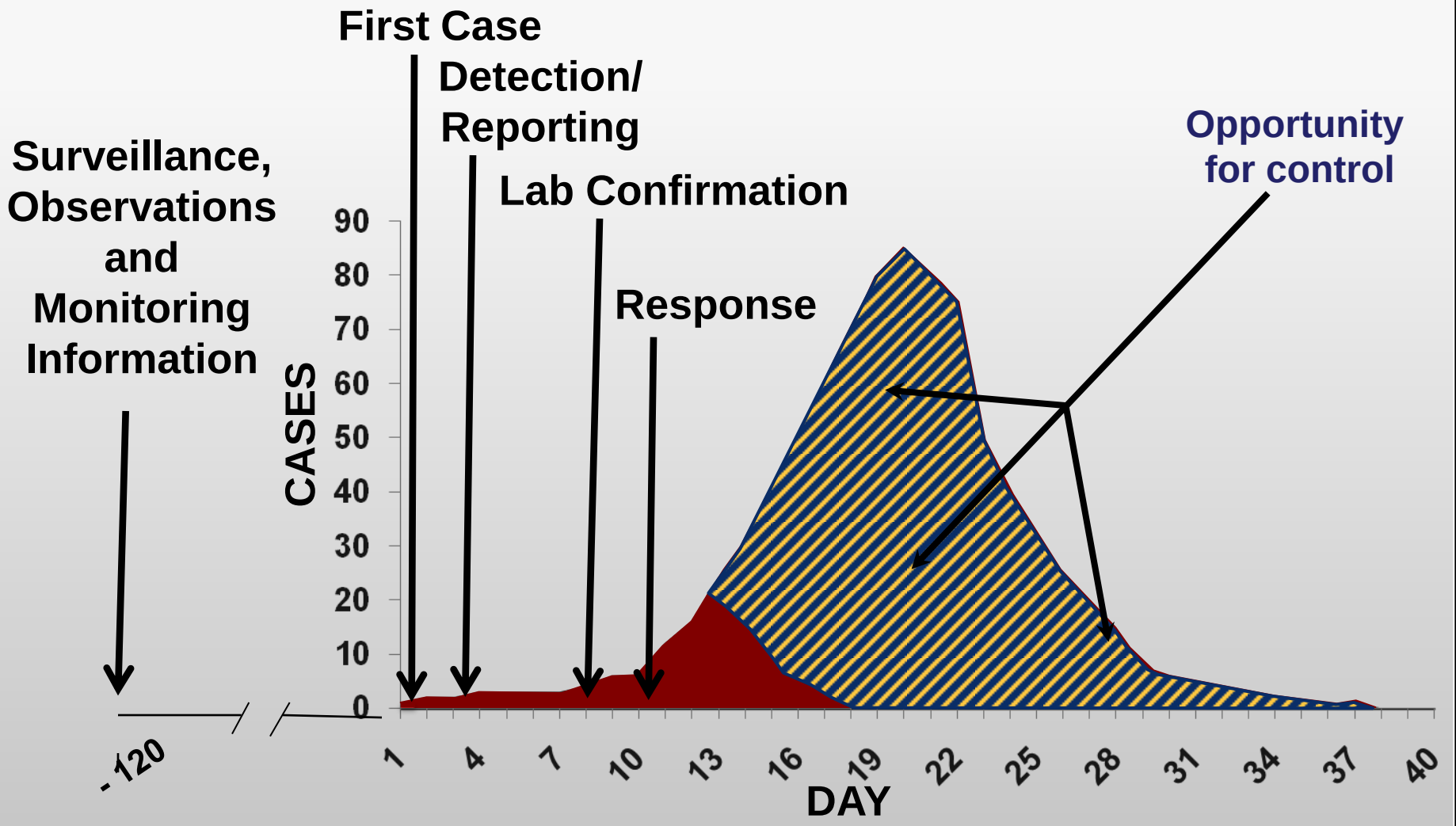
- **Majority of emerging infectious diseases (EIDs) in people are of animal origin (zoonotic)**
- **75% of emerging zoonoses have wildlife origins**
- **Human activities at the interface linked to EIDs (Nipah virus, SARS, Ebola)**
- **Annual population growth among highest in buffers to protected areas near wildlife**

Current Outbreak Detection and Response



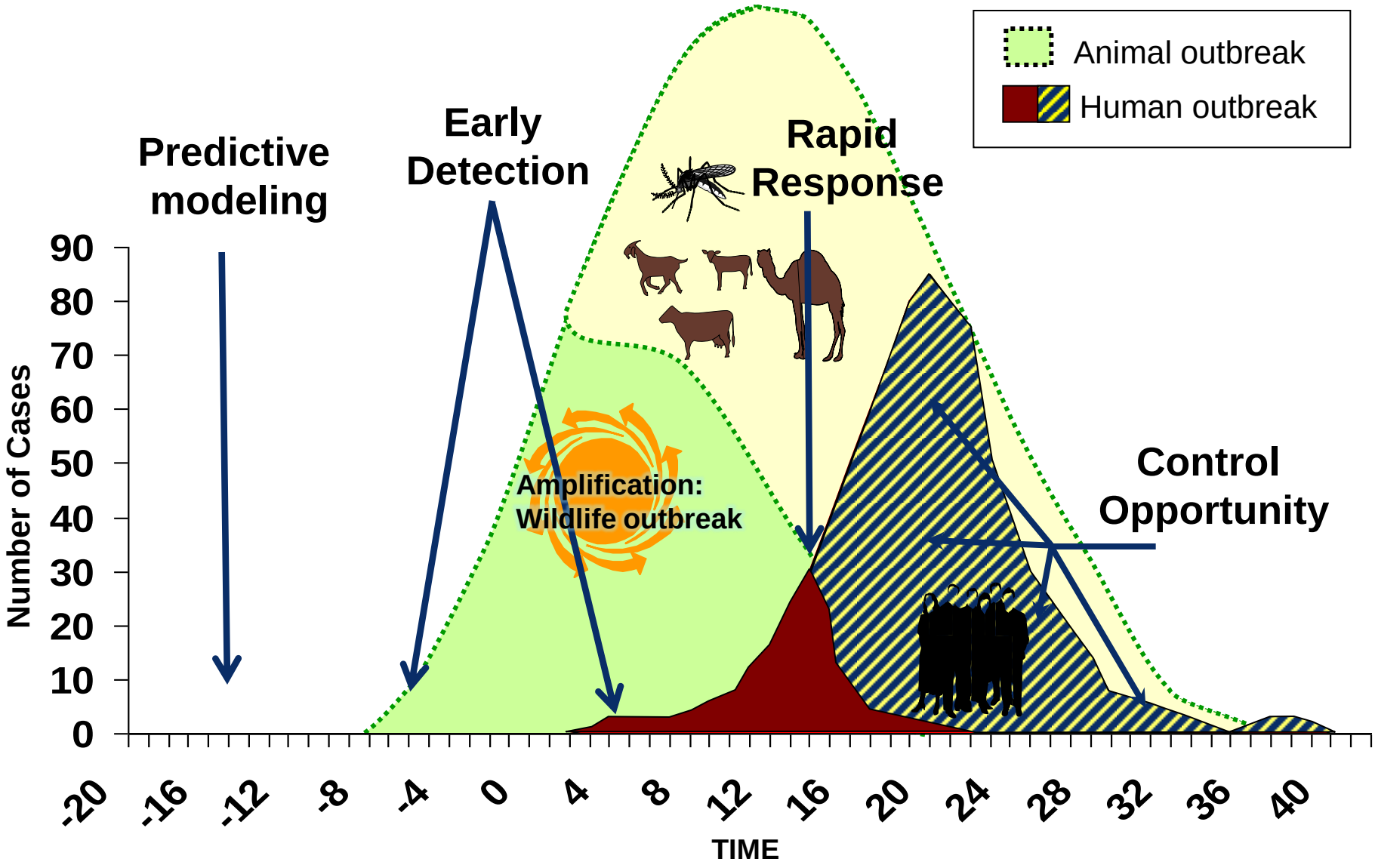
Adapted from J. Davis, Climate Adaptation Workshop, Nov. 2003

Effective Health Early Warning

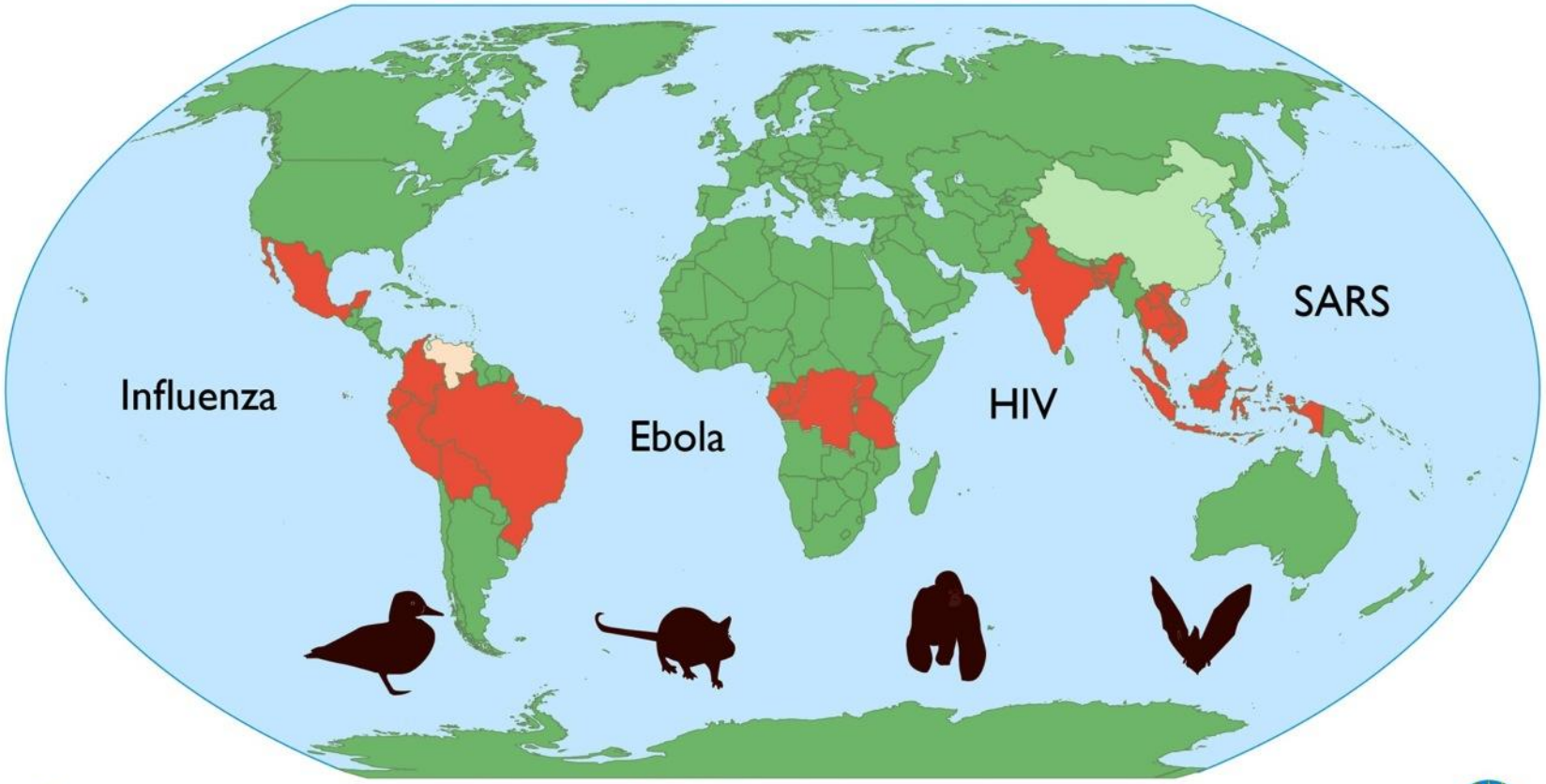


Adapted from J. Davis, Climate Adaptation Workshop, Nov. 2003

A successful EID outbreak alert and response system



PREDICT: Building a global early warning system for emerging diseases that move between wildlife and people



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UCDAVIS VETERINARY MEDICINE Wildlife Health Center
WILDLIFE CONSERVATION SOCIETY
EcoHealth Alliance
GVFI Global Viral Forecasting Initiative
Smithsonian Institution

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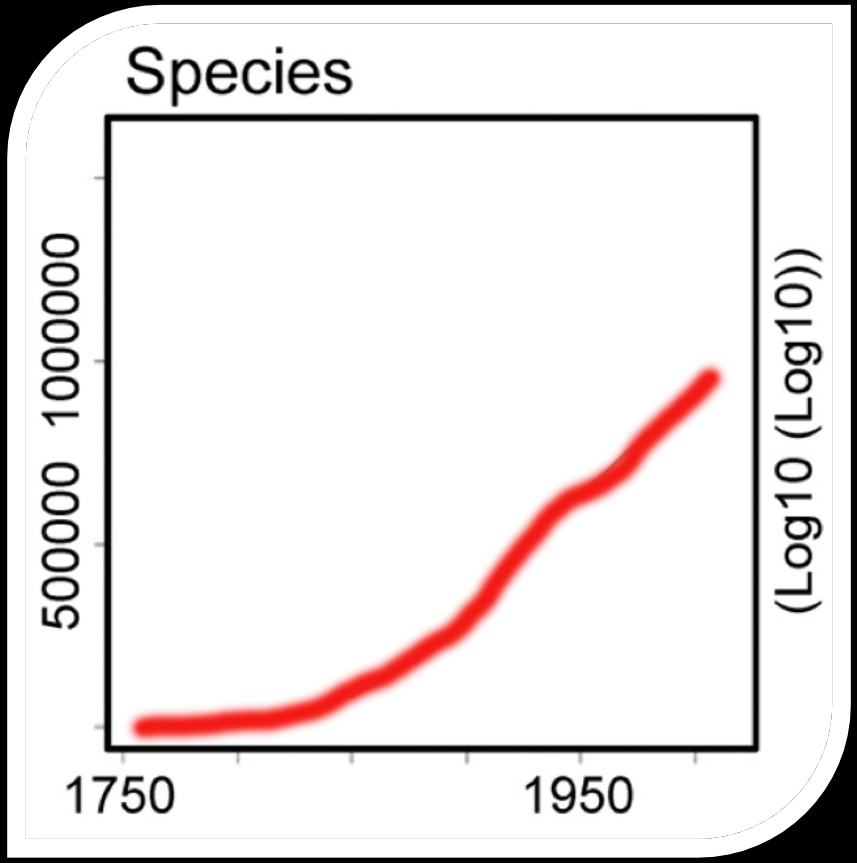
Where do we start?

How many species are there?



~9,000,000 ‘species’

Mora et al. 2011 PLoS Biology

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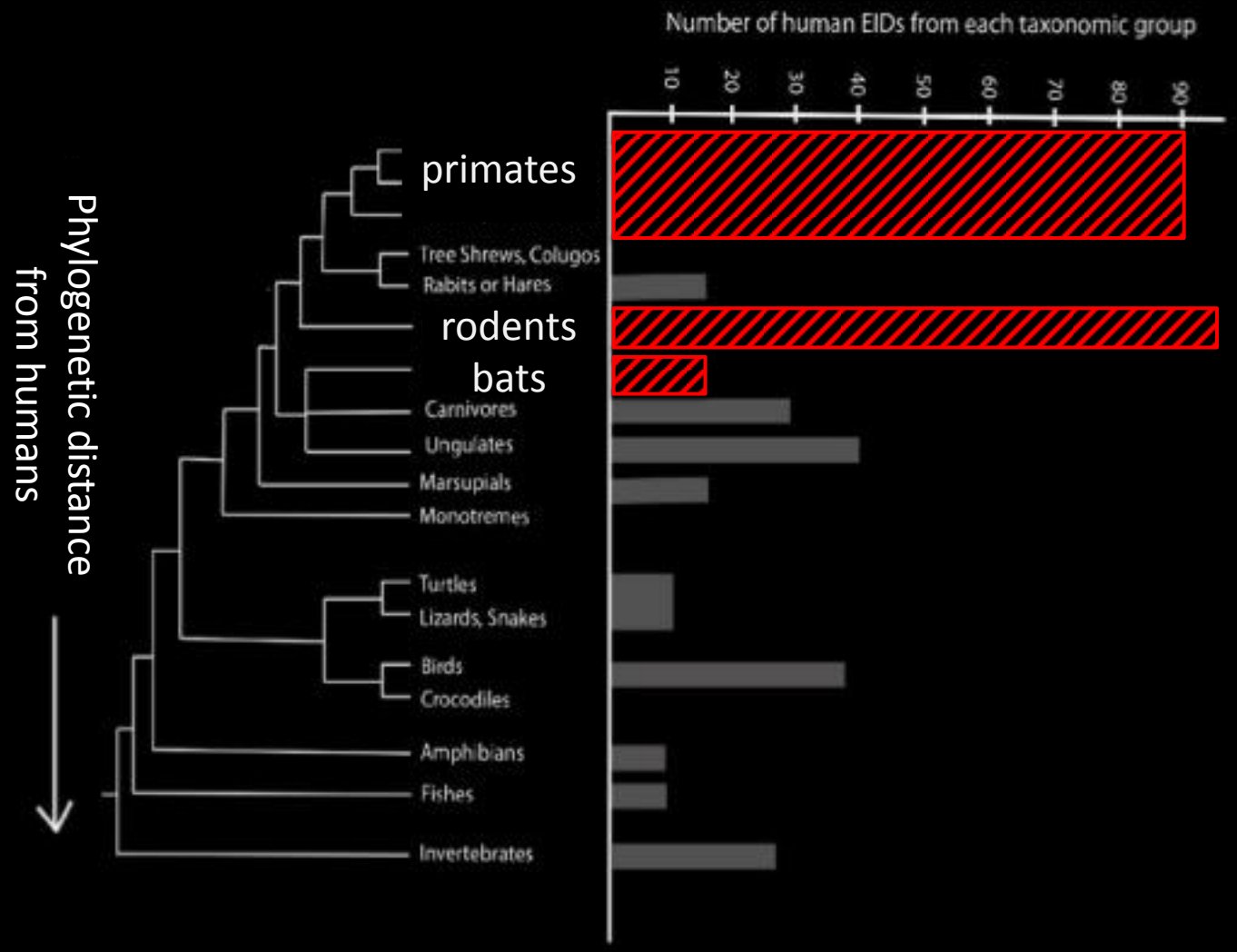
Developing a Targeted Surveillance Strategy

for wildlife species of highest risk



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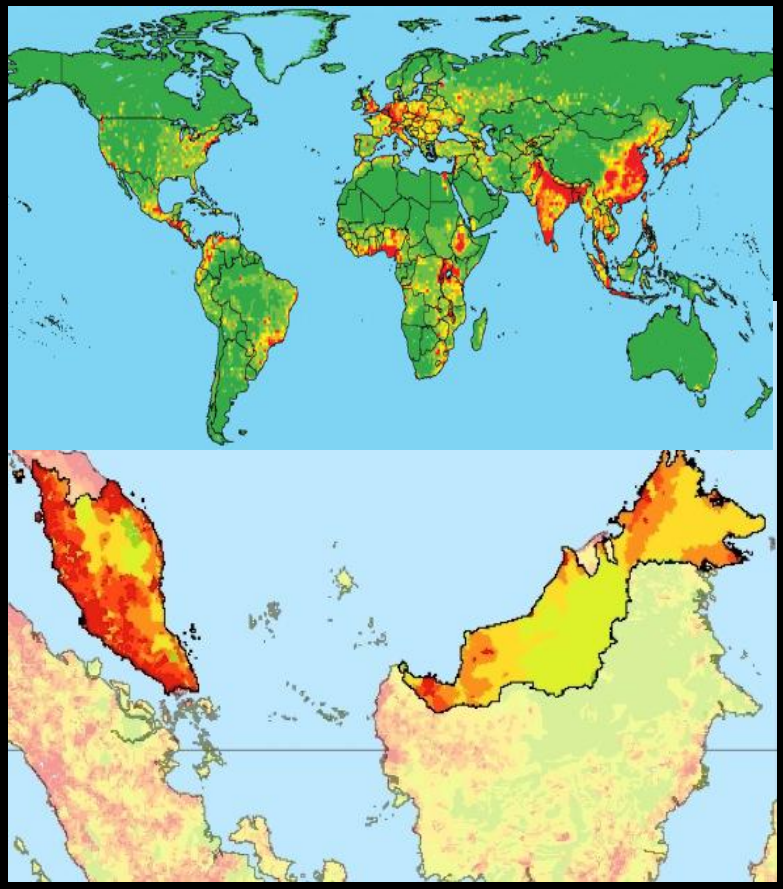
Developing a Targeted Surveillance Strategy

Strategic selection of geographic locations for surveillance



Strategic selection of species for surveillance

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Risk-based Approach to Surveillance *in hotspot regions around the world*

- Sample along **high risk disease transmission pathways**
  - **Hunted animals, animals in wildlife trade,** (wildlife destined for human consumption, local and international trade)
- *People have a high level of **sustained and direct contact** with pathogens from these sources*

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<u>Targeted</u> Approach to Surveillance *of wild caught free-ranging animals*

- **Sample wild caught free-ranging wildlife** in areas where disease emergence is promoted by:
  - landscape change,
  - land use,
  - anthropogenic activities,
  - sharing of limited resources, and
  - incursion of domestic animals

- *Identify natural **reservoirs** for zoonotic pathogens*

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Key Sites

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Cameroon / China / San Francisco CA, USA / Sierra Leone / Washington DC, USA

Field & Lab Operations

Democratic Republic of Congo
Gabon Indonesia / Kazakhstan
Malaysia / Vietnam

Field Collection Partner

Cambodia / Laos / Madagascar

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Longitudinal Studies of Individuals Occupationally Exposed to Animals

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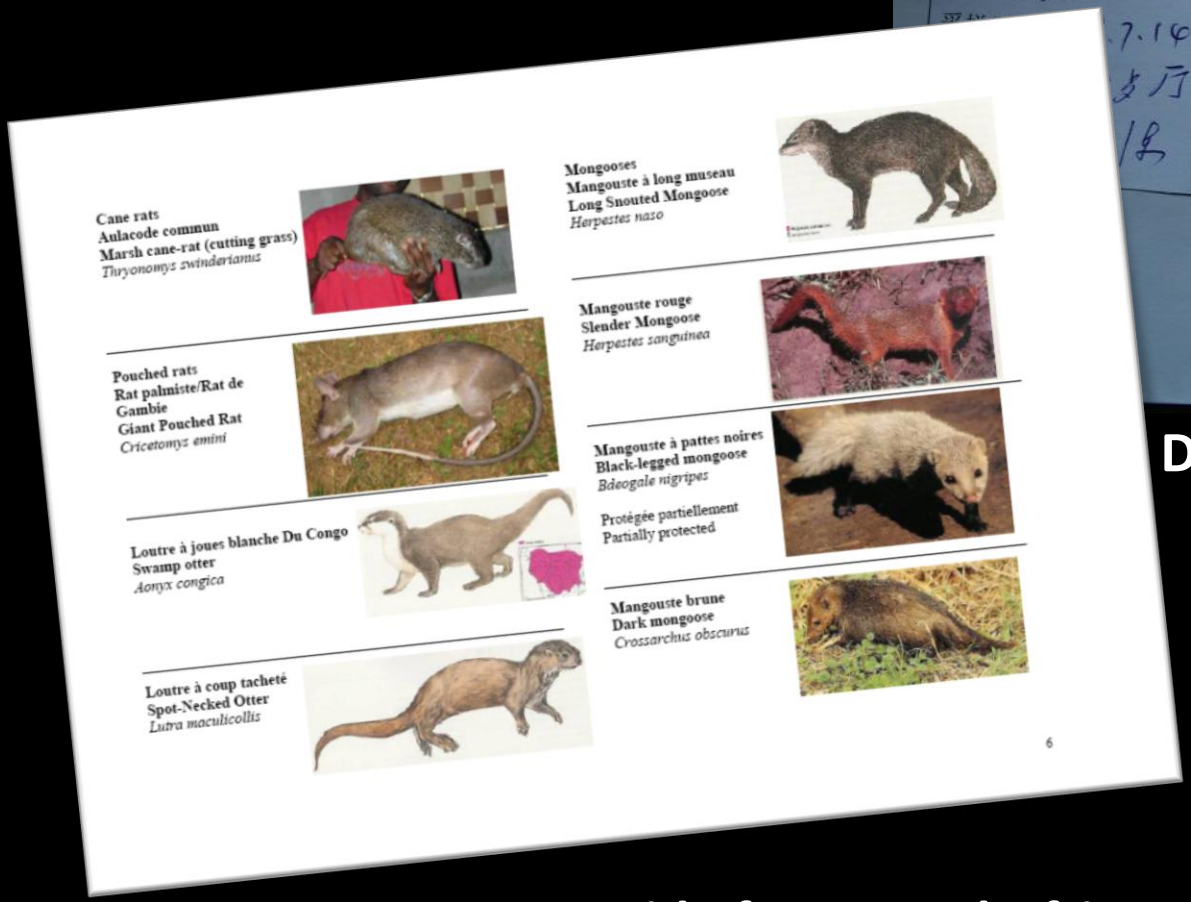
Self-collected animal dried blood spots

DBS from Chinese Wet Market



ID Guide for Central African Hunters

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Active Collections from Wildlife

Wildlife Sanctuary Work

Wild animal capture

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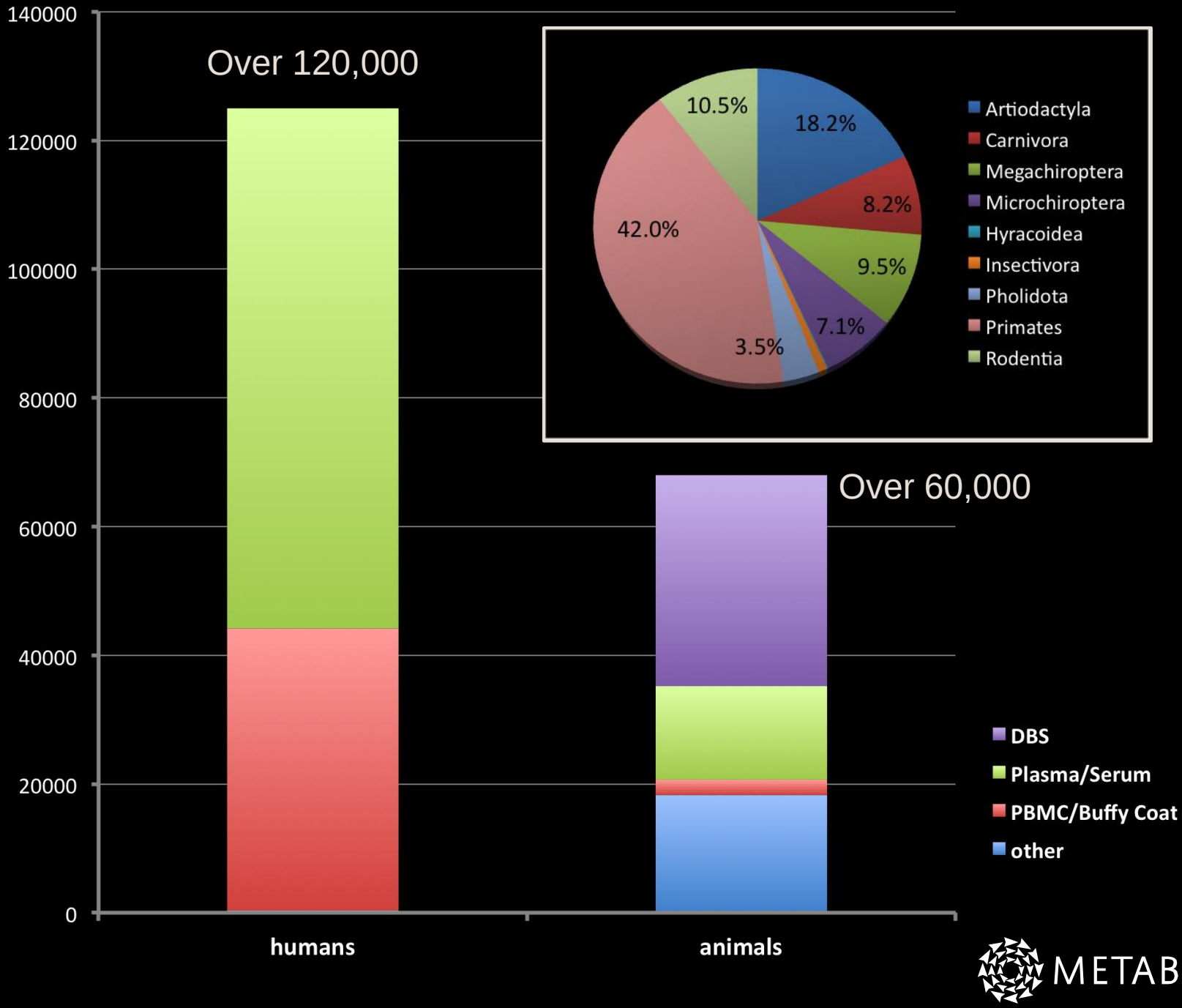
140000
120000
100000
80000
60000
40000
20000
0
Over 120,000
Over 60,000
humans
animals
DBS
Plasma/Serum
PBMC/Buffy Coat
other
10.5%
18.2%
8.2%
42.0%
9.5%
7.1%
3.5%
Artiodactyla
Carnivora
Megachiroptera
Microchiroptera
Hyracoidea
Insectivora
Pholidota
Primates
Rodentia

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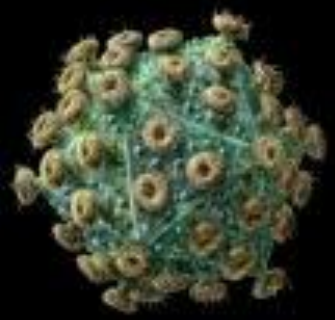
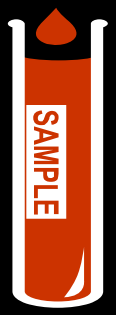
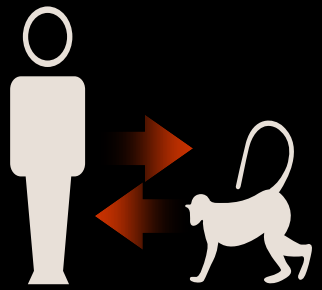
RESULTS AFTER 10 YEARS



IDENTIFIED NEW VIRUSES, INCLUDING RETROVIRUSES



COLLECTED
>100k HUMAN &
>50k ANIMAL SAMPLES



DOCUMENTED VIRAL JUMPS FROM ANIMALS TO HUMANS

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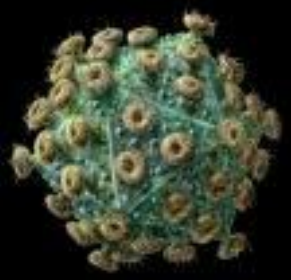
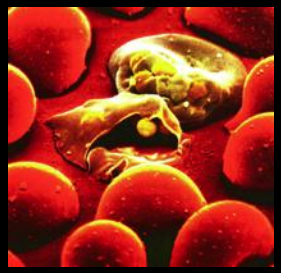
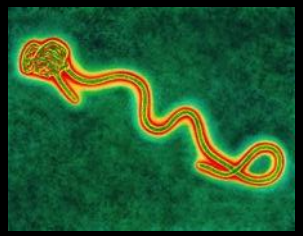
NEW AGENTS DISCOVERED INCLUDE:



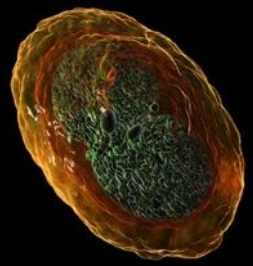
HTLV-3, HTLV-4
NOVEL STLV & SFV LINEAGES
RETROVIRUSES – LIKE HIV



Plasmodium
NOVEL PRIMATE LINEAGES
MALARIA PARASITES



NOVEL CLADE OF EBOLA
FILOVIRUSES



Various new/divergent paramyxoviruses, coronaviruses, adenoviruses, astroviruses, poxviruses, rhabdoviruses, etc.

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Adaptive Surveillance Strategy

to identify situations requiring enhanced surveillance

- **Ongoing epidemiologic analysis of data**
  - To describe zoonotic pathogens in wildlife in each hotspot region
  - Identify zoonotic disease threats that require further investigation
  - Refine our sampling strategies

- **Digital feedback**
  - Use triggers that signal a high potential for zoonotic pathogen outbreaks
    - Unusual outbreaks in humans and domestic animals with zoonotic pathogens of possible wildlife origin

EPIDEMIC RESPONSE UNITS

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VETERINARY MEDICINE
Wildlife Health Center

PREDICT

EcoHealth Alliance

GVFI

METABIOTA

Smithsonian
Institution


USAID
FROM THE AMERICAN PEOPLE


ARMED FORCES
HEALTH SURVEILLANCE CENTER


DEPARTMENT OF STATE
UNITED STATES OF AMERICA


U.S. DEPARTMENT OF
HOMELAND SECURITY


DEFENSE THREAT REDUCTION AGENCY
UNITED STATES OF AMERICA


Department of Defense
Global Emerging Infections System


DEPARTMENT OF DEFENSE
HIV/AIDS PREVENTION


DARPA


CENTERS FOR DISEASE CONTROL AND PREVENTION
CDC


NATIONAL CANCER INSTITUTE

RESEARCH COLLABORATORS

- ACMS/PSI International Cameroon Program
- Blood Systems Research Institute
- Centre International de Recherches Médicales de Franceville (CIRMF)
- Care and Health Program Cameroon (CHP)
- CARE International
- Catholic Relief Services (CRS)
- Centers for Disease Control and Prevention (CDC)
- Centers for Disease Control and Prevention of Guangdong Province
- Centre Pasteur, Cameroon
- Columbia University
- Department of Orang Asli, Malaysia
- Department for Veterinary Services, Malaysia
- EcoHealth Alliance (EHA)
- FHI 360
- Guangdong Entomological Institute (GDEI)
- Institut Congolais pour la Conservation de la Nature (ICCN)
- Institut de Recherche pour le Développement (IRD)
- Institut Pasteur, Cambodia
- Kinshasa School of Public Health (KSPH)
- Lola ya Bonobo Sanctuary
- Ministry of Health of Cambodia
- Ministry of Public Health of Cameroon
- Ministry of Health of the People's Republic of China
- Ministry of Health of Democratic Republic of Congo
- Ministry of Health of Gabon
- Ministry of Health of Malaysia
- Ministry of Health of Laos
- Ministry of Health & Sanitation of Sierra Leone
- Ministry of Water and Forests of Gabon
- National Institute for Biomedical Research (I.N.R.B.)
- National Public Health Laboratory (NPHL)
- Naval Medical Research Unit -2 (NAMRU-2), Phnom Penh
- PERHILITAN (Malaysian Wildlife Department)
- Robert Koch-Institute (RKI)
- Smithsonian Institute
- Stanford University
- University of California, Davis
- Tropical Medicine Research Program of Oxford University
- Tulane University
- University of California, Davis
- University of California, Los Angeles
- University of California, San Diego
- University of California, San Francisco
- University of Edinburgh
- University of Massachusetts, Amherst
- University of Oxford
- US Army Medical Research Institute of Infectious Diseases (USAMRIID)
- US Centers for Disease Control (CDC)
- US Department of Defense Threat Reduction Agency (DTRA)
- World Health Organization (WHO)
- World Health Organization (WHO), Sierra Leone Country Office

OUR MISSION

To mitigate the risk of microbial threats

METABIOTA

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