Conservation & Ecosystem Health Alliance

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Impact and challenges of emerging infectious diseases in great ape conservation and public health implications

ITFC-UWA Sharing Workshop
14-15th March, 2012

Dr. Lawrence Mugisha, BVM, MSc WHM, PhD
Makerere University, Kampala, Uganda

EcoHealth Research Group

Emergence and Re-emergence Infectious diseases

75% of emerging human infectious diseases are zoonotic from wildlife hosts , livestock and their products

Most of the EIDs (60.3%) are zoonoses and the majority of these (71.8%) originate from wildlife hosts (Tabish, 2009).

Multihost Pathogens

60% of all human pathogens are zoonotic

80% of animal pathogens

Ecological generalists

CDC's Most Significant Global Epidemics Over the Last 15 Years

1993 – Hanta virus

1994 – Plague (India)

Ebola virus (Zaire)

1996 – New Variant of CJD (UK)

H_5N_1 influenza (Hong Kong)

1998 – Nipah virus (Malaysia)

1999 – West Nile

2000 – Rift Valley fever

2001 – Anthrx

2002 – Norovirus

2003 – SARS

2004 – Marburg Virus

2005 – H_5N_1 Influenza

2006 – *E. coli 0157H7*

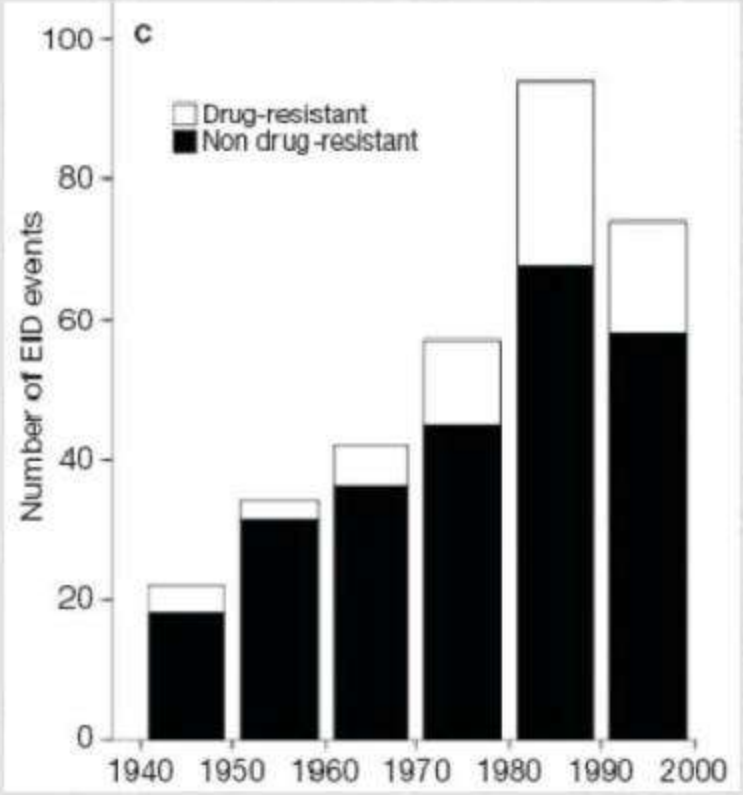
2007 – P.I.N.

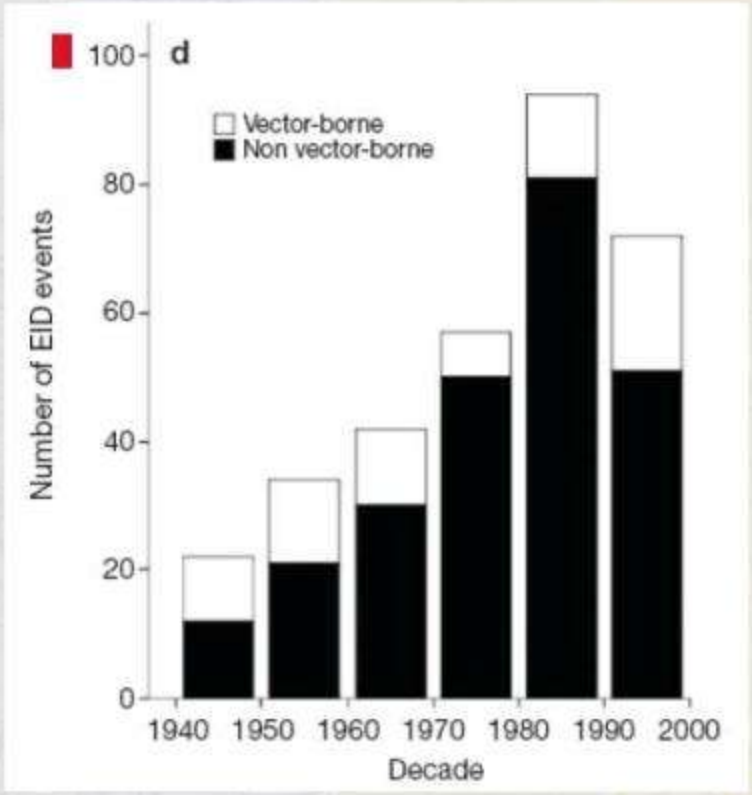
2008 – Salmonella StPaul

2009 – H1N1 Influenza

2010 – Cryptococcus gattii

Global Trends in Emerging Infection Diseases (EID)





335 EID events: 1940-2004

Steady increase with peak decade in 1980

20.9% drug-resistant microbes

22.8% vector-borne (28.8% in the last decade

Foresight Analysis

EID are the “New normal”

Expect 3-4 new EID annually; 8-34 by 2015

87 new EID since 1980

- 58 viruses… 49 RNA
- mostly zoonotic

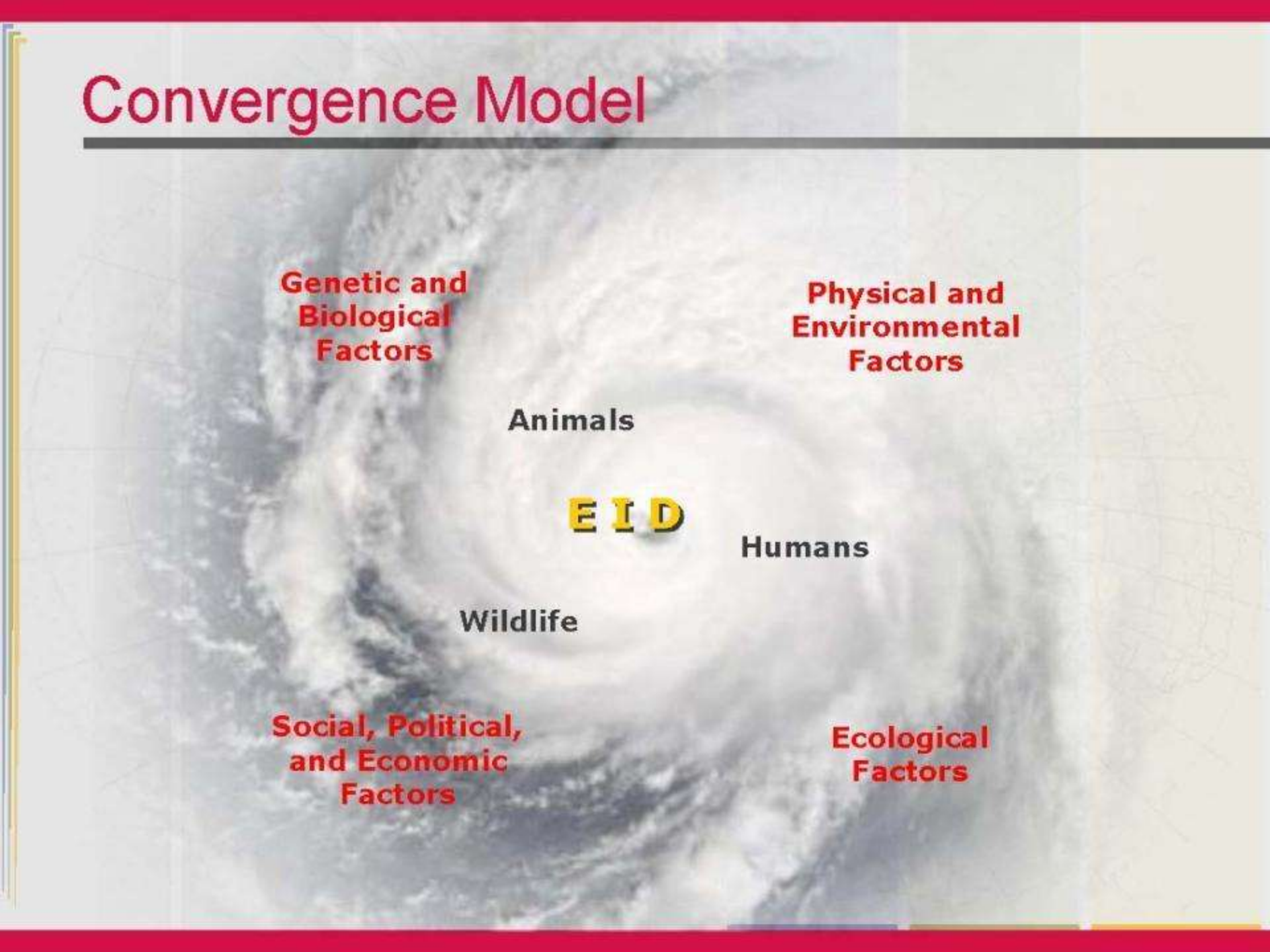
Found worldwide but proximity to animal populations or products is the key risk factor

Change in the host-pathogen ecology will be the most important single driver

Why Diseases Emerge

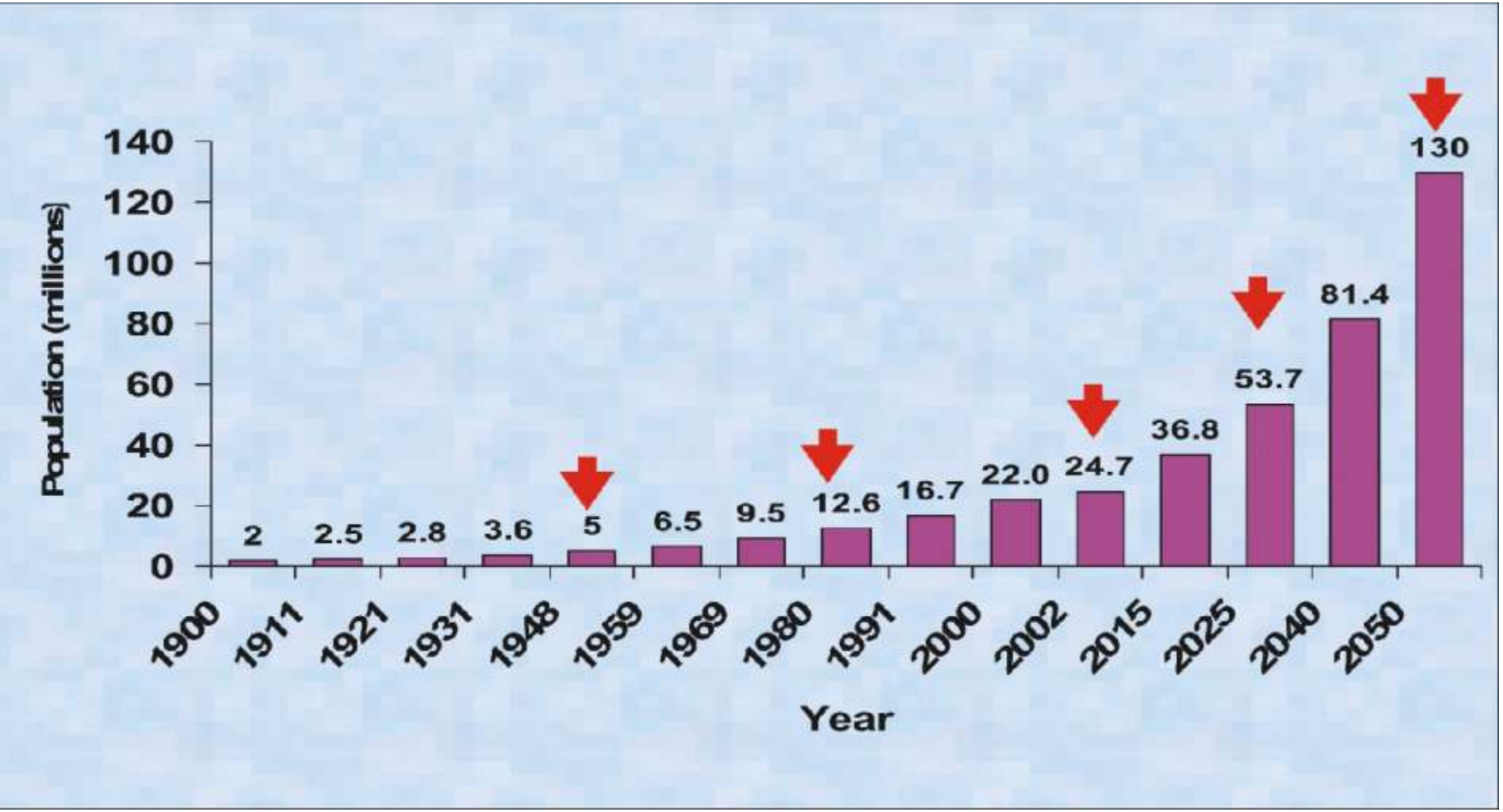
- Genetic and biological factors
  - Microbial adaptation and change
  - Human susceptibility to Infection
- Physical environmental factors
  - Climate and weather
  - Economic development and land use
- Ecological factors
  - Changing ecosystems
  - Human demographics and behavior
- Social, political, and economic factors
  - International Travel and commerce
  - Poverty and Social inequity
  - War and Famine
  - Lack of political will
  - Intent to harm

Convergence Model



Uganda Population Growth Trends

STATE OF UGANDA POPULATION, 2011 REPORT

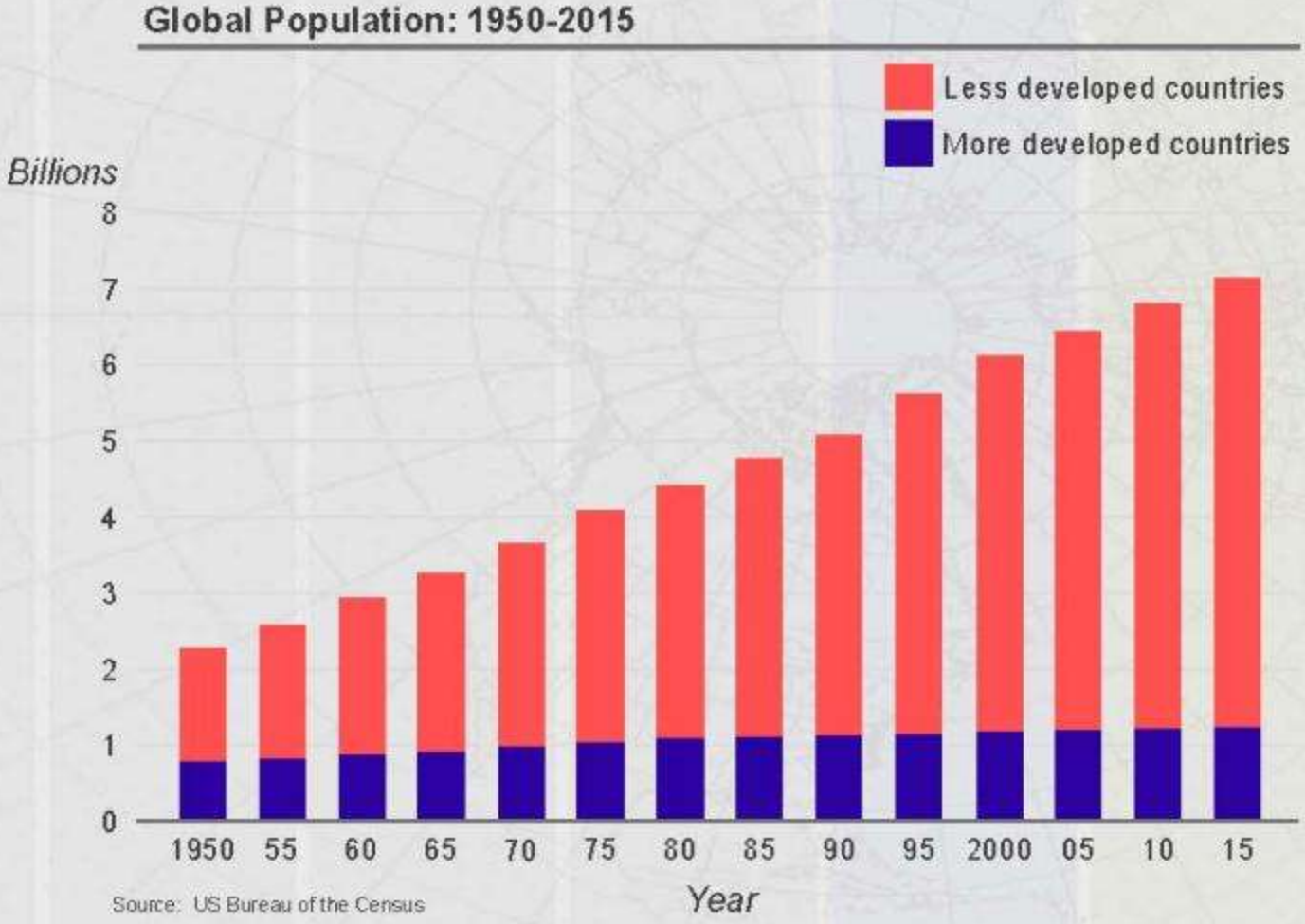


HUMAN POPULATION GROWTH

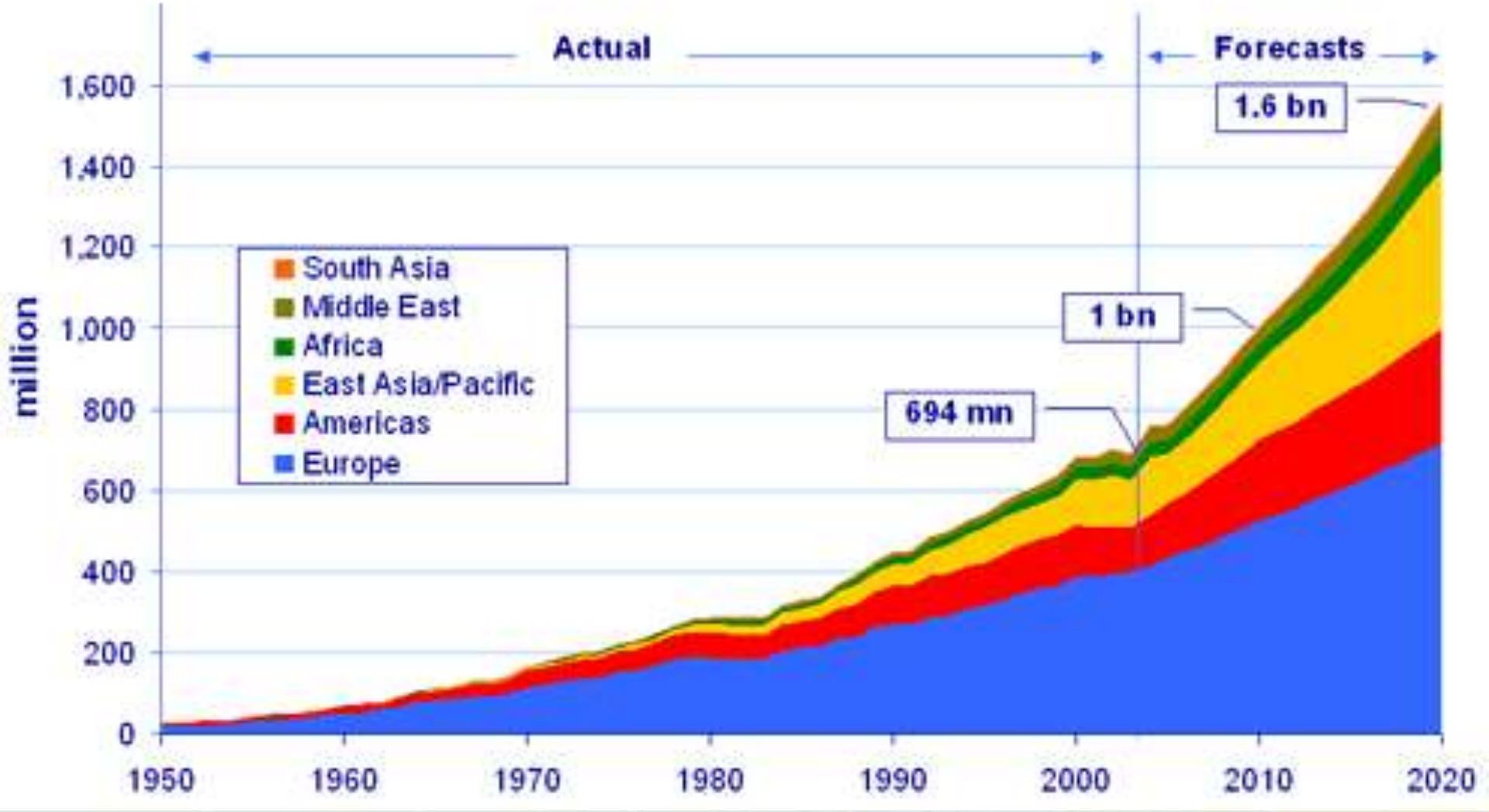
	Time to Attain	Year Attained
• 1st Billion	2-5 Million Years	About 1880
• 2nd	Approx. 130 Years	1930
• 3rd	30 Years	1960
• 4th	15 Years	1975
• 5th	12 Years	1987
• 6th	12 Years	1999
• 6.7	10 Years	2009
• 7	2 Years	2011

http://math.berkeley.edu/~galen/popclk.html

Trends in Global Population



International Tourist Arrivals, 1950-2020



Great Ape Habituation and Tourism

Of the 480 gorillas in the Virunga Massif, 352 (73%) are habituated for tourism

In Bwindi Impenetrable National park with estimated population of 300 mountain gorilla , more than 53% is habituated for tourism comprising of 9 habituated gorilla groups.

Tourist statistics from UWA shows that:
10, 503 gorilla permits were solid in 2008 and 10,797 permits in 2009
hence pressure to habituate more groups

Conservation Status and Risks for chimpanzee populations

Climate Change's Impact on Infectious Diseases

Vector-borne diseases

Water-borne diseases

Agriculture Production

Migration of Animals

Changing ecosystems for wildlife and animals

Built environment

Human-Animal Interface

Ecologies and a new research portfolio

Evidence-based public health

Annual consumption of wood is est at 33m tones

Muteme, Kizirafumbi, Feb, 2012

How is Agriculture affecting Biodiversity?

49, 318, 620 sq km area is under Agriculture by 2007

Short Overview on Pathogens in Wild Great Apes

- Viruses (non-lethal)
  - Retroviruses
    - STLV
    - SFV
  - HBV
  - Adenoviruses
  - Herpesviruses
  - Polyomaviruses
  - Parvoviruses
  - TT-Viruses

- Viruses (lethal)
  - Filoviruses
    - Ebola
  - SIV
  - Polio (?)
  - Measles (?)
  - RSV, HMPV

Infectious diseases from Apes to humans

Human Immuno-dificiency Virus (HIV I and II)SIVcpz (Gao et al., 1999; Hahn et al., 2000;; Peeters et al., 2002; Keele et al., 2006)

- HIV-1 lineage (HIV-1 group P) : (SIVgor) was discovered in a Cameroonian woman (Plantier et al., 2009)

- Simian Foamy Virus (SFV) chimpanzee and other primates Calattini et al., 2007; Wolfe et al., 2004

in humans

Apes being Driven to extiction by Infectious Diseases

Ebola virus	Walsh et al., 2003
	Leroy et al., 2004
	Barmejo et al., 2006
Anthrax	Leendertz et al., 2004, 2006

Respiratory diseases (HMPV, RSV, S.Pneumonie etc)

Londsdorf et al., 2006

Hananura et al., 2007

Kondgen, et al., 2008

Bush meat Trade

PetTrade

Infectious Diseases like Ebola

Human Metapneumovirus Infection in Wild Mountain Gorillas, Rwanda

Gustavo Palacios, Linda J. Lowenstine, Michael R. Cranfield, Kirsten V.K. Gilardi, Lucy Spelman, Magda Lukasik-Braum, Jean-Felix Kinani, Antoine Mudakikwa, Elisabeth Nyirakaragire, Ana Valeria Bussetti, Nazir Savji, Stephen Hutchison, Michael Egholm, and W. Ian Lipkin

The genetic relatedness of mountain gorillas and humans has led to concerns about interspecies transmission of infectious agents. Human-to-gorilla transmission may explain human metapneumovirus in 2 wild mountain gorillas that died during a respiratory disease outbreak in Rwanda in 2009. Surveillance is needed to ensure survival of these critically endangered animals.

The world's remaining 786 mountain gorillas (*Gorilla beringei beringei*) live in 2 parks in Rwanda, Uganda, and the Democratic Republic of the Congo. An ecotourism industry for viewing human-habituated mountain gorillas in the wild is thriving in all 3 countries. Mountain gorilla tourism helps ensure the sustainability of the species by generating much-needed revenue and increasing global awareness of the precarious status of this species in the wild. Tourism, however, also poses a risk for disease transmission from humans to the gorillas.

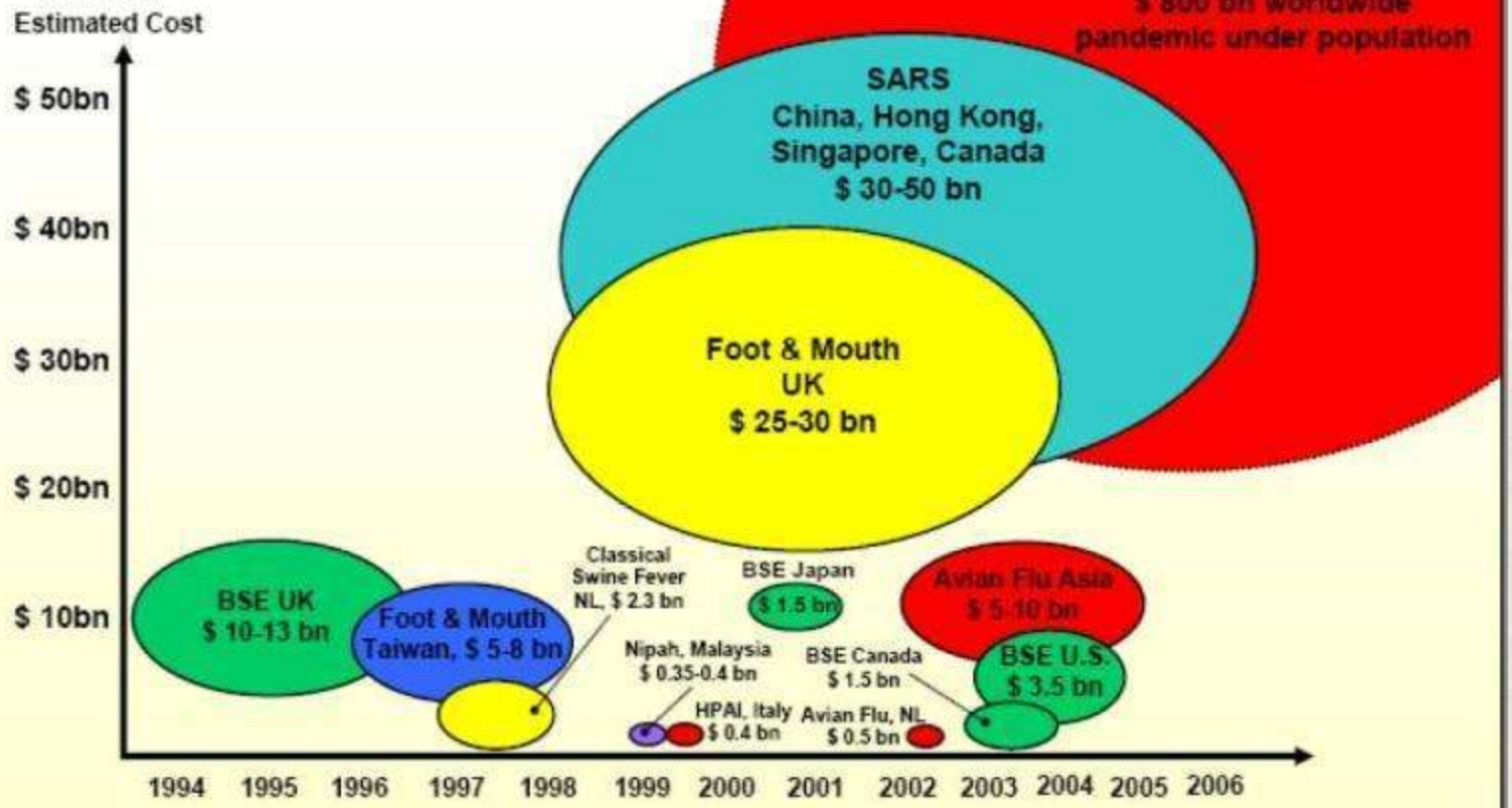
surveillance efforts focus on risk for humans, mountain gorillas are immunologically naive and susceptible to infection with human pathogens. The parks in which mountain gorillas live are surrounded by the densest human populations in continental Africa. In addition, research and gorilla ecotourism brings thousands of persons from the local communities and from around the world into direct and indirect contact with the gorillas. The frequency and closeness of contact is particularly pronounced in Virunga National Park, where 75% of mountain gorillas are habituated to the presence of humans.

To minimize the threat of disease transmission, the Rwandan, Ugandan, and Congolese governments restrict tourist numbers and proximity, and the Congolese wildlife authority mandates that masks be worn by persons visiting gorillas. Nonetheless, the frequency and severity of respiratory disease outbreaks among mountain gorillas in the Virunga Massif have recently increased. From May through August 2008, sequential respiratory outbreaks occurred in 4 groups of mountain gorillas accustomed to tourism in Rwanda. Between June 28 and August 6, 2009, a fifth outbreak occurred in 1 of these groups, Hirwa. We describe the Hirwa outbreak. Respiratory outbreaks were defined as more than one third of animals in a group exhibiting signs of respiratory disease (coughing, oculonasal discharge, and/or lethargy).

The Cases

The Hirwa group consisted of 12 animals: 1 adult male, 6 adult females, 3 juveniles, and 2 infants. Moderate to severe respiratory disease (>2 characteristic signs) developed in 11 of 12 animals. Five (3 juvenile males and 2 adult females) received antimicrobial drug therapy (ceftriaxone, 50 mg/kg for adults, 100 mg/kg for infants), 4 by remote delivery and 1 while chemically immobilized. Two untreated animals (1 adult female and 1 male infant

Economic Impact of Selected Infectious Diseases, 1994 - 2006



Source: Newcomb, J., One World - One Health: An Economic Perspective, 2004, FAZ, 09.11.2005

Dr. Manfred Kern / Jürgen Geiß
Business Relations

Bayer CropScience

Veterinary Intervations

Routine Monitoring

OPEN ACCESS Freely available online

PLoS one

Extreme Conservation Leads to Recovery of the Virunga Mountain Gorillas

Martha M. Robbins[1]*, Markye Gray[2], Katie A. Fawcett[3], Felicia B. Nutter[4], Prosper Uwingeli[5], Innocent Mburanumwe[6], Edwin Kagoda[7], Augustin Basabose[2], Tara S. Stoinski[3,8], Mike R. Cranfield[4], James Byamukama[2], Lucy H. Spelman[4], Andrew M. Robbins[1]

1 Department of Primatology, Max Planck Institute for Evolutionary Anthropology, Leipzig, Germany, **2** The International Gorilla Conservation Programme, Kigali, Rwanda, **3** Dian Fossey Gorilla Fund International, Atlanta, Georgia, United States of America, **4** Mountain Gorilla Veterinary Program, School of Veterinary Medicine, University of California Davis, Davis, California, United States of America, **5** Parc National des Volcans, Rwanda Development Board, Gishushu, Kigali, Rwanda, **6** Parc National des Virunga-sud, Institut Congolais pour la Conservation de la Nature, IGCP-DRC, Gisenyi, Rwanda, **7** Mgahinga Gorilla National Park, Uganda Wildlife Authority, Kampala, Uganda, **8** Zoo Atlanta, Atlanta, Georgia, United States of America

Abstract

As wildlife populations are declining, conservationists are under increasing pressure to measure the effectiveness of different management strategies. Conventional conservation measures such as law enforcement and community development projects are typically designed to minimize negative human influences upon a species and its ecosystem. In contrast, we define "extreme" conservation as efforts targeted to deliberately increase positive human influences, including veterinary care and close monitoring of individual animals. Here we compare the impact of both conservation approaches upon the population growth rate of the critically endangered Virunga mountain gorillas (*Gorilla beringei beringei*), which increased by 50% since their nadir in 1981, from approximately 250 to nearly 400 gorillas. Using demographic data from 1967–2008, we show an annual decline of 0.7%±0.059% for unhabituated gorillas that received intensive levels of conventional conservation approaches, versus an increase 4.1%±0.088% for habituated gorillas that also received extreme conservation measures. Each group of habituated gorillas is now continuously guarded by a separate team of field staff during daylight hours and receives veterinary treatment for snares, respiratory disease, and other life-threatening conditions. These results suggest that conventional conservation efforts prevented a severe decline of the overall population, but additional extreme measures were needed to achieve positive growth. Demographic stochasticity and socioecological factors had minimal impact on variability in the growth rates. Veterinary interventions could account for up to 40% of the difference in growth rates between habituated versus unhabituated gorillas, with the remaining difference likely arising from greater protection against poachers. Thus, by increasing protection and facilitating veterinary treatment, the daily monitoring of each habituated group contributed to most of the difference in growth rates. Our results argue for wider consideration of extreme measures and offer a startling view of the enormous resources that may be needed to conserve some endangered species.

Citation: Robbins MM, Gray M, Fawcett KA, Nutter FB, Uwingeli P, et al. (2011) Extreme Conservation Leads to Recovery of the Virunga Mountain Gorillas. PLoS ONE 6(6): e19788. doi:10.1371/journal.pone.0019788

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Competing Interests: One author is affiliated with Zoo Atlanta. Zoo Atlanta is a non-profit 501(c) 3 and therefore there are no competing interests. The authors have declared that no competing interests exist.

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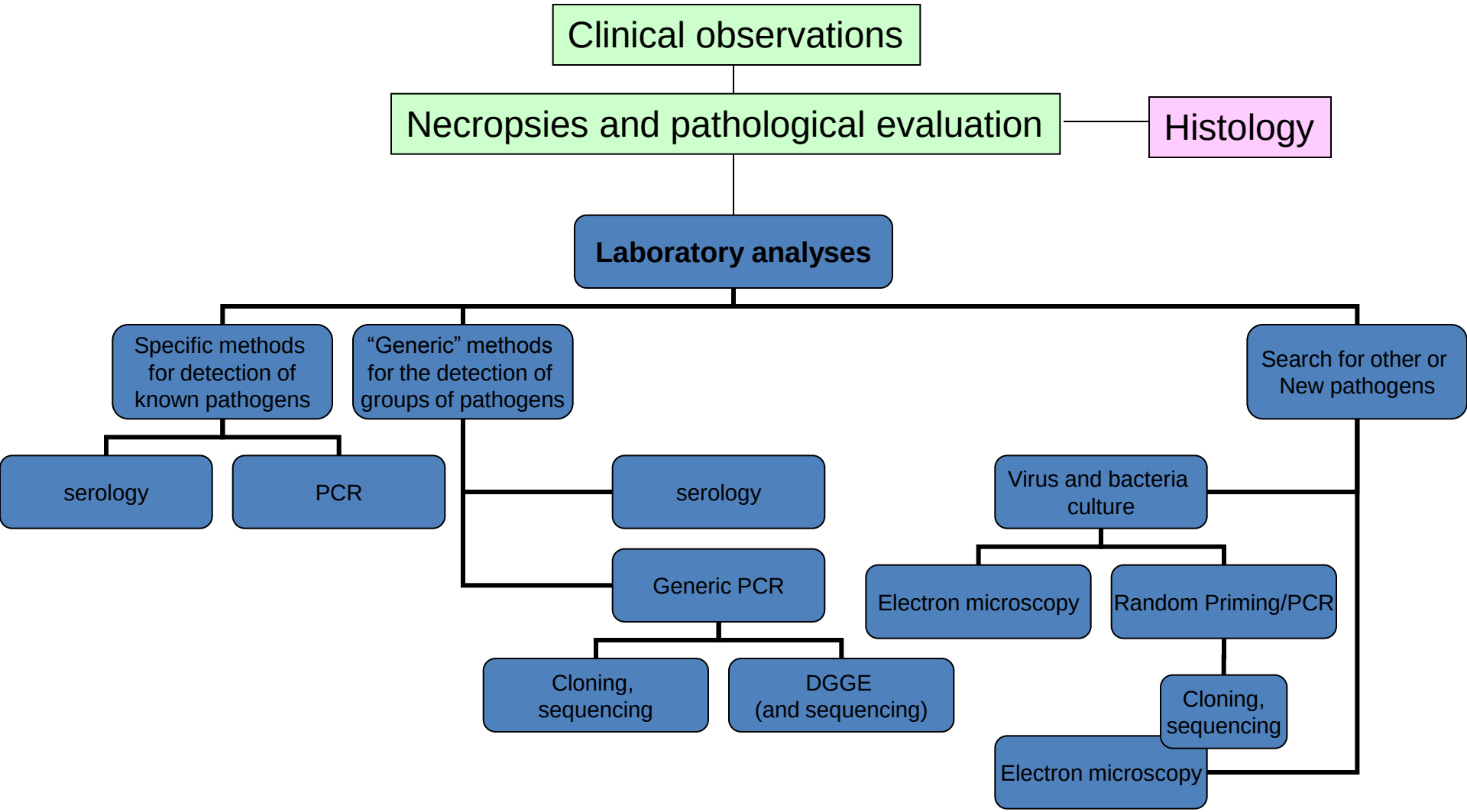
Wear mask
Keep distance (7m)
Be healthy and vaccinated

Integration of Pathogen investiagtion in Gorilla Census, 2011

Disease and outbreak investigation



All PCR products are sequenced => phylogenetic analyses

Current and Future Focus my Work and Research

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NGO: Registered in USA and Uganda

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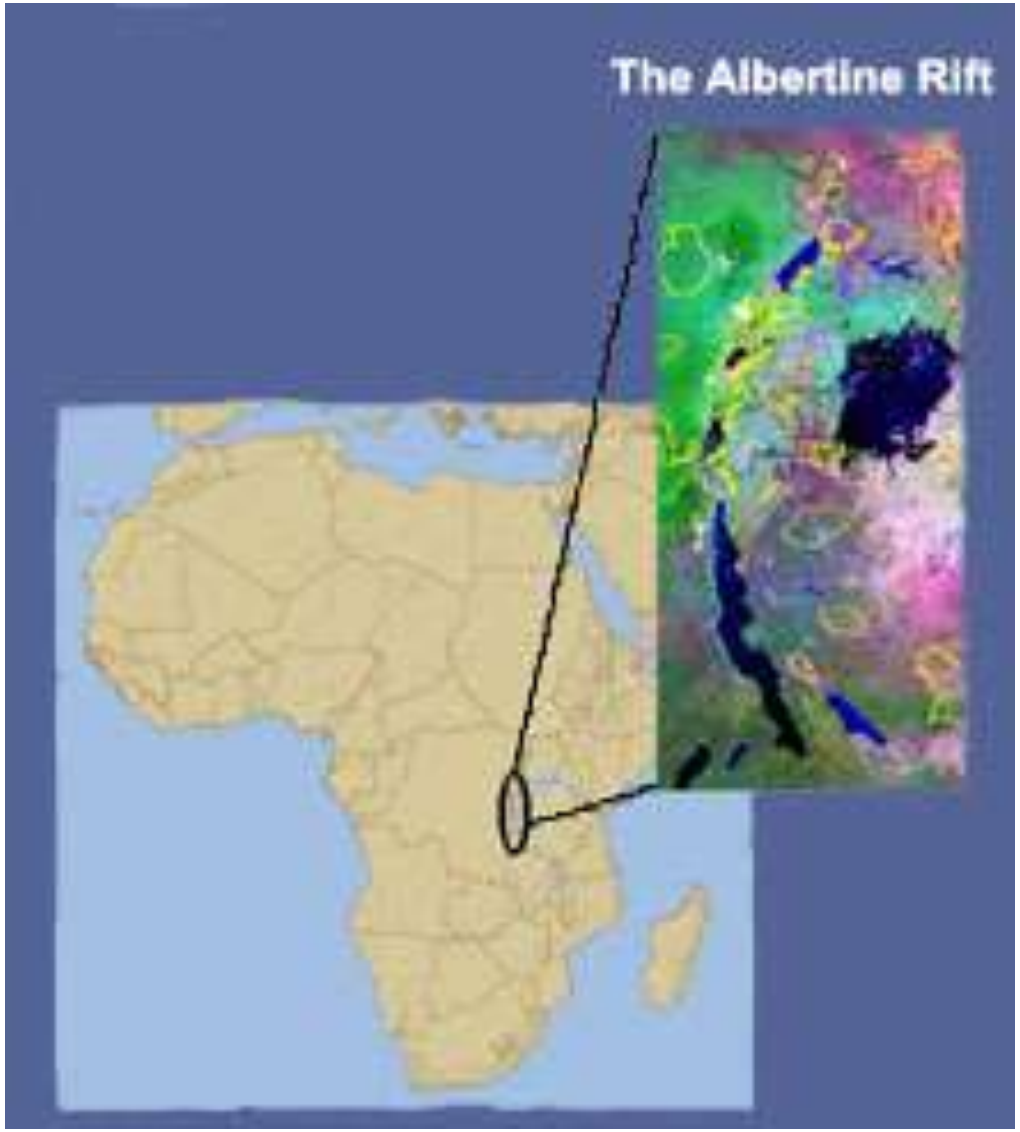
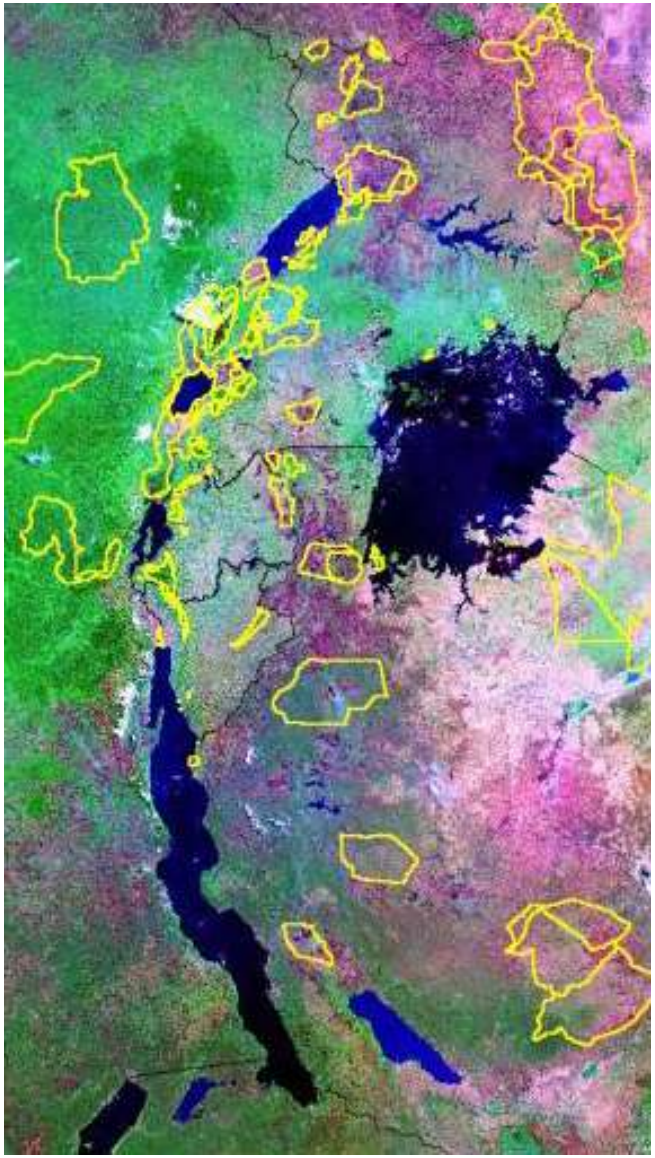
CEHA's Mission: "**To achieve sustainable conservation through multidisciplinary research while promoting nature conservation, ecosystem and human health** "

EcoHealth Research Group

Area of Focus: Albertine Rift Ecosystem





Albertine Biodiversity

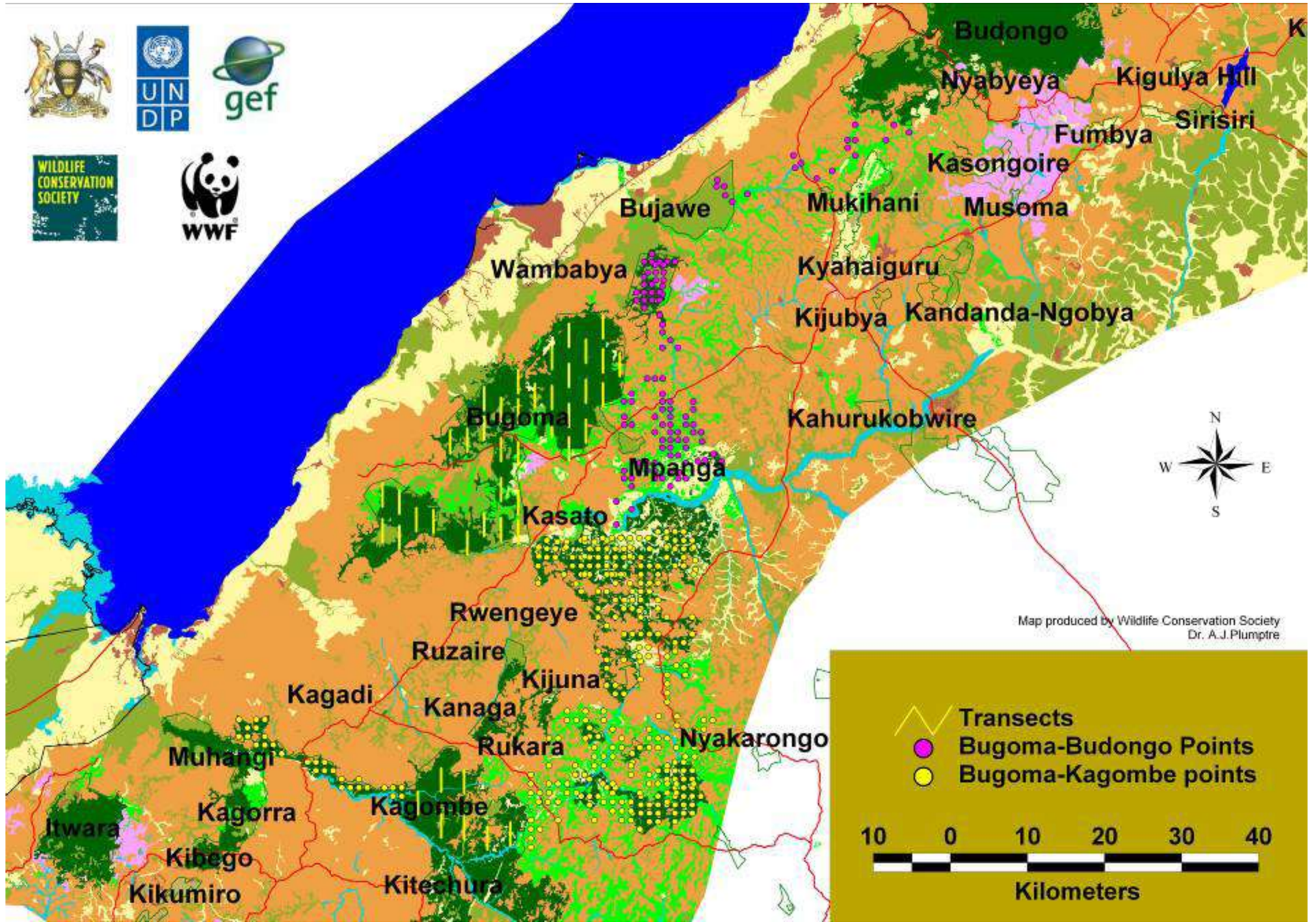
The Albertine Rift has been identified as:

Endemic Bird Area by Birdlife International

Ecoregion by the World Wildlife Fund

Biodiversity Hotspot by Conservation International.

The Albertine Rift is very high in "species richness," which means it has a very high total number of species and a large number of endemic species (species that are only found in this region of the world).


Budongo
Nyabyeya
Kigulya Hill
Sirisiri
Fumbya
Kasongoire
Mukihani
Musoma
Bujawe
Wambabya
Kyahaiguru
Kijubya
Kandanda-Ngobya
Bugoma
Kahurukobwire
Mpanga
Kasato
Rwengeye
Ruzaire
Kijuna
Kagadi
Kanaga
Rukara
Nyakarongo
Muhangi
Kagorra
Kagombe
Itwara
Kibego
Kikumiro
Kitechura
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S
Map produced by Wildlife Conservation Society
Dr. A.J.Plumptre
Transects
Bugoma-Budongo Points
Bugoma-Kagombe points
10 0 10 20 30 40
Kilometers

Program Activities 2011-2015

EcoHealth Research Group

1. Wildlife-Livestock-Human EcoHealth Research and Health Monitoring

Establishment of interdisciplinary consortium of local and international scientists to build capacity for the detection and epidemiological investigation of emerging diseases at wildlife / human interface in the Albertine biodiversity hotspots.

Capacity building at different levels

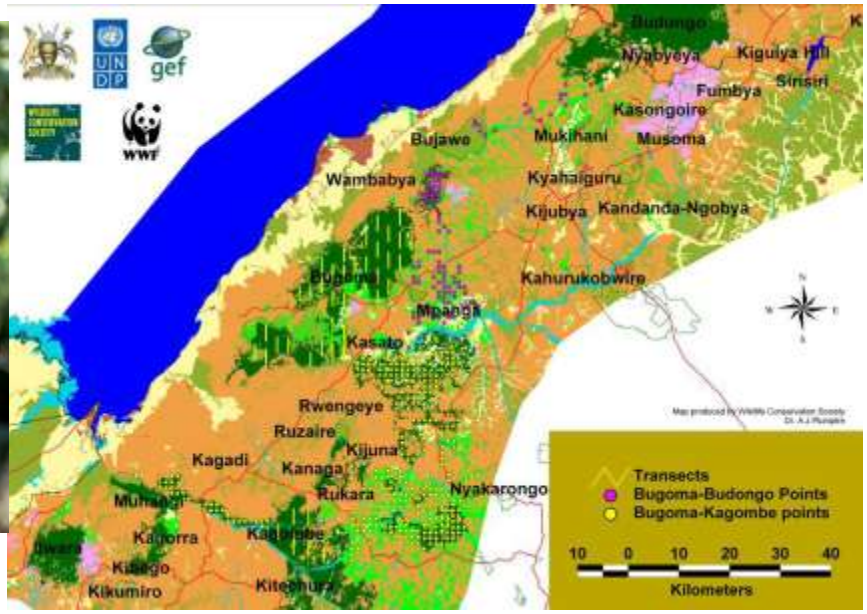
Establish research satellite centers in Hoima and Masindi for proper coordination, information sharing, sample collection and storage.

Putting One Health Concept to work

Program Activities 2011-2015

EcoHealth Research Group

2. Chimpanzee Health Monitoring and other wildlife in fragmented private forests between Budongo Forest Reserve and Bugoma Forest Reserve and other chimpanzee sites



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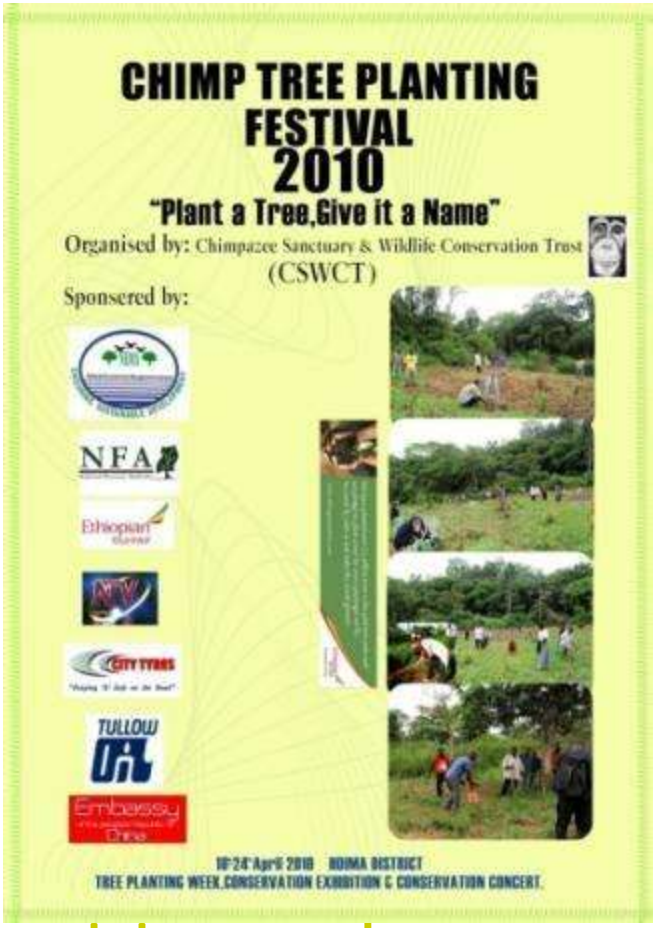
Program Activities 2011-2015

EcoHealth Research Group

3. Conservation Initiatives and Ecosystem Health Assessments



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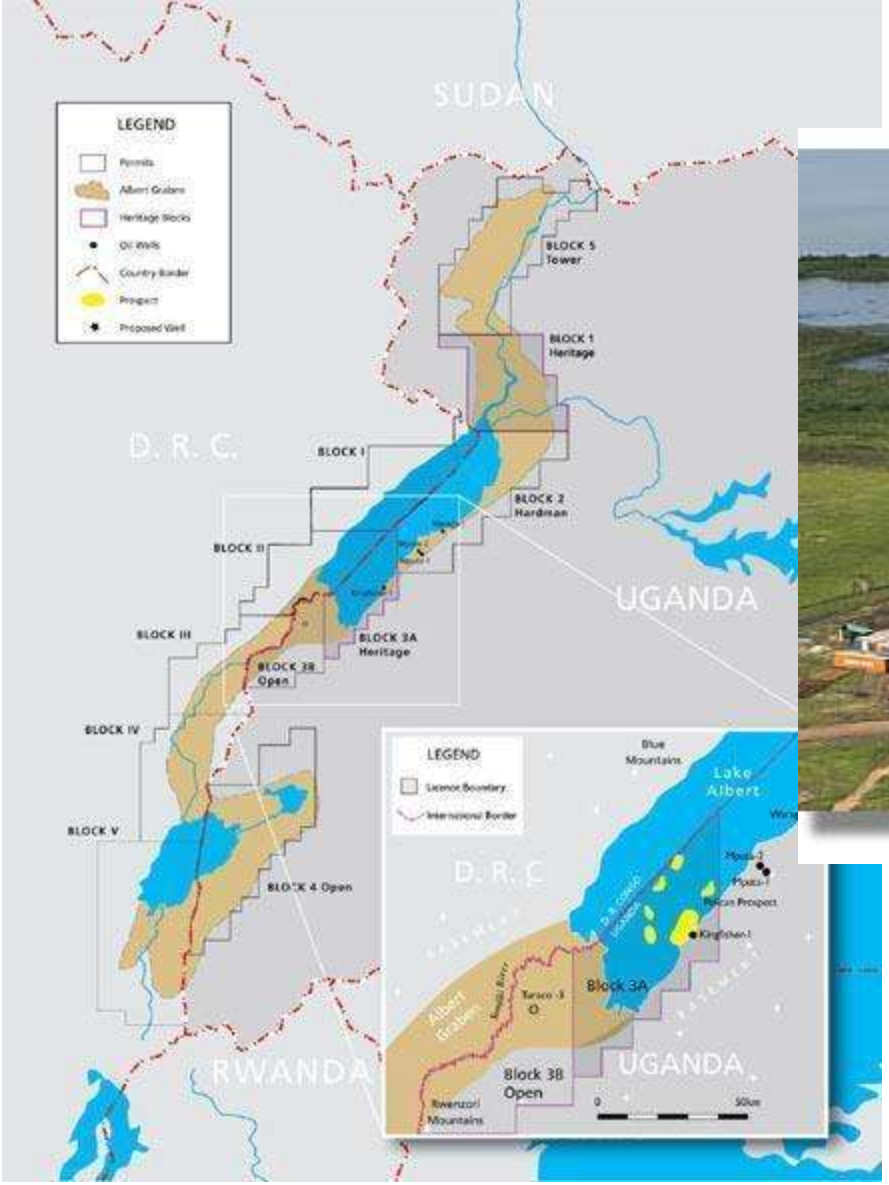
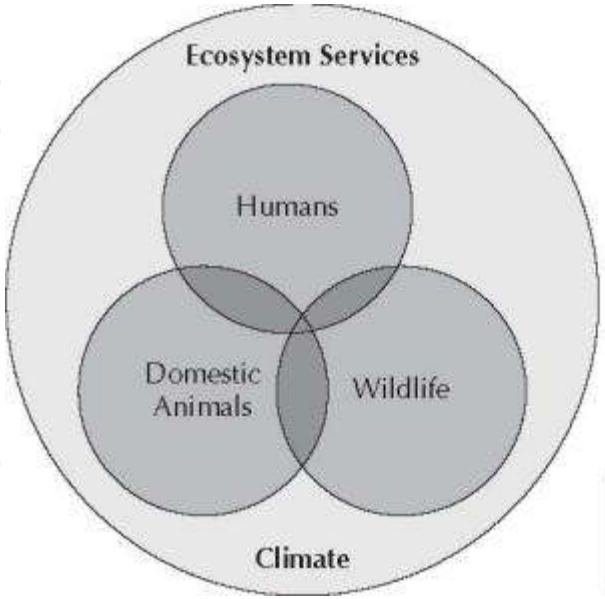


Oil production and mining impacts on ecosystem, wildlife and human health in the Albertine ecosystem.

Program Activities 2011-2015

EcoHealth Research Group

3. Conservation and Health Education Initiatives at the interface



Putting One Health Concept to work

Program Activities 2011-2015

4. Capacity Building and Research

CEHA_HDLG MOU Process

24th Nov, 2011

15th Feb, 2012

Office Handover

Putting One Health Con

Program Activities 2011-2015

EcoHealth Research Group

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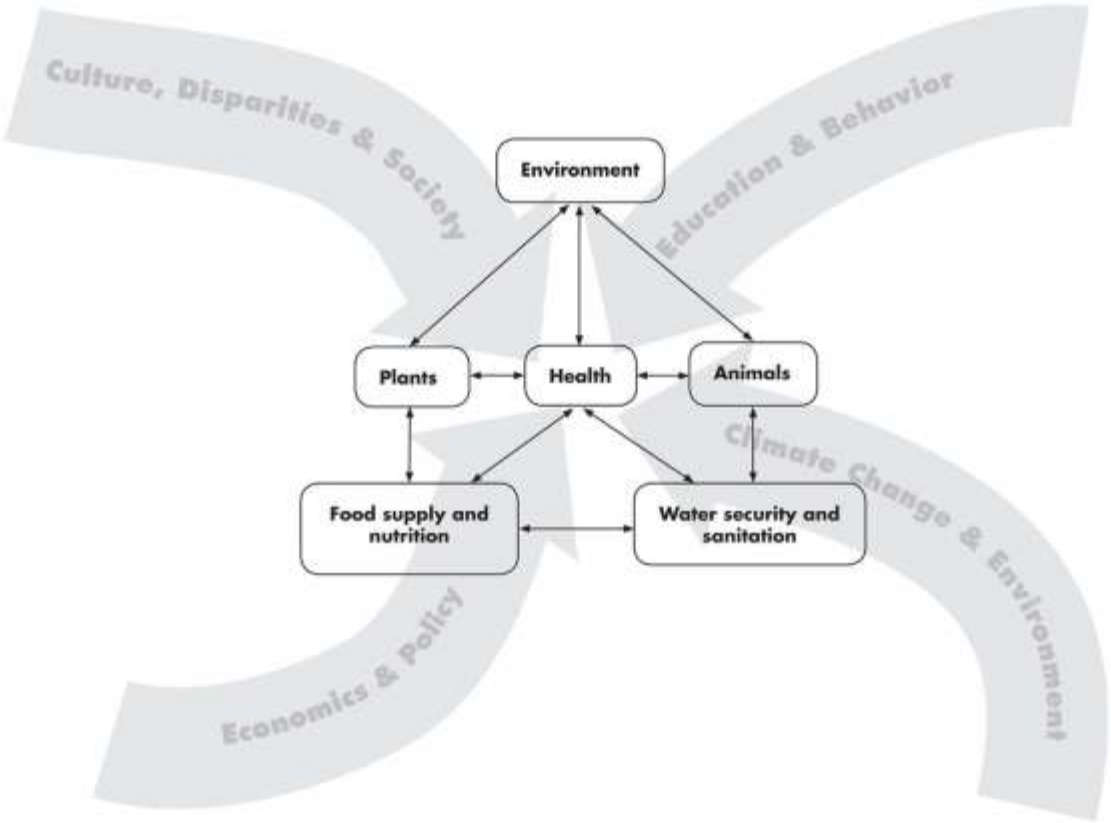
Program Activities 2011-2015

EcoHealth Research Group

CEHA's ONE HEALTH APPROACH



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Program Activities 2011-2015

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THANK YOU

Putting One Health Concept to work