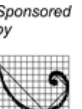
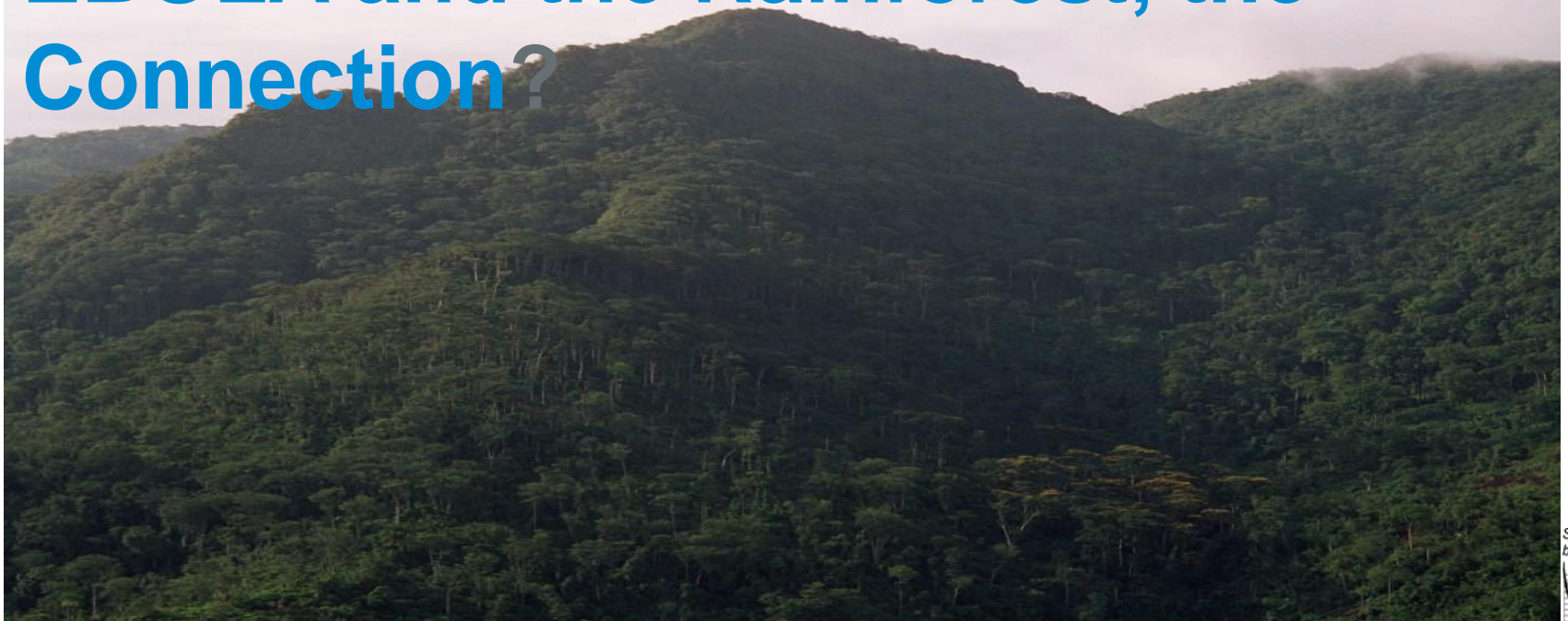




EBOLA and the Rainforest, the Connection?



Maslow's Hierarchy of Needs

How do you tell an illiterate subsistence farmer whose farming calendar is disrupted by erratic rains, that it's due to CC and they should act more responsibly?

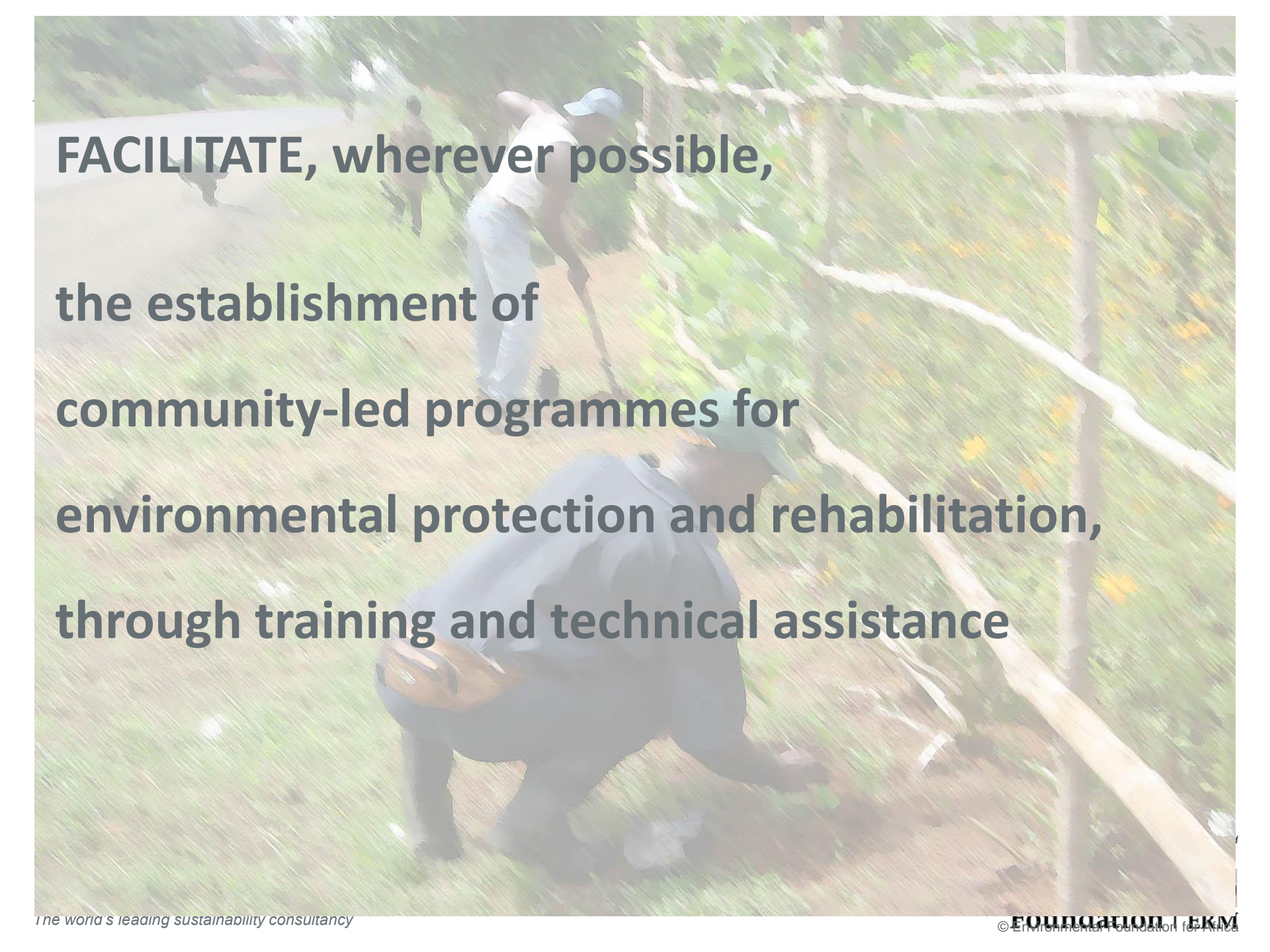


WHY EFA?

I established EFA in 1992:
to empower the local people to protect the
integrity of nature in their local environs.

Five key program areas have evolved

- Advocacy;
- Environmental Education;
- Landscape Restoration,
- Protected Area Management
- Renewable Energy



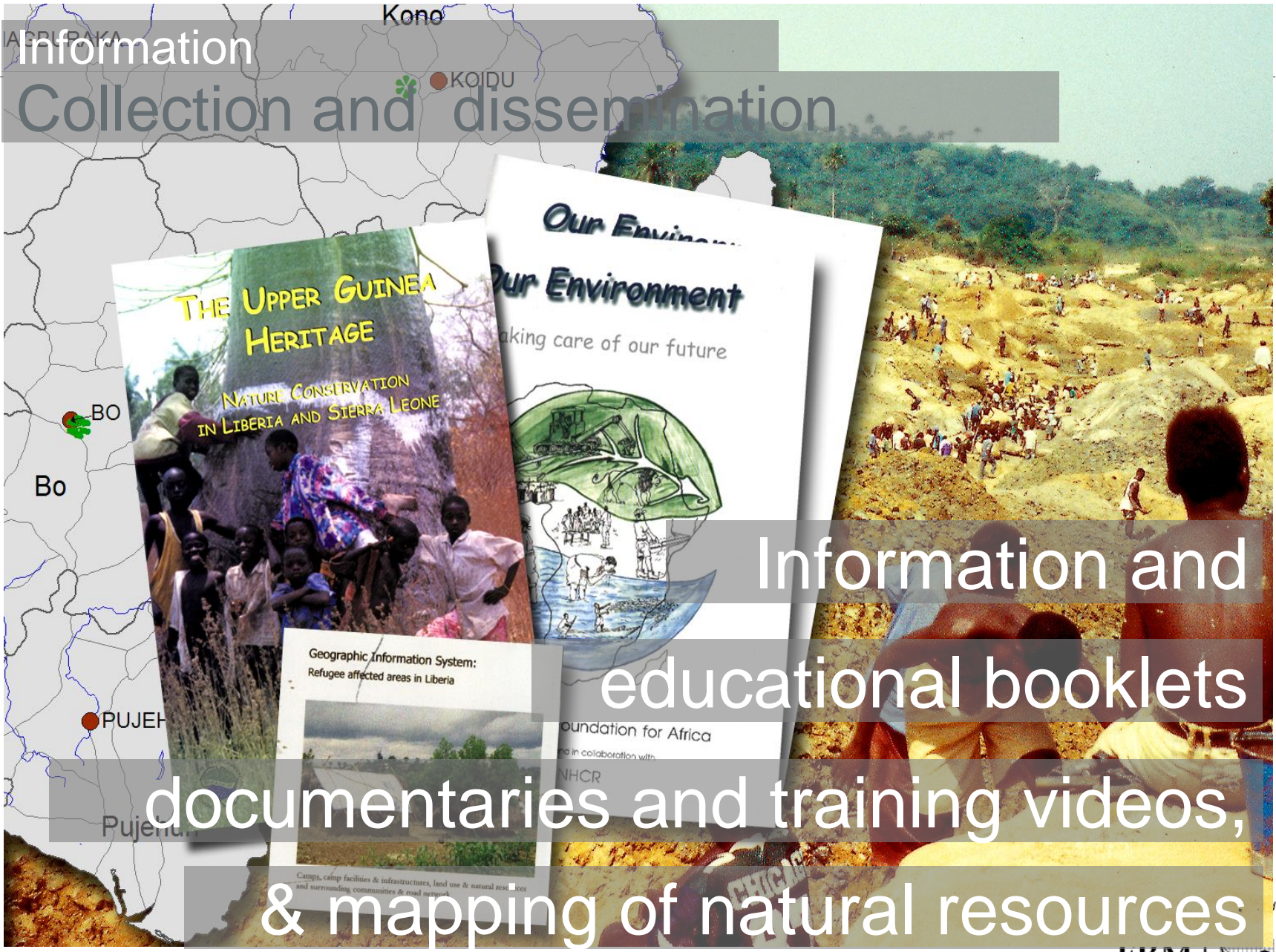
**FACILITATE, wherever possible,
the establishment of
community-led programmes for
environmental protection and rehabilitation,
through training and technical assistance**

Environmental Awareness Raising & Education





Environmental Awareness Raising, in a village



Information Collection and dissemination

Information and educational booklets documentaries and training videos, & mapping of natural resources

Renewable Energy

Installation of lighting and thermal systems in schools and clinics;

Renewable Energy training by EFA staff at

local trades institute



Goal is to bring lighting to off grid Communities and help improve quality of learning in school, and services in local clinics and highlight the benefits of clean energy.

Eco-tourism

Community mobilisation



for protection of
their local environment

Natural Resources Management & the Ebola Crisis

Is forest fragmentation one of the causal factors behind Ebola zoonosis?

A collaborative research project between the **Environmental Foundation for Africa (EFA)** and the **ERM Foundation**



- **c.10,000** people have died from the current Ebola Virus Disease (EVD) outbreak in West Africa
- ***US\$1.6 billion** forgone in economic growth in Liberia, Sierra Leone and Guinea
- **US\$1.62 billion** mobilised by the World Bank Group for Ebola **response** and recovery efforts
- The global community is preparing to **respond** better to the next epidemic...

Could anything be done to *prevent* the likelihood of future outbreaks?

*World Bank, estimated figure for 2015

If we can understand the conditions in which Ebola virus is most likely to pass into the human population, then we could act to reduce the risk of those conditions re-occurring.

Zoonosis

- **Zoonosis**: an animal infection that is transmissible to humans
- More than **60%** of emerging infectious diseases are zoonoses (e.g. SARS, HIV..)
- Zoonotic pathogens require a **reservoir host** (species that can carry the pathogen while suffering little or no effect)
- **Bats** are thought to be the reservoir host of Ebola.



Ebola virus ecology

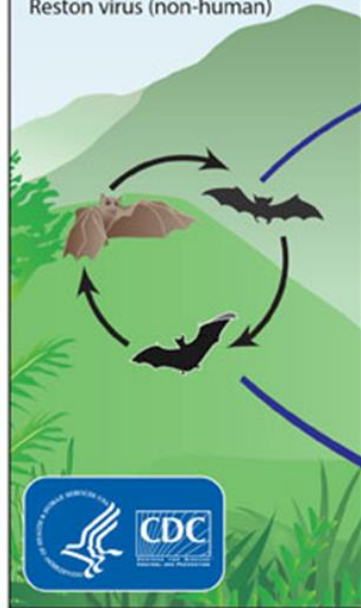
Ebolavirus Ecology

Enzootic Cycle

New evidence strongly implicates bats as the reservoir hosts for ebolaviruses, though the means of local enzootic maintenance and transmission of the virus within bat populations remain unknown.

Ebolaviruses:

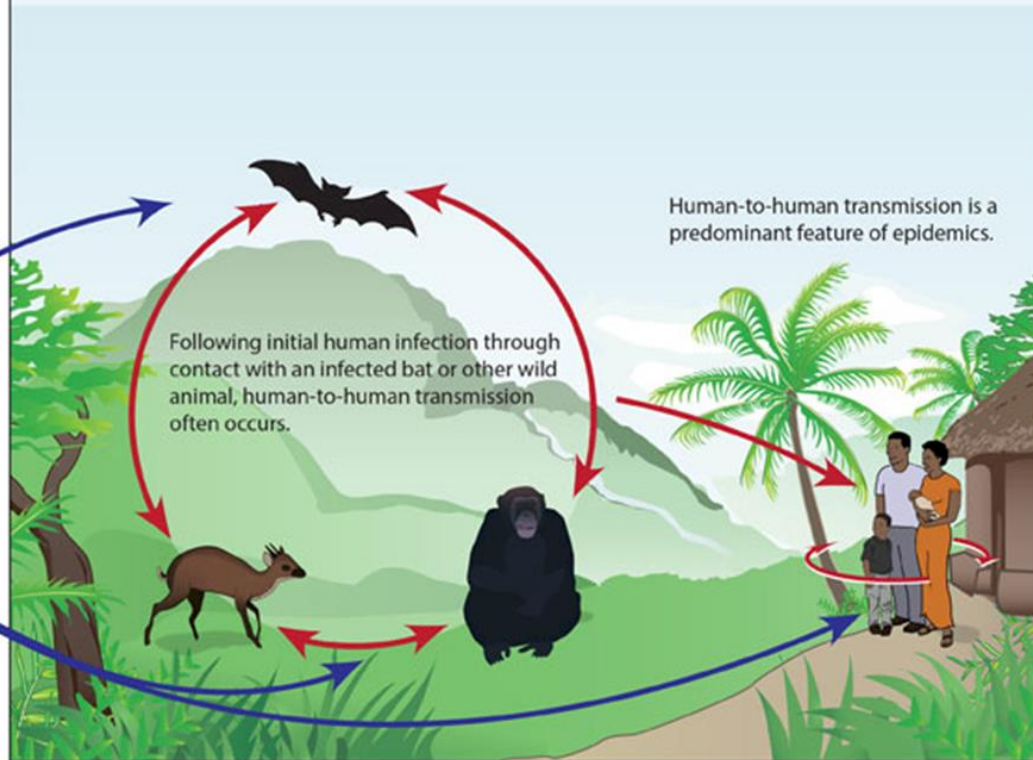
Ebola virus (formerly Zaire virus)
Sudan virus
Taï Forest virus
Bundibugyo virus
Reston virus (non-human)



Epizootic Cycle

Epizootics caused by ebolaviruses appear sporadically, producing high mortality among non-human primates and duikers and may precede human outbreaks. Epidemics caused by ebolaviruses produce acute disease among

humans, with the exception of Reston virus which does not produce detectable disease in humans. Little is known about how the virus first passes to humans, triggering waves of human-to-human transmission, and an epidemic.



Centers for Disease Control and Prevention: Ebola Virus Ecology

- We are investigating the **empirical conditions** in which Ebola virus seems most likely to transfer or **‘spillover’** from its **‘reservoir host’** into humans or other mammals, such as gorillas
- We are not looking at the subsequent human-to-human spread of the disease, which is dependent on social factors

Ebola zoonosis and forest fragmentation



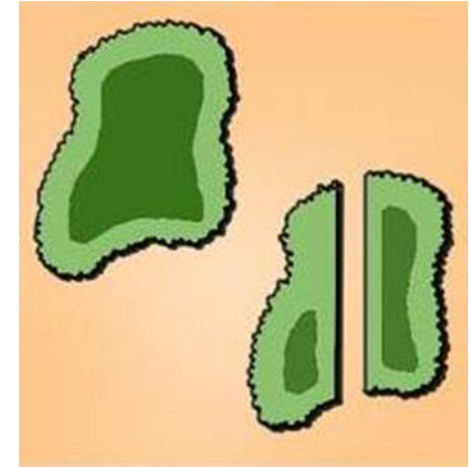
When humans disturb animal accommodation and encroach into forests, ecosystems are disrupted and this could create opportunities for pathogens to **‘spillover’** from their **‘host’** into other populations.

“It’s critical that we recognize the relationships between humans, wildlife and our environment. Disease spillover is not a malicious act of wild animals, rather an unfortunate consequence of people continuing to put pressure on ecosystems, creating increased contact with wildlife through urbanization, agricultural expansion, travel and trade. The majority of zoonotic diseases can be linked to human activities and that’s where we need to focus our efforts in order to prevent the next epidemic.”

Dr. Jonathan Epstein. Eco Health Alliance

Patient zero: 2013/14 index case: Meliandou, nr. Guéckédou, Guinea

- Heavily fragmented anthropogenic landscape of forest, agriculture, fallow and urban patches
- Forest fragmentation reduces land down to progressively smaller forest patches
- The edges of these patches are influenced by the environmental conditions adjacent to the patch and so differ from the forest interior
- Edge density between anthropogenic environment and forest patches is 10-12 times higher than in landscapes without fragmentation



The two forest patches have the same area, one fragmented and one unified. The unified area will retain higher levels of biodiversity and negative 'edge effects' will be reduced

*A possible outcome of this fragmentation is that it could create a **frontier of contact** between forest fringes and humans, increasing the risk of contact between humans and the Ebola virus.*

Landscape fragmentation in West Africa



Slash and burn



Subsistence farming



Forest fragmentation



Logging



“Shake a tree and things falls out..”

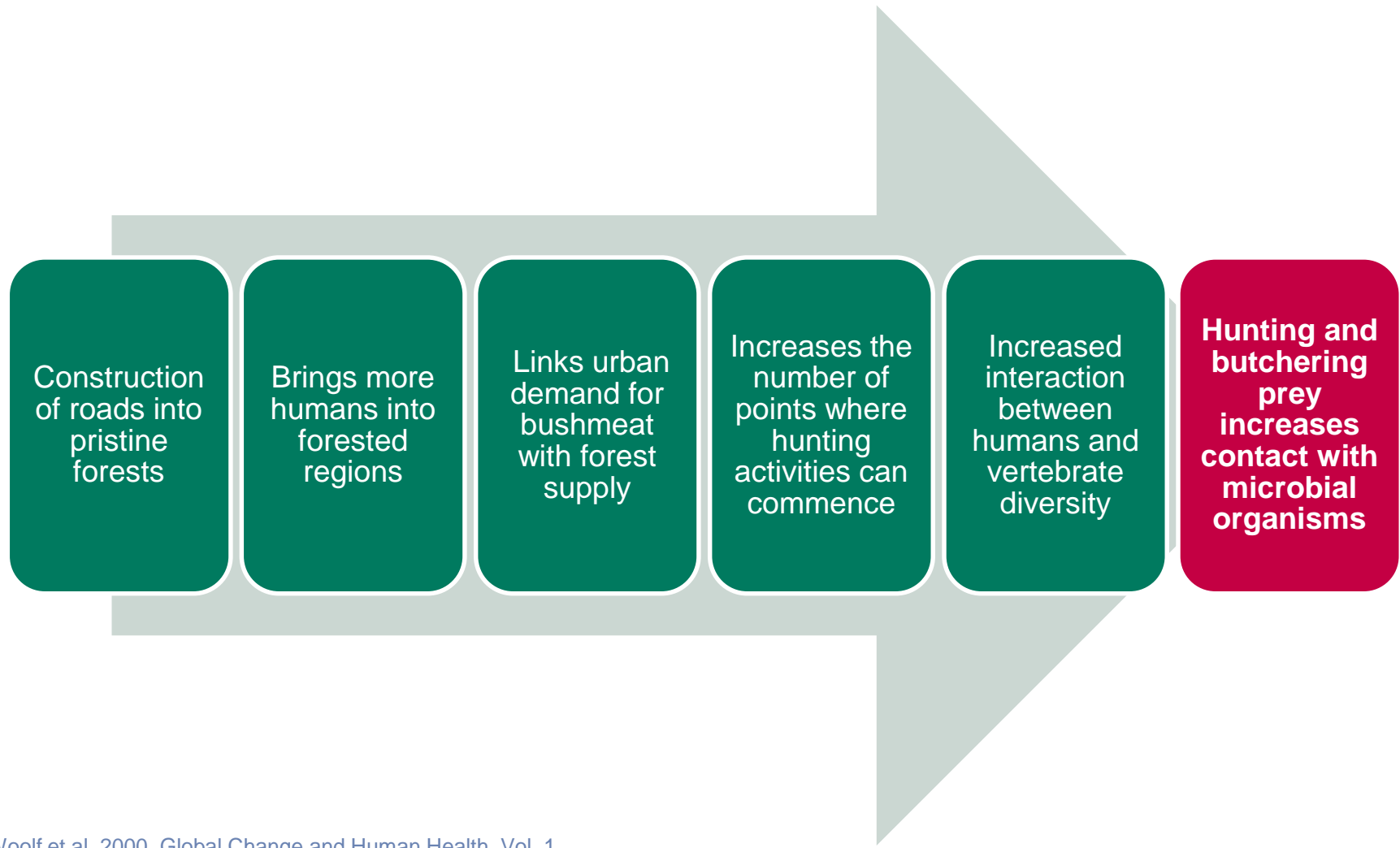
David Quammen,

author of *Spillover: Animal Infections and the Next Human Pandemic*

Landscape fragmentation could have an impact on the Ebola virus passing from 'host' to human and other animal populations, by:

- **Disarticulating people from their homes and livelihoods**
- **Altering habitat in ways that change the behaviour of Ebola-virus hosts (bats)**
 - Wild bats must adapt to rapidly changing ecologies that effect their migratory, mating and feeding behaviours
 - Larger than normal populations of wild bats migrate from across the region to attractive anthropogenic landscapes and forest patches that contain plentiful cultivated fruit, insects, trees and dense vegetation for roosting.

Deforestation & microbial emergence in Africa



Woolf et al. 2000. Global Change and Human Health, Vol. 1

Our approach



- Focus on **index cases** where initial transmission took place
- Three case studies (Guinea, Uganda, DRC)
- Map **historic trends in land use** and forest/vegetation cover in the 30 year period leading up to each outbreak
- Seeking **common patterns** or trends that could inform our understanding of the conditions in which Ebola zoonosis is most likely
- Analysis of the **research, policy and funding** landscape



Facilitate **cross-sectoral dialogue** on post-EVD recovery planning.

Historic EVD Outbreaks (1976 – 2014)



EBOLAVIRUS OUTBREAKS BY SPECIES AND SIZE, 1976 - 2014

Species

- Zaire ebolavirus
- Sudan ebolavirus
- Tai Forest ebolavirus
- Bundibugyo ebolavirus

Number of Cases

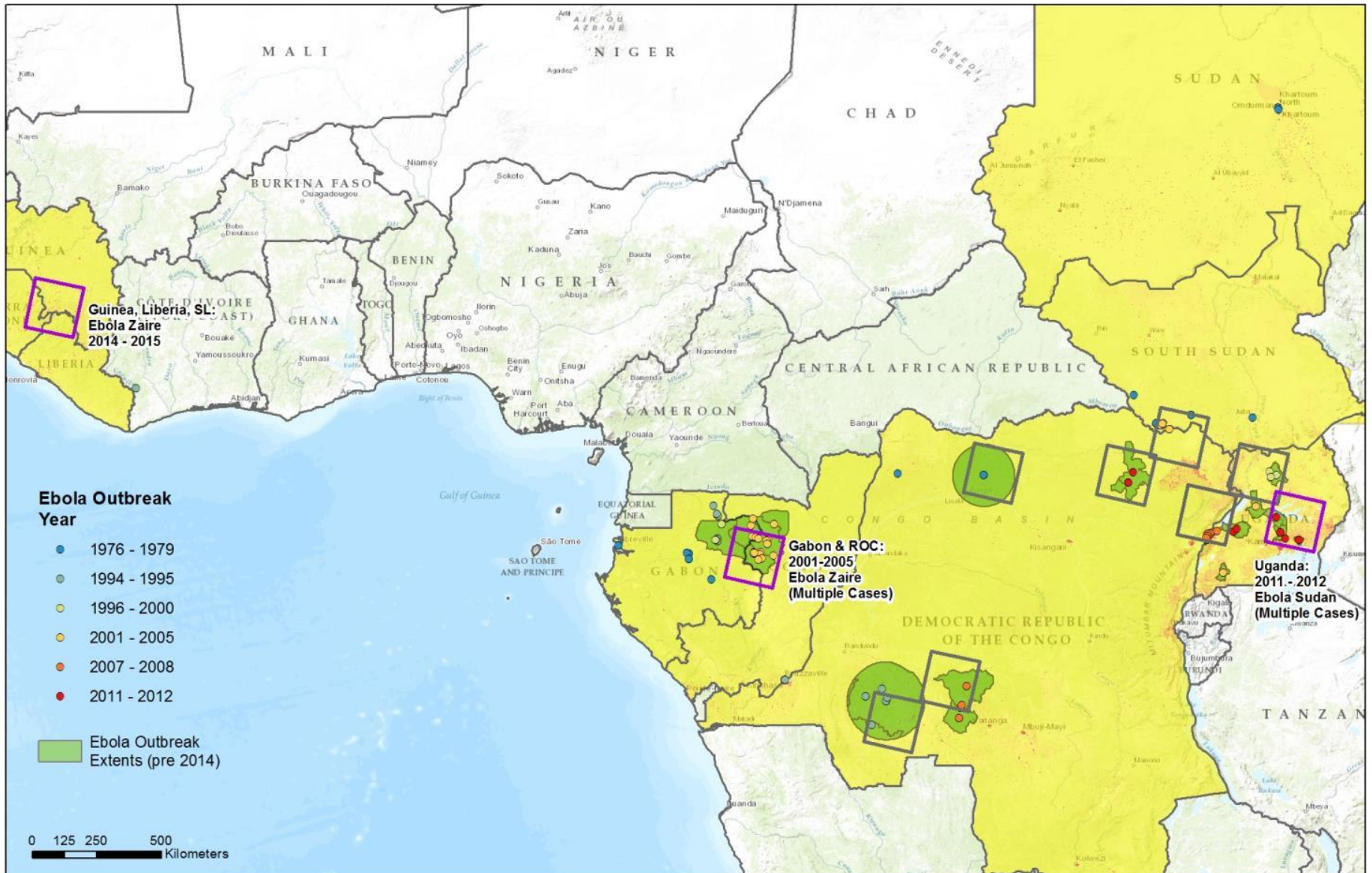
- 1 - 10
- 11 - 100
- 101 - 300
- Greater than 300 reported cases

0 240 480 960 Miles

Country	Town	Cases	Deaths	Species	Year
Dem. Rep. of Congo	multiple	66	49	Zaire ebolavirus	2014
Multiple countries	multiple	23948	9729	Zaire ebolavirus	2014
Uganda	Luwero District	6*	3*	Sudan ebolavirus	2012
Dem. Rep. of Congo	Isiro Health Zone	36*	13*	Bundibugyo ebolavirus	2012
Uganda	Kibaale District	11*	4*	Sudan ebolavirus	2012
Uganda	Luwero District	1	1	Sudan ebolavirus	2011
Dem. Rep. of Congo	Luebo	32	15	Zaire ebolavirus	2008
Uganda	Bundibugyo	149	37	Bundibugyo ebolavirus	2007
Dem. Rep. of Congo	Luebo	264	187	Zaire ebolavirus	2007
South Sudan	Yambio	17	7	Zaire ebolavirus	2004
Republic of Congo	Mbomo	35	29	Zaire ebolavirus	2003
Republic of Congo	Mbomo	143	128	Zaire ebolavirus	2002
Republic of Congo	Not specified	57	43	Zaire ebolavirus	2001
Gabon	Libreville	65	53	Zaire ebolavirus	2001
Uganda	Gulu	425	224	Sudan ebolavirus	2000
South Africa	Johannesburg	2	1	Zaire ebolavirus	1996
Gabon	Booue	60	45	Zaire ebolavirus	1996
Gabon	Mayibout	37	21	Zaire ebolavirus	1996
Dem. Rep. of Congo	Kikwit	315	250	Zaire ebolavirus	1995
Côte d'Ivoire (Ivory Coast)	Tai Forest	1	0	Tai Forest ebolavirus	1994
Gabon	Mekouka	52	31	Zaire ebolavirus	1994
South Sudan	Nzara	34	22	Sudan ebolavirus	1979
Dem. Rep. of Congo	Tandala	1	1	Zaire ebolavirus	1977
South Sudan	Nzara	284	151	Sudan ebolavirus	1976
Dem. Rep. of Congo	Yambuku	318	280	Zaire ebolavirus	1976

*Numbers reflect laboratory confirmed cases only.

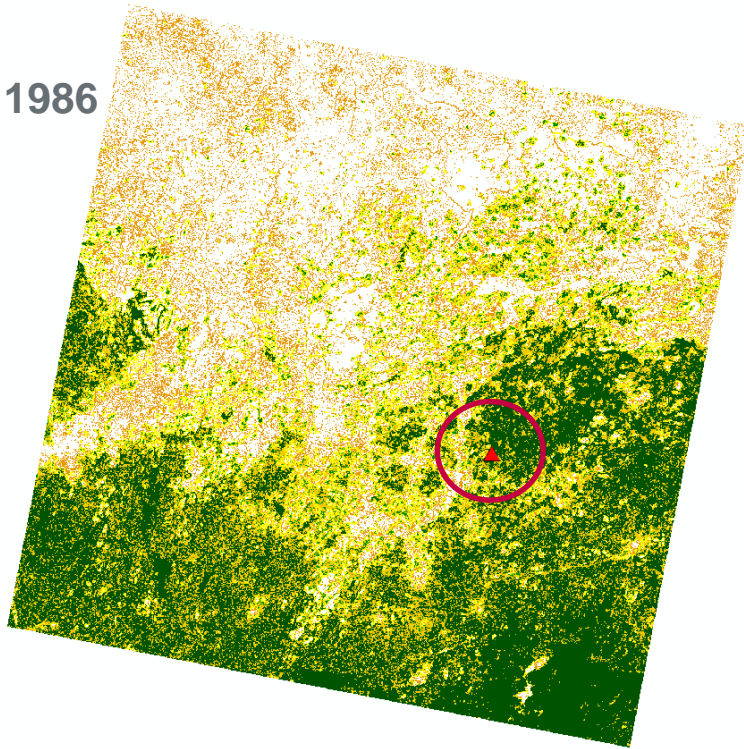
Case study locations



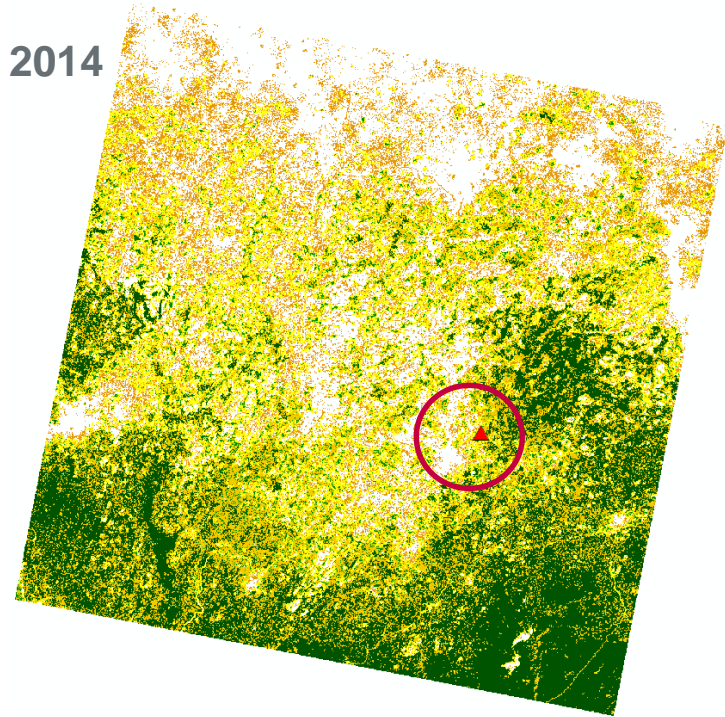
Mapping forest fragmentation (2014 outbreak)







1986



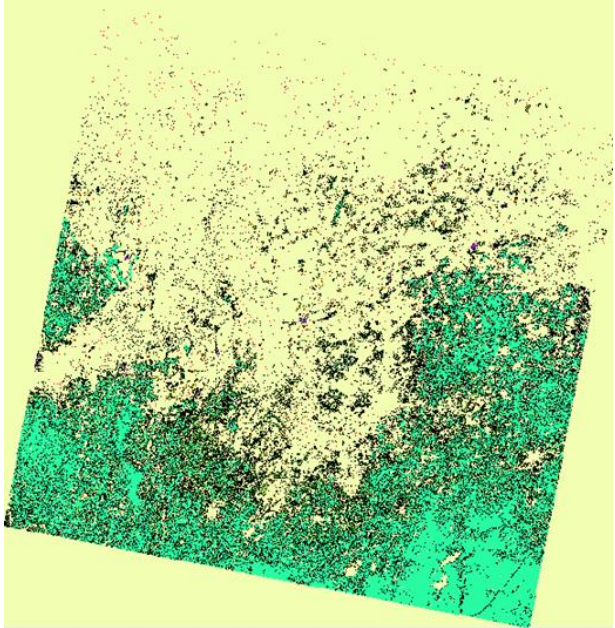
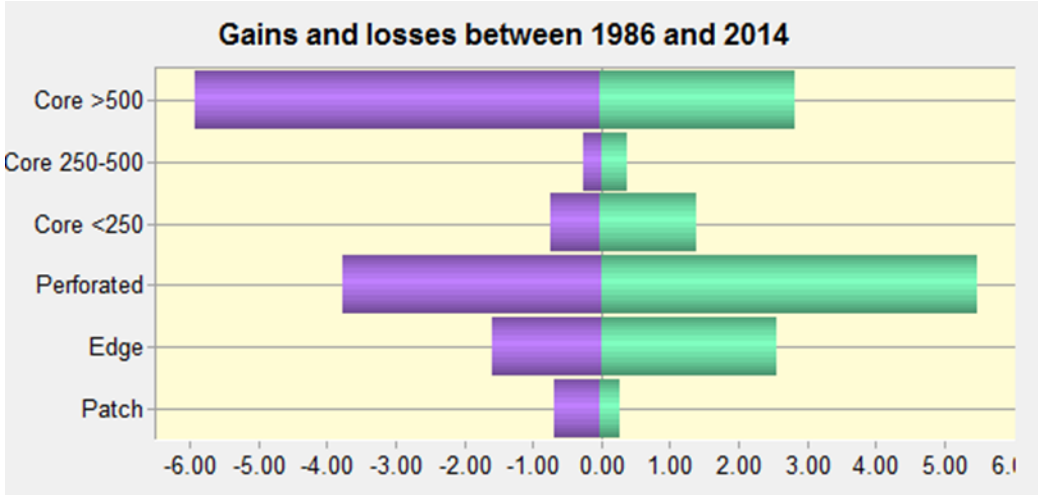
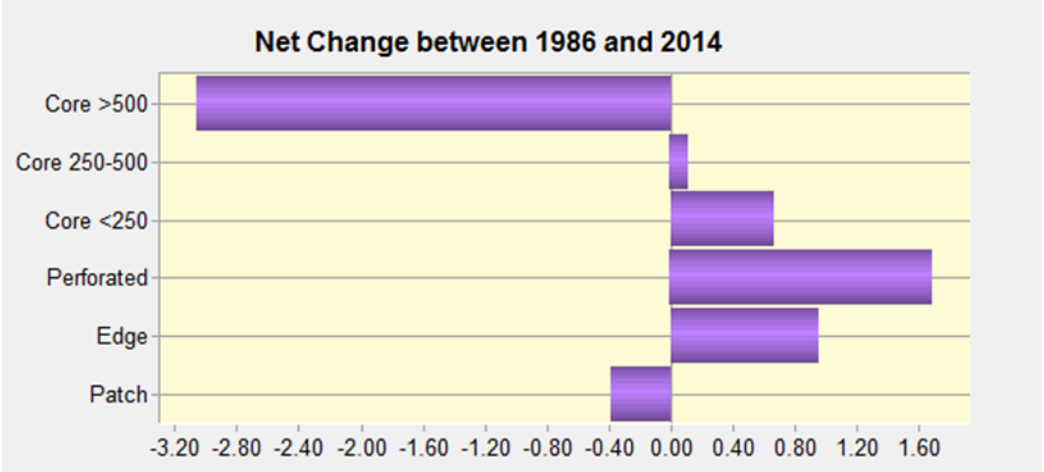
2014



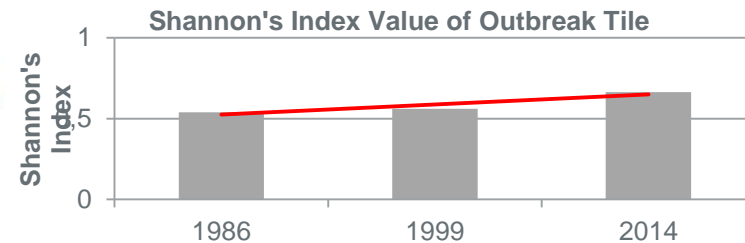
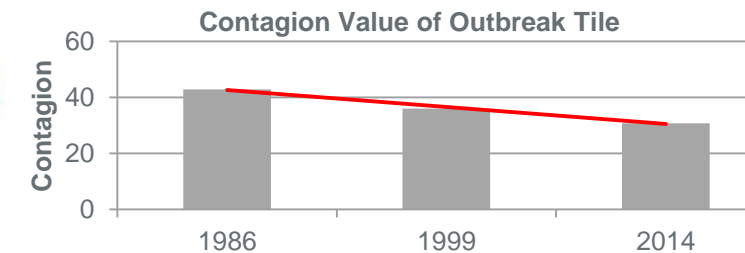
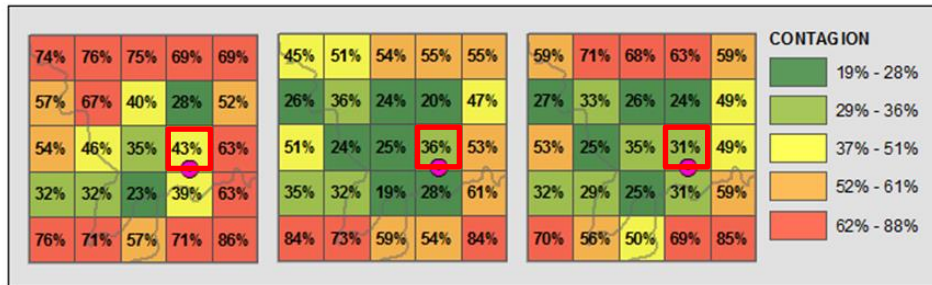
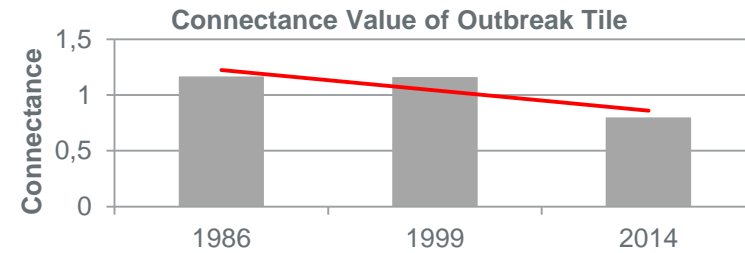
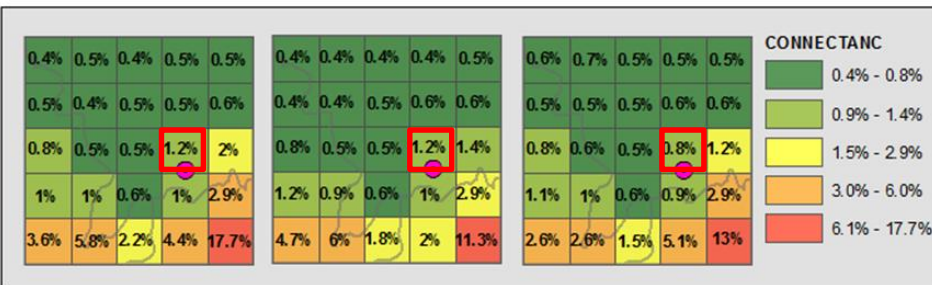
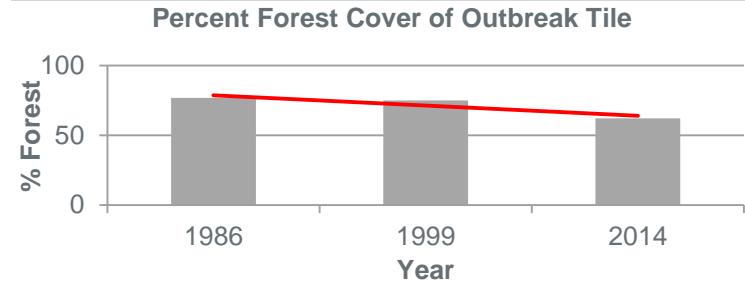
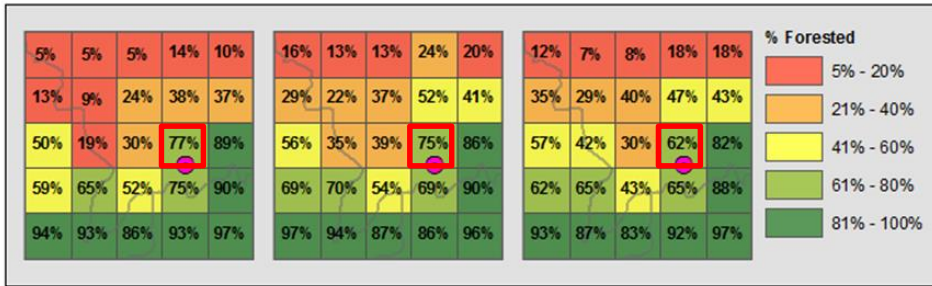
-  patch
-  edge
-  perforated
-  core (< 250 acres)
-  core (250-500 acres)
-  core (> 500 acres)

- core pixels are any forest pixels that are more than 100 meters from the nearest non forest pixel
 - small core patches have an area of less than 250 acres
 - medium core patches have an area between 250 and 500 acres
 - large core patches have an area greater than 500 acres
- patch pixels are within a small forest fragment that does not contain any core forest pixels
- perforated and edge forests are with 100 meters of non forest pixels but are part of a tract containing core pixels:
 - edge pixels are along the outside edge of the forest tract
 - perforated pixels are along the edge of small forest gaps

Rates of forest loss and fragmentation (1986-2014)



Guéckédou: trends in forest fragmentation



Is there a connection between zoonotic disease outbreaks?

Zoonotic diseases represent the unintended results of things humans are doing [1]

- Marburg (1967)
- Lassa (1969)
- **Ebola (1976)**
- HIV-1 (isolated in 1983)
- Sin Nombre (1993)
- Hendra (1994)
- Avian flu (1997)
- Nipah (1998)
- West Nile (1999)
- SARS (2003)



Goal 15

“Protect, restore and promote sustainable use of terrestrial ecosystems, sustainably manage forests, combat desertification, and halt and reverse land degradation and halt biodiversity loss”

- **15.2** ...sustainable management of all types of forests...
- **15.9** ...integrate ecosystems and biodiversity values into national and local planning...
- **15.b** mobilize significantly resources from all sources and at all levels to finance sustainable forest management, and **provide adequate incentives to developing countries to advance sustainable forest management**, including for conservation and reforestation

Country Programmable Aid (CPA) to Guinea

CPA to Guinea by sector, **2004 – 2012**
(multilateral & bilateral)



Report due: June 2015

- Plans to convene a **cross-sectoral workshop** that brings together experts in community health, rural community development, natural resources management, zoology, medical science/epidemiology and development planning
- **Objective:** to brainstorm realistic recommendations to be incorporated into EVD recovery planning.

A final thought...



*“When the current outbreak stops, ebola virus will not be gone. It will only be hiding again. It will recede into its reservoir host somewhere amid the forest and await its next **opportunity**. We live on a complicated planet, rich with organisms and vast diversity, including viruses - all interacting **opportunistically**, and although we are 7 billion of us humans, the place has not been arranged for our convenience and pleasure...”*

David Quammen,

Author of Spillover: Animal Infections and the Next Human Pandemic

Biodiversity and Renewable Energy Learning Centre



Background

The Biodiversity and Renewable Energy Learning Centre (BRELC) “the Learning Centre” is to endow Freetown with a place where its citizens and visitors to the city can learn about the **environmental challenges from across the region** in meaningful ways to various audiences:

Primary and Secondary schools,

Colleges and Universities,

Community groups,

Tourists,

NGOs

Corporate companies

and the general public.



The centre will benefit all Sierra Leoneans for generations to come.

The Learning Centre

This is *the first centre of its kind* in Sierra Leone, where visitors will be creatively inspired about the **Western Area Peninsular Forest Region (WAPFoR) ecosystem, biodiversity, renewable energy** and **sustainability**.

Will discuss and present solutions to environmental challenges with a focus on **learning by doing and experiencing**.

The local environment surrounding the Centre comprises of three unique ecosystems of outstanding beauty and conservation interest: **rainforest (10 acres of WAPFoR), mangroves,** and a **coastal strip** – Sussex beach.



Facilities at the Centre

Services available:

Guided forest walks

Exhibitions and Films (collaborating with other NGOs and companies)

Conservation Symposiums and Seminars

Workshops (incl. hosting workshops for different parties)

Conference Hall

Tree Nursery & Medicinal Plant Garden

Renewable Energy and Examples of Best Practice

Community Outreach and training

School Education Programme

Library & Resource centre

Internet Hub

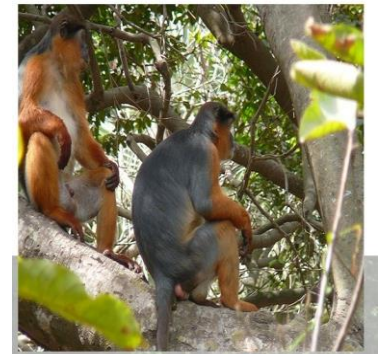
Juice bar & Cafeteria



Key themes – 1. Biodiversity & Conservation

The special theme of the permanent exhibitions will be '**Protection of the Western Area Peninsula Forest**' (WAPF) and other nature reserves, using a wide range of photographs and video material to create awareness about the current status of and threats to these reserves including sand mining, deforestation and poaching.

The centre will also showcase **environmental, economic and social issues affecting West Africa's Upper Guinean Rainforest**, stretching south from Guinea through Sierra Leone to Liberia, Ivory Coast, Ghana and western Togo including all of the region's protected areas.



Key Themes – 2. Environmental Sustainability

The Learning Centre will help facilitate the **Millennium Development Goal 7** – *To ensure environmental sustainability by 2015*, through regular workshops, exhibitions, films and symposiums available to **young people, schools, the public, local communities, GoSL Ministries, private sector, civil society, donors and implementing partners** - promoting sustainable development and management of natural resources.



Key themes – 3. Renewable Energy

*Demonstration facilities of proven renewable energy powered technology that are appropriate for the Sierra Leonean context including **solar lighting, water heating, food dryers, biogas digester and compost toilets.***





“Through educational and interactive exhibits, BRELC strives to inform, inspire and empower individuals to protect and restore the environment for the benefit of future generations.”

