

# WHO Emerging Viral infections and diseases: Focus on monkeypox

## Central African Republic Perspective

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# One health – monkeypox - CAR

## ZOOLOGY

Animal reservoir and intermediate hosts  
identification – proliferation - contacts

## ECOLOGY

Environnement, ecotopes,  
ecological changes

## VIROLOGY

Molecular field diagnostic test  
Sequencing & phylogeny  
Serological test

## ANTHROPOLOGY

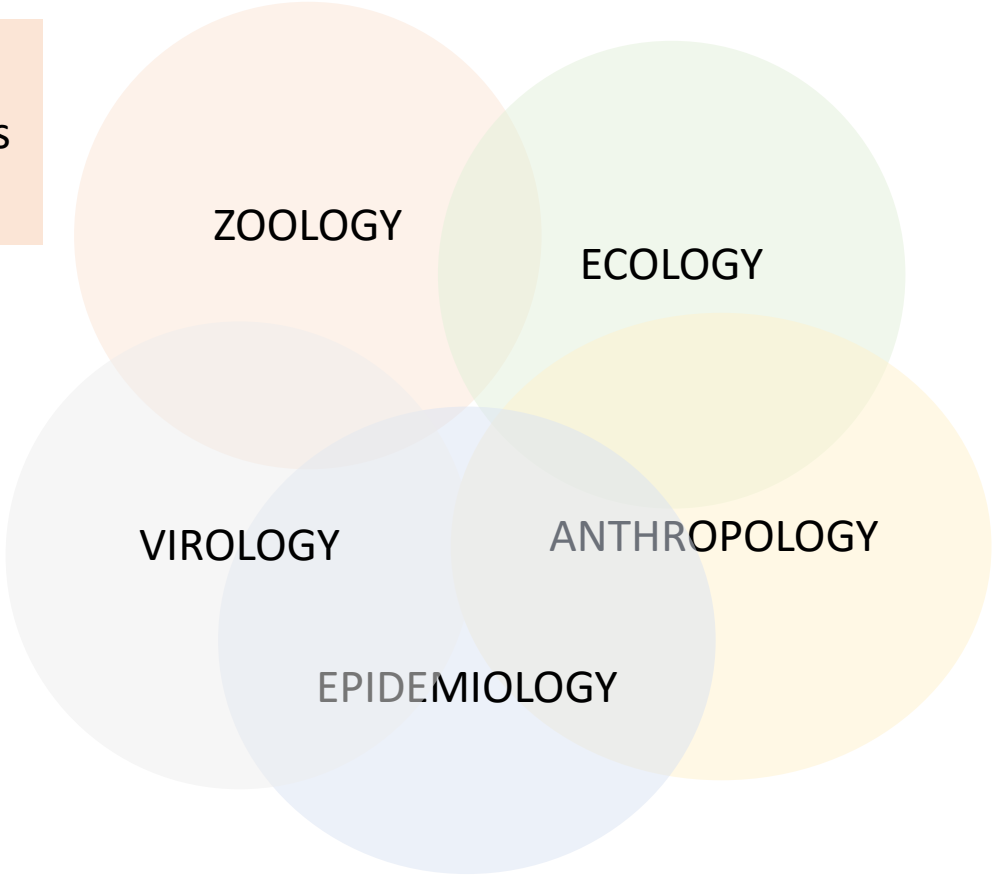
illness, changing ecologies,  
wildlife

## EPIDEMIIOLOGY

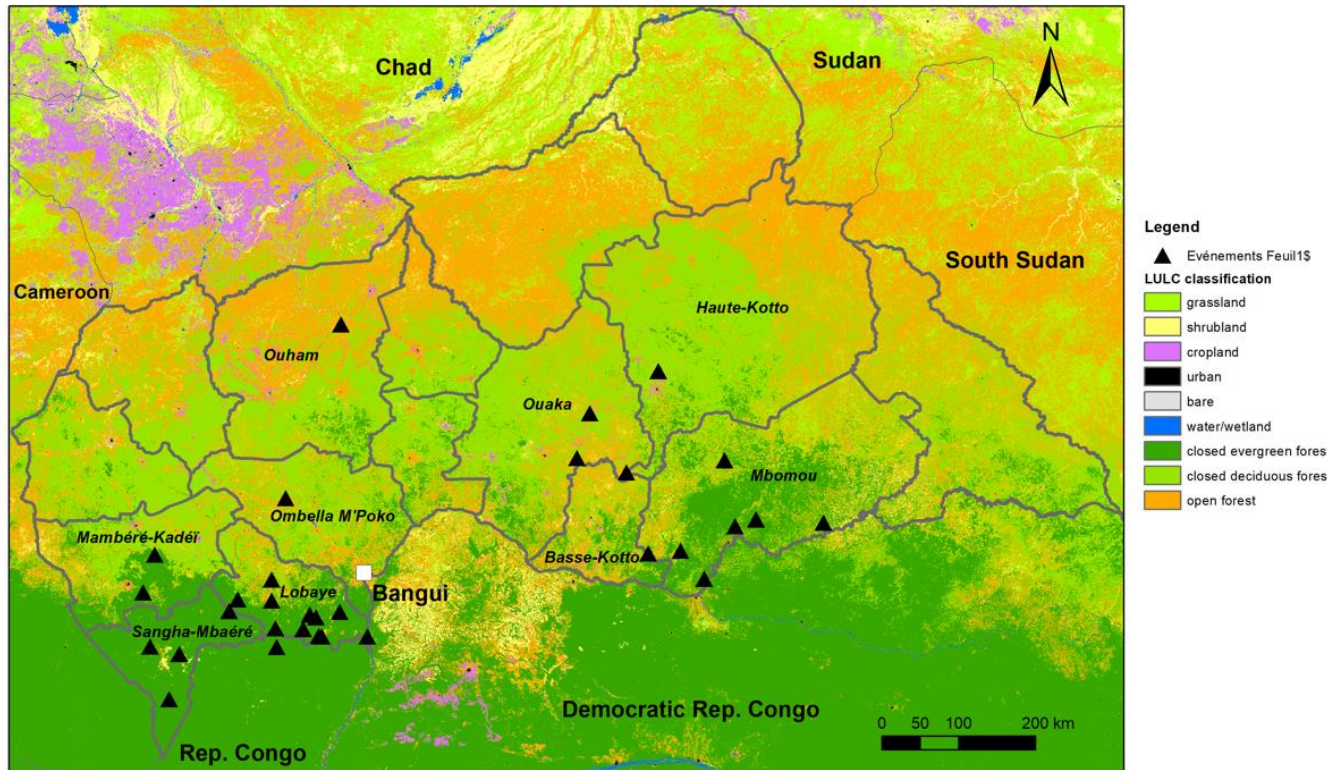
Surveillance, outbreak investigation,  
modeling, transmission, natural history

## CLINICAL RESEARCH

with University of Oxford:  
clinical trial of tecovirimat

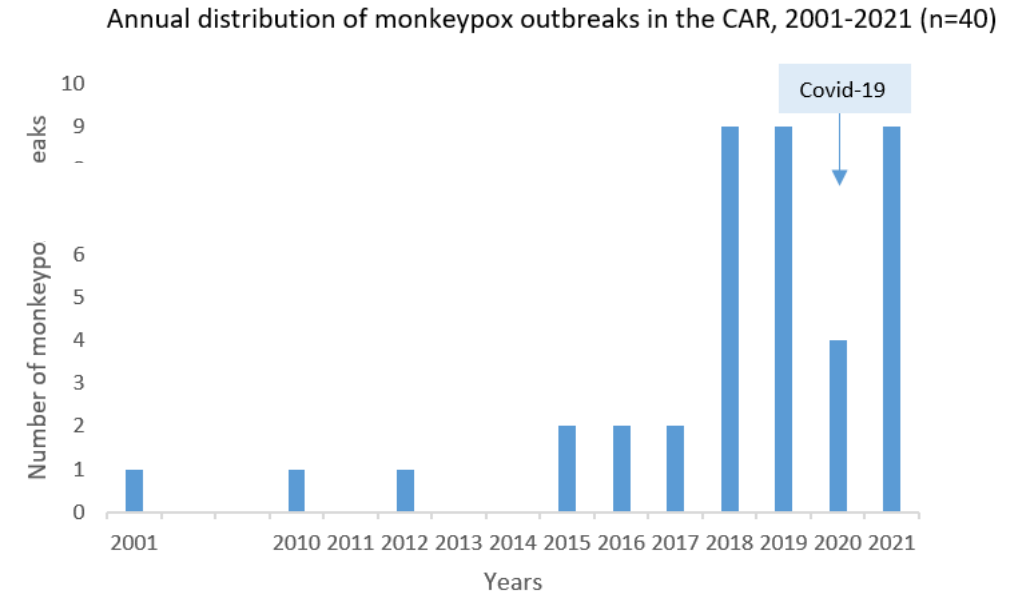


# EPIDEMIOLOGY



Landuse/Landcover data source: Copernicus 2019 Global 100m Landcover

Buchhorn, M.; Lesiv, M.; Tsendbazar, N. - E.; Herold, M.; Bertels, L.; Smets, B. Copernicus Global Land Cover Layers — Collection 2. Remote Sensing 2020, 12, Volume 108, 1044. DOI 10.3390/rs12061044



**60** outbreaks, size range: 1 to 13 (1 to 25)  
**107** confirmed cases, (204 with suspected cases)  
 Case-fatality rate: 12/160 (7.5%)

(Besombes et al, in preparation)

# VIROLOGY – diagnostic tools

## Molecular field diagnostics

-Monoplex (RT-LAMP) and multiplex (RT-LAMP QUASR) rapid tests

Integrated test cartridges (Withings) (MPX lineage, VZV)

-Detection by isothermal amplification / RPA strip technology



## Serological diagnostic tests

-Multiplex test based on a library of more than 7891 viral peptides representative of the proteome of human pathogenic OPXV (MPXV, VACV, CPXV, VARV) (PhiP-Seq)

-Multiplex assay based on a combination of a selection of 10 MPXV proteins and peptides (MMIA)

# VIROLOGY - sequencing

- Use of capture probes for long DNA fragments
- Microfluidic technology and droplet generation for targeted enrichment of droplets containing viral genome fragments
- Direct Illumina sequencing, or direct and real-time MinION sequencing on samples

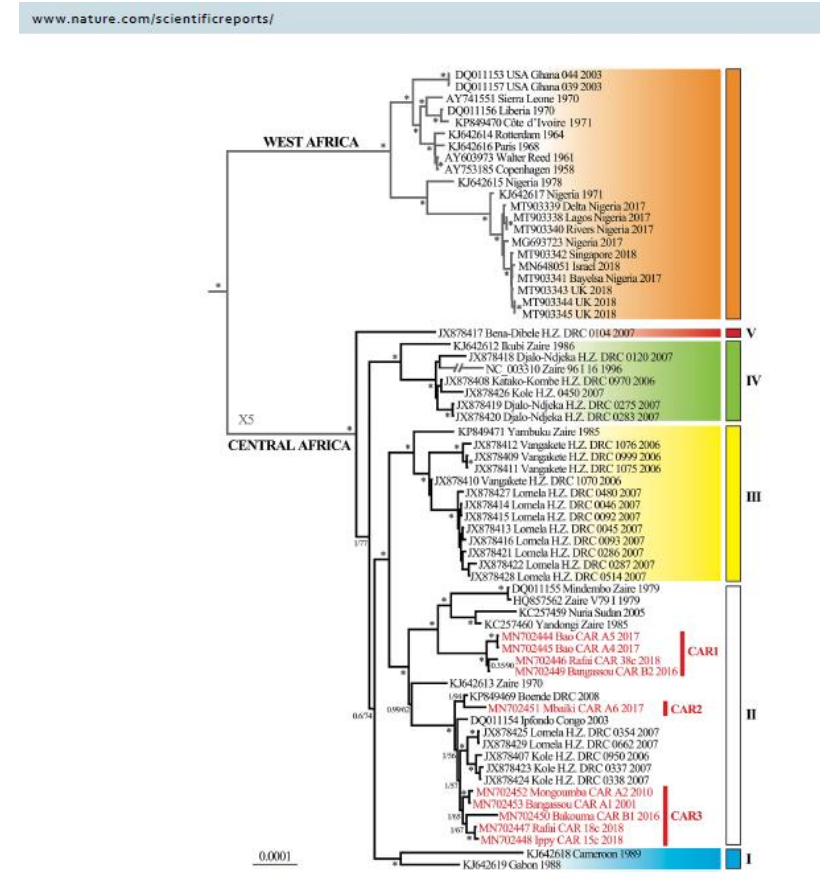
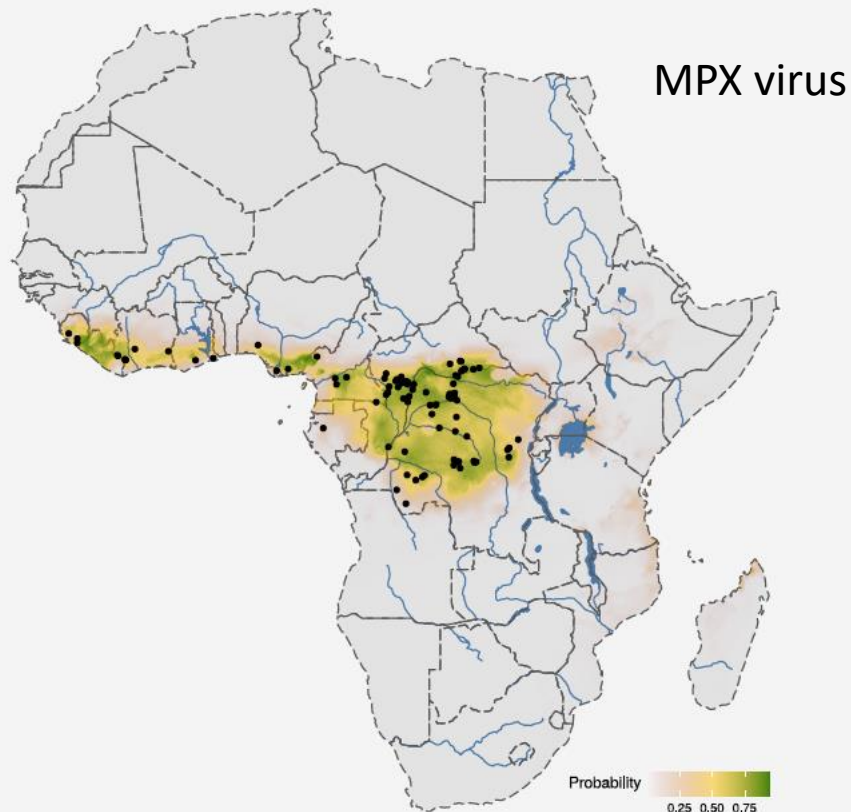


Figure 2. Phylogeny of monkeypox viruses (MPXV) based on complete genomes. The Bayesian tree was

(Berthet et al, Scientific Reports, 2021)

# ZOOLOGY – Ecological niche



Curaudeau *et al.*, in prep

Ecological Niche Modelling with MaxEnt in R

## African squirrels as a potential reservoir of Monkeypox virus

### Squirrels



*Funisciurus anerythrus*



*Funisciurus bayoni*



*Heliosciurus rufobrachium*

1. MMPXV isolated from two African squirrels
    - *Funisciurus anerythrus* (Khodakevich *et al.*, 1986)
    - *Funisciurus bayonii* (Mariën *et al.*, in review)
  2. MPXV DNA in African squirrel museum specimens (Tiee *et al.*, 2018)
    - Five species of *Funisciurus* including two new species
  3. Anti-OPXV antibodies in African squirrels (Khodakevich *et al.*, 1988)
    - *Funisciurus*
    - *Heliosciurus*
- **African squirrels are good candidates for the reservoir of Monkeypox virus**
- **Focus on African squirrels**

# ZOOLOGY – Field work



**Animal samples: 376**

2019 Toma outbreak

2021 Moloukou outbreak

2021 Grima outbreak

Rodents, duikers, squirrels,  
bats, pangolins

PCR

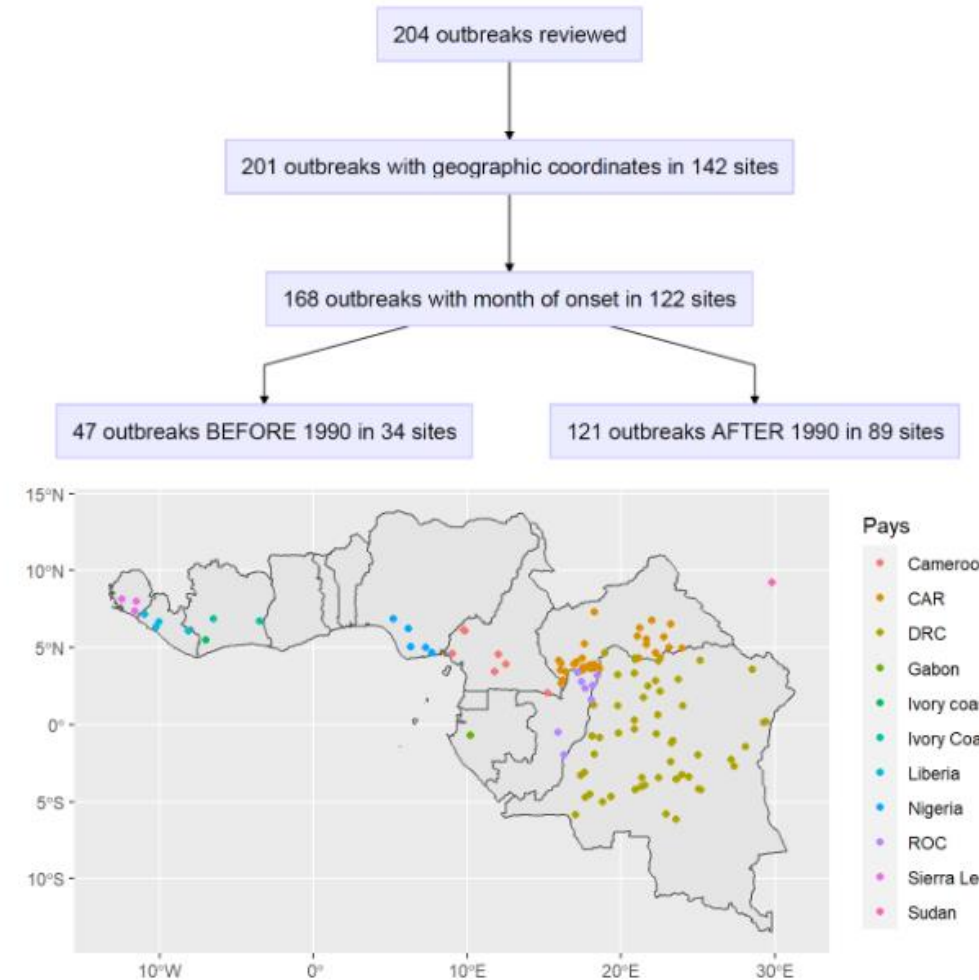
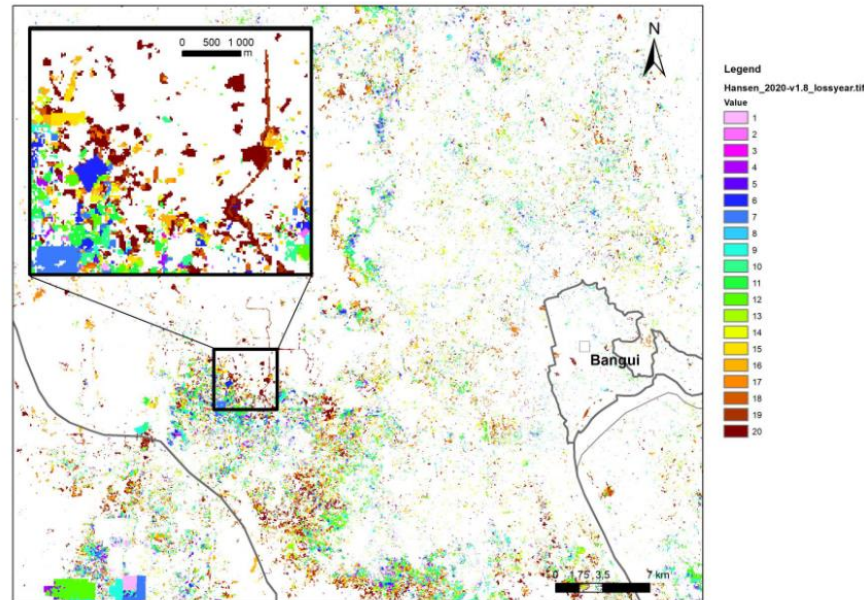
Serological assay



# ECOLOGY

Environmental atlas  
Climate profile  
Human activities

Deforestation





# ANTHROPOLOGY

- **Anthropological investigation** of monkeypox illness, diagnosis & treatment pathways, care: formal health care workers, traditional healers, former patients
- **Participatory investigation of « local epidemiologies »** (local understandings of origins, emergence, transmission)
- **Ethnohistorical** study of local ecological (forest, wildlife) & social changes implied in monkeypox emergence in the CAR since 1970
- **Ethnoecology:** local conceptions and observations of wildlife; current practices with wildlife



# OUTLOOK FOR CAR

- Validation of the response plan against the MPX endemic
- Establishment of an endemic response team
- Review and validation of the new investigation form
- Distribution of contact tracing tools
- Distribution of guidelines on MPX (case definition, how to avoid the disease etc)
- Adaptation of the WHO management protocol to the CAR context

# OUTLOOK FOR CAR

- Follow-up mission of the WHO regional office
- Training on management at the national level and in the Mbomou
- Adaptation of the therapeutic trial and vaccination protocol
- Development of awareness and community engagement tools
- Continued compassionate use of Tecovirimat<sup>®</sup>.

# Collaborators

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