# PREDICT
# REPUBLIC OF CONGO

One Health in action (2009-2020)

*Discovering unknown viral disease threats surrounding people in their daily lives*

# REPUBLIC OF THE CONGO

In the Republic of Congo, the PREDICT project began in 2009 with the general aim of reducing pandemic risk and promoting global health. Our objectives were to generate an evidence base that informs strategic investments in surveillance, detection, and response to zoonotic disease threats and to strengthen capacity of the health system to prevent and detect emerging infectious diseases. Public health capacity in the Republic of Congo (RoC) faces critical challenges, including a low density of health personnel and limited laboratory infrastructure. Human-wildlife contact interfaces are prevalent in many parts of the country, and the country has experienced outbreaks of zoonotic diseases, including an outbreak of monkeypox in 2017. However, RoC has recently made significant progress in zoonotic disease prevention and preparedness, using a One Health approach to promote improvements in public health capacity that benefit multiple sectors.

The PREDICT project put One Health in action and conducted wildlife surveillance in Ouesso within the Sangha Department, and in the Sibiti district and Zanaga districts within the Lékoumou Department. Fieldwork was conducted at high-risk human-animal interfaces such as artisanal gold mining, logging, road construction sites, and areas with ecotourism near Odzala-Kokoua National Park. As we worked to strengthen disease detection capacity in RoC, samples safely collected from wildlife were sent to the PREDICT project partner lab at the Institut National de Recherche Biomédicale/National Institute for Biomedical Research (INRB) in Kinshasa (Democratic Republic of Congo) where they were tested for priority zoonotic diseases and other emerging viral threats.

Over 10 years, our team detected 70 unique viruses (56 new viruses and 13 known viruses) in samples collected from bats, non-human primates, and rodents. Our discoveries highlight the utility of the PREDICT project's viral detection strategy and underscore the need for proactive surveillance when confronting viral threats at the human-wildlife interface.

Another major focus in RoC from 2014 onwards were social and behavioral investigations to explore the risks of viral spillover and spread in the animal value chain. Our team performed in-depth, ethnographic interviews and focus groups with more than 100 individuals, targeting Brazzaville bushmeat market vendors and surrounding restaurants. By integrating this socio-anthropological approach with the evidence from surveillance and virus findings our team helped raised awareness of the risk of zoonotic diseases in people's daily activities.

The PREDICT project raised awareness of the importance of monitoring wildlife (rodents and bats), brought together various stakeholders involved in wildlife health, and fostered the creation of a One Health inter-ministerial group dedicated to examining emerging disease threats and developing contingency plans in case of an emergency outbreak. We collaborated with the Government of RoC to build wildlife surveillance capacity and strengthened multisectoral communications, sharing knowledge and informing surveillance and risk reduction strategies relevant for both the animal and public health sectors.

## LOCAL PARTNERS

- Laboratoire National de Santé Publique
- Laboratoire de Diagnostique Vétérinqire de Brazzaville

**>60**
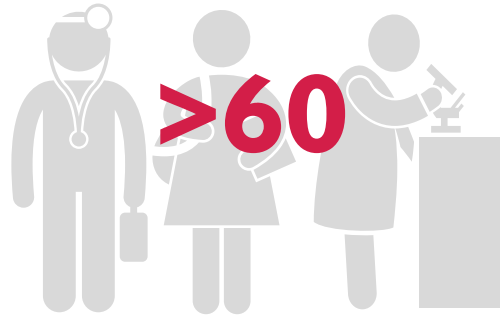
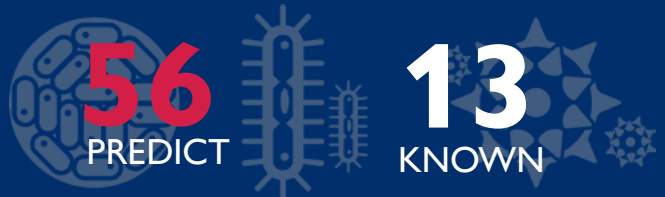**DEVELOPED** the One Health Workforce by training more than 60 people in Republic of Congo.

**>1.9K**

**OPERATIONALIZED** One Health surveillance and sampled over 1.9K animals and people, helping minimize the spillover of zoonotic disease threats from animals into human populations.

# VIRUS FINDINGS

**56** PREDICT     **13** KNOWN

**DETECTED** 69 unique viruses in both animal and human populations.

## CYNTHIA
### GOMA NKOUA

Country Coordinator
*Laboratoire National
de Santé Publique*

*"The contributions of PREDICT are incredibly valuable in terms of identifying weaknesses and strengths of the current biosafety and biosecurity procedures, sampling, zoonotic disease surveillance monitoring, reporting and mapping. This experience has confirmed my desire to improve the technical and managerial capacities of our institution."*

## HILARION
### MOUKALA NDOLO

Behavioral Risk Survey
Investigator
*Independent Consultant*

*"I was hired by PREDICT to perform ethnographic interviews, focus groups and questionnaires in the communities and bushmeat markets in Brazzaville. In these studies, we discovered there are those who don't understand the concept of protected animal species, nor that handling animal species presents multiple risks of contamination with zoonotic diseases agents. I want to find ways to better educate communities and raise awareness about wildlife conservation."*

# ACHIEVEMENTS

- Published evidence-based animal surveillance recommendations for a series of human Ebola virus outbreak investigations in Africa.
- Worked with the National Public Health laboratory (Laboratoire National de Santé Publique, LNSP) to strengthen disease detection capacity for emerging viral threats and priority zoonoses.
- Advocated for the establishment of an EPT Consortium as part of the national "One Health" platform through the establishment of an International Health Regulations Committee.

- Enhanced disease surveillance capacity and coordination among animal and public health officials to ensure communication across health sectors.
- Contributed to development of the Ebola contingency plan and operationalization of the One Health framework.

# ONE HEALTH SURVEILLANCE



From 2014 onwards, the PREDICT project in RoC sampled bats and rodents in Sibiti and the Brazzaville area, two sites with high priority human-animal interfaces for One Health surveillance. Brazzaville is the capital city and one of the major urban areas in country. In Brazzaville residents engage in small-scale agriculture, but a large portion of the local diet is derived from meat, from both domesticated animals and hunted or purchased bushmeat from local wildlife markets (either live for slaughter, fresh, or smoked). These markets were targeted for behavioral risk investigations to explore the dynamics of the markets and learn more about the potential social and biological dimensions of disease transmission. In the markets, individuals in many high-risk occupations (hunters, vendors, and consumers) are directly exposed to potential pathogens in domestic animals, live wildlife, and bushmeat.

Sibiti, located between Brazzaville and Pointe-Noire, has a population of >20,000 people and straddles the forest and plains of the Valley of the Niari. Sibiti, along with surrounding towns is a central attraction and one of the largest suppliers of bushmeat in the area for the larger cities of Dolisie, Nkayi, Pointe-Noire, and Brazzaville. Economically, agriculture, forestry, mining, and hunting are main contributors to livelihoods, though two local companies in the extractive industrial sector employ a large number of workers. We conducted surveillance in Sibiti as the close proximity of wildlife to humans, the presence of the mining and forestry industries, restaurants selling wildlife, and markets that trade fresh and smoked bushmeat present unique interfaces for viral spillover from wildlife.

# VIRUS DETECTION

From 2014 onwards, the PREDICT project's strategy for viral detection focused on screening samples using broadly reactive consensus PCR (cPCR) for five priority viral families: corona-, filo-, flavi-, and paramyxo- families, and influenza virus. Prior to 2014, we screened samples for a broader range of viral families such as adenoviruses, bunyaviruses, and herpesviruses (see Further Reading below). Positive samples detected using these assays were sequenced to identify the viruses and compare their relationship to known pathogens, and viruses were prioritized for further characterization. This approach allows for detection of both known and novel viruses and improves our understanding of the presence and diversity of viruses, as well as potential pathogens, in humans and animals.

In RoC, as we worked to strengthen disease detection capability at the National Public Health laboratory (Laboratoire National de Santé Publique, LNSP), wildlife samples collected from surveillance sites were transported to the PREDICT project's partner lab, INRB in neighboring DR Congo.

## VIRUS FINDINGS IN WILDLIFE

Two coronaviruses (1 known and 1 new coronavirus) were detected in bats from samples collected between 2014 and 2016.

A strain of the known Kenya bat coronavirus BtKY56/BtKY55 was detected in 9 bats at the Brazzaville site. This virus was detected in multiple species of bats including Peter's dwarf epauletted fruit bats (*Micropteropus pusillus*), Angolan free-tailed bats (*Mops condylurus*), and unidentified fruit bats belonging to the *Myonycteris* genus.

Additionally, a new betacoronavirus, PREDICT_CoV-30, was detected in two bats: a Franquet's Epauletted Fruit Bat (*Epomops franqueti*) and a Woermann's fruit bat (*Megaloglossus woermanni*) at the Zanaga district site. While Betacoronaviruses include viruses of public health significance, such as SARS and MERS, currently, there is no evidence to suggest that this virus poses a threat to human health.

# VIRUS TABLE (2014-2019)

| VIRAL FAMILY | VIRUS | SPECIES | SAMPLING LOCATION | TOTAL POSITIVE INDIVIDUALS |
|---|---|---|---|---|
| Coronavirus | PREDICT_CoV-30 | Franquet's Epauletted Fruit Bat, Woermann's Fruit Bat | Zanaga district | 2 |
| | Kenya bat coronavirus/ BtKY56/BtKY55 | Angolan Free-Tailed Bat, Peter's Dwarf Epauletted Fruit Bat, Unidentified Myonycteris Fruit Bat | Brazzaville | 9 |
| **Total** | | | | **11** |

# INVESTIGATING BEHAVIORAL RISKS IN BUSHMEAT MARKETS AND THE WILDLIFE VALUE CHAIN

The PREDICT project's behavioral risk team had the unique opportunity to investigate social and behavioral dynamics in a large bushmeat market. Working in 12 sites throughout Brazzaville and the Pool, our team used in-depth one-on-one interviews and focus group discussions to engage with the diverse actors in the value chain: hunters, suppliers and middlemen, vendors, consumers, and employees of adjacent shops and businesses.

## UNDERSTANDING THE BAT-HUMAN INTERFACE

Two coronaviruses (1 known and 1 new coronavirus) were detected in bats from samples collected between 2014 and 2016. While these semi-structured investigations covered a wide range of wildlife taxa involved in the bushmeat trade, the team was particularly interested in learning about the ways in which bats were handled and consumed, and how bushmeat contributed to individuals' livelihoods. The interviews, along with our team's observations, made it clear that bats were a visible staple in the marketplace. Bats were described as being available for purchase either freshly killed and ready to be butchered at home, or alive and available to be slaughtered on demand in the market. Smoked bushmeat was also a recurring preference. According to respondents who reported slaughtering bats (putting them into direct

contact with the viscera), bats were seen as having little that could not be consumed. In addition, when asked about Ebolaviruses and the risks associated with bat consumption, an adult female shop owner shared her perception, "since we saw nobody die of it, we keep eating them." Other respondents shared that though they did not sell nor eat bats, this did not necessarily mean that they did not handle the animals, as they would handle the animals during the course of preparing meals for other household members.

Hunters also spoke at length about the techniques they used to capture the animals. A commonly described method was using nets in trees to live capture bats – a method that necessitated precaution around sharp teeth and claws. Several respondents described having been bitten or knowing others who had been bitten by bats. Bat teeth were seen as particularly nasty, as illustrated by the following comments.

> *When the bat really bites you, it is hard to remove it because its teeth are like claws. It can stay there even up to an hour.*

MALE BUSHMEAT HUNTER

MALE BUSHMEAT CONSUMER

> *You have to be very careful because they have sharp teeth, you have to know the techniques otherwise you can lose your fingers. I often when I buy, I ask the seller to kill it if it's still alive.*

## CONTRIBUTIONS TO LIVELIHOODS & FOOD SECURITY

Income generated from bat sales varied based on the size of the animal and ranged from 500 to 1,500 francs (~$0.25-0.75 USD). Bat hunting, particularly during mango season, could yield substantial income for a family, and working with bats was perceived as the only way to make ends meet for some households. For example, in the words of one respondent:

> *I just wanted to point out that really hunting bats is something that helps us a lot and with this hunt we provide for our families.*

ADULT MALE TRAPPER

Other respondents highlighted the importance of bats to household food security and nutrition describing the purchase, slaughter, and preparing of bat meat.

> *Well we buy [them] at the market. The prices of bats vary according to their sizes. They are often in the cages. When we buy them, we come back with them home.*

FEMALE BUSHMEAT CONSUMER

MALE BUSHMEAT CONSUMER

> *Yes, I kill them myself. […] The bat's skin is hard, so it takes a lot of time to [cook]. When it is cooked, I can now put the sauce, or I only make a simple broth.*

# COMMUNITY ENGAGEMENT & RISK COMMUNICATION

When the PREDICT project's risk reduction and behavioral change communication resource *Living Safely with Bats* was translated into French "Vivre en toute sécurite avec les chauves-souris", the team in RoC adapted the resource as an easy-to-carry, small format tool to use in the field. Outreach events were organized in the four Brazzaville markets where the PREDICT behavioral work was carried out by our behavior risk team. Street vendors of bats, bushmeat vendors, and heads of each market were provided with the bat book and were engaged in a dialogue balancing health and conservation goals to raise awareness about the risks of disease transmission, along with the benefits of bats to our ecosystems.



Vivre en en toute sécurité avec les chauves-souris

# CAPACITY STRENGTHENING

## ESTABLISHING NATIONAL ONE HEALTH PLATFORMS

Through the PREDICT project our team pioneered advocacy and promotion of One Health in RoC. We helped to successfully establish a multisectoral One Health consortium involving: Ministry of Defense Ministry of Agriculture, Ministry of Forestry and Wildlife, Ministry of Environment, Ministry of Scientific Research, Ministry of Finance, Homeland Ministry, World Health Organization (WHO), and the Food and Agriculture Organization of the United Nations (FAO). Our team worked the Ministry of Health and WHO to establish the consortium and to operationalize One Health at the national level through the establishment of an International Health Regulations committee, which in RoC acts both as a One Health consortium as well as an intersectoral/multisectoral committee for preparedness and response to disease outbreaks. The body is chaired by the Director General of Epidemiology and Disease Control and Response (DGELM) and is one of the major success stories of the PREDICT project's investment. Under this multi-sectoral framework the PREDICT RoC team supported the investigation of the Monkeypox outbreak in the North zone of the country in 2017, effectively moving One Health from policy to action for disease surveillance and control.

## STRENGTHENING THE NATIONAL LABORATORY SYSTEM

At the national public health laboratory (LNSP), the PREDICT project invested in laboratory infrastructure with support from the NIH. Equipment and supplies were procured in

2017, and the PREDICT team supported staff at LNSP to oversee quality control of the equipment and implement disease detection protocols. Funds were allocated to outfit the laboratory with a sustainable power system provided by Africa Solaire, which facilitated operation of all essential lab equipment and ensured maintenance of cold chain for safe sample storage.

In addition, the PREDICT project provided unique opportunities for One Health training and collaboration, and engaged ministry staff, as well as staff from the national laboratory system, LNSP and the national veterinary diagnostic laboratory (Laboratoire de Diagnostic Vétérinaire de Brazzaville, LDVB) in capacity strengthening efforts. The PREDICT project offered one of the most comprehensive training opportunities in disease detection. Staff in the national laboratory system were trained to meet the needs of the Ministries of Health, Agriculture and Forestry and to support the efforts of the Ministry of Defense. These efforts greatly increased the country's capacity for surveillance, diagnostics, and biosafety. Improvements in training and laboratory facilities were put to test during the chikungunya outbreak in 2019, demonstrating the benefits of a prepared workforce and well-equipped laboratory for detection and response to health emergencies. There is continued interest from the Ministry of Agriculture for training staff and analyzing samples and fostering collaboration across sectors. In addition, the laboratory conducts tests to investigate wildlife mortalities, which are now recognized as a possible public health threat in the country, given earlier discoveries that ape deaths can precede human cases of Ebola virus, and that sustained investments in wildlife surveillance can provide "early warning" for triggering potential public health interventions.

# PRACTICAL IMPLICATIONS

- The history of zoonotic disease outbreaks with wildlife origins in RoC and the diversity of virus findings identified in rodents, bats and non-human primates over 10 years of the PREDICT project in this country highlight the continued need for vigilance in wildlife surveillance for emerging viral threats.

- PREDICT project investment at LNSP empowered the national laboratory system for success in detection and response to disease threats; these investments in facilities and human resources are critical to sustain for achieving national health security.

- PREDICT project personnel along with LNSP staff and other stakeholders were engaged in several outbreak preparedness, risk communication, and disease investigation collaborations.  Multisectoral partnerships that move One Health from policy to action are crucial addressing outbreaks at their source before they turn into epidemics.

- In depth, behavioral risk investigations were conducted in multiple bushmeat markets and restaurants in Brazzaville. These markets constitute an important animal value chain and disease risk interface, and our data provide clear insights into the complexities of the bushmeat trade and health risks layered with the importance of bushmeat to livelihoods and food security. These insights are invaluable for informing interventions designed to reduce spillover risk while simultaneously respecting livelihoods, cultural norms and wildlife conservation objectives.

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