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Factors of rabies maintenance in dog population in Kinshasa, Democratic Republic of Congo (DRC)

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Purpose: Rabies kills every year 61 000 humans in the world, mainly in Asia and Africa. In the Democratic Republic of Congo (DRC), rabies is endemic and the dog is the main vector of human rabies. From 1937 to 2017, around 1400 positive dog rabies cases were recorded across the country. The study aims to better understand the epidemiological factors of rabies maintenance in dogs in Kinshasa.

Methods & Materials: We conducted 4 studies. (i) A household survey in 22 study sites in 3 municipalities of Kinshasa suburb (Mont-Ngafula, Ngaliema and Lemba). It provided information about the dog density, roaming and vaccination coverage. Based on these factors, a risk scale of rabies transmission was established. (ii) Owned dogs ($n = 16$) were tracked during 24 hours using GPS collars. The probability of contact with other dogs was calculated. (iii) The proportion of feral dogs was estimated by the street count method. (iv) Finally, the serological status of dogs that were reported vaccinated was checked. Generalized linear models were used for statistical analysis.

Results: We recorded 922 dogs in 504 surveyed households. 60% (2–100%) of these dogs were free roaming. Feral dogs were estimated to be less than 2% of the free roaming dogs. Dog density was estimated to be 47 dogs/km². The mean distance covered by tracked dogs was 0.718 km (0.046–2.341 km) per day and each dog had a chance to come in contact with 27 free roaming dogs. The vaccination coverage was 53% (24–81%). 91% of the dogs that were reported vaccinated ($n = 131$) were seropositive, confirming owners' reports. The proportion of protected dogs (serology ≥ 0.5 IU/ml) was not associated with the time since the last vaccination ($p = 0.4$). In DRC, vaccination of dogs is exclusively funded by owners. This may explain why the coverage is low in young (≤ 1 year old) and free roaming dogs. The estimated risk of rabies transmission ranged from moderate to high in 80% of study sites ($n = 22$).

Conclusion: The risk of rabies transmission is high in the study area, given the high proportion of unvaccinated free roaming dogs and low vaccination coverage ($< 70\%$) mainly in young dogs.

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Unraveling the role of *Myotis myotis* in the ecology and transmission of rabies-related lyssaviruses (RRLVs)

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Purpose: Insectivorous bats have been found to carry a variety of Rabies-Related Lyssaviruses (RRLVs) across Europe, among which European bat Lyssavirus 1 (EBLV-1) is the most widely distributed. Despite the majority of lethal infections are reported from serotine bats, serological data suggest that other species might have a role in the ecology of this pathogen. EBLV-1 has been associated with spillover events to humans, domestic and wildlife animals, causing a neurological disease clinically indistinguishable from classical rabies. Unraveling its ecology would then be crucial in predicting and mitigating associated risks for public health.

Methods & Materials: During 2012–2018, we investigated the role of *Myotis myotis* in the maintenance and transmission of EBLV-1, through the longitudinal screening of roosts for neutralizing antibodies and viral shedding. Five neighboring maternal colonies were investigated in Northern Italy, whose connectivity was assessed using genetic and capture-recapture studies.

Results: Antibodies neutralizing EBLV-1 were detected yearly, confirming that *M. myotis* are constantly exposed to the virus in the area and do survive the infection. In addition, longitudinal data revealed wide oscillations of antibodies during a single reproductive season, suggesting waning of antibodies and waves of infection. All colonies showed similar serological trends over consecutive years. Indeed, we found evidence for genetic panmixia at the nuclear and mitochondrial level and confirmed the movement of adult females between roosts.

Conclusion: Altogether, our results support the role of *M. myotis* as natural host for an EBLV1-like RRLV. While this bat species usually inhabits underground sites in the Mediterranean areas, *M. myotis* is a strictly house dweller species in northern areas, with all colonies investigated in this study being located in church roofs. Based on both serological and virological findings, we suggest that the risk for human exposure to the virus is limited, with viral excretion restricted to short predictable windows of time. We predict that this study will be useful to secure public health while maintaining a positive relationship between humans and these large vesper bats, whose critical role in the control of pest insects is well recognized in the area.

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