


Pangolins and bats living together in underground burrows in Lopé National Park, Gabon

David Lehmann^{1,2}  | Michel Louis Halbwax¹ | Loïc Makaga¹ | Robbie Whytock^{1,2} | Lisa-Laure Ndindiwe Malata¹ | Wesley Bombenda Mouele¹ | Brice Roxan Momboua¹ | Aurélie Flore Koumba Pambo^{1,3} | Lee J. T. White^{2,4,5}

¹Agence Nationale des Parcs Nationaux, Libreville, Gabon

²University of Stirling, Biological and Environmental Sciences, Stirling, UK

³Institut de Recherches Agronomiques et Forestières, Libreville, Gabon

⁴Institut de Recherche en Écologie Tropicale, Libreville, Gabon

⁵Ministère des Eaux, des Forêts, de la Mer, de l'Environnement, chargé du Plan Climat, des Objectifs de Développement Durable et du Plan d'Affectation des Terres, Libreville, Gabon

Correspondence: David Lehmann, Agence Nationale des Parcs Nationaux, Libreville, Gabon.

Email: mandrill.lope.anpn@gmail.com

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1 | INTRODUCTION

In light of recent publications (e.g. Lam et al., 2020; Shang et al., 2020) that indicate a link between pangolin and bat coronaviruses related to SARS-CoV-2 (severe acute respiratory syndrome coronavirus 2), we believe that recent observations of pangolins and bats sharing burrows in Lopé, Central Gabon, is of general interest. Our observations were made during an ecological and spatial movement study of the giant pangolin, *Smutsia gigantea*.

2 | METHODS

We used direct animal tracking, telemetry and 30 camera traps to study a mature male giant pangolin in the northern part of Lopé National Park in late 2019. We incidentally recorded the movement and behaviour of other individuals using the same territory. Individuals could be recognised by scale pattern and size. On 10 occasions, two individuals were filmed simultaneously. The different located burrows used by the focal male were also thoroughly visually inspected.

3 | RESULTS AND DISCUSSION

3.1 | Burrow architecture

The burrows consist of complex, interlacing underground networks with up to 10 concealed entrances dug out between large roots and rocks (Figure 1). They span up to 75 m², are up to 4 m deep and tunnels are up to 30 m long (Figure 1). Galleries intersect to form large ovoid resting chambers.

3.2 | Giant pangolin burrowing behaviour

The focal male ranges over 38 km² of savannah, gallery forest, forest fragments, secondary and mature tropical rain forest. We identified twelve different sleeping sites in gallery and forest fragments that are regularly used by the focal male, nine of which are burrow systems and three are hollow trees. Preliminary telemetry data suggest several more potential burrows exist in mature forest but these have not yet been inspected visually.

Seven of the 12 burrows were frequently visited by at least one smaller male. Three of them were used by two different pangolin

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FIGURE 1 In (a) two of the 10 entrances of a giant pangolin burrow complex; in (b) a vertical gallery (50–100 cm wide, 20 m long and 3 m steep); in (c) a transversal gallery (40–100 cm wide; >25 m long); and in (d) team leader for scale [Colour figure can be viewed at wileyonlinelibrary.com]

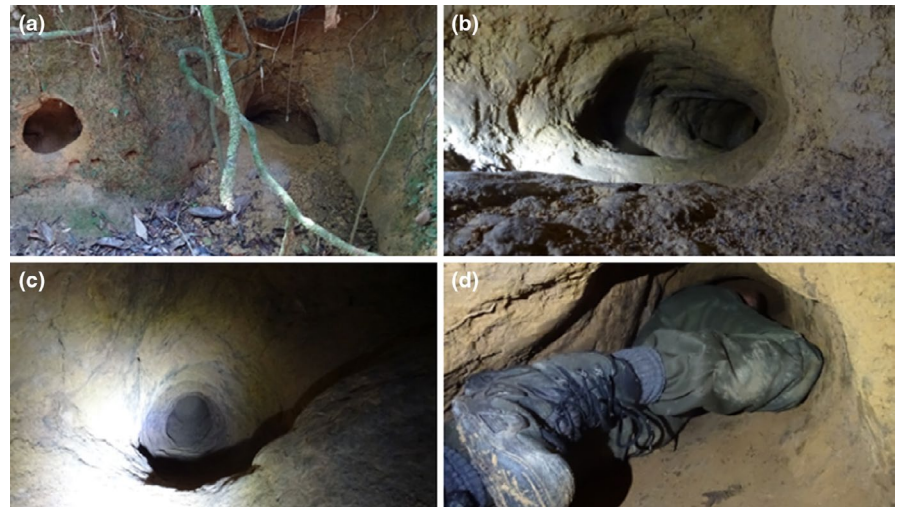


FIGURE 2 (a) White-bellied (*Phataginus tricuspis*) and (b) giant (*Smutsia gigantea*) pangolins emerging from the same burrow

females with infants that were never observed together. Six of the burrows were frequently visited by a large lone female; with whom the male was observed walking, feeding and interacting during successive nights. Burrows were rarely used on two successive nights. Two hollow trees were occasionally visited.

3.3 | Species using the burrows

These galleries also provide shelter for other animal species. We observed the presence of African rock pythons (*Python sebae*) in two burrows. One python used a burrow as a nest. The giant

pangolin co-occurred in this burrow but rested in a separate chamber.

Brush-tailed porcupine *Atherurus africanus* and white-bellied pangolin *Phataginus tricuspis* opportunistically occupied giant pangolin burrows (Figure 2), more frequently when the pangolin was not simultaneously present. At night, small rodents *Rodentia*, genets *Genetta* sp. and mongooses (e.g. marsh mongoose *Atilax paludinosus*) species are also often seen in burrows.

We observed at least three different species of Microchiroptera bats roosting inside nine of the investigated burrows *Hipposideridae* sp., *Emballonuridae* sp. and *Miniopterus* sp. (Figure 3). They usually hang in small group from the ceiling of large galleries and empty resting chambers. On one occasion, we disturbed a single individual fruit bat *Micropteropus* sp. Bat faeces and traces of guano were observed in eleven of the twelve sleeping sites. We captured numerous videos of pangolins and unidentified bats emerging from the same burrow at the same time. At least two unidentified bat species roosted in one of the hollow trees. We therefore assumed that all sleeping sites accommodate bat species.

3.4 | Promiscuity and viruses

Bats are considered to be the reservoir of many emerging virulent viruses, highly pathogenic for humans, such as SARS coronaviruses (CoV) (Hu et al., 2017; Wang et al., 2018), Ebola virus and Marburg virus (Maganga et al., 2011). In Gabon, previous studies highlighted the cocirculation of Ebola and Marburg viruses in bat populations, with a high seroprevalence of both viruses in fruit bats (Maganga et al., 2011; Pourrut et al., 2009). Furthermore, *Miniopterus inflatus*, *Hipposideros ruber* and *Coleura afra* were found carrying novel species of Astrovirus (Rougeron et al., 2016). Ultimately, *Hipposideros ruber* were found infected with CoVs (Maganga et al., 2020). Lam et al. (2020) found recombination signals between Malayan pangolins, *Manis javanica* coronaviruses, bat coronaviruses RaTG13 and human SARS-CoV-2.



FIGURE 3 (a) Female and infant giant pangolin; (b) our focal male and (c) *Hipposideros ruber* are observed using the same burrow [Colour figure can be viewed at [wileyonlinelibrary.com](https://onlinelibrary.wiley.com)]

4 | CONCLUSION

The fact that both giant and white-bellied pangolins in Lopé, Central Gabon, use burrows that are inhabited by several species of bats illustrates that there is frequent opportunity for pangolins to be exposed to bat-borne viruses. Pangolins are also commonly found in game meat markets in Gabon and are sometimes sold alive (Ingram et al., 2017; Mambeya et al., 2018) demonstrating risk of viral infection to humans. Until the links between bat, pangolin and human coronaviruses are better understood we suggest that Gabon takes steps to stop people capturing, handling or eating wild bats or wild pangolins. In this respect, wildlife researchers should conduct a detailed serological survey of the giant pangolin burrow's ecosystem.

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CONFLICT OF INTEREST

Lee White is a minister in the Gabonese Government.

DATA AVAILABILITY STATEMENT

Data are available at the Agence Nationale des Parcs Nationaux du Gabon.

ORCID

David Lehmann  <https://orcid.org/0000-0002-4529-8117>

REFERENCES

Hu, B., Zeng, L.-P., Yang, X.-L., Ge, X.-Y., Zhang, W., Li, B., ... Shi, Z.-L. (2017). Discovery of a rich gene pool of bat SARS-related coronaviruses provides new insights into the origin of SARS coronavirus.

PLOS Pathogens, 13(11), e1006698. <https://doi.org/10.1371/journal.ppat.1006698>

- Ingram, D. J., Coad, L., Abernethy, K. A., Maisels, F., Stokes, E. J., Bobo, K. S., ... Scharlemann, J. P. W. (2017). Assessing Africa-wide pangolin exploitation by scaling local data: assessing african pangolin exploitation. *Conservation Letters*, 11(2), e12389. <https://doi.org/10.1111/conl.12389>
- Lam, T. T., Shum, M. H., Zhu, H., Tong, Y., Ni, X., Liao, Y., ... Guan, Y. (2020). Identifying SARS-CoV-2 related coronaviruses in Malayan pangolins. *Nature*. <https://doi.org/10.1038/s41586-020-2169-0>
- Maganga, G. D., Bourgarel, M., Ebang Ella, G., Drexler, J. F., Gonzalez, J. P., Drosten, C., & Leroy, E. M. (2011). Is Marburg virus enzootic in Gabon? *The Journal of Infectious Diseases*, 204(suppl_3), S800-S803.
- Maganga, G. D., Pinto, A., Mombo, I., Madjitobaye, M., Mbeang Beyeme, A. M., Boundenga, L., ... Leroy, M. E. (2020). Genetic diversity and ecology of coronaviruses hosted by cave-dwelling bats in Gabon. *Scientific Report*, 10, 7314. <https://doi.org/10.1038/s41598-020-64159-1>
- Mambeya, M. M., Baker, F., Momboua, B. R., Koumba Pambo, A. F., Hega, M., Okouyi Okouyi, V. J., ... Abernethy, K. (2018). The emergence of a commercial trade in pangolins from Gabon. *African Journal of Ecology*, 56(3), 601-609. <https://doi.org/10.1111/aje.12507>
- Pourrut, X., Souris, M., Towner, J. S., Rollin, P. E., Nichol, S. T., Gonzalez, J. P., & Leroy, E. (2009). Large serological survey showing cocirculation of Ebola and Marburg viruses in Gabonese bat populations, and a high seroprevalence of both viruses in *Rousettus aegyptiacus*. *BMC Infectious Diseases*, 9(1), 159. <https://doi.org/10.1186/1471-2334-9-159>
- Rougeron, V., Suquet, E., Maganda, G. D., Jiolle, D., Mombo, I. M., Bourgarel, M., & Leroy, E. M. (2016). Characterization and phylogenetic analysis of new bat astroviruses detected in Gabon, Central Africa. *Acta Virologica*, 60, 386-392.
- Shang, J., Ye, G., Shi, K. E., Wan, Y., Luo, C., Aihara, H., ... Li, F. (2020). Structural basis of receptor recognition by SARS-CoV-2. *Nature*, 581(7807), 221-224. <https://doi.org/10.1038/s41586-020-2179-y>
- Wang, N., Li, S. Y., Yang, X. L., Huang, H. M., Zhang, Y. J., Guo, H., ... Hagan, E. (2018). Serological evidence of bat SARS-related coronavirus infection in humans, China. *Virologica Sinica*, 33(1), 104-107.

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