Wildlife crossing structures aid bats with a high-risk collision to cross the road safely.

Célia Lhérondel[1], Cédric Heurtebise[2], Thibaut Ferraille[1], Philippe Chavaren[2], Benjamin Allegrini[1], Fabien Claireau[1,3]

1 *Naturalia environnement, Avignon, FRA*
2 *VINCI Autoroutes- réseau ASF, Vedène, FRA*
3 *Centre d'Ecologie et des Sciences de la Conservation (CESCO), Paris, FRA*

Corresponding author: c.lherondel@naturalia-environnement.fr

Context

Roads have a multitude of negative effects on wildlife, including their prominent role in road kills. Most bat species rely on life history traits characterised by high adult survival (associated with long lived species) and low reproduction rates (hence slow growth rates), hence road kills are expected to negatively affect local abundance and bat population dynamics. Wildlife crossings are among the proposed improvements intended to reduce collisions. Among these structures are mainly monitoring for large mammals but they have rarely been tested for bats. Whereas wildlife crossing structures are proposed to restore ecological habitat connectivity and reduce the risk of wildlife collisions, they are rarely scientifically tested, particularly for bats.
This poster presents **the quantitative and qualitative use of two wildlife overpasses by bats through a detail plan and innovative tools**.

Material and methods

- Study sites: two wildlife overpasses located in woodland habitats, in France, on A89 and A64 highways
- For each study sites: monitoring during three consecutive years → three consecutive months each year → three consecutive nights each month
- One treatment site (wildlife structure) and one control site (without wildlife crossing with same environmental characteristics) were selected as sampling plan using two new innovative methods:
  - ✓ the **A**coustic **F**light **P**ath **R**econstruction (**AFPR**) to assess bat road crossings using acoustic recorders
  - ✓ the **B**at **T**racking **T**oolbox (**BTT**) for characterize bat flight behaviour using a thermal camera

AFPR

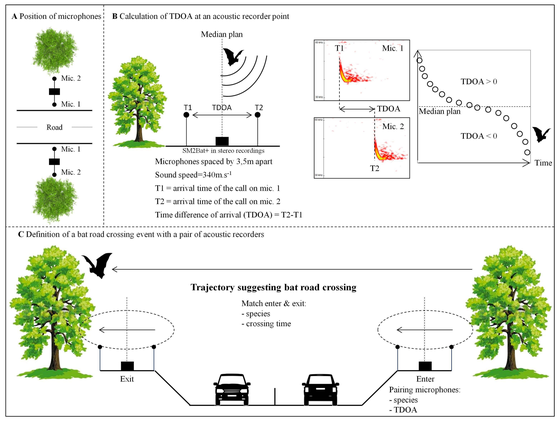

Figure 1. A Positions of the microphones: the left channel (mic 1) facing the road and the right channel (mic 2) facing the habitat context and perpendicular to the road. **B** Calculation of the time difference of arrival (TDOA). **C** We defined a crossing as when a bat that entered the road on one side was detected exiting the road on the other side. As it was not possible to identify individual bats based on their commuting/foraging calls, we matched entering and exiting using species identity and time elapsed.

(**Claireau *et al*., 2019b**)

Four acoustic recorders placed in two pairs: a treatment site and a control site.
The treatment site corresponding to the location of the wildlife overpass and the control site was placed 50 meters from the treatment site in the same habitat.

BTT

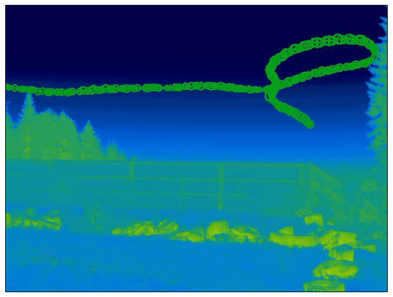

Figure 2. The Bat Tracking Toolbox (i) detect all object present in each frame, (ii) linked pairs of objects between consecutive frames, (iii) classes trajectories with a confidence score (0, non-bat; 1, bat) and (iv) determine the relative flight heights of bats above the road.

(**Claireau *et al*., in press**)

Two observation sites with a thermal camera (FLIR T640bx) in order to assess the flight behaviour of bats (utilization of overpass or not, use of the palisade or not)

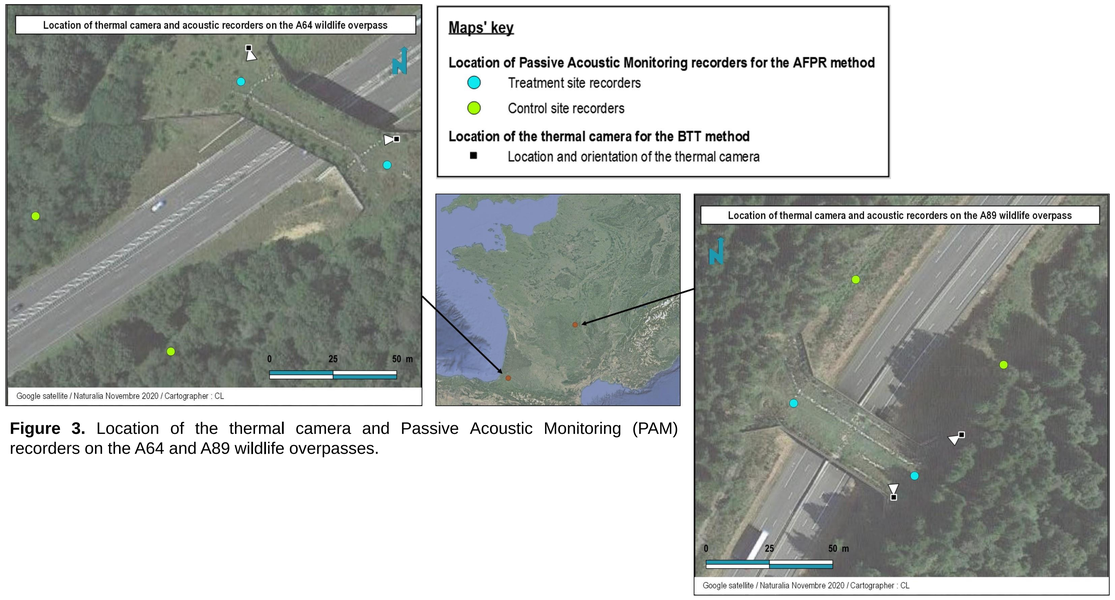

Figure 3. Location of the thermal camera and Passive Acoustic Monitoring (PAM) recorders on the A64 and A89 wildlife overpasses.

Results & discussion

Concerning the assess bat crossings

- Over 160 000 bat passes
- Over 700 bat crossings: 70% of bat crossings were located at the treatment site // 30% were located at the control site
- Species with a very or a high risk of collision with vehicles crossed the road only at the location of wildlife structure

AFPR method revealed that the majority of bat crossings were at the wildlife overpass level, thus ensuring that bats could cross safely.

Concerning the flight behaviour

- Bats used mainly the wildlife overpass for crossings the road
- Very few of bats used the wildlife crossing structure for foraging: 9% of bats trajectories
- Bats do not used the wooden palisade for foraging and commuting: 98% of flight behaviour observed

BTT method revealed that the wildlife overpass is used by bats mainly for transit on both sides of the motorway, without using the palisade.

In conclusion, it has been demonstrated that the use of these two new complementary (standardized and reproducible) methods is a useful approach for testing the effectiveness of mitigation measures and can thus be used for other types of studies, for example in environmental assessment.

References

Barré, K. *et al*. 2019 in Methods in Ecology and Evolution
Bas, Y., *et al*. inJournal of Open Research Software, 5(1)
0Berthinussen, A., & Altringham, J. 2012. Do bat gantries and underpasses help bats cross roads safely? PLoS ONE, 7(6), e38775. https://doi.org/10.1371/journal.pone.0038775
CEREMA ITM. 2016. Chiroptères et infrastructure de transport. Paris, France: Cerema.
Claireau, F., Kerbiriou, C., Charton, F., De Almeida Braga, C., Ferraille, T., Julien, J.-F., Machon, N., Allegrini, B., Puechmaille, S.J., Bas, Y., In press. Bat overpasses help bats to cross roads safely by increasing their flight height. Acta Chiropterologica 24.
Claireau, F., Bas, Y., Julien, J.-F., Machon, N., Allegrini, B., Puechmaille, S. J., & Kerbiriou, C. 2019a. Bat overpasses as an alternative solution to restore habitat connectivity in the context of road requalification. *Ecological Engineering*, *131*, 34–38. doi: https://doi.org/10.1016/j.ecoleng.2019.02.011
Claireau, F., Bas, Y., Puechmaille, S. J., Julien, J.-F., Allegrini, B., & Kerbiriou, C. 2019b. Bat overpasses: An insufficient solution to restore habitat connectivity across roads. Journal of Applied Ecology, 56(3), 573–584. https://doi.org/10.1111/1365-2664.13288
Naturalia environnement. 2019. Suivi de l'écopont de Boucaud (A89) - Volet Chiroptères - Rapport final : suivis 2017-2019. Pour le compte d'Autoroutes du Sud de France (ASF).
Naturalia environnement. 2019. Suivi de l'écopont de Peyreharasse (A64) - Volet Chiroptères - Rapport final : suivis 2017-2019. Pour le compte d'Autoroutes du Sud de France (ASF).