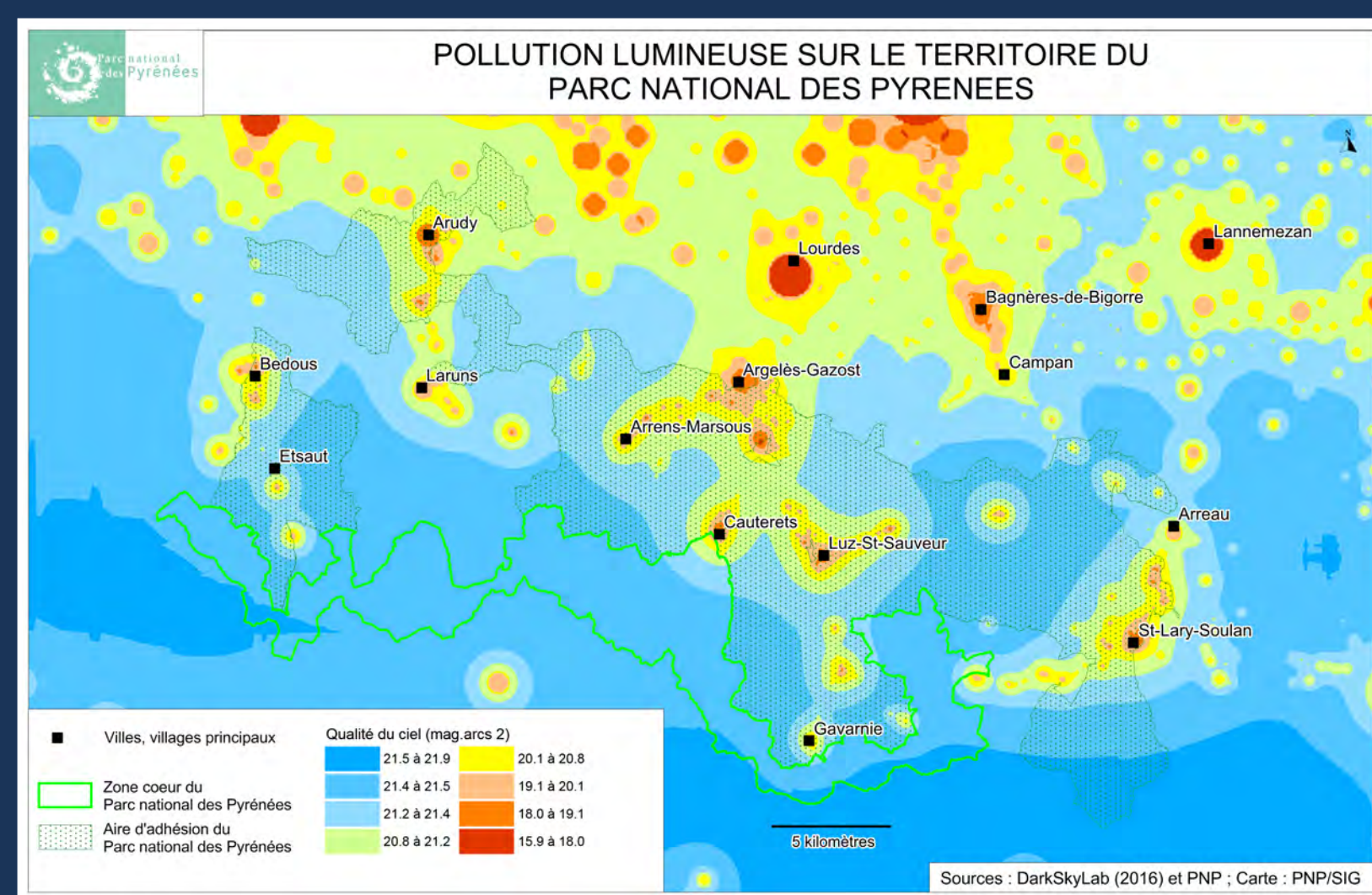


# BATS : WHICH TOLERABILITY FOR LIGHT POLLUTION ?

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In 2017, as part of the ADAP'TER program, the National Park of the Pyrenees (PNP) requested the engineering office Dark Sky Lab for modelling and mapping light pollution on its territory. The PNP later asked to cross these informations with indicatives and day-light fleeing species' behaviour. These species enjoy the darkness but avoid too bright environments. Goals are first to identify a range of light pollution below which the presence of these species would decrease and second to prioritize areas where light pollution should be reduced. As nocturnal species, bats have been selected for this study.



This new study is financed by the POCTEFA «Pyrénées la Nuit» program which is driven in France by the CPIE Bigorre-Pyrénées. It focuses on two species: the Greater Horseshoe Bat (*Rhinolophus ferumequinum*), the Lesser Horseshoe Bat (*Rhinolophus hipposideros*) and on the genus murines (*Myotis sp.*). The purpose is to calculate their activity level and their probability of presence in order to compare these results with the light pollution gradient. Murines and horseshoes bats are day-light fleeing species. As a consequence, they are good indicators for the entire nocturnal wildlife.

The light pollution, or sky quality, is measured in mag.arcsec<sup>2</sup> and expresses the brightness of the sky background. Brightness and sky quality are better when this value increases.

## Protocole ?

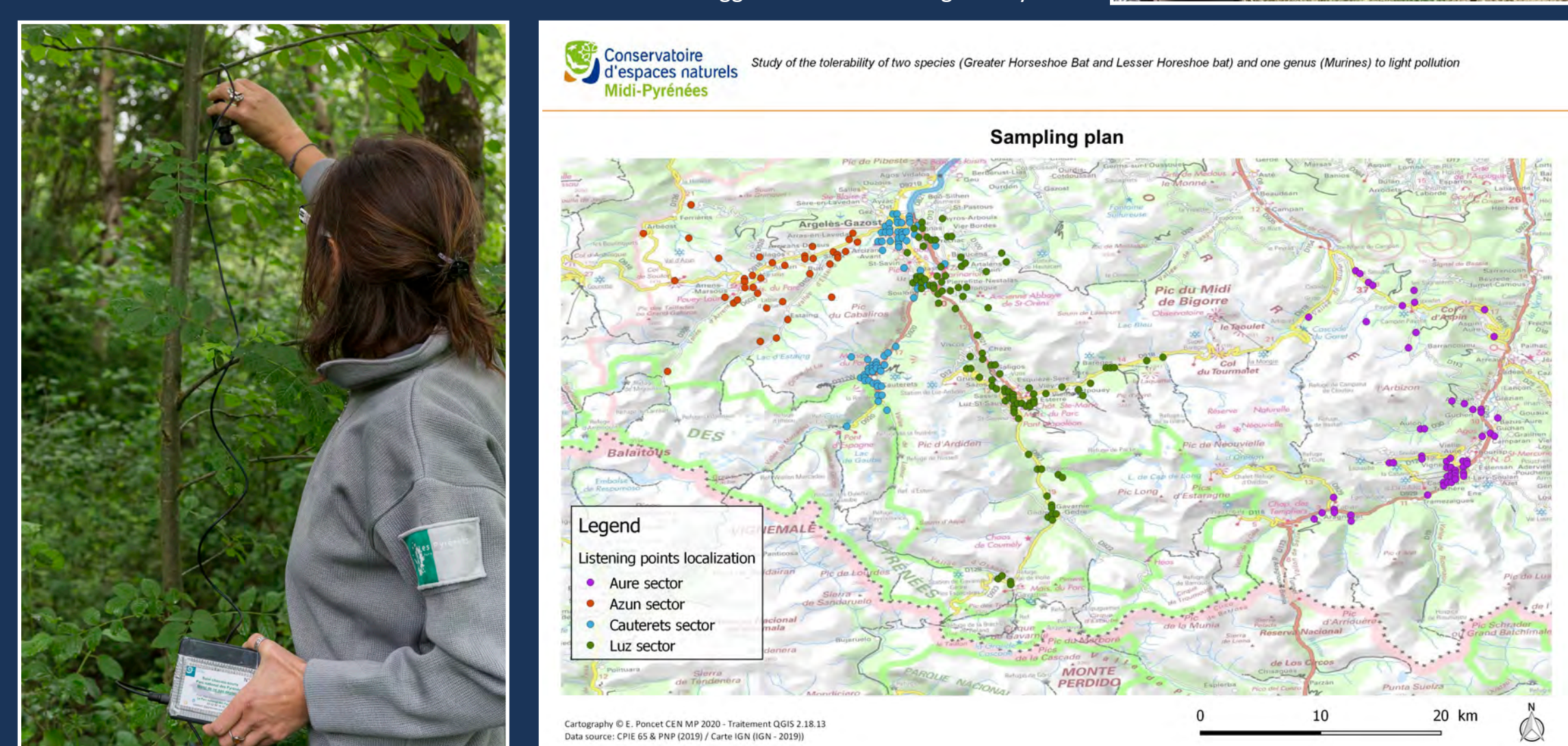
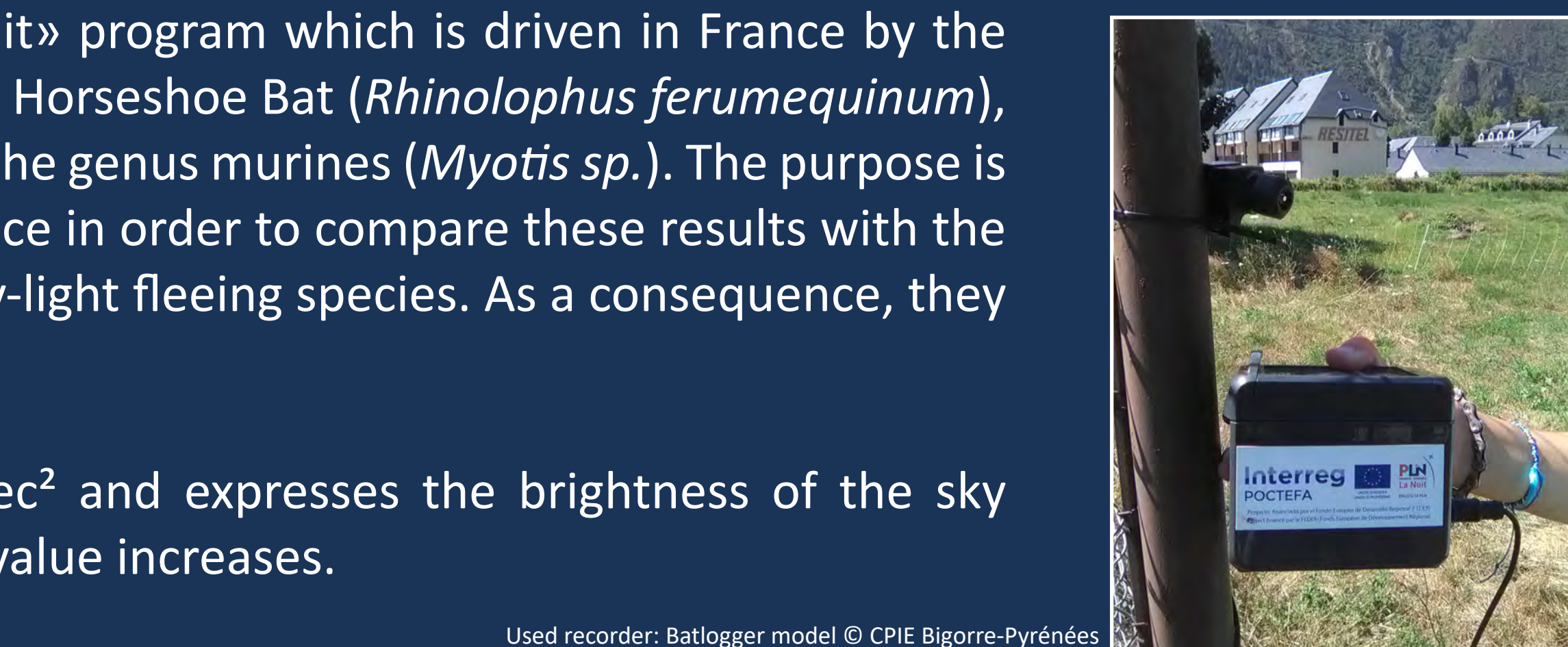
280 listening points have been distributed over the major valleys of the National Park of the Pyrenees in the Hautes-Pyrénées department. Between 2018 and 2019, an automatic recorder has been located on each of them during two consecutive nights to recording every bats visit.

Apart from the sky quality, the altitude and the distance of the nearest water point were calculated for each point. Moreover the rates of urban, forested and open areas have been measured into a surface of 6,25 hectares around each point.

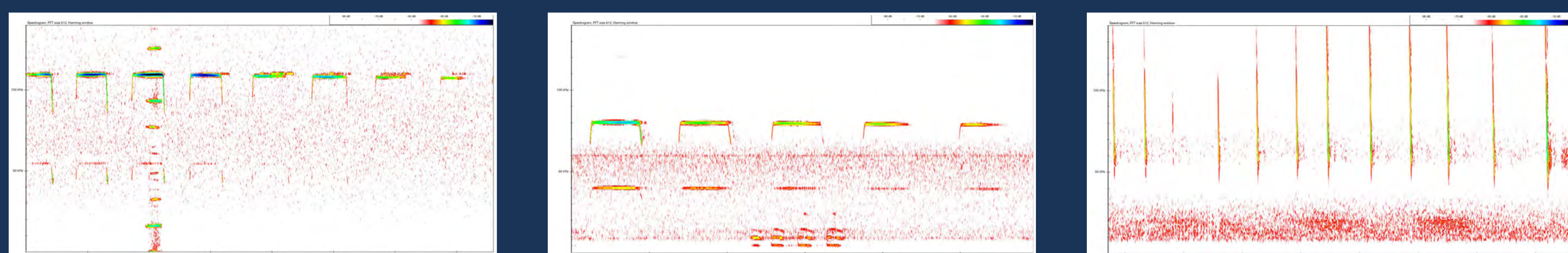
Recordings have then been analyzed to determine the activity and the presence of studied species in order to compare these results with the differents measured variables.

## Results: the example of the Greater Horseshoe Bat

The Greater Horseshoe Bat has been detected at least once on 114 listening points with an average of 6 contacts. The most important activity has been recorded near the Agos lake in Aure valley between the 22<sup>nd</sup> and 24<sup>th</sup> June 2018.



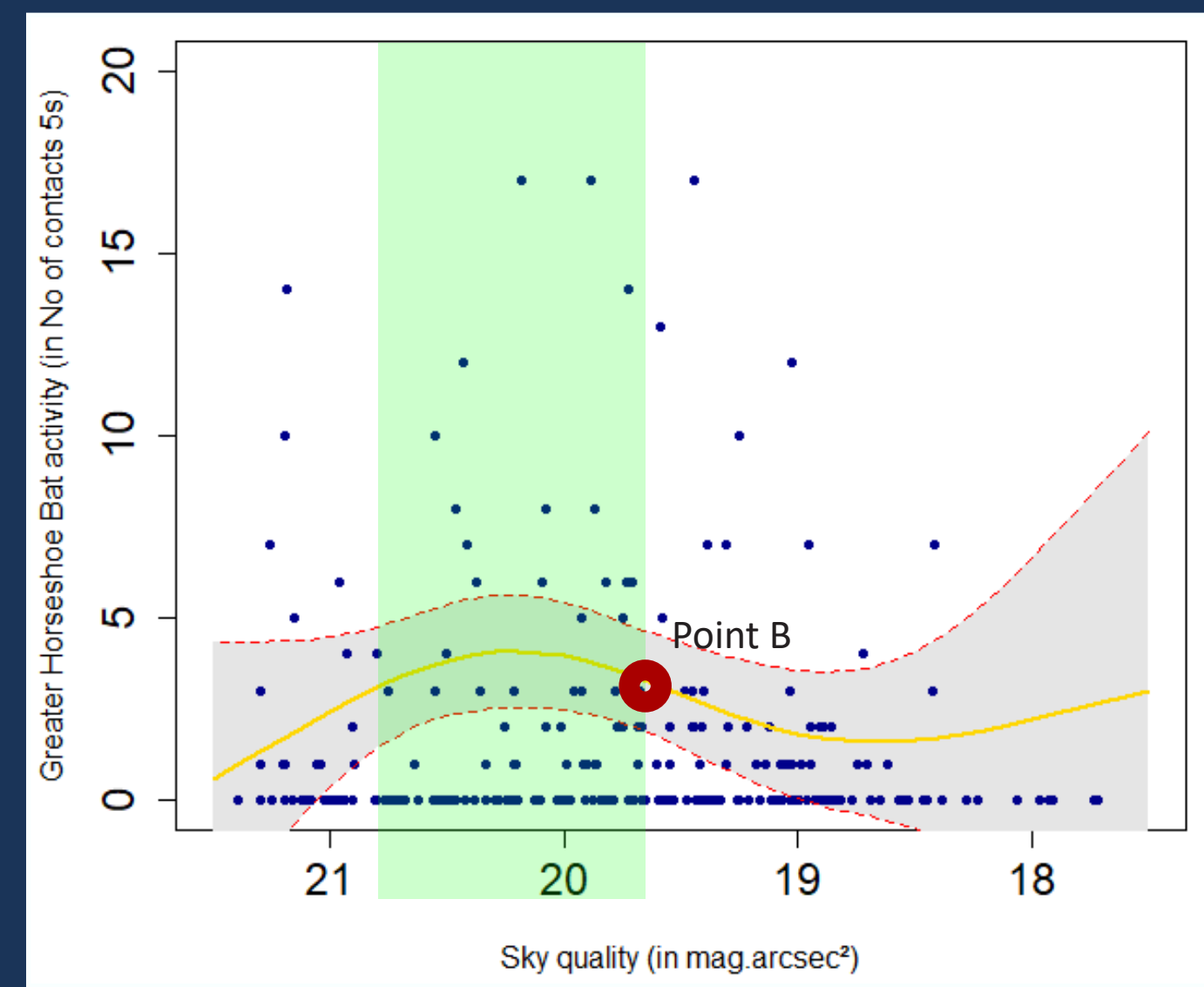
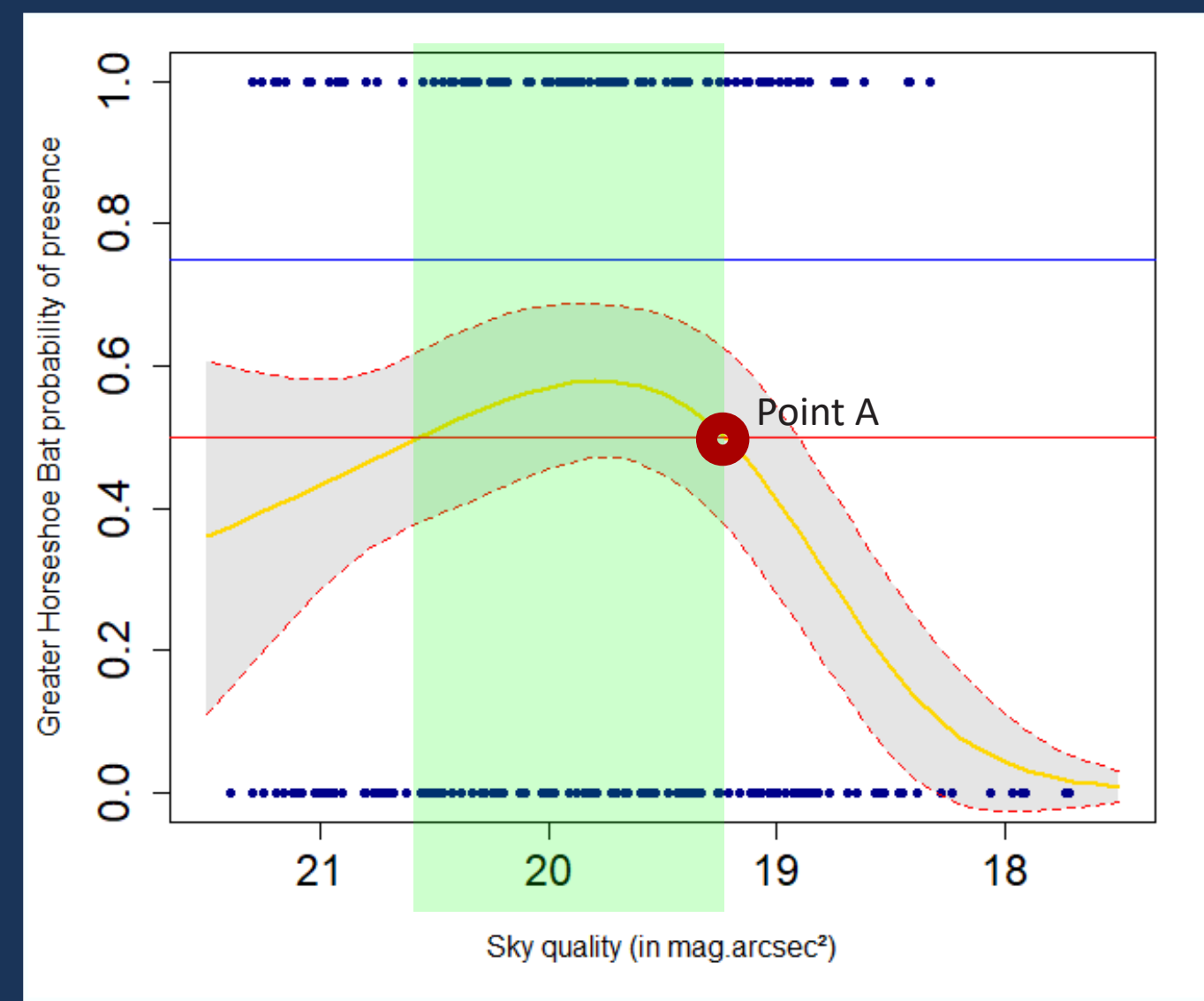
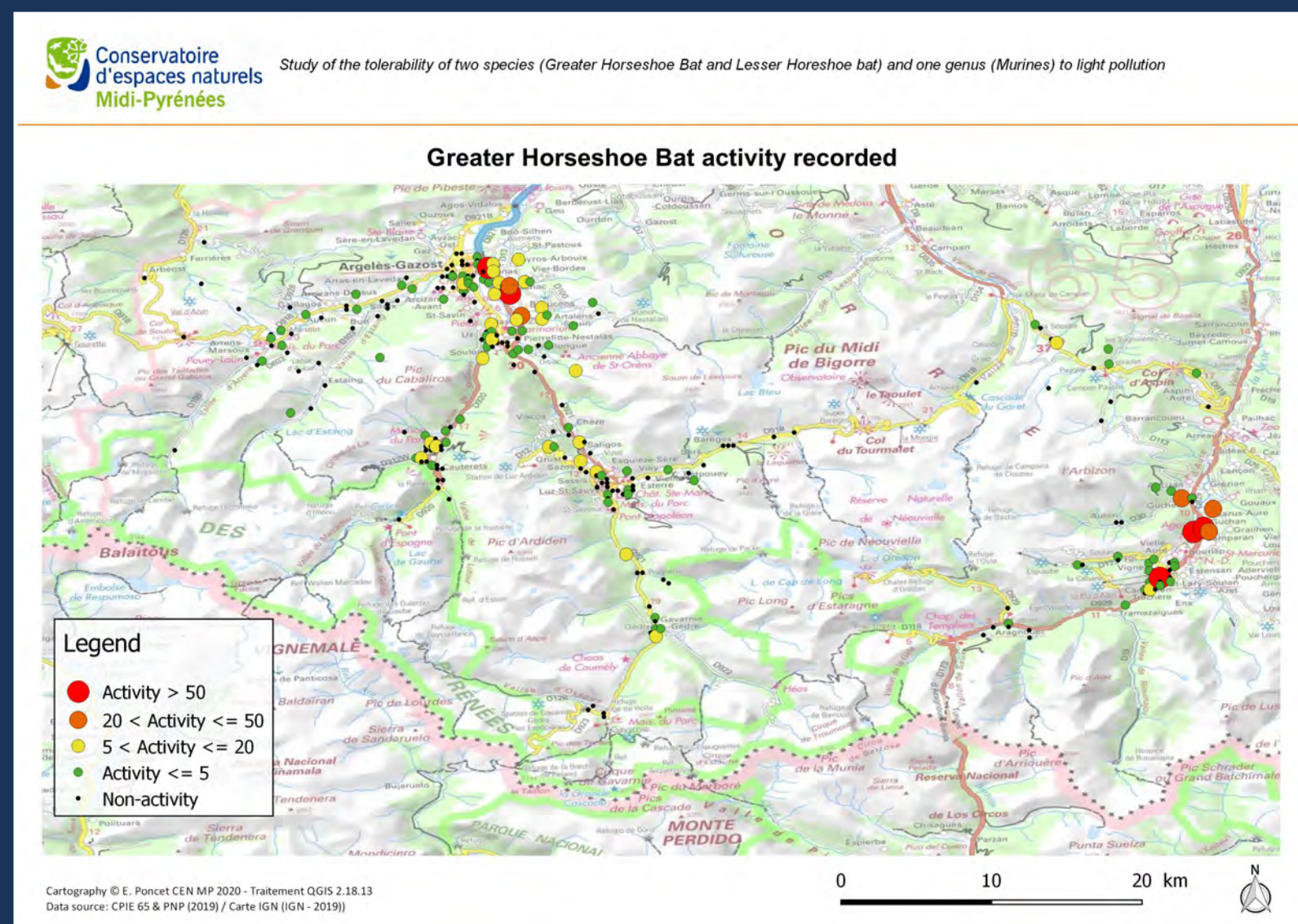
Left: setting up of a recorder © Emeline Fresse / Right: listening points localization



From left to right: acoustic signals of Lesser Horseshoe Bat, Greater Horseshoe Bat and one species of murine © Emile Poncet



Above : two Greater Horseshoe Bats © Sophie Bareille  
On the right : number of recorded contacts for this species on each point of the study



Sky quality effect on the probability of presence (left) and the activity (right) of the Greater Horseshoe Bat

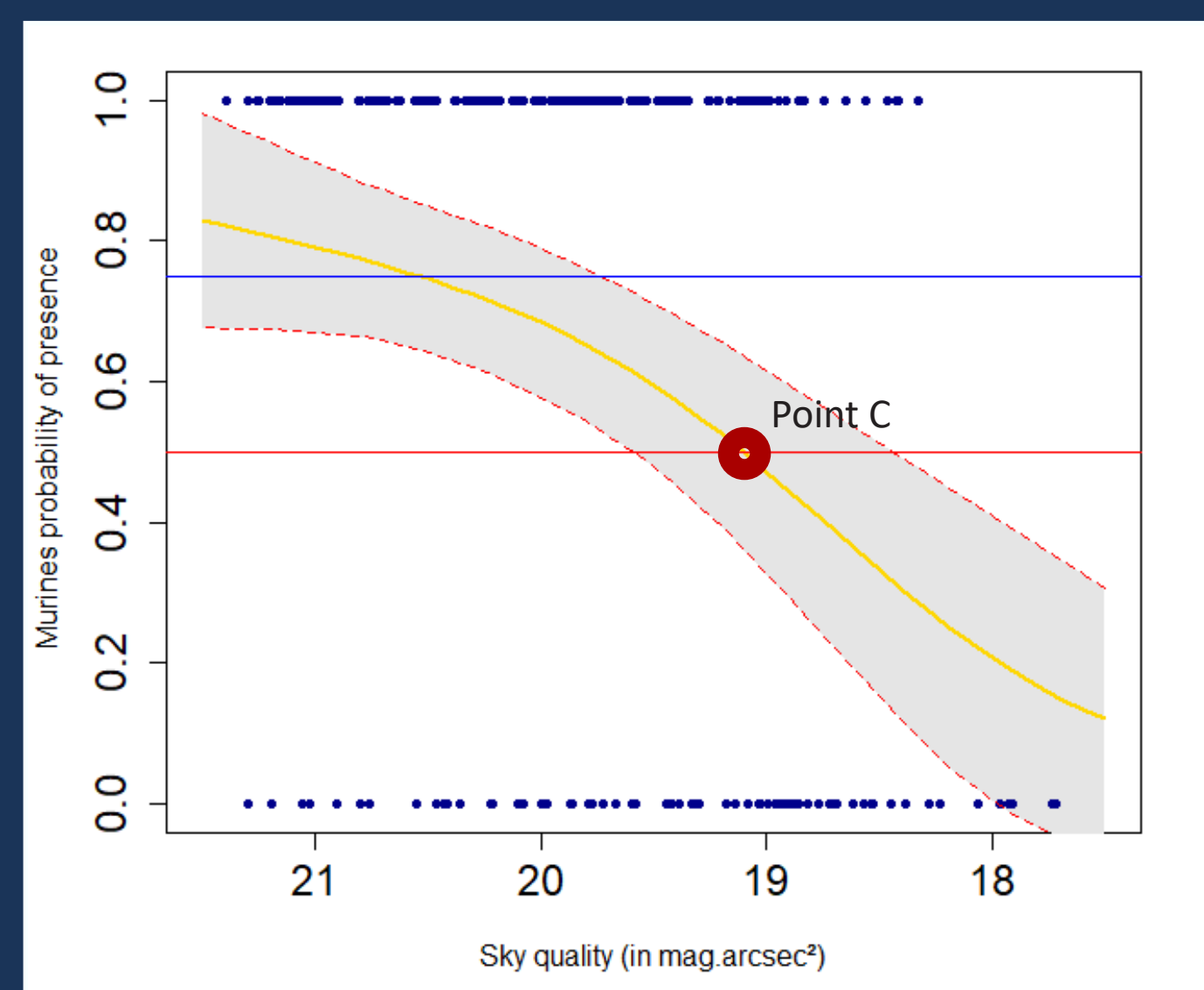
- The Great Horseshoe Bat probability of presence is lower than 50% for a sky quality lower than 19.3 mag.arcsec<sup>2</sup> (point A),
- Activity peak ends around 19.6 mag.arcsec<sup>2</sup> (point B),
- Probability of presence and activity decrease for high sky quality values, around 21 mag.arcsec<sup>2</sup>,
- The optimum of probability of presence and activity seems to be for sky quality values ranging from 19.3 to 20.6 mag.arcsec<sup>2</sup>.

The open areas rate and the altitude also have an effect on probability of presence and activity. In fact, they both increase for a higher amount of open environments but decrease with altitude for the Greater Horseshoe Bat. This is consistent with the species' biology which is uncommon in high mountain and prefers hunting along hedges around grassland and grazing fields.

## Results: the others studied species ?

- The murines probability of presence is lower than 50% for a sky quality lower than 19.1 mag.arcsec<sup>2</sup> (point C). No effect on activity has been identified,
- The Lesser Horseshoe Bat seems non affected by sky quality.

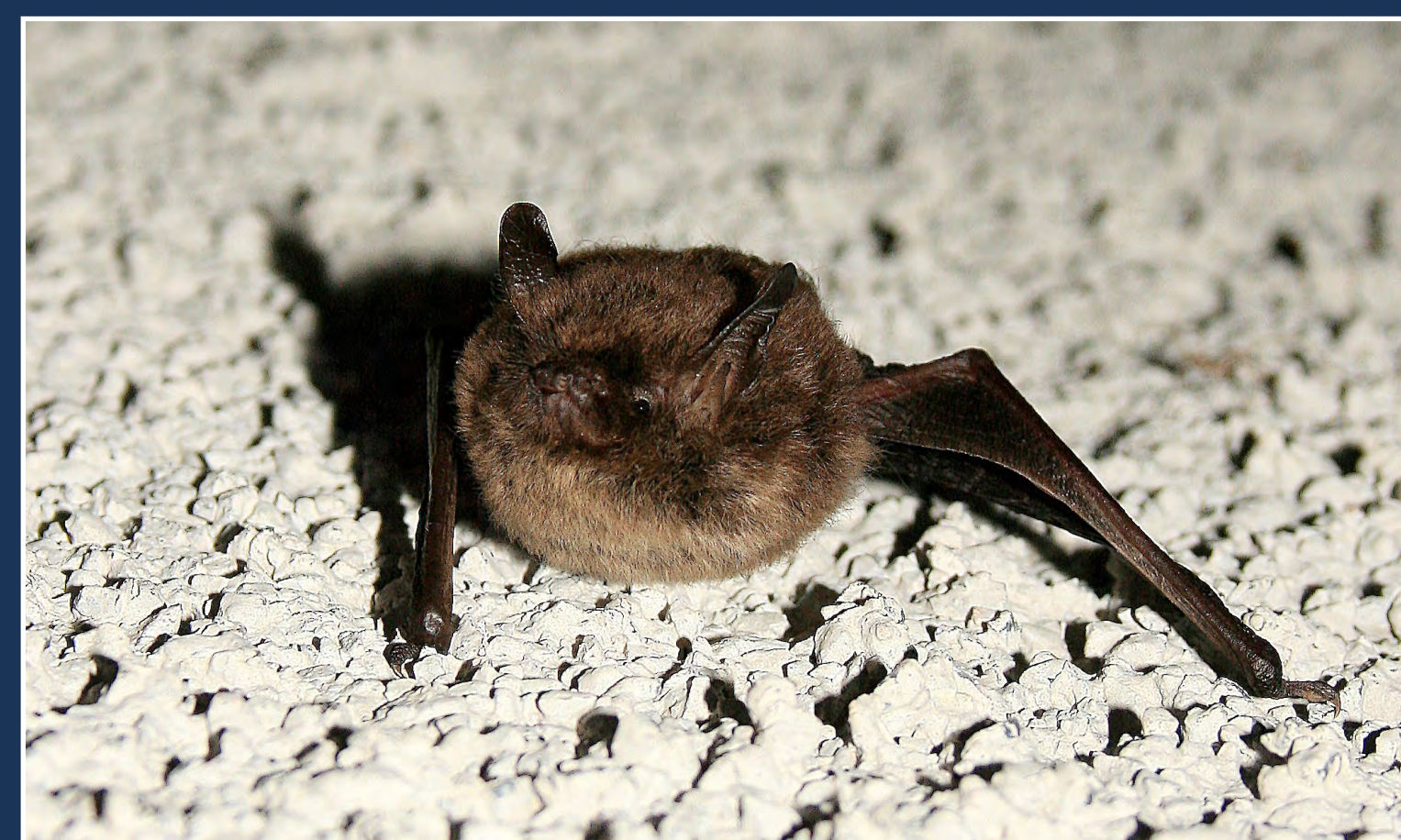
For the murines and the Lesser Horseshoe Bat, the proximity with water is important. Probability of presence and activity of the Lesser Horseshoe Bat are also better when forested area is higher, but this species is rarest in altitude.



Sky quality effect on the murines probability of presence

## Conclusions ?

- The murines and Greater Horseshoe Bat probability of presence and Greater Horseshoe Bat activity decrease for sky quality values ranging from 19.1 to 19.6 mag.arcsec<sup>2</sup>,
- necessity of reducing light pollution on the areas where the sky quality is lower than these threshold values,
- is Important to ensure a good sky quality around water points, forests and opened environments. All of this landscape componants are essential for the two species and the genus studied in this work, but it is also the case for all bats.



Above: Alcahoie murine © Sylvain Déjean  
A droite: Lesser Horseshoe Bat © Sylvain Déjean



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