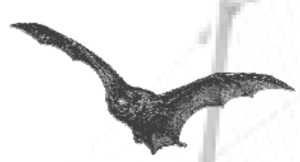
MONITORING THE EFFECT OF A SCREEN INSTALLED TO MITIGATE THE IMPACT OF A HIGH SPEED RAILWAY ON BATS

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1. INTRODUCTION AND OBJECTIVES

A new 160-km stretch of high speed railway (HSR) between Cordoba and Malaga (Andalusia, southern Spain) began operation at the end of 2007. As established in the Environmental Impact Assessment (EIA), the public company ADIF that is responsible for the construction and maintenance of the infrastructure must undertake a monitoring project to analyse the effectiveness of measures taken to mitigate the impact of the railway on birds and mammals. The monitoring project is being carried out by a team of experts in bats and wildlife management and will continue until the end of 2011.

One measure that is being monitored is the screen installed between the Alora and Espartal tunnels to prevent bat mortality (Figure 1). This screen is a 5-m high wire fence that runs for 110 m along the tracks on an embankment built between two tunnels that has an underpass (8 x 6.4 m).

There are no previous studies on the effectiveness of these measures, so the results of this monitoring project may be of interest not only for this case, but also for future projects.


Figure 1. Screen to prevent bat mortality installed between the Alora and Espartal tunnels along the HSR from Cordoba to Malaga.
Photos by: Minuartia.

2. STUDY AREA AND DESCRIPTION OF THE BAT COLONY

Close to the infrastructure (less than 50 m from the southern entrance of the Alora tunnel), on the right bank of the Arroyo Morales, there is a horizontal well that houses a colony of cave-dwelling bats formed by a minimum of six species, all of high conservation value that are protected in Andalusia and listed in Annex II of the *Council Directive 92/43/EEC of 21 May 1992 on the conservation of natural habitats and of wild fauna and flora* (Figures 2 and 3):

- The Schreiber's bat (*Miniopterus schreibersii*)
- The greater mouse-eared bat and/or lesser mouse-eared bat (*Myotis myotis / blythii*)
- A minimum of two species of small bats of *Myotis*'s genus
- The Mediterranean horseshoe bat (*Rhinolophus euryale*)
- The greater horseshoe bat (*Rhinolophus ferrumequinum*)

The cave is used as s breeding site by a population of 400 adult individuals of *Myotis myotis / blythii* in the spring. The other bat species use the cave as a refuge, with fluctuating populations. For example, around 1,350 *Miniopterus schreibersii* individuals were counted in May 2009.


Figure 2. The mine water that houses a colony of cave-dwelling bats.
Photos by: Minuartia

Figure 3. Group of *Miniopterus schreibersii* group in a cave.
Photo by: Carles Flaquer.

3. METHODS

3.1 Determination of routes used by bats to cross the railway

In May and June of 2009 and 2010, sixteen fixed listening stations were located in different areas around the railway line between the Alora and Espartal tunnels, to determine the main crossing routes of bats through the HSR once they had emerged from the mine. We used ultrasound detectors (Pettersson Elektronics 240, 230 and 240x, with a heterodyne system, frequency division and expanded time), connected to digital recorders (Archos Gmini 200 and Edirol R9 to 48 KHz and 16 bits).
During the recording, the observer stood with the detector about 1.5 m above the ground and guided it around 45º from the vertical (Sherwin et al. 2000), as follows:

- Sound sample recording in expanded time (factor 10) of the contacts produced (automatic method of sampling to 0.1 seconds). The records were analyzed in the laboratory, where ultrasound was identified on a computer using the BatSound 3.1 program (Pettersson Elektronics), following the criteria defined in Flaquer et al. (2007) and Ayuso (2005).
- Bat passes were counted in situ by the tracking heterodyne system and frequency division.

3.2 Analysis of flight behaviour in relation to the screen

We used a delayed counting system consisting of a video camera with infrared light (SONY CVX-V18NSP) and ultrasound detectors (Pettersson Elektronics 230 and 240x with frequency division and expanded time), both connected to a digital recorder for subsequent laboratory analysis (Figure 5). The image and sound recording equipment were placed close to the screen, focusing on 15-20 m of the fence (Figure 4). In May and June of 2009 and 2010, five recording stations were established.
Subsequently, we counted and identified the species and determined their flight behaviour. These procedures were carried out in the lab by viewing the film in slow motion and identifying ultrasound on a computer using the BatSound 3.1 program (Pettersson Elektronics).

Figure 4. Image and sound recording equipment.
Photo by: Carles Flaquer.

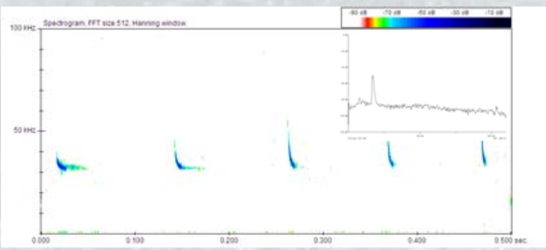

Figure 5. Example of the spectrogram and spectrum potential used in the laboratory to identify species from the records.

4. RESULTS

4.1 Determination of routes used by bats to cross the railway

In 2009 and 2010, the sixteen fixed listening stations registered 2,222 cave-dwelling bats: 55% were *Miniopterus schreibersii* and 35% were *Myotis myotis / blythii*.

Fifty-seven percent of the total number of bats recorded (1,269 records) were identified on the opposite side of the HSR to the cave. These were bats that had crossed the infrastructure on emerging from the cave, or that were observed directly crossing it.

The bats used two main routes to cross the railway (Figure 6):

- Above the entrance of the Alora tunnel: mean of 409 records, which represents 38.3% of the bats moving around the HSR in May.
- Through the underpass located in the middle of the stretch between the two tunnels: mean of 255 records, which represents 45.2% of the bats detected in May.

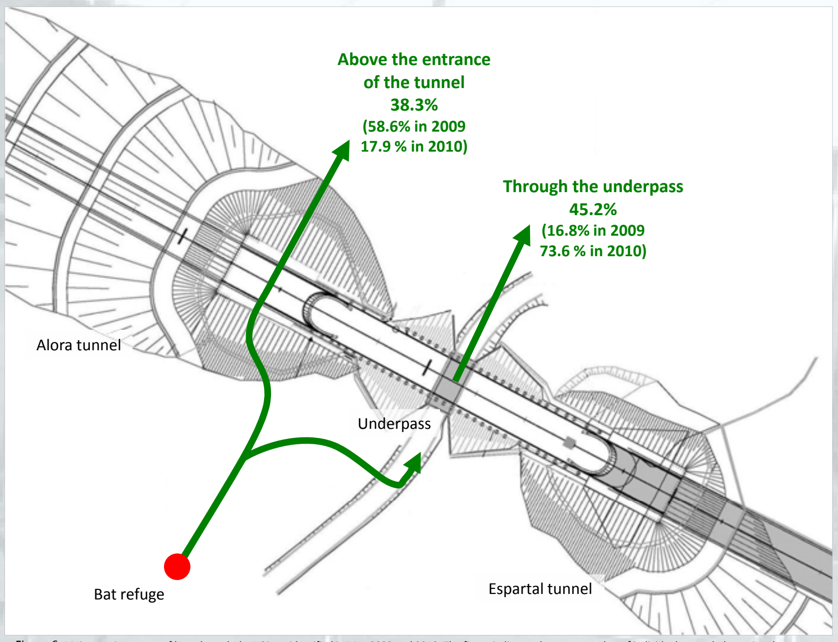

Figure 6. Main crossing routes of bats through the HSR, as identified in May 2009 and 2010. The figure indicates the mean number of individuals recorded crossing the railway in 2009 and 2010. (N = 1,675 records).

4.2 Analysis of flight behaviour in relation to the screen

In 2009 and 2010, we obtained 176 activity records (120 in 2009 and 56 in 2010) from the five recording stations located next to the screen. These records were of *Miniopterus schreibersii*, *Myotis myotis / blythii* and other unidentified species.

Using the films made at the same time as the sound recordings, we clearly distinguished the movements of 114 bats (70 in 2009 and 44 in 2010). These were divided into four categories, depending on the behaviour of bats in relation to the screen:

- Turn back near the screen: the bat came to the screen and turned back without crossing the infrastructure, circling 180º.
- Cross the HSR below the catenary: the bat flew over the screen, then flew down and crossed the infrastructure below the catenary.
- Cross the HSR above the catenary: the bat flew over the screen and crossed the infrastructure above the catenary.
- Fly in parallel to HSR: the bat flew parallel to the outside of the screen, but we could not distinguish if it then crossed the infrastructure and how.

The category that poses the greatest risk of bat collision with trains is crossing the HSR below the catenary. This route was observed in a mean of 11.2% of cases. However, a mean of 46.3% of the observed movements involved bats crossing the infrastructure above the catenary.

5. CONCLUSIONS

I. Most of the bats (57%), especially *Miniopterus schreibersii* and *Myotis myotis / blythii*, crossed the HSR on emerging from the mine.

II. The bats used two main routes to cross the railway:
   - Above the entrance of the Alora tunnel (mean of 38.3% of the bats moving around the HSR)
   - Through the underpass located in the middle of the stretch between the two tunnels (mean of 45.2%)

III. Preliminary results show that the screen is conditioning the movements of bats in relation to the HSR by forcing individuals to move through areas in which there are no risk of collision with trains. From the overall data collected in two years of monitoring, it appears that a mean of only 11.2% of the movements observed next to the screen were of bats crossing the infrastructure through areas with a high risk of collision with trains (between catenary and the train tracks).

IV. Monitoring will continue…

6. LITERATURE CITED

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