sciencematters

Biedermann M, Karst I, Zinke O, Bontadina F, Schorcht W. 2021. Rare lesser horseshoe bat *Rhinolophus hipposideros* as traffic casualty after the opening of a motorway. ScienceMatters, 22 March 2021. doi:10.13140/RG.2.2.26079.74407

Discipline
Biological

Keywords
Road Kill
Bat Mortality
Systematic Fatality Search
Effectiveness Of Mitigation Measures

Observation Type
Standalone

Rare lesser horseshoe bat *Rhinolophus hipposideros* as traffic casualty after the opening of a motorway

Biedermann Martin[†], Inken Karst[†], Olaf Zinke, Fabio Bontadina*[†], Wigbert Schorcht[†]

NACHTaktiv, Biologists for bat research GbR; Museum der Westlausitz , Kamenz; SWILD, Urban Ecology & Wildlife Research, Swiss Federal Research Institute WSL, Biodiversity and Conservation Biology

Abstract

Roads affect bats through barrier effects and collisions with vehicles. In particular, low-flying bat species are killed through collisions when flight corridors are cut by roads. One of the last populations of the endangered lesser horseshoe bat *Rhinolophus hipposideros* lives in close proximity to the newly constructed motorway A17 connecting Dresden (Germany) and Prague (Czech Republic). The bats' flight paths were studied [before and after the construction of the motorway. To locate possible victims of collisions on the newly opened motorway, we conducted a systematic fatality search in the first summer after road opening. The search scheme focused on former flight paths crossing the track of the motorway as well as on new crossing structures which were particularly built for these bats (hedge bridges; culverts). We included emergency lanes and banks into the search scheme on six survey days in the early morning hours.

The total length of the searched motorway added up to 3'600 meters (two lanes in both directions). We recorded 140 dead animals of various vertebrate species: 70 rodents (mice, rats) and insectivores (shrews), 67 amphibians (toads, newts), two small birds and one bat (*Rhinolophus*

hipposideros). The collided bat was found at a site where the motorway runs through a deep, rocky incision. At this time, the hedge bridge, which had been built to restore the passability of the landscape, was only partially functional due to the plantings on the bridge still being too small. As a consequence of the monitoring results in year one, glare protection and protective fences were retrofitted. This example shows that the opening of a new road can lead to a large number of road casualties including rare species. We stress the importance of wildlife monitoring after the opening of a new road to identify critical locations and to optimize mitigation measures.

Figure

a b c d

Location and situation (red circle) in which the bat was found on the emergency lane shortly after the opening of the new motorway.

a) Location near a hedge bridge (in the background), constructed for bats to safely cross the motorway. The site of the accident is near a former flight corridor (revealed by radio-tracking prior to the road construction).

b) Motorway cuts into rocky terrain.

c) Dead lesser horseshoe bat, early morning of August 26th, 2007, on the emergency lane, next to it a crane fly (fam. *Tipulidae*), typical prey for this bat species.

d) Dead specimen with injuries visible in the abdominal wall.

One supplementary information file available

Introduction

In recent decades, various studies have demonstrated that traffic routes (both with high traffic and newly built) can have serious negative effects on the fauna. Negative effects of roads on amphibians have been known for a long time; among mammals an increasing focus on bats has also identified various negative effects (e.g. mortality due to collisions, habitat loss due to light pollution, noise or barrier effects, [1]).

A meta-analysis by [2] lists 1.207 bats collected as road casualties in Europe to date. These data highlight that low and slow flying bat species are particularly affected by collision compared to fast and high flying

species. Furthermore, the analysis revealed that juveniles collide more frequently than adults.

Various studies in recent years have shown that, for example, the low-flying lesser horseshoe bat, *Rhinolophus hipposideros* (IUCN: LC (Least Concern, [3]), Red List EU: NT (Near Threatened, annexes II & IV of the Habitats Directive [4]), is particularly affected by or sensitive to disturbances related to vehicles ([5], [6], [7], [8], [9], [10]). The echolocation range of this species is small, forcing the bats to fly close to vegetation or the ground, therefore making them vulnerable to collision with vehicles.

From 2003 to 2006, a section of the federal motorway (Bundesautobahn BAB A17) connecting Dresden (Saxony, Germany) and Prague (Czech Republic) was built between Dresden and the German-Czech border, cutting through the habitat of some remnant colonies of the lesser horseshoe bat, at the Northern border of its range. The motorway's layout separated colonies and feeding grounds of these bats ([11]). In order to retain the passability of the flight paths for the bats, but also to receive the authorisation to build the road, various mitigation measures were planned and implemented (over- and underpasses, such as culverts and hedge bridges, as well as guiding vegetation structures). The effectiveness of these measures was studied over a 10-year monitoring period ([11]).

Objective

In this paper we report the results of a systematic search for wildlife road kill in the first season after a newly built motorway had been opened to traffic.

Results & Discussion

The sectors of the motorway searched added up to 3'600 meters (two lanes in both directions). On six days we found a total of 140 dead animals of different vertebrate species: 70 rodents (mice, rats) and insectivores (shrews), 67 amphibians (mainly toads, newts), 2 small birds and 1 bat (*Table 1*). On Sunday morning, 26 August 2007, we found a dead adult male lesser horseshoe bat near hedge bridge 3 (*Fig. 1*). The individual was lying on the outermost lane (emergency lane) on the east side of the motorway in the direction towards Dresden (50°55'1.16" N, 13°53'31.81" E). Measurements of the specimen are: forearm length: 37.3 mm, total length: 77.0 mm, tail length: 28.0 mm, thumb/thumb claw: 4.9 / 1.5 mm, mass: 5.1 g, ear length: 17.0 mm. The bat is archived at the Zoological Collection of the Museum der Westlausitz in Kamenz (det. OZ; alcohol preparation n° 490/07). An autopsy on September 9th, 2007 revealed a fracture of ulna and radius on the left side without the

development of a hematoma, skin of the left wing ruptured extensively, rupture of the abdominal wall on the right side with organs partially visible outside of the abdominal cavity, extensive tearing of the skin ventrally from chest to chin, diaphragm rupture, pericardial rupture and lung ruptures on both sides (*Fig. 1d*). Damages indicate the collision with a vehicle.

Crossing structure for wildlife must be fully functional before opening of a road

At the site of the road kill the motorway deeply cuts through rocky terrain. The bat possibly flew along a traditional flight corridor (previously identified by radiotracking and habitat suitability analysis, [11]). We assume the bat tried to cross the road flying close to the ground due to missing leading structures (vegetation) needed for their faint echolocation calls (see below). The bat presumably hunted near to the road, indicated by the typical prey insect next to the dead bat (Fig. 1c), as they occasionally do while commuting. [12], [13] already demonstrated a relationship between landscape structures adjacent to roads and road casualties of bats. This stresses the necessity of suitable and safe crossing structures, particularly at transportation infrastructure with heavy traffic.

At the time of our study, the nearby crossing structure - a hedge bridge designed for bats (Fig. 1a) - was not yet fully functional. This was also one of the results of the acoustical monitoring within the framework of the monitoring of the hedge bridge's effectiveness . We assume that the limited or even missing functionality was mainly due to the lack of developed vegetation on the bridge functioning as guiding structure. Shrubs along the bridge had been planted the previous year only and were still small. The high number of casualties in other animal groups reveals the deficit in protective measures for these taxa and the limited potential to restrict the number of victims.

Mitigation measures must be monitored and, if necessary, optimised

Based on the results of the monitoring in the first year (see the multi-step monitoring program: [11]), glare protection and protective fences were retrofitted to improve the acceptance of this bridge as flight corridor. The effectiveness of this type of hedge bridge could be confirmed in the course of the 10-year monitoring program ([11]).

This example shows the need to examine the full functionality of mitigation measures at newly built roads using standardised methods to limit the risk of death to a broad range of animal species. Particularly in species already endangered, an additional mortality due to collisions with vehicles can have a major impact on small populations. This is most

severe in long-lived animal species with low reproduction ([14]), such as the lesser horseshoe bat. If functional deficiencies are found during monitoring, critical locations can be identified and mitigation measures optimised before the clearance of a new road for traffic.

Conclusions

This example shows that the opening of a new road can lead to a large number of road casualties including rare species. It is therefore important that structures designed for the crossing of wildlife must be fully functional before the opening of a road.

We stress the importance of wildlife monitoring after the opening of a new road to identify critical locations and to optimize mitigation measures.

Limitations

This is an individual case study that contributes observations to draw general inferences in a later, more general review.

Alternative Explanations

It is very unlikely to find a dead bat on a road with these injuries - without a road traffic collision being the cause.

Conjectures

Because road casualties of small wildlife, particularly of rare species, are single events which are hard to detect, we advice to repeat such studies and to report also occasional observation to contribute to a complete picture.

Methods

We used the wildlife monitoring conducted from 2007 to 2016 as baseline. The checking of the function of the wildlife passages by acoustical and optical means had shown unsufficient functionality both shortly before and shortly after the road had been opened. Therefore, in this study, we searched for possible road kill of lesser horseshoe bats at the BAB17 in August 2007, eight months after the opening of the motorway.

Between August 19th and 26th, 2007, we searched for dead bats and other animals in the early morning hours six times, focusing on stretches of 100 m on either side of the newly built structures (hedge

bridges, underpasses) as well as their vicinity. This included the lanes of the motorway, emergency lanes and the adjacent banks.

Funding Statement

Handling editors and reviewers will not be able to see this section.

This study was part of a scheme to monitor the success of mitigation measures implemented at the newly built motorway BAB17 in Germany, partially funded by DEGES GmbH (Deutsche Einheit Fernstraßenplanungs- und -bau, Berlin).

Acknowledgements

Handling editors and reviewers will not be able to see this section.

We would like to thank Dr. Ulrich Zöphel (Fledermausmarkierungszentrale, Dresden) and Thomas Frank (ChiroPlan, Dresden/Steina) for support and cooperation. We are grateful to Dr. Angelika Meschede (Berlin) and Prof. Dr. Rüdiger Krahe (Berlin) for useful comments to improve the manuscript.

Conflict of interest

Handling editors and reviewers will not be able to see this section.

The authors declare no conflicts of interest.

Ethics Statement

Handling editors and reviewers will not be able to see this section.

No animals have been harmed by this monitoring study.

No fraudulence is committed in performing these experiments or during processing of the data. We understand that in the case of fraudulence, the study can be retracted by ScienceMatters.

References

1. John Altringham, Gerald Kerth
Bats and roads
In: Bats in the Anthropocene: Conservation of Bats in a Changing World, Springer, Cham/2016, pages 35-62 DOI: 10.1007/978-3-319-25220-9

2. Amy Grace Fensome, Fiona Mathews
Roads and bats: a meta-analysis and review of the evidence on vehicle collisions and barrier effects
Mammal Review, 46:4/2016, pages 311-323 DOI: 10.1007/978-3-319-25220-9

3. Taylor, P.
Rhinolophus hipposideros

IUCN Red List of Threatened Species, 2016 DOI: 10.2305/iucn.uk.2016-2.rlts.t19518a21972794.en

4. Council Directive 92/43/eec
The Conservation of Natural Habitats and of Wild Fauna and Flora.
1992

5. Wolfgang Rackow, Detlef Schlegel
Fledermäuse (Chiroptera) als Verkehrsopfer in Niedersachsen
Nyctalus, 5/1994, pages 11-18

6. Andreas Kiefer, Hubert Merz, Wolfgang Rackow, ... , Detlef Schlegel
Bats as traffic casualties in Germany
Myotis, 32-33/1995, pages 215-220

7. Zurcher Arthur A., Sparks Dale W., Bennett Victoria J.
Why the Bat Did Not Cross the Road?
Acta Chiropterologica, 12/2010, pages 337-340 DOI: 10.3161/150811010x537918

8. Robert Brinkmann, Martin Biedermann, Fabio Bontadina, ... , Wigbert Schorcht
Planung und Gestaltung von Querungshilfen für Fledermäuse
Eine Arbeitshilfe für Straßenbauvorhaben im Freistaat Sachsen. Sächsisches Staatsministerium für Wirtschaft, Arbeit und Verkehr, 2012, page 116, http://www.verkehr.sachsen.de/download/verkehr/bq_SMWA_Querungshilfen_WEB.pdf

9. Denis Medinas, J. Tiago Marques, Antonio Mira
Assessing road effects on bats: the role of landscape, road features, and bat activity on road-kills
Ecological Research, 28/2013, pages 227-237 DOI: 10.1007/s11284-012-1009-6

10. Vuk Ikovic, Mariana Durovic, Primoz Presetnik
First data on bat traffic casualties in Montenegro
Vespertilio, 17/2015, pages 89-94 DOI: https://doi.org/10.13140/RG.2.1.3113.2322

11. Nachtaktiv, Swild
Sonderuntersuchungen zur Planung und ein 10-jähriges Monitoring als Erfolgskontrolle von Schadensbegrenzungsmaßnahmen für die Kleine Hufeisennase Rhinolophus hipposideros an der Deutschen Bundesautobahn BAB17 zwischen Dresden und Prag.
Website mit den Ergebnissen und Publikationen, Erfurt & Zürich, 2021, page http://swild.ch/ottendorf DOI: 10.13140/RG.2.2.35242.13763

12. Lesiński Grzegorz
Bat road casualties and factors determining their number
mammalia, 71/2007 DOI: 10.1515/mamm.2007.020

13. Lesiński Grzegorz, Sikora Anna, Olszewski Adam

Bat casualties on a road crossing a mosaic landscape
European Journal of Wildlife Research, 57/2010, pages 217-223 DOI: 10.1007/s10344-010-0414-9

14. Wigbert Schorcht, Fabio Bontadina, Michael Schaub
Variation of adult survival drives population dynamics in a migrating forest bat
Journal of Animal Ecology, 78/2009, pages 1182-1190 DOI: 10.1111/j.1365-2656.2009.01577.x

Matters ISSN: 2297-8240 Matters Select ISSN: 2297-9239

ScienceMatters AG
Bahnhofstrasse 3
8001 Zürich