

# habitat fragmentation due to transportation infrastructure



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## EDITORIAL

Four years after the last technical workshop of the Working Group on Habitat Fragmentation due to Transport Infrastructures ([Current knowledge on vertebrate roadkills and advances in mitigating technologies 2019](#)) held in Barcelona, we met again in May-June in Seville in a joint meeting with European projects LIFE Lynx Connect and LIFE Safe Crossing (see Past Events).

Focused on “Ecological Restoration and Transport Infrastructures”, the workshop aims at serving as meeting point to think about reducing the impact of transport infrastructures on biodiversity in combination with ecological restoration. Such a goal respond to key actions to fulfil with International agreements and the future European Law on nature restoration (whose institutional management is being [trickier than expected](#)).

The organizing committee expresses its gratitude to the number of speakers and attendants (more than 200) that participated in the different sessions, showing their knowledge, interest and ideas from multiple disciplines ranging from civil engineering, tourism, biodiversity conservation and management, to landscape planning.

All relevant information could be accessed through the workshop webpage. Nonetheless, some of the most important conclusions are summarized here:

International experiences showed in the workshop demonstrated that defragmentation plans constitute important tools to boost restoration ecology actions. They should be approached from a holistic point of view, considering an integrated landscape perspective that include all biodiversity elements, and the cooperation of local stakeholders.

It is required to identify and protect ecological corridors to ensure long-term conservation of defragmentation measures. To identify such corridors, and other places where defragmentation and restoration actions are required, is crucial to use efficient models using updated high-quality information.

Discussions also highlighted the already obvious effects of climate change, not only on ecosystems, but also on infrastructures. Different experiences shared during the workshop showed several opportunities where measures enhancing biodiversity can be developed, as well as nature-based solutions. New technological and innovative developments also open new perspectives, and informed us on their long-term monitoring requirements based on standardized protocols.

Finally, we should continue promoting people awareness as well as improving communication between the biological and engineering realms, but also among different administrative departments and with stakeholders. This workshop constituted a good example on such a collaborative and cooperative environment.

**Looking forward to see you in future workshops!**

Picture: Minuartia.



## WORKING GROUP

During these months, the Working Group on Habitat Fragmentation due to Transport Infrastructures has been working on the participative process to elaborate the National Plan of defragmentation regarding Transport Infrastructures. The process was organized in four technical sessions:

Session 1: Plan introduction. General concepts and strategic lines. October 27<sup>th</sup> 2022. Espacio Ronda (Madrid).

Session 2: Actions to be included in the plan. January 12<sup>th</sup> 2023. CETA building (CEDEX headquarters, Madrid).

Session 3. Research, innovation and transference of knowledge. March 9<sup>th</sup> 2023. CETA building (CEDEX headquarters, Madrid).

Session 4. Monitoring and governance. April 13<sup>th</sup> 2023. CETA building (CEDEX headquarters, Madrid).

During these sessions, 127 people (averaging 32 per session) from national and regional governments, companies, research centers, NGO, etc. contributed to build the first draft of the National Defragmentation Plan. The preliminary version of the document was shared with all participants along with a questionnaire where further suggestions and amendments could be gathered.

**The consulting service** regarding habitat fragmentation due to transport infrastructures is still active, also giving support to project [SAFE](#). Any question on this topic can be sent to: [habitat\\_infraestructuras@ebd.csic.es](mailto:habitat_infraestructuras@ebd.csic.es)

## NEWS

### Reversing fragmentation of the special conservation area of Down Aljucen Rver and the Special Protection Area of Montijo

The building project regarding high speed railway platform entering Merida (section Cuarto de la Jara – Arroyo de la Albuera) started in July 2019. This project included the reconstruction of the section of regional road EX209 overlapping with the platform.

The owner of the road (Extremadura Regional Government) highlighted the importance of the road as one of the main entrance to the city, which invalidated the original idea of temporarily close the road.

In addition, environmental sensitivity of the area is high, including the special conservation area of "Río Aljucen Bajo" (ES4310017) that constitutes an important ecological corridor connecting Cornalvo Natural Park with the Embalse de Montijo SPA (ES0000328). This special protection area together with the Guadiana river are important habitats for water birds in the area. Therefore, the building project should account for such an environmental protection.



In terms of ecological connectivity, it should be mentioned that former regional road constituted a barrier for animal movement, as it dissected both protected areas, only providing three small bridges and a short (65m) viaduct inside the area to allow habitat connectivity.

In this context, different alternatives were discussed with the regional government, and it was finally decided to design and build a new route by using a prefab concrete viaduct of 352m, restoring to natural conditions the old section of the road by using appropriate plant species and providing some artificial nesting platforms under the viaduct.

This action was already completed, fulfilled the requirements posed by the Regional Government in terms of both access to the city and environmental sensitivity of the area, whose fragmentation was reduced. The detailed improvements to this Natura 2000 area were:

- Substantial improvement of habitat permeability along the main axes of the two areas belonging to the Natura 2000 network.
- Placement of the new viaduct, in part out of the flooded area, constitutes an underpass for terrestrial species, thus increasing habitat connectivity for them. This also reduces the risk of animal-vehicle collisions.



- The project makes available additional breeding areas provided by the removal of the former road, and under the bridge.

Source of information: ADIF High Speed Trains



### Castilla y León Regional Government installed 30 smart signaling devices in 11 roads

As informed in previous volumes (see bulletin 19 and 21), Castilla Y León Regional Government, in collaboration with the University of Salamanca developed a smart-signaling system that aims at informing drivers in real time about the risk of animals crossing the road. The system is designed in a way that only if the risk is above a certain threshold, the signal is activated. By focusing the alert to specific moments, the system aims avoiding driver habituation to signals. After the experimental phase, the Department in charge of the project (see source of information below) has installed 30 of these devices in 11 road sections where wildlife vehicle collisions are especially frequent. In Burgos Province, they were in roads CL-117 between Salas de los Infantes and Abejar, road CL-632 between Briviesca and Cornudilla, road BU-542 between Espinosa de los Monteros and Loma de Montija, road BU-820 between Úzquiza dam and Riocavado de la Sierra, road BU-904 between Covarrubias and Lerma, and road BU-925 between Peñaranda de Duero and La Gallega. In Palencia Province they were installed on road CL-615 between Palencia and Guardo and road CL-619 between Magaz de Pisuerga and Castrillo de Don Juan. In León Province they were installed in road LE-125 between Castrocontrigo and La Bañeza and road LE-420 between La Bañeza and La Magdalena. In Soria Province they were installed on road SO-920 between San Leonardo de Yagüe and El Burgo de Osma.

The smart system has three levels of signaling depending on predicted risk: off, when risk is low (the signal looks as a conventional one), yellow lights and message panel informing on high risk of wildlife vehicle collision, and red lights and the message panel informing on very high risk of wildlife-vehicle collision.



Source of Information: Dirección General de Carreteras e Infraestructuras de la Consejería de Movilidad y Transformación Digital de la Junta de Castilla y León y Universidad de Salamanca.

### Video-monitoring of ecoduct placed in high speed railway Zamora-Pedralbes-Orense at Otero de Bodas

The high speed railway Olmedo-Zamora-Puebla de Sanabria crosses one of the highest ungulate density areas within the Iberian Peninsula. Habitat requirements of these animals are high. Therefore it is frequent that linear infrastructures create habitat fragmentation of their populations. Trying to mitigate this effect, transport infrastructures are increasingly incorporating wildlife crossings as part of their regular building. In this particular case, two big crossing were built: a 120m-wide one between Perilla de Castro and Otero de Bodas, and a 130m-wide one between Otero de Bodas and Cernadilla.

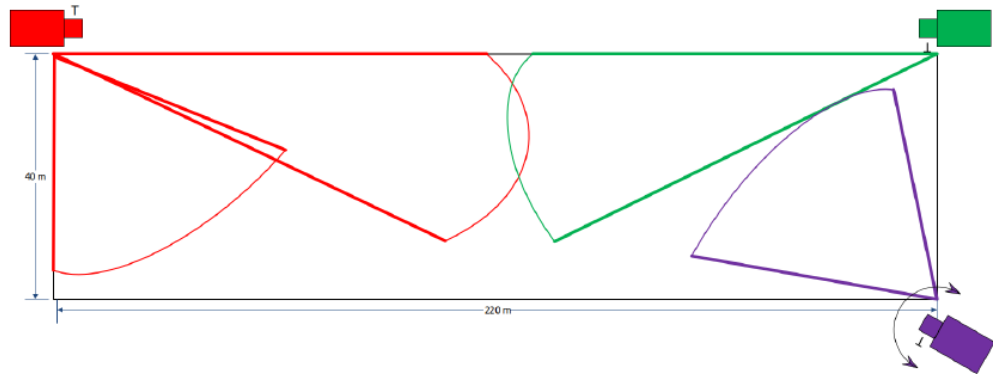


Satellite image of the viaduct. Source: iberpix, IGN

The monitoring of these crossings is complex because regular deployments (camera-traps, track-traps) are difficult to install in such a wide area and they would also require frequent visits to check the numerous traps.

For that reason, our Environmental Department established a fruitful collaboration with the Telecommunications Department to get profit from the already installed communication system aimed to inform on the infrastructure and the trains. The system could be also used to facilitate the monitoring of the wildlife crossing structures. On the basis of that system, a closed-circuit tv camera system (CVC) was implemented. This is formed by two IP cameras and a PTZ (pan-tilt, and zoom) dome camera. This allows remote surveillance, which reduces costs while increasing the quality and quantity of monitoring data.

The system is able to monitor the 130m of the crossing entrance by using two Infra red cameras and a PTZ dome camera placed at 6m above ground level. IR cameras include a video-analysis chip that allows local analysis of videos. The two IR cameras where placed at both edges of the entrance, therefore minimizing blind spots, while covering the whole entrance.



For that purpose, long-distance IR lights were used (model IIR-50850-XR, lighting range of 850 nm) to allow the camera getting images even in extremely low light circumstances (camera itself is able to get color images until 0,0077 lux). IR lights illuminate the whole scene (see picture).

The system started gathering data in September 2020, requiring further adjustment and checking. After that, the system is recording a daily rate of 50-80 ungulate's crossings, demonstrating the ability of the crossing pass to effectively provide connectivity from one side of the railway to the other.



Source of Information: ADIF high speed trains.

### **Additional actions from project LIFE SAFE CROSSING to reduce both wildlife-vehicle collisions and roadkill mortality of Iberian lynxes**

The Andalusian Regional Council for Sustainability, Environment and Blue Economy, and the Andalusian Agency for the Water and the Environment made an important investment to improve lynx visibility and road safety in different roads within the regional road network where roadkill is frequent, as committed in the Recovery Plan for the species. This was done in the framework of LIFE project SAFE CROSSING (see bulletin 17), but also in collaboration with other projects such as LIFE LYNX CONNECT (see bulletin 22), FEDER European funds and PRTR (European Union Recover and Resilience Plan), among others.

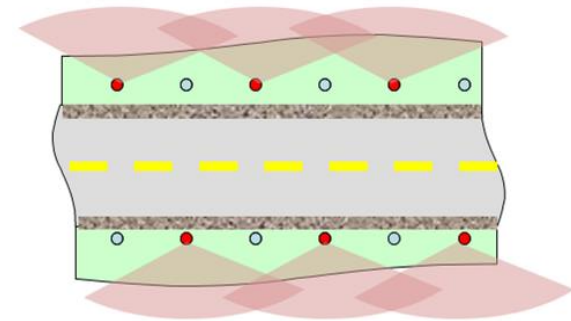
In spite of the numerous road sections where mitigating structures were developed, significantly reducing roadkill, the population recovery of the species and its subsequent range expansion is contributing to increase the number of road sections where actions are required.

The regular measures implemented in these sections were fencing, wildlife crossing structures, or modification of drainages to serve as underpasses, as well as vertical signaling. Recently, cheaper, less invasive new techniques already implemented in other countries have been also used in the framework of the project LIFE SAFE CROSSING, led by the Andalusian Regional Government. The main objective of this project is implementing actions that reduce wildlife-vehicle collisions in Italy, Greece, Romania and Spain. Actions are especially devoted to endangered species such as the brown bear, the wolf, and the Iberian Lynx.

As detailed in previous bulletins, three different devices were installed:

- Innovative Animal-Vehicle Collision (AVC) prevention tool (see bulletin 22).
- Neuromarketing-based warning panels (see bulletin 22)
- Virtual fences

Virtual fences are formed by a series of light&sound emitters placed at both sides of the road (often on side-poles). They are designed to prevent animals to cross the road when vehicles approach. As soon as devices detect a vehicle, they emit both a sound and blinking lights, which are expected to help animals to stop crossing the road. Devices are placed at 50 m from each other, they work with solar-fueled batteries, and they are quite invisible while paused, therefore they do not constitute any permanent barrier for animals.



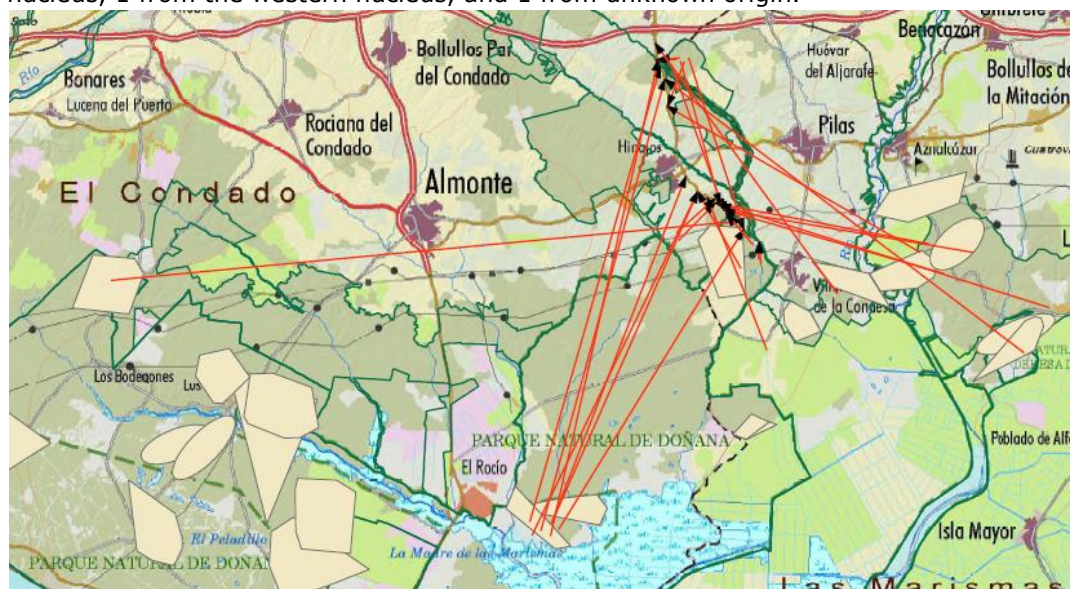
Source of Information: Andalusian Council for Sustainability, Environment and Blue Economy

### Some conclusions about Iberian lynx mortality in Road A-481

Iberian lynx subpopulation in Doñana-Aljarafe during 2022 got its maximum: 108 individuals since population monitoring started in 2002. The population has tripled in 20 years currently occupying 700 square kilometers, where almost every potential territory is occupied. In this population is possible to distinguish two nuclei: the western and the northeastern. The forested area of Cabezudos, Bodegones and La Matilla, Almonte, Moguer and Lucena del Puerto constituted the western population while the northeastern one is formed by Forested area of Matasgordas, Hinojos, Villamanrique de la Condesa, Puebla del Río and Aznalcázar (see polygons on map).

Because of this population growth and expansion, habitat fragmentation has become more conspicuous for the species in the form of boundary and edge effects (and roadkill). The most evident effect is located in Road A-481, crossing the border between Seville and Huelva provinces, more precisely between Hinojos and Villamanrique de la Condesa. In this road sector 28 roadkilled individuals were found between 2011 and 2023, but only 3 between 1985 and 2010.

17 out of 28 roadkilled individuals have territories nearby the road: 11 were born there and 6 came from other territories within the Northeastern nucleus. The remaining 11 individuals were dispersing juveniles from different parts: 9 from the Northeastern nucleus, 1 from the western nucleus, and 1 from unknown origin.



This suggests that positive population trend of the species in the area, and especially in the Northeastern nucleus (26 out of 27 individuals of known origin were from there) may explain the relative high number of roadkilled individuals.

Productivity in terms of kittens also seems to explain this trend, as roadkill numbers are lower during low productivity years. For instance, no roadkill was recorded during 2021, a low productivity year, while during years of maximum productivity (like 2020, and 2022), the number of roadkilled individuals also peaked.

This suggest BACI (Before After Control Impact) analysis should be refined to account for such variability, ideally considering more than one year for each state (before and after) to evaluate the effectiveness of mitigating actions. In this case, continuous monitoring of both camera traps and radio-collared individuals allowed detailed information on their movements and population dynamics to be gathered. This help understanding animal behavior and roadkill patterns.

In addition to mitigating actions being already implemented to reduce roadkill rates in this road section, it is clear that further grow of this population is strongly limited, as nearly all available territories are already occupied and surrounded by a non-friendly matrix that also limit or even prevent dispersal and connectivity with other nuclei of the lynx population.

Source of information: Andalusian Council for Sustainability, Environment and Blue Economy

### **Navarra Regional Government started building an ecoduct over road A-10**

As previously reported in Bulletin number 23, the Navarra Regional Government planned to build a 60m-wide ecoduct over Highway A-10 to avoid fragmentation of two Special Area of Conservation (SAC): Urbasa-Andia Mountain range and Aralar Mountain range, thus allowing movement and the subsequent gene flow among vertebrate populations at both sides of the road. The project was funded by REACT-EU funds, and the company in charge of the work that is already in progress is OBENASA. It is planned that main building process will be finished by October, and afterwards, restoration and enrichment activities will be developed on both the corridor and its neighboring areas to really create a forest corridor that connect both SAC. It is expected that further monitoring of the ecoduct give information on its effectiveness to reduce roadkill in this road.

Source of Information: Department of Rural Development and the Environment. Navarra Government.

## **PUBLICATIONS**

Benard, A. et al. 2023. A biologically realistic model to predict wildlife-vehicle collision risks. *BioRxiv* 2023.02.15.528614

Cassimiro, I. M., Ribeiro, M. C., & Assis, J. C. (2023). How did the animal come to cross the road? Drawing insights on animal movement from existing roadkill data and expert knowledge. *Landscape Ecology*, 1-17.

Cerri, J. et al. 2023. Accounting for cloud cover and circannual variations puts the effect of lunar phase on deer-vehicle collisions into perspective. *Journal of Animal Ecology* 00:1-10  
Dhiab, O. et al. 2022. Experimental evidence of increased carcass removal along roads by facultative scavengers. *Environ Monit Assess* 195: 216.

Lacroix, C., Schueler, F. W., & Rollinson, N. (2023). A 91% decline in a common anuran in an otherwise stable amphibian community inferred from 17 years of rapid road surveys. *Animal Conservation*.

Moore, L.J. et al. 2023. Demographic effects of road mortality on mammalian populations: a systematic review. *Biological Reviews* in press

Morelli, F. et al. 2023. Potential hotspots of amphibian roadkill risk in Spain. *Journal of Environmental Management* 342, 118346.

Peng, Y. et al. 2023. Analysis of moose motion trajectory after bullet train-moose collisions. *Engineering Failure Analysis* 151: 107373.

Pinto, T., Santos, S. M., Mira, A., & Sillero, N. (2023). Importance of water availability for amphibian roadkill in a mediterranean landscape. *Biodiversity and Conservation*, 32(7), 2513-2537.

Rodríguez, C. et al. 2023. Fauna atropellada: el proyecto SAFE evalúa los muestreos. *Quercus* 448:48-49

St. Clair, C. C., & Raymond, S. (2023). Mammals responded to reduced road traffic. *Science*, 380(6649), 1008-1009.

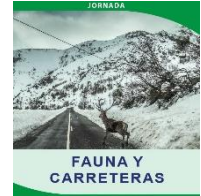
Tucker, M. A., Schipper, A. M., Adams, T. S., Attias, N., Avgar, T., Babic, N. L., & Stacy-Dawes, J. (2023). Behavioral responses of terrestrial mammals to COVID-19 lockdowns. *Science*, 380(6649), 1059-1064.

Viviano et al. 2023. Aliens on the road: surveying wildlife roadkill to assess the risk of biological invasions. *Biology* 12: 850

## PAST EVENTS

### Technical workshop on Roads and Wildlife

The Spanish Roads Technical Association organized this meeting on February 16 2023 in the College of Civil Engineers of Madrid (Almagro street 42). More [info](#).



### Sustainable land use day

Held by the Worldwide Railway Organization in Paris on February 27 in the UIC headquarters in Paris, France. More [info](#).



### Final Conference of project LIFE SAFE-CROSSING

Held in Sulmona, Italy on 17 and 18 May, 2023. More [info](#)

### Technical workshop on ecological restoration and transport infrastructures

Joint event organized by the Ministry for the Ecological Transition and the Demographic challenge and LIFE projects SAFE-CROSSING and LYNX CONNECT, this event was held in Seville from May 31 to June 2nd. Both [conclusions](#) and [talks](#) are available in the web page of the Ministry.

### ICOET 2023. International Conference on Ecology and Transportation

Organized by the Road Ecology Center (UC Davis), the 2023 conference will combine in-person and virtual programming and training ("hybrid"). The in-person conference was held in Burlington, Vermont (US) between 4 and 8 June 2023. More [info](#).



### BISON final seminar

Held at the European Council in Strasbourg on 5-9 June 2023. The final seminar itself was held from 5 to 7 June. A young researchers' day at ENGEES (École nationale du génie de l'eau et de l'environnement) was on 8 June and field visits on 9 June. More [info](#).



## COMING EVENTS

### I International Congress CONSERBIO

Organized by the University of Huelva between 14 and 17 September 2023. More [info](#)



### ACLIE + GCLIE 2023. International Conference on Ecology and Transportation

The African Conference for Linear Infrastructure and Ecology (ACLIE) will organize this event in Kenya between 18 and 21 September 2023. Despite it was initially programmed jointly with IENE (see bulletin number 23), the Global Congress on Linear Infrastructures (GCLIE) will be finally organized in coordination with ACLIE. More [info](#).



### XXVIIth World Road Congress

Organized in close cooperation between PIARC (World Road Association), the Czech Road Society and PIARC Czech National Committee, with the support of the Ministry of Transport of the Czech Republic and the Slovak Road Association on 2-6 October 2023, in Prague (Czech Republic). More [info](#)



### ANET 2023

With the motto "Resilience, recovery and restoration in a changing world", ANET is the premier event for ecologists, transport planners, regulators, construction and operation professionals, and the local community to engage on the interactions between transportation and ecology. The conference will be held in the Christchurch Conference Centre from 27 to 29 November 2023. More [info](#)



### Transport Research Arena 2024

The foremost European transport event that covers all transport modes and all aspects of mobility will be held in Dublin, Ireland from 15 to 18 April 2024. More [info](#)



As part of the European project COST 341 on Habitat fragmentation due to transportation infrastructure and its continuity by the Working Group actions, various resources have been created to contribute to the knowledge and mitigation of impacts of habitat fragmentation caused by transport infrastructures.

The following documents have been published:

- **COST 341. La fragmentación del hábitat en relación con las infraestructuras de transporte en España.** (Habitat fragmentation due to transportation infrastructure in Spain). Review of the state of the art, published in 2003.
- **COST 341. Wildlife and traffic. A European Handbook for Identifying Conflicts and Designing Solutions** (40 MB). Published in 2003 as a coda to Action 341, drawn up by experts from various European countries.
- **COST 341. Fauna y Tráfico. Manual europeo para la identificación de conflictos y el diseño de soluciones** (33 MB). Published in 2005; a translation of *Wildlife and Traffic*.
- Series **Documentos para la reducción de la fragmentación de hábitats causada por infraestructuras de transporte** (Documents for the reduction of habitat fragmentation caused by transport infrastructure).
  - **Nº 1. Prescripciones técnicas para el diseño de pasos de fauna y vallados perimetrales** (1.8 MB) (Technical prescriptions for the design of wildlife passages and perimeter fences). In 2008 the Catalan version of this document was published **Prescripcions tècniques per al disseny de passos de fauna i tancaments perimetrals** by the Department of the Environment and Housing, Regional Government of Catalonia.
  - **N 1. Technical prescriptions for wildlife crossing and fence design. (Second edition, revised and expanded)** (5.5 MB). English version of the previous document. Published in 2016.
  - **Nº 2. Prescripciones técnicas para el seguimiento y evaluación de la efectividad de las medidas correctoras del efecto barrera de las infraestructuras de transporte** (2 MB) (Technical prescriptions for monitoring and evaluating the effectiveness of measures to correct the barrier effect of transport infrastructure). Published in 2008.
  - **Nº 3. Prescripciones técnicas para la reducción de la fragmentación de hábitats en las fases de planificación y trazado** (45 MB) (Technical prescriptions for the reduction of habitat fragmentation in planning and alignment phases). Published in 2010.
  - **Nº 4. Indicadores de fragmentación de hábitats causada por infraestructuras lineales de transporte** (31 MB) (Indicators of habitat fragmentation due to linear transport infrastructures). Published in 2010.
  - **Nº5. Desfragmentación de hábitats. Orientaciones para reducir los efectos de las carreteras y ferrocarriles en funcionamiento** (53 MB) (Habitat defragmentation. Guidelines to reduce the effects of operating road and railway networks). Published in 2013.
  - **Nº 6. Identificación de áreas a desfragmentar para reducir los impactos de las infraestructuras lineales de transporte en la biodiversidad** (12.4 MB) (Identification of areas to defragment to reduce the impacts of linear transport infrastructure on biodiversity). Published in 2014.
  - **Nº 7. Efectos de borde y efectos en el margen de las infraestructuras de transporte y atenuación de su impacto sobre la biodiversidad** (3.23MB) (Edge and barrier effects in transport infrastructures. Minimizing their impact on Biodiversity). Published in 2019
  - **Nº 7. Edge and verge effects of transport infrastructure. Mitigating their impact on biodiversity** (2,8 MB) Published in 2021.
  - **Nº 8. Prescripciones técnicas para hacer efectivos los seguimientos de las medidas de mitigación del efecto barrera de las infraestructuras de transporte (diseño, documentación y archivo del seguimiento ambiental)** (7.19 MB) (Technical prescriptions to make effective the mitigating measures of the barrier effect of transport infrastructures. Design of environmental monitoring, documentation, and archive). Published in 2020.

For further information, see the [MITECO](#) and [IENE](#) sites.

- This publication is part of the project 'Habitat fragmentation due to Transportation Infrastructure', which is promoted by the Sub-Directorate General for the Terrestrial and Marine Biodiversity, Directorate General of Biodiversity, Forests, and Desertification, and carried on in collaboration with EBD-CSIC.
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