

# habitat fragmentation due to transportation infrastructure



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## EDITORIAL

The knowledge on the state of wildlife crossing structures in both roads and railways in terms of their suitability for animal use is crucial to evaluate the potential permeability of transport infrastructures and the ability of crossings to reduce barrier effect by increasing connectivity.

In the web of the Ministry for the Ecological Transition, it is possible to see the [Location of Crossing Structures Potentially Useful for Wildlife](#), classified according to their fulfillment of criteria given in the [Technical prescriptions for wildlife crossing and fence design](#) (second edition, revised and expanded).

When crossing features were analyzed, we found that only 8.6% of them met the requirements of the Technical Prescriptions. The most frequent shortcomings were related to dimensions, lack of dry ledges in drainage culverts placed in flood-prone areas, inadequate substrate, vegetation around the crossing, and fencing. Despite all crossing structures complying with Technical Prescriptions were viaducts, not all viaducts fulfilled the prescriptions.



Although some of the limitations found are difficult to fix, such as dimensions, the presence of unbridgeable obstacles or the distance to the nearest infrastructure, some others require relatively low investment (either in the form of money or as collaboration with different entities and organizations) to be adapted to prescriptions. This effort would be a good pay off to improve the current transportation infrastructure network and make it more environmentally friendly.

In fact, it would be a good way of completing the actions proposed in the environmental assessment of the projects that were insufficiently developed.

For this reason, we found appropriate to encourage the review and improvement of crossing structures. Additional funding required to do that job may come from the remaining budget of the projects, or using compensatory measures that fit to these actions.

In this scenario, we encourage administrations and companies to share information on the structures that are being improved: their location, type, and other features to build a database and related viewer. These tools would allow evaluating the increasing permeabilization process of our transport infrastructures, as well as the support given by these companies and administrations to the objectives of the Working Group on Habitat Fragmentation due to Transportation Infrastructure. This information could be sent to [galvarez@miteco.es](mailto:galvarez@miteco.es)

## WORKING GROUP

During the last year, the Working Group on Habitat Fragmentation due to Transportation Infrastructure has been quite busy because of the two documents of Technical Prescriptions that are being launched by the group. The contributions made by different members of the working group help improving different aspects of the two documents. In fact, the annual meeting of the working group was held in October 2018, but an additional meeting was required in March 2019 to agree on the contents of the pre-print version of the document: *Efectos de borde y efectos en el margen de las infraestructuras de transporte y atenuación de su impacto en la biodiversidad* (Edge effects of transport infrastructures. Mitigating its impact on biodiversity) before it was sent to press. Likewise, there is a second document in a early writing stage. It is the third version, revised and expanded of the document *Prescripciones técnicas para el seguimiento y evaluación de la efectividad de las medidas correctoras del efecto barrera de las infraestructuras de transporte* (Technical prescriptions for monitoring and evaluating the effectiveness of mitigating measures for barrier effect of transport infrastructures). Although the second edition was simply a reprint made by a different publisher (the National Parks Autonomous Organism published the first one, and the Ministry of Agriculture published the second), this third edition does constitute a real update.



This new version incorporates the very recent legal changes prevailing since January 2019, which imposes higher protection levels (especially regarding hydrologic and hydromorphological resources or the impact of climate change), and higher quality standards for technical documentation of the environmental assessment process. In addition, this document uses information from more than 1.000 crossing structures monitored during the last 10 years in almost 50 transport infrastructures across Spain. This information is used to find weakness points regarding the monitoring of crossing structures where further effort should be done. Therefore, this new edition helps improving the current knowledge on the effectiveness of crossing structures by considering the most recent technical and scientific findings, but also pointing to the protocols and procedures where weakness points were found. With this information it is possible to offer the set of good practice measures for the design, development and documentation of studies aiming to monitor the effectiveness of actions planned in the environmental assessment of transport infrastructures. Such measures are designed to prevent, mitigate or compensate the impacts of the transport infrastructure on the environment. The preliminary results of this study will be presented in the International Conference on Ecology and Transportation (ICOET) to be Held in Sacramento, California in September (see coming events).

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

## NEWS

### **Project LIFE LINES in Portugal. Linear Infrastructure Networks with Ecological Solutions**

This project is running from 2015 to 2020 in Portugal. It belongs to the LIFE program of the European Union, and it is led by Professor Antonio Mira, from Évora University. Other partners are Porto University, Aveiro University, and several stakeholders from the transport, energy, and development sectors, as well as some local and regional governments. It is funded with more than 5 million euros and its objectives are to evaluate and disseminate the activities aiming to mitigate the negative impacts of transport infrastructures on wildlife, and at the same time to encourage building a demonstrative green infrastructure based on ecological corridors that improve local connectivity and biodiversity conservation at the local and regional levels. These are common goals shared by all professionals involved in mitigating the impact of transport infrastructures. The project has coordinated different actions devoted to improve the public awareness on the impact of infrastructures such as meetings, campaigns, volunteers' training, etc. It also supported direct actions such as building crossing structures, amphibian and owl barriers, removal of invasive plants from road verges and margins of the regional road network, and planting of local species. This project is the responsible of organizing the IENE Conference that will be held in Évora in 2020 (see coming events).

Source of Information: editorial team

## **The Gipuzkoa regional government is pioneering the use of recyclable materials in road pavement**

The Gipuzkoa Regional Government is evaluating the use of cold mix paving. In this procedure, the paving mix reaches a maximum temperature around 40 Celsius degrees, which is much lower than conventional paving that reaches 180 Celsius degrees. This helps reducing the spreading of pollutants, and energy wasting during the process (up to 50% less fuel than in the conventional procedure). In addition, the cold mix and the related process are safer for workers, and can be used even in cold and rainy days. The regional government aims to generalize the use of cold paving in all regional roads suitable for it.

Source of information: editorial team.

## **Barriers inventory in rivers as a management action for habitat defragmentation**

Preserving biodiversity in aquatic ecosystems require a proper knowledge on their conservation status and their threats, especially those regarding habitat fragmentation. Transport infrastructures constitute a source of threats that jeopardize connectivity in these ecosystems, and their impact on both habitats and species should be evaluated.

Lack of connectivity and streams de transport infrast normally associate and drainages. Th state of the suppo frequently produ fragmentation because erosive generally strong natural river bed supporting structu artificial steps tha barriers for the n aquatic organis looking for habitat, roou or shelter.



Confederación Hidrográfica del Ebro

It has been estimated that 90% of non-regional rivers suffer from this lack of linear connectivity. For that reason, the Spanish Department of Water (Dirección General del Agua) is identifying, characterizing, evaluating and mitigating the barrier effect of transport infrastructure on aquatic ecosystems since 2017. They built a barrier inventory in all water bodies of the "river" category. This inventory is based on the information given by the different administrations responsible of river catchment areas, but updated with more than 6.400 new elements (summing up a total of 25.000). All of them will be evaluated in terms of ecosystem fragmentation, using a common protocol ([Protocolo de caracterización hidromorfológica de masas de agua de la categoría río](#)), recently published. This protocol allows to characterize river continuity depending on how bridgeable are those artificial barriers that prevent aquatic organisms to move up and down the river. The protocol also allows rivers to be classified according to their degree of fragmentation.

In this framework, the Department of Water is also supporting the application of measures to recover habitat connectivity along rivers, by removing or permeating obstacles, as well as using different bypass systems for aquatic animals.

Source of information: Dirección General del Agua. Miteco

## **Project Road Impact on predator-prey relationships**

This project is running for 4 years since March 2019. It is funded by the Madrid Regional Government, and it is led by Rafael Barrientos, from the Biodiversity, Ecology and Evolution Department of the Complutense University of Madrid. It is based on two main research lines, strongly interconnected: the nature and persistence of hot spots of vehicle-wildlife collision, and the impact of transport infrastructures on food webs. In the first research line, car surveys will be carried out to find carnivore carcasses along predetermined road sections and compare results with a previous survey (Barrientos and Bolonio 2009. Biodivers. Conserv.). In the second research line, a camera-trapping sampling will be developed in 45 cells of 10 x 10 km to evaluate the sensitivity of the carnivore community (as a whole and species by species) to road density. Density of key prey such as the European rabbit and vegetation will be used as covariates. Carnivores are expected to be more sensitive to roads than prey-species. Therefore, prey species may prefer to settle close to road because of the lower predator pressure. A literature review will check whether other studies also found an influence of roads on the prey-predator relationship.

Source of information: Rafael Barrientos Yuste. Universidad Complutense de Madrid

## **Law 7/2019 on the environmental and economical sustainability of Formentera Island. BOE 67. March 2019**

As described in the rationale of the law, Formentera Island has a surface of 83.2 km<sup>2</sup> and a road network of 38.5 km. Permanent population is about 14000, and the vehicle fleet is about 21.000, half of them devoted to renting (2.000 cars and 8.000 motorbikes). Additionally, 40.000 vehicles arrive each year by sea route (the majority during the peak season). This dramatic increase of people and vehicles constitutes an environmental risk because of the small size of the island and the numerous natural areas with different protection levels due to ecological, landscape or urbanistic reasons (Natura 2000 network, natural areas of especial interest, etc.). All these areas are somehow threatened by the overcrowding tourism because of the close proximity of towns and roads.

Formentera is therefore the first Spanish island that limit the number of arriving vehicles to better protect the environment and mitigate the impact of roads. The law will establish a limit in the number of vehicles that can run through the island during the peak season. Such a limit will also apply for renting. It also encourage the use of public transport and sustainable mobility. The limit in the number of vehicles will be established every year or every two years by the Regional Government. This limit will determine the number of permits given for that period. People and companies should apply for such a permit that will also have a fee.

Source of information: Editorial team

### **Innovative warning signs in La Rioja**

As a joint work with different companies and institutions, the Regional Government of La Rioja has developed several initiatives regarding road signs and markings, and road safety. First, they have developed tougher road signals to be used in mountain areas. There, free-ranging livestock use warning signs and their poles for scratching, causing damages to them that require frequent replacement. New warning signs are made of rubber, coming from recycled tires, and attached to PVC poles, also coming from recycled windows. The result is a more elastic sign's pole able to flex up to 30% and return to the original position.



Regarding road safety, they have focused on motorbikes, designing a new road barrier made of recycled rubber, also coming from recycled tires, and attached to the pole by means of a shock absorber aiming to avoid any additional injury to riders. They have also designed a new warning sign that help motorbike riders to negotiate curves, indicating them the best place to take the curve either by schematic vertical signs or by using opened arrows painted close to the border line or to the center line, depending on the curve (see picture).



They are also developing an automatic system to detect bike riders in the road and alert drivers. This improves the safety of bike riders, but also constitutes an interesting experience with lessons that may be applied to similar initiatives such as automatic wildlife detection systems that may help drivers to better cope with the presence of them in the proximity of roads.

Source of information: Regional Government of La Rioja

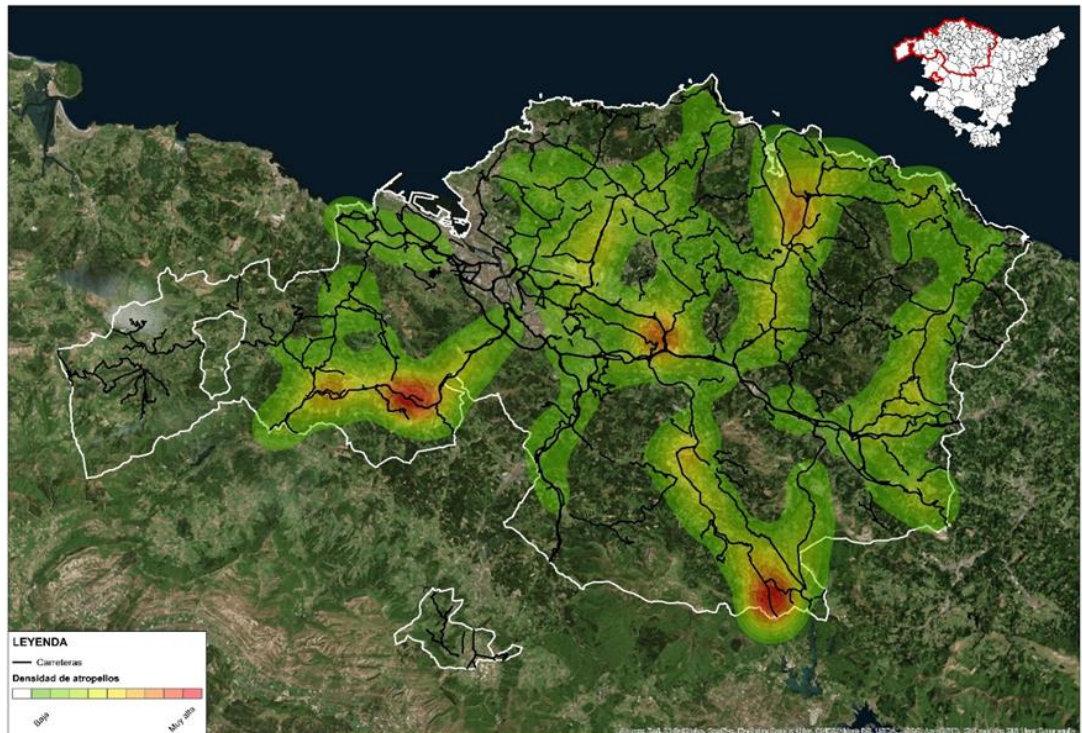
### **Campaign of public awareness in Murcia to avoid road killing in natural areas**

The wildlife hospital *El Valle* reported 99 animals coming from road collisions last year, which constitutes the third cause of admission in the hospital. For this reason, the Regional Government of Murcia has designed a campaign to improve the public awareness about this topic. The campaign also aims at encouraging good driving practices to prevent and minimize the number of animal-vehicle collisions. They have designed different materials, and media such as posters, cartoons, tales, and videos to share via web or social networks. They also organized workshops, talks, meetings, and volunteers training. A mobile app will be also available. The campaign includes management actions on both paved and unpaved roads, such as speed bumps in high risk areas, as well as vertical signals informing on the risk of collision with wildlife. They are also writing a protocol on what to do in case of a collision or in case of finding an injured animal. Finally, they are working on improving and boosting the identification of hot spots of vehicle-wildlife collision in protected areas as part of the species-monitoring program of the Regional Government.

Source of information: editorial team

## Study on the permeability of transport infrastructures in Bizkaia based on a data base of wildlife-vehicle collisions

The Regional Government of Bizkaia is developing several studies on the importance of road killing in its road network based on data from 2008 to 2018. In this period, they recorded more than 4.000 collisions involving both domestic and wild animals. They have focused on wildlife to evaluate whether casualties clumped, thus defining hot spots of vehicle-wildlife collision, and therefore those areas where the barrier effect of transport infrastructures is highest. Information on road-kill animals did not define any particular road sector with higher risk. For this reason, they performed GIS-based analyses (kernel density) to see the areas where collision probability is higher.



The results of this analysis show 5 areas with high density of collisions (reddish areas in the map). These areas were visited to characterize them in terms of land uses, EUNIS habitat type, slope, etc., and evaluate whether these features may explain the high probability of collision. The analysis of kernel density allows prioritizing those areas where improving permeability should be done first by means of improving the suitability of drainage and other structures to serve as wildlife crossing, fixing fences, or creating new wildlife crossings that will be part of the green infrastructure (corridors) of the region.

Source of information: Regional Government of Bizkaia

## Regional plan to eradicate Pampa grass in Asturias

The eradication plan of the Pampa grass (*Cortaderia selloana*) in Asturias started past year in the western part of the region. The Regional Government removed a total of 2.815.265 plants from 284 places belonging to 20 different villages (yellow dots in the map). They used mechanical and chemical treatments. This year, they started in June, covering a similar area, checking treated areas, but also treating new areas towards the center of the region. During the first two years, the plan is especially focused in the western part of the region. The third and fourth year will be focused on the eastern part, sequentially delimitating the expansion area of the plant.



The plan was designed by Professor of botany Tomás Díaz, from the University of Oviedo and it has an horizon of 7 years, when all individuals should be eradicated. The plan started in the areas where the density is lower, and it will finish in the areas where they found the highest density (Oviedo). The process is long, and one of the hardest points is obtaining all required permits from landowners to carry out the treatments. For instance in Avilés there are several landowners involved, including the Railway Administration Agency and the Regional Government. The application of the *National Strategy of Control and Potential Eradication of the Pampa Grass* would open the possibility of acting directly on the plants with no explicit permit from the landowner. The plan includes herbicide treatment with glyphosate, and mechanical pull out of individuals. 26% of inventoried individuals (green dots in the map) are distributed following the regional road network, mainly from east to west along highway A-8 (Cantabrian Highway), which highlights the importance of transport infrastructures in the spreading of this invasive plant.

Source of information: Regional Government of Asturias

### **Workshop on how to characterize and measure wildlife crossings in transport infrastructures**

In a review of studies on wildlife crossings that connect both sides of transport infrastructures, the Ministry for the Ecological Transition found a high heterogeneity in both type assignment and measurement of dimensions, even among different working groups within the same study. This indicates the lack of sufficiently detailed and standardized protocols to carry on this work in the field. For instance, drainages and viaducts are frequently mixed up in small infrastructures. Height of viaducts was also measured following different criteria. Descriptions and measurements of complex crossing structures (those composed of more than one crossings because of e.g. supporting structures) shown the highest heterogeneity. This enormous variation may confound results, decreasing the reliability and robustness of data. It also prevents these data to be incorporated to meta-analyses (pooling data from different projects). This heterogeneity is also detrimental to understand and interpret data from studies that monitor the effectiveness of crossing structures in relation to their features. Literature is also poor in providing detailed methods on how crossing characterization was done. For these reasons, the Ministry for the Ecological Transition organize this workshop, aiming to help solving this issue and harmonize data gathering regarding wildlife crossing structures. During the meeting, it is planned to agree on the standardized criteria to be used when measuring these structures in the field. The workshop (morning and afternoon sessions) will be held on October 2<sup>nd</sup>, 10:00 A.M. in the Ministry headquarters (San Juan de la Cruz square, room A-631). Because of the limited capacity of the room, assistants should write an e-mail to [galvarez@miteco.es](mailto:galvarez@miteco.es) to show their interest in the workshop, also providing information that allows evaluating their fitting to the topic of the workshop.

Source of information: Dirección General de Biodiversidad y Calidad Ambiental. MITECO

## **PUBLICATIONS**

Donazar, J.A., Ceballos, O. and Cortes-Avizanda, A. 2018. Tourism in protected areas: Disentangling road and traffic effects on intra-guild scavenging. *Science of The Total Environment* 630: 600-608.

Longcore, T. et al. 2018. Rapid assessment of lamp spectrum to quantify ecological effects of light at night. *Journal of Experimental Zoology* DOI: 10.1002/jez.2184

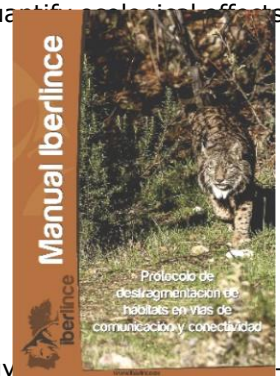
Life+Iberlince (LIFE10NAT/ES/570). Protocol for defragmentation of habitat around roadways and connectivity. [Pdf](#)

Plante, J., Jaeger, J.A.G., Desrochers, A. 2019. How do landscape context and fences influence roadkill locations of small and medium-size mammals? *Journal of Environmental Management* 235: 511-520

Polak, T. et al. 2018. Optimal planning to mitigate the impacts of roads on multiple species. *Journal of Applied Ecology* 2664.13258

Seymoure, B.M., White, J. 2019. Connecting spectral radiometry of anthropogenic light sources to the visual ecology of organisms. *Journal of Zoology* doi:10.1111/jzo.12656

Sillero et al. 2018. A road mobile mapping device for supervised classification of amphibians on roads. *European Journal of Wildlife Research* 64-77



Smith, L.L. et al. 2018. Biological connectivity of seasonally ponded wetlands across spatial and temporal scales. Journal of the American Water Resources Association 1-20.

Sobrino, N., Monzón, A. 2018. Towards low-carbon interurban road strategies: identifying hot spots road corridors in Spain. Sustainability 10: 3963.

## PAST EVENTS

### **Transportation Research Board Annual Conference.**

Organized by the Transportation Research Board in Washington D.C. USA. January 13 – 17, 2019. More [info](#)

### **Impacto de las carreteras en aves (Impact of roads on birds)**

The local group of the Spanish Ornithological Society (SEO) organized a talk given by Juan Domingo Delgado, from University Pablo de Olavide in the Science House of Seville. The talk was about the effects of transport infrastructures on bird populations, especially focusing on Andalusia.

### **African Conference for linear infrastructure & Ecology**

Held from 10 to 15 March 2019, in Skukuza Rest Camp, Kruger National Park, South Africa. The Working Group on Habitat Fragmentation due to Transportation Infrastructure presented a talk and a poster. More [info](#)



### **15th World Conference on Transport Research.**

Organized by the World Conference on Transport Research Society in Mumbai, India. May 26 – 31, 2019. More [info](#)

### **Pathways to Greener Transport Infrastructure. Conference on solutions and policy options for sustainable road & rail networks in Europe.**

Organized by the Project TRANSGREEN in Bucharest, Romania on June 25, 2019. More [info](#)

## COMING EVENTS

### **International Conference on Ecology and Transportation.**

From 22 to -26 September 2019. Sacramento, California (USA). The Working Group on Habitat Fragmentation due to Transportation Infrastructure will present a talk. More [info](#)



### **Seminario sobre tipología y mediciones de pasos de fauna en vías de transporte (workshop on how to characterize and measure wildlife crossings in transport infrastructures)**

October 2<sup>nd</sup> 2019. Room A-631, Ministry for the Ecological Transition. San Juan de la Cruz square, Madrid (Spain). Limited capacity. Registration by e-mail to [galvarez@miteco.es](mailto:galvarez@miteco.es)

### **World Road Congress.**

Organized by the World Road Association in Abu Dhabi, United Arab Emirates. From 6 to 10 October, 2019. More [info](#)

### **Jornadas técnicas del Grupo de trabajo de fragmentación de hábitats causada por infraestructuras de transporte (Technical meeting of the Working Group on Habitat Fragmentation due to Transportation Infrastructure)**

Wildlife mortality in transport infrastructures. State of the art and methodological advances. Organized by the Ministry for the Ecological Transition and the Department of territory and sustainability of the Catalonia Government. October 24 – 25, 2019. Museu de Ciències Naturals de Barcelona (Spain). Registration open until September 30. More [info](#)

### **II Congreso Iberoamericano de Biodiversidad e Infraestructura Viaria – CIBIV (Iberoamerican congress on biodiversity and transport infrastructures)**

Organized by the Instituto Tecnológico Metropolitano in Medellin, Colombia. November 28 - 30, 2019. More [info](#)

### **IENE 2020 International Conference**

Organized by the project LIFELINES. Linear Infrastructure Networks With Ecological Solutions. Évora, Portugal. April 6-9 2020. More [info](#)

## DOCUMENTS OF THE WORKING GROUP

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 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 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** (Identification of areas to defragmentate to reduce the impacts of linear transport infrastructure on biodiversity). Published in 2014.

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

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