habitat fragmentation due to transportation infrastructure

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PREVIOUS NEWSLETTERS

EDITORIAL

The Ministry for the Ecological Transition resumes the publication of this bulletin after a gap due to budgetary constraints. Its aim continues to be serving as information hub that allows knowing the activities performed by transportation and environmental agencies, both national and regional, in relation to habitat defragmentation.

The main topic of this issue is the ongoing process of publishing a new volume of the series *Documents for the reduction of habitat fragmentation due to transportation infrastructure* focusing on the edge effects caused by transport infrastructures, as well as the effects that occur within road and railway verges.

This document reviews the current knowledge about these topics. Both kinds of effects occur at the edge of the infrastructure, but they differ spatially and functionally in the way they impact the environment. While edge effects spread perpendicularly from the infrastructure to the surrounding environment showing a declining incidence as we move away from the infrastructure (the closer, the stronger the effect), the effects that occur in the verges do not show such an spreading component to the surrounding habitat, but mainly occur along the infrastructures, conditioning the movement of organisms, or water, between others.

Despite these effects are never mutually exclusive, in this document we separated those whose spreading effect into the environment is more important from those where the effect along the infrastructure is predominant. Recent studies suggest a change in the way we perceive road margins and verges, from both the geomorphological and hydrologic point of view, and considering their revegetation as an ecological process instead of a gardening activity. A cumulative number of studies also stress the importance of reducing light and acoustic pollution, especially in protected and other sensitive areas. These effects were partially covered in previous documents of the series, such as number 4: *Indicadores de fragmentación de hábitats causada por infraestructuras de transporte [Indicators of habitat fragmentation produced by transport infrastructures]* and the second edition of the number 1: *Prescripciones técnicas para el diseño de pasos de fauna y vallados perimetrales [Technical prescriptions for the design of wildlife passages and perimetral fencing].* In these documents, several edge effects were identified: spread of pollutants, noise and vibrations, light pollution, anthropogenic disturbance. As effects that occur within verges, the creation of new habitats, and the guiding effect on water, sediments and organism's movements, were also considered.

All these effects will be considered in depth in the new document, offering updated information from sound international scientific and technical reports. As previous documents of the series, technical prescriptions to prevent or mitigate these impacts will be also offered. In addition, this document also includes the effect of invasive plants arriving to, establishing in and dispersing from transport infrastructures, as well as other conflictive species such as the European rabbit that may produce damages to them, especially in cuttings and embankments, due to their digging habits. Finally, this document also explores the role of transport infrastructures as starting points of forest fires.

WORKING GROUP

In spite that it was not possible to disseminate the activities of the **Working Group on Habitat Fragmentation due to Transportation Infrastructure** (part of the Spanish National Commission on Natural Heritage and Biodiversity) during the past four years, the Group, which has been running since 1999, has been active. It is composed by representatives of agencies and administrations in charge of infrastructures, traffic and the environment, both at national and regional levels. It is led by the *Subdirección General de Biodiversidad y Medio Natural* as part of the Ministry for the Ecological Transition. Its goal is developing a common inter-professional and inter-administrative understanding to implement solutions to prevent or reduce fragmentation caused by transport infrastructures.

The working group meets annually to share information and experiences, as well as to agree and coordinate on new activities. One special feature of the group is its methodology, based on the respectful communication among its members, regardless of their areas of expertise, as well as long-term, common understanding of the terms and concepts to be used in the group. The group uses proactive and inclusive messages, and active hearing to ensure a proper understanding. All statements and proposals are given the same importance irrespectively of their discipline (i.e. engineering and environmental sciences). Data, conflicts, solutions, and results from different projects are shared in the group. On the basis of this common understanding, knowledge, and experiences, the group produces general recommendations that are compiled in handbooks on good practices called "technical prescriptions". These manuals sequentially focus on different topics related to the fragmentation caused by transport infrastructures, giving reliable and realistic solutions from a scientific and technical point of view.

Based on this methodology, the regional government of Extremadura also created a working group with similar features (see news below), and other regions are also expected to create their own regional working groups.

During the last years, a reviewed and extended version of document 1 in the series *Documents for the reduction of habitat fragmentation due to transportation infrastructure* has been published, both in Spanish and in English, which has improved its international dissemination.
Nowadays, two new documents are being prepared: the above-mentioned edge effects and other effects within verges of transport infrastructures, and the updated and extended version of document number 2: *Technical Prescriptions for the monitoring and evaluation of the effectiveness of corrective measures of barrier effects produced by transport infrastructures.* Contents for these documents are being developed by researchers lead by Eloy Revilla (Estación Biológica de Doñana, CSIC), with comments and suggestions from the working group. The first document is planned to be published in the first semester of 2019, while the second document is expected to be published in 2020.
This research group is also providing a new service for questions on habitat fragmentation due to transport infrastructures, and potential solutions, available at habitat_infraestructuras@ebd.csic.es

NEWS

New regional working group in Extremadura

The Regional environmental agency of Extremadura (DGMA) created in 2016 a working group that replicates the methods used in the National Working Group on Habitat Fragmentation due to Transportation Infrastructure. Thus, it has representatives from both the National and the Regional agencies of infrastructures and the provincial governments of Caceres and Badajoz. The group meets annually, applying the technical prescriptions suggested by the National working group. To conduct their activities, they follow internal agreements between the above-mentioned agencies, approved by the Govern council or the legal services of the different administrations.

Among other activities, they have removed invasive plants from road verges and margins of the regional road network, this action being still active in country-based infrastructures. All these actions were highly successful.

An specific agreement has been established between DGMA and the transport infrastructure agency for the conservation of the Pyrenean desman in the Gredos Mountain range and the Jerte river valley. The aim is to avoid river fragmentation and improve connectivity along riverbeds by means of adaptation of some bridges and culverts.

The DGMA, the transport infrastructure agency and the provincial government of Badajoz continue collaborating in the Life project Iberlince. In this framework, they have modified some perimeter fencing, and improved wildlife crossing structures and the signaling to alert drivers on the potential encounter with animals on the road. The Transport infrastructure agency funds these actions, and they are conducted by the DGMA, who is also in charge of the monitoring of these actions. For instance: after adapting a section in E-103 road where a lynx was road-killed, no additional casualties with this species have been recorded. Redirecting the fencing for one of the wildlife crossing structures was a cost-effective action. During the video-monitoring of crossing structures, one female lynx was observed while she trained her cubs to use a wildlife crossing structure. It was also observed that spraying the crossing with lynx urine speeds up its use by lynxes and other carnivores.

In agreement with the traffic agency, the maximum speed of some road sections was reduced down to 70 km/h. In roads adjacent to a river belonging to the Natura 2000 network, the speed was reduced down to 50 km/h. The traffic police is also using mobile traffic radars in road sections where lynx casualties have been recorded. They also strengthened surveillance during the period of lynx reproduction. More road signaling is being installed in areas where lynx reintroduction is planned or IT has been already done. According to information gathered during meetings with representatives of driving schools, NGO, and local councils, it seems that lynxes use roads quite frequently during foraging.

DGMA is getting funds from ongoing projects on defragmentation, but led by other entities. This is the case of an Interreg 5a cooperative project in collaboration with the Portuguese administration. This project aims at improving connectivity in the area of influence of the Alqueva dam. The Portuguese Ministries of the Environment and Infrastructures, as well as the public company in charge of the dam (EDIA) are also partners in this project. Other funds come from the EU (Life+ program), SUDOE, and from the Regional agency of Infrastructures, which is fully involved in these activities, placing new signaling in a 20-30 km road section to inform the public, and make them more sensitive to the lynx reintroduction project.

The regional infrastructure agency found crucial the maintenance of road verges and margins, according to technical prescriptions to reduce casualties. Because of recent modifications of the Spanish hunting law, insurance companies can make responsible the regional infrastructure agency of casualties involving game species in road sections that cross hunting grounds. Therefore, they will continue applying mechanical methods for the maintenance of road verges and margins, while avoiding the use of herbicides.

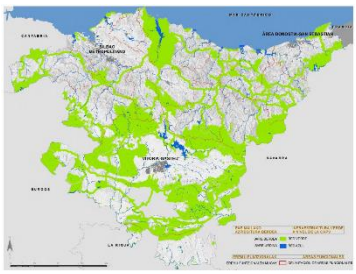
Green Infrastructure Program of Catalonia

During 2017, Catalonia developed its Green Infrastructure Program (PIVC) 2017-2021. In addition to the European directives and the *National Strategy of Green infrastructure, ecological connectivity and restoration*, the reference framework for this program is the *Strategy for the natural heritage and biodiversity of Catalonia 2030*. One of the action lines of this strategy is developing and applying a program of improvement and restoration activities of the green infrastructure.

One of the main objectives of the program is restoring ecological connectivity. Among other, this includes habitat defragmentation measures focused on transport infrastructures. Those actions included in the program are based on previous studies and planning and management instruments together with expert criteria gathered from different units within the Department of territory and sustainability (DTES). Finally, a GIS analysis was carried on to identify particular defragmentation actions. To locate and prioritize them, different information layers were used: main and secondary ecological corridors, as well as critical points identified in the ecological connectivity maps, as well as casualties, and their aggregation points (black spots). The document number 6 of the series *Documents for the reduction of habitat fragmentation caused by transport infrastructures* (MAPAMA 2013) was also considered as source of critical points where defragmentation should be considered. In addition, the ecological value of the area for habitats, protected areas (Red Natura 2000 etc), particular animal and plant species (endangered species for which the DTES has detailed information) was also considered in the prioritization process.

Around 40 out of the 100 actions considered by the program are devoted to improve permeability of transport infrastructures, corresponding to 89 cells identified by the document number 6 above mentioned.

Provisional approval of the guidelines of territorial planning in the Basque country



These guidelines (hereafter DOT) are the general reference framework for territorial and urban planning in the Basque country (hereafter CAPV), which will determine further planning, programs and actions developed by different public administrations.

The document includes a chapter on green infrastructures, and ecosystem services with three main objectives: introducing the concept of green infrastructure to be considered further, establishing the Basque green infrastructure, which is the one to be considered by the DOT, and establishing guidelines to develop the green infrastructure through the territory and urban planning.

As introduction to the concept, the definition given by the EU is assumed, highlighting concepts such as inclusive, open, multi-scale, multi-purpose, and multi-profitable infrastructure. Within the multi-purpose section is where ecosystem services are considered.

The green infrastructure includes protected areas, areas belonging to the Natura 2000 Network, the network of ecological corridors (defined in a previous study by the Regional Government in 2016) and other areas that, in spite of lacking protection, are required for the system functioning.

Among the guidelines to develop the green infrastructure in territory and urban planning, the crossings with transport infrastructures are considered, requiring the participation of the planning tools developed in the DOT (Partial territory planning) to define and develop those mitigations actions that improve connectivity. For instance, one of the guidelines state: *the location and design of any infrastructure must show several alternatives on the basis of previous or ongoing studies that allow to know the sensitivity of the area and its ability to cope with the infrastructure, considering, at least, these points: implementation of actions that allow the permeabilization of the infrastructure to allow ecological connectivity, as well as a proper landscape integration of the planned and built infrastructures, considering the required works of conservation and maintenance*.

All these aspects are considered in the guidelines, especially in chapter 4: guidelines regarding the green infrastructure and ecosystem services, establishing, among others these points:

1. Creation of the Green infrastructure

2. The Green Infrastructure will be inclusive, flexible, and strategic, will warranty the ecological connectivity of the territory, halt biodiversity loss and mitigate the effects of habitat fragmentation caused by human settlements and grey infrastructures (transport and other lineal infrastructures), aiming to reinforce the services provided by nature.

3. The following criteria should be considered:

a) Identify sites where a grey infrastructure jeopardizes the ecological connectivity of the green infrastructure at the regional level. In areas where the green and the grey infrastructure overlap, the green should take priority over the grey to conduct the required actions for ecological restoration.

b) Any human activity or use to be conducted within the green infrastructure should not jeopardize its function of ecological connectivity at the regional level. This action should be performed using the legal figure of "condicionante superpuesto".

4. When developing infrastructures, encourage prioritizing solutions based on the environment, and those compatible with ecological continuity rather than technical solutions of high impact, building wildlife bridges, tunnels and other bioengineering structures.

5. The objective of the partial territory plans will be

a) Identify sites of interaction between the green and the grey infrastructure, establishing measures to properly manage such interactions.

b) Any proposal to be applied in the territory should be complemented in the partial territory plan with the appropriate measures of funding and execution by the corresponding administration. All administrations involved must coordinate among themselves to plan and fund the above mentioned proposals.

It is planned that DOT will be officially approved in summer 2019. It is also planned to review the partial territory plans expected to develop the DOT, including the concept of green infrastructure. Identified ecological corridors will be considered as official once DOT is approved, automatically being considered in the territory and urban planning of the Basque country.

Pilot study on traffic slow-down in Castile and Leon

The Regional agency for the environment and infrastructures of Castile and Leon has developed a pilot project on speed reduction together with the National Traffic Agency (DGT). This joint project focuses on the prevention of car accidents in the regional road network. For the DGT, this project belongs to its Strategy 2011-2020 of road safety, and combines radar speed surveillance and specific pattern-painting, which helps drivers to associate this pattern with speed limitation. The tool used to locate these actions was the speed surveillance index (INVIVE), a quantitative index developed by the DGT that considers car accident frequency, speed and type of road and road section.

This index allows identifying those road sections that need higher surveillance (over speed and accidents rate). High values of this index were found in several roads within the regional road network, such as CL-613, from Palencia to Sahagún and CL-615 from Palencia to Guardo. The two roads were included in the project that has a budget of 235.000 €. Actions included in the project were a longitudinal green painting parallel to edge lines and 10-15 cm inside, vertical signs of speed limit and speed control, as well as installation of surveillance equipment. These actions were completed by January 2017. DGT installed speed control devices (road section radars), starting to work between July and October 2017.

After working for a year, preliminary results show a reduction in the number of car accidents with victims and the number of seriously injured persons in both roads, probably because drivers reduced their driving speed: mean of 94 km/h in CL-615, and 89 km/h in CL-613, both below the limits of 100 and 90, respectively.

In road CL-613, accidents with injured people were reduced by 63% from 2016 to 2017 (75% reduction if only seriously injured people are considered). In road CL-615, similar values of 59% and 72% were recorded, quantifying the effectiveness of the above described actions.

Guiding plan for improving ecological connectivity in Andalusia (PDMCEA). A green infrastructure strategy

The need of maintaining connectivity to preserve biodiversity is part of biodiversity conservation management. Habitat and ecosystem fragmentation were soon considered (and nowadays they are widespread in literature) as a relevant issues that requires developing policies and actions devoted to mitigate its effects.

The development of a plan to improve connectivity in Andalusia has been directly or indirectly considered in different strategies and action lines. Its implementation into the legal and management framework, as well as the development of green infrastructures are also considered in EU policies regarding biodiversity and the environment.

In this scenario, the environment and territory planning agency of the Andalusian Regional Government built a guiding plan for improving ecological connectivity, with the aim of ensuring and even improving ecological connectivity in Andalusia, prioritizing the development and design of natural solutions (green infrastructure and ecological restoration). In this sense, it is important to highlight that this guiding plan does not require the application of new laws or rules, but the consideration of habitat connectivity in urban and territory planning, and the appropriate management of natural resources, including protected areas.

The guiding plan aims at improving Andalusian ecosystems, reinforcing the services they provide, also reducing the effects derived from habitat fragmentation and climate change, two of the main drivers of biodiversity loss worldwide. It also aims at building an ecological network at the regional scale that facilitates wildlife movement, ensuring ecological flows, improving the integration of Natura 2000 network into the territory in a consistent way, and contributing to a better adaptation of the Andalusian society to climate change. It also considers the development of a green infrastructure, which is beyond the objectives of biodiversity conservation. Its proposals are also devoted to increasing resilience and adapting capabilities of Andalusian ecosystems, contributing to ensure and improve ecosystem services.

The plan considers 6 main objectives:

1. Promote permeability and improve ecological connectivity, prioritizing the development of solutions based on nature, such as the green infrastructure and techniques of ecological restoration.

2. Encourage the establishment of a green infrastructure at a regional level, which favor the movement of wildlife species, ensuring ecological flows, improving the integration and consistency of the Natura 2000 network in the area.

3. Develop an integrated monitoring system of the habitat and ecosystem fragmentation processes and ecological connectivity in Andalusia

4. Ensure and reinforce the ecological connectivity of the territory, promoting strategies and initiatives of green infrastructure in relevant policies, including coordination and application of guidelines and criteria in territory management.

5. Facilitate the improvement of ecological connectivity in the framework of international and interregional cooperation, and developing the European policies regarding green infrastructures.

6. Improve public awareness about effects of habitat fragmentation and the opportunities of designing solutions based on nature, promoting the commitment of strategic sectors of the society in green infrastructure policies.

All these objectives are developed by means of strategic lines, each of them considering specific objectives, whose application depends upon guidelines and management criteria. In summary, the plan includes 20 strategic lines, 59 specific objectives, and 264 actions focused on public natural spaces, rivers, and their riversides, tree groves and other isolated patches of non-forested habitats, droving roads and adjacent areas, and other elements such as the network of rural paths. All these elements offer good opportunities to improve ecological connectivity and reinforce green infrastructure depending on their potential to be managed by the regional government.

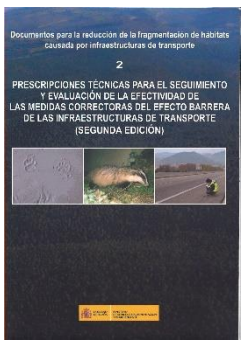
PUBLICATIONS

Bendsten, H. et al. 2017. ON-AIR Guidance book on the integration of noise in road planning. Conference of European Directors of Roads. 189pp.

Borda-de-Água, L., Barrientos, R., Beja, P., Pereira, H.M. (Eds). 2017. Railway Ecology. Springer

Elmeros, M., Møller, J.D., Dekker, J., Garin, I., Christensen, M., & Baagøe, H.J. 2016. Bat mitigation measures on roads - a guideline. Conference of European Directors of Roads, Brussels

García Sánchez-Colomer, M.R. et al, 2018. Redefinición de las medidas correctoras de impactos ambientales residuales en infraestructuras lineales de transporte. CEDEX. 207 pp. In Spanish



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Ministerio de Agricultura, Alimentación y Medio Ambiente. 2013. Identificación de áreas a desfragmentar para reducir los impactos de las infraestructuras lineales de transporte en la biodiversidad. Documentos para la reducción de la fragmentación de hábitats causada por infraestructuras de transporte, number 6. 260pp. In Spanish.

Ministerio de Agricultura, Alimentación y Medio Ambiente. 2015. Prescripciones técnicas para el diseño de pasos de fauna y vallados perimetrales. (second edition, reviewed and updated). In Spanish. This document also has an English version: Technical prescriptions for wildlife crossing and fence design. (Second edition, revised and expanded) 2016.

Schuler et al. 2017. How common road salts and organic additives alter freshwater food webs: in search of safer alternatives. Journal of Applied Ecology 54: 1353-1361

O'Brien, E., van der Grift, E., Elmeros, M., Wilson-Parr, R., Carey, C. (Eds). 2018. CEDR Contract Report 2018-3. Call 2013. Roads and Wildlife. The Roads and Wildlife Manual. ISBN: 979-10-93321-42-4

Tamayo, P. Pascual, F. y González, A. 2015. Effects of roads on insects: a review. Biodiversity and Conservation 24: 659-682

PAST EVENTS

IENE Conference 2018. Crossing borders for a greener and sustainable transport infrastructure.

The IENE network conference was held in Eindhoven, The Netherlands, in 11-14 September. Among other presentations, the Conference of European Directors of Roads (CEDR) presented a new manual on roads and wildlife. Several representatives of the working group attended the conference. Further information is available here

XXIII Meeting on Canarian roads. Las Palmas De Gran Canaria, Spain. October 30, 2018. In Spanish

VI Ibero-American Congress on road safety (CISEV) Lima, Perú. October 16-18, 2018. In Spanish

XIII International Congress on Hispanic roads, CONICAM XIII. Madrid, Spain. November 22 – 24, 2017. In Spanish

XV Meeting on Conservation and exploitation of roads. Valencia, Spain. May 22 – 24, 2017. In Spanish

International Conference on Ecology and Transportation (ICOET 2017). Salt-lake City, UTAH, USA

The ninth biennial ICOET conference was co-hosted by the Utah and Wyoming Departments of Transportation, with support from the US DOT Federal Highway. Further information is available here

COMING EVENTS

Transportation Research Board Annual Conference. January 13-17, 2019, Walter E. Washington Convention Center, Washington DC, USA

African Conference for Linear Infrastructure & Ecology. March 10-15 March, 2019, Skukuza Rest Camp, Kruger National Park, South Africa

International Conference on Ecology and Transportation. September 22-26, 2019. Sacramento, California, USA.

World Road Congress. October 6-10, 2019. Abu Dhabi, United Arab Emirates

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.
  - ***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.

This publication is part of the project 'Habitat fragmentation due to Transportation Infrastructure', which is promoted by the Sub-Directorate General for the Natural Environment, Directorate General of Quality and Environmental Evaluation and Environment and carried in collaboration with EBD-CSIC.

Any information for publication can be sent here.

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