

habitat fragmentation due to transportation infrastructure



e-newsletter • **APRIL 2021** • number 19



CONTENTS

- > Editorial
- > Working Group
- > News
- > Publications
- > Past Events
- > Coming Events
- > Documents of the Working Group

PREVIOUS NEWSLETTERS

- > Number 0
- > Number 1
- > Number 2
- > Number 3/4
- > Number 5
- > Number 6
- > Number 7
- > Number 8
- > Number 9
- > Number 10
- > Number 11
- > Number 12
- > Number 13
- > Number 14
- > Number 15
- > Number 16
- > Number 17
- > Number 18

EDITORIAL

The presence of linear transport infrastructures is one of the main causes of habitat fragmentation. This impact was first studied in developed countries, but nowadays it constitutes a global threat, influencing some of the most important biodiversity hotspots on earth, also increasing the concentration of greenhouse gases.

In parallel, our knowledge on the ecosystems services provided by nature has increased. Globally, ecosystem services are estimated to yield more than the Gross World Product of 2019.

The United Nations Organization has recognized the failure of the Aichi targets associated with the loss and fragmentation of natural habitats. For this reason, conservation and restoration of ecological connectivity have been considered as major flagships in the preparation of the upcoming United Nations Post-2020 Global Biodiversity framework. Similarly, The European Green Deal and the new European Biodiversity Strategy for 2030, stress the need to develop a resilient Trans-European Nature Network supported by ecological corridors allowing the free flow of genes and individuals in the long-term. To achieve such a goal, it is crucial the development of more biodiversity-friendly infrastructure networks. This requires immediate, stringent action and shared responsibilities from all stakeholders.

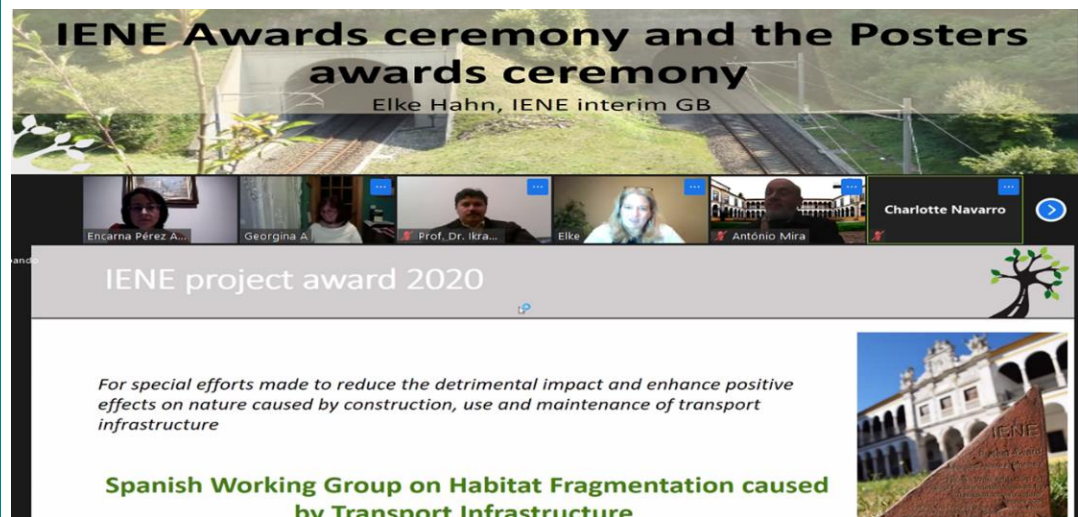
The above-mentioned conclusions were highlighted in the last IENE congress, held in January 2021 as a fully online event. To help solving many of the difficulties associated to create a sustainable global transport infrastructure network, IENE published in 2018 the [International Guidelines for Ecologically-adapted Linear Infrastructures](#). In collaboration with its Australian (ANET), African (ACLIE) and American (ICOET) counterparts, WWF, and the Connectivity Conservation Specialist Group from the IUCN, IENE has published in December 2020 the “Global Strategy to Ecologically Sustainable Transport and other Linear Infrastructure”. This includes an Action Plan involving many stakeholders (see Publications).

Because writing and developing projects require funding, the Recovery and Resilience Facility, funded by the European Union to build a greener and more resilient Europe constitute a great opportunity to fund projects in the framework of more biodiversity-friendly transport infrastructures. There are, at least, two components where such a funding could be requested: Component 4 focused on the conservation and restoration of ecosystems and their biodiversity, and Component 6 focused on sustainable, connected and safe mobility. Both components are linked to the Infrastructure, and resilient ecosystems policy of the Union. Several proposals on the restoration of road sections have been already submitted to the General Directorate of Biodiversity, Forests, and Desertification belonging to the Ministry for the Ecological Transition and the Demographic Challenge. However, there are no insights of other proposal submitted under Component 6, coordinated by the Ministry for Transportation, Mobility and Urban Planning. The Working group on Habitat Fragmentation due to Transport Infrastructures is making a big technical effort to raise public awareness on this topic, also providing integrated solutions to get more biodiversity-friendly infrastructures. Therefore, we encourage keynote politicians to get the required agreements at both the national and regional levels to combine the available funding and the existing scientific and technical knowledge to materialize a greener, and more sustainable transport infrastructure network in Spain.

WORKING GROUP

In the meeting of the Working Group held in October 15th, it was approved the publication of the eighth document of Technical Prescriptions to Make Effective the Monitoring of Mitigation Measures of the Barrier Effect of Transport Infrastructures (Design, Documentation and Archive of Environmental Monitoring), already available in the Ministry's web page (see Documents of the Working Group).

In January 2021, IENE organized its International Conference as a fully online event. The Conference was initially planned to be held in Evora (Portugal) in April 2020, but it was postponed due to COVID pandemic. As part of the Conference program, the IENE celebrated its General Assembly on January 13, when they officially announced that the Spanish Working Group on Habitat Fragmentation due to Transport Infrastructures got the IENE Project Award 2020. They highlighted the 21 years trajectory, perseverance and goals as main reasons for this award. The group's methods based on active listening and constructive speaking are key for these attributes. All represented disciplines in the Working Group try to understand each other needs, accepting them, understanding technical terms as well as the rationale behind each specific objective. This means biologist understanding the requirements of the construction process as well as civil engineers understanding habitat requirements of species, and population dynamics. Every opinion is given the same weight and respect within the Working Group. As a result of this methodology, all products derived from the Working Group (see Documents of the Working Group at the end of this bulletin) are given in a pragmatic way for a better understanding and application.



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

NEWS

Mitigation of the impact of high-speed railways to birds

Between 2013 and 2017, Adif Alta Velocidad has coordinated the project: LIFE12 BIO/ES/000660: Development and demonstration of an anti-bird strike tubular screen for High Speed Rail lines in collaboration with FCC Construcción, PROINTEC, RENFE viajeros, and the Autonomous University of Madrid. The main objective was to reduce the impact of high speed railways on birds by implementing a prototype of anti-collision barrier. As pilot areas, two sections of 5 km of the active line Madrid-Valencia were selected: one in Santa Cruz de la Zarza, and the other in Villarubia de Santiago, both in the Toledo Province. Controls were placed in the line Palencia-León (Esla and Bernesga valleys), which still have not traffic at that time. Fieldwork started in summer 2014, with four seasonal campaigns covering a whole year cycle. Four types of studies were made: 1) presence and distribution of bird populations, 2) Height of crossing flights, crossing frequency and flight behavior, 3) Mortality/collision studies, and 4) On-board video-recording to analyze both crossing and mortality.

Parts of these studies were published in collaboration with Dr. Malo's lab, from the Autonomous University of Madrid. One as book chapter: *Cross-scale Changes in Bird Behavior Around a High Speed Railway: From Landscape Occupation to Infrastructure Use and Collision Risk*, in *Railway Ecology* (2017), and the other as scientific article: *On-Board Video Recording Unravels Bird Behavior and Mortality Produced by High-Speed Trains*, in *Frontiers in Ecology and Evolution* (2017).

Regarding the barrier prototype, it was finally installed in a section of 400m of the line Madrid-Valencia in Santa Cruz de la Zarza. In this section, the line runs along a 8 m-high embankment, and the barrier consisted on tubular poles of 5m-high and 0.12 m-diameter, placed every 2.4m at both sides of the line. Conic perch-deterrents were also installed on top of the poles, finally reaching 5.5 m. Poles series at both sides of the line were not aligned, but staggered. This way, visual distance between poles from the orthogonal perspective is about 1 m. See picture and visit the following link: <https://www.youtube.com/watch?v=rHyRhBBR0pM>



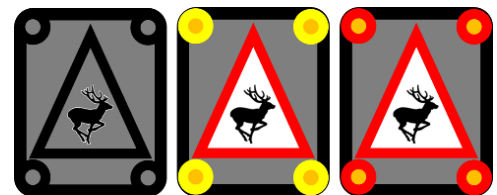
A new campaign including the four studies above mentioned was carried out from summer 2018 to spring 2019, in both treatment and control lines. In the treatment section, bird movement patterns and distribution, flying behavior and barrier effectiveness were checked. For some of these tasks, several high definition video cameras were used to record flying birds. The barrier helped reducing mortality by 32% when compared with similar sections without barrier. The mitigation was higher for birds with wingspan higher than 60 cm, and those flying in flocks.

Source of Information: Adif Alta Velocidad.

New prototype of adaptive signaling in the Castilla y León road network based on temporal models to alert drivers on collision risk with wildlife

There are several mitigating measures aiming at reducing wildlife vehicle collisions. They are focused on both the driver and the wildlife with varied effectiveness. This variety may be used to select the ones that are more cost-effective in each of the road sections where collisions are more frequent. Because of the broad regional road network, such solutions should be cheap, and they should not contribute to increase the barrier effect of the road. They should also consider uncertainty inherent to wildlife behavior, suddenly invading the road from the surrounding habitat. In this sense, vertical signaling aimed to reduce car speed, may fulfill these requirements. However, it has been noted that drivers easily get habituated to this signals, and their effectiveness drops. In this project, the aim is avoiding this habituation by increasing alert level on the moments where collisions are more likely, as derived from known temporal patterns on of collisions. Having this in mind, the Department of Transport of Castilla y León Regional Government, together with the Department of Animal Biology of the University of Salamanca is developing a new signaling that informs drivers on the real-time probability of animals crossing the road. Risk levels were obtained from a temporal model that analyzed collisions as function of date and time, moon phase, weather and winter maintenance. In the near future, this model will also include hunting activity in the area. The risk model is running in real time, sending information to the signal via Virtual Private Network (VPN).

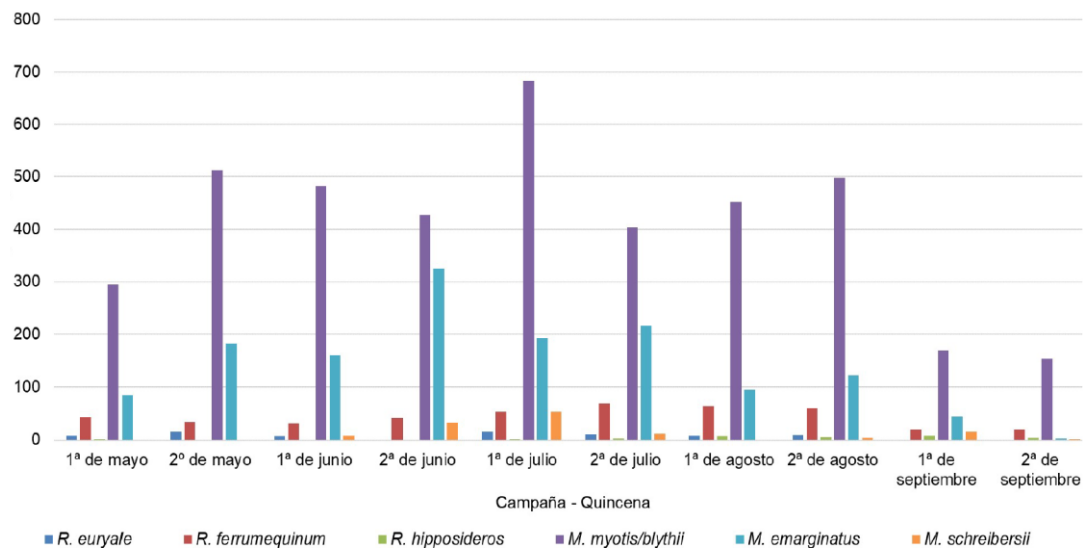
Depending on the risk calculated by the model, the signal would remain passive (no lighting) if the estimated risk is low, if the risk is high the signal would start emitting a yellow light that would turn to red if the risk is very high. The first prototypes will be installed this spring in two road sections (road CL-117, and SO-920) where collisions with roe deer, red deer and wild boar are frequent. Their effectiveness will be evaluated in terms of speed reduction, and number of collisions. In case of being successful, it may be a cost-effective measure to be installed in many other points within the road network.



Source of Information: Junta de Castilla y León.

Monitoring of bat populations in the Mosseguellos cave

In spring 2020, Adif Alta Velocidad started the monitoring of bat populations in the Mosseguellos cave (Special Area of Conservation ES5214003), also belonging to the Special Protection Area Sierra de Martés-Muela de Cortes (Valencia Province). This cave is only 1km far from the new high-speed line. Census were performed fortnightly during spring and summer, getting records ranging from 434 individuals of 5 species to 1000 individuals from 6 species, all of them considered Species of Conservation Concern (see Figure below).



Each census was made by using an infrared cam recording the exit of bats from the cave and a ultrasonic detector that records echolocation pulses from bats. Population size obtained during these censuses were similar or are even higher for some species than previously reported by conservation authorities (Generalitat Valenciana 2013), suggesting no current impact of the high speed line on the population.



Source of Information: Adif Alta Velocidad.

Mitigation measures for amphibians implemented in road ZA-102 from N-525 to Porto de Sanabria

Habitat degradation due to road verges maintenance may negatively influence amphibians. These animals perform seasonal migrations during rainy periods, crossing roads and suffering road-kills. To mitigate this, the Regional Government of Castilla y León, while performing improvements to road pavement, has installed several crossing in points where amphibian density is high. They used the experience previously gathered in 2011, in road CL-501 (Avila Province) where they adapted culverts as amphibian crossings, where high mortality was reported or where the road intersected water bodies. They also used guiding barriers to derive amphibian movements through culverts.

In this case, they installed a small continuous vertical barrier made by a metal sheet of 2mm thick and 25cm tall, stuck in the ground and supported by rebar sticks also attached by wires (by performing a small hole in the sheet where convenient). No space was left between sheet sections or between the sheet and the ground to guarantee barrier effectiveness.



Seven culverts were adapted in this way along the ZA-102 road at variable distances depending on whether water courses were ephemeral or permanent (priority), and on topography. Two of them were located between kilometer 2.5 and 3.5, while the remaining 5 were located between kilometer 23 and 25.

Some of the benefits of this method are:

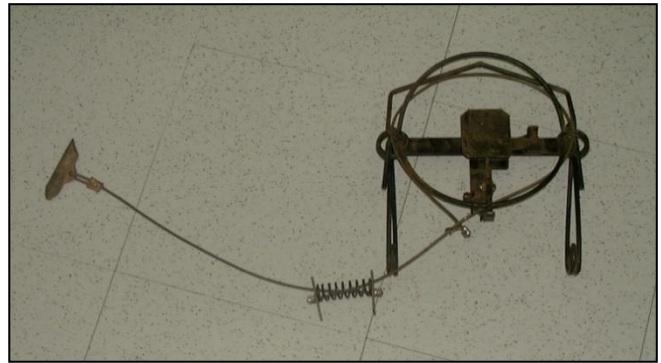
- They are easy to adapt to almost any road section.
- They easily adapt to culverts.

- They are easy to install.
- They are long-lasting devices.
- They are cheap and require low maintenance.
- They are very stable because of their thinness.

Source of information: Junta de Castilla y León.

Wildlife monitoring during the working phase of the high-speed railway line between Palencia and León

Past September, we started the wildlife monitoring regarding the operation of the high-speed railway between Palencia and León. Monitoring protocols were established according to the methodological guidelines we are using since 2012. They have the following objectives: a) quantify the use of wildlife crossing structures (number of crossings, frequency, efficiency of crossing, etc.); b) quantify the mortality due to the infrastructure in the



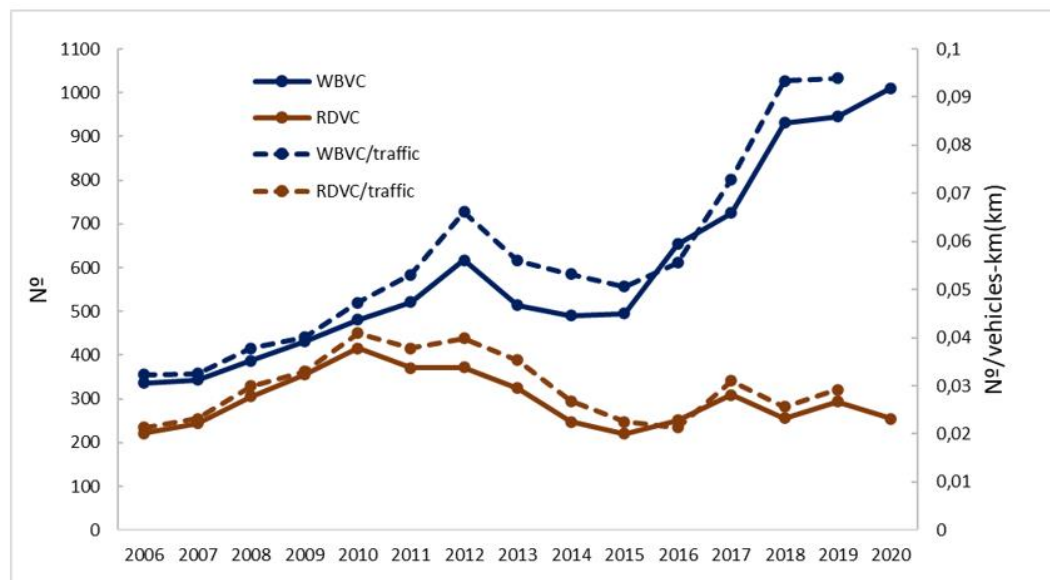
different animal groups inhabiting the area, also evaluating the efficiency of mitigation measures implemented in the railway; c) estimate probability of wildlife mortality; d) evaluate the efficiency of fencing and associated escape systems. In this particular case, we have also included the study of the Iberian wolf, and its relationship with the railway. For that purpose, it is planned to capture and mark some wolves, to be afterwards monitored with GPS-collars. This study will be carried out by a team of experts on the capture and study of wolves. Wolves will be captured by using Belisle traps. Two types of GPS-collars will be used: Tellus Iridium (Televit-Followit), and Vertex Plus (Vectronic). Both models are equipped with a drop off system that release the collar when battery is exhausted. Potential prey around the railway will be also studied. The final aim is evaluate to what extent the railway act as a barrier for the wolf population inhabiting the area. Because of the cut and fill excavations made during the construction, the micro-topography of the site is altered. As part of the restoration of the area, several ponds were created and we will carry on specific studies to check their use by birds (both in the breeding and wintering periods), also performing calling frog surveys for amphibians.



Source of information: Adif Alta Velocidad.

Vehicle collisions with roe deer and wild boar in Asturias and Cantabria during COVID-19 lockdown

Among vehicle-wildlife collisions in Asturias and Cantabria between 2006 and 2020, those involving roe deer or wild boar constituted 88% to 93% in Arena2 (the system created by the Spanish Transport Agency –DGT- to quantify such collisions). During this period, the role played by the wild boar has increased from a relationship of 1:1.15, to the current 1:3.97 (see Figure).



In this framework, the lockdown imposed in March 2020 due to COVID-19 pandemic, caused a reduction in the number of collisions, when compared with both the past year (2019), and the period 2016-2019. In the roe deer, the number of collisions was reduced during both the hard and the soft lockdown period. On the contrary, the wild boar only showed less collisions during the hard period (see table). Afterwards, it showed more collisions than in past years.

Ref.	Whole lockdown (14/3-21/6)		Hard period (14/3-10/5)		Soft period (11/5-21/6)	
	2019	2016-19	2019	2016-19	2019	2016-19
Roe deer	-42.24%	-34.63%	-53.25%	-46.47%	-20.51%	-12.06%
Wild boar	-20.09%	-0.99%	-37.66%	-20%	21.54%	39.21%

When considering the type of road (high capacity vs conventional roads), the roe deer showed similar values, while the wild boar only showed reduced roadkill in conventional roads. The results depicted a clear and consistent increase in the number of collisions with wild boars. Regarding the roe deer, it should be noted that the lockdown matched the period when road-kill mortality is more frequent in this species. In addition, it should be noted that traffic reductions were probably higher during daytime, and more noticeable in conventional roads.

Source of information: Íñigo García, Juan Antonio Ruiz de Villa y Jorge Rodríguez

Preventive and corrective measures to minimize the impact of high-speed railways on endangered species

The high-speed railway Olmedo-Zamora-Orense, when running close to Requejo (Zamora Province) affects the Requejo river and several small tributaries, where stable populations of the endangered Iberian Desman (*Galemys pyrenaicus*) inhabit. To minimize the impact on the species, several measures were adopted to protect the river ecosystem. In addition, during the construction of the Pedregales viaduct, 22 individuals were captured with fyke nets (see picture), anesthetized by inhalation, radio-equipped with A2426 glue-on transmitter (ATS Inc.), and released in non-impacted river sections every three months. Radio-tracked animals allowed us to know their activity patterns, movements and distances during activity, home ranges, as well as size and ecological features of core areas.



The high-speed railway Vitoria-Bilbao-San Sebastian, in the so-called Bergara crossing,



intersects areas of special concern for the European mink (*Mustela lutreola*), as depicted in the Management plan of the species in the Biscay historical region. Therefore, mitigation measures were implemented to minimize the impact on the environment, and especially on this species. Some unpaved roads were paved to avoid erosion and reduce road dust. Runoff was reduced, also using barriers for solid and decanting pools. We also monitored the impact on the species by using fortnightly surveys (intensified to weekly during most sensitive periods) using both transects and camera-trapping. When constructions require provisional bridges, they were equipped with appropriate crossings with dry ledges (see picture) to minimize the impact on the species.

Source of information: Adif Alta Velocidad.

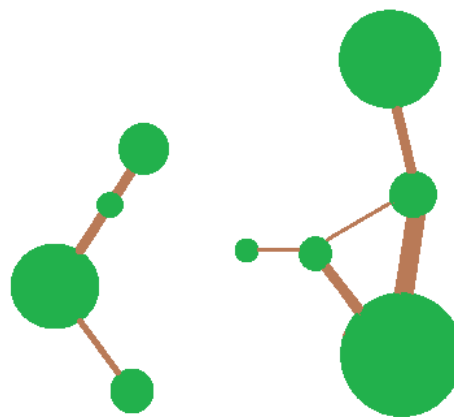
Pilot project on connectivity analyses, and fragmentation in Cabañeros National Park

The National Park Authority, together with the Technical University of Madrid (UPM), and Tragsatec, has developed a project to analyze fragmentation and ecological connectivity in the Cabañeros National Park (Castilla La Mancha Province).

The developed methods allow their application to the monitoring and management of habitats that could be also applied to other regions to identify priority areas for conservation or restoration. Those areas with a major role in connecting the territory may be considered as part of the future green infrastructure.

For connectivity analyses, two spatial scales were used: 1) National Park limits, and a more broader approach considering those neighboring protected areas also contributing to preserve the same habitats than the National Park.

We used graph theory (mainly least cost paths) to evaluate functional connectivity. Graphs are mathematical structures formed by nodes, which represent habitat patches (green circles in the figure), and links connecting nodes (brown lines). This method is particularly suited to analyze connectivity in networks. Least cost paths are those that run along areas where friction to movement of the species or group of species is lower. From these analyses we have obtained (and imported into maps) a set of links that significantly contribute to the conservation or improvement of targeted habitats. We considered three prioritizing scenarios: 1) conservation scenario; 2) restoration scenario; and 3) cost-effective restoration scenario. Depending on the aim of the scenarios, different links were selected.



In addition to the analysis of connectivity, this study analyzed fragmentation of some natural vegetation systems that are representatives of the park, as well as the habitat of selected species and eco-profiles in the Cabañeros National Park, using landscape indexes.

Source of information: National Park Authority

The Bison Project. Biodiversity and Infrastructure synergies and opportunities

For the first time, the European Union is providing €3,000,000 in funding for a project of a strategic nature aimed at committing Europe's transport infrastructure to a better mainstreaming of biodiversity. A consortium of 39 members is involved



in the BISON project. The partners are representatives of governments, research institutes, companies, and associations. The Departament de Territori i Sostenibilitat from the Catalanian Regional Government and Minuartia Environmental Consultancy are part of the consortium. The specific objectives of the project are:

- To identify future research and innovation needs for a better integration of biodiversity with infrastructure.
- To identify the construction, maintenance and inspection methods and materials, which are long lasting and resilient and can be used by different transport modes to mitigate pressure on biodiversity.
- Support European Member States to fulfil their international commitments by engaging all stakeholders into biodiversity mainstreaming for infrastructure planning and development.
- Support European Member States to become political leaders through collaboration and support of European research.

Source of information: Minuartia

PUBLICATIONS

Ciudad, C. et al. 2021. Landscape connectivity estimates are affected by spatial resolution, habitat seasonality and population trends. *Biodiversity and Conservation*. <https://doi.org/10.1007/s10531-021-02148-0>

Dasoler, B.T. et al. 2020. The need to consider searcher efficiency and carcass persistence in railway wildlife fatality studies. *Eur J Wildl Res* 66: 81.

Driessen, M. M. 2021. COVID-19 restrictions provide a brief respite from the wildlife roadkill toll. *Biological Conservation* 109012

IENE 2020. A global strategy for ecologically sustainable transport and other linear infrastructure.

IENE 2020 International Conference LIFE LINES –Linear Infrastructure Networks with Ecological Solutions–. Abstract Book.

Jacek, B. et al. 2020. Birds crossing over roads: species, flight heights and infrastructure use. *European Journal of Ecology*, 6(2). <https://doi.org/10.17161/eurojecol.v6i2.14788>

Macpherson, M.R. et al. 2021. Barriers for big snakes: Incorporating animal behavior and morphology into road mortality mitigation design. *Global Ecology and Conservation* 26: e01471

Martín, B. et al. 2021. Improvements in high-speed rail network environmental evaluation and planning: An assessment of accessibility gains and landscape connectivity costs in Spain. *Land Use Policy* 103: 105301.

Myslajek, R. W. et al. 2020. Mammal use of wildlife crossing structures along a new motorway in an area recently recolonized by wolves. *European Journal of Wildlife Research* 66:79

Neumann, W. et al. 2020. Strength of correlation between wildlife collision data and hunting bags varies among ungulate species and with management scale. *European Journal of Wildlife Research* 66: 86

Plaschke, M. et al. 2021. Green bridges in a re-colonizing landscape: Wolves (*Canis lupus*) in Brandenburg, Germany. *Conservation Science and Practice*. DOI: 10.1111/csp2.364

Shilling, F. et al. 2021. A Reprieve from US wildlife mortality on roads during the COVID-19 pandemic. *Biological Conservation* 109013.

PAST EVENTS

IENE 2020 International Conference

Organized by the Infrastructure and Ecology Network Europe in January 12-14. It was a fully online event. More [info](#).

Infrastructure and Nature Webinar series

To convene the Infrastructure and Nature Pavilion at the upcoming IUCN World Conservation Congress, a coalition of more than 20 organizations organized a webinar series between October and December 2020. Here we highlight the webinars on October 15 about sustainable infrastructures, on November 5 about Engineering with Nature, and on November 19 about Balancing Ecological Connectivity and Linear Infrastructure. This webinars could be seen as YouTube videos [here](#).



COMING EVENTS

IAIA20 International Conference

Smartening Impact Assessment: Science, technology and governance advancements towards efficiency and effectiveness. The Spanish Association of Environmental Impact Assessment organize this conference in Seville on May 18-21 2021. More [info](#).

Asphalt 4.0 for future mobility 2021

The Euraspalt and Eurobitumine association will organize this virtual meeting on June 15 - 17 2021. More [info](#).

IUCN World Conservation Congress

The IUCN and the French government have agreed to hold this event from 3 to 11 September 2021 in Marseille (France). More [info](#)

African Conference for Linear Infrastructure & Ecology

This year, the ACLIE Conference will be fully online in August 12 - 17 2021. More [info](#).

International Conference on Ecology and Transportation (ICOET) 2021

Focused on "Transforming Transportation Ecology in the Global Village", it will be a fully online event from 21 to 30 September 2021. 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 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 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.
- Any information for publication can be sent [here](#).
- Legal Notice: the information contained in this document can be copied, with an indication of the source and the date of the last update, if applicable: Newsletter 'Habitat Fragmentation due to Transportation Infrastructure' (Directorate General of Biodiversity, Forests, and Desertification, Ministry for the Ecological Transition and the Demographic Challenge, number 19, April 2021).
- Edited by: Ministry for the Ecological Transition and the Demographic Challenge. NIPO: 665-20-075-0
Catálogo de Publicaciones de la Administración General del Estado: <https://cpage.mpr.gob.es/>.

