

# habitat fragmentation due to transportation infrastructure



e-newsletter • DECEMBER 2011 • number 11

## EDITORIAL

### Are the aims of wildlife passages met?

The concept of wildlife passages is not a recent one. The first structures were built in Andalusia and Catalonia in 1994 and 1995. Shortly afterwards, the first handbooks appeared on this subject. However, *Wildlife and Traffic* was not published until 2003, initially in English and subsequently in a Spanish translation. This handbook brought together European knowledge of this topic. Five years ago, in 2006, Spanish reference standards were published, called [Prescripciones técnicas para el](#)

[diseño de pasos de fauna y vallados perimetrales](#) (Technical prescriptions for the design of wildlife passages and perimeter fences). These prescriptions adapted information from the European handbook to Spain. The aim was to produce recognized standards.

Since then, wildlife passages have been incorporated in many road and railway projects: some in newly constructed transport infrastructures and others in existing networks that have been enlarged or improved (defragmentation measures). The database managed by the Spanish Ministry, MARM, as part of the project *Habitat fragmentation due to transportation infrastructure* contains references to over 500 wildlife passages built in recent years. This is only a small fraction of the activities that have been carried out.

Nevertheless, on many occasions, and particularly during these times of major economic tensions, doubts can arise about the investment in wildlife passages. This leads to a series of questions. Are they really used by the wildlife species for which they are designed? Do they reduce the number of collisions with cars and accidents caused by wildlife? In most cases, the answers are clearly affirmative. However, the dissemination of information on monitoring results and the difficulty in accessing such results does not help us to see the entire picture and leaves the ground open for speculation and opinions based on isolated data and on wildlife passages that have not been built in the right way or in the right place.

We now have many results of monitoring projects and assessments of the effectiveness of measures, most of which are carried out in compliance with the provisions established in Environmental Impact Statements. In general, the conclusion of these studies is that wildlife passages are functional when they are correctly designed and built and when they are situated in the right place (see some examples in the [News](#) section).

Of course, we continue to find cases in which inappropriate measures are implemented – one of the most obvious being the installation of escape gates in perimeter fences along roads - or wildlife passages that are smaller than recommended are constructed, which leads to maintenance difficulties and restricts their use to the species or individuals that are most adaptable and have the least restrictive requirements. However, these are no more than shortcomings that can clearly be resolved through good practice.

The current context of economic recession means that, more than ever, we should invest in measures with proven effectiveness that provide the most benefits at the lowest possible cost. The key is to invest firstly in the correct design of routes so that expensive compensatory or mitigation measures do not need to be applied and secondly in the appropriate implementation of measures, in accordance with standards prescribed in reference documents, which have a scientific and technical basis.

Cuts (in the size, the fitting out of passages and points of access and good studies to identify appropriate locations) could result in investments failing to meet objectives. This could lead to a greater risk of wildlife mortality and a reduction in road safety – effects that also have considerable social and economic costs.



## CONTENTS

- > Editorial
- > Working Group
- > News
- > Publications
- > Events
- > Documents of Working Group and Action Cost 341

## PREVIOUS NEWSLETTERS

- > Number 0
- > Number 1
- > Number 2
- > Number 3/4
- > Number 5
- > Number 6
- > Number 7
- > Number 8
- > Number 9
- > Number 10



## WORKING GROUP

In November 2011, the thirteenth meeting of the Working Group on Habitat fragmentation due to Transportation Infrastructure was held in Madrid. This group is part of the National Commission of Nature Protection. The meeting was attended by around 40 representatives from the transport and environment departments of the regional governments and the Spanish state.

In the meeting, the last volume of the series Documents for the reduction of habitat fragmentation caused by transport infrastructure was presented. This volume is in the process of being published and is entitled

*Desfragmentación de hábitats. Orientaciones para reducir los efectos de las infraestructuras de transporte en funcionamiento* (Habitat defragmentation. Guidelines to reduce the impact of active transport networks). In addition, work started on new documents in the series. In particular, a Technical Committee was formed to write the sixth volume, whose provisional title is *Análisis de prioridades de desfragmentación en corredores ecológicos y ENP afectados por infraestructuras de transporte* (Analysis of defragmentation priorities in ecological corridors and protected areas affected by transport networks).

At the meeting, participants also discussed actions related to the Working Group's aim that were included in the recent publication the *Strategic Plan for Natural Heritage and Biodiversity* of the Spanish Government. Much of the day was devoted to the delegates' presentations of studies that are underway, new projects, and monitoring to assess the effectiveness of measures. In particular, two videos and various presentations included films and photographs of various species of animals using wildlife passages or exit ramps in fenced stretches of roads and railways.



Ministry of the Environment and Rural and Marine Affairs



## NEWS

### **The effectiveness of a passage over the Lugo-Sarria rail tracks in O Corgo (Lugo) has been established**

In 2002, as a mitigation measure associated with the construction of the new Palencia-A Coruña railway, the Spanish National Railways (RENFE) built an overpass specifically for wildlife in the stretch between Lugo and Sarria (Lugo). This pass is 30 m wide and 28 m long and the approaches to it have been revegetated so that it is better integrated into its surroundings.

The overpass is situated in a stretch of the railway in which the tracks run through a cutting whose inclination prevented animals from moving freely in the area. The approaches to the passage have been

revegetated using various species of shrub that are characteristic of plant communities in the surrounding area. To prevent vehicles from using the overpass, two rows of large stones have been put across each one of the approaches to the structure.

With time, the passage has become naturalized and integrated into the environment, which means that it may be used as a suitable habitat by wildlife.

Its effectiveness has been demonstrated in the monitoring activities carried out by the rangers of Environmental District Nine (Lugo-Sarria). Many animal trails were found, including tracks, hair, excrement and other trails of wild boar, roe deer and fox, among other species have been found. Various species of wildlife from the area use this passage to traverse the rail line, which would be difficult to cross if the structure had not been built. The passage is situated at the boundaries of the areas Tecores LU-10151 "Beira Miño" and LU-10119 "Chamoso", and is a good corridor that facilitates the movements of various game species.



Fondo Galego de Garantía Agraria

Source: José Manuel Pena, Department of the Rural Environment, Regional Government of Galicia.



## The Iberian lynx already uses the overpasses that were recently build in the area of Doñana

The Department of the Environment of the Regional Government of Andalusia has proved, through monitoring carried out by camera trapping, that lynxes use the wildlife passages that have recently been constructed in Doñana. The structures are situated in two busy roads that are close to lynx populations. The aim of these structures is to help to reduce mortality caused by collisions that affect the conservation of this threatened species.



Department of the Environment, Regional Government of Andalusia

These structures were built by the Department of Public Works and Housing as one of the actions in the European Project LIFE06 / NAT / E / 000209

“Conservation and reintroduction of the Iberian Lynx in Andalusia”. The project is managed by the Department of the Environment, with the participation of other administrations and ecological and business associations.

In recent years, the Department of Public Works and Housing has carried out work on eight roads in Doñana to reduce habitat fragmentation, as data from monitoring the lynx population have shown that these roads represent a considerable risk for the definitive colonization or continuity of specific groups of the species in the region. The works, which together represent a 5.2 million euro investment, 50% financed by the European Union, consist in building wildlife passages, installing perimeter fences, clearing vegetation from the roadsides and adapting drains and existing bridges. All of these measures were proposed and their design and location assessed by experts in this field and by those directly responsible for the conservation of this species in Andalusia.

In May 2011, work was completed on the two first wildlife overpasses that have been promoted by the Regional Government of Andalusia as part of the aforementioned LIFE-NATURE project. These two structures are situated in the roads A-483 (between El Rocío and Matalascañas) and the A-494 (between Mazagón and Matalascañas), which have the heaviest traffic in Doñana and are close to lynx populations.

The passages that have been constructed are two 50 m-long arch bridges with a width of 15 m to facilitate the passage of wildlife. They have fences and opaque wooden screens along each side. A layer of soil has been spread over the walkway and plants have been introduced to provide cover. In addition, fencing along the entire stretch prevents wildlife from accessing the road and guides animals towards the passages.

Due to the size and characteristics of the wildlife passage, this is one of the largest projects carried out to date to prevent collisions with this species. Its effectiveness has been proven in the first few months of monitoring.

*Source: Luis Ramajo, Department of Public Works and Housing, Regional Government of Andalusia.*



## The effectiveness of the wildlife passages included in a Catalan defragmentation project has been verified

The wildlife passages that were built in 2000 in the road C-260 (Girona) are one of the first examples of projects to increase road permeability whose effectiveness has been proven. During works to widen the road, which crosses the wetlands of an Integral Nature Reserve, several underpasses were built for wildlife, at the suggestion of the managers of the Aiguamolls de l'Empordà Natural Park.



Minuartia

In 2001, a first project to monitor the wildlife passages was carried out by GISA and by what was then the Department of Town and Country Planning and Public

Works of the Catalan Regional Government. In this project, it was shown that the passages are frequently used by many species of fauna found in the surrounding area.

In 2009, Minuartia carried out a project using camera trapping to monitor the wildlife passages as part of the research project *Evaluation of the impact on wildlife of habitat fragmentation caused by transport networks in Mediterranean wetlands*. This project was funded by the Ministry of the Environment and Rural and Marine Affairs, and carried out by the Technical University of Valencia and the environmental consultancy Minuartia. The monitoring showed that the structures are used by numerous species, the most common being the rabbit, hare, fox, genet, otter and wild boar. In contrast, the movement of fallow deer has not been detected. This species is present, though in low numbers, in the area surrounding the wildlife passages.

Notably, one of the structures used by wild boar was monitored continuously for a year. A high rate of use was found by solitary adult males, matriarchal groups and groups of subadults. These are the same types of groups as those recorded in the surrounding habitats.

A comparison of the results for 2001 and 2009 shows a considerable increase in the rates of use of the passage. When the passage was first monitored in 2001, it was only used by some family groups made up of females and their offspring.

The main conclusions of the study are that wildlife passages are crucial in wetland areas fragmented by transport networks, as they reduce the barrier effect of roads and railways and reestablish the flows of wildlife between different areas of their range. In addition, the study highlighted the need to locate structures appropriately, according to the distribution of the habitats and target species. Furthermore, different types of passage need to be built, depending on the requirements of the species.

*Source: Aiguamolls de l'Empordà Natural Park, Department of Land Planning and Sustainability, Regional Government of Catalonia and GISA*



### **In Menorca actions have been implemented to reduce wildlife mortality in cattle grids**

Livestock farming, especially of cattle, is a very important activity in Menorca. Cattle grids are often used in roads to prevent livestock from escaping from the farms where they graze. These grids consist of small trenches covered by metal bars.

When cattle grids are constructed, it is rarely considered that the ditches can represent a death trap for small mammals, amphibians and reptiles and that additional measures are needed to reduce wildlife mortality.



Evarist Coll (GOB Menorca)

The association *Grup Balear d'Ornitologia i Defensa de la Naturalesa* (GOB Menorca) became aware of this problem. It then identified the most critical points and asked the Department of Roads of the Menorca Island Council's to implement measures to reduce mortality in the most conflictive spots. During 2011, the Department installed exit ramps for small animals inside five cattle grids in which wildlife mortality had been registered. Mainly hedgehogs (many of which were dead) have been found trapped in these grids, but turtles and other species have also been registered. The initial results show the effectiveness of this action, as no animals have been found in the cattle grids after the installation of the exit ramps.

As a result of these positive results, GOB Menorca has created a [webpage](#) to provide information on this problem. The website is open to the participation of volunteers, who can post information on the cattle grids in which trapped animals are found. This helps to identify conflictive points at which corrective actions can be implemented.

In addition, the association has proposed other measures to reduce collisions with small vertebrates at junctions between rural tracks and roads at which high mortality rates are detected.

*Source: Miquel Camps. GOB Menorca.*



### **Fox and stone marten use the exit ramps in stretches with perimeter fences in Navarra**

In Navarra, a recent project monitored measures to reduce habitat fragmentation that have been implemented in the last few years along different roads. One of the measures assessed was an exit ramp installed alongside a perimeter fence. The ramp was found to be used by animals who had managed to get inside the fenced off stretch of the road.



Gestión Ambiental Viveros y Repoblaciones de Navarra

In recent years, many structures have been built in the Autonomous Community of Navarra to increase the permeability of new road networks to wildlife.

The construction of wildlife passages has gradually helped to defragment habitats affected by transport networks.

Once structures had been completed in Navarra, their effectiveness was evaluated in a project to monitor twenty wildlife passages of various types and other measures used to reduce habitat fragmentation. The monitoring, which was undertaken by the public company *Gestión Ambiental Viveros Repoblaciones de Navarra, SA*, was carried out using methods recommended in 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 assessing the effectiveness of measures to correct the barrier effect of transport networks; Number 2 in the series *Documents for the reduction of habitat fragmentation caused by transport infrastructure*). The following techniques were used: camera trapping, bands of marble powder to detect tracks and transects to identify signs of wildlife.

One of the escape devices monitored along stretches of roads with perimeter fences was an exit ramp, which was assessed by camera trapping. It was found to be used by foxes and beech martens, among other species, and was shown to be an effective escape route for animals trapped in the fenced stretches of the road. This effectiveness is in contrast with the negative results obtained for other measures to enable trapped animals to escape, such as different types of exit doors. These deteriorate rapidly and require high maintenance costs to ensure their continued effectiveness.

Source: Javier Forcada, Department of Housing and Spatial Planning, Regional Government of Navarra.



### **A study has identified priority areas for increasing road permeability between the Cantabrian Mountains and the Western Alps**

The connectivity between networks of protected areas depends on key connecting elements situated in strategic positions in the landscape, which support ecological flows, maintain the diversity and long-term viability of the biota and help different species to adapt to shifts in their optimal distribution areas due to climate change.



Gurrutxaga et al. 2011

A novel method based on the index of connectivity probability was described in a recent study published

in the magazine *Landscape and Urban Planning*. The aim was to analyse the connection between a network of protected areas from the Cantabrian Mountains to the Western Alps (the northern third of Spain, the south of France, Andorra and the north east of Italy). The following were taken into consideration: areas of community interest with forest formations, the characteristic dispersal distance of the various groups of forest mammals and the barrier effect of high capacity roads. Specifically, the method evaluated the contribution of each protected space and the connecting elements situated in the rest of the region as providers of connectivity that promote ecological flows in this transnational study area. The researchers identified the protected areas and the links that contribute most to maintaining functional connectivity in this network of protected areas. In addition, they identified the stretches of high capacity roads in which it is an essential priority to assess the degree of permeability and, when necessary, implement the corresponding defragmentation measures. The areas of intersection between key connectors and high capacity roads are mainly situated in the transition zones between the Cantabrian Mountains, the Pyrenees, the Iberian System, the French Central Massif and the Western Alps. Particularly notable is the transition between the Cantabrian Mountains and the Pyrenees, due to the high density of roads to evaluate and act upon.

The proposed methodological approach could be used in various conservation and landscape planning applications at different scales. The required tools are available online and have been used in many countries worldwide in a wide range of plans and studies (see [www.conefor.org](http://www.conefor.org)).

The study was carried out by researchers from the University of the Basque Country, the Technical University of Madrid and the University of Lleida.

Reference:

Gurrutxaga, M., Rubio, L. & Saura, S. 2011. Key connectors in protected forest area networks and the impact of highways: A transnational case study from the Cantabrian Range to the Western Alps (SW Europe). *Landscape and Urban Planning* 101: 310-320. Available online [here](#).

Source: Mikel Gurrutxaga, University of the Basque Country.



## The project LIFE+ “Bear Corridors” implements actions to improve the connectivity between bear subpopulations in the Cantabrian Range

Between January 2009 and December 2011, the project LIFE+ “Corridors for Cantabrian brown bear conservation” was carried out. The aim of this project was to improve the connectivity between the two subpopulations of Cantabrian brown bear through actions that promote a social situation that is favourable to the species and measures to manage the habitat and reduce risks.



Fundación Oso Pardo

The promoter and main contributor to the project was the *Fundación Oso Pardo* (FOP, Brown Bear

Foundation), an NGO with extensive experience in monitoring and conserving the brown bear and its habitat. With a total budget of 1,100,000 euros, other project contributors included the Biodiversity Foundation and the Social Projects of the Caixa Catalunya savings bank, with the collaboration of the Regional Government of Castilla y León, the Regional Government of Asturias and the twelve town councils of León and Asturias that have land in the bear's corridors.

The project was carried out with a field team and a technical team who undertook activities related to the dissemination of information, demonstrations and environmental education in the region, in addition to collaboration with hunters, livestock farmers, bee keepers and other social agents, research and data gathering on the presence of bears, and custodianship of land through the purchase and plantation of farms and mountains in the area of Leitariegos, where the habitat of the western subpopulation narrows.

Data on the presence of bears gathered in the corridor between the populations have contributed to a better understanding of how the process of dispersion works between both reproductive groups and the main paths that the bears use in their movements or the obstacles that they encounter. The barrier that the AP-66 motorway represents and the points where the bears cross have been analysed in particular. In addition, a permeability study has been carried out on the León-Gijón railway as it passes through the area of the corridor. In the final stage of the project, work is being done on a Handbook of Good Practices for the Management of Bear Corridors. The aim of this guide is to have an impact on the most advisable measures for increasing connectivity through actions to improve habitat and make the infrastructures more permeable to wildlife crossings.

Further information, newsletters and other materials can be downloaded from the [project website](#).

Source: *Fundación Oso Pardo*.



## In Greece, the Infra Eco Network Europe (IENE) held its general assembly and award giving ceremony

The general assembly of the organization took place in Kastoria and Nymfeo, and was organised with the local support of the ARCTUROS association and the University of Western Macedonia. The event coincided with a technical-scientific conference entitled *Highways and wildlife: How do they co-exist?*, which addressed various aspects such as the planning and design of high capacity routes, measures to maintain ecological connectivity through them and monitoring and management.



The topics presented at the conference included the measures implemented in the “Egnatia” motorway (which connects Greece with Albania) that is crossing a brown bear population (see the presentations [here](#)).

IENE is comprised of organizations and European experts in transport networks and ecology. Its aim is to promote a safe and sustainable road network by recommending measures and planning procedures to diminish the effects of transport networks on biodiversity, mitigate habitat fragmentation and reduce traffic accidents caused by collisions with wildlife.

At the general assembly, the annual awards were presented. These awards are given by the IENE in recognition of a person and a project that had contributed to achieving the overall objectives of the organization. The project award was given to *Landscape fragmentation in Europe* and the individual award was given to Carme Rosell, who provides technical assistance to the Spanish Working Group on Habitat Fragmentation

due to Transportation Infrastructure. For further information see [IENE Awards 2011](#).

In the general assembly, the management committee was restructured to incorporate new members, including a representative of the organization of the American conference ICOET (International Conference on Ecology & Transportation), who has joined the management committee of IENE to strengthen the links between the European and American associations, which have common objectives.

Finally, the assembly focused on aspects related to the organisation of the next [International IENE conference](#), which will be titled *Safeguarding ecological functions across transport infrastructures* and will take place in Postdam-Berlin, Germany, from 21 to 24 October 2012.

Source: *Infra Eco Network Europe*.



## PUBLICATIONS

***Landscape fragmentation in Europe. Joint EEA-FOEN report*** that describes the results of a project to assess the degree of habitat fragmentation in Europe. The analysis was carried out using the indicator 'Effective Mesh Size' applied at three different levels: countries, regions and a grid of 1x1 km squares. The use of a standard method for the entire study area has enabled the comparison of different countries and regions and the analysis of factors that contribute to this effect. The results show that measures need to be implemented to increase the permeability of both existing roads and the many new roads that are planned, particularly in East Europe.



Reference:

Jochen Jaeger, Luis Madriñán, Thomas Soukup, Christian Schwick y Felix Kienast. 2011. *Landscape fragmentation in Europe. Joint EEA-FOEN report*. European Environmental Agency - Swiss Federal Office for the Environment. Copenhagen, 87pp. Available online [here](#).



***Restauración ecológica de áreas afectadas por infraestructuras de transporte. Bases científicas para soluciones técnicas*** (Ecological restoration of areas affected by transport networks. Scientific bases for technical solutions) summarises the major impacts of the environmental changes caused by the creation and use of transport networks and addresses the main scientific criteria for reducing these impacts. The book, which gathers together the work and experience of over thirty experts from different fields and includes information from many projects, has been designed as a useful tool for technicians. Therefore, the chapters include the most common mistakes in the implementation of actions as well as examples of successes (and failures) that could help more effective decisions to be taken.



Reference:

Fernando Valladares, Luis Balaguer, Ignacio Mola, Adrián Escudero y Valentín Alfaya (Eds). 2011. *Restauración ecológica de áreas afectadas por infraestructuras de transporte. Bases científicas para soluciones técnicas*. Fundación Biodiversidad. Madrid, 322 pp. Available online [here](#).



## EVENTS

***VI Congreso Nacional de la Ingeniería Civil*** (Sixth National Civil Engineering Conference). Valencia, 23 and 24 February 2012. Organised by: Colegio de Ingenieros de Caminos, Canales y Puertos.

***IUCN World Conservation Congress***. Jeju (Korea), 6 to 15 de September 2012. Organised by: International Union for Conservation of Nature.

***The 8th European Conference on Ecological Restoration***. Ceské Budejovice (Czech Republic), 9 to 14 September 2012. Organized by: the University of South Bohemia, the Czech Republic Academy of Sciences, the Czech Republic Agency for the Conservation of Nature and Landscape Protection, the European Commission's

Directorate General for the Environment and the Society for Ecological Restoration (SER Europe).

***IENE 2012 international conference. Safeguarding ecological functions across transport infrastructure.*** Postdam-Berlin (Germany), 21 to 24 October 2012. Organised by: Infra Eco Network Europe.

#### Events that have already been held

***Seminario "Fragmentación de hábitats por infraestructuras lineales"*** (Habitat fragmentation due to linear infrastructure). Alcalá de Henares (Madrid), 22 June 2011. Organised by: Observatory for Sustainability in Spain and CEDEX (Ministry of Development). Further information is available [here](#).

***ICOET 2011. International Conference on Ecology and Transportation "Sustainability in Motion"***. Seattle (Washington, USA), 21 to 25 August 2011. Organised by: Center for Transportation and the Environment. Further information is available [here](#).

***IENE 2011 Scientific Workshop and General Assembly.*** Nymfeo and Kastoria (Greece), 21 to 24 September 2011. Further information is available [here](#).

***12th European Ecological Federation Congress.*** Ávila, 25 to 29 September 2011. Organised by: European Ecological Federation, the Asociación Española de Ecología Terrestres and the Sociedade Portuguesa de Ecologia. Further information is available [here](#).







***Jornada técnica "Fragmentación de hábitats y corredores ecológicos"***. (Fragmentation of hábitats and ecological corridors). Madrid, 6 October 2011. Organised by: Ecopás (Technical Association of Landscape Ecology and Environmental Monitoring). Further information is available [here](#).

***International Conference Environment – Landscape – European Identity.*** Bucharest (Rumania), 4 to 6 November 2011. Organised by: University of Bucharest. Further information is available [here](#).



## DOCUMENTS OF WORKING GROUP AND ACTION COST 341

As part of the European project COST 341 on Habitat fragmentation due to transportation infrastructure and the Working Group that have led to the project's continuity, following documents have been published to contribute to increase the knowledge of habitat fragmentation caused by transport infrastructures and the ways to reduce its effects:

- ***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 Ministry of the Environment and Housing (Catalan Government).
  - ***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.



- **No 5. Desfragmentación de hábitats. Orientaciones para reducir los efectos de las infraestructuras de transporte en funcionamiento.** (Habitat defragmentation. Guidelines to reduce the effects of operating transport networks). In press.

For further information, see the [MARM](#) and [IENE](#) websites.



- This publication is part of the project 'Habitat fragmentation due to Transportation Infrastructure', which is promoted by the [Ministry of the Environment and Rural and Marine Affairs](#). Directorate General of the Environment and Forest Policy.
- Any information for publication can be sent [here](#).
- The information contained in this document can be copied for non-commercial purposes, indicating the following source: Newsletter 'Habitat Fragmentation due to Transportation Infrastructure' (Directorate General of the Environment and Forest Policy, Ministry of the Environment and Rural and Marine Affairs, number 11, December 2011).

[SUBSCRIBE / UNSUBSCRIBE](#)

[SEND INFORMATION AND/OR COMMENTS](#)