habitat fragmentation due to transportation infrastructure

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PREVIOUS NEWSLETTERS

EDITORIAL

With the new year comes new beginnings, but is also time to review some of the most important events of 2022 regarding habitat defragmentation

In the international context, past December 22th, the Conference of the Parties of the Convention on Biological Diversity approved the Kunming-Montreal global biodiversity framework. This strategic plan, committing the 196 adhered countries includes as goals the integrity, connectivity and resilience of all ecosystems, which should be maintained, enhanced, or restored, substantially increasing the area of natural ecosystems by 2050.

The framework has 23 action-oriented global targets for urgent action over the decade to 2030. Among others, target 2 is devoted to ensure that by 2030 at least 30 per cent of areas of degraded terrestrial, inland water, and coastal and marine ecosystems are under effective restoration, in order to enhance biodiversity and ecosystem functions and services, ecological integrity and connectivity. Target 4 claims for urgent management actions, to halt human induced extinction of known threatened species and for the recovery and conservation of species, in particular threatened species. Also to significantly reduce extinction risk, as well as to maintain and restore the genetic diversity within and between populations of native, wild and domesticated species to maintain their adaptive potential, including through in situ and ex situ conservation and sustainable management practices, and effectively manage human-wildlife interactions to minimize human-wildlife conflict for coexistence. Finally, target 12 ask for significantly increase the area and quality and connectivity of, access to, and benefits from green and blue spaces in urban and densely populated areas.

In the national context, on December 31st it was approved the Strategic plan for the Natural Heritage and Biodiversity until 2030. This plan, which assume the core principles of the Convention of Biological Diversity and its long-term vision of living in harmony with Mother Earth is a key tool to plan and define next targets and actions to halt ecosystem degradation, to be develop by the Spanish Government. The plan encourage the development and implementation of the green infrastructure, ecological connectivity and ecosystem restoration. Overall, in 2030 a 15% of degraded ecosystems would be restored.

Among the actions devoted to the development of the green infrastructure, this strategic plan includes the adoption, by 2024 of the strategy of permeabilization and defragmentation of transport infrastructures. While improving human connectivity, the strategy ask for a better integration of biodiversity in the development of transport infrastructures in Spain. It will also improve the identification of those sectors within transport infrastructures that already limit species and habitat conservation or are expected to constitute such a conflict. Likewise, it will identify those areas greatly contributing to ecological connectivity, or offering good opportunities to restore it.

Finally yet importantly, we are experiencing a rapid increase in the development of renewable energy projects, especially regarding wind and solar farms. This belongs to the process of ecological transition and global decarbonisation goal for 2050 (fulfilling Spanish commitments with the European Union and the Paris agreement). It also constitutes a response to the consequences in terms of energy supply of the Russia's war against Ukraine. Nonetheless, it is crucial to highlight that these projects are one of the most important sources of habitat fragmentation nowadays, and both preventive and corrective actions that ensure ecosystem (and their connectivity) and species conservation should be accomplished.

Picture: Manuel Oñorbe.

WORKING GROUP

The Working Group on Habitat Fragmentation due to Transport Infrastructures met on October 27 during a hybrid meeting (online and in person), to inform on the activities and news developed during the last months by the different assisting authorities and organizations. Among them, the Spanish Ministry of Transport, Mobility and the Urban Agenda (MITMA) informed on the actions developed to reduce roadkill of Iberian lynx in Extremadura (see news). Representatives of the LIFE project SAFE-CROSSING informed on the completion of this project during 2023. The closing event will be held in May in Italy (see events). Marcello D'Amico, from Doñana Biological Station introduced the starting project Natura Connect (see news). The Ministry for the Ecological Transition and Demographic Challenge (MITECO) informed on the state of the art of the SAFE project and the related document of Technical Prescriptions (number 9) that are being developed in agreement with the Doñana Biological Station (CSIC). Such an agreement, initially planned until August 2023 was recently extended for one additional year. During this time, Marcello D'Amico will be part of the directive board of the project in the Doñana Biological Station.

The consulting service regarding habitat fragmentation due to transport infrastructures is still active, also giving support to SAFE. Any question on this topic can be sent to: habitat_infraestructuras@ebd.csic.es

NEWS

MITMA installed a high frequency system to avoid the roadkill of Iberian lynx in the National Road Network in Extremadura

The Spanish Ministry of Transport, Mobility and the Urban Agenda (MITMA) is developing several actions in the National road network to avoid Iberian lynx roadkill. Since May 2022, remote detection systems are being installed to avoid the roadkill of this species in Extremadura:

- In Road N-432 between kilometers 89 and 150 in Badajoz Province.

- In two links of highway A-66 in kilometer 675 and 677, in Badajoz Province.

- In three links of highway A-5, in kilometer 184, 185, and 197 in Cáceres Province.

The system uses the very high frequency radio signal (VHF) emitted by the radio-collar carried by the more than 50 lynxes released by the Extremadura Government, as part of the ex-situ conservation program for the species.

Once a radio-collar is detected (the VHF signal is received), a complex system of interconnected devices (cameras, transmitters, batteries, led signals) is activated near the road (see picture). Signals are currently activated for 15 minutes. Afterward they stop for 1 minute. If the VHF signal is still present, they activated again. If not, they keep inactive. This increased effectiveness of signals, avoiding the habituation experienced by drivers exposed to conventional signals and panels.

These actions are the result of an agreement between the former Ministry of Agriculture, Food and the Environment and MITMA to develop actions to reduce roadkill risk of animal species listed in the Spanish Catalogue of Endangered Species in the National Road Network.

In addition to the above-mentioned road sections, but using a different contracting figure, a similar system was also installed in the link between highway A-66 and road N-630 (kilometer 613 of A-66) close to the village of Mirandilla, in the Province of Badajoz.

These actions, published in August 2021 and contracted in February 2022 with a budget of 244.904 euros (VAT included) belong to the Recovery, Transformation and Resilience Plan of the Next Generation EU funds (component 6). This funding has a total budget of 357 million euro to enhance the protection of wildlife and vulnerable users of roads, and to adapt tunnels to European standards.

Source of information: MITMA

Navarra Regional Government will build an ecoduct on road A-1

Highway A-1, especially between the villages of Izurtzun and Altsasu constitutes an important barrier to local wildlife movements. The difficulty of crossing from one side to the other results in a high number of roadkill occurrences. Between 1998 and 2019, 29 wild boars, 25 roe deer, 24 stone martens, 22 foxes, and 21 badgers were road killed in this highway. Less frequently, carcasses of wild cats, genets, hares, European vison and otter were also found. Because observed mortality is always higher than actual mortality, these are important numbers to acknowledge the important impact this constitutes for both driving safety, and viability of local populations of some of the above-mentioned species, some of them of conservation concern.

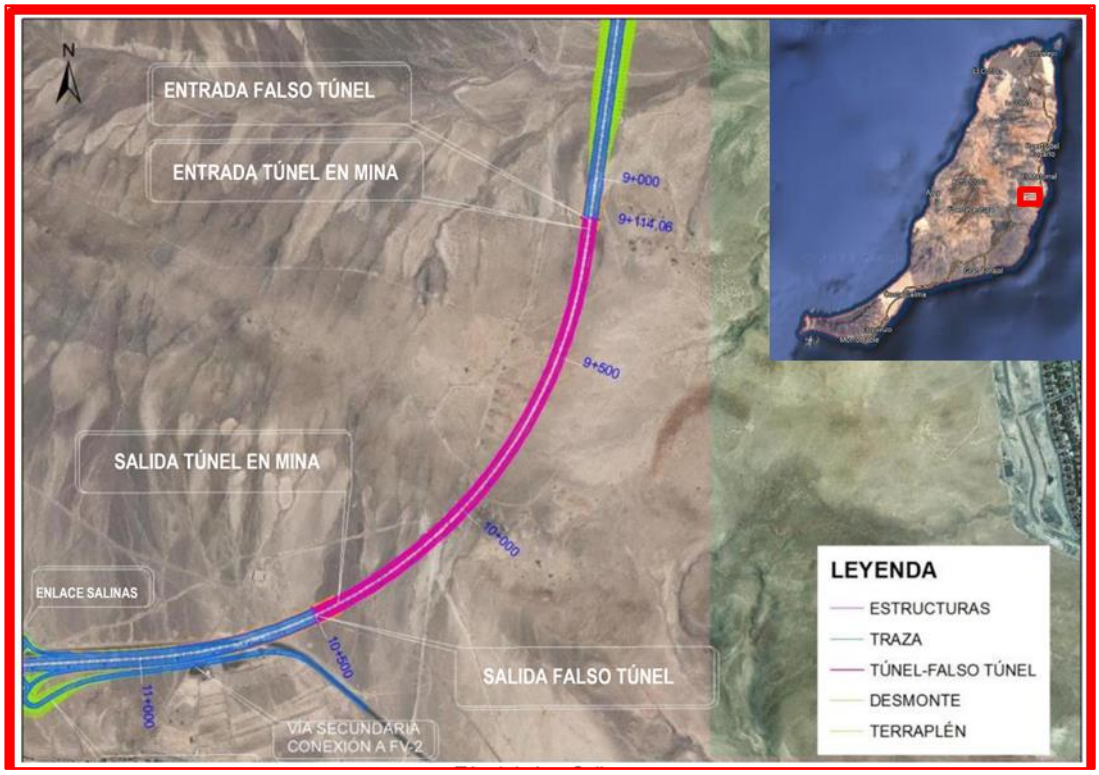
In this scenario, the Department of Rural Development and the Environment promote this project that will construct an overpass of 60m on the highway (see yellow line in the picture) to link the two natural areas at both sides of the road: the Urbasa-Andia Natural Park and the Aralar mountain range. This would allow wildlife to move between the two areas resulting in a higher genetic exchange and therefore a better conservation horizon for terrestrial wildlife populations. The place where the ecoduct will be built, close to the village of Etxarri Aranatz, constitute the best of the several options simulated, connecting two patches of the Aritzako oak forest, and also facilitated by the local topography.

This project is funded by the Recovery Assistance for Cohesion and the Territories of Europe (REACT-EU) funds, as acknowledged in the regional strategy of ecological transition "Navarra Green", and aligned with the European Green Deal and the European biodiversity strategy for 2030.

Navarra Regional Government published the contract to build the ecoduct with a budget of 5.288.907 euros (VAT not included), and the submission process was open until January 10th.

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

The Regional Government of Canary Islands will build a tunnel in the road between the airport and Pozo Negro, in Fuerteventura Island to mitigate fragmentation of steppe bird habitat.



The Regional Council for the Ecological Transition, Fight against Climate Change and Territory Planning published in the Official Regional Bulletin of March 2022 (volume 67) the positive environmental assessment regarding the project update: Road from Puerto del Rosario to Morro Jable, sector Airport-Pozo Negro crossing, placed in the municipalities of Puerto del Rosario and Antigua (Fuerteventura), and promoted by the Regional Council for public works, transport and housing. This sector of 18.117m from Matorral Airport, close to Puerto del Rosario (main city of the island) to Pozo Negro crossing belongs to the axis North-South of the Island. Once finished the adjacent sectors of Corralejo-Caldereta, and Caldereta-Airport, it will constitute the main North-South Road in the Island.

This new sector will join four localities: El Castillo, Las Salinas, Antigua and the airport. The new road will run parallel to the old one (FV-2), but in a shorter path, with four lanes, and maximum speed of 120 km/h. This road will hold the majority of the traffic, while FV-2 will be used as service road for local traffic. The new road also pretends to be more environmentally friendly.

The Environmental Assessment was strongly motivated by the presence of the Special Protection Area (SPA ES0000310) of "Llanos y Cuchillos de La Antigua", according to the Birds Directive. In this area, species such as the Canarian houbara (*Chlamydotis undulata fuertaventurae*), the cream-colored courser (*Cursorius cursor*), the trumpeter finch (*Bucanetes githagineus*), the Canarian subspecies of Eurasian stone-curlew (*Burhinus oedicnemus insularum*), and Egyptian vulture (*Neophron percnopterus majorensis*), the Barbary partridge (*Alectoris barbara*), the Barbary falcon (*Falco pelegrinoides*), and the Black-bellied sandgrouse (*Pterocles orientalis*).

For this reason, the project of the road path and the Environmental Impact Assessment consider since the initial stages of the project, the construction of a tunnel between kilometers 9.112 and 10.5 to mitigate the impact on secondary habitat of the Canarian houbara in the Cancela Plain, where several nesting places of Egyptian vulture were also found. This measure would reduce habitat fragmentation and the barrier effect, but also would constitute a visual and acoustic barrier to the traffic, reducing the impact on the wildlife species in this road section.

An additional corrective measure consist in the creation of a bird observatory (OAA) which will be active while this sector is under construction, and during a minimum of two additional years afterwards. This observatory, already built, aims at providing continuous monitoring of both expected and unexpected impacts on avian populations of this road sector. This bird monitoring program will be especially focused on species and habitats of conservation concern (Birds and Habitats Directives). It will help creating a data base on the species and their threats. Based on this information, additional conservation actions could be implemented. Given the importance of both the Canarian houbara and the Egyptian vulture populations it is required to preserve avian richness in the SPA and its vicinity. Therefore, the observatory will be strongly related to the Recovery plan of the Houbara, currently in development by the General Directorate for the Environment, and Fight against Climate Change, and with other Regional Departments and Institutions dealing with the study and conservation of birds, such as the Island Main Authority and SEO Birdlife.

Source of Information: Regional Council on Public Works, Transport and Homing. Canary Island Government.

Natura-Connect started in 2022

NaturaConnect receives funding under the European Union's Horizon Europe research and innovation program, brings together 22 partner institutions spanning across 15 European Union Member States, including the Doñana Biological Station (CSIC) in Spain. The Consortium unites universities and research institutes, government and public bodies, and non-governmental organizations working together with key stakeholders to create targeted knowledge and tools, and build the capacity needed to support European Union Member States in realizing an ecologically representative, resilient and well-connected network of conserved areas across Europe. In fact, NaturaConnect aims to design and develop a blueprint for a truly coherent Trans-European Nature Network (TEN-N) that builds on the existing network of European protected areas and Green and Blue Infrastructure. In the process of achieving such ambitious goals, the achieved knowledge and tools will help developing the Spanish Green Infrastructure.

Source of Information: Doñana Biological Station (CSIC)

MITMA completed the wildlife crossings aimed to reduce Iberian lynx mortality due to roadkill in the road N-420, Córdoba Province

As published in this bulletin on July 2021, the Ministry of Transports, Mobility and Urban Agenda (MITMA) has completed the works to reduce the roadkill probability of Iberian Lynx in Road N-420 between Montoro and Cardeña (Córdoba Province). The works had a budget of 970.000 euros funded by the Recovery Assistance for Cohesion and the Territories of Europe program, which has a whole budget of 357 million euros to enhance the protection of wildlife, vulnerable users and adapt tunnels to European standards.

The action is the result of a collaborative agreement between the MITMA and the Ministry for the Ecological Transition and the Demographic Challenge (MITECO). Such an agreement has the objective of developing actions that help reducing the risk of mortality derived from national transport infrastructures on species included in the Spanish Catalogue of Endangered Species. This agreement was signed on November 27 2017, and it is also aimed to increase driving safety.

This framework also included similar actions in the same road but northwards (between Cardeña and Ciudad Real Province boundary: kilometers 81 to 93). These actions covered the road sectors where the highest lynx mortality rates were recorded, therefore jeopardizing the population recovery of the species. Because of this inter-Ministry collaboration and coordination, animals can now cross safely by using the wildlife crossings built in these sectors. The detailed works included:

Clearing of road verges, including vegetation mowing in a two-meters-wide strip adjacent to the road, pruning of trees and shrubs and fencing. Fences are 2m-tall with an overhang of 0.5m with an upward angle of 45 degrees.

Three underpass tunnels of 2x2m made of concrete with lateral dry ledge and guiding walls (see picture) were installed.

The road sectors where these actions took place were repaved with hot-mix bituminous asphalt properly painted and provided with traffic signals. All existing culverts or drainages in the affected road sectors were also cleaned to serve as wildlife crossing.

Road poles and wildlife warning reflectors were also installed, together with reinforcing vertical signs and warning panels informing on the eventual crossing of lynx.

Source of information: MITMA

Roadkill constitute one of the most important threats for the wildcat in Navarra

The rangers of Navarra recorded a total of 18 wild cats (*Felis silvestris*) road killed in the roads of the Province during 2022. As a reference, the platform observation.org where volunteers of the SAFE project (leaded by MITECO, see bulletin 20) has recorded only six wildcats in the same period in the whole country. This highlights the importance of the numbers recorded by the rangers, and its potential impact on the species' population.

Despite feral cats may look similar to wildcats, the later are normally more stocky, have thicker tales with clear rings ended in a thick black tip. The top of the head and the forehead bear four well-developed dark bands.

To face this problem, several actions could be taken, as described in several numbers of this bulletin and in some of the documents published by the working group on habitat fragmentation by linear infrastructures (see below). Among them, reducing traffic speed, the signaling of problematic road sections, fencing, and building or habilitating wildlife crossings with appropriate guiding. In fact, the Navarra Regional Government is already constructing an ecoduct to reduce roadkill numbers (see above and MAGRAMA 2015).

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

Tenerife Island Authority improved landscape integration or road TF-65 between Aldea Blanca and Las Zocas

The road TF-65 between Aldea Blanca and Las Zocas in the municipality of San Miguel de Abona has been subject of a landscape integration to enhance the landscape and the nature value of the area. It is a place of high visibility with low vegetation cover, especially regarding shrubs and trees, where several issues were detected: exotic tree species in a bad condition, rubbish, invasive species, irrigation malfunctioning, sheet erosion and multiple tire tracks as consequence of illegal driving maneuvers with consequences on driving safety. For these reasons, different actions were considered to be carried on within the contract with the road's maintenance service.

Between June and November, the following actions were developed:
Old pavements were scarified; rubbish, dry vegetation, and invasive and exotic plants were removed. New elements were also introduced to change the flat topography of verges into a more hilly landscape in agreement with the surroundings. This was done by land movement, including big stones (see picture) that build a terrace. Colors of these added elements were chosen to be similar to the ones already present in the area. In total, more than 500 m^3 of land, and 400m of stones were used.

Regarding vegetation, some individuals of *Ceratonia siliqua* and *Schinus terebinthifolia* were preserved, while several individuals of *Jacaranda mimosifolia*, *Delonix regia*, and *Ficus* sp. were transplanted. In addition, a total of 1278 individuals of Canarian flora were planted, including *Tamarix canariensis*, *Olea cerasiformis*, *Juniperus turbinata*, *Phoenix canariensis*, *Jasminum odoratissimum*, *Plocama pendula*, *Convolvulus floridus*, *Euphorbia canariensis*, and *Euphorbia balsamifera*. A new irrigation system was also installed.

In collaboration with the municipality of San Miguel de Abona, 48 *Ficus microcarpa* and 1 *Schinus molle* were pruned and transplanted to different places within the villages of Las Chafiras and Las Zocas. Transplanted trees have the advantage of being bigger than regular seedlings, immediately giving environmental quality to the place where they arrive.

The total budget was 123.214,89 euros.

These works contributed to a better integration of the road into the landscape, enhance the area from the scenic point of view, halted environmental degradation, and improve sustainability reducing water consumption and the associated carbon footprint due to maintenance activities.

Source of information: Tenerife Island Authority

PUBLICATIONS

Barg, A. et al. 2022. Spatial and temporal trends in western polecat road mortality in Wales. PeerJ, 10, e14291.

Burgstahler, K. et al. 2023. Daily roadkill monitoring and long-term population census reveal female-biased mortality for a small mammal along a wildland-urban interface. Biological Conservation, 277, 109863.

Campioni, L. et al. 2022. Mud-puddling on roadsides: a potential ecological trap for butterflies. Journal of Insect Conservation 26: 131-134.

Cunningham, C. X. et al. 2022. Permanent daylight saving time would reduce deer-vehicle collisions. Current biology, 32(22), 4982-4988.

De Jonge, M. M. et al. 2022. The impacts of linear infrastructure on terrestrial vertebrate populations: A trait-based approach. Global Change Biology, 28(24), 7217-7233.

Dhiab, O. et al. 2022. Experimental evidence of increased carcass removal along roads by facultative scavengers. Environ Monit Assess 195: 216.

Dixon, H.J. et al. 2022. The effects of roadways on lakes and ponds: a systematic review and assessment of knowledge gaps. Environmental Reviews 30: 501-523.

García-Martínez, I. et al. 2022. Impact of COVID-19 lockdown on wildlife-vehicle collisions in NW Spain. Sustainability 14, 4849.

González-Bernardo, E. et al. 2022. The influence of road networks on brown bear spatial distribution and habitat suitability in a human-modified landscape. Journal of Zoology 319: 76-90.

MITMA 2022. Past December, MITMA published an internal notice for the maintenance service on the protocol to remove road-killed animals from roads. More info.

Rodríguez, C. et al. 2022. Encontrada una gineta (Genetta genetta) de coloración anómala atropellada en la provincia de Sevilla, España. Galemys 34: 46.

Seburn, D. et al. 2022. Do turtle roadkill hotspots shift from year to year? The Canadian Field-Naturalist, 136, 145-152.

Torres, R. T. et al. 2023. Landscape and population drivers of ungulate-vehicle collisions in Portugal. Applied Geography, 151: 102859.

Toth, et al. 2022. A stochastic simulation model for assessing the masking effects of road noise for wildlife, outdoor recreation, and bioacustic monitoring. Oecologia 199: 217-228.

Valerio, F., Godinho, S., Salgueiro, P. et al. Integrating remote sensing data on habitat suitability and functional connectivity to inform multitaxa roadkill mitigation plans. Landsc Ecol (2023).

Veals, A. M. et al. 2022. Landscape connectivity for an endangered carnivore: habitat conservation and road mitigation for ocelots in the US. Landscape Ecology, 1-19.

PAST EVENTS

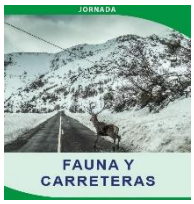
6th European Congress of Conservation Biology
The Society for Conservation Biology organized this Congress on the *Biodiversity crisis in a changing world,* in Prague (Czech Republic) from 22 to 26 August 2022. More info

IENE 2022 International Conference
Under the motto "connecting people, connecting landscapes", the IENE network organized this hybrid meeting (online and in-person) in Cluj-Napoca, Romania on 19-23 september 2022. More info.

Transport Research Arena 2022
The largest European research and technology conference on transport and mobility, themed *Moving together – reimagining mobility worldwide,* was held in Lisbon from 14 to 17 November 2022. Among other topics, theme 4: *Policies and Economics for a Competitive Europe*, considered the impact of transport corridors on biodiversity. More info

COMING EVENTS

Technical workshop on Roads and Wildlife
The Spanish Roads Technical Association will organize this meeting on February 16th 2023 in the College of Civil Engineers of Madrid (Almagro street 42). More info.



Sustainable land use day
Held by the Worldwide Railway Organization in Paris on February 27 in the UIC headquarters in Paris, France. More info.

Final Conference of project LIFE SAFE-CROSSING
Held in Sulmona, Italy on 17 and 18 may, 2023. More info

ICOET 2023. International Conference on Ecology and Transportation
Organized by the Road Ecology Center (UC Davis), the 2023 conference will combine in-person and virtual programming and training ("hybrid"). The in-person conference will be in Burlington, Vermont (US) between 4 and 8 June 2023. More info.

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

ACLIE + GCLIE 2023. International Conference on Ecology and Transportation
The African Conference for Linear Infrastructure and Ecology (ACLIE) will organize this event in Kenya between 18 and 21 September 2023. Despite it was initially programmed jointly with IENE (see past events), the Global Congress on Linear Infrastructures (GCLIE) will be organized in coordination with ACLIE. 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 7. Edge and verge effects of transport infrastructure. Mitigating their impact on biodiversity*** (2,8 MB) Published in 2021.
  - ***Nº 8. Prescripciones técnicas para hacer efectivos los seguimientos de las medidas de mitigación del efecto barrera de las infraestructuras de transporte (diseño, documentación y archivo del seguimiento ambiental)*** (7.19 MB) (Technical prescriptions to make effective the mitigating measures of the barrier effect of transport infrastructures. Design of environmental monitoring, documentation, and archive). Published in 2020.

For further information, see the MITECO and IENE sites.

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

Any information for publication can be sent here.

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