



HABITAT FRAGMENTATION

DUE TO TRANSPORTATION INFRASTRUCTURE



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EDITORIAL

With the start of 2026, this newsletter once again reflects a particularly intense period of work and collaboration in the field of habitat fragmentation caused by transport infrastructure. The past few months have been marked by significant technical advances, the exchange of experiences, and a growing commitment to innovation and digital tools as support for decision-making.

On the technical front, the *Habitat Fragmentation Working Group* has completed the update of the *Technical Specifications for the design of wildlife crossings, perimeter fencing, and other measures to promote biodiversity in transport infrastructure*, now reaching their third revised and expanded edition. This document strengthens its role as a common reference for the planning, design, and implementation of measures aimed at improving ecological connectivity, incorporating accumulated experience and the latest technical advances.

One of the most notable milestones of this period was the Technical Workshops held in Valladolid, focused on the digital transformation of transport routes and its application to biodiversity management. The high level of participation and the debate generated highlighted the potential of tools such as artificial intelligence, geographic information systems, digital twins, and BIM methodologies to improve the monitoring, evaluation, and effectiveness of mitigation measures. At the same time, the need to move toward robust methodologies, comparable data, and planned maintenance of these technological solutions was emphasized.

Along these lines of knowledge enhancement, the results of the *SAFE* project also stand out, offering an unprecedented comprehensive overview of the sensitivity of Spanish wildlife

to roadkill mortality. Beyond the specific findings, the project's value lies in the development of a replicable methodology that helps guide mitigation and conservation strategies at different scales, strengthening the integration of biodiversity conservation and transport planning.

This issue also includes relevant advances in the regulatory and technical spheres, such as the publication of the guide on *Road traffic accidents involving animals* and the introduction of the new P-24a traffic sign warning of the risk of collisions with wild boar. Both initiatives reflect an increasingly integrated approach that brings together road safety, land management, and biodiversity conservation.

The examples of actions carried out in different territories—from improvements to roadside green infrastructure in Tenerife to recent defragmentation interventions in Catalonia—illustrate how these principles are translated into concrete projects. These initiatives are aligned with the objectives of ecological connectivity, territorial resilience, and ecosystem restoration, in coherence with national and European strategic frameworks.

We would like to once again thank all public administrations, scientific institutions, and professionals involved for their commitment to this collective effort. Their joint work is helping to advance toward a more integrated and sustainable approach to transport infrastructure, in which ecological connectivity and biodiversity play a central role.

WORKING GROUP



Over recent months, the Working Group on Habitat Fragmentation caused by Transport Infrastructure (GTFHT), through the Technical Committee established for this purpose, has completed the update of Technical Specifications Document No. 1, which has been renamed "*Technical specifications for the design of wildlife crossings, perimeter fencing, and other measures to promote biodiversity in transport infrastructure (3rd edition, revised and expanded)*".

In addition, some members have also been actively involved in various initiatives led by MITECO.

Within the framework of the development of the "*National inventory of wildlife crossings and other structures with potential to improve ecological connectivity*" (IPFEC), they have provided information on the crossings present in their territories using an Excel template.

Furthermore, during the process of drafting the "*Guidelines for the identification and proposal of control measures for Invasive Alien Species (IAS)*", they identified, through a questionnaire, the most problematic species in their respective territories.

NEWS

Digital transformation of transport routes and biodiversity management: opportunities for cooperation. GTFHT Technical Workshops

On 16 and 17 October 2025, Valladolid hosted the biennial technical workshops of the Working Group on Habitat Fragmentation caused by Transport Infrastructure, jointly organised by the Ministry for the Ecological Transition and the Demographic Challenge and the Regional Government of Castile and León (Department of Mobility and Digital Transformation and Department of the Environment, Housing and Spatial Planning).

With the participation of more than 170 national and international experts, the event focused on the use of digital tools to improve biodiversity management along transport routes. The presentations were organised into four thematic sessions: 1) international perspectives; 2) technologies for the prevention of wildlife-vehicle collisions and monitoring of mitigation measures; 3) ecological modelling and environmental data digitalisation; and 4) technology, research and analysis of wildlife roadkill. Within the final session, a debate on the technologies used to monitor wildlife collisions and the application of the data collected stood out, with strong audience involvement through direct interaction with experts, enriching the discussion. The opportunity was also taken to assess the results of the SAFE project.

The event concluded with a presentation by Carlos de Hita, writer and soundscape artist, who captivated attendees with his work "The Interrupted Symphony: Soundscape and Habitat Fragmentation".

On the second day, a field visit was organised to showcase different measures implemented in the province of Palencia to reduce wildlife collisions and mitigate the effects of fragmentation. Specifically, participants visited the regional road CL-615, where a wildlife crossing located between kilometre points 19 and 23 and variable signage based on spatio-temporal models installed between kilometre points 38.6 and 54.4 were presented. A reduction in wildlife-related accidents has been recorded along these sections.

Finally, the workshops concluded with a visit to the Torquemada and Astudillo plateaus, an area where the Iberian lynx is being reintroduced. An overview was provided of the reintroduction project, as well as the habitat defragmentation and connectivity measures currently being implemented within its framework.

Source: MITECO and the Regional Government of Castilla y León.



Moments from the technical workshops in Valladolid: on the left, the presentation sessions; on the right, the field visit.



The conclusions of the workshop highlighted the advantages of incorporating new technologies (artificial intelligence, digital twins, BIM tools, GIS tools, etc.) into the monitoring and management of biodiversity associated with transport routes. However, they also identified challenges that require priority attention, such as the standardisation of data collection to facilitate comparison and the use of information from different sources; the need to support digital tools with robust methodologies; and the importance of assessing the cost-effectiveness of each technology and planning for its maintenance.

To address these challenges, strengthening cooperation among all stakeholders involved (public administrations, researchers, the private sector and civil society) is essential. In this regard, the importance of establishing formal collaborative networks at both national and international levels was underlined, in order to facilitate the exchange of data, technologies and good practices.

To learn more about the presentations delivered at the conference, the book of abstracts can be consulted.

Source: MITECO website.

Phase 2 of the SAFE project (Stop Wildlife Roadkill in Spain) comes to an end

This project, funded by the Ministry for the Ecological Transition and the Demographic Challenge (MITECO) and carried out by the Doñana Biological Station (EBD-CSIC), had as its main objective the assessment of the vulnerability of Spanish wildlife species to mortality caused by road traffic collisions.

To this end, a review of scientific literature on roadkill was conducted, focusing on studies that included any species present within Spanish territory. Specifically, studies were selected in which one or more of these species were shown to be "sensitive" to this impact or where road mortality was found to have population-level consequences. In addition to the scientific literature, consultations were held with the main scientific societies in Spain (the Spanish Herpetological Association –AHE–, the Spanish Society for the Conservation and Study of Mammals –SECEM–, and the Spanish Ornithological Society –SEO–), which were asked to assess, based on their expertise, which species present in the territory could be considered sensitive to roadkill mortality.

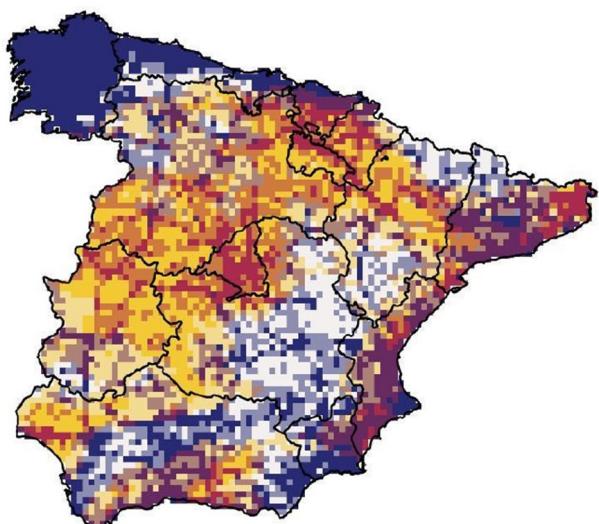
For all species selected through both approaches (literature review and expert knowledge), distribution maps from the IUCN (International Union for Conservation of Nature) were obtained and overlaid with the road and paved track network, as well as with a grid of 10 × 10 km cells. This made it possible to calculate, for each grid cell, the number of sensitive species affected and the density of roads. To combine both metrics, values for road density and number of species were first grouped into three categories—high, medium and low—using values from 1 to 3. In other words, if a cell had a low number of affected species, it was assigned a richness value of 1, and if it had a low road density, it received a density value of 1. The final value for each cell resulted from multiplying the richness value by the density value, yielding values between 1 and 9, following a defined distribution and colour scale.

	Densidad baja	Densidad media	Densidad alta
Riqueza alta	3	6	9
Riqueza media	2	5	8
Riqueza baja	1	4	7

Applying this methodology to the entire peninsular geography resulted in a "sensitivity" map in which red cells indicate areas with both high road density and a high

number of sensitive species according to expert criteria, while mustard-coloured areas indicate zones with a high density of sensitive species but a low density of roads.

Although the scale of this approach is not the most suitable for direct management purposes, it provides an unprecedented overview that can help guide conservation strategies.



Sensitivity map of wildlife to roadkill mortality in peninsular Spain, produced by combining transport infrastructure density with the richness of sensitive species identified through scientific literature and expert judgement, based on collaboration with different scientific societies.

For example, in areas with a high concentration of red cells, the most appropriate management strategy would be mitigation, whereas in areas dominated by mustard-coloured cells, priority management should focus on preservation—that is, avoiding, as far as possible, the construction of new infrastructure.

In this regard, the main value of the study lies not only in the specific results obtained, but in the establishment of a replicable and scalable methodology that can be applied in regional and local assessments. This lays the groundwork for progress toward a more integrated approach to territorial management, in which biodiversity conservation and transport planning are no longer treated as separate domains, but are conceived as complementary dimensions of a single sustainability strategy.

Source: EBD-CSIC.

Guide on “Road Traffic Accidents Involving Animals” Published

The Directorate-General for Traffic (DGT), in collaboration with the Spanish Road Association (AEC), has published the guide “Road Traffic Accidents Involving Animals”, a technical reference document that comprehensively addresses one of the main impacts of transport infrastructure on biodiversity and road safety.

The guide provides a review of the current situation in Spain, including an analysis of the scale of the problem, the factors influencing wildlife-related accidents, and the management procedures employed by the various road authorities. It also offers a compilation of the most commonly used measures to prevent and reduce such accidents. These measures are organized into five categories, ranging from signage and roadside management to fencing, wildlife crossings, and intelligent detection and alert systems. Each measure is accompanied by a traffic-light-style graphic indicating its effectiveness.

In addition, the guide presents a wide range of experiences and best practices implemented in other countries, along with references to national strategies, plans, and programs related to road safety, ecological connectivity, and biodiversity conservation, enhancing its value as a decision-making support tool.

This publication helps improve understanding of the interactions between transport infrastructure, wildlife, and road safety, providing technical criteria and practical examples that can serve as a basis for planning and implementing measures aimed at reducing wildlife-vehicle collisions and minimizing habitat fragmentation associated with the road network.

Source: DGT.

New DGT P-24a Sign: Wild Animals Crossing (Wild Boars)

The Directorate-General for Traffic (DGT), based on Royal Decree 465/2025 of 10 June—which modifies the General Traffic Regulations approved by Royal Decree 1428/2003 of 21 November regarding traffic signage—has added a new vertical sign, P-24a, to its catalogue. This sign is intended to warn drivers of the frequent presence of wild boars on the roadway.

The P-24a sign specifies and complements the generic P-24 sign, which alerts drivers to crossings of wild animals, allowing for the clear identification of one of the species most often involved in traffic accidents in Spain.

Its implementation responds to the sustained increase in vehicle-wild boar collisions, associated with factors such as habitat fragmentation, the expansion of road infrastructure, and the growth of wild boar populations in peri-urban and rural areas. The sign aims to improve drivers' risk awareness in high-accident zones, promoting more cautious driving.

From the perspective of conservation and land management, this measure forms part of broader strategies to

mitigate the impact of infrastructure on wildlife.



P-24a Sign: Warning – Presence of Wild Animals (Wild Boars).

The P-24a sign is therefore both a road safety tool and a reminder of the role that infrastructure planning and ecological connectivity play in reducing conflicts between traffic and wildlife.

Source: DGT.

Measures to Improve Habitat Connectivity for Insects Along Transport Routes – XXI Iberian Entomology Congress, October 2025

During the 21st edition of the Iberian Entomology Congress, held at the Universidad Católica de Ávila from 6 to 10 October 2025, the Center for Studies and Experimentation of Public Works (CEDEX) presented a talk entitled “Measures to Mitigate Habitat Fragmentation for Insects Caused by Linear Transport Infrastructure.”

The presentation highlighted the fragmentation of insect habitats—particularly those of pollinators—caused by linear transport infrastructures, as well as the high morta-

lity rates associated with these structures.

To address this issue, the talk emphasized the existence of effective management measures, such as restoring ecological connectivity between habitats through the adaptation or construction of transversal structures (e.g., wildlife overpasses, ecoducts, etc.) and improving habitat quality in margins and auxiliary areas.



Poster of the presentation "Measures to Mitigate Habitat Fragmentation for Insects Caused by Linear Transport Infrastructure", delivered at the 21st Iberian Entomology Congress.

The audience, composed of specialists in the study and conservation of insect fauna, showed great interest in the future application of these measures, the post-implementation monitoring of insect populations, the scientific evidence supporting the use of transversal structures by this faunal group, and the proposed corrective measures.

The authors of the presentation were Sergio Ibarra Mellado and Manuel García Sánchez-Colomer from CEDEX; José Luis Viejo Montesinos, Professor of Zoology at the Universidad Autónoma de Madrid; and Manuel Oñorbe Esparraguera, representing the Habitat Fragmentation Working Group.

Source: CEDEX.

Actions for the Conservation and Improvement of Green Infrastructure along Tenerife's Road Network

The Technical Service for Roads and Mobility of the Cabildo Insular de Tenerife, through the service contracts "Conservation, Improvement, and Cleaning of Green Areas Adjacent to the Island Road Network," has carried out various initiatives throughout 2025 aimed at reducing the environmental and visual impact of roads on the territory, enhancing the quality of the surroundings visible from the roads, and highlighting the island's landscape richness.

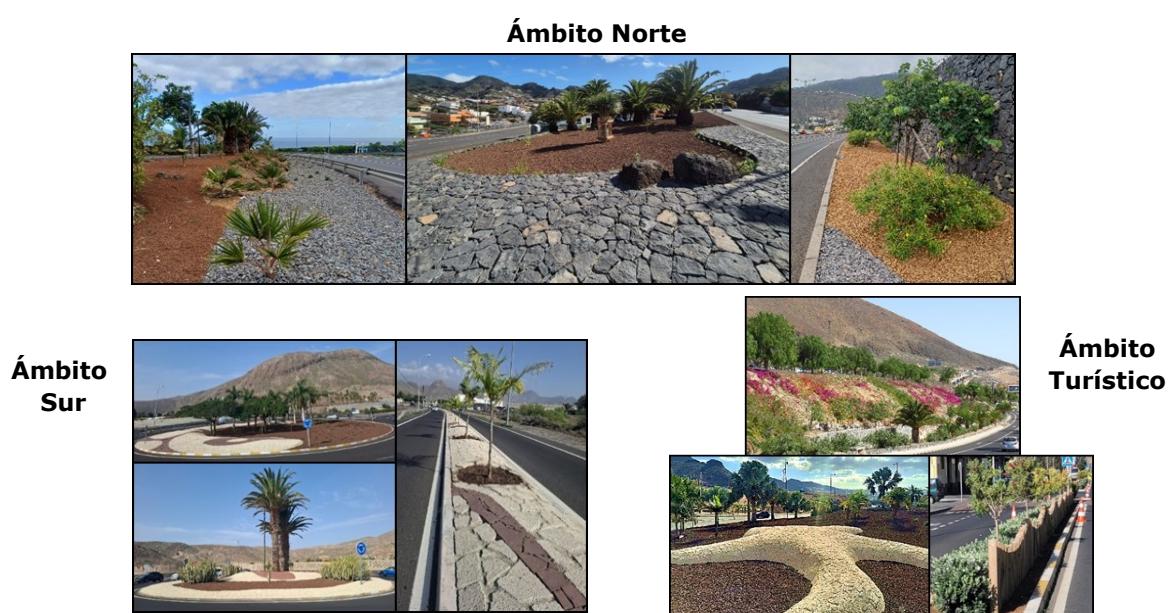
The main goal has been the landscape integration of roads, standardizing interventions according to a model based on environmental, aesthetic, and functional criteria specific to each area of the island. These green infrastructure solutions provide multiple benefits, including carbon sequestration, contribution to ecosystem connectivity, and the protection and conservation of Tenerife's biodiversity and landscapes.

The actions have been implemented following the

"Technical Criteria for Landscape Integration in Environmental Rehabilitation Projects of Roads under the Competence of the Cabildo Insular de Tenerife", approved in Agreement No. 28 of the Ordinary Session of the Island Government Council on 16 April 2012, derived from the "Guidelines for Environmental and Landscape Improvement of Tenerife's Island Road Network."

Today, the Cabildo of Tenerife continues to face the challenge of advancing the landscape integration of green infrastructure across more than 2 million square meters, with an annual budget of €4,394,270.62, aiming to promote the sustainability of the island's transport infrastructure through the conservation and enhancement of these spaces.

Source: Cabildo Insular de Tenerife, Department of Mobility. Technical Service for Roads and Mobility, Environment and Landscape Unit.



Examples of actions carried out in different areas of Tenerife for the conservation and improvement of green infrastructure along the island's road network.

Completion of Two Habitat Defragmentation Projects within the Catalonia Green Infrastructure Program

The Catalonia Green Infrastructure Program (PIVC), promoted by the Department of Territory, Housing, and Ecological Transition of the Generalitat de Catalunya, was established in 2017 to proactively and strategically address biodiversity loss and the increasing fragmentation and degradation of ecosystems. Furthermore, the 2025–2029 Work Program of the Strategy for the Defragmentation of Habitats Affected by Linear Transport Infrastructure includes the action “Restoration of ecological corridors connected to wildlife crossings,” with projects implemented in Catalonia.

Recently, two habitat defragmentation projects around transport infrastructure have been completed:

The project **“Improving Terrestrial Connectivity: Permeabilization of Infrastructure – La Múnia Marmellar”** has been focused on interventions along approximately 7.7 km of three major watercourses important for ecological connectivity in the area: the Riera de Marmellar, the Rieres de Estalella and Estalleta, and the Torrents de Cal Biel and de la Bruixa, within the municipalities of L’Arboç, Banyeres del Penedès, Castellet i la Gornal, Castellví de la Marca, and Santa Margarida i els Monjos, spanning the Alt and Baix Penedès regions.

The Works included:

- Removal of invasive exotic species populations (mainly giant reed, *Arundo donax*).
- Demolition of a preexisting concrete ford.
- Adaptation of the underpass beneath the N-340 road for mixed use (drainage, pedestrian, and bicycle passage) and improvement of drainage capacity.
- Compatibility of truck passage on a service road with continuity of the Marmellar stream bed under the conventional ADIF railway line.
- Enlargement of the riverbed in various sections and slope stabilization using bioengineering techniques (revetments).
- Revegetation with riparian species and hydroseeding.



Final state of the Works on the Riera de Marmellar, near the N-340 road

“Connectivity Improvement: Wildlife Crossing on the N-150 Road at Torrente de la Grípia”: Located in the municipality of Terrassa, this project strengthens the ecological corridor in a section of the Vallès region historically fragmented by numerous transport infrastructures and urbanization, which hindered connectivity between the Red Natura 2000 protected areas of Collserola and the Sant Llorenç del Munt i l’Obac massif. The works included:

- Removal of an unused weir at Can Cintet, which represented a bottleneck for wildlife and improved hydraulic capacity, reducing flood risk during heavy rains.
- Removal of approximately 1,100 m³ of accumulated sediments, restoring the functionality of the existing drainage structure as a wildlife passage.
- Reprofiling of the Torrent bed and stabilization of slopes.
- Removal of invasive exotic species (giant reed), hydroseeding, and planting with native riparian species.

Both projects were carried out by the public company Infraestructures.cat, financed through European Next Generation funds within the Recovery, Transformation, and Resilience Plan, and are part of priority actions to



Final state of the Works on the Torrente de la Grípia along the N-150 road.

strengthen Catalonia’s green infrastructure. The execution cost of the La Múnia Marmellar project was €874,061, while the Torrente de la Grípia project cost €287,636.

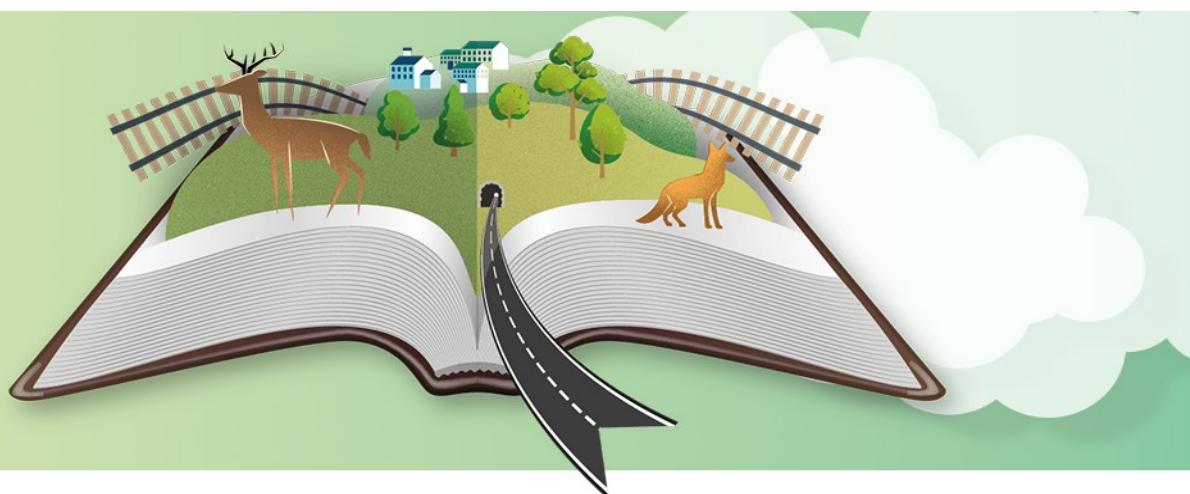
These interventions also align with the European Nature Restoration Law, which aims to restore 20% of degraded ecosystems in the European Union by 2030 and all degraded ecosystems by 2050.

Source: Generalitat de Catalunya.

PUBLICATIONS

Given the large number of scientific publications related to the newsletter's topic, this section includes only those that meet the following criteria: (1) they are published documents, (2) they are representative of or applicable to the Iberian context, and (3) they focus on at least one taxonomic group rather than on individual species.

- Barrientos, R., Ascensão, F., Fahrig, L., Teixeira, F. Z., & D'Amico, M. (2025). Population abundance should be an Essential Biodiversity Variable in infrastructure impact assessment. *Environmental Impact Assessment Review*, 115, 108021. <https://doi.org/10.1016/j.eiar.2025.108021>
- Botting, I., Ascensão, F., Navarro, L. M., Paniw, M., Tablado, Z., Román, J., ... & D'Amico, M. (2025). The road to success and the fences to be crossed: considering multiple infrastructure in landscape connectivity modelling. *Wildlife Biology*, 2025(3), e01187. <https://doi.org/10.1002/wlb3.01187>
- Dispan de Floran, L., Mergey, M., Galan, M., Vitte, I., Jouanillou, A., Le Barh, M., ... & Helder, R. (2025). Variability in the impact of linear transportation infrastructures on gene flow in French wild ungulate populations. *Landscape Ecology*, 40(2), 31. <https://doi.org/10.1007/s10980-025-02052-w>
- Fonda, F., D'Amico, M., Petruzzellis, F., Scridel, D., Pesaro, S., Tomè, P., & Bacaro, G. (2026). Rethinking road mitigation priorities through detection-informed interpretation of roadkill data and road crossability. *Biological Conservation*, 313, 111619. <https://doi.org/10.1016/j.biocon.2025.111619>
- Hušek, J., Kvičerová, J., & Cukor, J. (2025). Spatio-temporal variation and factors affecting European hare (*Lepus europaeus*) road mortality: Landcover diversity as a remedy. *Global Ecology and Conservation*, e04013. <https://doi.org/10.1016/j.gecco.2025.e04013>
- Kourchi, Y. E., Santos, X., Fahd, S., & Chergui, B. (2025). Occupancy analysis uncovers environmental factors contributing to road mortality of amphibians. *European Journal of Wildlife Research*, 71(3), 53. <https://doi.org/10.1007/s10344-025-01932-5>
- Patterson, S., Fahrig, L., Jaeger, J. A., Meek-Sauriol, O., Teixeira, F. Z., Torres, A., & Rytwinski, T. (2025). Mammals with large home ranges, low reproductive rates and small body sizes are most vulnerable to roads: A meta-analysis. *Journal of Applied Ecology*, 62(12), 3227-3239. <https://doi.org/10.1111/1365-2664.70190>
- Román, J., Blas, J., Bastianelli, G., Suárez-Couselo, M. A., Revilla, E., & D'Amico, M. (2025). Colonizers on the road: European bee-eaters shift nest-site selection to roadside habitats. *Ecology*, 106(6), e70125. <https://doi.org/10.1002/ecy.70125>
- Stamatiou, M., Zotos, S., & Vogiatzakis, I. N. (2025). Roadkill on islands: where road and island ecology meet. *Frontiers in Conservation Science*, 6, 1656280. <https://doi.org/10.3389/fcosc.2025.1656280>
- Sukhontapatipak, C., Saralamba, C., Piyapan, P., Duangta, P., Klubchum, T., & Sawangproh, W. (2025). Global wildlife roadkill research: a bibliometric synthesis of historical trends, thematic gaps, and future directions. *Urban Ecosystems*, 28(4), 130. <https://doi.org/10.1007/s11252-025-01747-x>
- van Dijk, R. E., Morel, T., Zwerver, K., van Els, P., & Foppen, R. P. (2025). Road traffic has a consistent negative impact on breeding density of a wide range of bird species in different habitats. *Landscape Ecology*, 40 (6), 118. <https://doi.org/10.1007/s10980-025-02100-5>
- van Strien, M. J., & Grêt-Regamey, A. (2025). Global expansion of the ecological impact of extra-urban road traffic. *Nature Sustainability*, 1-10. <https://doi.org/10.1038/s41893-025-01637-2>



UPCOMING CONGRESSES AND CONFERENCES

CONEIA26

La evaluación ambiental como herramienta de prevención de riesgos

May 6-8, 2026 - Toledo. Spain



March 23-25, 2026 - Brisbania. Australia

International Transport Forum

May 6-8, 2026 - Leipzig. Germany



March 10-13, 2026. Chambéry. France

XIII National Congress on Environmental Impact Assessment

From 6 to 8 May 2026 at the El Greco Conference Center (Toledo, Spain). This congress focuses on environmental assessment as a tool for risk prevention, bringing together professionals and experts to discuss, share experiences, and explore solutions related to sustainability and environmental management.

Check [the thematic blocks](#) of the congress.

ANET 2026. Breaking Barriers: Innovating to Improve Ecological Outcomes in Transport and Other Infrastructure

A congress focused on the future of road ecology and transport infrastructure in Australia and New Zealand. The event will also feature international experts, aiming to gather innovative global practices and solutions that enhance environmental stewardship within transport networks and associated infrastructure.

The [program](#) is now available.

ITF 2026. Finding Resilient Transport

Under the theme "Promoting Resilient, Inclusive, and Net-Zero Transport", the summit will explore how to finance transport systems that can withstand threats such as climate change, geopolitical tensions, pandemics, and cyberattacks.

The program will focus on the social, environmental, and economic aspects of four cross-cutting themes: innovation, capacity building, stakeholder engagement, and governance.

17th World Congress on Winter Road Maintenance, Road Resilience, and Decarbonization

The adaptation of France's road network to climate change will be featured in several sessions of the congress, although the presentations will primarily focus on improving road operability under adverse weather conditions, designing for greater resilience, and reducing associated emissions.

The [program](#) is now available.

CONGRESSES AND CONFERENCES HELD



Valladolid, Spain

Digital Transformation of Transport Routes and Biodiversity Management: Opportunities for Cooperation

With a focus on technological innovation in the service of sustainability, these workshops were organized to examine the application of digital and artificial intelligence tools in the management of transport infrastructure and biodiversity conservation, addressing aspects such as safety, resilience, and sustainability. The [book of abstracts](#) and [conclusions](#) is now available.

CONGRESSES AND CONFERENCES HELD



Sevilla, Spain



Abu Dhabi, EAU



Évora, Portugal

7th International Congress on Biodiversity and Nature Conservation

Aimed at fostering interdisciplinary collaboration and the development of joint proposals for biodiversity conservation in the context of global change, the 7th International Congress on Biodiversity and Nature Conservation was held in Seville from 18 to 21 September. The [book of abstracts](#) is now available.

World Conservation Congress—IUCN

Held every four years, this congress brought together policymakers, international organizations, Indigenous peoples, the scientific community, and the private sector to address the main global challenges in biodiversity, climate, and sustainable development. It concluded with the adoption of new resolutions and commitments to strengthen collective action worldwide.

The congress [conclusions](#) are now available.

17th International SECEM Congress

The event provided a platform to share the latest advances in research and conservation, facilitated the exchange of experiences, and reinforced SECEM as a fully Iberian society, marked by high participation and the promotion of new professional collaborations.

The congress [conclusions](#) are now available.

DOCUMENTS ON THE WORKING GROUP: LATEST PUBLICATIONS



[Technical Specifications for the Design of Wildlife Crossings, Perimeter Fencing, and Other Measures to Promote Biodiversity in Transport Infrastructure.](#)
(3rd Edition, Revised and Expanded)

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