

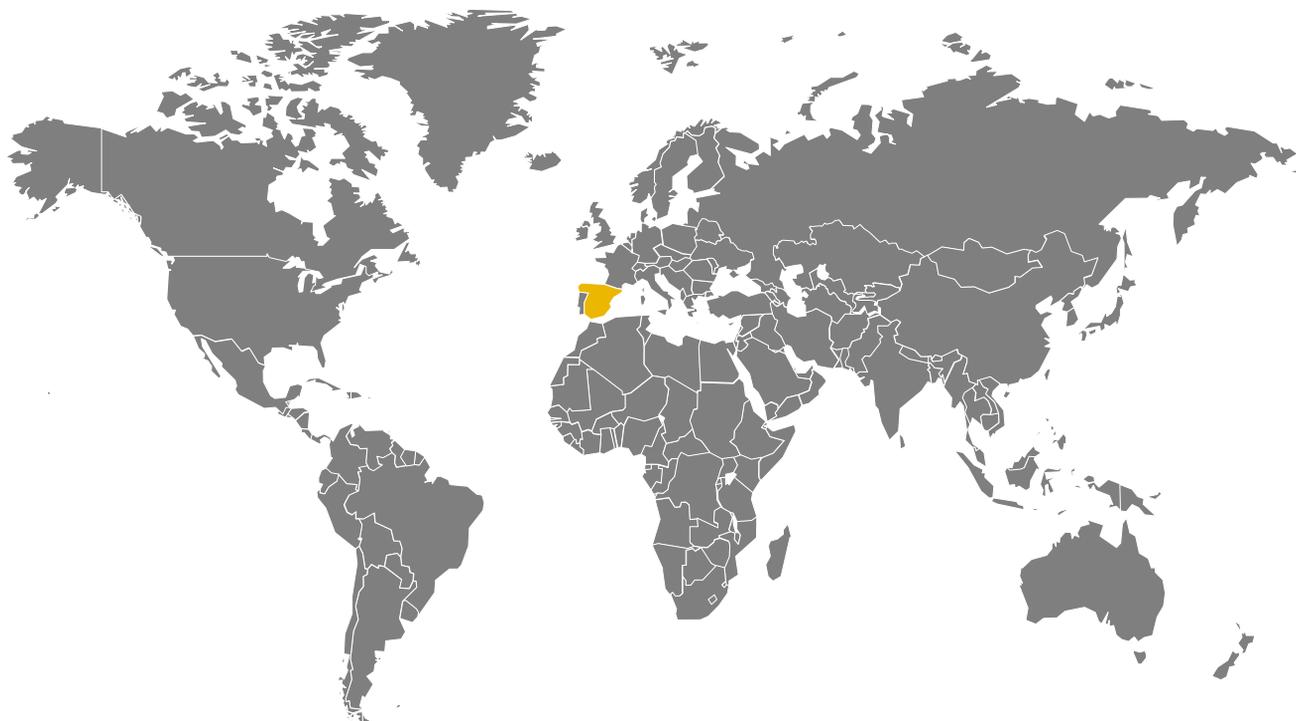
An aerial photograph of a winding asphalt highway cutting through a lush, green, hilly landscape. The road curves through the terrain, with some sections showing exposed reddish-brown earth. The surrounding area is covered in dense vegetation, including trees and shrubs. In the background, more hills are visible under a clear sky. The overall scene is a mix of natural beauty and infrastructure.

Catálogo de Iniciativas de Biodiversidad 2018

ferrovial

ÍNDICE

1. [Estudios de protección de aves esteparias. Ramal Este Torrelaguna, España](#)
2. [Estudios de seguimiento y vigilancia faunística. Zamora, España](#)
3. [La protección ambiental en una reserva de la biosfera. Islas Baleares, España](#)
4. [Restauración ecológica de taludes y recuperación de poblaciones de maytenus senegalensis, Granada, España](#)
5. [Protección de la fauna](#)



Ramal Este Torrelaguna

El proyecto de Refuerzo del Ramal Este del sistema de abastecimiento de agua tramo Torrelaguna-Alapardo afectaba dos espacios singulares: LIC "Cuencas de ríos Jarama y Henares" y ZEPA "Estepas cerealistas de los ríos Jarama y Henares". De acuerdo a la DIA, dada la presencia en la zona de fauna protegida no se podía ejecutar obra en el periodo de nidificación, comprendido entre el 1 de marzo al 31 de julio.



Durante el mes de diciembre de 2015 se realizó un estudio bibliográfico sobre presencia de zonas de reproducción de especies de aves esteparias amenazadas en el ámbito del proyecto, con el objeto de tener una identificación previa de la fauna nidificante. El estudio concluía que aparecen amplias zonas dentro del área de estudio donde no existen registros históricos de reproducción de estas especies de aves esteparias. Por ello, se consideró viable la ejecución de las obras sin generar "a priori" afecciones sobre la reproducción de estas especies.

Este estudio sirvió de base para solicitar a la Dirección General del Medio Ambiente de la Comunidad de Madrid, que en los tramos referenciados, puede realizarse la obra durante cualquier periodo del año adoptando las oportunas medidas preventivas.



Así mismo, los extremos de la conducción quedaban cerrados al final de cada jornada, y en el caso de arquetas se instalaron rejillas, para evitar atrapamientos de fauna en su interior.

Ventajas obtenidas:

- ✓ Se garantizó la ausencia de daños sobre especies de aves amenazadas en la zona
- ✓ Con los estudios y trabajos desarrollados se evitó la parada de obra, que hubiese supuesto un incremento de plazo mínimo de 10 meses.

Previo al inicio de las obras se realizaron informes de campo con objeto de comprobar la presencia/ausencia de zonas de reproducción de fauna en las zonas especialmente sensibles tales como entorno de cauces, verificándose la no existencia de nidos, puestas o camadas en los campos y cauces atravesados por el ramal.



El área de estudio se ha establecido en 500 m a cada lado del trazado, dado que esta es la distancia media de huida de la avutarda ante la presencia humana, así como la distancia de protección tenida en cuenta en la Consejería de Medio Ambiente para especies amenazadas.

Las especies de aves esteparias objeto de estudio han sido las siguientes:

- Aguilucho cenizo *Circus pygargus*
- Aguilucho pálido *Circus cyaneus*
- Aguilucho lagunero *Circus aeruginosus*
- Cernicalo primilla *Falco naumanni*
- Avutarda *Otis tarda*
- Sisón *Tetrax tetrax*
- Ganga ortega *Pterocles orientalis*
- Ganga ibérica *Pterocles alchata*



AVE Madrid-Galicia. Túnel de Padornelo-Lublan. Zamora

La obra se sitúa en la proximidad de cauces fluviales incluidos en Red Natura 2000 como el Lugar de Interés Comunitario (LIC) "Riberas del río Tuela y Afluentes", en el que hay presencia de especies altamente sensibles a las variaciones en las condiciones ambientales en los cauces:

- Desmán Ibérico (*Galemys pyrenaicus*).
- Trucha Común (*Salmo trutta*).
- Náyades (*Margaritifera margaritifera*).

Desmán Ibérico (*Galemys pyrenaicus*)

Es una especie catalogada como Vulnerable / En peligro de extinción. Esta especie es un bioindicador del estado de conservación de los ecosistemas fluviales. Se llevan a cabo estudios y muestreos para determinar la abundancia de la especie y valorar la potencialidad del hábitat:

- Muestreos directos (captura-marcaje-seguimiento de ejemplares)
- Muestreos indirectos (análisis genético de excrementos)

Trucha Común (*Salmo trutta*)

Se realizan estudios para determinar la composición de las comunidades piscícolas:

- Control de calidad de las aguas, arriba y debajo de la zona de obra
- Muestreos directos mediante pesca eléctrica.

Náyades o Mejillón de río (*Margaritifera margaritifera*)

- Infestación de las truchas capturadas con larvas de náyade.
- Muestreos directos e indirectos para determinar la presencia de *Margaritifera* y su evolución mientras se desarrollan las obras.

Ventajas ambientales:

- Colaboración con el Servicio Territorial de Medio Ambiente de Castilla y León en el estudio y protección de la fauna
- Confirmación de la ausencia de daños sobre la fauna más vulnerable durante la ejecución de la obra.



Ejemplar de Desmán Ibérico capturado para su marcaje



Trucha común



Muestreo mediante pesca eléctrica



Ciclo del mejillón de río



Mejillón de río



La protección ambiental en una Reserva de la Biosfera.

Variante de Ferreries. Menorca, Islas Baleares.

La carretera ME-1 es la principal vía de comunicación de Menorca. Antes de las obras, esta vía atravesaba Ferreries, ocasionando importantes trastornos de tráfico, afectando negativamente a la seguridad y calidad de vida de sus habitantes. El proyecto permite circunvalar Ferreries mediante una carretera de nueva construcción de 4,8 km.

El proyecto estuvo condicionado por la catalogación de Menorca como Reserva de la Biosfera. Además la obra limitaba con dos espacios incluidos en Red Natura.

Se ejecutaron numerosas medidas de protección entre las que destacan el trasplante de ejemplares de encina y acebuches, realización de batidas para la captura y traslado de tortugas, reposición de 9.200 metros de muros de piedra seca y ejecución de más de 200 dispositivos de escape para la fauna.

Desde el punto de vista de la restauración de hábitats, cabe destacar que la planta utilizada en los trabajos de revegetación se obtuvo a partir de semillas recolectadas en la propia zona, estando toda la producción certificada como agricultura ecológica. En las siembras se utilizaron especies características de la isla, como la enclova, diseñándose tratamientos diferenciados según el tipo de superficie a restaurar.

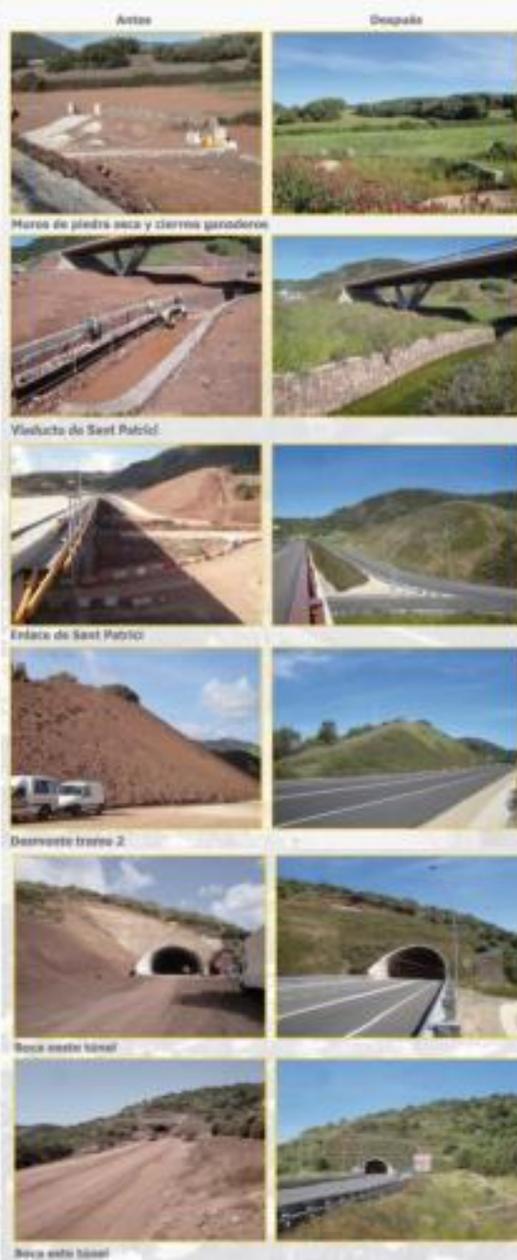
Además, se realizaron otra serie de actuaciones:

- Ejecución de hidrosiembras con mulches hidráulicos específicos según el tipo de talud.
- Desarrollo de un proyecto específico de integración paisajística de los emboquillados del túnel.
- Ejecución de motas paisajísticas que actúan a su vez como barreras acústicas.
- Instalación en los enlaces de un sistema de iluminación eficiente energéticamente.
- Utilización de mezclas bituminosas a partir de polvo de caucho procedente del reciclado de neumáticos.

La construcción de la variante de Ferreries es un ejemplo de cómo la variable ambiental puede y debe ser integrada en un proyecto de obra civil, especialmente cuando se trata de una actuación en una Reserva de la Biosfera.

Ventajas ambientales:

- Adecuación del trazado de la carretera al relieve natural del terreno, minimizando los movimientos de tierra y las necesidades de préstamos y vertedero.
- Plantación de más de **11.700 arbustos y 3.200 árboles**.
- Soterramiento de **2.500 m** de líneas eléctricas y de comunicaciones.
- Restauración ambiental de los tramos de carretera fuera de uso.



Restauración ecológica de taludes y recuperación de poblaciones de *Maytenus senegalensis*.

Autovía del Mediterráneo (A-7). Tramo: Enlace de Polopos-Enlace de Albuñol. Granada

La compleja orografía y tectónica de los suelos de obra implican grandes desmontes en terrenos áridos, cuya recuperación es especialmente difícil. La presencia de endemismos protegidos refuerza la exigencia de las labores de revegetación.

Los trabajos realizados comprenden varias actuaciones:

- Compensación de tierras para reducir las necesidades de suelos afectados por vertederos de tierras y préstamos de materiales.
- Adecuación de las superficies de talud para favorecer la implantación de especies propias de la zona litoral seca.
- Se ha tratado de adaptar al máximo la morfología de los taludes a los relieves preexistentes, manteniendo las pendientes y orientaciones.
- La carencia de tierra vegetal que caracteriza la zona se compensa con micro repisas y rugosidad de los acabados de las superficies de los taludes, lo que permite la implantación espontánea de semillas autóctonas y su sujeción al terreno en periodo de lluvias intensas.
- Recuperación de la población de Arto, endemismo iberoafricano de zonas litorales cálidas.

A pesar de no establecerse ninguna medida correctora en relación a las unidades afectadas, se multiplican con la reproducción vegetativa y por semillas de la siguiente manera:



Primavera de 2007: 5 trasplantes
Invierno 2009: 30,000 esquejes
Primavera 2009: 5,000 semillas
Primavera de 2010: 4,000 semillas
Noviembre de 2013: trasplante de 1,000 individuos
Octubre 2013/Marzo de 2014: 11,237 esquejes

El seguimiento de los trabajos y sus resultados se hace en colaboración de la Consejería de Medio Ambiente de la Junta de Andalucía.

Se demuestra la viabilidad de técnicas de restauración ecológica en un ecosistema tan árido, con resultados de revegetación muy superiores a los convencionales en términos de diversidad de especies, así como en integración paisajística. Se ha conseguido revegetar grandes taludes de terraplén y de desmonte sin emplear tierra vegetal ni técnicas complejas de hidrosiembra.

Además se ponen en práctica las diferentes técnicas de reproducción del *Maytenus senegalensis*, evaluando sus resultados.

Ventajas ambientales:

- Recuperación de poblaciones del endemismo. Reintroducción de **467 %** veces mayor que el existente.
- Recuperación de taludes de hasta **130 m** con vegetación propia del entorno mediante técnicas de restauración ecológica.
- Minimización de los movimientos de tierras y aportes de materiales a obra. Se han reutilizado todas las tierras excavadas inclusive un excedente de **3M de m³** que no estaba contemplado.



Protección de la fauna

Objetivo: Una de las principales afecciones de la construcción y explotación de las autopistas es el denominado "efecto barrera" que se provoca sobre las poblaciones de especies animales de la zona atravesadas por las autopistas. Para facilitar el tránsito de la fauna por la autopista y evitar atropellos en las autopistas se implementan las siguientes medidas.

Actuaciones:

Cerramiento de la autopista: A lo largo del trazado se instala una valla o cerramiento que actúa como obstáculo al tránsito y que evita que los animales accedan a la autopista de manera involuntaria. En aquellas zonas donde haya presencia de fauna con hábitos excavadores como por ejemplo tejones, es frecuente que estas estructuras se entierren unos centímetros en el suelo y se doblen hacia el exterior.

Dispositivos de escape de fauna: Estos dispositivos permiten que los animales que han accedido accidentalmente a la vía puedan evacuarla lo más rápidamente posible. Estos dispositivos pueden tratarse de puertas integradas en el cerramiento que sólo permiten el giro de apertura desde la autopista al exterior o bien rampas que permitan el ascenso del animal sobre la valla.

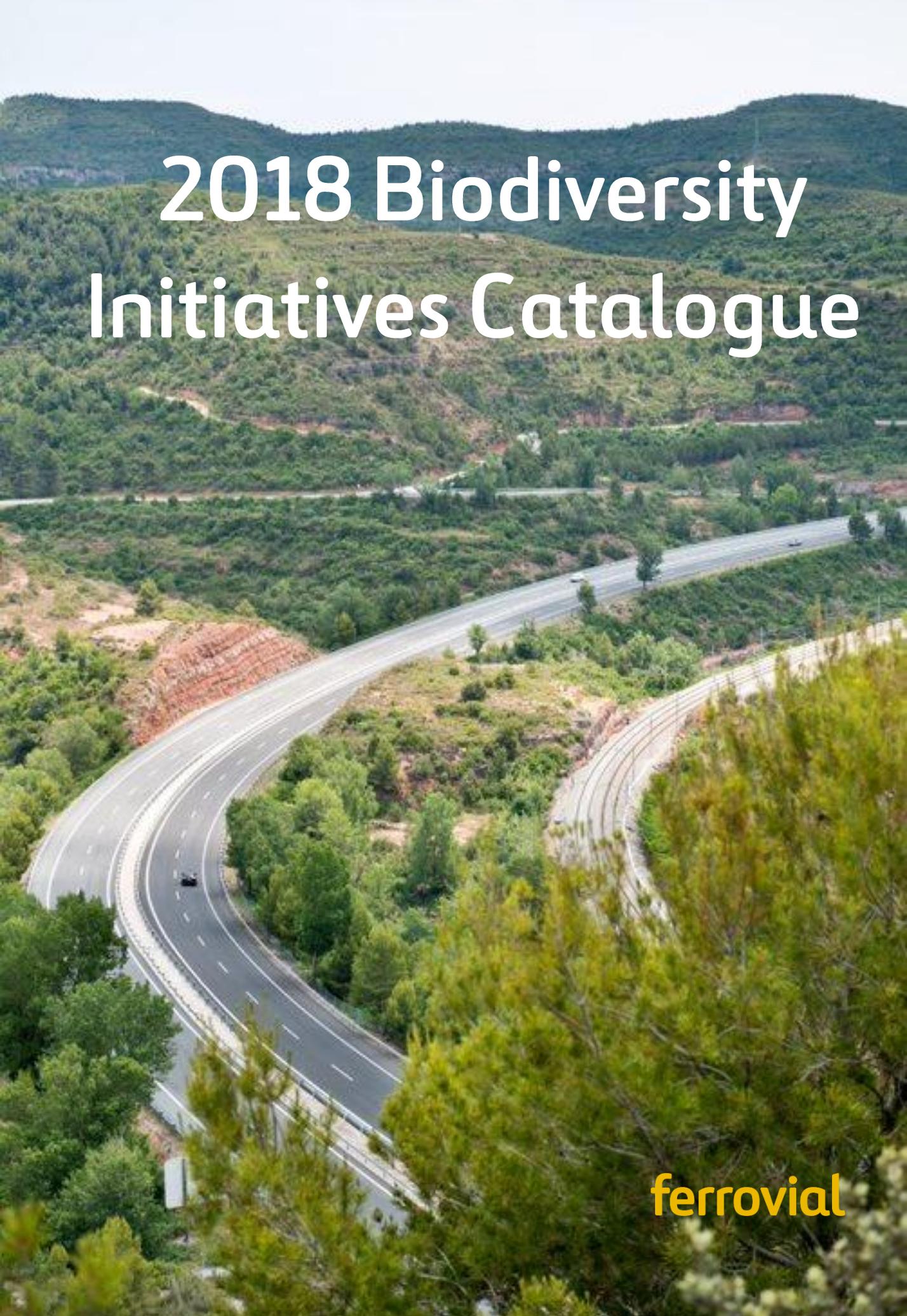
Pasos de fauna: Además de la construcción de pasos inferiores específicos para el tránsito de pequeños mamíferos adaptados a las dimensiones de los mismos, algunas de las obras de drenaje transversal (ODT) se adaptan como pasos de fauna mediante la creación de bancales, que permiten zonas de paso secas, y se crean lucernarios a la altura de la mediana que hacen posible la entrada de luz al interior de la estructura.

Dispositivos de elevación de vuelo: Con el objeto de evitar afecciones a la avifauna, se instalan dispositivos de elevación de vuelo. Estos dispositivos, que normalmente consiste en una barrera arbórea, permiten que las aves tomen una altura suficiente de vuelo antes de que atraviesen la autopista, evitando así que sean golpeados por los vehículos.

Proyectos de Cintre con medidas de protección de la fauna:

- Autopista del Sol
- Autema
- Radial 4
- AP36
- Autoestradas Norte Liberal
- Euroscut Algarve
- Euroscut Azores
- M3
- M4
- ...



An aerial photograph of a winding asphalt highway cutting through a lush, green, hilly landscape. The road curves from the bottom left towards the top right. The surrounding terrain is covered in dense vegetation, including trees and shrubs. In the background, there are rolling hills under a clear sky. The overall scene is bright and natural.

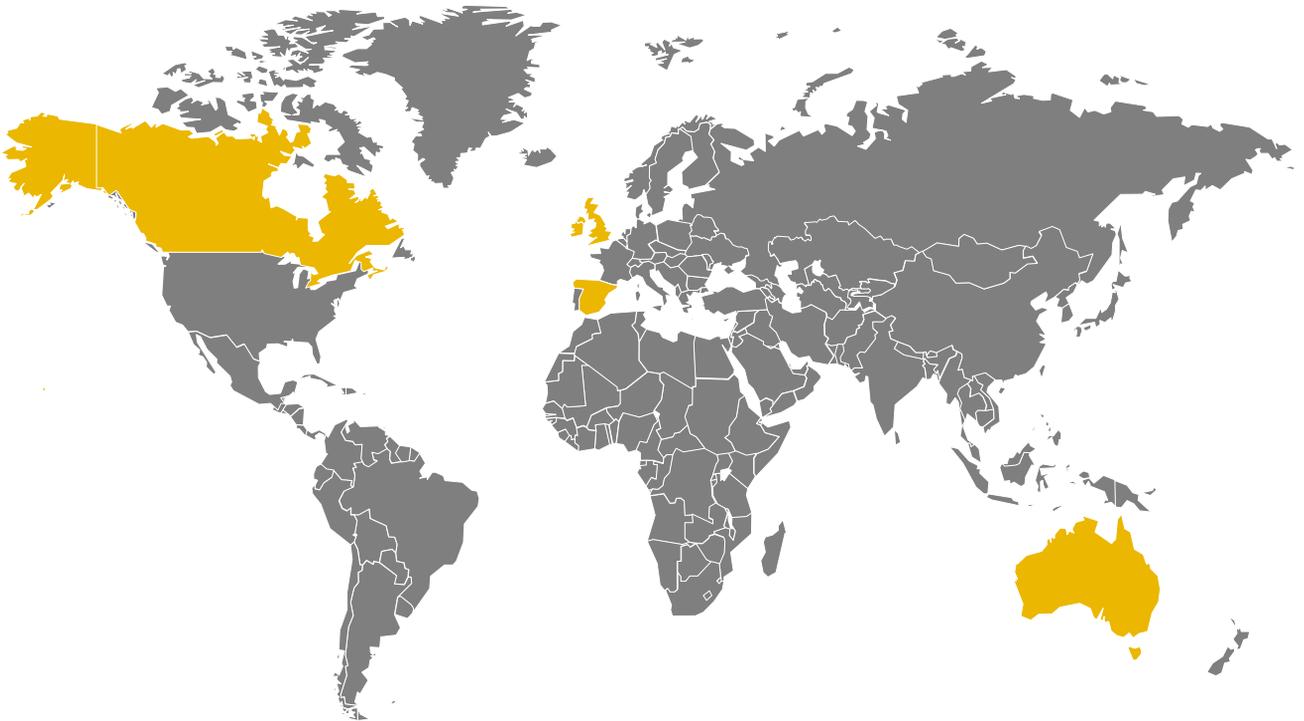
2018 Biodiversity Initiatives Catalogue

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2018 Biodiversity Initiative Catalogue

INDEX

1. [Living Highways, UK](#)
2. [Wildlife monitoring and surveillance studies, Zamora, Spain](#)
3. [Fauna protection: Delma Torquata, Toowoomba Australia](#)
4. [Protection of Native Fauna \(Giant Barred Frog\), Australia](#)
5. [Ecological restoration of slopes and recovery of Matenus Senegalensis, Granada, Spain](#)
6. [Fauna protection and relocation, Texas, USA](#)
7. [Environmental protection in a Biosphere reserve](#)
8. [Wildlife protection](#)



Living Highways – Project Update

Living Highways is a collaborative working group involving the Sheffield and Rotherham Wildlife Trust (SRWT), University of Sheffield, Sheffield City Council and Amey to consider alternative management of highway verges in Sheffield.

The aims are:

- enhance biodiversity, especially within core ecological networks,
- improve ecosystem services such as carbon sequestration, flood risk mitigation and air quality (in line with EU limits),
- enhance the amenity and leisure use of verges creating additional social value
- reduce verge management and maintenance costs

So far the project has delivered:

- A review of existing European research and biodiversity projects
- Soil chemistry and microbial community analysis to inform plant selection
- Wildflower trials including Yellow Rattle, a semi-parasitic wildflower that reduces the growth rate of grass
- During 2016 and 2017 the project is delivering 12 large scale mowing trials; reducing mowing from 12 to between 2 and 4, creating wildlife verges.

Next steps:

During 2018 we will roll-out these trials to 20% of the city's verges, over 400,000m² of green space.

The trials have to date shown that the change in management regime will deliver an increase in biodiversity, with direct cutting costs being broadly neutral due to the need to collect grass cuttings to create a nutrient poor environment where wildflowers can thrive.

The project expects a significant saving in traffic management costs and a reduction in risk from cutting steep banks and adjacent to high speed roads.

Environmental benefits:

- Enhance biodiversity, especially within core ecological networks,
- Improve ecosystem services such as carbon sequestration, flood risk mitigation and air quality (in line with EU limits)
- Reduce verge management and maintenance costs



Madrid-Galicia High Speed Train (AVE).
Padornelo - Lubian tunnel, Zamora, northern Spain.

The project is located close to waterways which make up part of the Natura 2000 network as a Site of Community Importance (SCI) on 'The banks of the river Tuela and its tributaries', where the following species - which are highly sensitive to variations in environmental conditions in the waterways - are found:

- Iberian Desman (*Galemys pyrenaicus*).
- Brown trout (*Salmo trutta*).
- Freshwater pearl mussel (*Margaritifera margaritifera*)

Iberian Desman (*Galemys pyrenaicus*)

This species, listed as vulnerable / endangered, is seen as a bioindicator of the state of conservation in fluvial ecosystems. The following studies and samples determine the population level of the species and assess the habitat's potential:

- Direct sampling (capture-marking-tracking of specimens)
- Indirect sampling (genetic analysis of excrement)

Brown Trout (*Salmo trutta*)

Studies are carried out to determine the make up of fish communities:

- **Water quality checks, upstream and downstream from the project site**
- Direct sampling by electro fishing.
- Level of naiad (dragonfly) larvae infestation in captured trout.

Freshwater Pearl Mussel (*Margaritifera margaritifera*)

- Direct and indirect sampling to determine the presence of *Margaritifera* and their behaviour while the site works are being carried out.

Environmental advantages:

- Working together with the Territorial Environment Service in Castilla & León in the study and protection of fauna.
- Confirmation of the absence of harm to the most vulnerable fauna while the works were being carried out.



Iberian Desman being captured for marking.



Brown Trout.



Sampling by electro fishing.



Freshwater Pearl mussel cycle.



Freshwater Pearl mussel.



Toowoomba Second Range Crossing Project (Australia)

Delma torquata, also known as the collared delma, is the smallest of the legless lizards contained within the *Delma* genus. It is endemic to South-East Queensland and has been identified in a number of locations across the Toowoomba Range, including within the Toowoomba Second Range Crossing (TSRC) project. As a result of its very specific habitat requirements and fragmented distribution, the collared delma has been granted **special protection status** to ensure further habitat loss is minimised.

TSRC project team has a specific management plan for the collared delma that includes minimising disturbance of their habitat, as well as translocation for specimens that have the potential to be impacted by the proposed works.



A World first two-year scientific monitoring program was conducted in order to protect and study the *Delma torquata* and to analyse the success of the relocation and rehabilitation program. Individuals were relocated from impacted habitat areas to a "soft release" enclosure.

There was a total of 10 extant soft release enclosures spanning various land zones. In total, **113 individuals were safely translocated**. It was discovered through this program that each collared delma has a unique chin pattern. Using these identifiable chin patterns, marking techniques were not required and 7 new individuals have been identified within the soft release enclosures.

The collared delma are reproducing within the enclosures and this will add to genetic diversity of the species population and future research opportunities. Cameras were used to learn more about the predation of these species in the wild.

Benefits:

TSRC Project demonstrates Environmental Best Practice Management in minimising impact on Australian native fauna. The main **benefits** of the successful translocation program are as follows:

- ✓ Compliance with Australian Federal legislation, the EPBC Act 1999
- ✓ Setting Industry benchmark as being the World's first successful translocation program on record
- ✓ Provides a sustainable habitat for the Vulnerable listed animal
- ✓ Help protecting the habitat for a little-known species
- ✓ A better understanding of the reproduction and predation of a Vulnerable species
- ✓ No delay in project completion due to potential issues and potential media
- ✓ Providing pathway for further research into Australian native animals



The unique chin pattern of a *Delma torquata*

Delma torquata, considered as a **Vulnerable species of National Significance**, was found along the TSRC corridor, requiring relocation to construct the project. The following **challenges** were overcome during the translocation and monitoring program:

- Very cryptic and small animals, very difficult to find and catch them in the wild
- Little available literature about the species and their habitat
- Setting a Pilot program for translocation
- Selection of suitable / alternative habitats for relocation
- Changes to construction program and methodology to allow time to identify and capture
- Discovery of unique chin pattern for aid in their identification



Pacifico Acclona Ferrovial JV

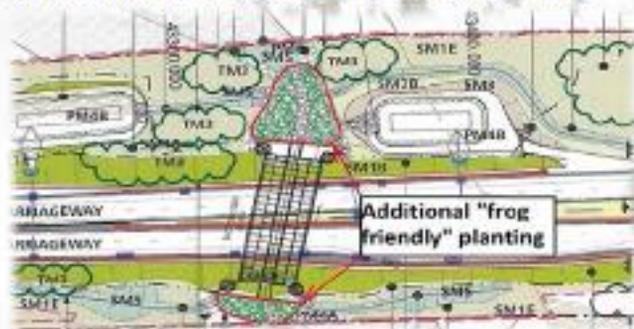
Pacifico is Joint Venture (JV) established to deliver the **Warrell Creek to Nambucca Heads** section of the Pacific Highway upgrade on the Mid-North Coast of NSW.



A **Frog-Friendly Treatment** (Giant Barred Frog EPBC Listed) was developed following an Unexpected Find at Butchers Creek Five Cell Reinforced Concrete Box Culvert.

The Unexpected Find of **Giant Barred Frog Tadpoles** (EPBC Protected Fauna Specie) at Butchers Creek occurred post RCBC Line Design finalization, as well as after the commencement of construction works.

The Environment team ensured the **protection of native fauna** through the use of an innovative and sustainable approach that is appropriate as a long-term solution.



Following the discovery, provision of a "frog-friendly" treatment to each invert of the five-cell box culverts was developed. Roads and Maritime coordinated a functional re-design with the contractor, Pacifico, using cobble stones salvaged from the culvert excavation that **emulated the natural creek bed** either side of the culvert.

Without compromising the drainage design, this method would encourage dispersal and **passage of adult frogs** and tadpoles by facilitating a more natural deposition of sediment and detritus during flood flows. In the floor of each culvert cell, cobble stones were set into a bed of wet concrete and dressed similarly to the pebble-crete finish of a concrete drive way.

Environmental benefits:

- ✓ Savings in terms of a **redesign** of the culvert to a plank bridge and removal of the constructed component of the RCBC Line.
- ✓ Saving in terms of **Program Delays** due to redesign.
- ✓ Best practice with **fauna management**.
- ✓ **Stakeholder satisfaction**: implementing such system increases the client and stakeholder satisfaction by demonstrating that the contractor is always looking for improved performance.



Giant Barred Frog

Pacifico prepared innovative sample test panels for review and approval by Agency officers



This initiative won the Australian Business Awards for Sustainability



Ecological restoration of slopes and recovery of *Maytenus senegalensis* populations.

Mediterranean highway (A-7). Stretch: Polopos interchange- Albuñol interchange. Granada

The complex orography and tectonics of the work sites' soils implies big clearing activities in arid terrains in which recovery is specially complicated. The presence of protected endemism reinforces the necessity of revegetation works.

The works realized cover several actions:

- Land compensation to reduce the necessities of affected soils by landfills and materials loans.
- Adaptation of slopes' surfaces to favour the implementation of typical species of dry littoral zones.
- It has tried to adapt to the maximum slopes' morphology to the preexistent topographies, maintaining the gradients and orientations.
- The scarcity of vegetal soil that characterizes the area is compensated with micro panels and the surfaces roughness of slopes finishes which allow the spontaneous implementation of autochthonous seeds and its securing to the terrain in intensive rain periods.
- Recovery of Arto's population, Ibero-African endemism of warm littoral zones.

In spite of not establishing any corrective measures relating to the affected units, they continue to grow with vegetative reproduction and by seeds in the following ways:



Spring of 2007: 5 transplants
Winter of 2009: 30,000 cuttings
Spring of 2009: 5,000 seeds
Primavera de 2010: 4,000 seeds
November of 2013: transplant of 1,000 individuals
October 2013/March of 2014: 11,237 cuttings

The works monitoring and their results are realized in collaboration with the Regional Council for the Environment of Junta de Andalucía.

It is proven the viability of ecological restoration techniques in such arid ecosystem with revegetation results far superior to the conventional ones in terms of species diversity, as well as landscape integration. It has achieved to regrow big slopes of cuttings and embankments without employing neither vegetal soil nor complex hydroseeding techniques.

Moreover, different reproduction techniques of *Maytenus senegalensis* are applied in practice, evaluating their results.



Environmental advantages:

- Recovery of endemic populations. Reintroduction of a **467%** times more than existing.
- Recovery of slopes from up to **130 m** with typical vegetation of this environment using ecological restoration techniques.
- Minimization of earth movements and work materials contribution. All the excavated soil has been reused including an excess of **3M** of m^3 that was not considered.



North Tarrant Extensions Project

In North Tarrant Extension Segment 3A prior to begin with the drill shaft in Trinity River Bridge, was necessary assess the current status of **freshwater native mussel** population in order to contribute their conservation and persistence. The mussel have to be removed and relocate upstream by specialist in relocation of this macro invertebrates. While the construction was in progress, the water condition was controlled by NTE Environmental Department.

Mitigation measures consisted of the removal of the live specimens and relocation out of the construction zone to **prevent accidental burying** of specimens and potential death caused by sediment entering the waterway as a result of the construction activities.



Scientists identified and relocated **33 native freshwater mussels** and identified an additional **66 shell-only** specimens; the four species of freshwater mussels recovered during survey activities are:

- fragile papershell (*Leptodea fragilis*)
- giant floater (*Pyganodon grandis*)
- southern mapleleaf (*Quadrula apiculata*)
- yellow sandshell (*Lampsilis teres*) [shell-only]

No state-listed freshwater mussels or Species of Greatest Conservation Need were identified during the freshwater mussel survey of the West Fork of the Trinity River and an unnamed tributary of the West Fork of the Trinity River.

Bluebonnet Contractors, LLC; NTEMP; and the North Tarrant Express Project were chosen by an independent panel of environmental specialists as a recipient of the **ARTBA 2014 Globe Award** for environmental excellence. The Globe Awards are an annual competition to honor and draw attention to private-sector firms and public-sector transportation agencies that do an outstanding job in **protecting and/or enhancing the natural environment** in the planning, design and construction of U.S. transportation infrastructure projects.

Freshwater mussel relocation:

- ✓ 4 species affected
- ✓ 33 specimens relocated



In addition to avoidance and minimization, mitigation for temporary project impacts that might occur to mollusk habitat consisted of implementing **water quality measures**.

Prior to sediment disturbance in the river by bridge construction background concentration levels of Polychlorinated Biphenyl, Total Organic Carbon and Total Suspended Solids were established to provide data needed to deal with sediments that could affect the water quality, native freshwater mussels habitat and Total Maximum Daily Load concentrations in the river if disturbed.

While the construction was in progress, erosion and sedimentation control devices were installed along the river bank to control run-off, turbidity curtains deployed in the river, and real-time surface water turbidity measurements were taken to continually monitor the water conditions.



During construction, eight active **red-winged blackbird nests** were discovered in conflict with construction. All eight nests were protected and monitored, and project schedule was adjusted, until nesting was completed.



Environmental protection in a Biosphere Reserve.

Ferrieres bypass, Menorca, Balearic Islands

The ME-1 road is Menorca's main communication route. Before the roadworks began, it passed through the town of Ferrerías, causing major traffic disruption and badly affecting its inhabitants' safety and quality of life. The finished project allows traffic to travel around Ferrerías on a newly constructed 4.8 km bypass.

The project had its constraints since Menorca is classified as a Biosphere Reserve. In addition, the roadworks bordered two areas included in Natura 2000 network.

Numerous protection measures were carried out, among them the transplanting of holm oak and wild olive trees, the search, capture and transfer of turtles, the shifting of 9,200 meters of drystone walls and the installation of more than 200 wildlife escape mechanisms.

As for the restoration of habitats, it should be highlighted that all the plants used in revegetating the area were grown following certified organic principles from seeds collected in the surrounding area.

Plant species characteristic of the island such as the sweet vetch (*Sulla coronaria*) were sown, using different methods depending on the type of ground to be restored.

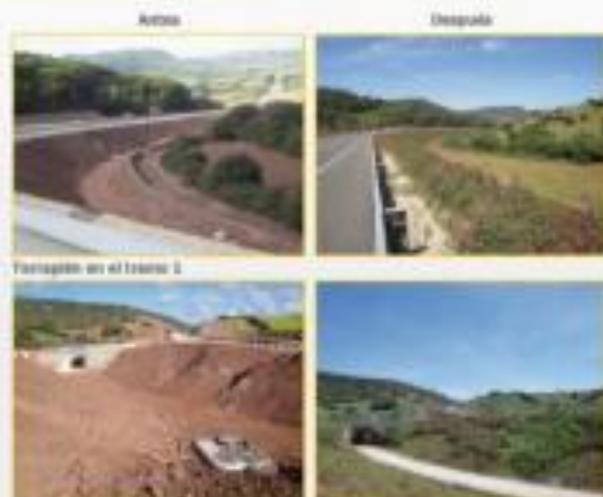
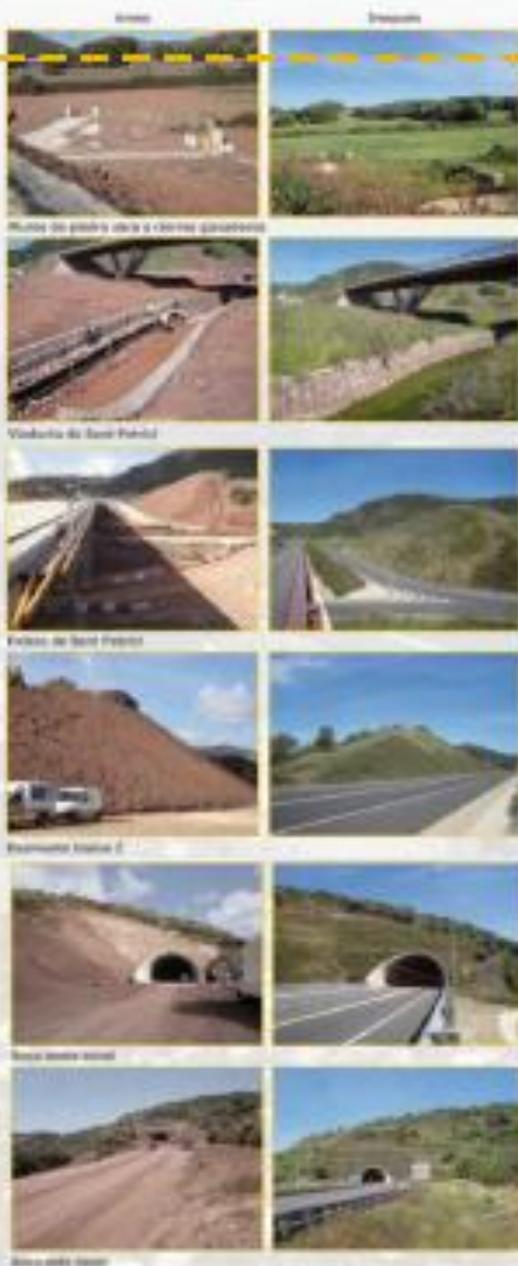
In addition, a further series of measures were taken:

- Hydroseeding with specific hydraulic mulches specifically suited to each type of slope
- Development of a specific landscape integration project for the tunnel mouths.
- Use of landscape features which act as noise barriers
- Installation of an energy efficient lighting system on link roads
- Use of bituminous mixtures from recycled tyre-rubber powder.

The construction of the Ferrerías bypass is an example of how environmental aspects can and should be integrated into a civil engineering project, especially when it is carried out within a Biosphere Reserve.

Environmental benefits:

- Roadside landscaped to follow the land's natural relief, thus minimizing the transporting of soil and the need for loans or dumps.
- Planting of over **11,700 bushes and 3,200 trees**.
- Burying of **2,500 m** of electrical and communications lines.
- Ecological restoration of disused stretches of road.



Wildlife protection

Objective: One of the main drawbacks associated with building and managing motorways is the so-called 'barrier effect' affecting the animal populations which inhabit the land these roads cut through. To ease the free movement of wildlife along these motorway stretches, and to prevent road accidents, the following measures are adopted.

Measures:

Closing off the motorway: Fences or walls are erected along the length of the road to provide a physical barrier, thus preventing animals from accessing the motorway zone unintentionally. In areas where excavating animals such as badgers are present, the fences are frequently inclined outwards away from the road with their bottom few centimeters being buried.

Wildlife escape mechanisms: These allow animals which have accidentally strayed into the motorway area to cross back out as quickly as possible. These consist, either of gates positioned along the fence which only open outwards, or ramps which give animals the chance to climb back out over the fence.

Wildlife passageways: In addition to the construction of wildlife underpasses which are specifically tailored to suit small mammals, some transversal drainage channels (ODTs) are adapted to incorporate banks which allow dry-track access for wildlife. Furthermore, skylights are fitted into the motorway's central reservation to let light into the passageways crossing underneath.

Flight-lifting strategies: With the aim of preventing injury to flying birds, systems are installed to lift their flight trajectory. These usually consist of arboreal barriers which force birds to reach a sufficient height before flying across the motorway, thus cutting the risk of being hit by passing vehicles.

Cintra projects with wildlife protection measures:

- Autopista del Sol
- Autema
- Radial 4
- AP36
- Autoestradas Norte Litoral
- Euroscut Algarve
- Euroscut Azores
- M3
- M4
- ...

