



PROYECT LIFE-NATURE (LIFE00NAT/E/0034) IMPROVEMENT OF POWER LINES IN ZEPAS IN ARAGON 2004-2008 / Gobierno de Aragón / Spain

THE APPROACH TAKEN: The problem and the solutions.

Overhead power lines: electrocution and collisions

Electrocution and collisions caused by high voltage overhead power lines (≥ 1 kV) represent one of the main causes of death amongst highly endangered species, including some which have been identified by the EU as high priority species with significant populations in the Aragonese Special Avian Protection Areas (Spanish abbreviation: ZEPA) (Figs. 1, 2 and 3).



Fig. 1: Bonelli's eagle (*H. fasciatus*) electrocuted.



Fig. 2: Grup of cranes (*Grus grus*) collided.



Fig. 3: Golden eagle (*A. chrysaetos*) electrocuted.

Incidents involving electrocution and collisions are common amongst large raptors in the ZEPAs (Bearded vulture, Bonelli's eagle, Golden eagle, Eagle owl, Griffon vulture, Egyptian vulture, etc) protect rocky areas with cliffs and escarpments where there are overhead distribution lines (10-66 kV) within the birds' range or in the rocky areas where they nest (Fig. 4).

Furthermore the ZEPAs in steppe-like areas are home to species which are particularly sensitive to collisions (Bustard, Little bustard, Stone curlew, Pin-tailed sandgrouse, Black-Bellied sandgrouse, Montagu's harrier, Lesser kestrel) and there are a large number of accidents amongst these birds involving the major high voltage power lines (≥ 110 kV) and distribution networks over bare cables (Fig. 5).

Finally, the wetland areas in Aragon which have been declared ZEPAs incorporate large breeding populations and winter colonies of species (Ardeidae, Limicolae, Anatidae, Ciconiidae, Eurasian Bittern included, which are susceptible to collisions during their daily flights, often at dawn or dusk and during the night (Fig. 6).



Fig. 4: Distribución line in ZEPA "Matarraña-Aigüabarreix" (electrocution and/or collision risk).



Fig. 5: Transmisssion line in ZEPA "Las Saladas de Sástago" (collision risk).

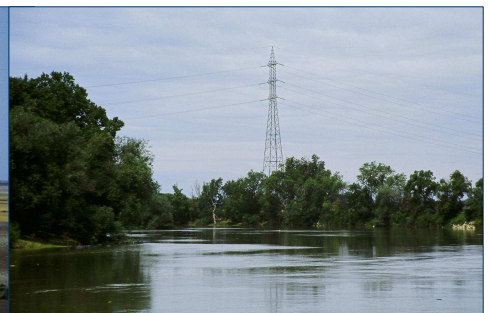


Fig. 6: Transmisssion line in ZEPA "Los Galachos de la Alfranca" (collision risk).

Strategy: awareness campaign, power transmission regulations and the suppression of dangerous elements on transmission networks

The problem is serious, the effects are persistent and they are more widely spread than originally thought. Furthermore, the dangers posed by power lines on land in the ZEPAs are simply an extension of what is happening in the rest of the region. While the risk of electrocution is concentrated on the medium voltage distribution networks (10-66 kV), the risk of collision exists on all overhead bare cable networks, whether for distribution or transmission (i.e. ≥ 110 Kv), and the steps which need to be taken will vary according to the risk of collision and/or electrocution which the measures aim to reduce. Finally, in order to deal with the problem it is advisable to differentiate between plans for new power lines, where preventative measures can be considered during the design and installation process and pre-existing power lines which must be dealt with step by step.

The Aragonese Regional Government recognised the gravity and extent of the situation and has launched a programme of steps intended to improve power lines which represent a risk to birds in the Natura 2000 area. This project, known as the LIFE-Naturaleza project (LIFE04NAT/E/0034), is part of the Natura 2000 network and aims to tackle the problem on three fronts:

Raising awareness, informing and educating.

- A public awareness and information campaign has been undertaken on the subject of overhead power lines and the risk they pose to birdlife through electrocution and collision. There have also been discussions with developers and engineers to suggest the most effective means of preventing such accidents and protecting birdlife.

Regulation of new power lines

- Regional power line regulations have been enacted and implemented which cover all new high voltage overhead power lines in order to provide for the adoption of supplementary preventative measures on lines located in ZEPAs.

Adapting pre-existing power lines

- Power lines which represent an electrocution and/or collision risk to birds in the Aragonese ZEPAs have been altered and/or made visible through agreements reached with the utility companies which own the transmission networks.

The LIFE PROJECT: Scope, participants and duration.

The **LIFE-Naturaleza Project (LIFE04NAT/E/0034) to Adapt Power Lines in ZEPAs in Aragón**, ran from 2004-2008 and received 60% of its funding from the EU body LIFE.

The steps taken under the LIFE Project were as follows:

Scope:

- ✓ In 18 ZEPAs throughout Aragon (Fig. 7), although the review of projects and the implementation of supplementary measures has been extended to the whole of the Natura 2000 Network and the legislative initiatives, awareness campaigns and employee training exercises have been extended to the whole of Aragon.

Organisers and supporting bodies

- ✓ The Project was run by the Aragonese Regional Government's Environment Department in co-operation with the two main electricity companies (the distribution utility ERZ-Endesa and the power transmission utility R.E.E.), who have financed 60% of the cost of the alterations to their own networks.

Duration:

- ✓ The Project ran for the five-year period from 2004-2008, consisting of the original period from 2004-2007 plus an additional year approved by the European Commission.

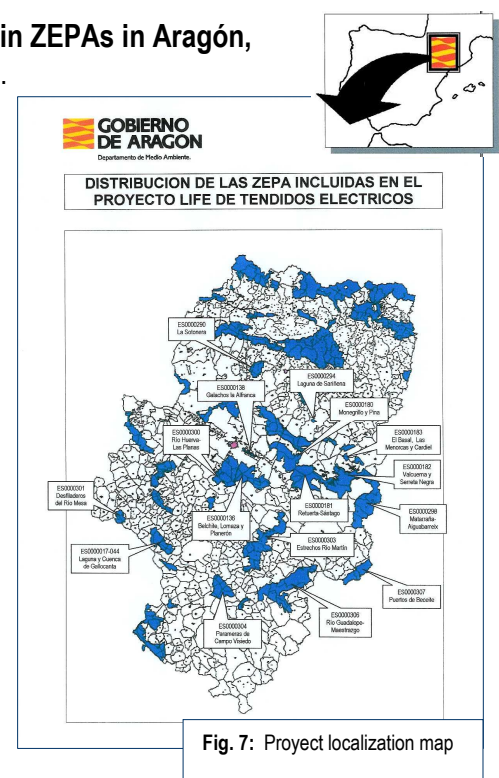


Fig. 7: Project localization map

Legislation, regulation and training

Power Line Act (Decree 34/2005):

Decree 34/2005 was enacted in February 2005 and laid out the technical requirements for the installation of overhead power lines with the purpose of protecting birdlife¹. The regional Power Lines Act covers all new overhead high voltage power lines (>1Kv) in Aragon, as well as additions and alterations to existing lines. It sets out a series of general mandatory requirements (prohibited elements, location of the live elements, insulation of conductors etc.) as well as specific measures aimed at preventing electrocution (accessible minimum safe distances for birds) and at reducing the risk of collision which is inherent in any bare overhead cable (choice of route, making cables visible to birds, removing lines which are no longer in use, etc).

Regulation of new power line projects, co-ordination meetings and training courses:

The power line act (Decree 34/2005) provides for additional measures for lines which extend over protected areas and it requires **consideration and authorisation by the relevant regulatory body** for all new projects, setting out minimum requirements for all such projects.

The INAGA (the Spanish abbreviation for the Aragonese Institute for Environmental Management) has been charged with handling all applications for new power line projects, promoting the adoption of supplementary measures in overhead lines which encroach on ZEPAs. Between 2005 and 2008 the INAGA has processed and proposed supplementary measures on over 80 power line projects affecting ZEPAs.

A document was drawn up in order to facilitate the practical application of the Act and to promote preventative measures on power lines which cross ZEPAs. The document sets out minimum requirements for projects so that they may be assessed for compliance with Aragonese Regional Government Decree 34/2005.

Furthermore, several **co-ordination meetings** have been held (*Fig. 7*) and **training courses** have been provided by the IAAP (the Spanish abbreviation for the Aragonese Institute of Public Administration) to the Regional Government's engineers and relevant employees (*Fig. 8*).



Fig. 7: Working group for the application of regional Power Lines Act



Fig. 8: Training courses (IAAP) about power lines.



Fig. 9: Monitoring group of ERZ's Co-operation Agreement.

AGREEMENTS WITH THE ELECTRIC COMPANIES: Addenda and monitoring groups.

With a view to adapting the pre-existing power lines a series of **Co-operation Agreements** have been reached with the major electricity distribution (ERZ-Endesa) and transmission (R.E.E.) companies in Aragon. The co-operation agreements cover a four-year period and have been implemented through **annual addenda** in which the **working groups** drawing on technical staff from both sides (*Fig. 9*) have held periodic meetings to determine their priorities and propose the alterations to be made to each power line. The owners of the power lines (ERZ-Endesa and R.E.E.), as partners in the LIFE Project, have been responsible for undertaking the alterations and funding 60% of the cost. The current co-operation agreements have provided a framework for implementing corrective measures, they have been instrumental in ensuring significant involvement by the electric companies in resolving the difficulties posed by the power lines and, going forward, they will provide continuity in the efforts to reshape those networks which represent a risk to birdlife in the Aragonese ZEPAs.

¹ All documents and other products can be found in PDF format on the LIFE Project website at [www.aragon.es/Medionatural/Biodiversidad/Proyectos Europeos/Tendidos eléctricos](http://www.aragon.es/Medionatural/Biodiversidad/Proyectos_Europeos/Tendidos_electricos) or by writing to: Servicio de Biodiversidad, Dpto. de Medio Ambiente, Gobierno de Aragón, Ed. Pignatelli, Pº María Agustín nº 36, E-50071, Spain

RECTIFYING POWER LINES WHICH REPRESENT A DANGER TO BIRDLIFE.

Between 2004 and 2008 the LIFE-Nature Project made it possible to **alter a total of 60 transmission grids and 325 Km** of power lines representing a danger to birdlife in 18 ZEPAs in Aragon. The LIFE programme has jointly financed activities leading to the alteration of 919 pylons over 187.4 km of power lines and the marking of 1,191 cables along 227.9 km of lines, as well as the removal of 18.3 km of disused overhead lines and the installation of 5.9 kms of high voltage line underground, all of which represents a substantial reduction in the danger of electrocution and/or collisions among the endangered avian species which originally prompted the creation of the ZEPAs.

The steps taken to alter the various elements of the network, the works themselves and the financing have varied depending on the owner of the lines identified as representing a serious danger to birdlife. The lines owned by ERZ-Endesa and REE have been altered by the companies themselves via the Co-operation Agreements, while the infrastructure owned by "other proprietors" have been altered through a series of contracts (made between 2006 and 2007) with authorised companies.

▪ Work undertaken by ERZ-Endesa:

The LIFE-Nature project and the successive Co-operation Agreements between the Aragonese Regional Government and ERZ-Endesa (in 2002 and 2006) have enabled 37 networks to be rectified in 17 Aragonese ZEPAs. The steps taken by ERZ-Endesa have seen the alteration of 781 pylons over 145.7 km of power lines and the installation of markers on 734 spans and 96.9 km of power lines, as well as the construction of 5.1 km of underground medium voltage lines and 4.7 km of overhead marked lines and the removal of 14.2 km of lines which were no longer used (Fig. 10).

▪ Transmission network owned by Red Eléctrica de España S.A.:

Between 2004 and 2008, R.E.E. marked twelve stretches of transmission line in seven different ZEPAs throughout Aragon. The steps taken by R.E.E. included the addition of 22,220 markers on the ground wires between 311 spans and over 111.1 km of transmission line (Fig. 11).

▪ Lines owned by other power companies

In addition, 12 networks owned by other companies (Town Councils, EMSA, Telefónica, the Ministry of Defence, the Environment Ministry, the River Ebro Hydrographical Commission) were retrofitted in 2006-2007. Overall, 138 towers and posts spread over 41.7 km of privately-owned lines were retrofitted between 2006 and 2007, 146 spans (19.9 km of power lines) were marked and 4.1. km of old lines were taken down (Fig. 12).



Fig. 10: Lin. (15 Kv) Campillo de Aragón to Calmarza; remodeled in 2004 by ERZ-Endesa in ZEPA "Hoces del Río Mesa".

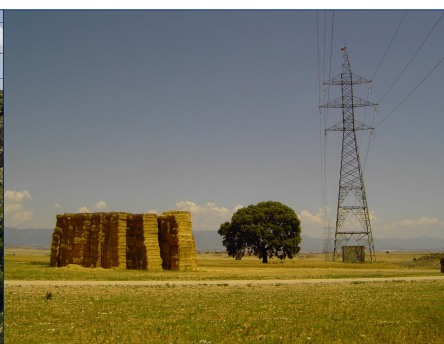


Fig. 11: Lin. (220 Kv) Sabiñánigo-Gurrea; marked in 2004 by REE in ZEPA "Embalse de La Sotonera".



Fig. 12: Derivation. (15 Kv) to Los Arenales in Berrueco; corrected in 2007 in ZEPA "Laguna de Gallocanta".

Preliminary reports, assessment of steps taken and project feedback

Preliminary reports were produced for the 60 retrofitted power lines. The reports included data on mortality, the measures to be taken on each tower/span and the projected costs. Once the relevant measures had been taken, they were all assessed and the data was compared with the preliminary reports, following which a document containing suggestions for improvement was drawn up. All these documents were sent to the utility companies and were discussed in the joint working groups which monitored the co-operation agreements (Fig. 9).

RETROFITTING ON POWER LINES REPRESENTING A DANGER TO BIRDS:

☑ On transmission lines: (collision risk):

Where there is a risk of collision on transmission lines, R.E.E. has marked the ground wires with 30x100 cm orange closed spiral markers (Fig. 13); employing a spacing of one marker every five metres. The markers were installed manually, either by helicopter, working on the energised line (Fig. 14) or working on a non-energised line using a cradle hanging from pulleys. 15).

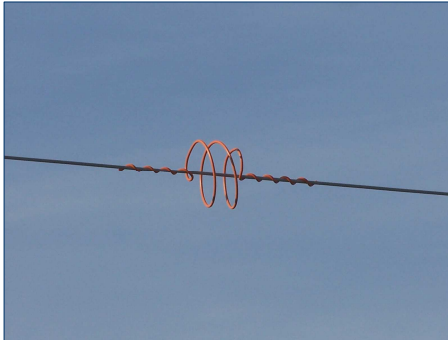


Fig. 13: Neoprene markers in the earth wire of distribution lines (REE).



Fig. 14: Manual placement of markers by helicopter in the lines with tension.



Fig. 15: Manual placement of markers by special device in line without tension.

☑ On distribution lines: (electrocution and/or collision risk):

✓ Anti-electrocution measures:

- The structural supports on **power poles** with upright insulators have been replaced with a vaulted structure, installing series of suspended insulators.
- The central power line on **strain poles with horizontal crossarms** has been moved to a location where it is suspended under the crossarm and 1.5m of conductor on each side of the chains on the three phases has been insulated with tubing.
- **Strain poles with a triangle-shaped frame** have been fitted with a bracket-mounted lamps while the central conductor has been suspended laterally under the top of the pylon body. Furthermore, the suspended conductor has been insulated, as has a 1.5m length of conductor either side of the chains on the three phases.
- The live elements on **special poles** have been moved to a lower crossarm, while the wire contacts and downconductors have been insulated, including all downconductor clips (Fig. 16).

✓ Collision prevention measures:

The potential for collisions with distribution networks has been reduced by taking three different steps:

- **Marking** conductors with X-shaped 5x35 cm neoprene markers placed in an alternating pattern on the three conductors, creating a spacing of one marker every five metres. Where this has been done, the markers have been installed with the help of a remote-controlled robot on a non-energised line. 17).
- Lines which are no longer used have been **dismantled**. This includes removing the wires and the pylon and the recycling and removal of all the materials.
- In certain exceptional cases where the affected species were of special interest and the mortality rate remained unacceptable after the lines had been marked, the lines have been **placed underground and/or located elsewhere** (Fig. 18).



Fig. 16: Correction of intersection poles to eliminate the electrocution risk.



Fig. 17: Marking a conductor of a distribution line by guided robot.



Fig. 18: Placing underground a high tension line in ZEPA "Laguna de Gallocañta".

Reducing mortality and testing the effectiveness of the measures taken:

The LIFE Project is calculated to have taken steps to improve 60 per cent of the dangerous networks in 18 ZEPAs and it is considered that the measures taken have achieved an 87.7% reduction in the mortality rate which had initially been observed in these networks. The anti-electrocution measures have, in general, proved highly effective, preventing the death rate by 93.7%, while marking only managed to reduce the observed risk of collision by 50%.

AWARENESS CAMPAIGNS AND PUBLICITY FOR THE PROJECT .

✓ Awareness campaigns and publicity:

While the LIFE Project has been running there has been a campaign to spread awareness of overhead power lines and their potential for electrocution and collision amongst endangered species. This has included press briefings and TV reports, documents in PDF format on a dedicated web page, the publication and dissemination of information leaflets and the installation of information panels on the improved networks in ZEPAs.

- The Aragonese Regional Government's website ("*Portal de Aragón*") incorporated a **web page** about the LIFE Project which provided access to the main published documents in PDF format.
- 2,000 **information leaflets** (Fig. 19) were distributed under the titles "The LIFE Project improves power lines in the Aragonese ZEPAs" and "Removing the danger to birdlife from power lines".
- Over **20 reports and news items related to the project** to improve power lines in Aragon were broadcast on regional television channels and in the press, with articles prompted by events such as formal approval of the LIFE Project, the ceremonies to sign the co-operation agreements with ERZ-Endesa and REE, the announcement of figures for investment in the project and the most eye-catching measures taken on the power lines in question.
- **30 informative panels** tailored to their specific location have been installed on location (Fig. 20), providing information about the steps taken on the most dangerous networks and placed near to the lines which have been improved, as well as at meeting points and on well-travelled routes in 14 ZEPAs.



Fig. 19: Information leaflets and the Life experience document.



Fig. 20: Informative panel in ZEPA "La Sotonera".



Fig. 21: Practical guide about technical solutions on electricity distribution networks .

✓ Information concerning the technical details and materials involved, produced for developers, engineers and other construction professionals:

- A practical guide has been published in collaboration with ERZ-Endesa and distributed to developers, engineers and contractors providing details on "Measures which can be taken by the construction industry to protect birdlife on electricity distribution networks (≤ 20 kV)" (Fig. 21). The guide offers suggested pylon designs and structural solutions, including materials, intended to comply with the relevant regional electricity regulations and to prevent electrocution and collision caused by overhead distribution lines.

✓ Dissemination of the experience amongst those involved in managing environmental issues:

- A **document containing technical information** has been published under the title "The **LIFE Experience** in improving power lines representing a danger to birdlife in Aragon" (Fig. 19). The document discusses the problem of electrocution and collision amongst birds caused by overhead power lines and provides a detailed description of the tools employed, the difficulties faced by the project, the measures taken (electricity regulation, official procedures and corrective measures) and their effectiveness.