Mitigating Bird Electrocution: Conservation Efforts and Successes in Andalusia, SE Spain

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Introduction

Bird electrocution on power lines is a significant conservation issue, particularly for endangered species. In Andalusia, Spain, there are approximately 150,000 power line structures that pose a risk to birds, causing an estimated 4,000 deaths annually until 2015. This high mortality rate nearly drove species like the Spanish imperial eagle to extinction and was the main limiting factor for Bonelli's eagle populations. Since the late 20th century, the Andalusian government has worked to mitigate this problem by correcting dangerous power lines and developing legislation for utility companies. However, it wasn't until 2015 that efforts became more effective, with the systematic collection of data and collaboration with major electric companies. This collaboration deepened in 2019 through an agreement with Enel-Endesa, enabling urgent modifications to the most dangerous power lines, particularly those responsible for bird deaths or located in critical areas for endangered species. This presentation aims to showcase the effectiveness of these efforts in reducing bird electrocution and its threat to the extinction of bird populations, especially endangered species, through targeted infrastructure modifications

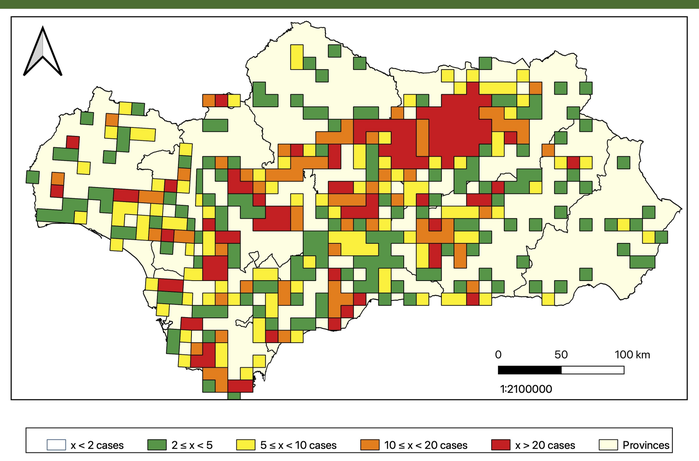
Method

To assess whether efforts in Andalusia have effectively reduced bird electrocution on power lines as a threat to avian extinction, an analysis was conducted using the Andalusian government's updated mortality database. The study examined changes in the number of electrocution black spots over three periods. The first period (1990-2015) saw no systematic data collection or targeted modification of dangerous power lines. The second period (2016-2019) included systematic data collection and adaptations based on electrocutions, along with regional (Decree 178/2006) and national legislation (Royal Decree 1432/2008) focused mainly on protected areas. The third period (2020-2023) continued systematic data collection but involved collaboration with Enel-Endesa under an agreement, allowing modifications to the most dangerous structures, regardless of their location within protected areas. Electrocution black spots were defined as 10x10 km UTM grid squares with more than 10 electrocutions per period. Six categories of electrocution frequency were identified: fewer than two, 2 to 5, 5 to 10, 11 to 20, and more than 20 electrocutions, with black spots defined as those with more than 10. A Chi-square test was performed to assess significant differences in the number of grid squares with over 10 electrocutions across the three periods, compared to the total number of squares with more than one electrocution

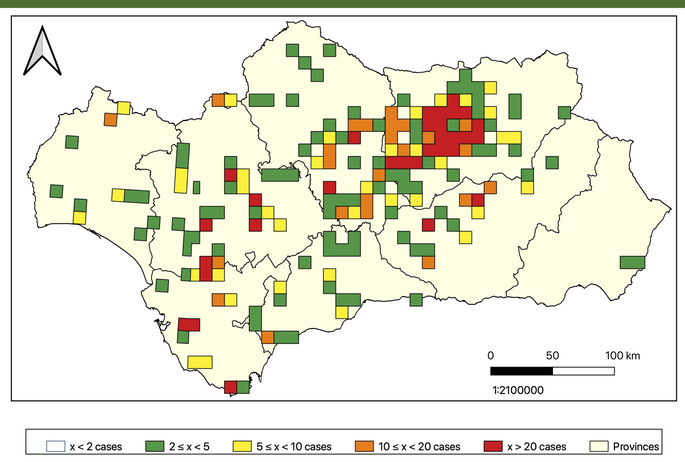
Result

Since 1990, 8,172 electrocutions of 70 different species have been recorded, including 7 species listed as threatened under Andalusian legislation (see table). During this period, around 35,000 dangerous power line structures have been modified in Andalusia, with 25,000 adapted by 2019. This has led to a significant reduction in the number of 10x10 km grid squares classified as electrocution black spots (see maps), decreasing from 41.5% of grid squares with more than 2 electrocutions in the first period, to 30.7% in the second, and to 18.8% in the 2020-2023 period (Chi-square=26.45, 2 degrees of freedom, $p<0.001$). The greatest reduction occurred in the last period, despite only 8,500 supports being modified, as these were targeted in the most critical areas for sensitive species distribution.It is noteworthy that most of the affected species now show increasing breeding trends (see table), including storks and medium to large raptors. Among the threatened species with negative trends, only the red kite remains vulnerable to electrocution due to its small population size in the region. In contrast, electrocutions of Egyptian vultures and Montagu's harriers are rare, but given their poor conservation status, further efforts to reduce these incidents are still needed.

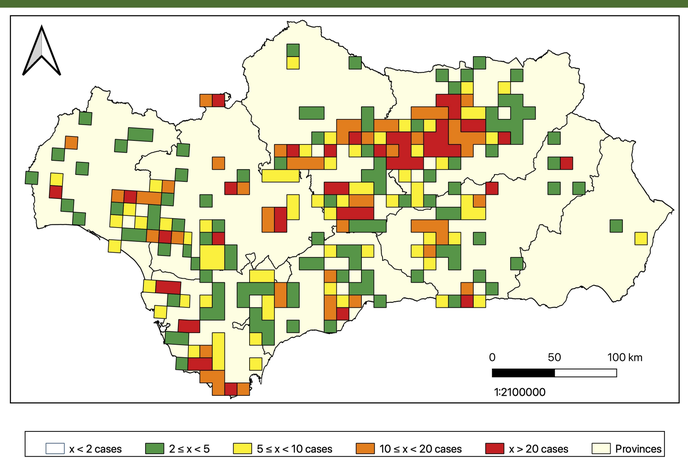
Electrocutions 1990-2023



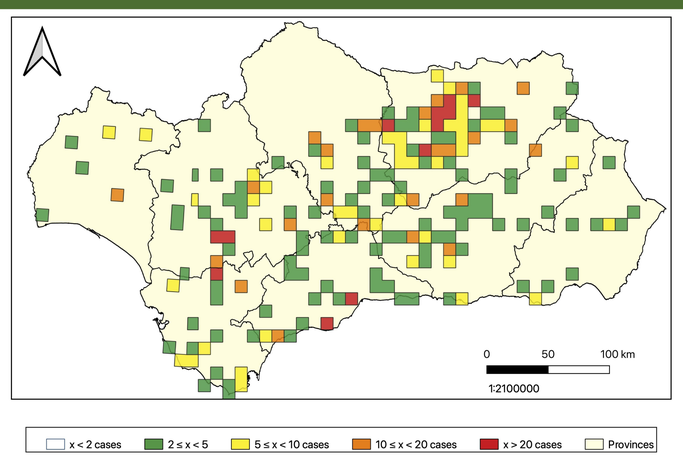
Electrocutions 2016-2019



Electrocutions 1990-2015



Electrocutions 2020-2023



Scientific name	Common name	Threat category	No. electrocutions	%	Breeding trend
Ciconia ciconia	White stork	NON THREATENED	1.818	22	↑
Bubo bubo	Eurasian eagle-owl	NON THREATENED	1.032	13	↑
Corvus corax	Northern raven	NON THREATENED	998	12	↓
Buteo buteo	Common buzzard	NON THREATENED	904	11	=
Gyps fulvus	Griffon vulture	NON THREATENED	373	5	↑
Circaetus gallicus	Short-toed snake eagle	NON THREATENED	305	4	↑
Milvus migrans	Black kite	NON THREATENED	301	4	=
Aquila fasciata	**Bonelli´s eagle**	**VU**	**235**	**3**	**=**
Falco tinnunculus	Common kestrel	NON THREATENED	169	2	↓
Falco naumanni	Lesser kestrel	NON THREATENED	125	2	↓
Aquila adalberti	**Spanish imperial eagle**	**EN**	**115**	**1**	**↑**
Hieraaetus pennatus	Booted eagle	NON THREATENED	114	1	↑
Aquila chrysaetos	Golden eagle	NON THREATENED	113	1	↑
Corvus monedula	Western jackdaw	NON THREATENED	68	1	↓
Accipiter gentilis	Northern goshawk	NON THREATENED	54	1	=
Sturnus unicolor	Spotless starling	NON THREATENED	45	1	=
Geronticus eremita	Northern bald ibis	NON THREATENED	43	1	↑
Milvus milvus	**Red kite**	**EN**	**41**	**1**	**↓**
Elanus caeruleus	Black-winged kite	NON THREATENED	33	0	=
Bubulcus ibis	Cattle egret	NON THREATENED	31	0	↓
Pandion haliaetus	Osprey	VU	20	4	=
Ciconia nigra	**Black stork**	**EN**	**15**	**3**	**=**
Aegypius monachus	**Cinereous vulture**	**VU**	**13**	**3**	**=**
Circus pygargus	**Montagu´s harrier**	**VU**	**6**	**1**	**↓**
Neophron percnopteru	**Egyptian vulture**	**EN**	**6**	**1**	**↓**
Other species (n=45)	-	-	1.255	15	-
Total (n=70 species)	**-**	**-**	**8.172**	**100**	**-**

Discussion

The results obtained indicate that the conflict between birds and power lines no longer represents a cause of extinction for bird species in Andalusia. Although the conflict persists and power lines continue to cause bird deaths due to the extensive electrical network and the growing populations of sensitive species, such as the Spanish imperial eagle, which are colonizing new areas previously considered non-critical, we are making progress toward eliminating this threat as a factor in extinction. Continuing in the same vein of collaboration with electric companies to adapt power lines, prioritizing the most sensitive areas, we estimate that by 2027-2030, no bird populations will be threatened by power lines. However, significant challenges remain, such as the adaptation of dangerous power lines owned by small proprietors who are unable to make these modifications themselves. In this regard, the regional government continues to work on securing funding for their adaptation. We believe that the solutions adopted in Andalusia, which are similar to those implemented elsewhere in Spain where have proven equally effective, should serve as a model for other European countries with less experience in addressing this issue. Andalusia collaborates in this area by developing cooperation programs with the IUCN Mediterranean Cooperation Center to identify and minimize these impacts in North Africa, thus promoting the conservation of European birds also in their migration and wintering areas, as well as producing reference documents and manuals for a global audience.

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