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# Renewable energy acceleration endangers a protected species: Better stop to light a torch than run in the dark

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A R T I C L E I N F O

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A B S T R A C T

The European Commission and EU Member States have recently promoted legislation (under the REPower EU Plan) to accelerate renewable energy projects by allowing the elimination or reduction of environmental assessment and public participation in the approval procedure. To avoid adverse effects on the environment, these regulations propose the exclusion of certain areas (identified through available information on protected and/or environmentally sensitive areas) from the procedure. This paper aims to evaluate whether such measures are effective to avoid damage to biodiversity from the implementation of photovoltaic energy.

To this end, we studied the distribution and abundance of a threatened bird species, the Black-bellied Sandgrouse, at two geographic scales: i) regional: Andalusia (southern Spain); ii) local: Campo de Tabernas (an excellent example of the semi-arid ecosystems of southeastern Spain) and evaluated the quality of the information that Administrations have on the species by comparing it with own censuses. We also assessed the effectiveness of the environmental impact procedure for photovoltaic plants planned in Campo de Tabernas.

Data from the regional Administration reveal that Andalusian protected areas cover a minimal part (17.7%) of the species' range. Moreover, neither the regional nor the national Administration have reliable and updated information on the distribution of the species in Campo de Tabernas (only 17% of the current distribution area is known).

The wrong choices made by developers about where to locate the photovoltaic plants together with wrong decisions of the regional Administration (with land-use planning competences, including the planning of power plant locations) have led to the loss of 630 ha of the species' range in Campo de Tabernas. Public participation of experts prevents, through allegations to the projects, an important part of the impact on the species.

Policy implications: the information that the Administrations have on this species does not allow them to make proper decisions on where to apply renewable acceleration. Obtaining complete and updated information on the distribution of endangered species to elaborate detailed wildlife sensitivity areas is essential and urgent before implementing measures to accelerate renewables.

## 1. Introduction

Fighting climate change requires decarbonisation of the economy, which in turn entails a reduction in economic development (Odugbesan and Rjoub, 2020) and the promotion of renewable energies (Gielen et al., 2019). The European institutions recognise that the deployment of the latter must guide investments and be reconciled with the conservation of ecosystems and biodiversity. For example, the development of photovoltaic solar energy (PSE) in the European Union (EU) must be undertaken within the framework of Regulation (EU) 2020/852 (known as the Taxonomy Regulation), to be an environmentally sustainable economic activity. However, a growing number of studies show that the deployment of renewables undermines biodiversity (Gasparatos et al., 2017; Serrano et al., 2020) and does not comply with the regulations that aim to ensure their environmental sustainability (Valera et al., 2022). The latter is particularly worrying given the severe and continuing decline in biodiversity and the failure to meet environmental targets (e.g. for the EU see EEA SOER, 2020; EEA Signals, 2021).

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The current Commission presented the Communication of 8 March 2022 REPowerEU (COM (2022) 108 final, see Suppl. Mat. Text SM1) in which, given the situations in the energy markets, 'requires to drastically accelerate the clean energy transition and thereby increase Europe's energy independence'. The Commission considered that, in order to accelerate the authorization procedures for renewable energy, States should first (a) ensure the planning, construction and operation of such installations, and (b) map and assess suitable land and sea areas.

Given the continuous increase in energy prices, the Council of the European Union adopted on 22 December 2022, Regulation (EU) 2022/2577 containing temporary emergency rules to accelerate the "permit-granting process". This rule was implemented in Spain by an urgent and exceptional rule (Royal Decree-Law 20/2022). These new regulations intend to accelerate the deployment of renewables via the following measures (see summary in Table 1):

i) Establishment of renewable energy zones (renewable go-to areas) through the implementation of prior planning subject to strategic environmental assessment and exemption from environmental impact assessment (EIA). The stages of the process according to the amended Renewables Directive (Directive (EU) 2023/2413, see Suppl. Mat. Text SM1) are: (1) Necessary areas. Member States will define the land and sea areas necessary for the installation of renewable energy plants required to achieve the national targets for 2030. (2) Renewable go-to areas. Member States will adopt one or more plans which, within the necessary areas, designate renewable go-to areas with respect to one or more types of renewable energy sources. Such areas will be sufficiently homogeneous territories where no significant environmental impacts are expected based on the best available information. The plan(s) will be subject to strategic environmental assessment (Directive 2001/42) and Natura 2000 assessment (Directive 92/43) where appropriate, made public and re-examined. Importantly, in Spain, spatial and land-use planning powers are the jurisdiction of the Autonomous Communities (e.g. Andalusia). (3) Exemption from EIA and public participation. New applications for renewable energy plants located in areas already designated as renewable go-to areas, as well as their connection to the grid, will be exempted from the requirement to carry out EIA and public participation. A screening of applications will be established to determine whether there is a high likelihood that any such projects will give rise to significant unanticipated adverse effects. The exemption is accompanied by a reduction in processing times.

This derogation in the recently amended Renewables Directive (Directive (EU) 2023/2413) has been implemented by the Acceleration Regulation in a less detailed manner (Regulation (EU) 2022/2577). In Spain, legislation excludes the Natura 2000 Network and other protected natural areas from these exemption zones, and eliminates public participation during the environmental procedure (allowing only 15 days to argue about the environmental impact in the substantive procedure). The need for prior strategic environmental assessment has also been removed (Royal Decree-Law 20/2022) (Table 1).

ii) Assuming renewable energy production actions "as being in the overriding public interest and serving public health and safety".

As a result of these regulations, "renewable go-to areas" become a key concept. These are specific sites, particularly suitable for the installation of renewables, where their deployment is not expected to have significant environmental impacts. In identifying "suitable areas for renewables energy projects", Member States will exclude Natura 2000 sites and nature parks and reserves, migratory bird routes, as well as other areas (e.g. important wildlife areas) identified on the basis of appropriate sensitivity maps, tools and datasets, including wildlife sensitivity mapping and, where necessary, specific field studies. To support Member States in identifying such "renewable go-to areas", the Energy and Industry Geography Lab (Uihlein and Hidalgo González, 2023), from May 2022, provides the following datasets (from now on: "non go-to areas"): Natura 2000 Network sites, nationally designated protected areas (CDDA), Important Bird Areas (IBA) and Key Biodiversity Areas (KBA). Other relevant datasets will be added in the future, being Member States responsible for the identification of the "non go-to areas".

The validity of the Council regulation is limited to 30 months and the one of the Spanish Royal Decree to 24 months. In addition, the amendment of the Renewable Directive makes this environmental approach permanent. This line of thinking may leave the door open for energy objectives to be achieved at the expense of biodiversity. To avoid this, it is urgent to identify the distribution of threatened or vulnerable species in order to assess the possible cumulative impacts of current intensive energy infrastructures caused by the energy transition policy (Serrano et al., 2020; Rehbein et al., 2020; Palacín et al., 2023).

Renewable energies can affect wildlife. There is a wealth of information demonstrating the impact of wind farms on birds and bats (Osborn et al., 2000; Hötker et al., 2006; de Lucas et al., 2007). However, the impact of photovoltaic plants (PPs) on avifauna has been much less studied (but see, for instance, Walston et al., 2016; Kosciuch et al., 2020). Renewable energy deployment can particularly affect certain habitat types and species. For instance, PPs, which require large areas, are usually developed preferentially in flat agricultural environments of low economic value that coincide with well-preserved steppe habitats important for steppe birds (Valera et al., 2022; Palacín et al., 2023). These species are known to be poorly represented in the Spanish Natura 2000 Network (Traba et al., 2007) even though the Spanish responsibility for their protection is paramount, given that Spain has long been the main European refuge for most of these birds (Santos and Suárez, 2005; Traba et al., 2013).

Here we study the potential impact of the new regulations favouring renewables by assessing the quality of the information that the Administrations have on the distribution of steppe wildlife, and the validity of their tools to avoid adverse effects from the renewable acceleration measures. For that, we used the Black-bellied Sandgrouse (*Pterocles orientalis*) as a model species, an endangered species (Mougeot et al., 2021a) considered of special interest to the European Union and included in the Annex I of Directive 2009/147/EC. Moreover, The Bern Convention (Convention on the Conservation of European Wildlife and Natural Habitats) lists the Black-bellied Sandgrouse in Anex II as strictly

**Table 1**
Most significant changes introduced by each of the new renewable acceleration regulations analysed in this paper. The non go-to renewable zones are described for each regulation as well as the main changes the latter include (or not). EIA: environmental impact assessment. CDDA: nationally designated protected areas, IBAs: important bird areas.

| | Regulation (EU) 2022/2577 | Amended Renewables Directive (Directive (EU) 2023/2413) | Royal Decree-Law 20/2022 |
|---|---|---|---|
| Non go-to areas | Natura 2000 Network, CDDA, IBA, Key Biodiversity Areas | Natura 2000 Network, CDDA, IBA, Key Biodiversity Areas | Natura 2000 Network, CDDA |
| Strategic environmental assessment (go-to areas) | Included | Included | Excluded |
| Overriding public interest | Included | Included | Excluded |
| Exemption from EIA & public participation (go-to areas) | Included | Included | Included |

protected. For these reasons, deterioration or destruction of its breeding sites or roosting areas, as well as disturbance during breeding, rearing and hibernation periods, is specifically prohibited. More than 90% of the total EU Black-bellied Sandgrouse population is concentrated in Spain (Tucker and Heath, 1994). In particular, the Andalusian population (southern Spain) hosts 12.9% of the Spanish one, and those of the arid southeast host 5.9% and are the most stable ones (Mougeot et al., 2021a), making it a key population for the conservation of the species. Given its habitat preferences (open and flat environments, Benítez-López et al., 2014), it is expected to be heavily impacted by the deployment of PPs and their electric lines, both through loss of habitat and direct mortality (Mougeot et al., 2021b; Gómez-Catasús et al., 2021; Smallwood, 2022). In this study, we specifically address the following questions using information from Black-bellied Sandgrouse (hereafter sandgrouse) in Andalusia: i) To what extent do protected areas and "non go-to areas" really protect an endangered species? ii) How complete is the information that the Administrations have on the sandgrouse to strategically design the deployment of renewables and "non go-to areas"? iii) How coherent are the "non go-to areas", the Important Conservation Areas (ICAs), and the environmental zonings designed by the national and regional Administrations with the current distribution of the species? iv) What is the outcome and effectiveness of the environmental impact assessment procedure regarding the conservation of the sandgrouse? Finally, we attempt a comprehensive discussion of the impact of the new legislation on this and similar species.

## 2. Material and methods

### 2.1. Study area and study species

The distribution and abundance of the sandgrouse has been studied at two different geographic scales: i) regional: Andalusia, where the species is mainly distributed along the Guadalquivir valley, the Subbetic peneplains and the semiarid southeast (Mougeot et al., 2021b); ii) local: Campo de Tabernas (Almería, SE Spain, 37.08ºN, 2.35°E).

Andalusia falls entirely within the Mediterranean climate domain, characterized by summer droughts and high temperatures. The climate in Campo de Tabernas is semi-arid Mediterranean, with a strong water deficit in summer. The mean annual rainfall is ca. 230 mm, with high interannual and intra-annual variability (Lázaro et al., 2001). The average annual temperature is 18 °C, with mild interannual oscillations and significant intra-annual fluctuations (Lázaro et al., 2004). The area consists of badlands with olive and almond groves, and cereal crops, interspersed among dry streambeds (ramblas) and steppe vegetation. Water scarcity has discouraged intensive agriculture until the last decades, when a process of intensification has given way to super-intensive irrigated olive orchards (Martínez-Valderrama et al., 2020). Yet, there are still well-preserved spots with xerophytic plant communities (Armas et al., 2011) and a high percentage of the area (potentially) covered by Habitats of Community Interest (HCI) (Junta de Andalucía, 2018).

Campo de Tabernas borders several natural protected areas of the Natura 2000 Network, namely the Special Area of Conservation (SAC, ZEC in Spanish) "Ramblas de Gérgal, Tabernas and south of Sierra Alhamilla" (ES6110006), the Special Protection Area for Birds (SPA, ZEPA in Spanish) and SAC "Sierra Alhamilla" (ES0000045), the SPA and SAC "Desierto de Tabernas" (ES0000047) and the SAC "Sierra de Cabrera-Bédar" (ES6110005). The recent construction of numerous PPs in Campo de Tabernas has affected at least 975 ha until now (see Valera et al., 2022 and sections below).

The most favourable areas for the sandgrouse in the Iberian Peninsula, are arid, flat and open areas with high minimum temperatures mainly dedicated to rainfed agriculture and extensive grazing (Benítez-López et al., 2014; Martín et al., 2014; Mougeot et al., 2021a). In Spain, the species is resident although it has seasonal displacements (Mougeot et al., 2021a). It is listed at national and regional level as "Vulnerable" (Royal Decree 139/2011 and Andalusian Catalogue of Threatened Species, Decree 23/2012 respectively). However, the peninsular populations have been recently labelled as "Endangered" (Mougeot et al., 2021b). This steppe bird is also included in the Regional Plan for the Recovery and Conservation of Steppe Birds (Junta de Andalucía Agreement, 18/1/2011).

### 2.2. Data collection and field work

#### 2.2.1. Analysis at regional scale (Andalusia)

Upon explicit request, the regional government (Junta de Andalucía) provided official records of the species in Andalusia (wintering and breeding censuses done between 2007 and 2019, REDIAM, 2021) that were used to calculate the home ranges and core areas of the sandgrouse in the region. The census method during the breeding period followed Suárez et al. (2006). It consisted of walking routes (minimum 3 km long) through favourable habitats (grasslands, wastelands, fallow land, ploughed land, stubble… avoiding wooded, shrub and dry or irrigated dense crops). The observation band on each side of the transect was 200 m. Breeding surveys were conducted in 2007 (152 transects and 571.03 km), 2010 (132 transects and 415.89 km), 2017 (79 transects and 251.23 km) and 2019 (119 transects and 469.4 km; of which 37.7 km were repeated 2 times and 91.6 km 3 times). The census method during the winter period consisted of transects by car, at low speed, with observation and listening stations. The transects were conducted in favourable environments for the species within the 5 × 5 km grid squares (sampling unit) included in the UTM 10 × 10 km grid squares of the known wintering area of the species (CAGPDS, 2011). Winter surveys were carried out in 2006/2007 (7 transects, distance not reported), 2010/2011 (146 transects and 1045.44 km), 2011/2012 (5 transects, distance not reported) and 2012/2013 (8 transects, distance not reported) (CAGPDS, 2007; CAGPDS, 2010; CAGPDS, 2011; CAGPDS, 2017; CAGPDS, 2019). A total of 759 locations – places where one or more individuals were detected- (142 in winter and 617 during the breeding period) were used to estimate the home range throughout Andalusia.

#### 2.2.2. Analysis at local scale (Campo de Tabernas)

The breeding and wintering population of the sandgrouse was studied in the westernmost part of Campo de Tabernas by using data from the regional government (REDIAM, 2021) and own censuses. Out of the regional government surveys (see above), the subset of data related to our study area is characterized by: i) breeding censuses carried out in 2007 (6 transects and 20.9 km), 2010 (7 transects and 25.62 km), 2017 (2 transects and 6.13 km) and 2019 (3 transects and 9.1 km, of which 6 km were repeated 3 times along the season); ii) winter censuses carried out in 2010/2011 (7 transects and 39.46 km). The methods used were the same as the ones described above. Forty locations (3 in winter and 37 in breeding period) were obtained, which were used to calculate home ranges and core areas of the species (CAGPDS, 2007; CAGPDS, 2010; CAGPDS, 2011, 2017, 2019).

Our censuses, done during the 2021 and 2022 breeding seasons, were distributed homogeneously throughout the study area (with the exception of unsuitable areas such as urban habitats, woody crops and greenhouses), and covering the entire range described by the regional government. We used the transect survey method (band width of 200 m, wide enough to avoid overlap and double counting). This methodology has been recommended for the species (Suárez et al., 2006; Mougeot et al., 2021a). Transects were geo-referenced and the number of individuals and their behaviour (flying vs sitting) were recorded for each observation. Transects were carried out in the first or the last 3 h of the day. During the 2021 breeding season (15 May-15 August), 8 transects (32.5 km) were done, obtaining 15 locations. In 2022, 64 transects (186.6 km) were carried out during the breeding season (15 May-15 August), post-breeding season (15 August-15 October) and winter period (15 December-15 February), obtaining 93 locations (70 on the ground and 23 flying). Data obtained in 2022 were used to estimate the current home ranges and core areas in Campo de Tabernas (hereafter updated information) that has suffered severe modifications due to the deployment of large PPs in the area (Valera et al., 2022). Each location was geo-referenced.

All the information gathered (i.e. data from the regional government and own data from 2021 and 2022) was used to depict comprehensively the home range and core area of the species in Campo de Tabernas during the period 2007–2022 (hereafter called complete information).

These three data sets (official, updated and complete) are used to accomplish the various aims of this paper.

### 2.3. Home range estimates

The home range and core area of the species was estimated to assess the impact of PPs (at a regional and local scale) and power lines (only at a local scale). For the first aim, all locations where sitting individuals were detected were used. We did not consider the number of individuals seen because sandgrouse' gregarious behaviour varies throughout the year: large flocks occur outside the breeding season, while during the breeding period several pairs form breeding clusters. Since our study covers the whole year, considering each individual would overestimate the importance of post-breeding concentration areas to the detriment of breeding ones (see Palacín et al., 2023 for the same criterion with a similar steppe bird, the Great Bustard *Otis tarda*). All locations (876 - regional government data and own data pooled-) were integrated into the same coordinate system (ETRS89, Zone 30 N). Shape files with the locations for each scenario (Andalusia, Campo de Tabernas) were created with the various data sets.

To assess the potential impact of power lines in Campo de Tabernas, the home range and core areas were estimated including 23 observations of individuals in flight to the complete data set.

We used the Gaussian Kernel Method (KDE, Kernel Density Estimator; Worton, 1989) to calculate the home ranges and core areas since is commonly used to study bird distribution in agricultural environments (Benítez-López et al., 2014; Palacín et al., 2023). This method describes a territory in terms of a probabilistic model and is free of parametric assumptions of the data (Worton, 1989). Kernel methods are the most statistically efficient non-parametric density estimators (Noonan et al., 2019). The Kernel method calculates isolines delimiting the area with the same intensity of use. The smoothing parameter (h) that provided the best fit was established by expert judgement (h = 400 m), as other methods fail if sample sizes or location density are too high (Kie et al., 2010). We estimated two contours representing 95% and 50% probability of space use. The first (KDE 95%) defines the home range and the second (KDE 50%) the core area (areas intensively used by birds or center of activity, see, for instance, Palacín et al., 2023). Autocorrelation is not an issue for home range estimation (Palacín et al., 2023). The analysis was conducted using ArcGis 10.5 Geographic Information System (ESRI, 2019) and HRT software (Rodgers et al., 2015).

### 2.4. Data analysis

#### 2.4.1. Aim 1: To what extent do protected areas and "non go-to areas" really protect an endangered species? (results in Section 3.1)

We estimated the overlap of the species' home range and core area in Andalusia with the following areas:

- Natura 2000 Network (SAC and SPA) (according to the Ministry for Ecological Transition and Demographic Challenge Metadata catalogue, MITECO, 2023).
- Important Bird Areas (IBAs) (MITECO, 2023). BirdLife IBAs Inventory provides a list of priority conservation areas for birds in each EU member state to satisfy, among others, the requirements of the Directive 2009/147/EEC on the Conservation of Wild Birds and the declaration of SPAs. IBAs identified by BirdLife have the same value as SPAs declared under Directive 2009/147/EEC, and so the deterioration of these areas must be avoided.
- Nationally designated protected areas (MITECO, 2023, named CDDA after Uihlein and Hidalgo González, 2023).
- Key Biodiversity Areas (Uihlein and Hidalgo González, 2023) that, for Andalusia, hold the three former areas. Given that the KBAs in Andalusia coincide with the IBAs and the Natura 2000 Network, the coverage of the "non go-to areas" is the same as that of the IBAs.

#### 2.4.2. Aim 2: How complete is the information that the administrations have on the sandgrouse to plan the deployment of renewables and "non go-to areas"? (results in Section 3.2)

We compared both the home range and core areas obtained for this species in Campo de Tabernas with three data sets available: i) Official information from censuses by the regional government (2007, 2010, 2017 and 2019), ii) Complete information: own data (2021 and 2022) and data by the regional government, and iii) Updated information: own data in 2022.

#### 2.4.3. Aim 3: How coherent are the "non go-to areas", ICAs, and environmental zonings designed by the national and regional administrations with the current distribution of the species? (results in Section 3.3)

We calculated the overlap between the home range of the sandgrouse and "non go-to areas", other ICAs and official environmental zonings in Campo de Tabernas to estimate the suitability of the latter for the protection of the species. The following spaces and criteria were considered:

1. Natura 2000 Network (SAC and SPA) (MITECO, 2023).
2. IBAs (MITECO, 2023).
3. Environmental zoning for renewables (MITECO, 2023b), published in December 2020 (hereafter MITECO zoning). This zoning classifies the entire territory into 5 categories. The 5 initial categories of environmental sensitivity to PPs were grouped into two groups: (i) maximum, very high and high; (ii) moderate and low.
4. Methodological guide for the assessment of the repercussions of solar installations on steppe bird species (MITECO, 2021), Strategies for the Conservation and Recovery of Endangered Species at a state level, specifically those referring to steppe birds (MITECO, 2022) and the last national census of the species (Mougeot et al., 2021a). These three documents use the same geographical criteria, identifying the UTM 10 × 10 km squares with the presence of the sandgrouse, based on Mougeot et al. (2021a). This ICA is named as Updated MITECO/SEO distribution.
5. Environmental zoning, published in January 2021, associated with the Guide of the General Directorate of Natural Environment, Biodiversity & Protected Spaces for the analysis of the location of PPs (Junta de Andalucía, 2021), (hereafter Junta de Andalucía zoning). This guide divides the Andalusian territory into 3 categories: (i) non-compatible zones (critical areas for steppe birds in the annexed zoning of the Environmental Conditions Viewer), in which PPs will be definitively reported unfavourably; (ii) conditioned compatibility zones (areas considered strategic for steppe birds), in which PPs may be installed if the environmental assessment is favourable; (iii) compatible zones (areas with no current or historical presence of steppe birds), where the zone is recommended by the Andalusian Administration for the location of PPs.
6. Areas of the scope of action of the Steppe Bird Recovery Program (AASBR, ZAPRAE in Spanish) of the regional government (Junta de Andalucía, 2023) (hereafter Junta de Andalucía Recovery plans).

#### 2.4.4. Aim 4: What is the outcome and effectiveness of the EIA procedure regarding the conservation of the sandgrouse? (results in Section 3.4)

We periodically reviewed during 2019–2022 the official gazettes of the Spanish state, of the autonomous community and of the province (Boletín Oficial del Estado – BOE-, Boletín Oficial de la Junta de Andalucía – BOJA -, and Boletín Oficial de la Provincia - BOP - in Spanish, respectively) in search of applications for authorization for PPs in Campo de Tabernas. The Environmental Impact Studies (EIS) of these projects were obtained and analysed in search of their main characteristics (see below). Information on other projects in Campo de Tabernas prior to our study (mostly applications presented between 2017 and 2018) was obtained from various NGOs that presented allegations, as well as from official sources (BOJA, BOP). This review provided information about: (i) characteristics of PPs proposed by enterprises (location, extension, length of the evacuation line and distance to the electric nodes); (ii) allegations to the PP projects (due to impact on wildlife, conflicts with the local population and with social organizations, etc.); and (iii) the response of the Administration and the enterprises to such allegations through the analysis of the Binding Reports. As a result, information was obtained on 33 applications, involving 34 PPs planned or built in the study area. Additionally, we obtained information from 3 PPs with right of access to the high-voltage network in Tabernas. The information provided here refers to 37 PPs in the study area (see Suppl. Mat. Table SM1). We geo-referenced all the proposed (in the pipeline), built and approved PP projects (fenced area) since 2017 ($n = 37$).

We also analysed the effect of allegations to PPs by experts (namely Estación Experimental de Zonas Áridas EEZA/CSIC and SEO/BirdLife), mainly occurring from the end of 2020 onwards. We distinguished between PPs: (i) without ($n = 10$), and (ii) with expert allegations ($n = 6$). For the latter, we compared the original project (i.e., before allegations) and the modified project (after allegations) to explore changes in overlap between PPs and electricity lines and home range or activity centres of the sandgrouse.

All this information enabled us to estimate the overlap of PPs with the home range and core area of the sandgrouse (calculated with all 3 data sets previously described and the complete one plus the information of flying individuals) which reveals the effectiveness of the process regulating PPs deployment in terms of protection of this endangered species.

A list of data sources used is provided in each corresponding section.

Supplementary Material includes information and links to websites for each cited legislation (Text SM1) and information on the PPs reviewed in this study (Table SM1).

## 3. Results

### 3.1. *To what extent do protected areas and "non go-to areas" really protect an endangered species?*

A total of 145 independent home range areas (KDE 95%; Fig. 1) covering 69,674 ha and 86 core areas covering 12,646 ha were identified in Andalusia (Table 2). Thirteen point 5 % of the home range and 12.6% of the core area were within SPA spaces and 17.7% of the home range and 17.6% of the core area were within Natura 2000 Network. Nationally designated protected areas (CDDA) that are not SPAs or SACs do not host populations of the sandgrouse (therefore, are not included in Fig. 1). IBAs hold 80.5% of the home range and 83.6% of the core area of the species in Andalusia (Table 2). IBAs out of protected areas still embrace a significant percentage of the distribution area of the sandgrouse.

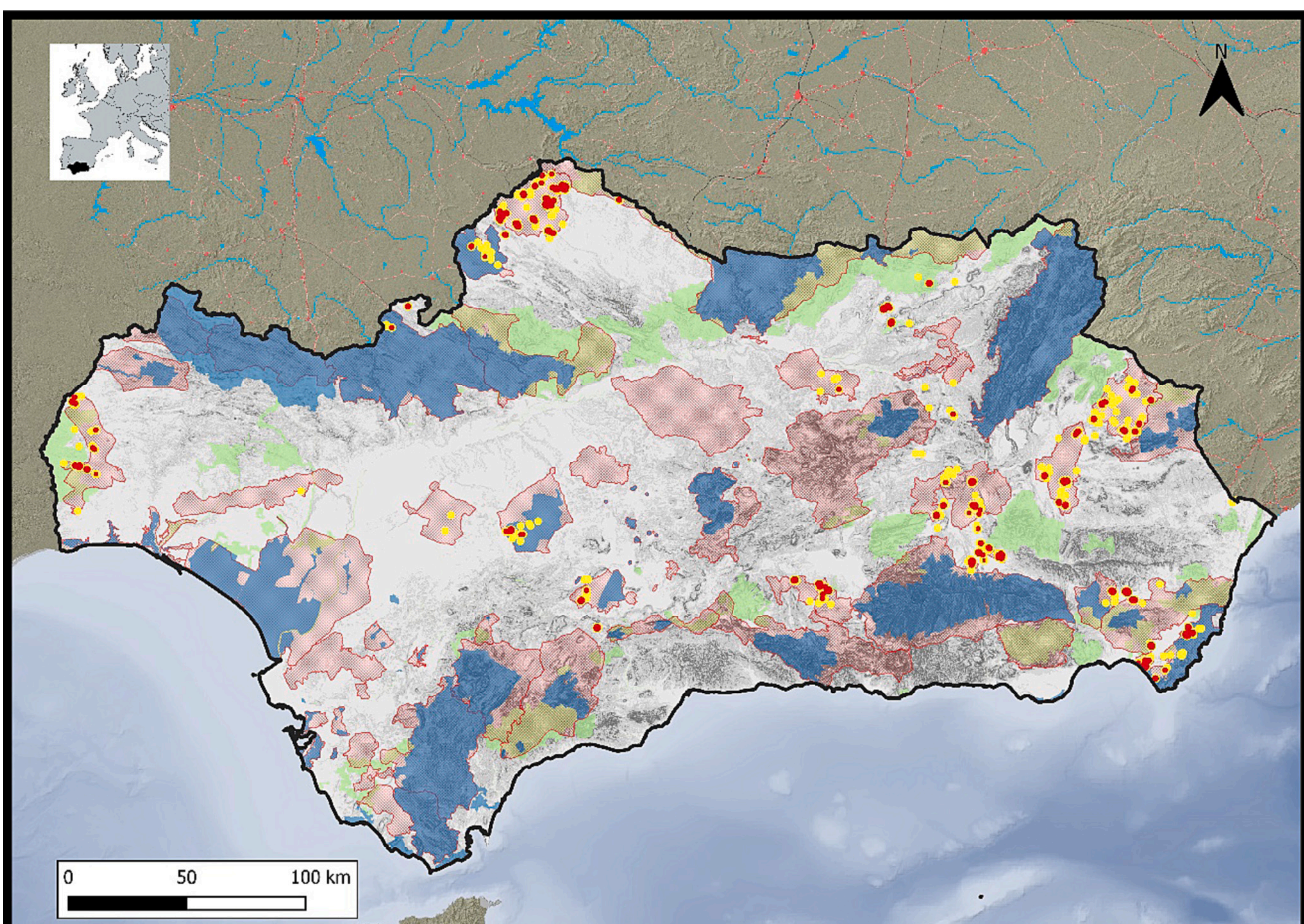


**Fig. 1.** Overlap between the home range (yellow) and the core area (red) of the Black-bellied Sandgrouse in Andalusia with the network of terrestrial SPAs (dark blue), terrestrial SACs out of SPAs (green) and IBAs (pink). Nationally designated protected areas (CDDA) outside the Natura 2000 Network are not represented as they do not host populations of the species. (For interpretation of the references to colour in this figure legend, the reader is referred to the web version of this article.)

**Table 2**
Overlap in ha (and %) of the home range and core area of the Black-bellied Sandgrouse in Andalusia with SPAs, SACs out of SPAs, all the Natura 2000 Network and IBAs (total and the ones out of protected areas). Nationally designated protected areas (CDDA) outside the Natura 2000 Network are not included as they do not host populations of the species.

| | Total (ha) | SPA (ha (%)) | SAC out of SPA (ha (%)) | Total Natura 2000 Network (ha (%)) | IBAs (ha (%)) | IBAs out of protected areas (ha (%)) |
|---|---|---|---|---|---|---|
| Home range | 69,674 | 9389 (13.5) | 2913 (4.2) | 12,302 (17.7) | 56,075 (80.5) | 45,740 (65.6) |
| Core area | 12,646 | 1594 (12.6) | 634 (5.0) | 2228 (17.6) | 10,570 (83.6) | 8976 (71.0) |

### *3.2. How complete is the information that the administrations have on the sandgrouse to plan the deployment of renewables and "non go-to areas"?*

A comparison of the official information on the distribution of the species used by the regional government (home range: 2619 ha, core area: 445 ha) with the complete data set (5495 ha and 1039 ha respectively) reveals that the Administration is only aware of 41.3% of the home range and 39.1% of the core area of the species in Campo de Tabernas (Fig. 2). Similarly, comparing the official information and the updated data set reveals that the regional government only knows 17.0% of the home range and 0.0% of the core area (3170 ha and 562 ha in the latter data set respectively). Between 2010 and 2022, the 3 core zones known by the Administration have disappeared. In addition, the regional government is unaware of the 5 current core areas of the species (Fig. 3).

### *3.3. How coherent are the "non go-to areas", ICAs, and environmental zonings designed by the national and regional administrations with the current distribution of the species?*

A very large part of the species' range lies outside the areas considered environmentally valuable in the zoning plans drawn up by the Administrations (Table 3). Just ca. 46% of the home range (complete data set) is within the maximum sensitivity areas of the MITECO and only 47% of the current core area (updated data set) is within the non-compatible zone of the regional government (Table 3). Only ca. 46–56% of the core area (complete and updated data sets) is within the IBA and just ca. 55% of the current home range is within the AASBR (Table 3). A similar percentage is covered by the Updated MITECO/SEO distribution (53% of the current home range and 43.6% of the current core area). The Natura 2000 Network has a token presence in the species' range, regardless of the database considered (9% at best).

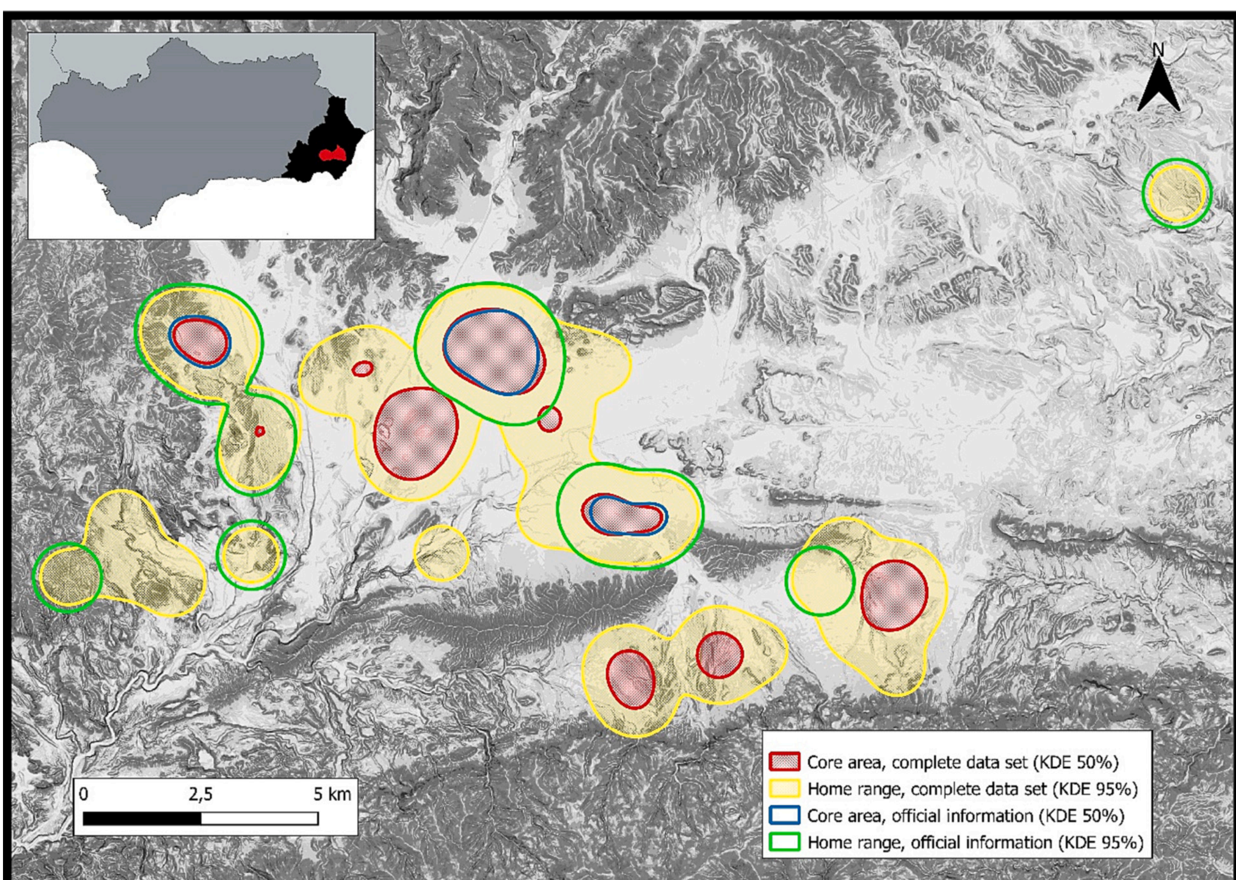


**Fig. 2.** Comparison of the home range (KDE 95%) and core area (KDE 50%) of the Black-bellied Sandgrouse estimated with official information (from the regional government) and with the complete data set (from the regional government completed with own information collected in 2021 and 2022) available for Campo de Tabernas.

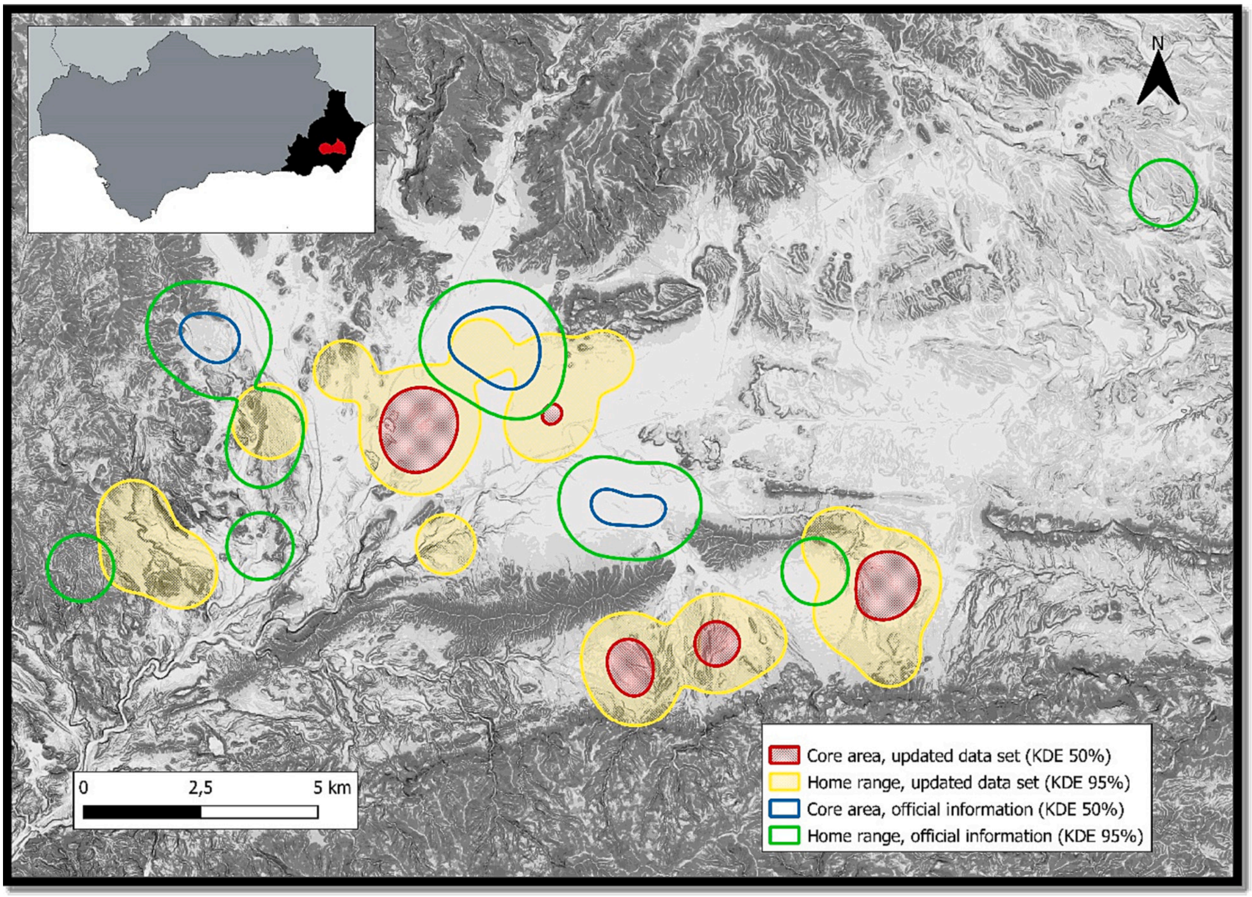


**Fig. 3.** Comparison of the home range (KDE 95%) and core area (KDE 50%) of the Black-bellied Sandgrouse estimated with official information (from the regional government) and with the updated data set (own information collected in 2022) available for Campo de Tabernas.

**Table 3**
Overlap in ha (and %) of the home range and core area of the Black-bellied Sandgrouse in Campo de Tabernas with "non go-to areas", Important Conservation Areas and environmental zonings made by national and regional Administrations. * = "non go-to areas".

| | Complete data set | | Updated data set | | Official data set | |
|---|---|---|---|---|---|---|
| | Home range (ha (%)) | Core area (ha (%)) | Home range (ha (%)) | Core area (ha (%)) | Home range (ha (%)) | Core area (ha (%)) |
| Category 1 (MITECO Zoning) | 2549.8 (46.4) | 764.5 (73.6) | 2148.3 (57.9) | 334.5 (59.5) | 2224.9 (85.0) | 404 (90.8) |
| Not Compatible (Junta de Andalucía zoning) | 3249 (59.1) | 746 (71.8) | 1634 (44.0) | 264 (47.0) | 1979 (75.6) | 445 (100.0) |
| IBAs* | 3635 (66.2) | 483 (46.5) | 2326 (62.7) | 316 (56.2) | 1905 (72.7) | 194 (43.6) |
| Natura 2000* | 400 (7.3) | 5 (0.5) | 335 (9.0) | 5 (0.9) | 141 (5.4) | 0 (0.0) |
| AASBR | 3673 (66.8) | 754 (72.6) | 2032 (54.8) | 330 (58.7) | 2065 (78.8) | 401 (90.1) |
| Updated MITECO/SEO distribution | 3183 (57.9) | 633 (60.9) | 1967 (53.0) | 245 (43.6) | 1688 (64.5) | 350 (78.7) |

### *3.4. What is the outcome and effectiveness of the environmental impact assessment procedure regarding the conservation of this species?*

A total of 1378 ha of PPs have been planned by developers within the range of the species in Campo de Tabernas, affecting 25.1% of its home range and 42.2% of its core area (complete data set, Table 4, Fig. 4). Official data also show considerable overlap: 884 ha of PPs have been planned by the developers within the distribution area of the species, affecting 33.7% of the home range and 55.7% of the core area (Table 4, Fig. 5).

Four out of the 10 first plants proposed (during 2017–2020) in Campo de Tabernas did not overlap with the distribution area of the sandgrouse. The remaining 6 plants (that did not receive expert allegations) were authorized despite their considerable overlap with the range of the species (Figs. 4–5, Table 5): 429 ha within the home range and 56 ha within the core area (complete data set), 252 ha within the home range and 35 ha within the core area (official data set).

Allegations to 6 plants had two different consequences: i) 3 plants were considered environmentally unfeasible by the Administration and, consequently, denied, ii) the developers of the other 3 plants modified their initial projects (i.e. location and design of evacuation lines). Overall, the rejection and modification of the PPs resulted in a lower impact on the species compared to the original projects (Table 5), ranging from 94% less overlap in home range to 89% less overlap in core area (complete data set), 88% in home range to 85% in core area (official data set). Only 39 ha were approved within the distribution area of the species following allegations, all of them replacing a spot of intensive and super-intensive olive groves within the range of the species.

Currently, there are PPs in the pipeline that would occupy 4.8% of the home range and 8.5% of the core area (Table 4, Fig. 5).

**Table 4**
Overlap in ha (and %) of photovoltaic plants with the home range and core area of the Black-bellied Sandgrouse estimated with two data sets (complete: from the regional government and own information collected in 2021 and 2022, official: from the regional government). Total values are not necessarily the sum of all the areas since some modified plants turned into approved with different size.

| | | Complete data set | | Official data set | |
|---|---|---|---|---|---|
| | Total (ha (%)) | Home range (ha (%)) | Core area (ha (%)) | Home range (ha (%)) | Core area (ha (%)) |
| Built PPs (n = 10) | 975 | 429 (7.8) | 56 (5.4) | 252 (9.6) | 35 (7.9) |
| Approved (not built) PPs (*n* = 15) | 1136 | 39 (0.7) | 28 (2.7) | 294 (11.2) | 62 (13.9) |
| Refused (denied and modified) PPs (n = 6) | 1316 | 646 (11.8) | 266 (25.6) | 329 (12.6) | 188 (42.2) |
| PPs in the pipeline (n = 6) | 691 | 264 (4.8) | 88 (8.5) | 48 (1.8) | 0 (0) |
| TOTAL (n = 37) | 4074 | 1378 (25.1) | 438 (42.2) | 884 (33.7) | 256.9 (55.7) |

With regard to the power lines of the PPs planned by the promoters, 29.2 km cross the home range of the sandgrouse and 7.8 km the core area. The PPs that did not receive allegations built 8676.3 m within the home range of the species and 2061.5 m within the core area (considering the complete data set plus the information of flying individuals, Table 6). The initial projects of the plants with allegations intended to build 17,719 m within the home range and 4309.1 m within the core area (complete data set). Both the rejection of some projects and the modification of others led to 91.9% reduction of the impact on the home range (1427.0 m) and 100% on the core area.

The deployment of PPs in Campo de Tabernas has provoked the disappearance of the sandgrouse in 2022 from the centre of its distribution in the study area, where it bred until 2021, just before the construction of the PPs (Fig. 6). This has meant the loss of a core area of 95.3 ha and a home range of 630.7 ha.

## 4. Discussion

As a consequence of the REPowerEU Plan, the EU and Spain have prompted new regulations to accelerate the implementation of renewables, namely: i) the exemption of certain sites from the environmental impact procedure and public participation, and ii) the acceleration of administrative deadlines in decision making. To avoid adverse effects, the new regulations propose: i) the exclusion of certain sites from the exemption, and ii) the planning of renewable energy acceleration zones, including a strategic environmental assessment. Among the tools available to carry out these zonings are the protected areas and other ICAs already recognized, but the need for wildlife sensitivity mapping is specifically indicated by amended Renewables Directive (Directive (EU) 2023/2413). In any case, plans to designate suitable areas for renewable energy projects and their subsequent strategic environmental assessment is an obligation under European Union law (Article 6 Regulation

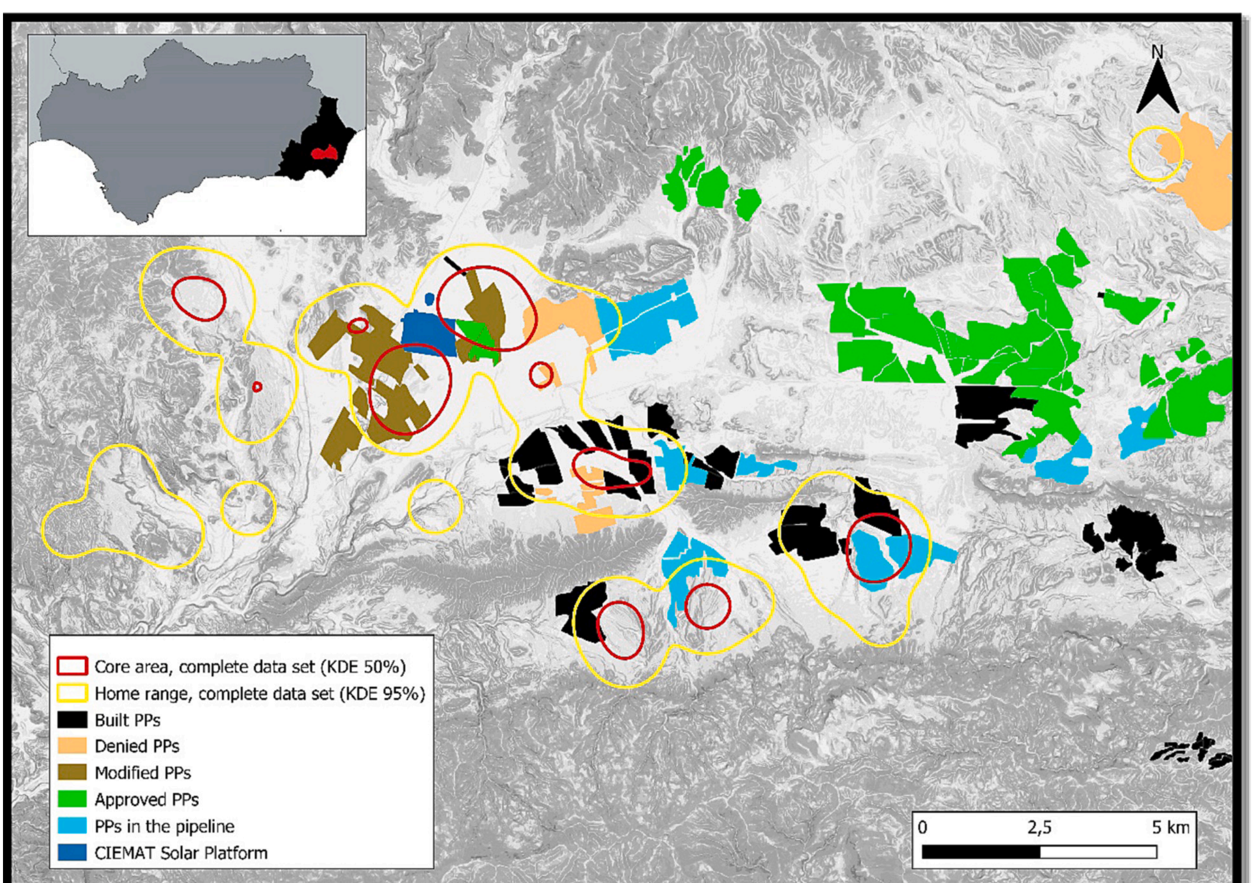


**Fig. 4.** Overlap of photovoltaic plants with the home range (KDE 95%) and core area (KDE 50%) of the Black-bellied Sandgrouse estimated with the complete data set (regional government information and own information collected in 2021 and 2022).

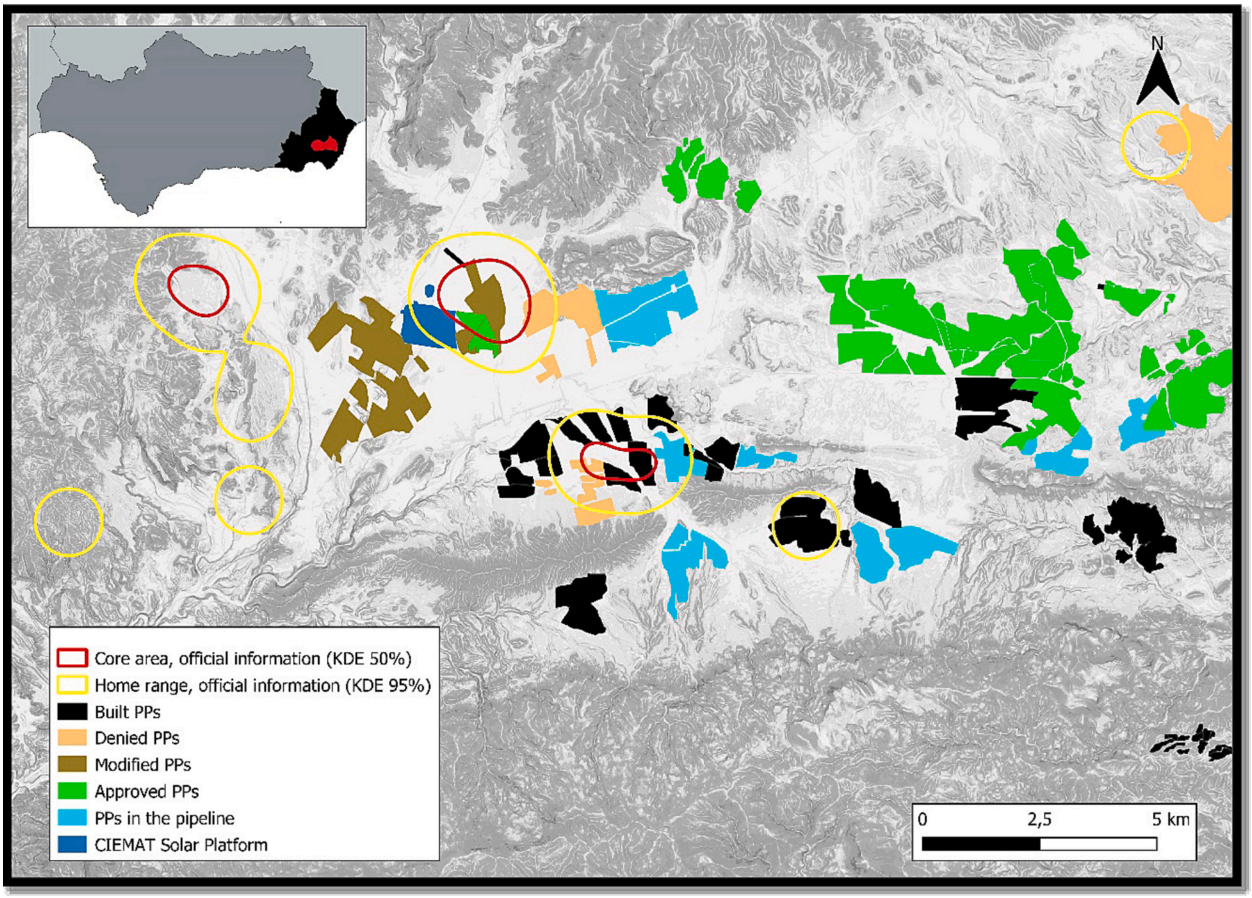


**Fig. 5.** Overlap of photovoltaic plants with the home range (KDE 95%) and core area (KDE 50%) of the Black-bellied Sandgrouse estimated with the official data set (regional government).

**Table 5**
Consequences of experts allegations with regard to the impact (i.e. overlap in ha) of PPs on the home range and core area (calculated with the complete and official data set) of the Black-bellied Sandgrouse in Campo de Tabernas.

| | Complete data set | | Official data set | |
|---|---|---|---|---|
| | Home range (ha) | Core area (ha) | Home range (ha) | Core area (ha) |
| PPs with claims (original project) (n = 6) | 646 | 266 | 329 | 188 |
| PPs with claims (modified project) (n = 6) | 39 | 28.1 | 39 | 28.1 |
| Changes after allegations (%) (n = 6) | −93.96 | −89.44 | −88.15 | −85.05 |

(EU) 2022/2577). Therefore, Spanish regulations for the acceleration of renewables (Royal Decree-Law 20/2022) would not be in line with European Union law, since the need for prior strategic environmental assessment has been removed, without explicit justification.

Information on the impact of PPs on avifauna is scarce. They have negative effects on wildlife, both sedentary and migratory species, due to the direct loss of habitat in home range areas, causing fragmentation and altering their connectivity (Turney and Fthanakis, 2011; Chock et al., 2020). These installations also cause mortality, especially of waterfowl and steppe birds (Walston et al., 2016; Kosciuch et al., 2020). Moreover, their preferential installation in flat, open areas, which are the habitat of numerous steppe birds, can cause significant habitat loss for these species (Serrano et al., 2020; Smallwood, 2022). Therefore, concern about the environmental setback of European regulations on the acceleration of renewables and their likely impact on biodiversity makes sense and it has been already stressed (Durá-Alemañ et al., 2023).

**Table 6**
Length (m) of aerial evacuation lines crossing the home range and the core area of the Black-bellied Sandgrouse (complete data set) in different categories of photovoltaic plants.

| | Authorized & already built power lines (meters) ($n$ = 11) | Denied lines after allegations (meters) ($n$ = 4) | Lines buried after allegations (meters) ($n$ = 2) | Proposed lines before allegations (meters) | Lines after allegations (meters) | Changes after allegations (%) |
|---|---|---|---|---|---|---|
| Home range | 8676.30 | 7332.00 | 10,387.00 | 17,719.0 | 1427 | −91.9 |
| Core area | 2061.50 | 2200.40 | 2108.70 | 4309.1 | 0 | −100.0 |

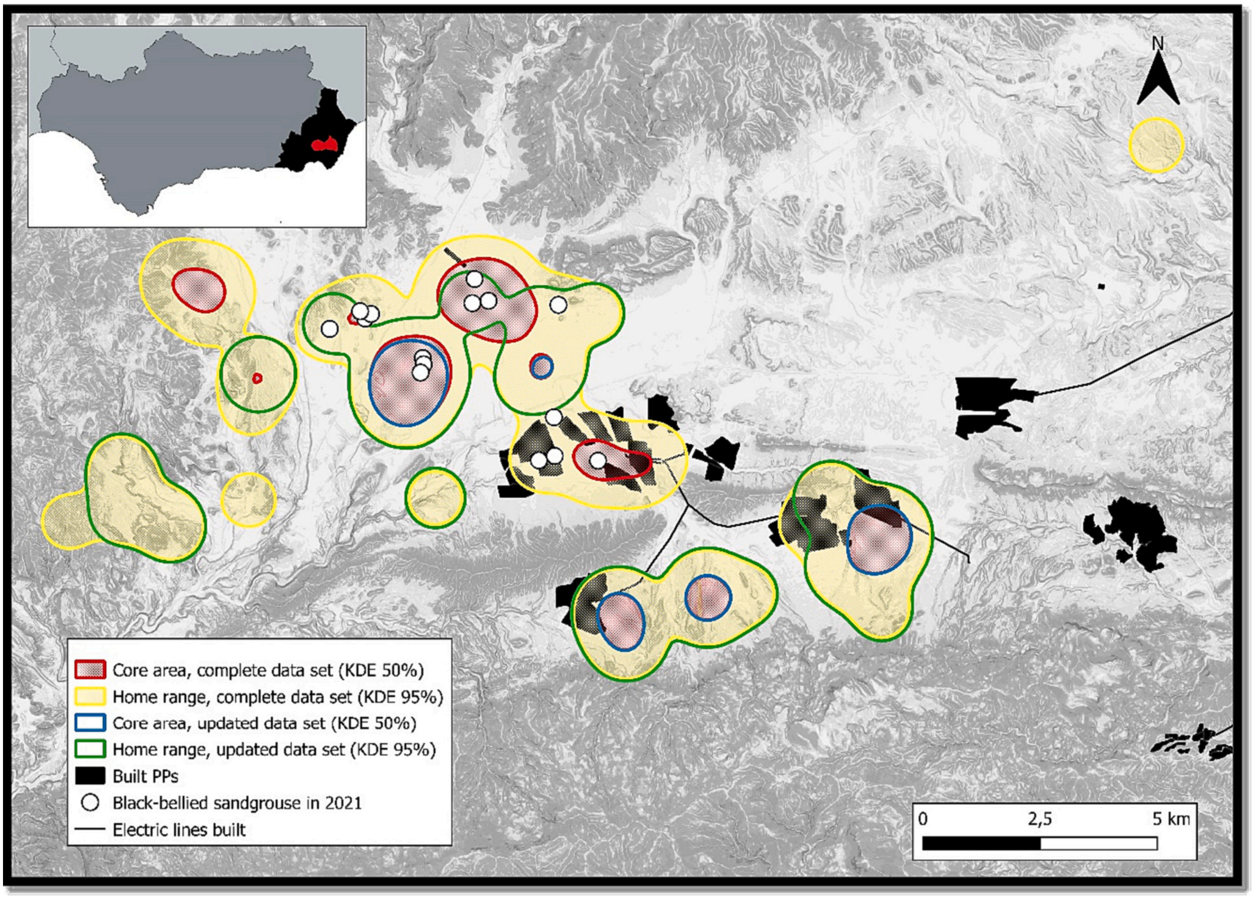


**Fig. 6.** Difference between the home range (KDE 95%) and core area (KDE 50%) calculated with the complete and the updated data set. The observations of the Black-bellied Sandgrouse in 2021 (before the construction of the PP plants and their evacuation lines) are indicated with white dots.

To analyze the negative effects of these measures on biodiversity and the validity of the tools proposed by these new regulations, we studied the distribution of the Black-bellied Sandgrouse in Andalusia. This is a particularly vulnerable species to infrastructures and human disturbance (Benítez-López et al., 2017) and PPs and power lines have been identified as main threats (Mougeot et al., 2021b). In addition, we analysed the effectiveness of the ordinary environmental impact procedure and the quality of the information the Administrations have on the distribution of the species to carry out wildlife sensitivity mapping and to plan the "non go-to areas" in Campo de Tabernas.

Our results show that zones excluded from the renewable acceleration by the already in force Spanish Royal Decree (Natura 2000 and other natural protected areas) are not enough to safeguard this species since most of its range is located outside such areas (82.3% of the official home range) in Andalusia. The "non go-to areas" cover 80.5% of the official home range in Andalusia, which could guarantee the preservation of the species (see IBAs in Table 2). However, our results in Campo de Tabernas show that information available to Administrations only cover ca. 40% of the complete home range of the species and only a minimal part of the updated home range (17%) (Figs. 2–3). In other words, the coverage of the "non go-to areas" drops in Campo de Tabernas to 62.7% when the most reliable and updated information is taken into account (see IBAs in Table 3). This means that much of the species' range lies outside the environmental sensitivity zoning of the Administrations and other ICAs (Table 3).

The shortcomings of the network of SPAs have already been indicated for other steppe bird species such as the Great Bustard, for which such network only covers 44.5% of the species home range (Palacín et al., 2023). This is a general problem already detected by the EU Biodiversity Strategy to 2030, in particular on the conservation status of species and areas of community interest (European Commission, 2021). Moreover, it has been demonstrated that the EU Biodiversity Strategy, based on the protection of SPAs, is not effective for the conservation of threatened steppe birds within these Natura 2000 sites (Palacín and Alonso, 2018) since they do not consider that many areas of high conservation for such bird species occupy agricultural areas (Serrano et al., 2020). Thus, the poor coverage and the lack of quality and up-to-date information on the distribution of threatened species means that the Spanish Royal Decree for the acceleration of renewables may leave a remarkable number of populations of several endangered species in Andalusia out of the ordinary environmental impact procedure, and that the "non go-to areas" must be improved.

By comparing different data bases (official information by the regional government and own data), this study also revealed that the ordinary environmental impact procedure is failing in the conservation of this species, because: i) developers project PPs within the range of the sandgrouse (overlap of 25.1% with the home range, and 42.2% with the core area, complete data set), and ii) the Administrations approve some of these projects (overlap of 8.5% with the home range and 8.1% with the core area, complete data set). Such flaws can be due to the lack of reliable information on the species and/or because neither the developers nor the Administrations correctly assessed the impact of PPs. In both cases, the measures to accelerate renewables (e.g. shortening of procedural deadlines and definition of "non go-to areas") will exacerbate these mistakes.

Consequently, the construction of PPs and their evacuation lines has already resulted in the loss of at least 630 ha of the species' range, where the species was recorded during the breeding season until 2021, but became extinct thereafter. To our knowledge, this is the first evidence of local extinction of a threatened steppe bird species caused by the deployment of PPs. Although we found no direct impact (i.e. occupation) on the Natura 2000 Network, indirect effects are likely to occur (De Sadeleer, 2017), as the declared Natura 2000 sites in Campo de Tabernas have this sandgrouse as a key element (even though most of its population is outside the Natura 2000 Network, as it is a highly mobile bird). If the ordinary environmental impact assessment is not being able to prevent projects from having adverse effects on Natura 2000 sites and even on priority species, it is to be expected that the planned acceleration of renewables will also produce such effects, something that the amended Renewables Directive (Directive (EU) 2023/2413) itself says it aims to avoid.

Public participation of experts improved the procedure (the impact of the projects was reduced by 94%, and the occupation of 646 ha within the home range was avoided, Table 5) since they provide updated and scientifically sound information to the Administrations to make the appropriate, scientifically based decision. In other words, without the participation of experts in the public information period, 20.3% of the home range and 33.6% of the core area (complete data set) would be occupied by PPs right now. Currently, 7.81% of the home range and 5.30% of the core area (complete data set) are occupied by 6 PPs built without expert claims (the remaining 4 PPs without expert allegations did not occupy sandgrouse home ranges). These percentages are probably an underestimation because the distribution of the species was probably wider, especially in the southern part of the study area (Campillo de Turrillas), where the sampling effort by the regional government was very low, and where 3 PPs were built before we started to census. In Campillo de Turrillas our results show that part of the home range overlaps with the constructed PPs. This is due to two reasons: i) in that area our sampling effort prior to the construction of the PPs (2021) was minimal; ii) the method used (KDE) may include areas of little value to the species if these are close to important zones (Kie et al., 2010). This is the case since this area was suitable until the recent disturbance caused by the construction of PPs (note that 3 core areas are located close to the PPs built in 2022, see Fig. 6).

The exemption from EIAs in renewable go-to areas and the presumption of overriding public interest constitute a reduction of controls for the protection of biodiversity. Thus, it implicitly leaves the door open for any such project to affect Natura 2000 sites and even priority species. This reduction of controls has not been sufficiently evaluated and its application, as in the case of Spain, may lead to a regression in the state of biodiversity protection. The above-mentioned presumption is a legal fiction, as it cannot guarantee a public interest override in all cases. The presumption is set out exhaustively in Regulation (EU) 2022/2577, although the preamble qualifies it as “rebuttable”. The Regulation was criticized by more than 477 scientists and more than 300 citizens’ groups from across Europe in an open letter calling on the European Institutions not to reduce controls for biodiversity protection (Biodiversity Without Excuses, 2022). The letter referred to a legal report of 21 November 2022 arguing that the proposal was contrary to EU law (La Calle, 2022). This criticism was echoed by Durá-Alemañ et al. (2023).

The occupation of the home range of the sandgrouse (and similar steppe bird species) by PPs leads to habitat loss and fragmentation, decreasing the connectivity of populations, and increasing the risk of unnatural mortality. Our results show how this can lead to very rapid local extinctions, which in turn can pose a risk to the viability of populations of this threatened bird species and others with similar requirements.

This study shows the ineffectiveness of the proposed EU measures to limit the impact of the accelerated deployment of renewables on an endangered species. Unfortunately, this is not an isolated case. Given that many species spend a large part of their life cycle outside ICAs (Pérez-García et al., 2022), assessing the impact of renewables on biodiversity solely in terms of ICAs will exacerbate biodiversity loss in the EU.

## 5. Policy recommendations

The deployment of large-scale renewable energy projects would have required strategic environmental plans that could have precluded environmental impacts as well as more efficient deployment of the infrastructures (Valera et al., 2022). In the absence of such plans, regulations aimed at achieving an efficient and secure ecological and energetic transition need high quality and scientifically robust knowledge as well as careful planning.

As pointed out by Palacín et al. (2023), and highlighted by the new regulation favouring renewables (Directive (EU) 2023/2413 on the promotion of the use of energy from renewable sources), there is an urgent need to identify the distribution of threatened or vulnerable species. Our results clearly show that the Administrations in Spain lack such information and probably do not have the needed resources (human and economic) to obtain it. In this context, it is difficult for Administrations: i) to assess the possible cumulative impacts of current intensive energy infrastructures development caused by the energy transition policy; ii) to carry out updated wildlife sensitivity mapping and design a reliable zoning of acceleration of renewables that do not harm biodiversity; iii) to evaluate correctly whether a project should be assessed by the express procedure or by the ordinary environmental assessment, nor can it adequately assess the impact of projects on the latter. Therefore, the Administrations need the collaboration of scientists to develop knowledge and evidence for decision-making. The EU’s Next Generation (https://next-generation-eu.europa.eu/index_en) aims to invest €806.9 billion in a healthier and greener Europe. This investment offers an excellent opportunity to obtain the biodiversity knowledge needed to minimise the impact of renewable energy development. If the shortened deadlines and limited public information were reversed, expert advice from researchers could help fill this information gap and allow time for targeted studies on the distribution of endangered species.

Member states have 2 years to design “renewable go-to areas” from the entry into force of the new Renewables Directive, which indicates that these studies could be carried out if necessary. Based on the results of these studies, wildlife sensitivity mapping should be designed and included as “non go-to areas”. Likewise, IBAs should be redesigned and a significant percentage of the species’ range should be declared SPAs. In the meantime, the current renewable acceleration regulations (Spanish Royal Decree and European Regulation) should be cancelled.

In summary, there are possibilities to harmonize the deployment of renewables and the conservation of biodiversity, but the haste of the decisions taken forces us to run in the dark without adequate knowledge, which makes it impossible for politics and decision-makers to take sound decisions. Studies like this should be encouraged as they are in line with the EU Commission’s platform Knowledge4Policy (K4P) whose main recommendation to researchers is to transfer scientific knowledge into public policy by bringing together evidence from scientists and decision-makers.

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## Data statement

Given that the study species is endangered and that part of the information belongs to a public Administration (Junta de Andalucia), we cannot share data concerning the distribution of the Black-bellied Sandgrouse (*Pterocles orientalis*). All other data used in the manuscript are included in the Supplementary material.

## Declaration of competing interest

The authors declare no conflict of interest.

## Data availability

We do not have permission to share some information. The rest of the information is available upon request

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## Appendix A. Supplementary data

Supplementary data to this article can be found online at https://doi.org/10.1016/j.eiar.2024.107432.

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