CÁTEDRA
STEPPE
FORWARD

UAM
Universidad Autónoma
de Madrid

CTFC

TotalEnergies

EXECUTIVE SUMMARY 2024

CÁTEDRA
STEPPE
FORWARD

What does the Steppe Forward Chair seek?

The Steppe Forward Chair, formed by the Autonomous University of Madrid (UAM) and the Forest Science and Technology Center of Catalonia (CTFC), with the collaboration and support of TotalEnergies, aims to generate knowledge to reconcile biodiversity conservation with the development of photovoltaic solar plants, promoting research on agro-steppe ecosystems and their interaction with such development. Based on three lines; Research, Transference, and Outreach, this Chair will enable the writing of scientific publications, the training of a network of researchers, the creation of technical documents available to private and public sectors, the organization of annual outreach events, and the dissemination of knowledge generated in national and international conferences, social media, and more traditional media outlets.

UAM
Universidad Autónoma de Madrid

CTFC

TotalEnergies

CÁTEDRA
STEPPE
FORWARD

What have we achieved in 2024?

This executive summary integrates the activities carried out by the Steppe Forward Chair during the year 2024.

UAM
Universidad Autónoma de Madrid

CTFC

TotalEnergies

CÁTEDRA
STEPPE
FORWARD

RESEARCH
2024

UAM
Universidad Autónoma
de Madrid

CTFC

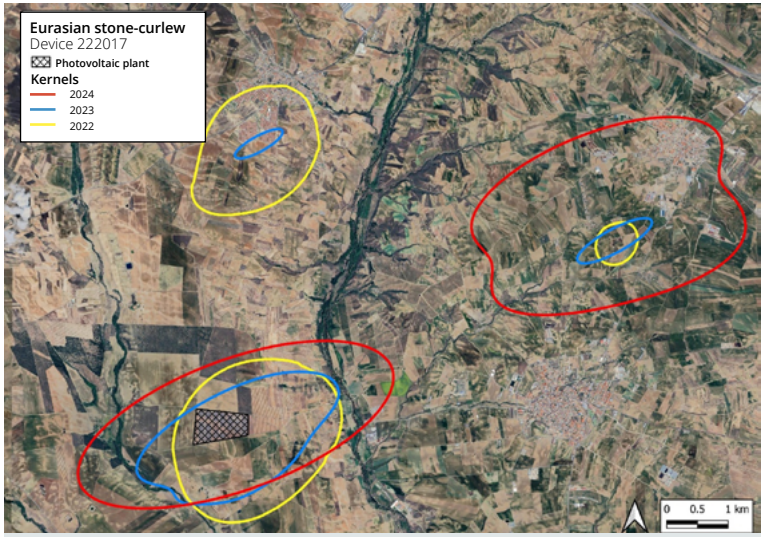
TotalEnergies

>

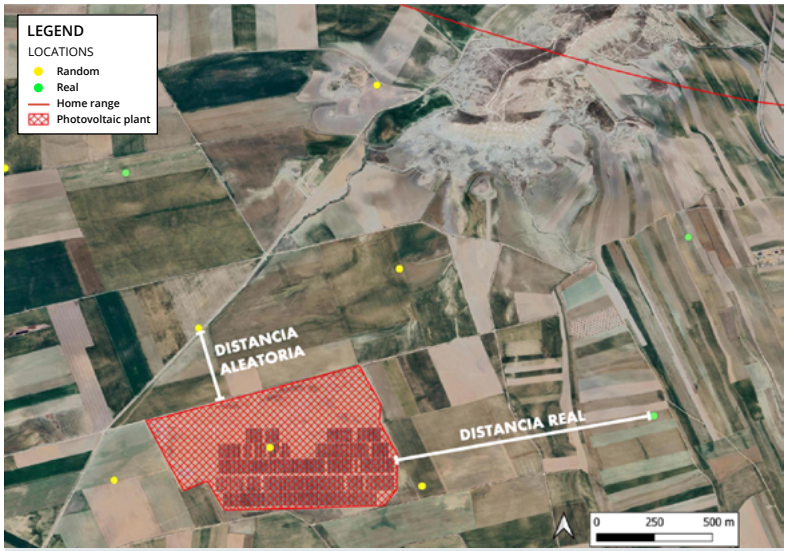
Evaluation of the response of steppe birds to the presence of photovoltaic solar plants: preliminary results

One of the most relevant potential impacts of photovoltaic plants on steppe birds is the displacement of individuals due to habitat loss, creating an avoidance effect of these infrastructures. Using the information provided by the 54 tagged individuals collected since the start of the Chair in 2022, **an analysis was conducted on the locations of the individuals in relation to already existing photovoltaic plants in the different study areas. On one hand, the maximum area used by the tagged individuals during the breeding season have been calculated**, thus obtaining valuable information about the degree of overlap between the areas used by the tagged individuals and the areas with existing photovoltaic solar plants.

On the other hand, to statistically test the degree of tolerance of these species to photovoltaic solar plants, **the distances from real locations to existing photovoltaic plants were calculated and compared with distances calculated from random locations**. This gave information on the degree of avoidance of the photovoltaic solar plants by these birds. The results, although preliminary due to the low number of individuals for some species, **constitute the first direct evidence of the avoidance, or tolerance, of steppe bird species** to the installation of photovoltaic solar plants.



Example of the estimated maximum area used for a Eurasian stone-curlew tagged in Toledo.



Example of real and random distance calculated in the analyses.

CÁTEDRA STEPPE FORWARD

>

Evaluation the 'lake effect' of the photovoltaic plants on migratory birds

In 2023, a pioneering study in Europe was launched to assess the potential attraction effect of photovoltaic panels on birds that migrate at night, called the 'lake effect'. Although some information exists on this subject for certain countries, it is primarily focused on in the United States and is insufficient to understand the magnitude of the impact in other, less-studied areas like Europe. The study is designed as a comparison of the situation before and after the installation of photovoltaic solar plants, with projects already in the operational phase (BACI design). **The issue is approached with innovative methodology, never before used for this type of study, based on recording bird vocalizations in flight as they pass over the photovoltaic plants**. In order to register the post-installation situation, sampling was repeated in autumn 2024 at the Guillena photovoltaic solar plant (Seville), a location where the installation of panels had already begun and where recordings were made in 2023 during the pre-installation phase. **12 autonomous sound recorders were placed, collecting over 1.5 TB of sound data for analysis**. The data obtained with the recorders, retrieved in December, will be analyzed shortly.

At the same time, the processing of recordings from 2023 have continued. The large volume of files obtained limits the possibilities for manual review, requiring the automation of species detection in order to later conclude the potential attraction effect of the photovoltaic panels. To achieve this, in 2024, **3,500 predictions for 5 species obtained through two automatic recognition tools for bird sounds (based on artificial intelligence)**, BirdNET Analyzer and BTO Acoustic Pipeline, **have been manually verified**. Results from this showed that both tools have low recognition capacity. However, for the species and areas where one of the tools showed better performance, **provisional**

Placement of a recorder on the perimeter fence at the Guillena photovoltaic plant.

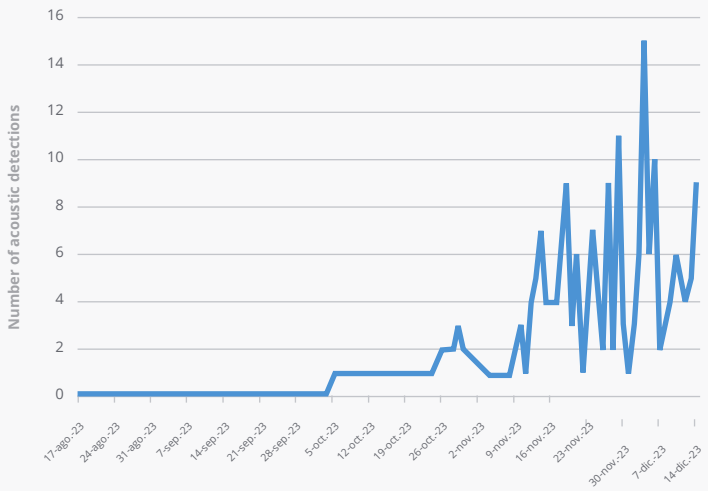
UAM Universidad Autónoma de Madrid

CTFC

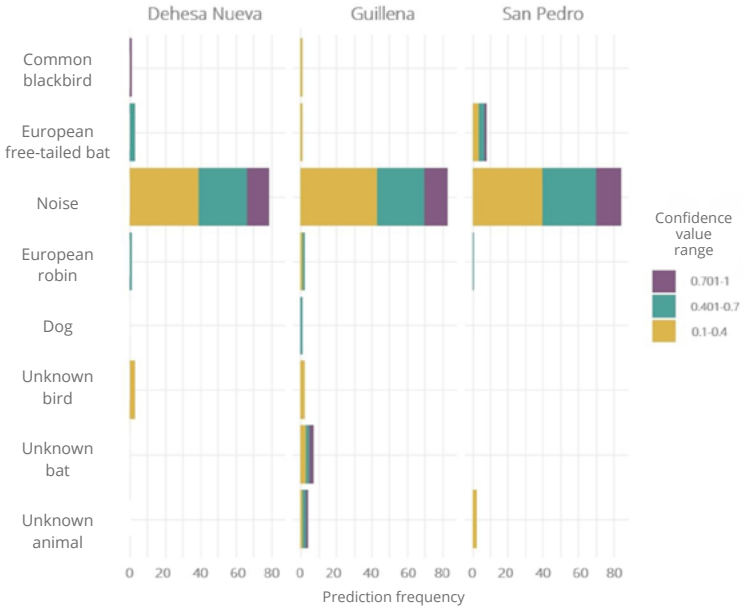
TotalEnergies

temporal and spatial detection patterns of the species in the pre-operational phase of the solar plants have been obtained as a preliminary step before analyzing the lake effect.

Additionally, **the causes of these prediction errors have been analyzed to improve the tool**, a task that will be carried out in 2025 thanks to the collaboration established with Dr. Simon Gillings of the British Trust for Ornithology, an expert in bioacoustics and creator of BTO Acoustic Pipeline.



Temporal pattern of Northern lapwing presence in Guillena based on automatic predictions with a high probability of being correct.



Causes of prediction errors for the Northern lapwing (*Vanellus vanellus*), one of the species selected for the fine-tuning of the recognizer, BTO Acoustic Pipeline tool, distinguished by location and prediction accuracy according to the tool itself.

3	/	**Study areas**
12	/	**Acoustic recorders installed in 2024**
4	/	**Monitoring months**
1,5	/	**TeraBytes of recordings obtained in 2024**
3.500	/	**Reviewed predictions for 5 species**
16	/	**Modelizations to compare automatic prediction tools**
3	/	**Species with phenological and spatial patterns obtained**

CÁTEDRA STEPPE FORWARD

>

Evaluation of the effect of photovoltaic plants on nest predation

Photovoltaic plants have the potential to provide nesting sites and reduce predation rates in birds. This is due to the presence of perimeter fences that limit the movement and access of potential terrestrial predators, as well as the solar panels, which could offer protection against aerial predators. Although scientific literature has discussed the potential benefits of solar parks for birds, there are still few studies that rigorously evaluate this relationship, with none existing in Spain.

Within the framework of the Steppe Forward Chair, **the first study in Spain was carried out in 2024 on this topic**, with a comparative Control-Impact design (inside and outside the photovoltaic plant). A total of **275 artificial nests** were installed across **5 study photovoltaic plants:** La Asomada (Murcia; owned by Total Energies), La Isla (Murcia; Total Energies), Llanos del Caudillo (Ciudad Real; Repsol), Chiprana, and Samper (Zaragoza; Galp). The artificial nests were placed inside each photovoltaic plant at different locations based on their distance from the perimeter fence and their position relative to the solar panel, as well as outside the plant. This study was carried out two times, at the beginning and end of the breeding season, and information on nest predation was gathered through camera trapping or visual nest inspections.

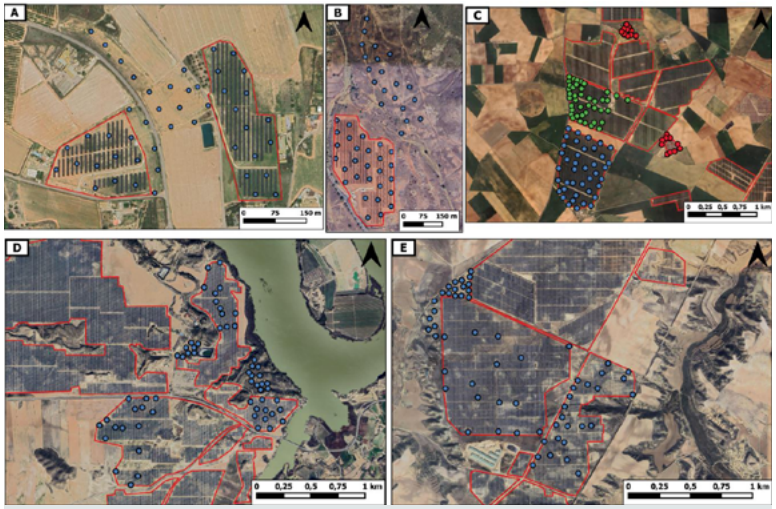
The Eurasian stone-curlew is one of the study species found nesting within the photovoltaic plants during the nest predation study. Therefore, the results of this study help to better understand the effects of photovoltaic development on the reproduction of this declining species, whose Spanish population, along with the French one, is the most important in Europe.

5	/	**Photovoltaic plants studied in 3 locations in Spain**
275	/	**Artificial nests created and reviewed**
2	/	**Breeding periods studied**

UAM Universidad Autónoma de Madrid

CTFC

TotalEnergies

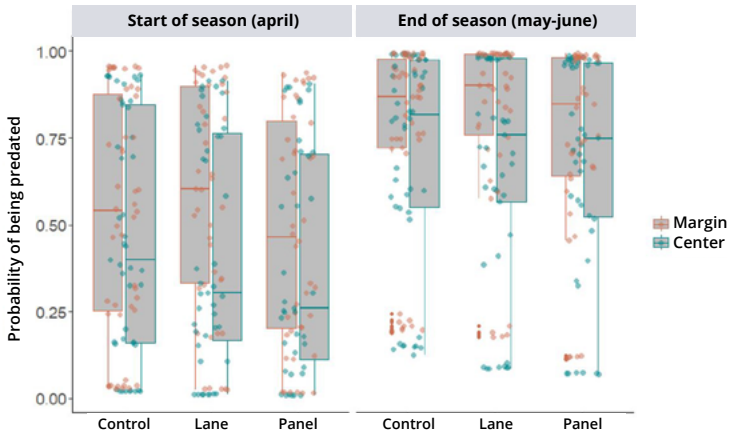


Location of the artificial nests of the study: A) La Asomada (Murcia), B) La Isla (Murcia), C) Llanos del Caudillo (Ciudad Real), D) Samper (Zaragoza), E) Chiprana (Zaragoza). For C, the locations of the nests sampled at the beginning and end of spring are indicated in blue and green respectively, as these differed.

The statistical models indicate that **nests located within photovoltaic plants have the same likelihood of being predated as those outside the plants**, meaning that photovoltaic plants neither negatively nor positively affect nest predation. No effect of the presence of photovoltaic panels on nest predation was observed either. However, nests closer to the edge of the plot, whether it was a photovoltaic plant or an area outside it, are more likely to be predated than nests located more centrally within the plot. Additionally, the type of predator varies between study locations, with birds predominating over mammals, as observed from the study.

Finally, predation was higher at the end of the breeding season (May-June).

These results, which are highly relevant for understanding the effects of photovoltaic development on the reproduction of the bird community, will be published soon in a scientific journal.



Predation probability observed at different locations and times in the study. Each point corresponds to a nest. The average predation of nests located in the center of the plot (gray boxes with blue horizontal line) is always lower than those located at the edge (gray boxes with red line), regardless of whether the nest is located outside the photovoltaic plant (Control), in the lane between photovoltaic panels, or under them. No differences were observed between control, lane, or panel, but there were differences between the beginning of the period (April), with lower predation probability, and the end of the period (May-June).

An artificial nest from the study, inside a photovoltaic plant. The eggs used are edible quail eggs, which simulate the size and color of some species' eggs that may nest inside the photovoltaic plants. Some of them have been filled with plaster to facilitate the identification of the predator through the marks it leaves.

>

Collection of existing scientific knowledge on the calculation of home range areas of steppe birds using telemetry

As part of the work of PhD student of the Chair, Laura Solé, **the process of reviewing existing scientific literature on the characterization and analysis of the home ranges of 7 steppe bird species has continued**. Understanding the area that species need to carry out their life cycles is essential for defining an appropriate study area in environmental impact studies, and thus, correctly assessing the potential impacts of photovoltaic projects. At the same time, the technology used for devices placed on birds to extract such information varies in spatial accuracy, which impacts the quality of the data obtained.

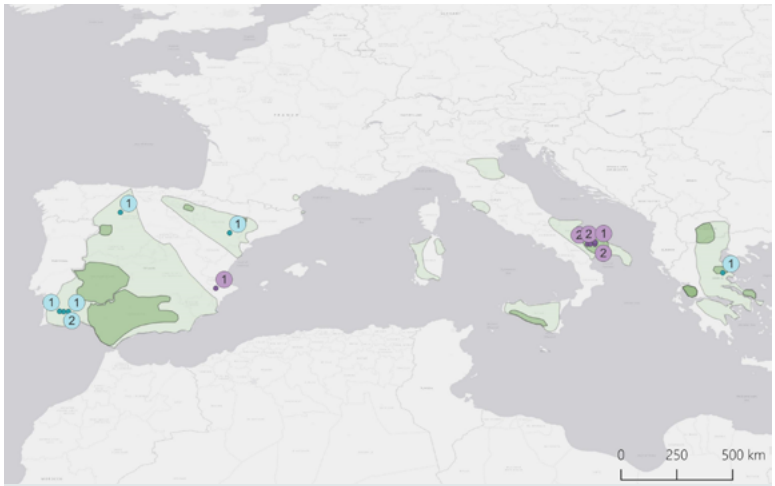
Depending on the environmental conditions of each zone or region, a species may show considerable geographical variability in the area needed for feeding and reproduction. Therefore, environmental impact assessments must be based on information generated under conditions that are as geographically and environmentally similar to the study area as possible. In this regard, in 2024, **the geographical locations of the reviewed studies on 6 steppe bird species were compared with their distribution area**. Additionally, **this literature is being evaluated to see whether it is representative of all the habitats** used by the species, and the data extracted from the literature is being standardized to **obtain average home range values for the different species**. Scientific literature for the Little bustard will be reviewed shortly.

6 Species reviewed

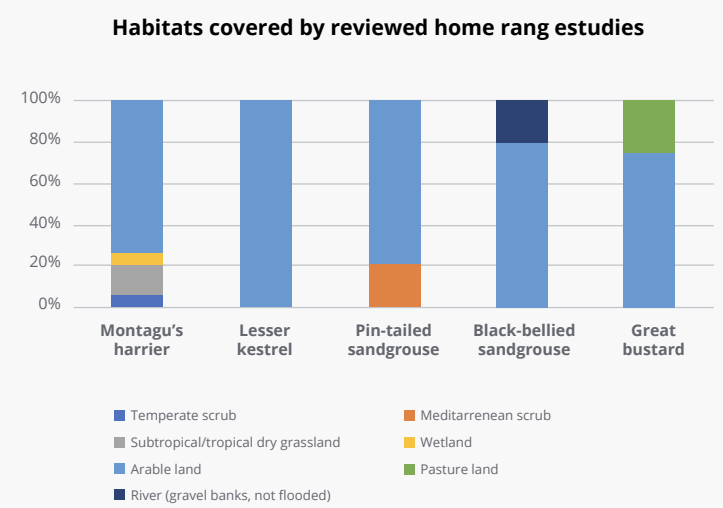
129 Articles reviewed

SPECIES	Availability of precise information on home ranges for the Iberian Peninsula	Availability of information for habitats present in the Iberian Peninsula
Montagu's harrier	Good	Average
Lesser Kestrel	Poor	Average
Pin-tailed sandgrouse	Poor	Average
Black-bellied sandgrouse	Very poor	None
Eurasian stone-curlew	None	Poor
Great Bustard	Very poor	Good
Little Bustard	To be evaluated	To be evaluated

Apart from the Montagu's Harrier, the available information on home ranges for the species in the Iberian Peninsula found by the Chair is poor. Regarding the representation of the habitats selected by these species in the Iberian Peninsula in this literature, it is generally average.



The existing studies on home ranges for the Lesser kestrel (circles, with the number of studies per location) do not fully cover the areas hosting its most important populations, especially in the Iberian Peninsula (dark green areas). Furthermore, almost all the studies conducted here use VHF tracking devices (blue circles), which show low location precision compared to GPS devices (purple circles).



The existing literature for some species does not represent some of the habitats they use in Spain, such as the case of the Eurasian stone-curlew with tree crops (almond trees and olive groves, which are absent in the chart). For the Black-bellied sandgrouse, there are no published studies, which makes it difficult to understand the spatial scale at which photovoltaic solar plants might affect the species.

CÁTEDRA STEPPE FORWARD

>

Threatened steppe birds' habitat use during the pre-operational stage of future photovoltaic solar plants

The monitoring of diversity and abundance of steppe birds has continued, as well as tagging individuals with GPS-GSM devices in Guillena (Sevilla), where photovoltaic plants are under construction. During 2024, **6 individuals from 3 threatened steppe bird species were tagged**, thus obtaining new data on the movement patterns of these species at both small and large scales during the pre-operational phase of the projects. The diversity and abundance monitoring of steppe birds has been carried out following standardized methodologies specific to the target species.

Male Montagu's harrier, one of the species tagged during 2024.

Additionally, 11 of the individuals tagged in 2022 and 8 tagged in 2023 continued to send GPS data during 2024. In total, the 54 GPS taggings conducted since 2022 have generated over **2 million locations**, making it one of the largest and most diverse pre-operational tagging projects for renewable energy projects in Spain in terms of species.

Of the 24 individuals that provided information in 2024, 14 of them remained near the study areas at some point during the year, with **spring being the period with the greatest presence of tagged individuals in these areas**.

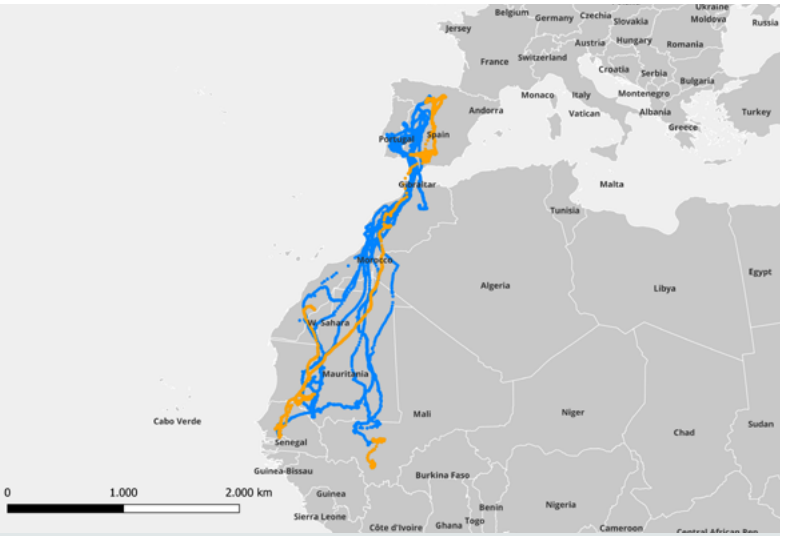
Table 1. Individuals tagged by the Chair since the start of the project (2022-2024).

Study Area	Pin-tailed sand-grouse	Black-bellied sand-grouse	Eurasian stone-curlew	Little bustard	Lesser kestrel	Montagu's harrier
ZARAGOZA	1	2	3	0	3	0
MADRID	0	0	5	1	2	0
TOLEDO	3	0	2	4	0	0
SEVILLA	0	0	0	6	12	10
TOTAL	**4**	**2**	**10**	**11**	**17**	**10**

UAM Universidad Autónoma de Madrid

CTFC

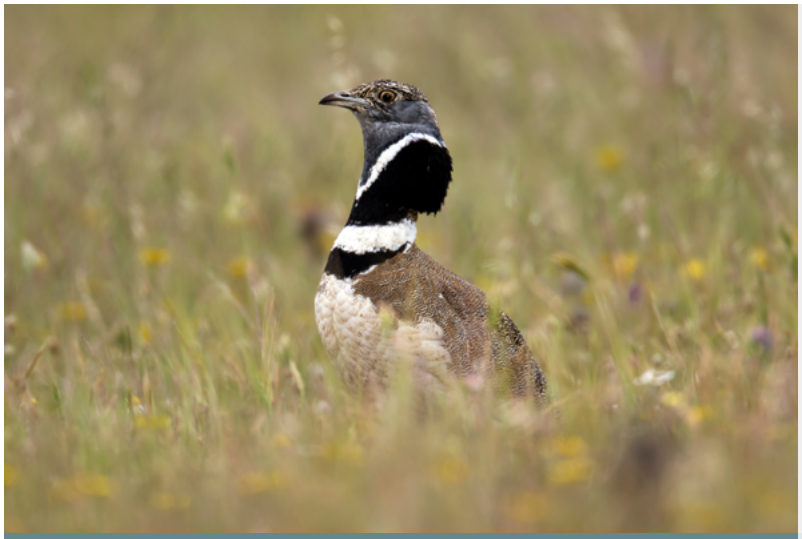
TotalEnergies

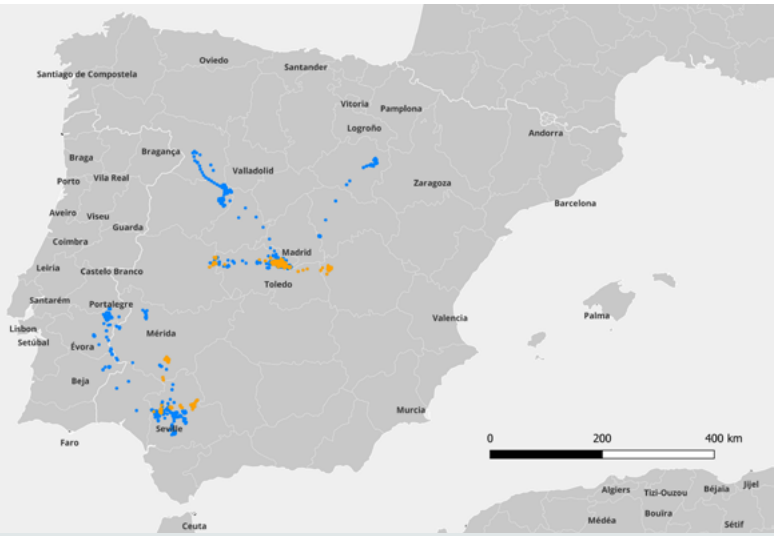


MONTAGU'S HARRIER

Movements of the Montagu's harriers tagged by the Steppe Forward Chair to date, with locations collected in 2022-2023 (blue) and 2024 (orange).

In 2024, Montagu's harrier individuals **wintered in similar areas to those recorded in previous years**, crossing the Sahara and visiting Senegal, Mauritania, and Mali during this period. They also showed wide dispersions within the Iberian Peninsula before migrating to Africa, even moving towards the northern part of the Iberian Peninsula. Of the 10 Montagu's harriers tagged since the beginning of the Chair, 1 individual continues to send data in 2025.





LITTLE BUSTARD

Movements of the Little bustard individuals tagged by the Steppe Forward Chair to date, with locations collected in 2022-2023 (blue) and 2024 (orange).

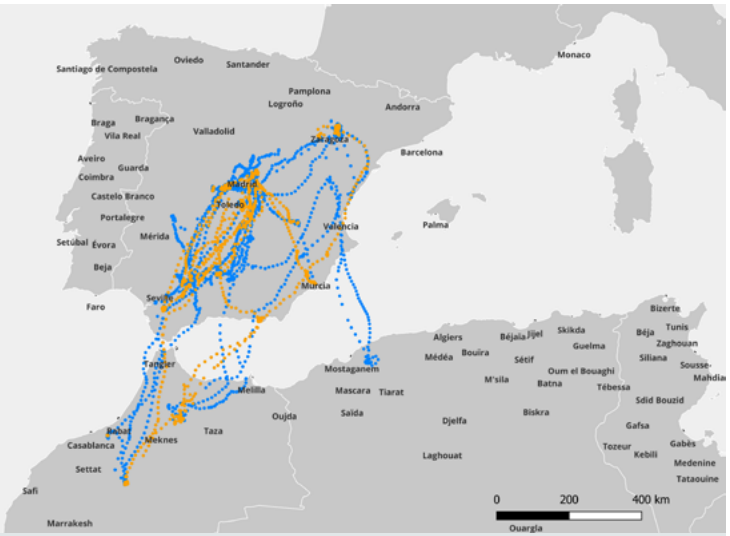
The Little bustard individuals **have shown short-range movements during 2024**, with the furthest movement being 150 km. Unlike previous years, they have not visited any regions of Portugal or areas in the northern Iberian Peninsula, like Castilla and León, as shown in 2023. 5 Little bustard individuals from the 11 individuals tagged since 2022 continue to provide data in 2025.

UAM Universidad Autónoma de Madrid

CTFC

TotalEnergies

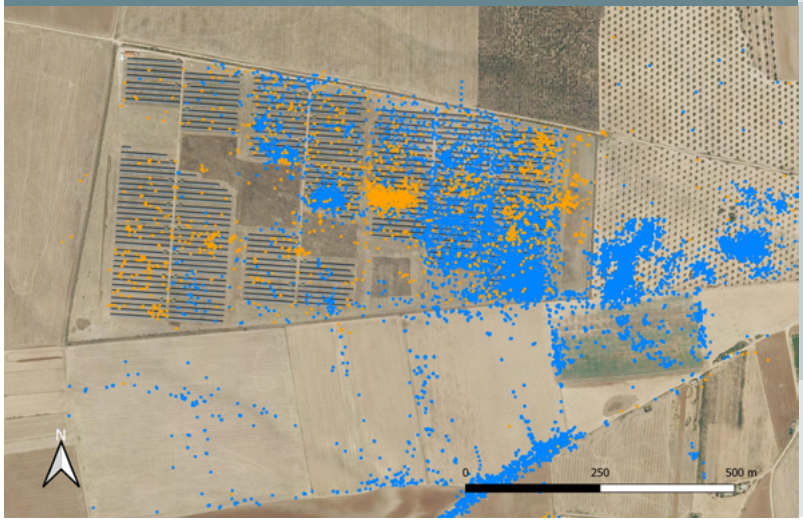
CÁTEDRA STEPPE FORWARD



Movements of the Eurasian stone-curlew individuals tagged by the Steppe Forward Chair to date, with locations collected in 2022-2023 (blue) and 2024 (orange).

EURASIAN STONE-CURLE

The Eurasian stone-curlew individuals that have provided data in 2024 **have shown wintering areas similar to or the same as those in 2023**: Northern Africa and Central and Southern Spain. Likewise, almost all individuals have attempted to breed in the same areas as in 2023, but their success could not be confirmed. **One of these individuals has attempted to breed again within the same photovoltaic plant as in 2023**. Of the 10 individuals tagged since 2022, 5 continue to correctly send data.

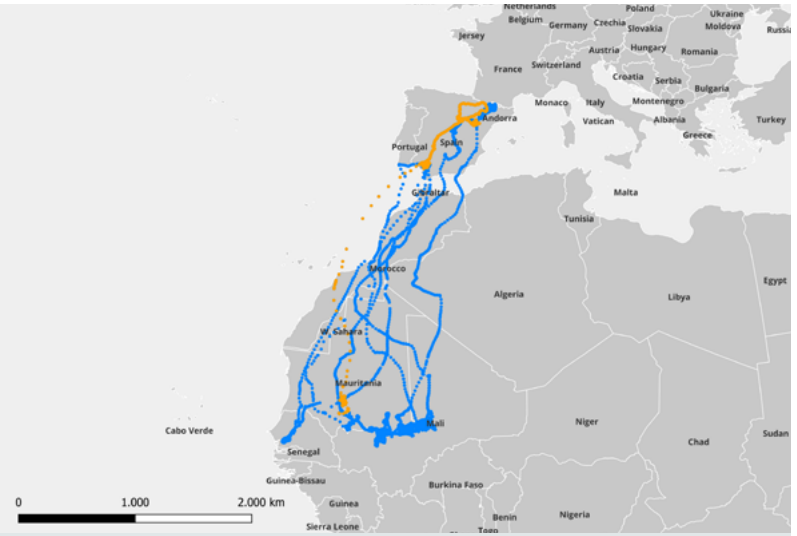


Locations of one of the Eurasian stone-curlew individuals tagged in Toledo during the breeding period of 2022-2023 (blue) and 2024 (orange), indicating possible nesting inside a photovoltaic plant.

UAM Universidad Autónoma de Madrid

CTFC

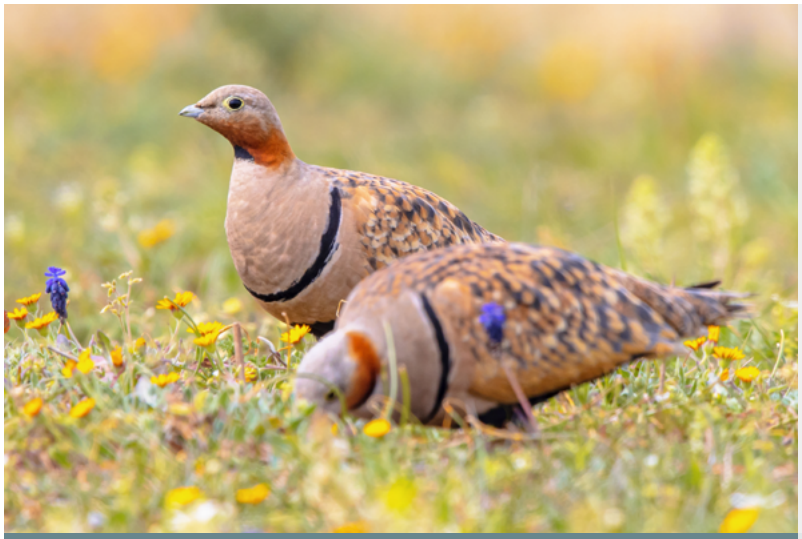
TotalEnergies



LESSER KESTREL

Movements of Lesser kestrel individuals tagged by the Steppe Forward Chair to date, with locations collected in 2022-2023 (blue) and 2024 (orange).

Regarding the Lesser kestrel, **dispersions have been observed again towards the north of the Iberian Peninsula and the Pyrenees after breeding and before visiting their wintering areas in Mauritania**, behaviours in line with those observed in previous years. Notably, one of the individuals migrated over the Atlantic Ocean, **traveling up to 250 km from the coast and covering 1500 km at night over 15 hours**, from the Western Saharan coast to Andalusia, only to return to the same breeding area as visited in 2023.



BLACK-BELLIED SANDGROUSE

Movements of the Black-bellied sandgrouse individuals tagged by the Steppe Forward Chair to date, with locations collected in 2022-2023 (blue) and 2024 (orange).

Of the Black-bellied sandgrouse individuals, only one individual sent data in 2024, while the other is in an unknown situation due to a lack of signal from the transmitter. **The individual has shown quite sedentary behaviour**, with no significant movements from the areas close to the tagging location, which took place in 2022. In 2024, this individual made 3 breeding attempts, all of which failed for unknown reasons.

PIN-TAILED SANDGROUSE

Movements of the Pin-tailed sandgrouse individuals tagged by the Steppe Forward Chair to date, with locations collected in 2022-2023 (blue) and 2024 (orange).

Finally, the only Pin-tailed sandgrouse individual that has provided information in 2024, also tagged in 2022, stopped sending data in March, making it impossible to know its breeding behavior and movements. **In 2025, the plan is to reinforce the information obtained from this species** by tagging more individuals.

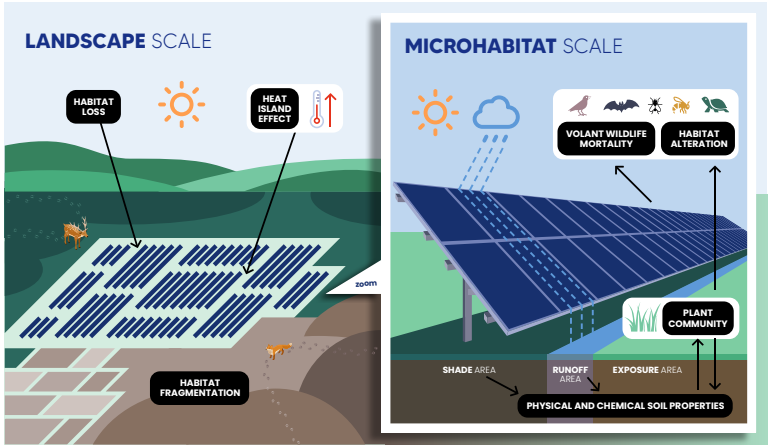
CÁTEDRA STEPPE FORWARD

> Publication of scientific articles

During 2024, **1 scientific article** was published about the current state of knowledge on the impacts of photovoltaic solar energy on biodiversity. Furthermore, another scientific paper has been published in collaboration, about the Little bustard's diet.

1 Scientific article published

1 Scientific article published in collaboration



ORIGINAL ARTICLE

Summer diet preferences of a declining steppe bird as revealed by DNA metabarcoding

REVIEW

Conservation Letters — WILEY

Solar photovoltaic energy development and biodiversity conservation: Current knowledge and research gaps

Received: 6 November 2023 | Revised: 25 April 2024 | Accepted: 10 May 2024

DOI: 10.1111/conl.13025

Conservation Letters

WILEY

REVIEW

Solar photovoltaic energy development and biodiversity conservation: Current knowledge and research gaps

Julia Gómez-Catasús[1,2] | Manuel B. Morales[1,2] | David Giralt[3] | David González del Portillo[1,2] | Robert Manzano-Rubio[3] | Laura Solé-Bujalance[3] | Francesc Sardà-Palomera[3] | Juan Traba[1,2] | Gerard Bota[3]

[1]Terrestrial Ecology Group (TEG-UAM), Department of Ecology, Autonomous University of Madrid, Madrid, Spain

[2]Centro de Investigación en Biodiversidad y Cambio Global (CIBC-UAM), Autonomous University of Madrid, Madrid, Spain

[3]Conservation Biology Group, Landscape Dynamics and Biodiversity Program, Forest Science and Technology Center of Catalonia (CTFC), Solsona, Spain

Correspondence
Julia Gómez-Catasús, Terrestrial Ecology Group (TEG-UAM), Department of Ecology, Autonomous University of Madrid, 28049 Madrid, Spain.
Email: julia.gomez@uam.es

Funding information
Spanish Ministry of Universities and Universidad Autónoma de Madrid - Margarita Salas postdoctoral fellowship, Grant/Award Number: CA4/RSUE/2022-00205; Steppe-Forward chair (UAM-CTFC-TotalEnergies)

Abstract

Solar photovoltaic (PV) has become the second renewable energy source, giving rise to potential conflicts with biodiversity conservation. However, the information available about the impacts and mitigation measures of solar PV energy is scarce and scattered, and a rigorous and comprehensive review on the topic is lacking. Here, we review the state of knowledge on its impacts and mitigation measures and identify main knowledge gaps. For that, we reviewed more than 2000 articles, out of which only 180 assessed the impacts of solar PV ($N = 138$) and/or propose mitigation measures (65). Even though Asia and Europe head the list of regions with the highest PV installed capacity (59% and 22%, respectively), a large portion of the existing knowledge is drawn from North American environmental contexts (48% of the studies), specifically from deserts (41%). Impacts were addressed on plants (26%), arthropods (14%), birds (10%), microorganisms (10%), reptiles (7%), mammals (4%), and bats (1%), but also on abiotic factors (e.g., humidity and temperature; 20%) and ecosystem services (3%). Most studies addressed the impact of PV on habitat alteration at landscape (33%) and microhabitat scale (20%), and on microclimate at microhabitat scale (17%), but other topics have been scarcely addressed (e.g., impact on microclimate at landscape scale or the potential of agrivoltaic systems). Lastly, 53% of the studies employed a single PV facility, and preconstruction situations were rarely reported (8%). There is a strong environmental context bias in the current understanding of PV impacts, which might not be extrapolable to other environmental situations like farmlands, where most of the solar PV capacity is being installed. Moreover, standardized and robust sampling designs are lacking to address cumulative, long-term, and long-scale impacts and produce comparable findings across contexts. Given the lack of empirical evidence and the irrepressible development of PV energy, it is advisable to apply an iterative monitoring and adaptive process

Link

Article led by **Dr. Julia Gómez Catasús**, along with other members of the Steppe Forward Chair, and published in the journal *Conservation Letters*, about the existing knowledge on photovoltaic solar energy and biodiversity conservation.

Solar photovoltaic energy development and biodiversity conservation: Current knowledgement and research gaps

Solar photovoltaic (PV) has become the second renewable energy source, giving rise to potential conflicts with biodiversity conservation. However, the information available about the impacts and mitigation measures of solar PV energy is scarce and scattered, and a rigorous and comprehensive review on the topic is lacking. Here, we review the state of knowledge on its impacts and mitigation measures and identify main knowledge gaps. For that, we reviewed more than 2000 articles, out of which only 180 assessed the impacts of solar PV (N = 138) and/or propose mitigation measures (65). Even though Asia and Europe head the list of regions with the highest PV installed capacity (59% and 22%, respectively), a large portion of the existing knowledge is drawn from North American environmental contexts (48% of the studies), specifically from deserts (41%). Impacts were addressed on plants (26%), arthropods (14%), birds (10%), microorganisms (10%), reptiles (7%), mammals (4%), and bats (1%), but also on abiotic factors (e.g., humidity and temperature; 20%) and ecosystem services (3%). Most studies addressed the impact of PV on habitat alteration at landscape (33%) and microhabitat scale (20%), and on microclimate at microhabitat scale (17%), but other topics have been scarcely addressed (e.g., impact on microclimate at landscape scale or the potential of agrivoltaic systems). Lastly, 53% of the studies employed a single PV facility, and preconstruction situations were rarely reported (8%). There is a strong environmental context bias in the current understanding of PV impacts, which might not be extrapolable to other environmental situations like farmlands, where most of the solar PV capacity is being installed. Moreover, standardized and robust sampling designs are lacking to address cumulative, long-term, and long-scale impacts and produce comparable findings across contexts. Given the lack of empirical evidence and the irrepressible development of PV energy, it is advisable to apply an iterative monitoring and adaptive process to guarantee a safe energy transition. This review may provide useful guidance on prioritizing research efforts for a smooth shift to renewable energy.

Journal of Ornithology
https://doi.org/10.1007/s10336-024-02250-4

ORIGINAL ARTICLE

Summer diet preferences of a declining steppe bird as revealed by DNA metabarcoding

David González del Portillo[1] · Xabier Cabodevilla[2,3] · Beatriz Arroyo[4] · Manuel B. Morales[1]

Received: 13 May 2024 / Revised: 15 November 2024 / Accepted: 17 December 2024

Abstract
Agricultural intensification is one of the main threats to steppe bird populations, leading to habitat degradation and the reduction of food resources. The Little Bustard (*Tetrax tetrax*), a highly endangered bird species in Europe, is particularly vulnerable to the loss of seminatural habitats containing such resources. Understanding its diet composition is crucial for the development of effective conservation strategies. Here, we describe Little Bustard diet composition and preferences during summer, which includes the chick rearing period, using DNA metabarcoding of faeces. Diet quality at this stage is critical for the adults to face reproduction costs (e.g. male display or parental investment by females) and for juveniles to ensure their survival and recruitment. Additionally, we identified arthropod taxa selected or avoided by Little Bustards by comparing the sequencing results with the estimated availability of these taxa in the study area (obtained from pitfall traps and sweep netting). Our findings suggest that arthropods are more relevant than plants in Little Bustard diet in this period and inform about the relevance of wild vs cultivated species in their diet. Among arthropods, the most commonly detected orders were Orthoptera, Coleoptera, and Lepidoptera, while the most consumed plant families were Asteraceae, Fabaceae and Brassicaceae. The analyses of arthropod preferences showed that Little Bustards select Orthoptera, Lepidoptera, Hemiptera, and Dermaptera among insects and avoid Hymenoptera and Aranea. Our results reinforce the importance of natural vegetation patches as feeding habitats, but also of cultivated habitats like rain-fed alfalfa, if managed to resemble natural grasslands, where Little Bustards can find the arthropods needed.

Keywords Agricultural management · Arthropods · Farmland birds · Foraging behaviour · Orthopterans · Steppe birds · Weeds

Communicated by M. Wink.

✉ David González del Portillo
david.gonzalezd01@estudiante.uam.es

[1] Department of Ecology and Research Center On Biodiversity and Global Change, Terrestrial Ecology Group (TEG), Autónoma University of Madrid, C/Darwin 2, 28049 Madrid, Spain

[2] Conservation Biology Group, Landscape Dynamics and Biodiversity Program, Forest Science and Technology Centre of Catalonia (CTFC), Solsona, Spain

[3] Department of Zoology and Animal Cell Biology, Faculty of Pharmacy, University of the Basque Country (UPV/ EHU), Paseo de La Universidad 7, 01006 Vitoria-Gasteiz, Alava, Spain

[4] Instituto de Investigación en Recursos Cinegéticos (IREC, CSIC-UCLM-JCCM), Ronda de Toledo 12, 13005 Ciudad Real, Spain

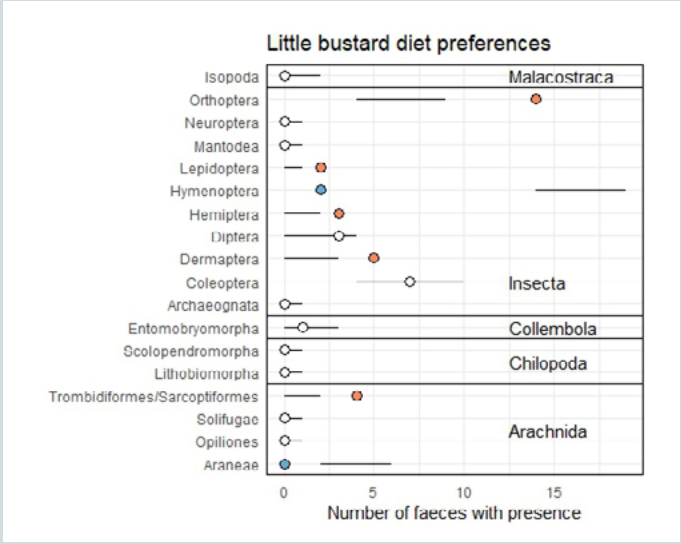
Published online: 31 December 2024

Springer

Link

Article co-led by the Autonomous University of Madrid, the University of the Basque Country, and the Research Institute in Hunting Resources (IREC, CSIC-UCLM-JCCM), and published in the Journal of Ornithology, where the Chair participated through **David González del Portillo** (technician) and **Dr. Manuel B. Morales** (coordinator) as co-authors of the article.

Summer diet preferences of a declining steppe bird as revealed by DNA *metabarcoding*



The study reveals that the arthropods most selected by the Little bustard in summer are orthoptera (grasshoppers), lepidoptera (butterflies), hemiptera (true bugs), and dermaptera (earwigs).

> Development of academic work

In parallel with the publication and collaboration on scientific articles, the Chair has coordinated **1 Master's Thesis and 3 Bachelor's Theses.** The coordination involved establishing objectives, designing a work schedule, and mentoring and guiding the 4 students during the analysis and writing process, with a final evaluation of the results obtained prior to the defense of each thesis. Additionally, the theses were based on information collected by the Chair.

The Master's Thesis, titled '***Temporal dynamics of nocturnal avian migration: a comparative acoustic analysis between two automated detection applications***', supported the comparative analyses of automatic sound detectors in the study of the potential 'lake effect' of photovoltaic plants on migratory birds.

The three Bachelor's Theses were titled "***Spatial ecology of the Little bustard (Tetrax tetrax): study of fidelity to the migratory route", "Effect of photovoltaic plants on nest predation rates", and "Effect of agricultural management on space use of the Lesser kestrel (Falco naumanni)***".

Data collected from individuals tagged with GPS transmitters by the Chair and from the camera trap systems installed for the nest predation study were used to develop this academic work. The coordination of this work promotes the generation of knowledge on steppe biodiversity and its interaction with solar photovoltaic projects, one of the Chair's primary objectives.

1 Coordinated Master's Thesis

3 Coordinated Bachelor's Theses

> Expansion of the technical and research team

In 2024, **the technical and research team of the Chair grew with the addition of 2 new members**. On one hand, Dr. Carolina Bravo joined the research team thanks to a postdoctoral research contract to enhance the scientific output of the Chair. On the other hand, Núria Pou joined the technical team as a part-time technician to support communication tasks and the technical secretariat of the international steppe bird congress to be held in Ciudad Real in 2025.

1 Postdoctoral researcher

1 Part-time technician

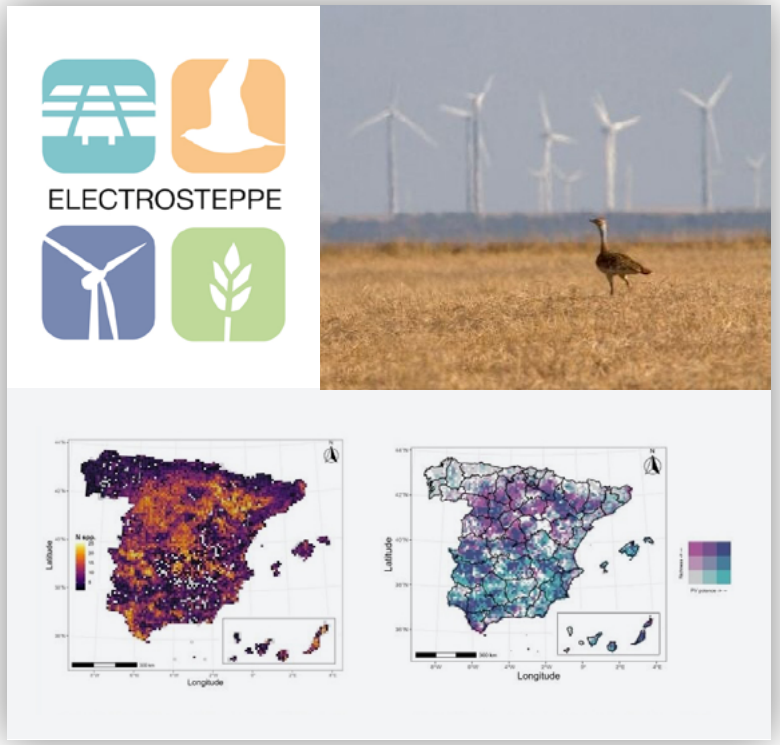
CÁTEDRA STEPPE FORWARD

> Collaboration with other projects

During 2024, **collaboration continued with the ELECTROSTEPPE project**, titled "Evidence-based solutions for an ecological transition compatible with the conservation of Iberian steppe birds." This is a competitive research project funded by the Ministry of Science and Innovation, led by the National Museum of Natural Sciences (CSIC) and the Institute of Research in Game Resources (CSIC-UCLM), where **4 researchers from the Chair actively participate in the research team**.

The general aim of the ELECTROSTEPPE Project is to provide solid scientific evidence for the development of renewable energy projects in Spain while avoiding negative impacts on steppe bird populations of high conservation interest.

In this collaboration, **in addition to contributing data from individuals marked with GPS, the Steppe Forward Chair is leading the analysis of the entire dataset** available to the project members to assess the response of tagged birds to the presence of photovoltaic plants across Spain. This is likely the largest and most comprehensive existing study on the subject.



1 Collaboration with external projects

Link

UAM Universidad Autónoma de Madrid

CTFC

TotalEnergies

CÁTEDRA
STEPPE
FORWARD

TRANSFERENCE
2024

UAM
Universidad Autónoma
de Madrid

CTFC

TotalEnergies

Celebration of the 3rd Steppe Forward Technical Conference

The **3rd Steppe Forward Technical Conference** was held in Madrid. These technical conferences were launched in 2022 with the aim of serving as an annual meeting point for various stakeholders (government agencies, the energy sector, the scientific community, environmental consultants, etc.) to share and discuss key aspects related to photovoltaic development and biodiversity conservation.

The 2024 conference was titled "Key Species in Photovoltaic Projects: Achievements and Challenges of Conservation Measures", featuring **8 presentations and 1 high-level technical and roundtable debate**. For the third consecutive year, the event had strong participation, with **275 attendees**, who rated the conference's logistics and topics very positively.

Representatives of the Steppe Forward Chair along with members of TotalEnergies, the administration, and FUAM (from left to right): Manuel B. Morales (Coordinator of the Steppe Forward Chair), Jordi Torres (General Director of TotalEnergies Spain), Fernando Magdaleno Mas (Deputy Director General of Terrestrial and Marine Biodiversity at MITERD), Iván Manzanares Recio (Director of the Innovation Support and Knowledge Transfer Center at FUAM), and Gerard Bota (Coordinator of the Steppe Forward Chair).

Roundtable debate held during the 3rd Steppe Forward Conference in Madrid.

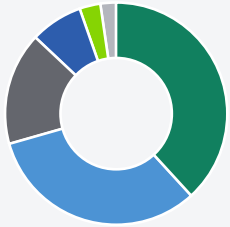
Participant profile types (%)

Speakers:

- Scientific community
- Industrial sector
- Public administration
- Environmental NGOs

Attendants:

- Environmental consultants
- Industrial sector
- Public administration
- Scientific community
- Others
- Environmental NGOs



Number of attendants by origin

CÁTEDRA STEPPE FORWARD

Publication of the 'Guide for artificial nest installation programs as a compensatory measure for solar photovoltaic projects'

The Guide for artificial nest installation programs as a compensatory measure for solar photovoltaic projects was published. This guide, developed by experts in the field—Francisco Valera, Luís Bolonio, and Radovan Václav—and coordinated by the Chair, **aims to be a reference work** for the effective implementation of artificial nest installation programs in photovoltaic solar plants, focusing on seven bird species.

The document consolidates all existing scientific literature into a single resource and takes a practical approach to outlining the necessary requirements for the proper design, installation, and monitoring of artificial nests based on the target species. Additionally, the introductory chapters summarize the legal framework surrounding compensatory measures, as well as the ecological processes to consider during the design phase. The guide is concluded by addressing common challenges associated with artificial nest installation and introducing alternative compensatory measures to support and enhance cavity-nesting bird species.

The result is a practical reference document, **illustrated with specially created photographs and drawings, and featuring technical datasheets, monitoring recommendations, and an extensive bibliography**, with over 150 referenced scientific publications. This, combined with the extensive expertise of the authors, form the foundation of this guide.

The guide was presented at the III Steppe Forward Technical Conference on November 27, 2024, and **has 370 downloads in just two months**, making it by far the most downloaded document on the website.

The guide can be downloaded here

UAM Universidad Autónoma de Madrid

CTFC

TotalEnergies

TRANSFERENCE LINE

CÁTEDRA STEPPE FORWARD

Development of the manual 'Complementary biodiversity monitoring methodologies for Environmental surveillance Programs of photovoltaic plants'

The manual 'Complementary biodiversity monitoring methodologies for Environmental surveillance Programs of photovoltaic plants' was published. The document complements existing publications on this topic and sets out reference recommendations for conducting biodiversity sampling within photovoltaic plants in the operational phase, a topic less covered by the literature. The document **covers various taxonomic groups such as birds, bats, and other mammals, vegetation, and invertebrates**. It also provides guidelines for mapping agricultural habitat at a landscape scale, inspecting nest boxes both inside and outside the photovoltaic plant, and monitoring wildlife collisions with photovoltaic panels and perimeter fencing. Finally, it includes a proposal for variables to collect during surveys, field sheets, and a work execution calendar.

The document **aims to establish standardized foundations for this type of biodiversity monitoring**, facilitating the analysis of future collected information and enabling robust conclusions about the impacts of photovoltaic projects on biodiversity.

Its publication on the Chair's website is planned for March 2025.

UAM Universidad Autónoma de Madrid

CTFC

TotalEnergies

CÁTEDRA STEPPE FORWARD

Update on the Observatory of scientific literature related to photovoltaic solar energy and biodiversity

The Observatory of scientific literature related to photovoltaic solar energy and biodiversity was updated. This tool, published in 2023, aims to provide the public and private sectors with a web repository for a quick search and consultation on existing scientific knowledge in this field.

A total of 53 scientific articles published between 2023 and 2024 in international scientific journals have been added. These new publications, related to photovoltaic solar energy and its effect on certain aspects of biodiversity, **include studies conducted in Asia, Europe, America, as well as those with a global scope**. They primarily present an empirical approach, although review articles, as well as those with political or legislative perspectives, are also included.

Birds are the most commonly studied component of biodiversity in these articles, but aspects related to plants, soil, bats, or microclimate, among others, are also covered.

With this update, the number of publications accessible through the Observatory now stands at **233 articles**, further facilitating access to information generated by the scientific community regarding the impacts and interactions between solar photovoltaic plants and biodiversity.

In fact, **the number of Observatory site views in 2024 was 46% higher than in 2023**.

Link

UAM Universidad Autónoma de Madrid

CTFC

TotalEnergies

Technical coordination of the 'International Conference on Paleartic Steppe Birds: Ecology and Conservation challenges'

During 2024, the Steppe Forward Chair supported the technical coordination of the **organization of the "International Conference on Palearctic Steppe Birds: Ecology and Conservation Challenges"** which will be held in Ciudad Real from March 25 to 29, 2025. The conference is organized by the Steppe Birds Research Group (GIAE), and the Chair is a collaborating entity for this event.

The Chair's technician, Núria Pou, from CTFC, is acting as the conference's technical secretary and serves as a liaison between the organizing committee, the scientific committee, and the professional conference organizing company that provides logistical support. **The Chair will also be present at the conference, organizing the roundtable on renewable energy**.

The scientific program of the conference includes over 80 studies on the ecology and conservation of steppe birds, and will be divided into **10 thematic sessions for oral presentations, and 2 poster sessions**. There will also be **5 invited plenaries** given by internationally renowned researchers and **2 roundtables**, one on agricultural practices and another on renewable energy.

All the conference information is available on the website:

Link

Attendance at congresses and workshops

The Chair was present at **1 scientific conference, 2 technical workshops, 2 round tables, and 1 public outreach event**.

The first comparative results on automatic acoustic detectors, within the framework of the study on the attraction effect of photovoltaic panels on migratory birds, were presented via poster at the **5th World Ecoacoustics Congress**, organized by the Autonomous University of Madrid and held in July.

The results of the analysis on the compatibility of photovoltaic solar energy with the conservation of agro-steppe biodiversity were presented at the **III Eco Ph-Day** (UAM-UCLM Doctoral Program in Ecology), held in May in Madrid.

Finally, the Chair was present at the **III CIBC-UAM Scientific Conference**, held in October in Madrid, presenting migration phenology data for the Little bustard obtained from tagged individuals.

In September, the **2nd course on Dematerialization, Degrowth, and Energy Transition** was held in Santiago de Compostela, where the Chair participated in a round table on the sustainability of renewable energy. The Chair also participated in a round table held at the **Listening to Science and Territory Workshop**, held in Seville. Lastly, the Chair took part in the **public outreach event 'Vidas y Renovables**, organized in November in Madrid, where a talk was given on the environmental impacts of wind and photovoltaic power plants.

MADRID	III Eco Ph-Day **May 30, 2024**
MADRID	5th World Ecoacoustics Congress **July 8-12, 2024**
SANTIAGO DE COMPOSTELA	2nd Course on Dematerialization, Degrowth, and Energy Transition: Key Insights from the Triple Social/Economic and Energy-Environmental Analysis **September 2-5, 2024**
MADRID	III CIBC-UAM Scientific Conference **October 10-14, 2024**
SEVILLA	Listening to Science and Territory Workshops **October 24-25, 2024**
MADRID	Public Outreach Event by UAM: "Vidas y Renovables. Una transición ¿justa?" **November 29, 2024**

CÁTEDRA
STEPPE
FORWARD

OUTREACH
2024

UAM
Universidad Autónoma
de Madrid

CTFC

TotalEnergies

CÁTEDRA STEPPE FORWARD

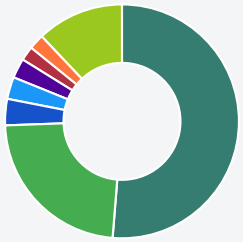
Website update

Link

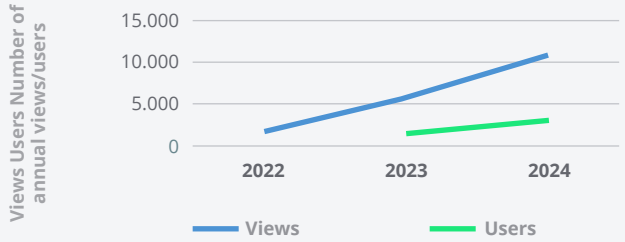
An update on the content of the website was carried out, including information and movements of the tagged individuals to date, as well as publications and scientific communications made. During 2024, **the website received 11,000 views (89% more than the previous year) from 3,200 users (128% more than the previous year)**, with 90% of the users coming from Spain, the United States, the Netherlands, France, China, Finland, and Ireland.

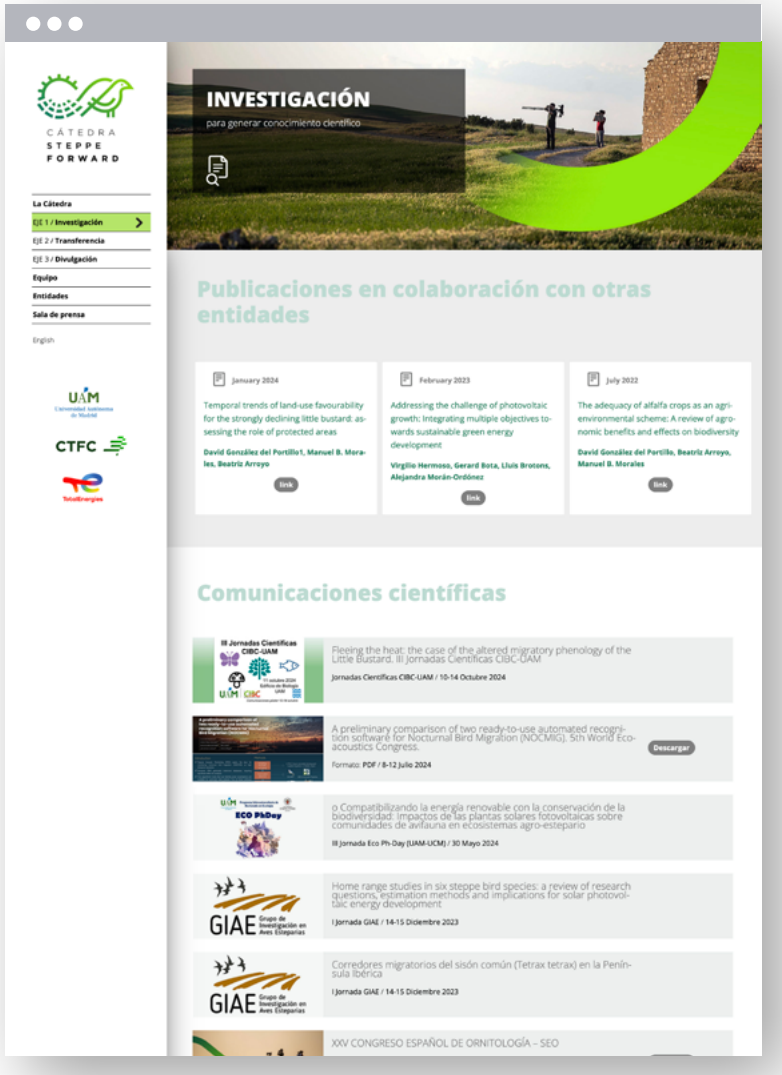
Country of origin of the users:

1.632	SPAIN
729	UNITED STATES
111	THE NETHERLANDS
96	FRANCE
90	CHINA
68	FINLAND
60	IRELAND
392	OTHER



Evolution of annual views and website users





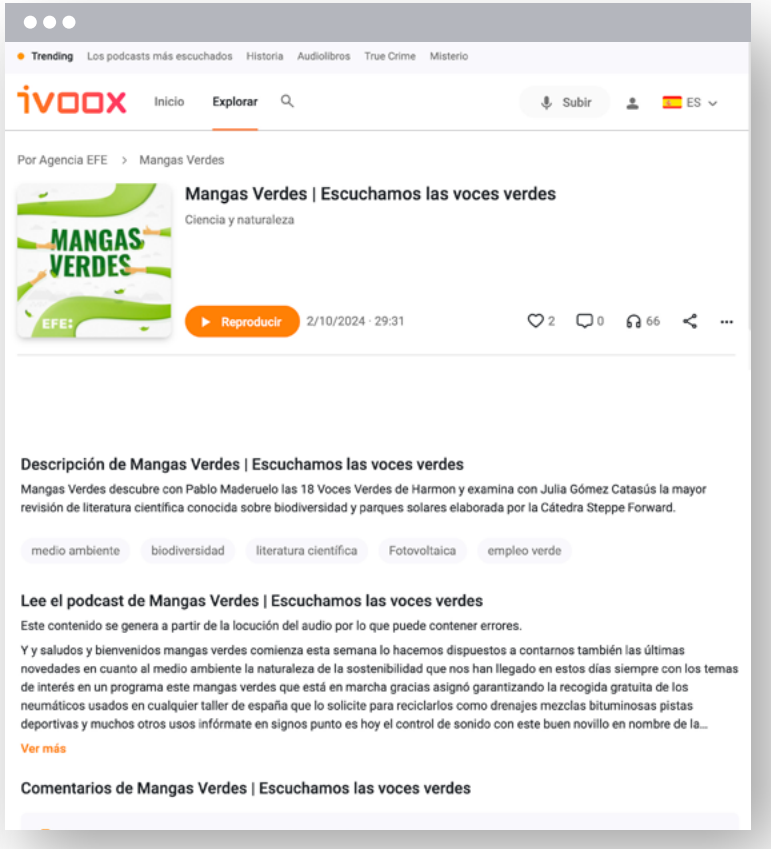
CÁTEDRA STEPPE FORWARD

Presence in the public media

The Chair participated in **2 interviews in the public media**, through **Dr. Julia Gómez Catasús**, researcher at the Chair, and **Dr. Gerard Bota Cabau**, coordinator of the Chair, on the **EFEverde Podcast Mangas Verdes** and in **El Periódico**, respectively. In these interviews, the published review article on the impacts of photovoltaic solar energy and biodiversity was presented, and discussions were held on the interactions between both elements.

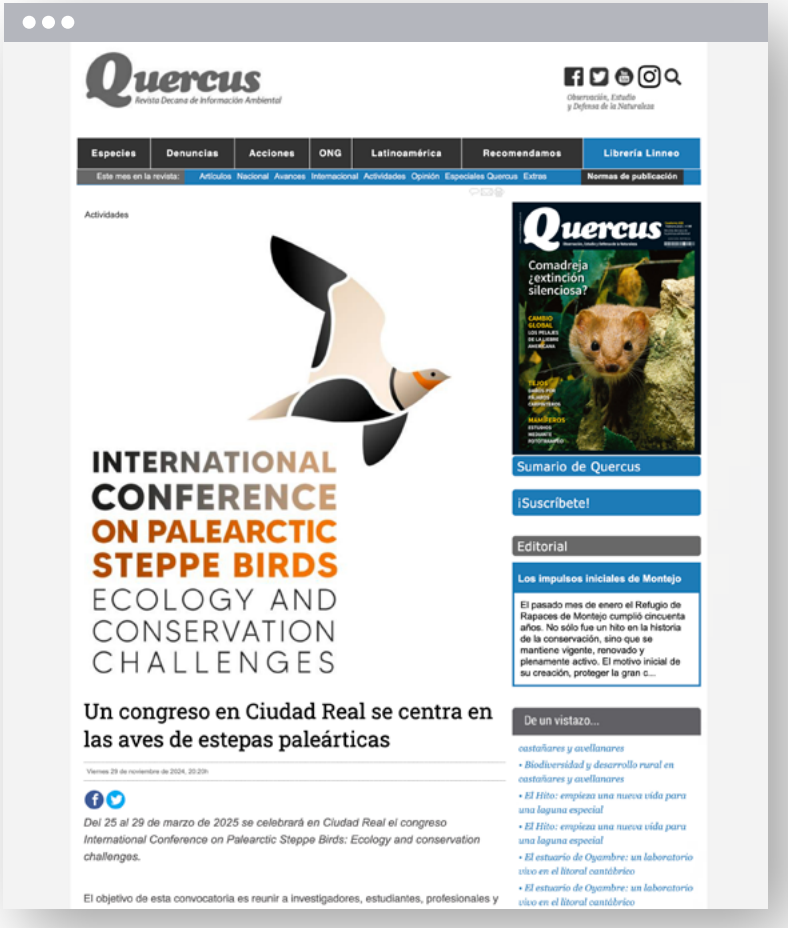
Una pareja de alcaravanes criando bajo placas fotovoltaicas. / CÁTEDRA STEPPE FORWARD

Link



Link

Also, the Chair's 3rd Technical Conference and the various studies carried out were shared in **2 renewable energy magazines and 2 news outlets**. Additionally, promoting the **International Congress of Palearctic Steppe Birds** has also increased the Chair's visibility in the media, appearing in 3 specialized magazines such as **Quercus, Aves y Naturaleza**, and the international journal **Sandgrouse**, in addition to the circulation through social media and the congress's own newsletter.



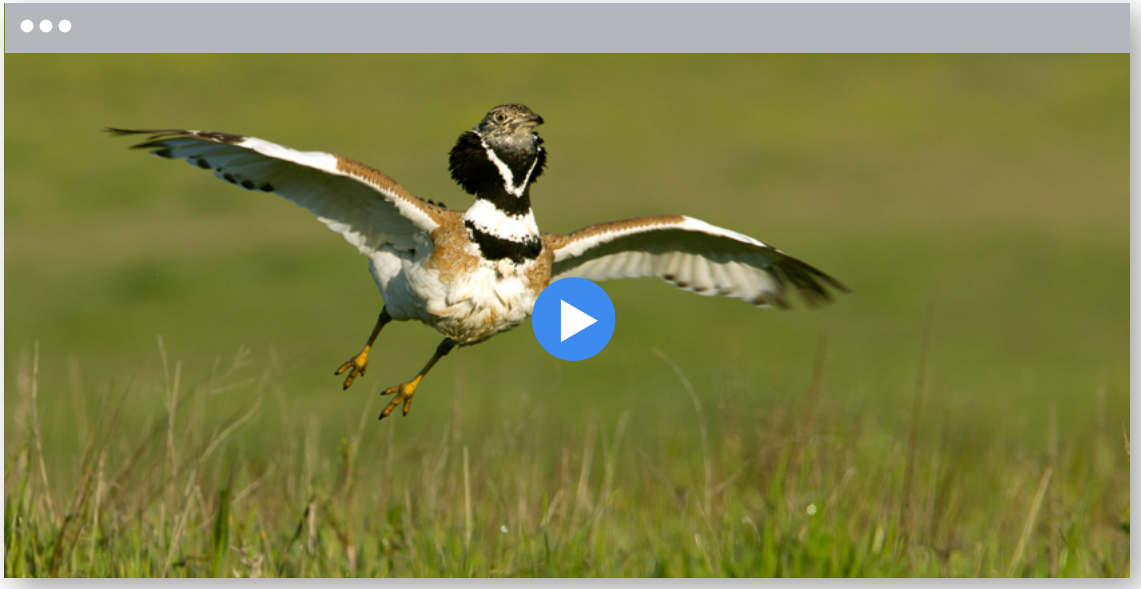
Link

Link

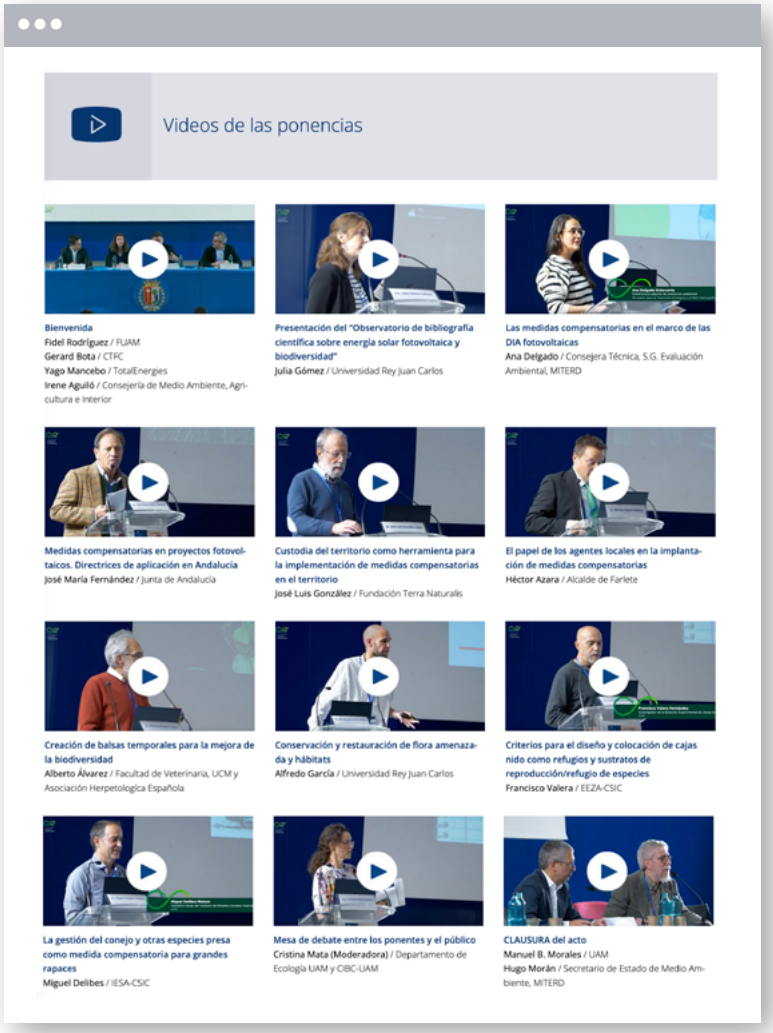
>

Generation of outreach videos

3 new outreach videos were created on three study species of the Steppe Forward Chair (Pin-tailed sandgrouse, Little bustard, and Lesser kestrel). Additionally, work has begun on two videos covering ongoing studies: one on the possible 'lake effect' of photovoltaic panels on nocturnal migratory birds, and another on nest predation rates in photovoltaic plants. These videos will be published on the website in the spring of 2025, with outreach also through social media.



Additionally, **all the presentations from the 2nd Steppe Forward Conference** have been added to the website in video format, along with statistics on participants and attendants, as well as the evaluation of the event.



Link

Publication of outreach articles

1 outreach article was published in the environmental magazine '**Quercus**'. This article summarizes, in popular terms, the results and conclusions from the work published in Conservation Letters, a review on the current knowledge of biodiversity conservation and the development of photovoltaic solar energy. The full article is available in issue 468 of the magazine, published in February 2025. A summary can be found here:

Link

CÁTEDRA

STEPPE

FORWARD

UAM
Universidad Autónoma
de Madrid

CTFC

TotalEnergies

---

www.steppeforward.eu