Solar Photovoltaic Expansion and Biodiversity Conservation: Evidence, Uncertainty, and Emerging Research Frontiers

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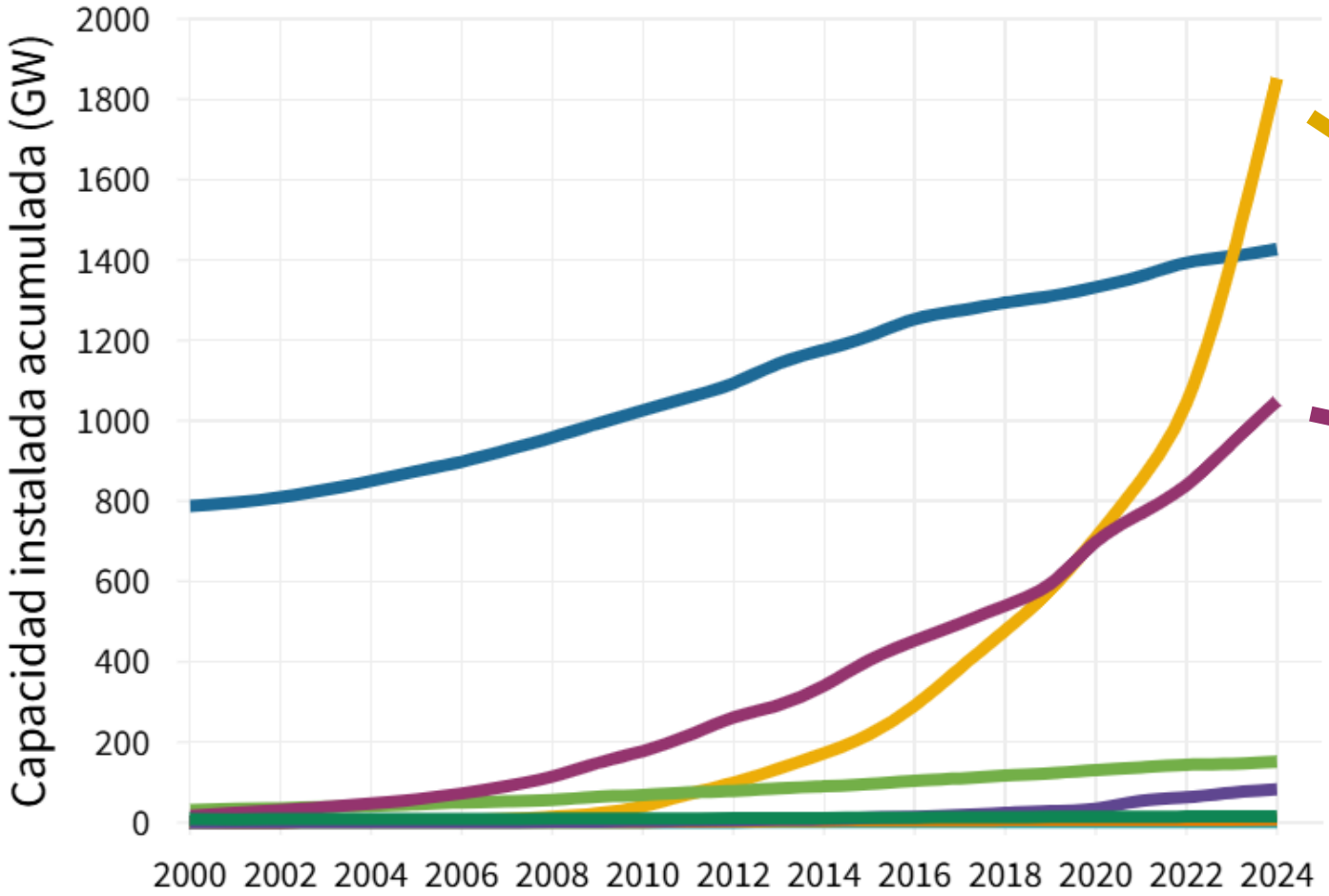
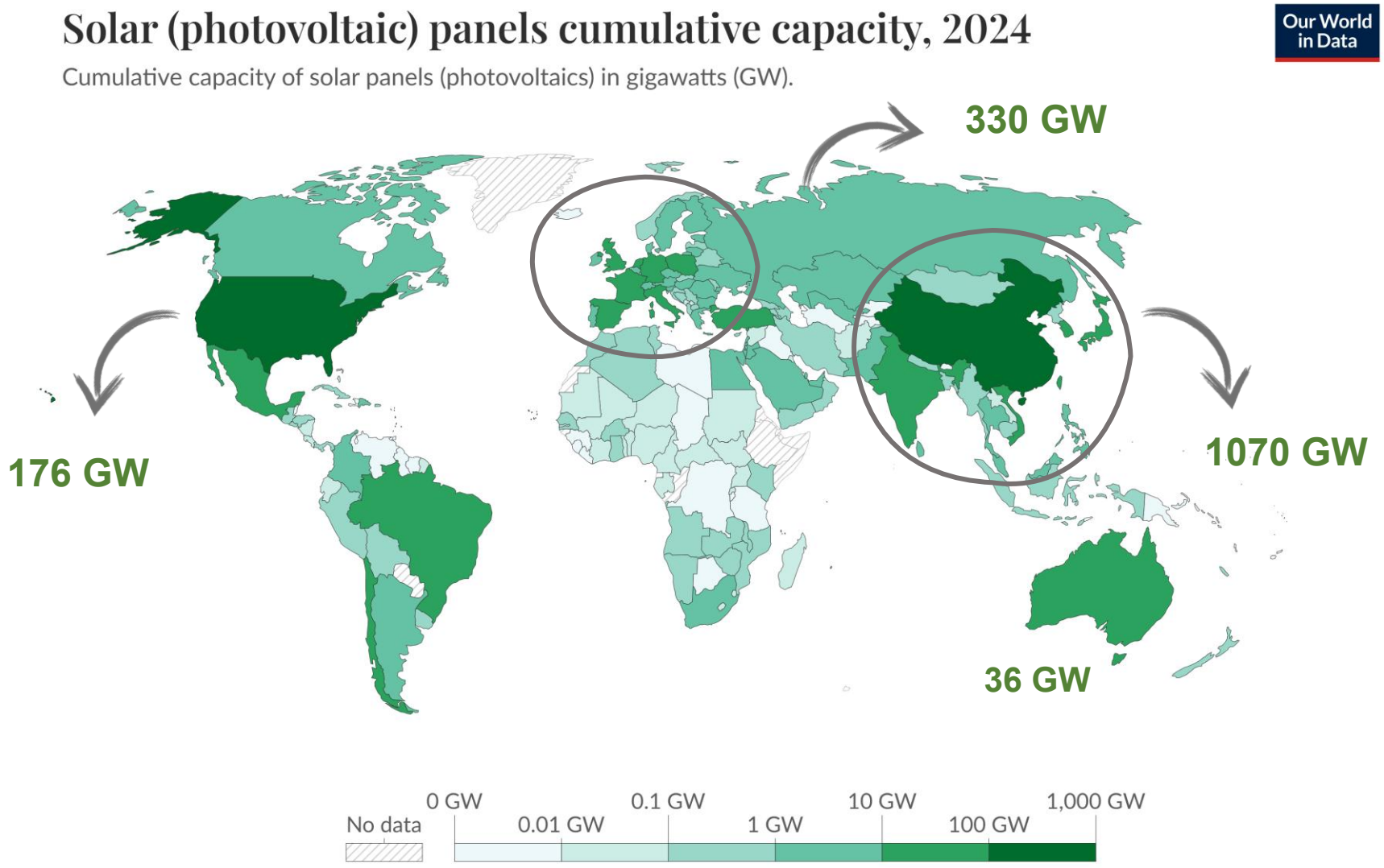
Renewable energies



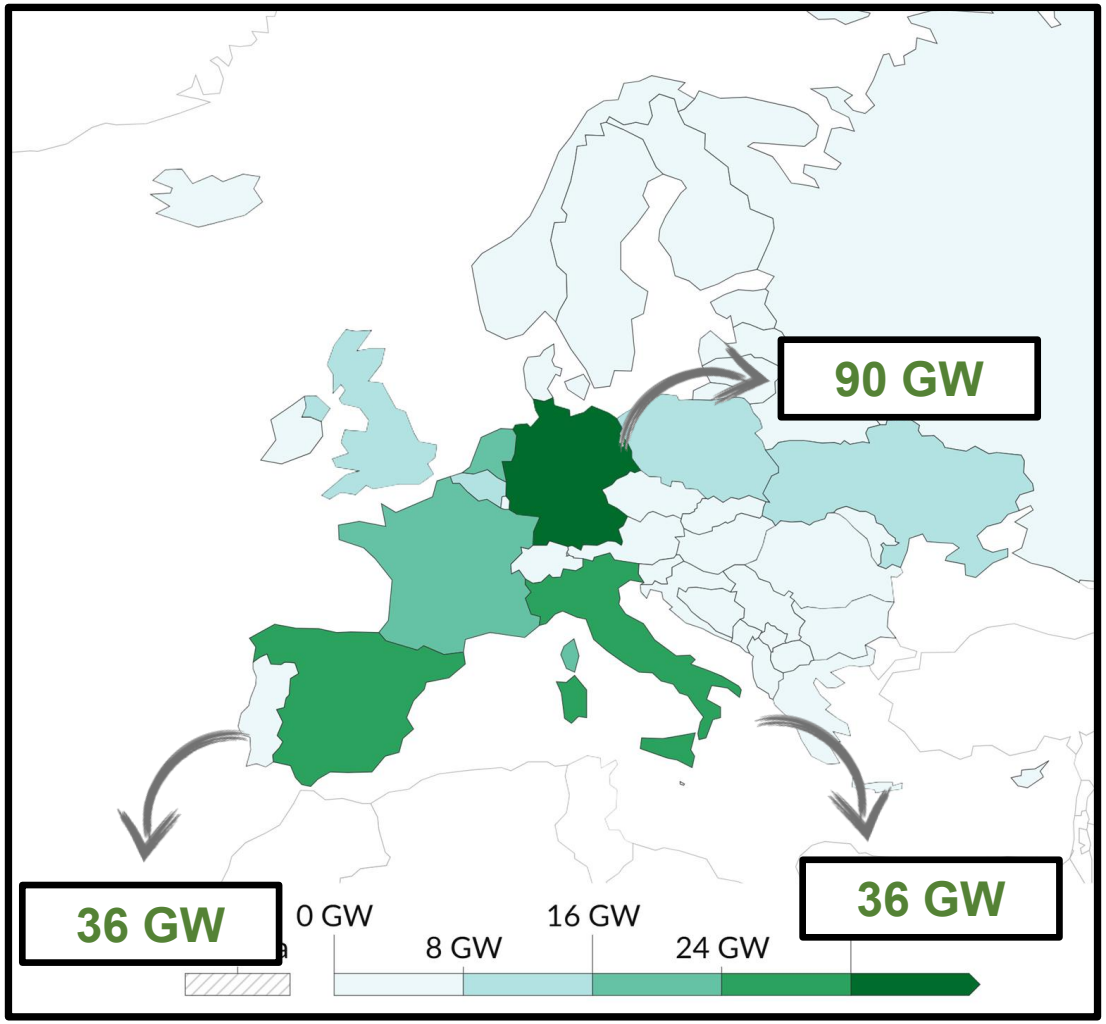
Solar Photovoltaic energy

Onshore wind energy

Solar PV energy



Solar PV energy



Steppe Forward Chair

CÁTEDRA STEPPE FORWARD

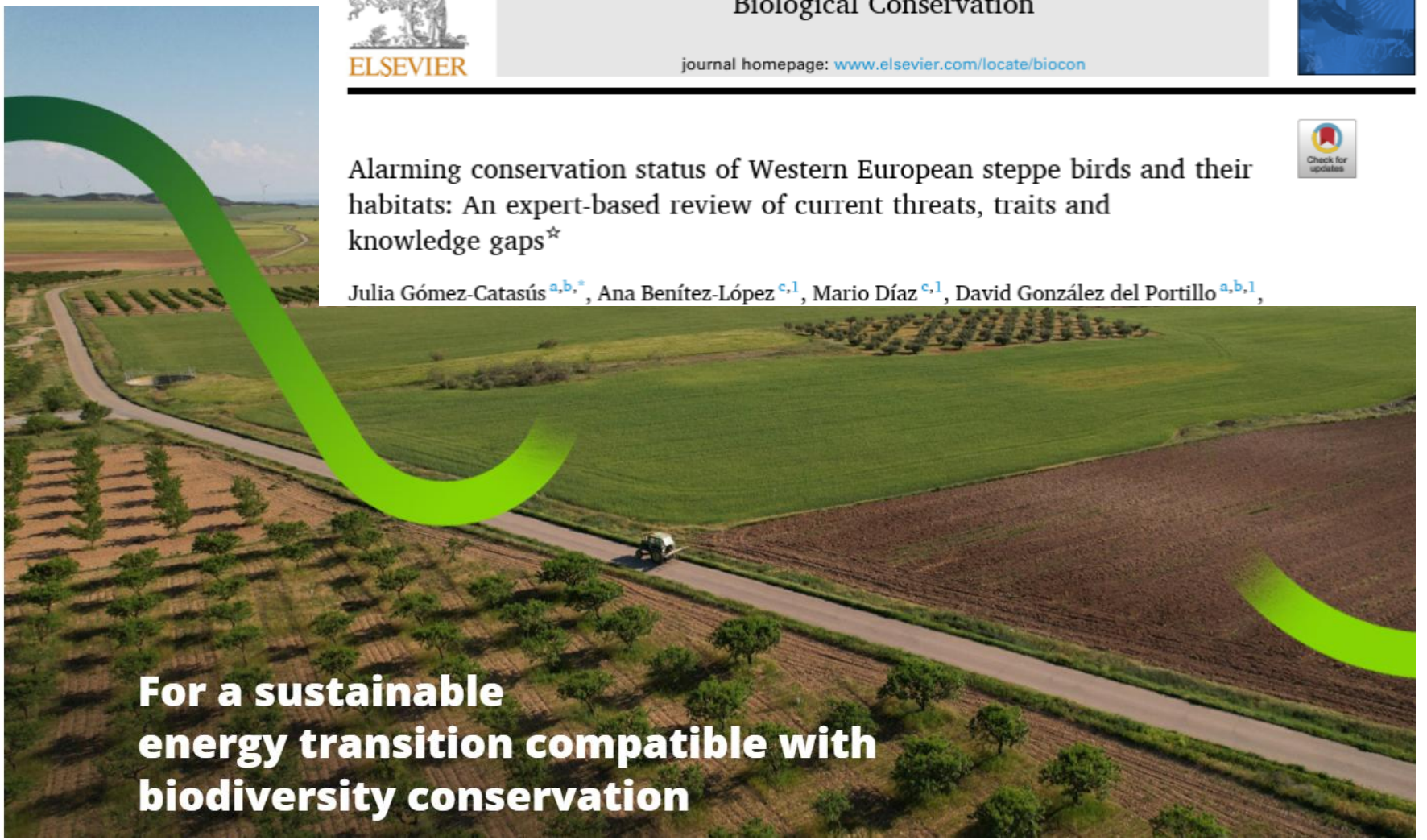
UAM Universidad Autónoma de Madrid

CTFC

TotalEnergies

- **The Chair**
- AXIS 1 **/ Research**
- AXIS 2 **/ Transference**
- AXIS 3 **/ Outreach**
- **Team**
- **Entities**
- **Press room**

Castellano



Contents lists available at ScienceDirect

Biological Conservation

journal homepage: www.elsevier.com/locate/biocon

Alarming conservation status of Western European steppe birds and their habitats: An expert-based review of current threats, traits and knowledge gaps☆

Julia Gómez-Catasús [a,b,*], Ana Benítez-López [c,1], Mario Díaz [c,1], David González del Portillo [a,b,1],

Other activities

CÁTEDRA STEPPE FORWARD

The Chair, called Steppe Forward, is based on three interrelated lines of work:

Research

to generate scientific knowledge

Transfer

of knowledge to the public and private sectors

Outreach

to transfer the results to the scientific community and society

Review of scientific knowledge on PV impacts

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

DOI: 10.1111/conl.13025

Conservation Letters
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Open Access
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]

Review of scientific knowledge on PV impacts

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

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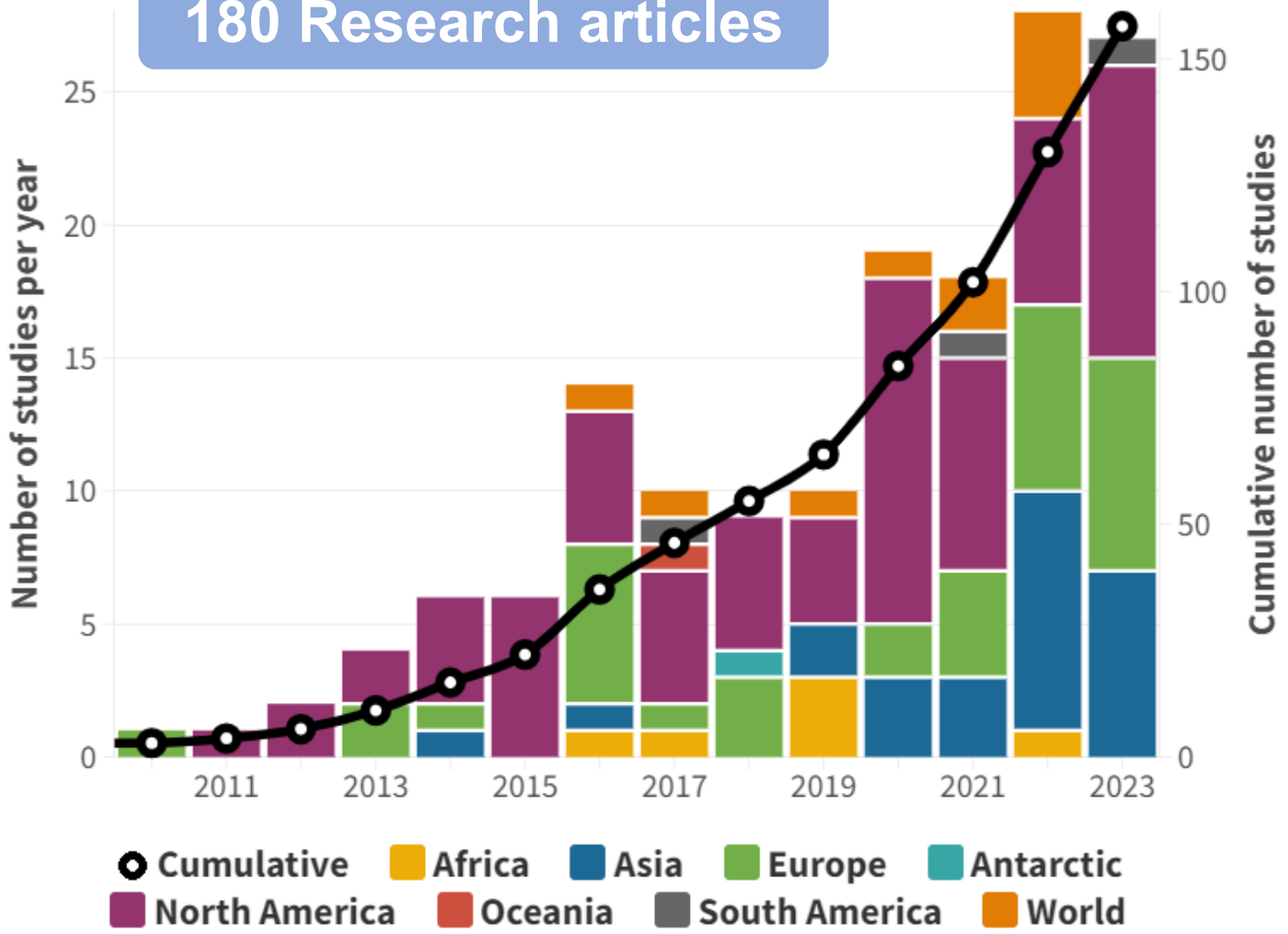
REVIEW

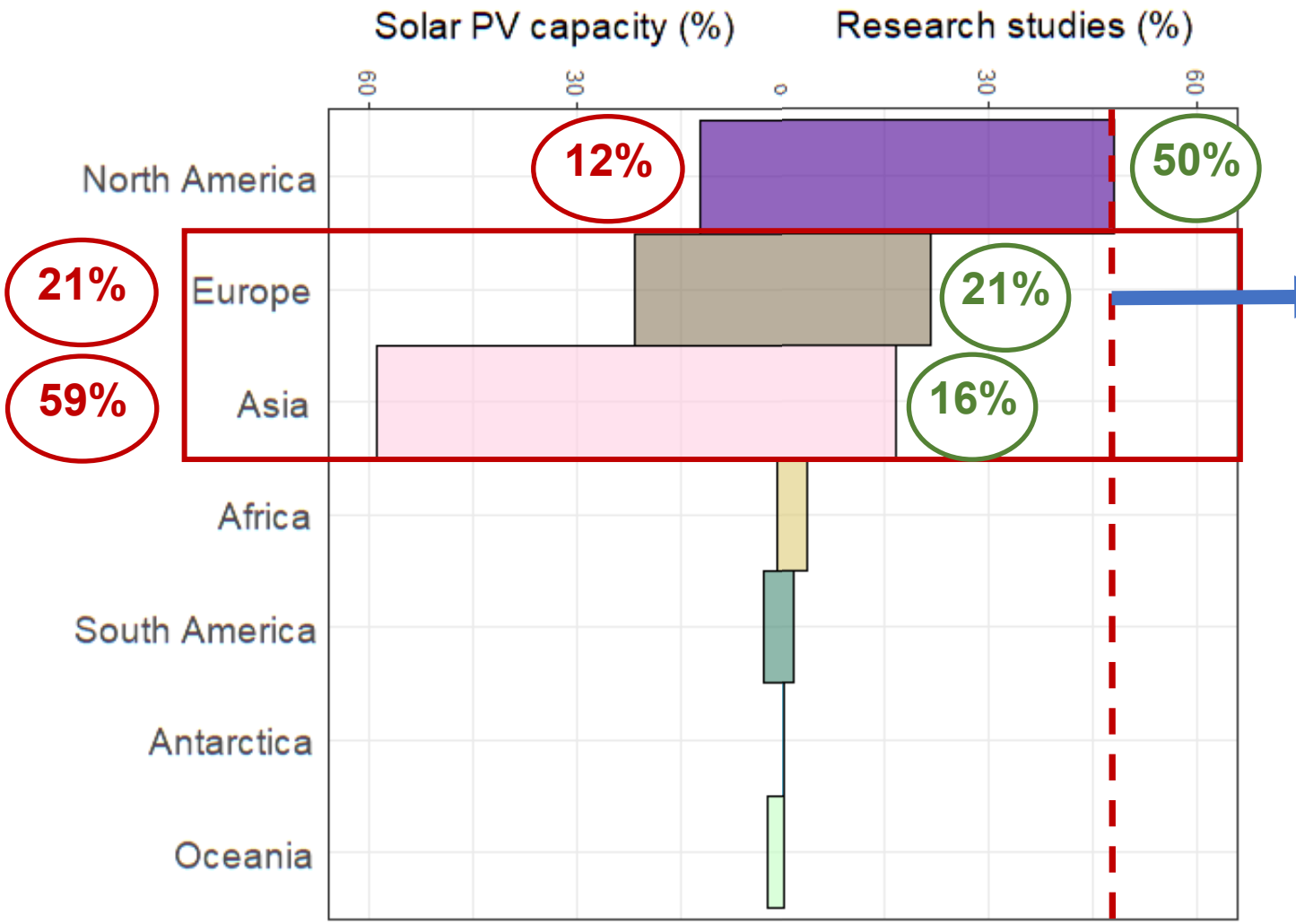
Solar photovoltaic energy devel
conservation: Current knowled

Julia Gómez-Catasús[1,2] | Manuel B. Morale
David González del Portillo[1,2] | Robert Mar
Francesc Sardà-Palomera[3] | Juan Traba[1,2]

180 Research articles



Geographical Bias in Knowledge



Study contexts and ecosystem components

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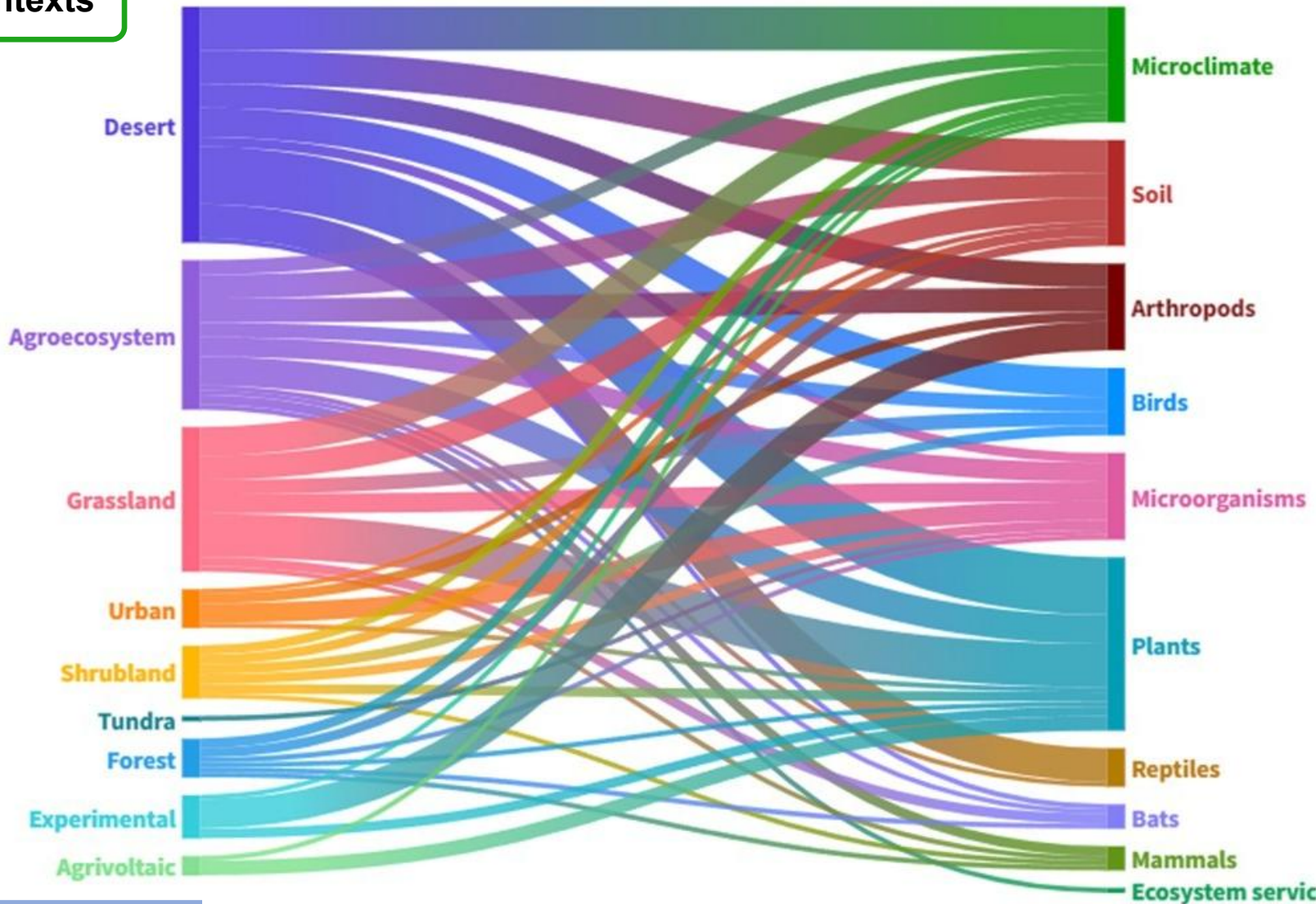
Study contexts

40%

20%

20%

<10%



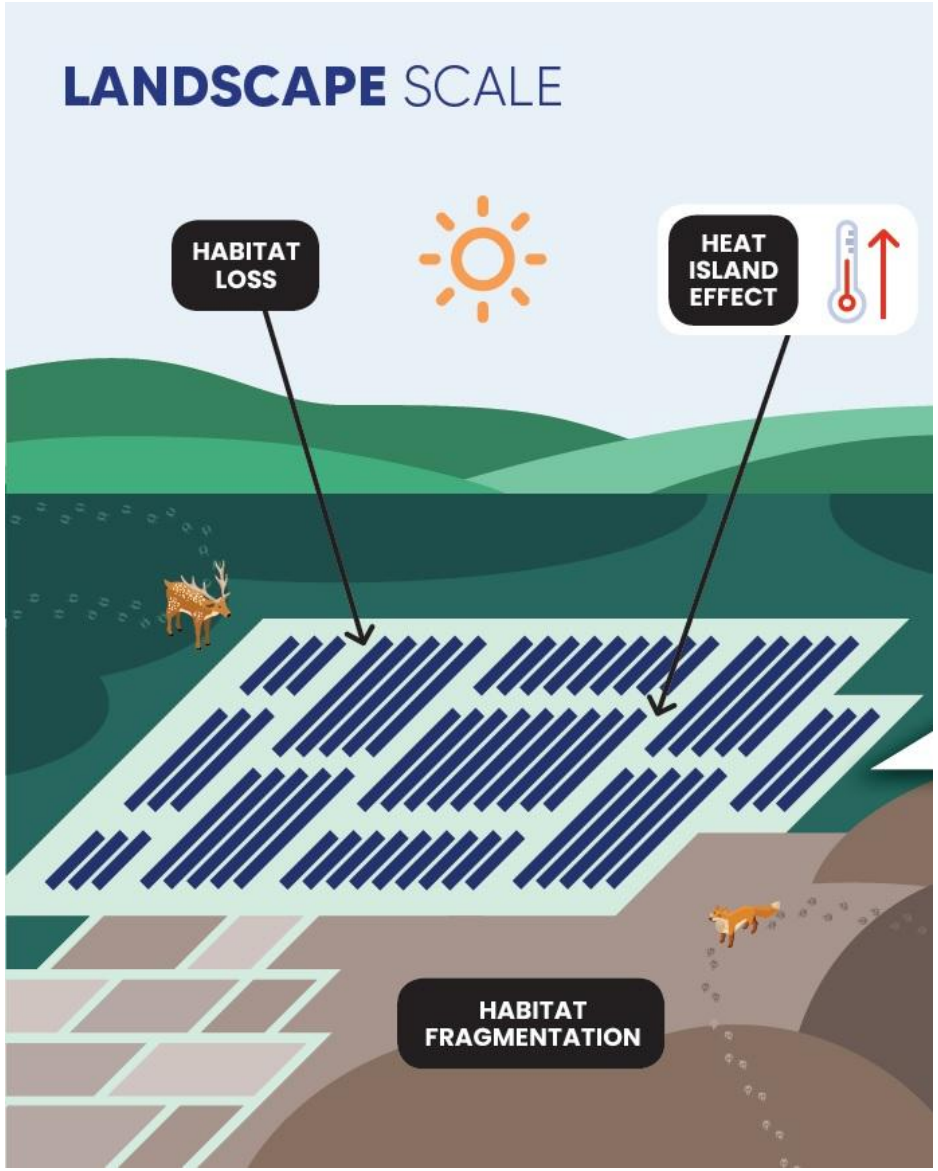
Ecosystem components

Abiotic — 30%

Biotic — 86%

4%

Impacts of Photovoltaics: What We Know

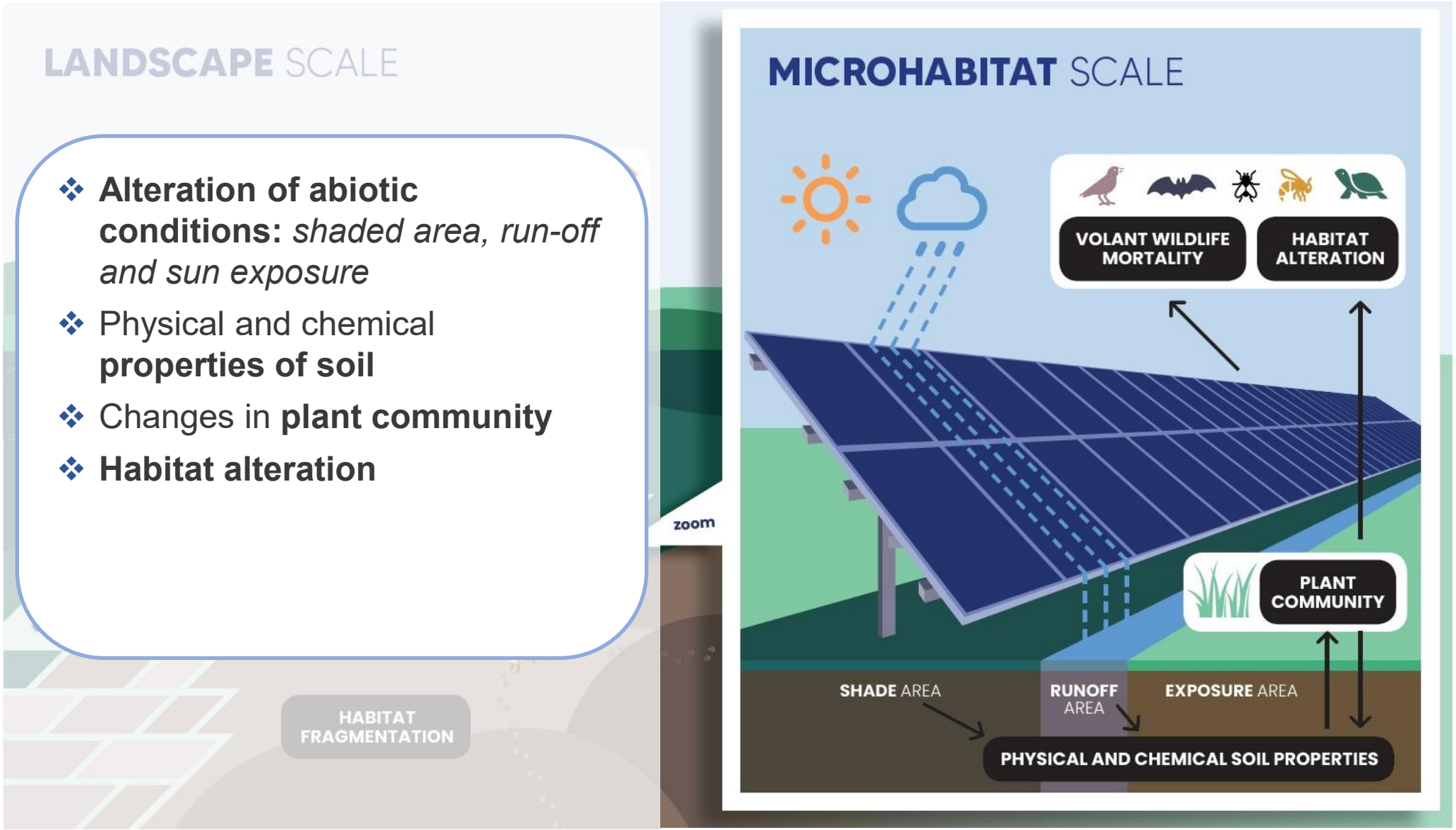


- Habitat loss
- Habitat fragmentation
- “Heat island” effect

Impacts of Photovoltaics: What We Know

CÁTEDRA STEPPE FORWARD

- **Alteration of abiotic conditions:** *shaded area, run-off and sun exposure*
- Physical and chemical **properties of soil**
- Changes in **plant community**
- **Habitat alteration**

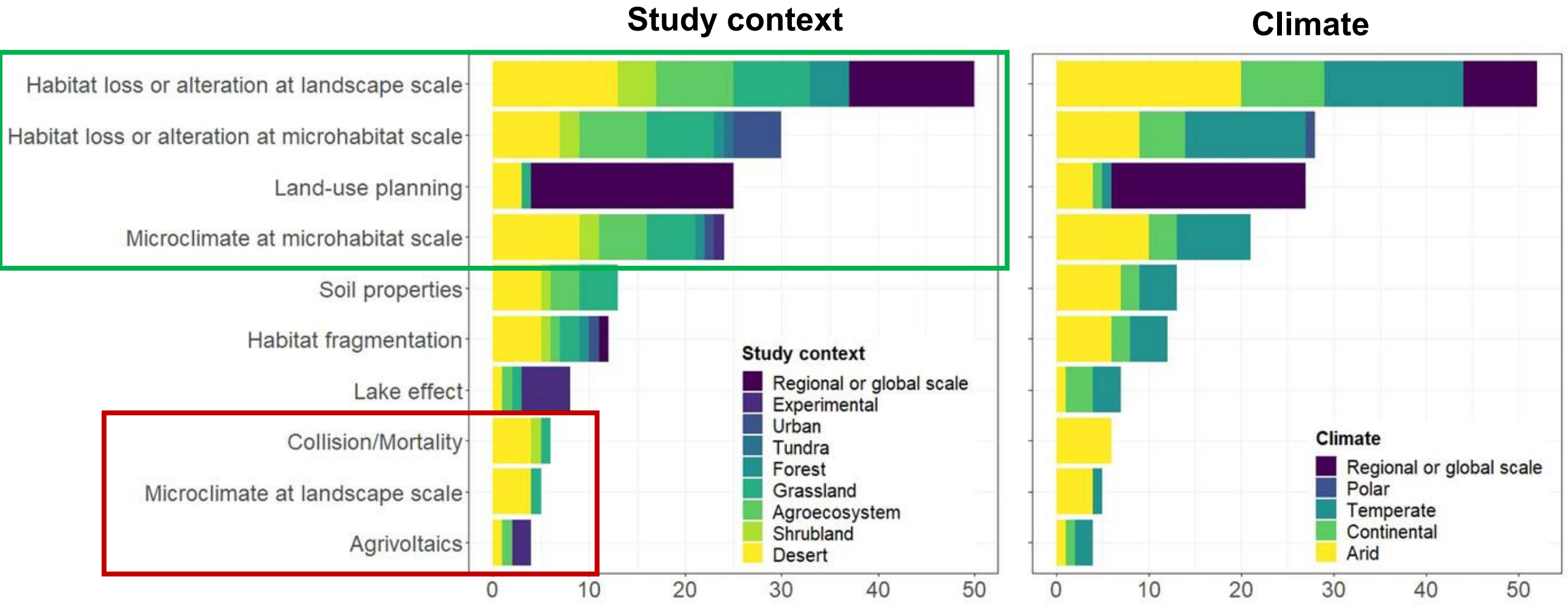


Impacts of Photovoltaics: What We Know

CÁTEDRA STEPPE FORWARD

- **Alteration of abiotic conditions:** *shaded area, run-off and sun exposure*
- Physical and chemical **properties of soil**
- Changes in **plant community**
- **Habitat alteration**
- Mortality of individuals due to **collision with solar panels** (lake effect)

Knowledge gaps



Methodological limitations

- **53% studies focused on a single PV facility**
- **2% of studies used a BACI design**

LACK OF STANDARDIZED AND ROBUST SAMPLING DESIGNS

NEED TO USE:

- **Comprehensive BACI designs** that provide critical information on the direct responses of sensitive wildlife, including a large number of years and facilities.
- **Standardized protocols** would allow findings to be comparable across contexts, opening the way to more robust and generalizable conclusions.

Observatory of Scientific Literature

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Castellano

Observatory of Scientific Literature

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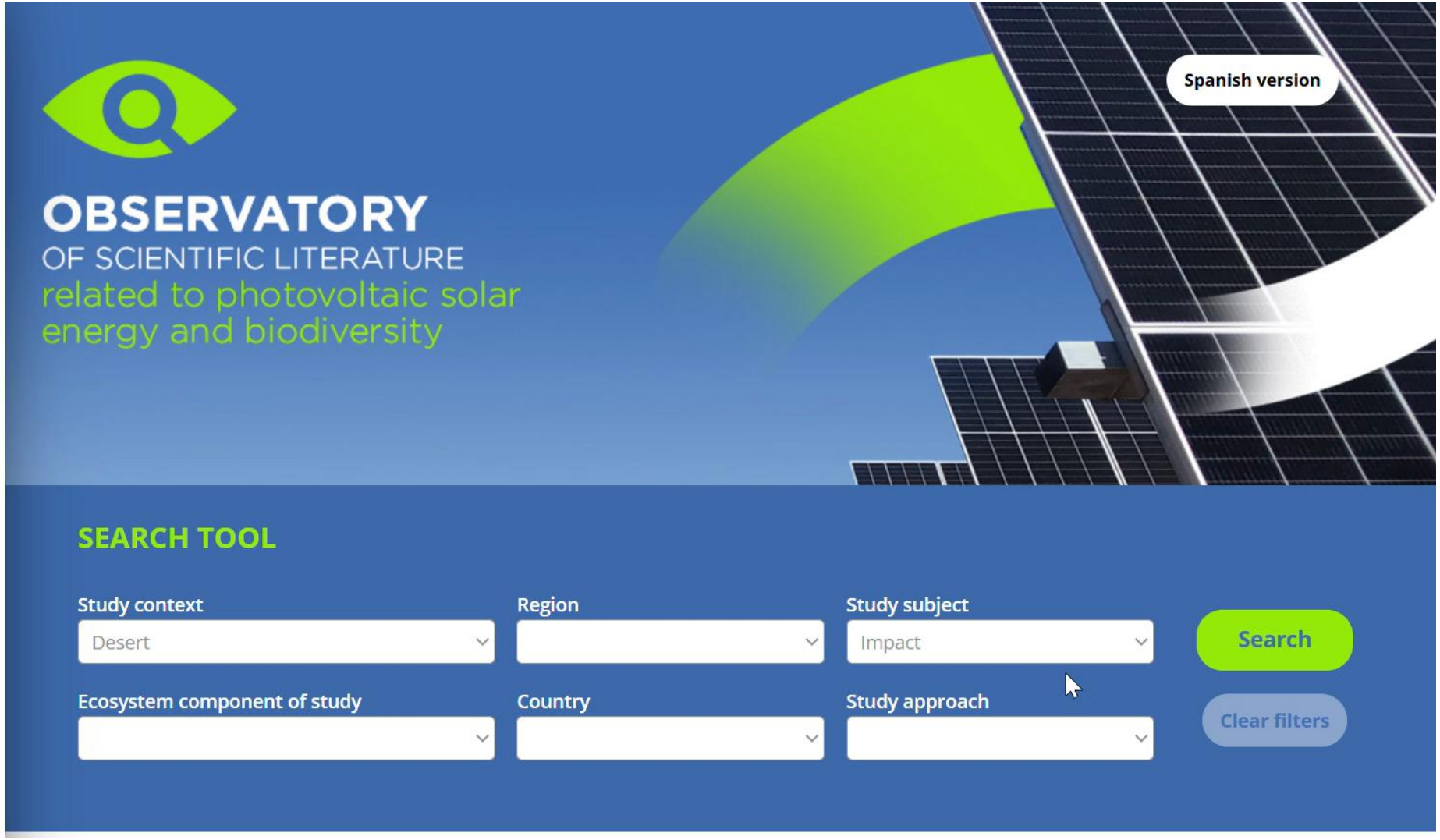

Observatory of Scientific Literature

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Excel

RESULTS (1 results out of 286 articles)

Publication title	Region	Country	Study Context	Component	Topic	Approach	Year
A case study identifying and mitigating the environmental and community impacts from construction of a utility-scale solar photovoltaic power plant in eastern Australia	-Oceania	Australia			Impact and mitigation	Review	2017

Solar Energy 146 (2017) 94–104

Contents lists available at ScienceDirect

Solar Energy

journal homepage: www.elsevier.com/locate/solener

A case study identifying and mitigating the environmental and community impacts from construction of a utility-scale solar photovoltaic power plant in eastern Australia

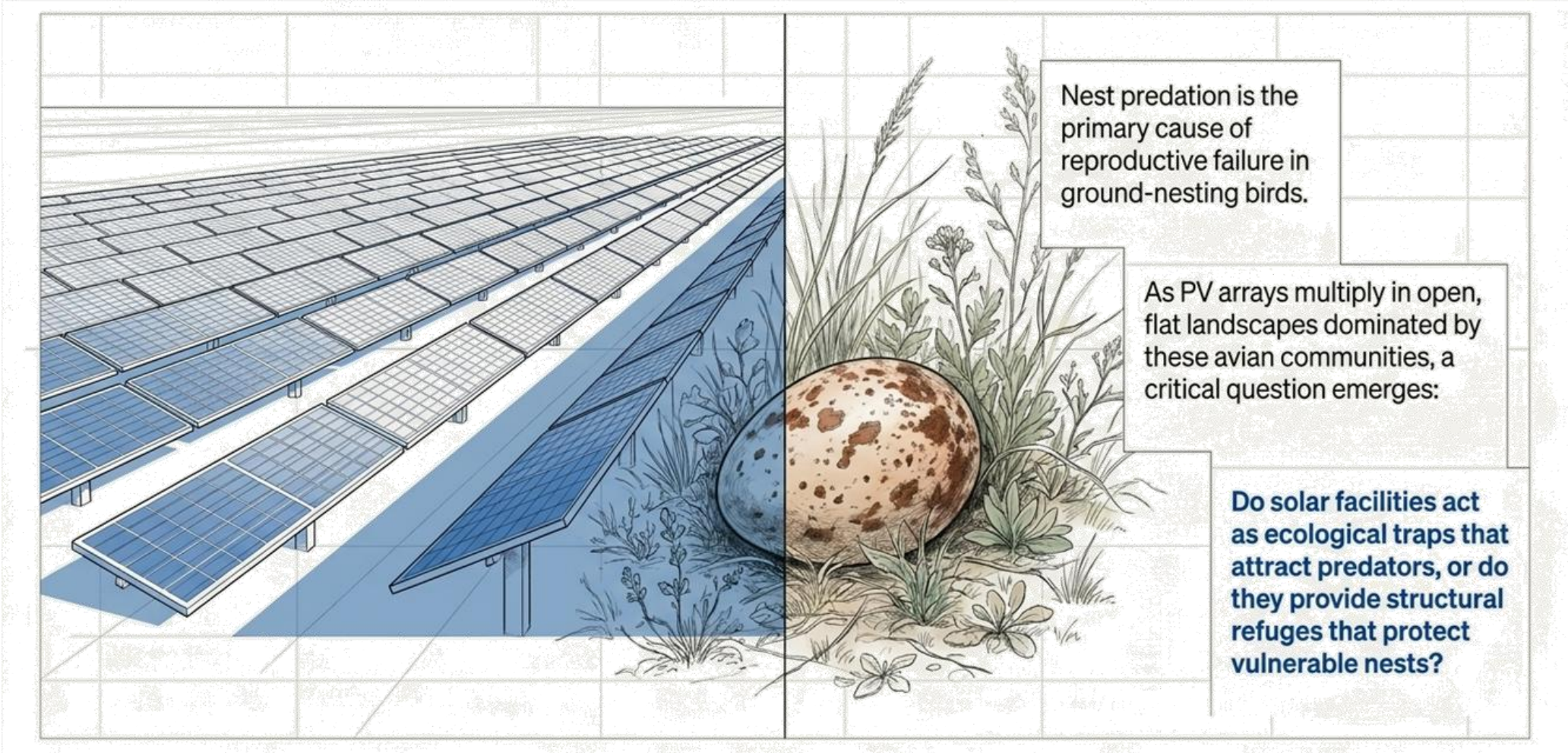
Turlough Guerin

Climate Alliance Ltd, C/o 5 Retreat Crescent, Sunbury 3429, Victoria, Australia

Ongoing Research under the Steppe Forward Chair

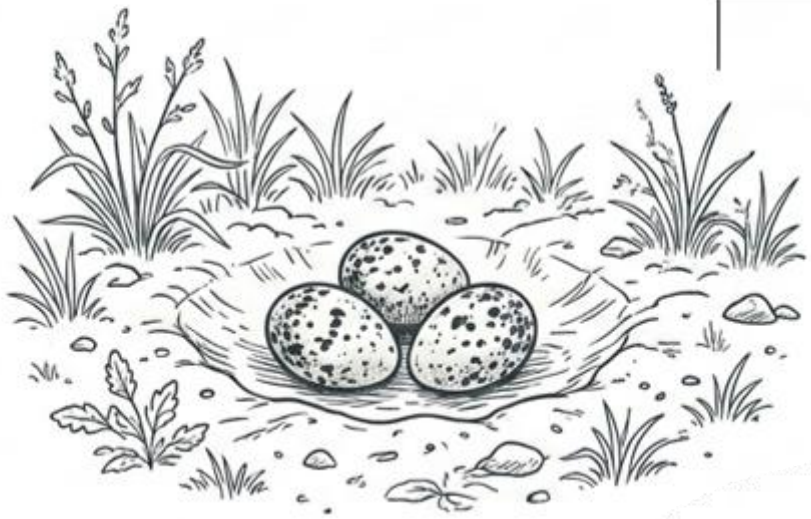
CÁTEDRA STEPPE FORWARD

❖ Effect of PV plants on nest predation rates



Ongoing Research under the Steppe Forward Chair

CÁTEDRA STEPPE FORWARD



Increase nest predation

Decrease nest predation

1. The Barrier Effect

Do permeable perimeter fences deter mammalian ground predators?

2. The Shelter Effect

Do solar panels block the line-of-sight for visually hunting avian predators (e.g., corvids, raptors)?

3. The Trap Effect

Does the infrastructure attract predators by offering them new perches and movement corridors?

Ongoing Research under the Steppe Forward Chair

CÁTEDRA STEPPE FORWARD

❖ Effect of PV plants on nest predation rates

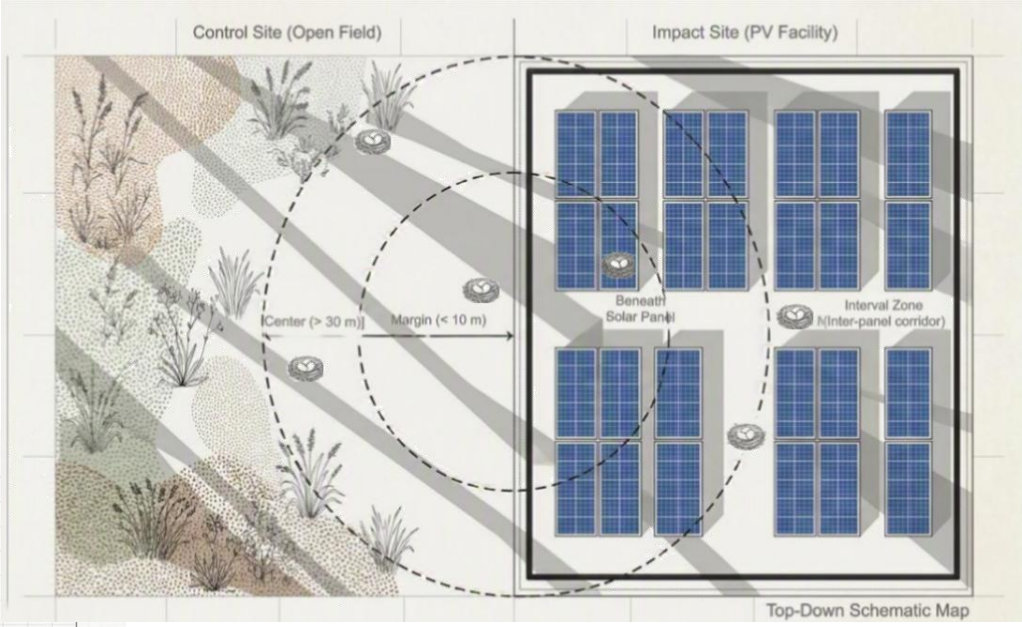
- 5 PV plants – N = 540 nests in 2 periods during 14 days

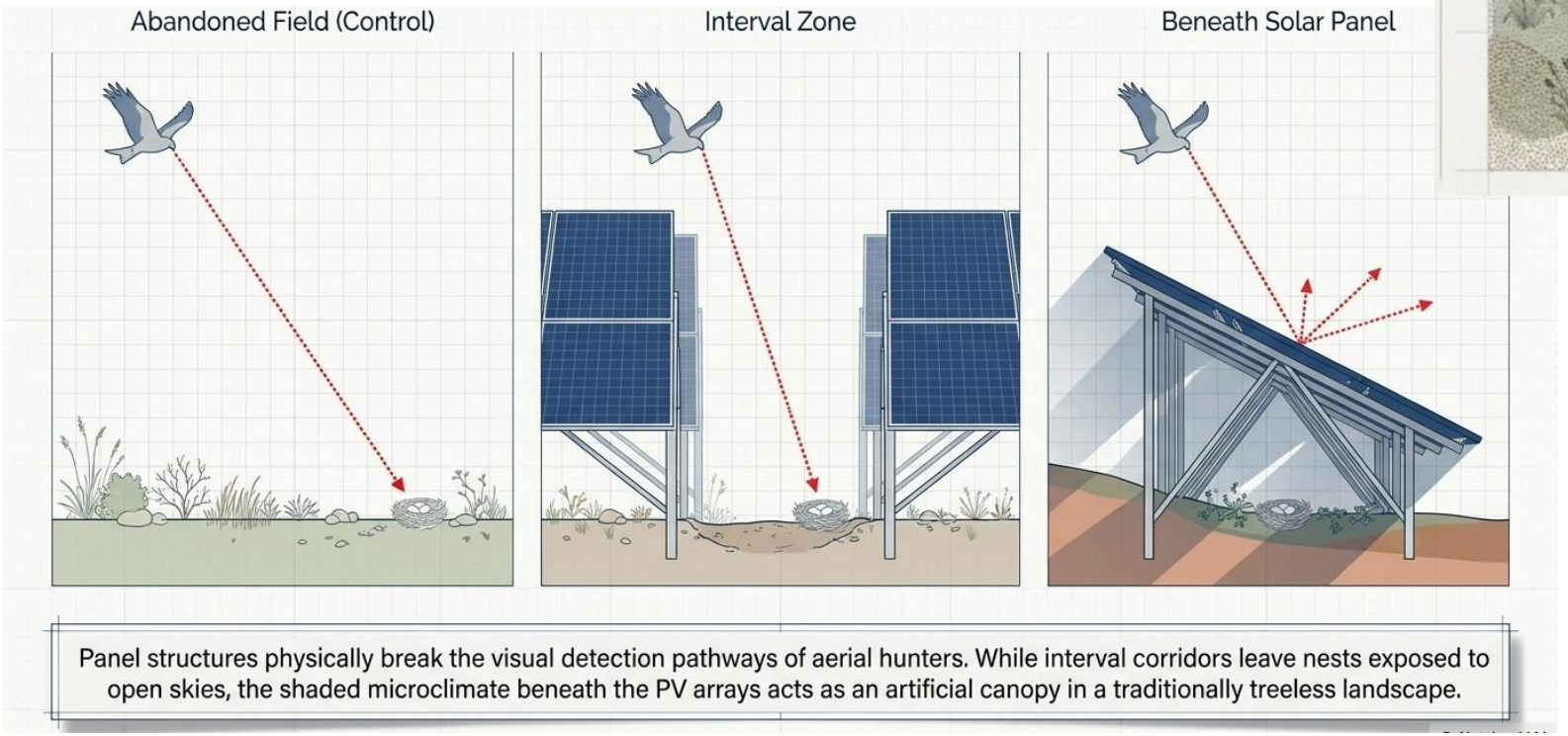
Burhinus oedicnemus

Ongoing Research under the Steppe Forward Chair

Control-Impact design:

- Control
- PV plants
  - Beneath PV panels
  - Interval zone





Distance to fence or plot boundary:

- Centre (> 50 m)
- Margin (< 10 m)

Expected higher predation rates near the margins

Ongoing Research under the Steppe Forward Chair

CÁTEDRA STEPPE FORWARD

❖ Effect of PV plants on nest predation rates

- 5 PV plants – N = 540 nests in 2 periods during 14 days

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❖ Effect of PV plants on nest predation rates

- 60 camera traps




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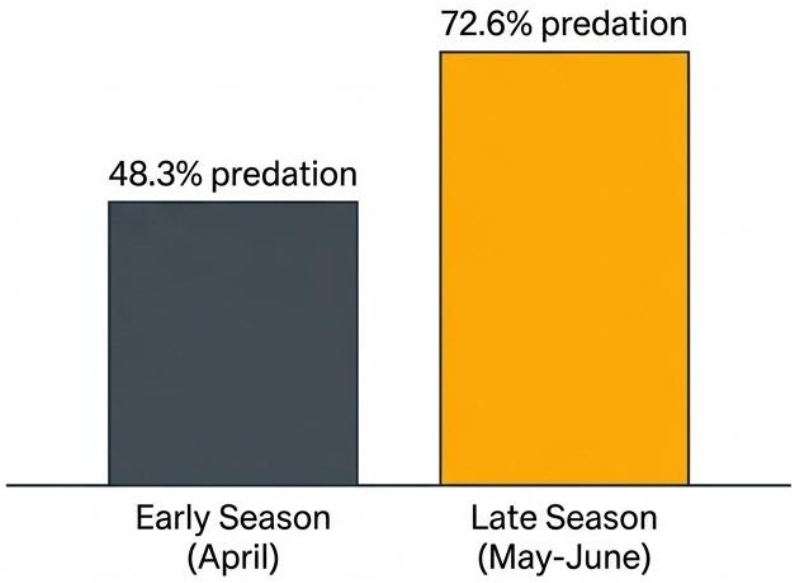
❖ Effect of PV plants on nest predation rates

60.6%

Overall predation rate across all 531 viable nests after 14 days of exposure.



Insight: Predation pressure surges in the late breeding season, likely driven by higher predator activity from post-breeding adults and dispersing juveniles.

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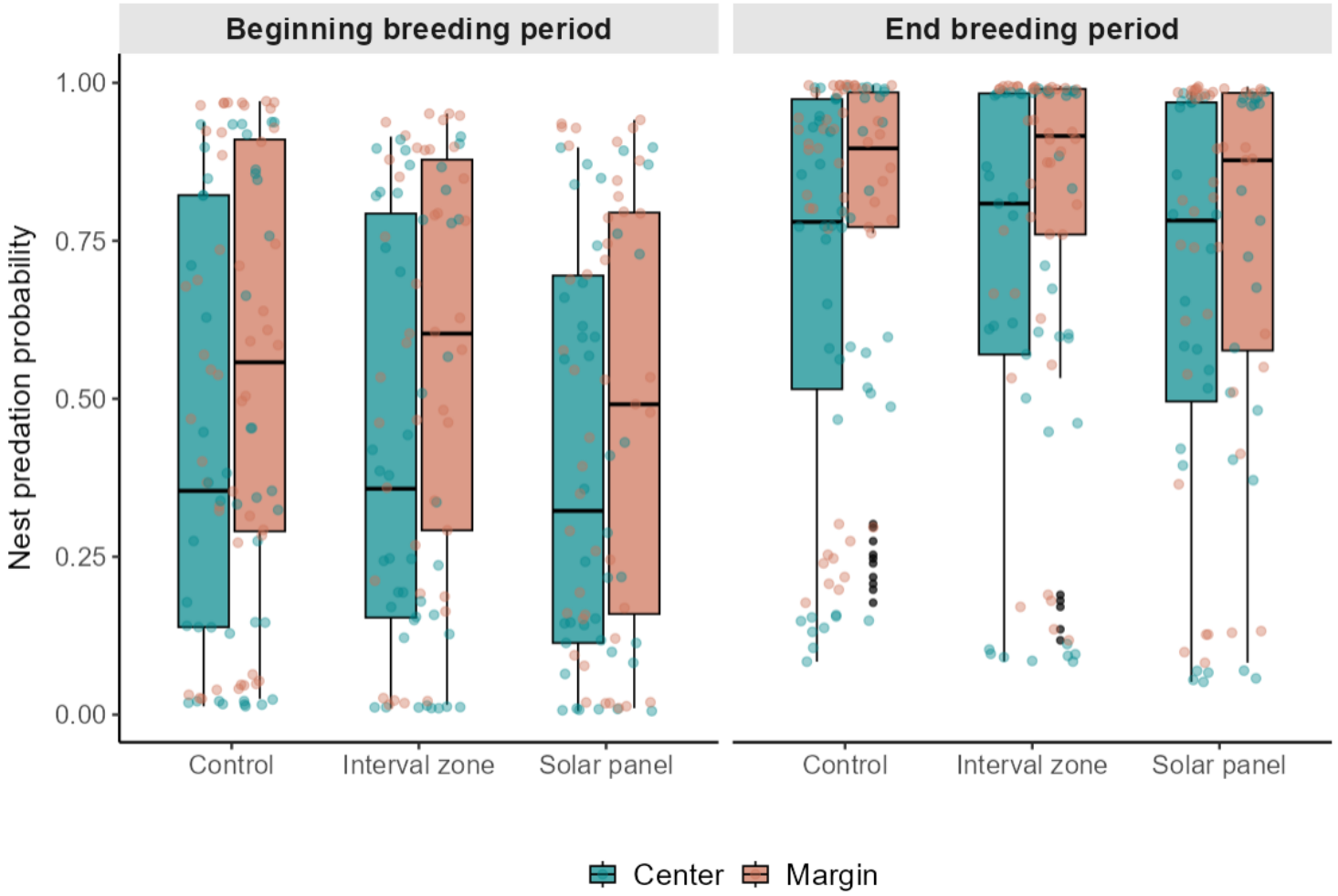
❖ Effect of PV plants on nest predation rates



1. **Edge effect**
2. **Solar panel effect**:
   - ~6% reduction early in the breeding season.
   - ~20% reduction later in the season.
3. **Interval zone effect**:
   - 4% early in the season
   - 14% later in the season

Ongoing Research under the Steppe Forward Chair

CÁTEDRA STEPPE FORWARD

❖ Effect of PV plants on nest predation rates

- Predator identification from camera traps

326 nests predated:

- 183 (56%) Predator identity could not be determined.

25.8 % Birds (N= 84)

18.1 % Mammals (N= 59)

Ongoing Research under the Steppe Forward Chair

CÁTEDRA STEPPE FORWARD

- Effect of photovoltaic plants on steppe birds' movements and habitat use

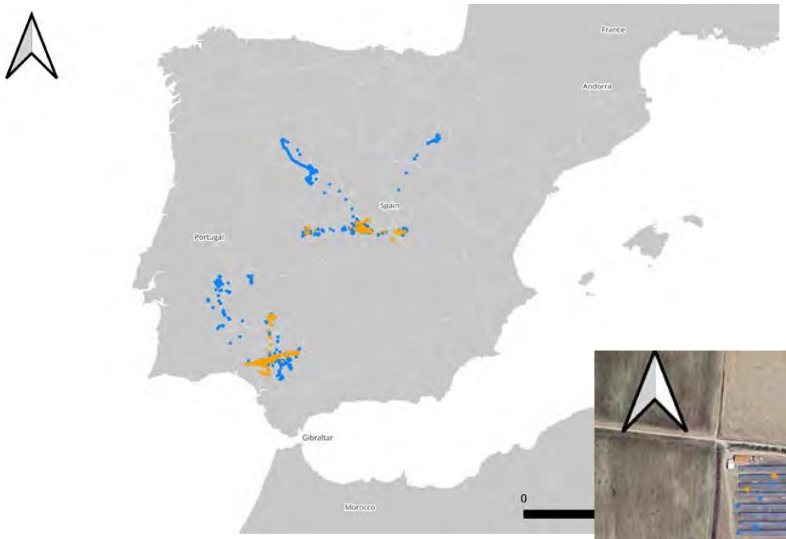
Ongoing Research under the Steppe Forward Chair

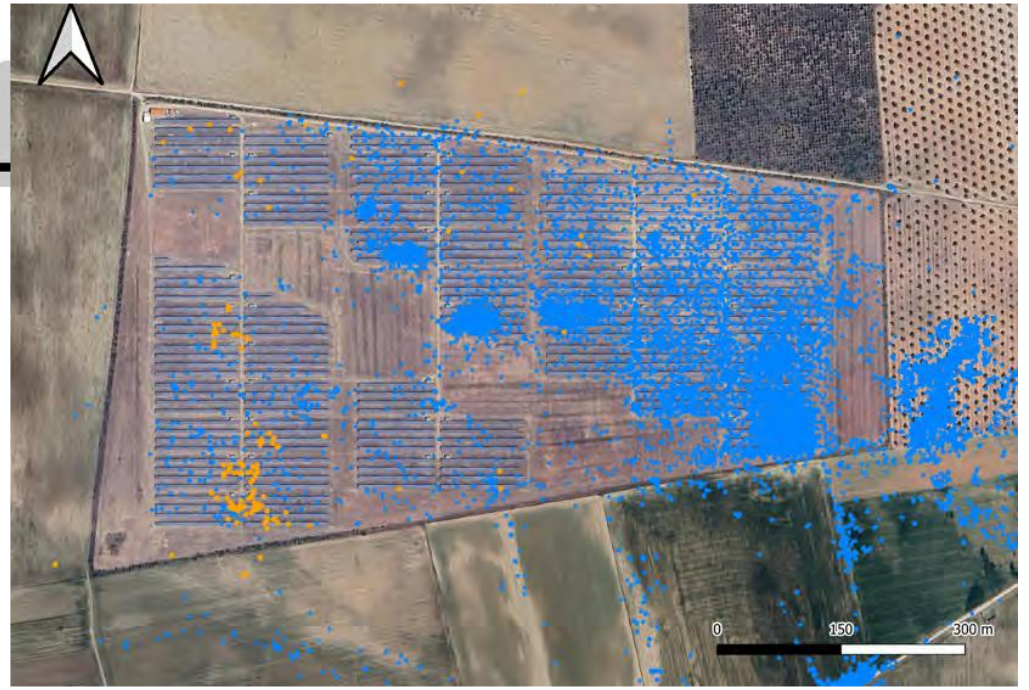
CÁTEDRA STEPPE FORWARD

- Effect of photovoltaic plants on steppe birds' movements and habitat use

Little bustard
Tetrax tetrax

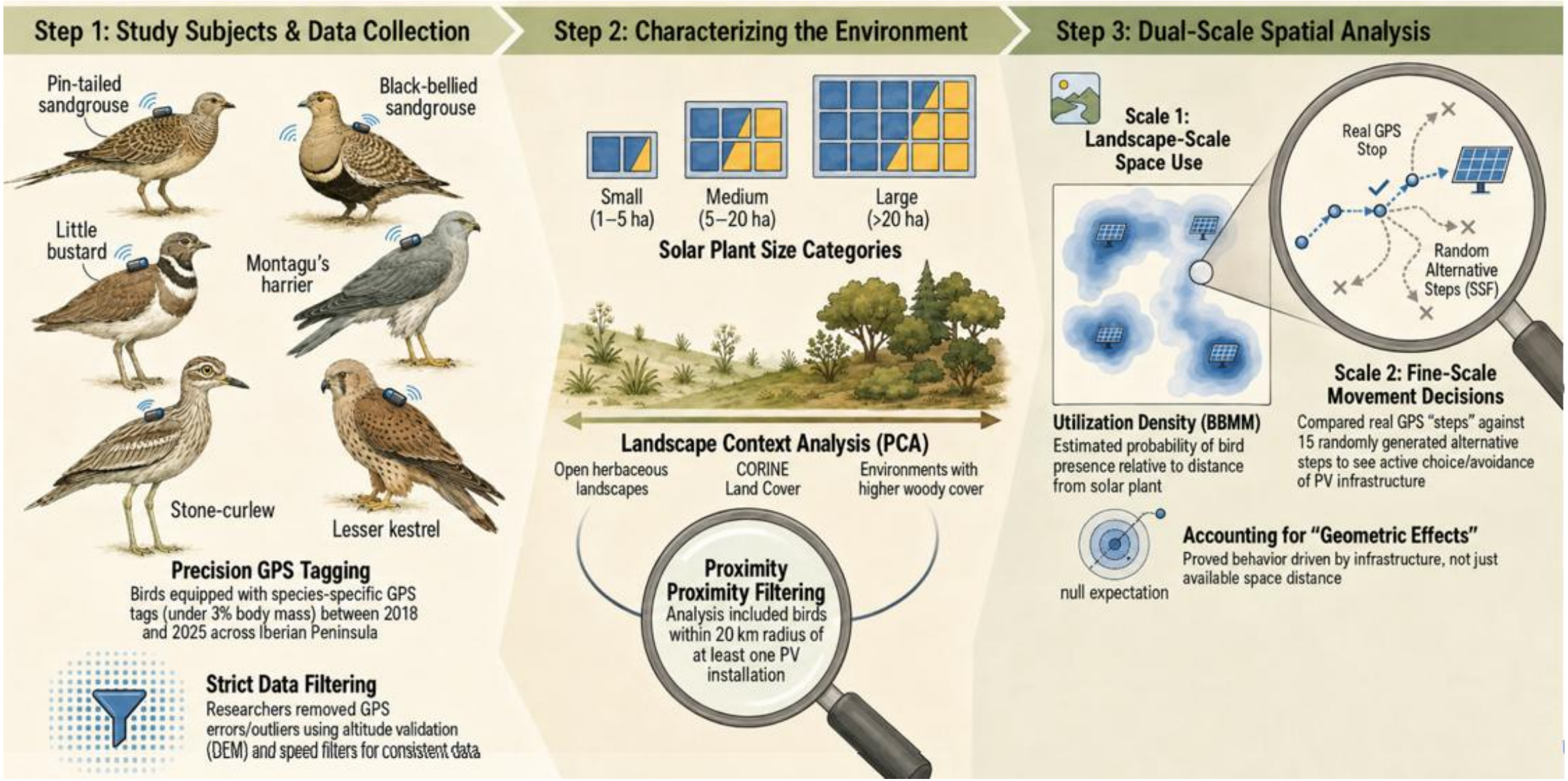
Eurasian stone-curlew
Burhinus oedicnemus





Ongoing Research under the Steppe Forward Chair

CÁTEDRA STEPPE FORWARD



Ongoing Research under the Steppe Forward Chair

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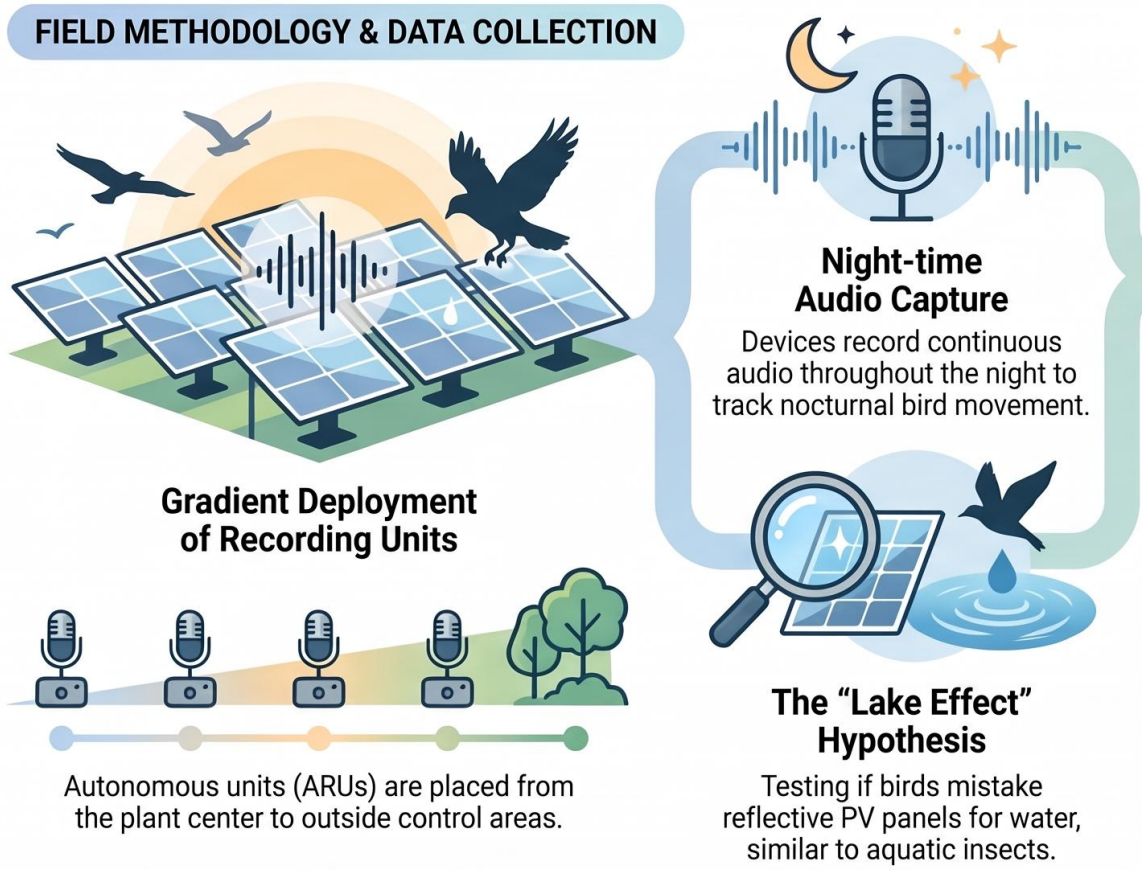
- **Assessment of the ‘lake effect’ on nocturnal migratory birds**



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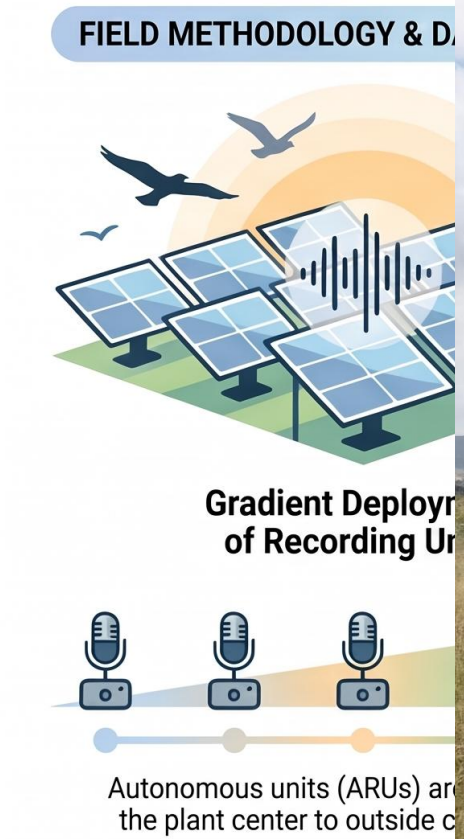
CÁTEDRA STEPPE FORWARD

- Assessment of the ‘lake effect’ on nocturnal migratory birds



Ongoing Research under the Steppe Forward Chair

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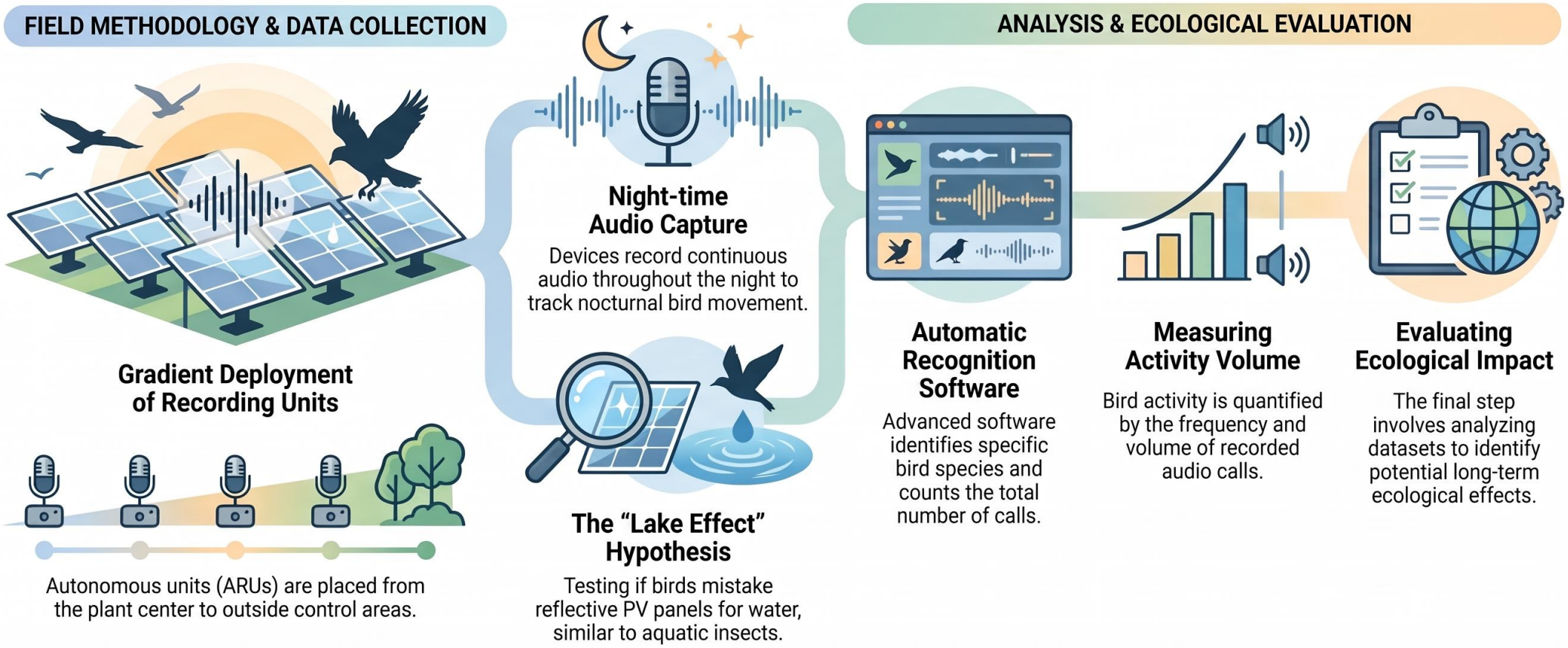
❖ Assessment of the ‘lake effect’ on nocturnal migratory birds



Transfer activities

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❖ MANUALS

Transfer activities

❖ Steppe Forward Technical conferences

- **1st Technical Conference in 2022**

  Environmental fallows in Steppe Areas

- **2nd Technical Conference in 2023**

  Compensatory measures in PV projects

- **3rd Technical Conference in 2024**

  Key species for conservation in PV projects

- ***4th Technical Conference in 2025***

Global challenges and experiences in PV projects

NOVEMBER 2026

Team

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Coordination Team

Technicians and researchers steppe forward

Collaboration Team

Scientific advisory board

Thank you!

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