COLLISION MORTALITY AND FUTURE WIND ENERGY DEVELOPMENT:

a challenge for Bearded Vulture reintroduction in the Maestrazgo region

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INTRODUCTION

The European Union is simultaneously promoting ecosystem restoration and the rapid deployment of renewable energy. Although both objectives are essential, poorly planned wind-energy infrastructure may undermine the recovery of threatened wildlife, especially long-lived species with low reproductive rates and extensive spatial requirements.

The Bearded Vulture (*Gypaetus barbatus*) reintroduction programme in Maestrazgo (eastern Spain), launched in 2015 with releases beginning in 2018, aims to reconnect geographically isolated European populations, enhance gene flow and reduce extinction risk.

MATERIALS AND METHODS

Here we show a case-based conservation and policy assessment rather than a field experiment. It brings together the documented outcomes of the Maestrazgo reintroduction programme, reported mortality incidents, published regional wind-farm mortality records and the spatial distribution of existing and proposed wind-energy infrastructure.

Spatial context is illustrated using release and collision sites, existing and planned turbines, and Natura 2000 protected areas within 50 km of the release area (Fig. 1). We then evaluate implications for adaptive reintroduction and renewable-energy planning.

RESULTS AND DISCUSSION

Reintroduction outcomes and causes of mortality

By 2025, 27 Bearded Vultures had been released: 25 in the Valencian Region and two in Aragón. Five released juveniles had died: two following predation by Golden Eagles (Aquila chrysaetos), two by electrocution and one by collision with a wind turbine. These losses illustrate how persistent anthropogenic threats can compromise otherwise intensive restoration efforts.

On 8 June 2024, “Masía”, a juvenile released in 2022, was found dead after colliding with an operating wind turbine approximately 25 km from the release site (Fig. 2). This was the first reported Bearded Vulture wind-turbine fatality in Spain and the third in Europe. Another bird released in 2022 died by electrocution on 27 August 2022.

Expansion of wind energy in the Bearded vulture reintroduction area

There are plans for 127 additional turbines (760 MW) in the Maestrazgo, including 85 (~67%) within a Site of Community Importance. This development overlaps an area considered highly suitable for the species’ recovery. Wind farms were also associated with 1,079 reported Griffon Vulture deaths in Maestrazgo during 2008–2018, indicating a broader conservation challenge for scavenging birds.

In July 2023, the FCQ temporarily suspended releases pending a reduction in wind-farm collision risks. Other programme partners continued releases, including three birds in 2024 and two in 2025, while the proposed energy developments became the subject of administrative litigation.

CONCLUSIONS AND MANAGEMENT IMPLICATIONS

In light of our results, we call for: (1) coordinated, transboundary territorial planning; (2) cumulative assessment of existing and proposed infrastructures; and (3) adaptive, enforceable mitigation and zoning informed by updated mortality risks and GPS tracking.

Reintroduction should not be treated independently of energy policy: threats must be reduced sufficiently to support long-term population viability.

SPATIAL OVERLAP WITH WIND POWER

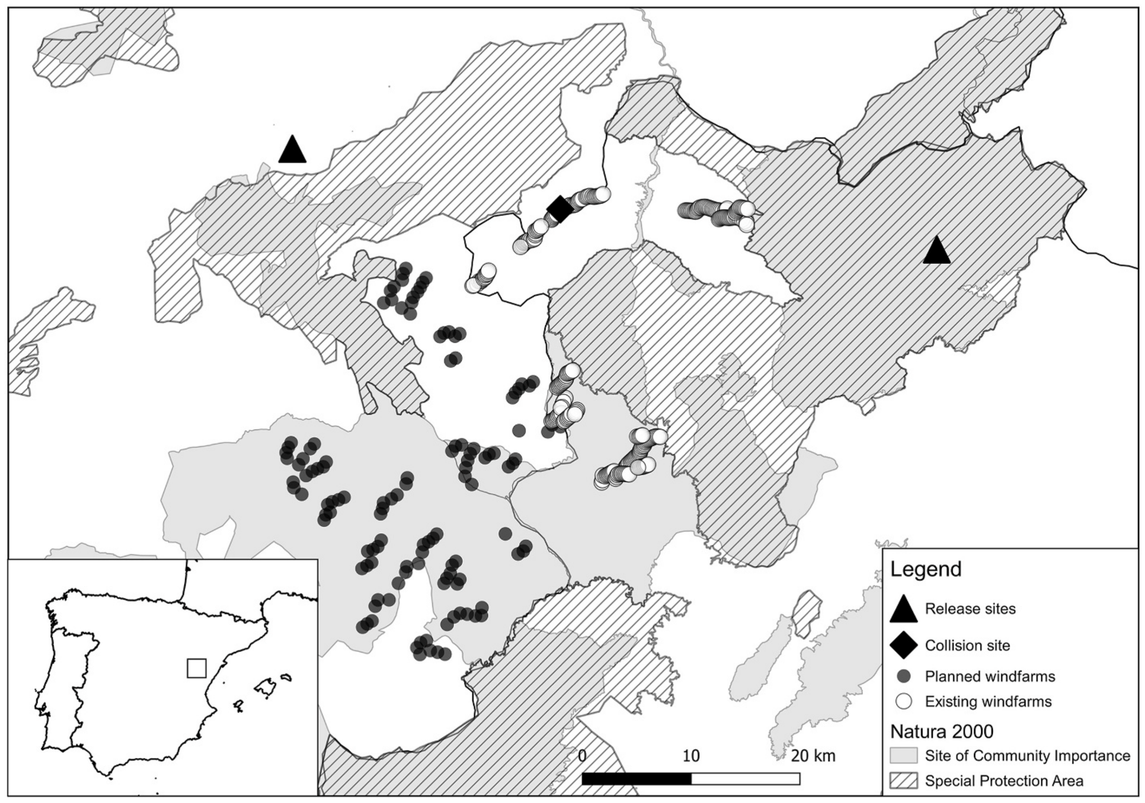

Figure 1. Maestrazgo reintroduction area: release sites, collision site, existing and planned wind farms, and Natura 2000 sites within 50 km of the release area. Reproduced from López-López et al. (2026)

DOCUMENTED COLLISION: “MASÍA”



Figure 2a. “Masía” found dead after collision with an operating wind turbine on 8 June 2024. Photo: FCQ.



Figure 2b. “Masía” photographed alive after its release in 2022. Photo: FCQ.

LÓPEZ-LÓPEZ, P.; ESTELLÉS-DOMINGO, I.; GIL, J.A. 2026. Wind energy and species reintroductions: a call to action for adaptive conservation planning. ***Journal of Environmental Management*** 397:128266 (https://doi.org/10.1016/j.jenvman.2025.128266)

Successful species recovery requires that renewable-energy deployment and reintroduction planning are evaluated together.