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COMMENT

The conservation management of European bison requires strong evidence and careful risk assessment: A response to "Comment: Nores et al. (2024) fail in their attempt to demonstrate the inappropriateness of an eventual introduction of the European bison to Spain as a rewilding initiative"

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We thank Bartolomé and colleagues for their interest in our recent article, "Rewilding through inappropriate species introduction: The case of European bison in Spain" (Nores et al., 2024). Our work critically evaluated the proposal to introduce European bison (*Bison bonasus*) into the Iberian Peninsula, considering ecological, biogeographical,

In Memoriam: To Concha Azorit, whose passion and dedication continue to inspire the conservation of Iberian habitats and wildlife.

For affiliations refer to page 3

conservation, and legal aspects. The reply by Bartolomé et al. presents alternative hypotheses but does not challenge our conclusions with new evidence. Our position relied on what the available data show and on the convergence of paleontological, ecological, climatic, and legal evidence (Nores et al., 2024). In contrast, Bartolomé and colleagues rely on hypothetical scenarios of the presence of European bison in Iberia, such as possible Holocene extinctions or preliminary sedaDNA signals (Gelabert et al., 2025), which, while intriguing, do not offer conclusive support for past presence of extant European bison in Iberia.

We emphasize that a huge number of well-studied Holocene sites across Iberia—110 sites with bovine remains—have yielded no remains of European bison. This absence is meaningful, especially when considered alongside the clear presence in many of them of the steppe bison (*Bison priscus*) and auroch (*Bos primigenius*). It is difficult to conceive that European bison could have lived throughout Iberia during thousands of years without leaving any recognizable trace, given the extensive Late Pleistocene (197 sites) to Holocene (222 sites) fossil record in the region (Arribas, 2004). Bartolomé et al. suggest that this absence could be explained by sampling bias or by misidentification of bone remains. However, these claims are unsupported. The Iberian fossil record has yielded remains of many other large herbivores—including reindeer (*Rangifer tarandus*) and muskox (*Ovibos moschatus*) (see Nores et al., 2024)—that present similar preservation challenges. If European bison had been present, it would be reasonable to expect some traces among this extensive fossil material. The diagnostic morphological features of *Bison* and *Bos* are well established and widely applied in paleontology (see references in Nores et al., 2024 and others as Martínez-Navarro et al., 2007) as well as in genomics (Llamas et al., 2025). While isolated misidentifications may not be discarded, they cannot account for a complete absence across hundreds of paleontological sites. The idea that European bison was overlooked remains unconvincing in the absence of supporting evidence. In contrast, Bartolomé and colleagues cited references that, upon closer inspection, align more closely with our conclusions than with their assertions: neither Benecke (2005), Kuemmerle et al. (2012), nor Pilowsky et al. (2023) concluded that European bison were historically present in Iberia or that it offered more than marginal habitat suitability, which explains the low fitness of Spanish bison populations and the failure of 30% of introductions (see Appendix of Nores et al., 2024) (see also Llamas et al., 2025).

The nature of sedaDNA findings by Gelabert et al. (2025) does not overturn the weight of multidisciplinary evidence, as they do not provide details of such a discovery (e.g., clade/subclade or species), nor it is supported by identifiable remains. Furthermore, the recent discovery of a bison skeleton in northern Spain, dated around 4000 years B.P. (Gobierno de Navarra, 2026), does not challenge our position. First, the clade/subclade of the bison remains is yet to be confirmed by DNA analyses. It is possible that those remains belong to part of the subclade Bb2 which is extinct (Grange et al., 2018; Massilani et al., 2016). Second, if the remains are identified by molecular evidence as extant European bison, the discovery places this skeleton in the Eurosiberian region of Spain during a Neoglaciation period (García-Ruiz et al. 2020). Accumulated evidence of the absence of the species in Iberian paleontological sites suggests that this discovery would be limited to a narrow area in nothern Spain, only 50 km distant from the French boundary in the Pyrenees. The recent discovery of periodicities in the temporal distribution of European bison during the Holocene, which coincided with colder and wetter phases of the North Atlantic atmospheric circulation (Llamas et al., 2025), could be in line with this recent discovery in northern Spain, and casts doubt on the plausibility of the persistence of this species in warmer climates, such as those occurring in most of the Iberian Peninsula.

Sound conservation policies require strong supporting evidence. Basing conservation decisions on uncertainty undermines the scientific standards that must guide the reintroduction (introduction in this case) of species. In contrast, Bartolomé and colleagues fail to demonstrate the presence of European bison across Iberia. A recent study suggests again that the extant European bison was not present in Iberia based on fossil, aDNA, paleoecological, and paleoclimatological evidence (Llamas et al., 2025). These authors also strongly challenge the introduction of European bison in Spain. The burden of proof lies with those proposing the introduction of a species and, to date, while awaiting the genetic results of the skeleton found in Navarra, no study has provided verifiable evidence of current European bison in Iberia.

In any case, habitat suitability for European bison is not expected to improve in the Iberian Peninsula. Current and projected climate trends there show a consistent increase in temperature and a reduction in precipitation (AEMET, 2024; IPCC, 2023). These trends are expected to intensify in the coming decades, including a marked increase in the number and intensity of hot days and heatwaves, and a spread of semi-arid conditions across several regions in Spain (see Lorenzo & Alvarez, 2022, among others). Under these conditions, the long-term survival of introduced European bison, without human intervention, is highly unlikely. Introducing a species into a region where future conditions are likely to become even less favorable for the species undermines

foundational principles of conservation planning. Climate-informed conservation requires forward-looking strategies, not speculative assumptions disconnected from environmental trajectories. Thus, this action would be against the international recommendations for species introductions (IUCN/SSC, 2013).

Bartolomé and colleagues argue that the bison could fill a missing ecological gap in Iberian ecosystems, acting as a substitute of extinct large grazers. However, this assumption overlooks a crucial point: The Iberian Peninsula already supports large populations of native wild herbivores alongside large populations of extensively managed domestic grazers, that is, 600,000 individuals of local cattle breeds, plus 14,000 horses, even amid their decline (https://www.mapa.gob.es/es/ganaderia/temas/zootecnia/razas-ganaderas/razas/catalogo-razas), are already fulfilling the ecological functions attributed to the European bison. Thus, introducing this bison in this context is not a necessity but a problem (Bescond-Michel et al., 2025; Bugalho et al., 2026). A sound conservation policy should focus on supporting and restoring herbivore populations where justified. There is no demonstrated ecological gap that the European bison alone can fill, especially considering the Mediterranean climate and habitat types, which differ markedly from the species' present range.

We acknowledge the conservation value of the European bison; however, introducing them to the Iberian Peninsula, dominated by the Mediterranean biogeographic region, is a high-risk intervention with an uncertain outcome. Any conservation introduction must adhere to the precautionary principle, which requires strong supporting evidence and careful risk assessment.

AUTHOR CONTRIBUTIONS

Conceptualization: C. Nores, D. Nogués-Bravo, and J. V. López Bao. *Original draft*: D. Nogués-Bravo and J.V. López Bao. All authors reviewed the manuscript and suggested additional information.

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CONFLICT OF INTEREST STATEMENT

Authors declare no conflict of interest.

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REFERENCES

Agencia Estatal de Meteorología (AEMET). (2024). Informe sobre sobre el estado del clima de España 2024. Ministerio para la Transición Ecológica y el Reto Demográfico Agencia Estatal de Meteorología, Madrid, 104 pp. https://doi.org/10.31978/666-25-002-1.2024

Arribas, O. (2004). *Fauna y paisaje de los Pirineos en la Era Glaciar* (p. 540). Lynx Nature Books.

Benecke, N. (2005). The Holocene distribution of European bison – The archaeozoological record. *Munibe Antropologia-Arkeologia*, *57*, 421–428.

Bescond-Michel, Z., Bacher, S., & Vimercati, G. (2025). Harms of introduced large herbivores outweigh benefits to native biodiversity. *Nature Communications*, *16*, 8260. https://doi.org/10.1038/s41467-025-63807-2

Bugalho, M. N., Pérez-Barbería, F. J., Pereira, J. M. C., & Gordon, I. J. (2026). Does re-wilding contribute to biodiversity conservation in Mediterranean cultural landscapes? *Ambio*, *55*, 546–557. https://doi.org/10.1007/s13280-025-02266-x

García-Ruiz, J. M., Palacios D., Andrés N., & López-Moreno J. I. (2020). Neoglaciation in the Spanish Pyrenees: A multiproxy challenge. *Mediterranean Geoscience Reviews*, *2*, 21–36.

Gelabert, P., Oberreiter, V., Straus, L. G., González Morales, M. R., Sawyer, S., Marín-Arroyo, A. B., Geiling, J. M., Exler, F., Brueck, F., Franz, S., Tenorio Cano, F., Szedlacsek, S., Zelger, E., Hämmerle, M., Zagorc, B., Llanos-Lizcano, A., Cheronet, O., Tejero, J. M., Rattei, T., … Pinhasi, R. (2025). A sedimentary ancient DNA perspective on human and carnivore persistence through the Late Pleistocene in El Mirón Cave, Spain. *Nature Communications*, *16*, 107. https://doi.org/10.1038/s41467-024-55740-7

Gobierno de Navarra. (2026). *El Gobierno de Navarra anuncia el hallazgo de un esqueleto de bisonte de hace 4.000 años en Urbasa*. https://www.navarra.es/es/-/nota-prensa/el-gobierno-de-navarra-anuncia-el-hallazgo-de-un-esqueleto-de-bisonte-de-hace-4-000-anos-en-urbasa

Grange, T., Brugal, J. P., Flori, L., Gautier, M., Uzunidis, A., & Geigl, E. M. (2018). The evolution and population diversity of bison in Pleistocene and Holocene Eurasia: Sex matters. *Diversity*, *10*, 65. https://doi.org/10.3390/d10030065

Intergovernmental Panel on Climate Change (IPCC). (2023). In Core Writing Team, H. Lee, & J. Romero (Eds.), *Climate change 2023: Synthesis report. Contribution of working groups I, II and III to the sixth assessment report of the intergovernmental panel on climate change* (p. 184). IPCC. https://doi.org/10.59327/IPCC/AR6-9789291691647

Kuemmerle, T., Hickler, T., Olofsson, J., Schurgers, G., & Radeloff, V. C. (2012). Reconstructing range dynamics and range fragmentation of European bison for the last 8000 years. *Diversity and Distributions*, *18*, 47–59. https://doi.org/10.1111/j.1472-4642.2011.00849.x

Llamas, B., van Loenen, A. L., Mitchell, K. J., Hofman-Kamińska, E., Bocherens, H., Heiniger, H., Pacher, M., Makowiecki, D., Piličiauskienė, G., Drucker, D. G., Brown, D., Thomas, Z. A., Turney, C. S., Kowalczyk, R., & Cooper, A. (2025). Coexistence, extinction and survival—The evolutionary history of bison species in Western Eurasia. *Global Change Biology*, *31*, e70354. https://doi.org/10.1111/gcb.70354

Lorenzo, M., & Alvarez, I. (2022). Future changes of hot extremes in Spain: Towards warmer conditions. *Natural Hazards*, *113*, 383–402. https://doi.org/10.1007/s11069-022-05306-x

Martínez-Navarro, B., Pérez-Claros, J. A., Palombo, M. R., Rook, L., & Palmqvist, P. (2007). The Olduvai buffalo Pelorovis and the origin of Bos. *Quaternary Research*, *68*, 220–226. https://doi.org/10.1016/j.yqres.2007.06.002

Massilani, D., Guimaraes, S., Brugal, J. P., Bennett, E. A., Tokarska, M., Arbogast, R. M., Baryshnikov, G., Boeskorov, G., Castel, J. C., Davydov, S., & Madelaine, S. (2016). Past climate changes, population dynamics and the origin of bison in Europe. *BMC Biology*, *14*, 93. https://doi.org/10.1186/s12915-016-0317-7

Nores, C., Álvarez-Laó, D., Navarro, A., Pérez-Barbería, F. J., Castaños, P. M., Castaños de la Fuente, J., Morales Muñiz, A., Azorit, C., Muñoz-Cobo, J., Fernández Delgado, C., Granado Lorencio, C., Palmqvist, P., Soriguer, R., Delibes, M., Vilà, M., Simón, M., Cabezudo, B., Galán, C., García-Berthou, E., … López-Bao, J. V. (2024). Rewilding through inappropriate species introduction: The case of European bison in Spain. *Conservation Science and Practice*, *6*, e13221. https://doi.org/10.1111/csp2.13221

Pilowsky, J., Brown, S., Llamas, B., van Loenen, A., Kowalczyk, R., Hofman-Kamińska, E., Manaseryan, N., Rusu, V., Kriznar, M., Rahbek, K., & Fordham, D. (2023). Millennial processes of population decline, range contraction, and near extinction of the European bison. *Proceedings of the Royal Society B*, *290*, 20231095. https://doi.org/10.1098/rspb.2023.1095

The International Union for Conservation of Nature/Species Survival Commission (IUCN/SSC). (2013). *Guidelines for reintroductions and other conservation translocations*. Version 1.0. IUCN Species Survival Commission. 57 pp.

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