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Navigating divergent perspectives on critical habitat designation: Insights from the little bustard (*Tetrax tetrax*) conservation in Spain

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ABSTRACT

The designation of *critical habitats* is a conservation tool extensively used worldwide. Although the effectiveness of this tool has been proved globally, its implementation in Spain is scarce, probably due to the ambiguous character of its definition in policy and other related problems. This study provides insight into some of these aspects and how different groups of experts interpret the concept of critical habitat. We used the little bustard (*Tetrax tetrax*) as a case study of an endangered species for which critical habitats must be designated. We interviewed 47 experts of the species, from researchers to environmental agency technicians, about the objectives that critical habitats should address, and which facilitating and constraining aspects should be considered in such designation. By grouping the answers in different categories and running ordination analyses (Non-Metric Multidimensional Scaling) we found that researchers mainly focused on ecological objectives for critical habitats, compared to the rest of the respondents who also considered socioeconomic aspects as basic objectives for critical habitats. Only 36% of the experts mentioned ecological factors as constraints to such designation, while socioeconomic constraints were mentioned by all but two of the experts (96%). These results suggest differences in the conceptualization of critical habitat between scientists and managers, from pure ecological requirements of the species to the actual implications and socioeconomic constraints of its implementation, respectively. Integrating multiple stakeholders and views will reflect these differences into the operational understanding of critical habitats and will ensure that future critical habitat designations are effective management tools.

1. Introduction

Nature across most of the globe has been significantly altered by multiple human drivers and the great majority of ecosystems and biodiversity indicators are showing a rapid decline. Unless action is taken to reduce these drivers, there will be a further acceleration in the global rate of species extinction (Díaz et al., 2019; Almond et al., 2020; Jaureguiberry et al., 2022). In the EU there are currently multiple policies in place focused on nature protection and restoration aiming to halt and reverse biodiversity loss and ecosystems degradation, such as the *Habitat and Birds Directives* (*Directives 92/43/EEC* and *2009/147/EC*; respectively); the *EU Green Deal* or the *EU's Biodiversity Strategy for 2030*; and even more recently the *Nature Restoration Law*. In Spain, the EU Directives were transposed into the *Spanish Law of Natural Heritage and Biodiversity (LPNB)* (*BOE-A-2007–21490 Ley 42/2007*), which includes the establishment and regulation of the *Spanish Catalog of Endangered Species (CEEA)*, a list with information on all the species classified as *endangered* or *vulnerable*.

As habitat protection plays a central role in the conservation of biodiversity, the *Spanish Law of Natural Heritage and Biodiversity* provides

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that every species listed as endangered in the *Spanish Catalog of Endangered Species* requires the adoption of a recovery plan, including, where appropriate, the designation of critical habitats (*áreas críticas* in the Spanish law). These are defined as "those areas included in the distribution area containing essential habitats to the conservation of the species or that, due to their strategic location, require adequate maintenance" (LPNB, 2007). The concept of critical habitats is also found in other international legislation, such as the United States *Endangered Species Act* (ESA), the Canada *Species at Risk Act* (SARA), the Australia *Environment Protection and Biodiversity Conservation Act* (EPBC Act) or the Mexico *Wildlife General Law* (LGVS). The definition of critical habitat under these policies is better detailed than under the Spanish one, specifying that these areas not only included where the species is present, but also "[…] areas outside the geographical area occupied by the species at the time it is listed" (ESA, 1973) and "[…] regularly used for feeding, depredation, foraging, resting, breeding or reproduction, or migration routes" (LGVS, 2000). However, only the Australia EPBC Act (1999) goes beyond the undefined "essential" concept and specifies detailed criteria to follow for the designation of critical habitat, including habitat used during periods of stress (e.g. flood, drought, or fire); areas necessary to maintain genetic diversity; or for use as corridors.

The term critical habitat is similarly interpreted in the scientific literature, and it is generally defined as the minimum subset of habitat, resources, and conditions, needed to ensure species survival and recovery (Jeffers, 2008) in the long term (Hall et al., 1997; Rosenfeld & Hatfield, 2006; Camaclang et al., 2015). First definitions of critical habitat focused only on areas that showed a higher occurrence of the species population (James Lazell, 1980; USFWS, 1999). However, this definition can fail to distinguish between source and sink areas and therefore, it has been later expanded to also cover currently unoccupied areas that can play a role into species recovery, e.g. because they contribute to connectivity among main populations (Scarpello, 2003, Rosenfeld & Hatfield, 2006; Bender et al., 2010; Heinrichs et al., 2010; Camaclang et al., 2015; Titeux et al., 2019). So, nowadays it is normally considered that critical habitat should be based on different characteristics directly related to habitat quality and quantity (Rosenfeld & Hatfield, 2006; Dunk et al., 2019; Millikin et al., 2020).

Despite the effectiveness of critical habitat has been proved in different contexts (Taylor et al., 2005), the implementation of this management tool remains scarce. For example, as of 2015, only 45 % of species listed under the ESA (U.S.), less than 13 % under SARA (Canada) and less than 1 % under EPBC Act (Australia) had fully designated critical habitats within their corresponding recovery plans (Martin et al., 2016; Bird & Hodges; 2017). In Spain, where only a small number of recovery plans for threatened species have been approved to date, the designation of critical habitat is rare among those, and when present, it is a very generic and ambiguous term and open to interpretation (García-Macía et al., 2021). The scarce use of critical habitat as a conservation tool has been largely discussed (Scarpello, 2003; Rosenfeld & Hatfield, 2006; Greenwald et al., 2012; Camaclang et al., 2015; Martin et al., 2016), finding several problems related to its application. The lack of precision and clarity in legal-scientific terminology stands out commonly, which often causes problems in conservation decision-making (Murphy & Noon, 1991; Hall et al., 1997; Greenwald et al., 2012). Also, when a species is listed as threatened, often there is a lack of information about its habitat and recovery needs; and this data limitation may lead to inadequate identification of critical habitat (USFWS, 1997; Rosenfeld & Hatfield, 2006; Camaclang et al., 2015) or delays in its designation (Shouse, 2002; Martin et al., 2017, Ferreira et al., 2019). Other issues that critical habitat designation faces are: the lack of social acceptance and socioeconomic conflict (Scarpello, 2003; Palm et al., 2020), insufficient funding (Camaclang et al., 2015), and lack of coordination across different administrations (European Court of Auditors, 2017). Additionally, in Spain its application is relatively recent in comparison with other countries, so its use is even more scarce (e.g., the *Spanish Law of Natural Heritage and Biodiversity* from 2007).

Therefore, there is a need to understand how critical habitat is understood, identified, and designated by conservation practitioners and to tackle some of its most important issues, such as its weak and ambiguous definitions and objectives. Our primary objective was to investigate the consistency of expert perspectives on the concept and identification of critical habitat, specifically focusing on the little bustard (*Tetrax tetrax*) as a case study. By analyzing the viewpoints of experts deeply involved in the management of this endangered species, we aim to determine whether there is a consensus or divergence in their understanding of critical habitat. This study contributes to the broader understanding of how stakeholder involved in the conservation of a species interpret and apply critical habitats. We chose the little bustard for its particular characteristics: first, it is a farmland bird species in steep decline. Spain is home to the largest European population of the species with populations that have dropped > 50 % over the last 10 years (García de la Morena et al., 2015). For this reason, the little bustard is classified as *Vulnerable* at the European level (BirdLife International, 2015) and recently reclassified as *Endangered* in Spain (Ministerio para la Transición Ecológica y el Reto Demográfico, 2023). Secondly, the species shows a wide distribution across the Spanish territory, although the population is concentrated in a few regions that hold more than half of the total population (García de la Morena et al., 2018). Third, their distribution and abundance are not constant throughout the year, with migratory movements of varying importance between different Spanish regions (García de la Morena et al., 2015). Finally, the species requires extensive cereal steppe habitats with mosaics of herbaceous vegetation typically associated with traditional agricultural practices like fallows. These habitats are subject to multiple threats such as agricultural intensification (Kuemmerle et al., 2016; Cervera et al., 2019), the substitution of herbaceous crops for woody crops, the reduction of fallow land (Traba and Morales, 2019), as well as the development of renewable energies, urbanization, etc. (Silva et al., 2022). All these reasons make the conservation of the little bustard a challenging case that could serve as an example for other species facing similar problems and conservation challenges (Morales et al., 2023). By exploring the concept of critical habitats for the conservation of the little bustard among the main managers and scientists we aim to demonstrate the importance of devoting effort to agree on the objectives pursued with this conservation management tool, that could be useful for other areas and species.

2. Methods

2.1. Experimental design

To evaluate how the concept of *critical habitat* is interpreted by different stakeholders, we sent an online questionnaire to 98 experts on the conservation and management of the little bustard and other steppe birds. The questionnaire was tested internally and then corrected, before being sent to the experts. The list of experts included public servants working in environmental agencies at national and regional level (46 %), academic researchers (41 %), and consultants knowledgeable about the species (13 %). This list is derived from a prior project aimed at developing the *Scientific Basis for the National Conservation Strategy for the little bustard*, a document that summarizes the current knowledge on the little bustard ecology and defines guidelines to fulfill the legal requirements for the conservation of a species listed in the CEEA. Our aim was to include at least one representative from each relevant department responsible for conservation across all autonomous communities where little bustard populations are present (autonomous communities hold delegated responsibilities for species conservation in Spain). We also sought representatives from The Ministry for the Ecological Transition and the Demographic Challenge (i.e., Ministry of Environment), national and regional NGOs actively engaged in steppe bird conservation, as well as Spanish and Portuguese scientists actively involved in the study of the little bustard or other steppe species. The participants were informed that the questionnaire was anonymous, and they were asked to keep the answers confidential and not share them with other potential participants. The experts were assured that their responses would be used solely for the purpose of exploring the concept of critical habitat for the little bustard and contributing to the overall understanding and conservation of the species. This anonymity was intended to encourage the participants to provide honest and unbiased answers, ensuring the validity and reliability of the results obtained from the questionnaire.

The questionnaire first asked the following three open-ended questions related to the definition of critical areas: 1) What objectives should critical habitats pursue?; 2) Which characteristics and considerations do you believe would be facilitating factors for the designation of a critical habitat?; 3) Which characteristics and considerations do you believe would be constraining factors for the designation of a critical habitat? The questionnaire also contained six closed questions aimed at collecting information about the main occupation of each respondent (public environmental agencies technicians, researchers, private company NGO, or others). (Appendix A).

The question on the critical habitatś objective was designed to uncover participants' understanding and values in relation to this management tool. On the other hand, questions 2 and 3 aimed to explore the conditions respondents viewed as impeding or supporting the identification of critical habitat for this species. While online questionnaires typically steer clear of open-ended questions (Fowler Jr, 2013; Dillman et al., 2014), we chose to incorporate them in our survey because they enable us to capture unanticipated responses that offer a more authentic reflection of participants' perspectives.

2.2. Data preparation

We carefully assessed each answer from the first open-ended question and extracted information to define them into 17 common simple objectives. Then, we classified these objectives following common themes. We identified four main themes or categories: i) *General*: listed objectives linked to the definition of critical habitat as contemplated in the current legislation, such as "being essential areas for the species"; without adding new specific criteria ii) *Species viability*: objectives which were clearly connected to ensuring the long-term survival and persistence of the species throughout the entire territory; iii) *Habitat protection*: objectives focused on ensuring the habitat conservation of the species, throughout its entire annual cycle, including those in unoccupied potential suitable areas and the connectivity among them; iv) *Socioeconomic*: objectives related to the need of minimizing threats and socioeconomic conflicts in the current available suitable habitat. We did the same for the different facilitating factors (from the second question) and constraining factors (from the third question), first defining them into 14 different factors and then grouping them into common themes. This led to the identification of three main categories of criteria: 1) *Ecological factors*: aspects related to the characteristics of the habitat, the presence of the species, or the availability of scientific information of any of the previous; 2) *Socioeconomic factors*: aspects related to the property of the land and the potential stability of land use; 3) *Administrative factors:* degree of legal protection will and ability of the administration to protect the species (Appendix B).

We then translated the responses into a binary database, where each respondent was a case (47 columns) and each response category a variable (17 and 14 rows; objectives and factors respectively) establishing a value of 1 if the respondent's answer fell into the category or 0 if not (Appendix B & C). To rule out the effect of our subjective assignment of responses to common objectives/factors and grouping themes, we repeated the analyses considering different ways of aggregating the responses into different objectives and facilitators/constraints (and their common themes). These aggregations were made by taking the first aggregation (17 objectives and 14 factors), and then unifying some objectives or factors that could be interpreted as very similar and/or by deleting the objectives or factors that were less mentioned (Appendix D).

This method we used mitigates one of the potential concerns associated with open-ended questions of receiving numerous relatively rare and non-analytically useful responses (Fowler Jr, 2013), as all answers, independently how rare or ambiguous, were classified into analytically useful categories. Additionally, the concern that missing data can easily happen (Groves et al., 2011), was addressed in the final section of closed-ended questions, which queried respondents about their expertise level (low, medium, high).

2.3. Data analysis

To explore differences in the interpretation of the concept of critical habitat, we carried out an ordination analysis on the matrix of responses using a Non-Metric Multidimensional Scaling (NMDS). The NMDS summarizes the multidimensional data into a small number of ordination axes (two in this case) while attempting to preserve the rank order of dissimilarity between pairs of samples (Vathy-Fogarassy & Abonyi, 2009). The NMDS was run on a Jaccard similarity matrix built from the binary matrix of responses detailed above. To represent the analysis, a plot with the same number of axes as dimensions is made. These axes display the data in a way that best represents their dissimilarity, where the data points that are more similar and common are closer to the 0 value of the axis, differentiated from the very singular ones which show higher values. The NMDS analysis was carried out using the *vegan* package (Oksanen et al., 2013) available for the statistical software R (R Core Team, 2021).

To explore differences in responses across types of experts, we grouped them into three categories based on their responses to the closed question on occupation: researchers, environmental agency technicians, and the rest (e.g., consultants, NGO technicians, and field technicians) included as others. To test whether answers given by these groups of experts were significantly different between each group in the two-dimension NMDS, a multivariate analysis of variance (MANOVA) test was applied when both axes showed normal distribution; and a Kruskal-Wallis test was conducted, for each axis independently, when their distributions were not normal. When a significant difference across groups was found, we ran a pairwise comparison test of Wilcoxon, with the *Holm* p adjustment method, to explore differences between pairs. These tests were also repeated for every different aggregation mentioned above to explore whether the grouping choice affected the ordination results (Appendix E).

3. Results

We received 47 complete answers out of the 98 surveys sent, from a wide range of respondents which we separated in three: 25 from environmental agency technicians, 13 from researchers (including 4 people working as researchers in environmental agencies), and 9 from other experts (e.g., consultants, NGO technicians, and field technicians). All respondents indicated a "high" level of expertise when asked about their knowledge on the topic of the questionnaire, which was expected, as they were deliberately chosen for their profound knowledge and management involvement of the species. This reduces the risk of missing data linked to open-ended questions, as respondents with high knowledge should be able to easily answer three simple questions related to their field of expertise. The different aggregations of objectives and constraining/facilitating factors tested resulted in very similar results. Hence, only one aggregation (aggregation 4 of objectives and 2 of factors in Appendix C & D), in which all categories had more than one respondent and also showed a good balance of objectives and factors (13 objectives and 11 factors) is shown hereafter (Appendix C & D for a comprehensive view of the other aggregations).

Among all the objectives, three of them (objectives 3, 4, and 5; related to the viability and habitat conservation of the species; Table 1) were consistently mentioned by 38–53 % of the experts. In contrast, objectives linked to socioeconomic aspects or related to specific

Table 1
Description and number of respondents of the objectives, classified into four main categories.

Main categories	Objectives	Respondents
General (1–2)	1. To protect the most important and irreplaceable areas for the species	4 (9 %)
	2. To define the areas where a higher conservation effort should be applied	2 (4 %)
Species Viability (3)	3. To secure the species viability over the entire territory (regionally and nationally) and in the long term	20 (43 %)
Habitat protection (4–9)	4. To protect and improve the species' specific habitat using direct and active management	25 (53 %)
	5. To protect the diversity of habitats providing resources over the entire specie's annual cycle: nidification, mating, feeding, resting, reproduction, and wintering.	18 (38 %)
	6. To protect the areas where the species is present	5 (11 %)
	7. To protect possible (re)colonizable areas	2 (4 %)
	8. To secure the connectivity between populations (area network and ecological corridors)	6 (13 %)
	9. To protect areas big enough for population viability of the species.	2 (4 %)
Socioeconomic (10–13)	10. To ensure adequate management by the landowners	5 (11 %)
	11. To establish aids (financial and informative) for the landowners	2 (4 %)
	12. To forbid or limit human activities that threaten the maintenance of land uses favorable for the species	9 (19 %)
	13. To establish a legal protection figure	2 (4 %)

Table 2
Description and number of respondents of the facilitators and constraints, classified into four main categories.

Main categories	Factors (Facilitating/ Constraining)	Facilitating f. answers	Constraining f. answers
Ecological	1. High/Low presence and abundance of the species (breeding population) during the annual cycle	25 (53 %)	2 (4 %)
	2. Availability/Lack of expert knowledge (scientific data)	10 (21 %)	7 (15 %)
	3. Favorable/Unfavorable habitat (generally, without specifics)	11 (23 %)	0 (0 %)
	4. Favorable/Unfavorable ecological characteristics of the area (vegetation structure, reproduction success)	22 (47 %)	5 (11 %)
	5. Favorable/Unfavorable physical characteristics of the area (extension, topography)	14 (30 %)	4 (9 %)
	6. Good/Bad connectivity and location (distribution)	12 (26 %)	1 (2 %)
	Total Ecological	45 (96 %)	15 (32 %)
Socioeconomic	7. Stability/Instability and favorable/unfavorable type of main land use	12 (26 %)	31 (66 %)
	8. Public/Private land and favorable/unfavorable landowner collaboration	10 (21 %)	23 (49 %)
	9. Favorable/Unfavorable general socioeconomic interests (development of agricultural, energetic, and forestation plans)	11 (23 %)	20 (43 %)
	Total Socioeconomic	27 (57 %)	43 (91 %)
Administrative	10. Good/Bad socioeconomic conflict resolution ability and will of the administration to protect the species	4 (9 %)	9 (19 %)
	11. High/Low protection level	12 (26 %)	4 (9 %)
	Total Administrative	13 (28 %)	13 (28 %)

*Note that the same factor could appear as facilitating or constraining in the responses, expressed positively or negatively sometimes even by the same respondent. For example, "having good scientific information" and "not having good scientific information" have been identified as facilitating and constraining factors respectively, but both refer to the same overall factor "knowledge of the ecology and requirements of the species". For the sake of clarity, both positive and negative responses were grouped and considered as a single factor.

characteristics of the current or historic areas of species occurrence and its functional connectivity (e.g., Objectives 6 to 9) were only mentioned by less than 13 % of respondents (Table 1) (exception of objective 12 mentioned by 19 % of respondents).

For the different factors mentioned, we observed that all of them were described, even sometimes by the same person, either negatively as constraints, or positively as facilitators. For instance, the *availability* or *lack* of scientific data could be mentioned either as a facilitator or constraint. Therefore, regardless of their category (ecological, socioeconomic, or administrative), every factor had the potential to be cited as either a constraint or a facilitator, depending on how it was phrased (Table 1). However, we noticed a significant distinction between factors identified as facilitators and those seen as constraints. When asked about constraints in designating critical habitats, a majority of respondents (91 %) highlighted socioeconomic aspects, while only 32 % mentioned ecological aspects. Conversely, when asked about facilitating factors, most respondents (96 %) cited ecological factors, while only 57 % mentioned socioeconomic factors (Table 2).

The NMDS showed a stress value of 0.065, suggesting a good representation of the data structure (Fig. 1). The ordination of objectives in the first two axes, showed how the objectives are distributed and their previously mentioned main categories (General, Habitat protection, Species viability, and Socioeconomics). The first axis is mostly explained by the two objectives within the *General* category, which are located on both extremes of the first axis. On the other hand, the second axis of the ordination differentiates between the more ecological type objectives (Habitat protection and Species viability), all showing positive values (except viability which is near 0), and the others (Socioeconomics and General), all having negative values.

We found significant differences between the responses given by researchers and the remaining groups on the first axis (Kruskal-Wallis: Chi-square = 6.17, p = 0.01; Pairwise Wilcoxon with Holm p-value adjustment: p = 0.04 (for both researchers vs administration agents and researchers vs others)). It was also noticeable that the responses from environmental agency technicians and others were more heterogeneous than those by researchers, which are closer to the ecological type objectives (Fig. 1 b).

The NMDS ordination of the identified facilitating and constraining factors reported a stress value of 0.21, indicating that the ordination was weaker than for the objectives. The socioeconomic factors, which were the most commonly factors mentioned (mean = 28 experts per socioeconomic factor), appeared closer to the center of the ordinations, while the ecological factors, which tended to be less commonly answered and, therefore, marking differences across respondents (mean = 17 experts per ecological factor), appeared closer to the extremes of the ordination axes (Fig. 2a). The ordination also shows a high similarity between factors 7, *stability and type of main land use*, and 10, *socioeconomic conflict resolution ability and will of the administration to protect the species*, which were classified as different main categories (socioeconomic and administrative, respectively); and factors 9, *socioeconomic interests*, and

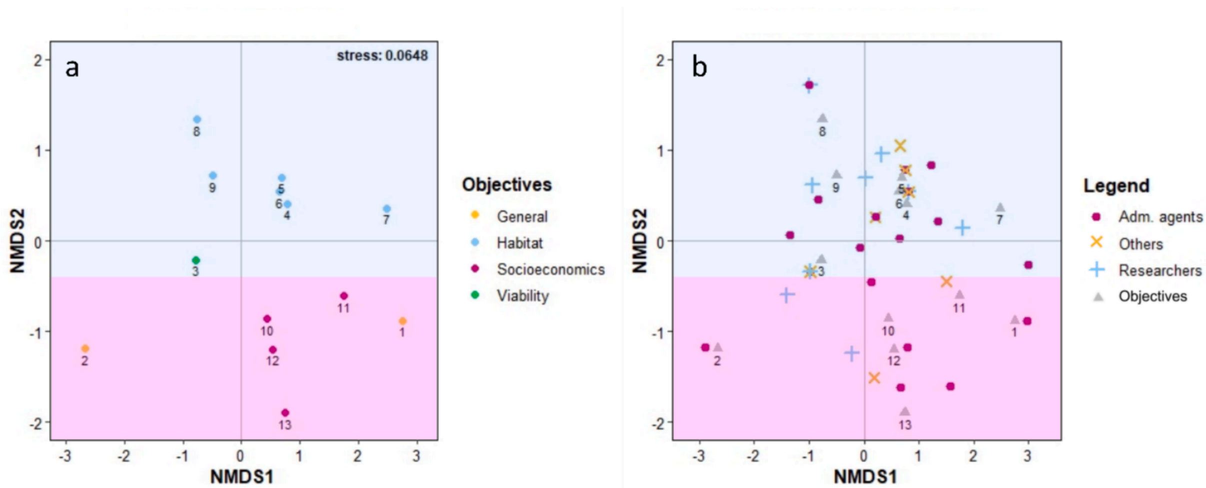

Fig. 1. Ordination results (NMDS) of stakeholders' perceptions about the objectives that should be pursued with the designation of critical habitats. a) Objectives (NMDS loadings) classified into the four main categories detailed in Table 1. The two background colors in the ordination plot aim to be a guide to show the separation between the more ecological type objectives (Habitat and Viability) and the Socioeconomic and General objectives (separation along the Y axis). b) Ordination of the different respondents, grouped by occupation (administration agents, researchers, and others). The ordination of objectives (as in Fig. 1a) is also shown in light grey colors for reference.

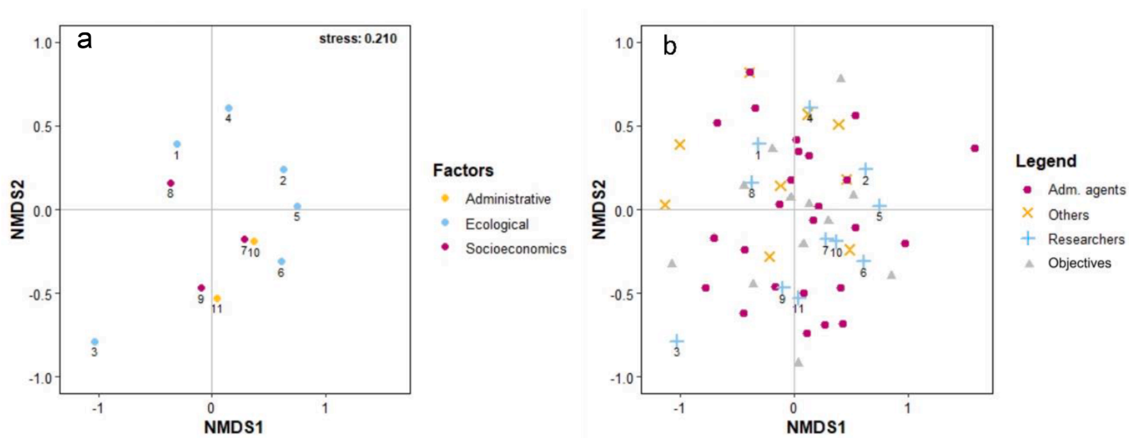

Fig. 2. Ordination results (NMDS) of stakeholders' perceptions about the facilitating and constraining factors when designating critical habitats. Every factor was treated as a single element, so this ordination does not differentiate between constraints and facilitators. a) Factors (NMDS loadings) classified in the three main categories detailed in Table 2. b) The different studied occupation groups are shown (administration agents, researchers, and others) for the cases (NMDS scores). The ordination of factors (as in Fig. 2a) is also shown in light grey colors for reference.

11, *protection level*, with the same different main categories as factors 7 and 10.

The MANOVA and Kruskal-Wallis test showed that there were not strong statistical differences between groups of experts ($F = 1.13$, $p = 0.35$).

4. Discussion

The legal concept of critical habitat varies in its definition and interpretation across different countries, with some nations, such as Spain, lacking clear guidelines for its designation process. Our work highlights the divergent interpretations and understandings of critical habitats held by Spanish practitioners. These variations in perception are crucial to acknowledge, especially when working with different stakeholders. In our study, we found that practitioners involved in the conservation of a threatened species held diverse interpretations of the critical habitat concept, often extending beyond what is explicitly outlined by policy. For instance, environmental agency technicians considered socioeconomic factors as relevant objectives for critical habitat, while researchers mostly defined objectives linked only to the species' ecological aspects. However, both groups of experts identified the same socioeconomic elements as constraints for the designation of critical habitats, while ecological aspects such as the abundance of the species or habitat characteristics were considered facilitators for such designation. We did not find a clear differentiation between groups of experts concerning the facilitating or constraining aspects of the critical habitat designation process.

The most mentioned objectives in the questionnaire were the ones related to the long-term population viability of the species and the conservation of its habitat across its entire annual cycle, suggesting that experts generally agree that the identification of critical habitat should be tightly linked to the habitat needs of the species and its potential to maintain viable populations (e.g. habitat quality) (Rosenfeld & Hatfield, 2006). Some experts also mentioned the need to define critical habitat in areas where the species currently occurs while only 4 % of the experts mentioned the need to aim to recover areas where the species has recently disappeared from. This perspective of focusing conservation based on species presence contrasts with the contemporary approach to prioritizing conservation areas with high quality habitats for species. To clarify, current conservation efforts typically focus on identifying regions based on favorable habitat conditions, prioritizing areas that can be (re)colonized by the species (Millikin et al., 2020), rather than only areas where the species still remains present (such as our results suggest) and may be affected by the *shifting baseline syndrome*, which refers to the perception of the current state of the environment or species population as normal, despite gradual changes over time (Soga & Gaston, 2018). The contrast in conservation strategies likely arises from conservative administrative approaches favoring safer, risk-averse methods prioritizing existing species presence. This reliance on established methods avoids uncertainties related to (re)colonization efforts, reflecting a cautious conservation decision-making stance. Unfortunately, this approach may hinder adapting strategies to address the *shifting baseline syndrome*, highlighting the need for a more dynamic conservation paradigm. Furthermore, in regions where only residual populations of the little bustard persist, targeted habitat restoration and reintroduction programs present promising opportunities. By restoring former habitats and reintroducing individuals, these areas can actively bolster little bustard populations. Such efforts, while potentially challenging, hold promise for fostering resilience in little bustard populations and contributing to broader conservation goals.

Other objectives mentioned by experts were related to socioeconomic factors but formulated in a way that shows they could have mistaken objectives for the plan on how to achieve those objectives. For example, giving subsidies and informative and educative programs to ensure good management practices by landowners is only a means towards achieving the main objective of ensuring that suitable habitat is available for the species. This confusion may have caused environmental agency technicians to include important socioeconomic aspects that are key to ensuring successful management and acceptance as objectives, explaining the difference in the NDMS ordination between the responses by researchers and the other experts. Administration agents must often directly face many of the conflicts that the management on the ground of these species generates, therefore explaining the importance that this group gives to socioeconomic objectives when designating critical habitats. However, not clearly defining objectives is a common mistake in conservation priority setting and when it happens, there is not a good basis for prioritization of actions, hampering and jeopardizing the efficient use of limited resources (Game et al., 2013). Our results suggest that researchers understand better the distinction between objectives and actions, as they have mentioned socioeconomic factors as possible considerations when designating critical habitat, but when listing the objectives of these areas, they have only mentioned objectives focused on the ecology of the species as defined in their legal and scientific definition.

The designation of critical habitats frequently leads to socioeconomic conflicts, such as opposing landowners and court haggles (Hagen & Hodges, 2006). In the case of the little bustard, these conflicts are even more obvious, as this species depends on extensive dry cereal steppes with presence of fallows and pastures. Since the second half of the twentieth century, the farmland birds and little bustard population specifically of this farming system have suffered population declines associated with the loss of fallow land and sheep grazing (Traba & Morales, 2019; Traba & Pérez-Granados, 2022), due to the shift from a traditional agriculture-dominated landscape to a more productive and intensive farming system (Kuemmerle et al., 2016; Morales et al., 2022) or the currently rising photovoltaic extensive systems, which are generally planned in low-cost marginal lands (Serrano et al., 2020). Given that little bustard populations are found on agricultural lands that are mostly private, it is no surprise we found the socioeconomic factors (e.g. potential land use, land ownership aspects) were mentioned by almost all respondents, independent from their professional backgrounds, generally as constraints. This emphasizes the need to integrate socioeconomic factors when defining critical habitats. While ecological goals are clear, socioeconomic considerations, especially for species like the little bustard, are crucial for their effective implementation (Knight et al., 2006; Redpath et al., 2013). Involving local stakeholders is essential thus, not only to prevent conflicts but also to promote conservation among those directly engaged with the species and its habitat, adding their on-the-ground insights that often are missed (Arlettaz et al., 2010; Cañedo-Argüelles et al., 2019).

5. Conclusion

In conclusion, our study highlights the diverse interpretations of critical habitats held by experts involved in the conservation of the little bustard in Spain. These differences in interpretation are important to pay attention and we believe it underscores the need for a collaborative, inclusive, and coordinated approach from the very outset of any critical habitat designation exercise, as many authors suggest (Game et al., 2013; Redpath et al., 2013; Whitehead et al., 2014; Martin et al., 2016). Furthermore, it is worth noting that the divergence in interpreting the concept may partly arise from the broad and ambiguous legal definition of critical habitats in Spain. Updating this definition to a more precise one could mitigate personal interpretations among experts, thus enhancing the effectiveness of conservation efforts. Nonetheless, the definition of objectives and facilitating/ constraining factors identified here could be used as a first guide for a critical habitat designation process and consequently help improve the management of the little bustard, and other species with similar ecological needs, in Spain.

Future studies should further explore how some of the aspects highlighted in this study (e.g., stakeholders' perspectives, socioeconomic conflicts, or administrative coordination) could be addressed in the process of designating critical habitats or in the definition of specific actions to be implemented. We suggest that more research on this matter should be done, especially on different species where the ecological need of every species is considered, and the group of experts consulted reflect the full diversity of stakeholders involved in the conservation and management of the species at different levels (horizontal consultation process).

6. Declaration of Generative AI and AI-assisted technologies in the writing process

During the preparation of this work the author used ChatGPT (https://chat.openai.com/) to improve language and readability of some parts of the text, as the author is not a native English speaker. After using this tool/service, the author reviewed and edited the content as needed and take full responsibility for the content of the publication.

CRediT authorship contribution statement

Gabriel Miret-Minard: Writing – original draft, Visualization, Methodology, Formal analysis. **Virgilio Hermoso:** Writing – review & editing, Supervision, Methodology, Formal analysis, Conceptualization. **Dani Villero:** Writing – review & editing. **Gerard Bota:** Writing – review & editing, Methodology. **Lluís Brotons:** Writing – review & editing. **Alejandra Morán-Ordoñez:** Writing – review & editing, Supervision, Methodology, Investigation, Funding acquisition, Conceptualization.

Declaration of competing interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

Data availability

Data will be made available on 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.jnc.2024.126633.

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