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Using Scenarios for Reducing Uncertainties in Biodiversity Conservation: From Global Targets to European Steppes

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ABSTRACT

Scenario analysis allows assessing how complex socio-ecological systems might respond to different policy pathways. We used an expert-based participatory approach to explore how four different European socio-ecological scenarios could impact (1) the implementation of the Kunming–Montreal Global Biodiversity Framework (KM-GBF) and (2) the achievement of priority conservation actions for safeguarding European steppe ecosystems. KM-GBF targets were expected to be met only under the scenario with increased commitment for sustainable development goals and global cooperation, but hardly achievable under the most environment-adverse and resource-demanding scenarios. Integrating different views from these scenarios, we identified six overarching recommendations for the conservation of European steppe ecosystems, including improving public awareness, empowering local communities, and promoting the engagement of private companies into conservation planning. Our approach identifies how socioeconomic drivers influence the success of the KM-GBF and the conservation of European steppes, providing a range of general conservation actions structured and prioritized to be effective under a wide range of likely future developments.

1 | Introduction

Human-driven biodiversity loss is taking place at an unprecedented rate across an increasingly interconnected world (Jaureguiberry et al. 2022), magnifying the challenges of biodiversity conservation (IPBES 2019; CBD 2022). Aiming to reverse biodiversity loss, the Kunming–Montreal Global Biodiversity Framework (KM-GBF) was adopted at the end of 2022 to set out an ambitious roadmap for realizing the "global vision of a world living in harmony with nature by 2050" (CBD 2022). Meeting this goal requires the development of long-term conservation actions, whose efficiency inherently depends on the evolution of socioeconomic, technological, and political factors in the short and medium term. In light of these uncertainties, exercises incorporating scenarios are gaining momentum in biodiversity conservation. Scenarios serve as powerful tools to anticipate and prepare for future unknowns, enabling the development of expert-based long-term strategies (Wiebe et al. 2018; Rosa et al. 2020; Roura-Pascual et al. 2024).

Scenario analysis is an established method for assessing how complex socio-ecological systems might respond to different policy pathways (Duinker and Greig 2007; Rosa et al. 2020; Roura-Pascual et al. 2021). Scenarios are holistic depictions of potential futures that allow the exploration of possible trajectories of different facets of the system (e.g., politics, economy, environment), which might be useful to anticipate the potential consequences of different events (Wiebe et al. 2018; Rosa et al. 2020). Previous studies have used scenarios to integrate alternative future pathways into a common set of conservation recommendations, which are usually of broad scope, as they should work under a wide range of political and economic environments (e.g., Leclère et al. 2020; Roura-Pascual et al. 2024). An example of such scenarios is the set of European Shared Socioeconomic Pathways (Eur-SSPs hereinafter; Kok et al. 2019, downscaled from the global SSPs; O'Neill et al. 2017), which outline potential socioeconomic trends and their impact on climate change at the European scale. Initially designed for climate studies, SSPs also aid interdisciplinary collaboration in biodiversity conservation efforts (Li et al. 2022; Alexander et al. 2023). Recent initiatives, such as the IPBES Nature Futures Framework, have been made to translate SSPs narratives to better support biodiversity assessments (Alexander et al. 2023).

European steppes encompass a diverse range of natural and semi-natural open habitats, including natural steppes, dry cereal farmlands, grasslands, and scrublands (Sainz Ollero 2013). Despite being an integral part of Europe's biodiversity, they are among Europe's most rapidly degrading ecosystems due to human socioeconomic activities, notably agricultural intensification, land abandonment, and development of energy infrastructures (Ellis et al. 2010). European steppes host unique animal and plant communities (Kirschner et al. 2020), with steppe birds being one of the most threatened bird groups in Europe (Burfield et al. 2023). Recently, Pérez-Granados et al. (2025) proposed ten priority conservation actions aimed to attain the KM-GBF targets for European steppes by 2050 and to reverse the decline of steppe birds. However, the proposed conservation actions lack additional guidance on their practical implementation as well as an assessment of their long-term feasibility.

In this study, we use a scenario framework that integrates the Eur-SSPs with (i) the achievement of global biodiversity targets and (ii) the development of long-term conservation recommendations for European steppe birds. First, we use the Eur-SSPs to explore how the different pathways impact the potential achievement of

Ten priority conservation actions for steppe birds and their ecosystems proposed by Pérez-Granados et al. (2025) aimed at achieving the first eight targets of the Kunming–Montreal Global Biodiversity Framework. Full descriptions of the priority conservation actions and the developed long-term recommendations can be found in Supporting Information S1

Management actions: *Manipulative, purposeful actions performed on species or their habitat.*
Action 1: Implement in situ habitat management actions.
Action 2: Restore degraded areas.
Action 3: Improve invertebrate availability.
Action 4: Fund environmentally friendly management actions.
Regulatory actions: *Actions that regulate certain activities or promote regulations on land-use transformation.*
Action 5: Minimize the impact of infrastructures.
Action 6: Legally protect priority areas.
Action 7: Reduce the use of pesticides, fertilizers, and coated seeds.
Societal actions: *Actions aimed to increase public engagement.*
Action 8: Engage local communities.
Action 9: Promote long-term land stewardship programs and land purchases.
Research action: *Actions that promote research for effective management decisions.*
Action 10: Improve the quality and implementation of monitoring programs.

the KM-GBF targets for European biodiversity. Second, we use four Eur-SSPs to delineate a set of long-term recommendations for the conservation of steppe birds based on a set of priority actions designed to achieve the KM-GBF targets (Box 1; Pérez-Granados et al. 2025). Our scenario framework might constitute a versatile tool to inform long-term conservation policies, such as the KM-GBF, and to further contribute to a resilient conservation planning for European steppe ecosystems.

2 | Material and Methods

2.1 | Participatory Process

The participatory process took place during an online workshop held on June 28 and 30, 2023, which was composed of two sessions lasting approximately 3 h each. The workshop was attended by 32 participants from nine European countries, mostly Western European, where remnants of steppe bird populations currently concentrate (Supporting Information S2). Participants were selected to represent active experts in different aspects of steppe bird and ecosystem conservation across Europe, including academic researchers, conservation managers, policymakers, and experts on scenario analyses (Supporting Information S2). Academic researchers mostly belong to the Research Group on Steppe Birds, and they have ample expertise in steppe conservation and global and European conservation initiatives, such as IPBES and IUCN. Academics in turn contacted managers, policymakers, and experts in scenario analyses with whom they have collaborated. Most participants were researchers specialized in steppe ecosystems (25 participants; 78%), while other attendees were managers or policymakers, or experts in scenario analyses (2 and 5 participants, respectively, see Supporting Information S2). All workshop participants, including researchers, managers, and experts in scenarios analyses, were invited to participate as co-authors in this manuscript.

Four scenarios—the Eur-SSPs—were considered, consisting of alternative future trajectories in relation to the socioeconomic, political, and environmental development in Europe. The Global-SSP2 was not downscaled for Europe, so it was not considered in this study (see Kok et al. 2019 and full descriptions in Supporting Information S3):

- Eur-SSP1 ("We are the World"): A sustainable future with global cooperation and less resource-demanding lifestyles;
- Eur-SSP3 ("Icarus"): A future in which countries struggle to maintain living standards in a high-carbon intensive Europe;
- Eur-SSP4 ("Riders on the Storm"): A world in which power becomes concentrated in a small elite and where Europe becomes an important international player with a shift toward a high-tech green development;
- Eur-SSP5 ("Fossil-fueled Development"): A future where a lack of environmental concern leads to the overexploitation of fossil fuel resources addressed by technological solutions.

Participants were divided into four groups, each with seven to nine experts, using stratified samples to ensure representation of different stakeholders, and four to five representatives from different European countries (Figure 1). The number of participants per group was selected to allow effective interaction among participants and reach consensus within each group swiftly. Each group worked on a different scenario, chaired by two facilitators: one with expertise in steppe habitats, and the other in scenario analyses and online participatory processes (Supporting Information S2). Prior to the workshop, the facilitators held a preparatory meeting to align on the participatory protocol, organize the session structure, and define practical guidelines to ensure consistency across the discussions. At the beginning of each group session, facilitators provided participants with clear instructions on the process, including how agreement and voting would be handled. The facilitators ensured that all participants had equal opportunities to contribute and that no single voice dominated the discussion. Consensus was reached through structured discussion rounds that incorporated diverse viewpoints, and participants verbally confirmed agreement on the final decisions.

2.2 | Step 1: Assessing Scenario Challenges

For each Eur-SSP scenario (group), the participants discussed the main challenges for achieving the first eight KM-GBF targets, following the global vision of the KM-GBF of "a world living in harmony with nature by 2050" (CBD 2022). We focused on the first eight targets of the KM-GBF because they specifically aim to tackle biodiversity loss through (i) effectively protecting, managing, restoring, and connecting at least 30% of important areas (Targets 1, 2, and 3); (ii) ensuring management actions to reduce extinction risk of threatened species and promoting

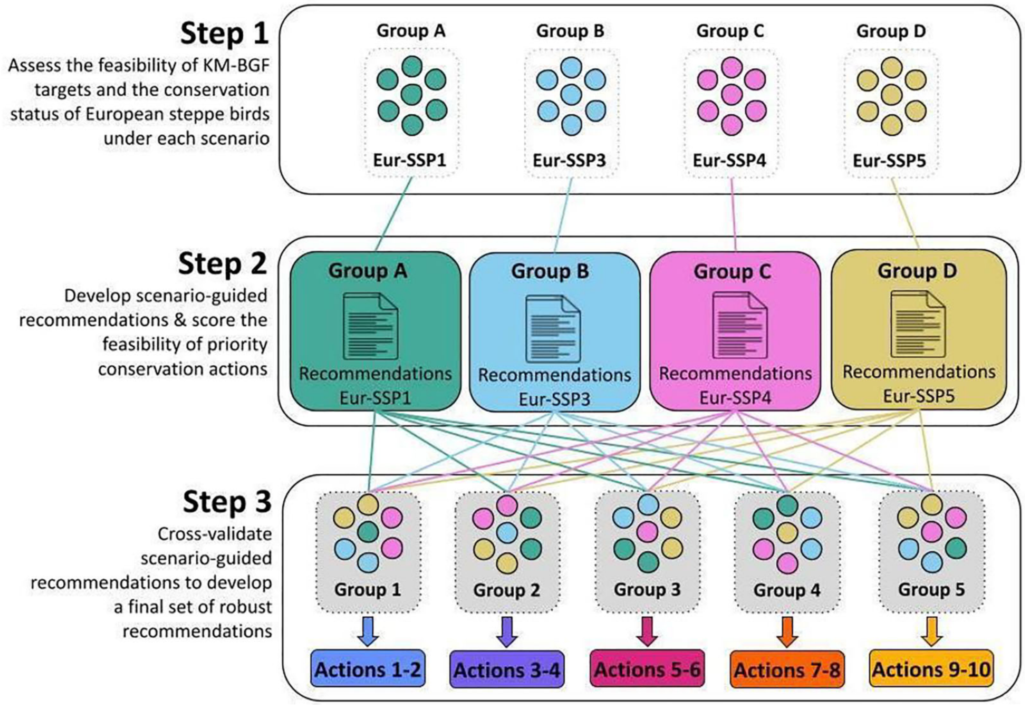

FIGURE 1 | Workflow for elaborating recommendations to achieve the Kunming–Montreal Global Biodiversity Framework (KM-GBF) targets and protect European steppe birds and their ecosystems under the most likely future socioeconomic scenarios for Europe (Figure 3). Step 1: Participants, divided into four breakout groups, assessed the feasibility of achieving the KM-GBF targets (Figure 2), and the future conservation status of European steppe birds under the different European Shared Socioeconomic Pathway (Eur-SSPs, Figure 3); Step 2: Each breakout group defined scenario-guided recommendations for the ten priority conservation actions developed to achieve the KM-GBF targets in European steppes (Box 1), resulting in four independent sets of scenario-specific recommendations; Step 3: Participants jointly developed a final set of recommendations by integrating the proposals made under each Eur-SSP (Box 1).

the sustainable use of species and ecosystems (Targets 4 and 5); (iii) preventing or reducing the introduction and establishment of invasive alien species (Target 6); (iv) reducing nutrient lost to the environment and the use of pesticides (Target 7); and (v) contributing to climate change mitigation and adaptation (Target 8) (CBD 2022). Each group discussed the feasibility of achieving each target by 2050 under their respective scenario, and collectively agreed to classify them as "very unfeasible," "unfeasible," "feasible," or "very feasible" (see consensual rationale in Supporting Information S3).

Second, the participants focused on the challenges of each scenario for the conservation of European steppe birds. Consensus was also reached on the expected conservation status of European steppe birds under each scenario in 2050, as compared to 2023. Conservation status for the overall community of steppe birds was classified as "highly unfavorable," "unfavorable," "equal," "favorable," or "highly favorable." A rationale was also provided for the expected conservation status under each scenario (Supporting Information S3).

2.3 | Step 2: Formulate Scenario-Guided Recommendations for Priority Actions

During this step, each participant anonymously assessed the feasibility of implementing each of the ten priority conservation actions proposed in Pérez-Granados et al. (2025) by 2050 according to its respective Eur-SSP, scoring them on a scale from 0 to 10 (0 = not feasible, 10 = totally feasible). Subsequently, each scenario group formulated recommendations taking into account the specificities and characteristics of its scenario to improve the long-term feasibility of each priority conservation action (Figure 1). We fitted two generalized linear mixed models with a Poisson error distribution to analyze overall differences in action feasibility across scenarios (m1), and whether there were differences between action types for each scenario (m2). To this end, we used the feasibility score for each action as response variable, participants as random effect to account for data nonindependence, and scenario as explanatory variable for m1, while we considered the interaction between action type and scenario as additional explanatory variables for m2. To assess pairwise similarity, we calculated marginal means based on the above models. Analyses were run in R v 3.6.2 (R Core Team 2023) using the packages *tidyverse* (Wickham et al. 2019), *emmeans* (Lenth 2023), and *lme4* (Bates et al. 2015).

2.4 | Step 3: Developing a Common Set of Recommendations

In this step, participants were reassigned to five different groups, each consisting of five to seven members, ensuring representation from every scenario group (Figure 1). Each group was attributed two of the ten priority actions, to discuss each of the four scenario-guided recommendations (developed during the second step)

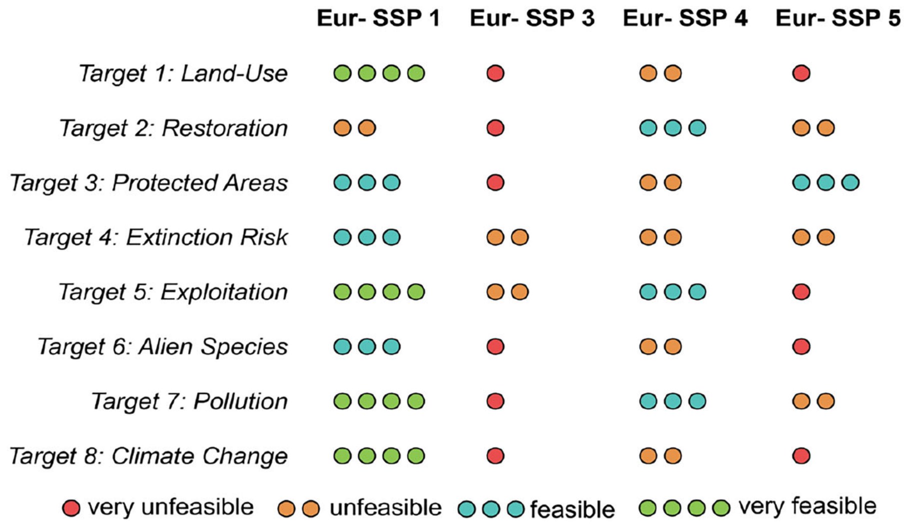

FIGURE 2 | Feasibility of achieving the first eight targets of the Kunming–Montreal Global Biodiversity Framework (see targets' description in Section 2.2) by 2050 under the four European Shared Socioeconomic Pathways (Eur-SSPs, Kok et al. 2019). Consensus rationales regarding each feasibility are in Supporting Information S3.

and elaborated a preliminary set of recommendations aimed at improving their feasibility under all scenarios. Then, all workshop participants discussed together the recommendations developed by each group, collaboratively drafted the final set of recommendations, and identified, through group consensus, key overarching recommendations, defined as those that appeared in multiple conservation actions. This subset of overarching recommendations was identified to facilitate the decision-making process and ensure efficient allocation of available funds, since their successful implementation might contribute to the achievement of multiple conservation actions simultaneously.

3 | Results

3.1 | Achieving the KM-GBF Targets Under Each Scenario

Eur-SSP1 was the most positive scenario, where all targets were deemed "feasible" or "very feasible," with the exception of Target 2 (habitat restoration), which was considered "unfeasible" (Figure 2). Effective steppe restoration may be compromised in this scenario by an increasing demand for arable land and intensive grassland. Under Eur-SSP4, five of the KM-GBF targets were categorized as "unfeasible" and three as "feasible." Feasible targets included habitat restoration (Target 2), reducing species' exploitation (Target 5), and controlling environmental pollution (Target 7), due to the predicted development of novel green technologies for human impact mitigation. Finally, Eur-SSP3 and Eur-SSP5 were the most pessimistic scenarios (Figure 2). Eur-SSP3 posed the greatest challenges, with all targets considered as "very unfeasible" (six targets) or "unfeasible" (two targets). Under Eur-SSP5, four targets were considered as "very unfeasible" and three as "unfeasible." Target 3 (related to protected areas) was however judged "feasible" due to the expected reduction of human pressure on rural areas, which may facilitate habitat protection under Eur-SSP5 (Figure 2).

3.2 | Projecting the Conservation Status of Steppe Birds

Consensus-based conservation status of steppe birds by 2050 also varied greatly under the different Eur-SSPs and ranged from "highly unfavorable" for Eur-SSP5 to "favorable" under Eur-SSP1 (Figure 3). The conservation status for Eur-SSP3 and Eur-SSP4 was projected as "unfavorable" (Box 2).

3.3 | Feasibility of the Ten Priority Actions for European Steppe (Bird) Conservation

We found statistically significant differences in the expert-assessed feasibility of implementing conservation actions across scenarios. Action feasibility in Eur-SSP1 was significantly higher than in all other scenarios and significantly lower in Eur-SSP3 compared to all other scenarios. Both Eur-SSP4 and Eur-SSP5 showed intermediate action feasibility but no significant difference among them (see graphs and pairwise results for each scenario in Supporting Information S4 and S5). The feasibility of implementing regulatory and management actions showed a similar pattern across scenarios, although the feasibility of implementing management actions was significantly lower in Eur-SSP5 than under Eur-SSP4. For research-related actions, Eur-SSP1, Eur-SSP4, and Eur-SSP5 showed equal feasibility, which was significantly higher than for Eur-SSP3. Finally, Eur-SSP1 and Eur-SSP5 had highest feasibility scores for societal actions, while Eur-SSP3 had, again, significantly lower feasibility scores than all other scenarios (see graphs and pairwise results for each scenario inSupporting Information S4 and S5).

3.4 | Conservation Recommendations

We developed recommendations to facilitate the long-term implementation of each of the ten priority actions for European steppe (bird) conservation across all target scenarios (Supporting Information S1). We also identified the following six overarching

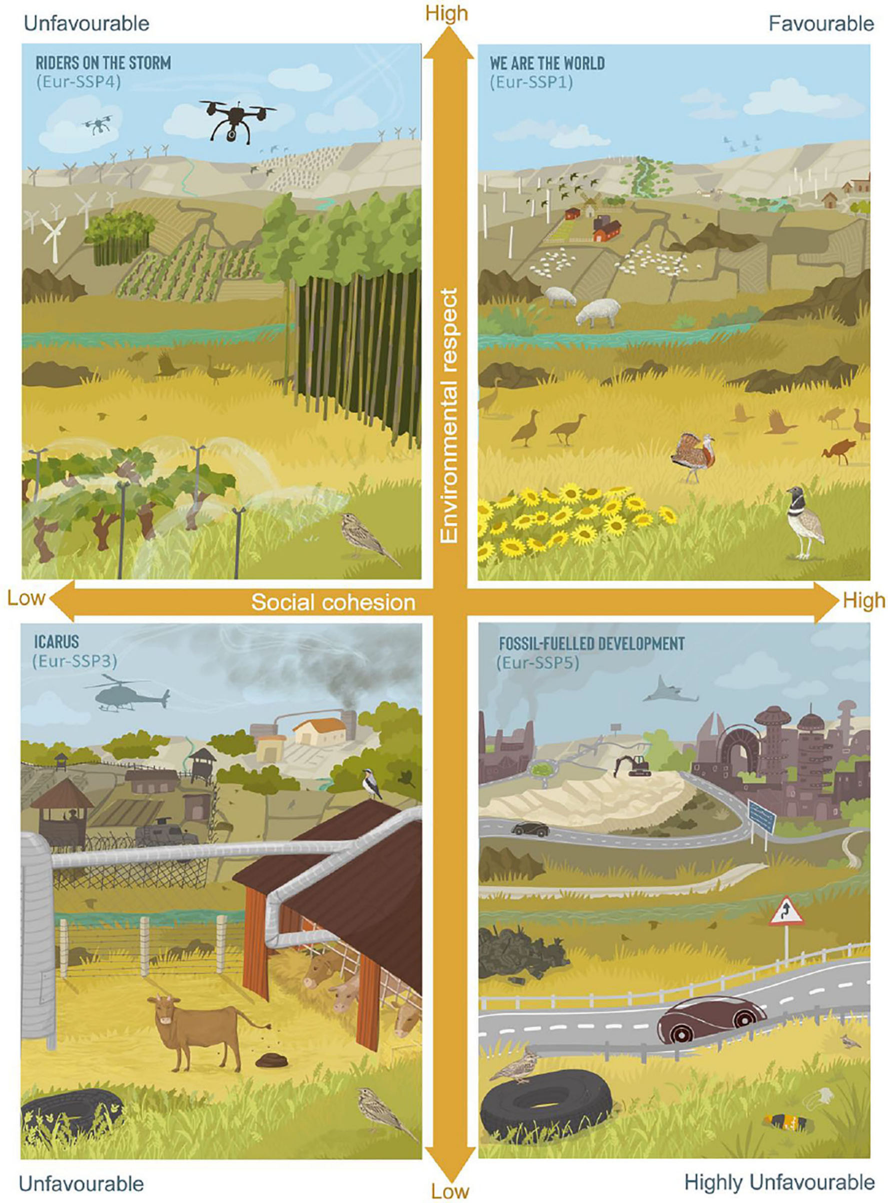

FIGURE 3 | Illustration of the four European Shared Socioeconomic Pathways (Eur-SSPs) regarding the future status of steppe birds in Europe. Scenarios are divided according to environmental respect and social cohesion. The projected conservation status of European steppe birds under each Eur-SSP is shown in the corner of each scenario. Scenario illustrations created by Carmen Cañizares.

recommendations (Box 3), whose implementation would benefit multiple priority conservation actions (Figure 4): (i) engaging the private sector in steppe conservation by promoting business opportunities, (ii) taking into account local knowledge and cultural heritage, (iii) promoting the development of more inclusive and participatory societies, (iv) raising public awareness, (v) making use of new technologies, and (vi) identifying and using iconic and umbrella species that may benefit the conservation of the entire European steppe bird community.

4 | Discussion

In this study, we combined a participatory approach, carried out together by experts and managers, with scenarios, focusing on the Eur-SSPs, to elucidate the potential impacts of socioeconomic trajectories on both the achievement of the KM-GBF targets at European scale and the implementation of conservation actions for preserving European steppes under alternative futures. Our online participatory process allowed us to reach consensus for safeguarding European steppes within a timely manner, but our findings should be interpreted with caution. The resulting recommendations are primarily grounded in the expertise of researchers with decades of cumulative experience on steppe (bird) ecology and conservation, predominantly from Western Europe. Although we made efforts to broaden this academic input across Europe and to include nonacademic stakeholders—such as land managers and representatives from the public and private sectors (e.g., hunters, farmers, agribusiness companies, NGOs, energy renewable corporations) only a small set of experts from these sectors accepted our invitation. We acknowledge that their perspectives are likely underrepresented; however, those experts

Consensus rationale for the projected conservation status of European steppe birds by 2050 under the different Eur-SSPs. See illustrations about potential futures of European steppes under each Eur-SSP in Figure 3

Eur-SSP1 ("We are the World"): Conservation status was projected to be "favorable," with a main caveat on how to reconcile steppe bird conservation with the expansion of renewable energy, arable land, and intensive grassland, land-use changes known to threaten steppe birds.

Eur-SSP3 ("Icarus"): Conservation status was projected to be "unfavorable" due to increasing pollution, climate change, energy production (expected to have a high negative impact in steppe ecosystems), and weaker governance (e.g., may increase illegal hunting and unregulated infrastructure development), although the projected increase of extensive agriculture may partly benefit steppe birds.

Eur-SSP4 ("Riders on the Storm"): Conservation status was projected to be "unfavorable" due to the projected increase in agricultural intensification, land abandonment, rural depopulation, and the expansion of renewable energies and associated infrastructures. Nonetheless, the transition toward a high-tech green Europe and high environmental respect opens the door for implementing certain actions.

Eur-SSP5 ("Fossil-fueled Development"): Conservation status was projected to be "highly unfavorable" owing to the high polarization between agricultural intensification and abandonment of agricultural land, which together with low environmental respect will make it difficult to protect steppe birds at European scale.

involved also work across a wide range of steppe systems and interact with stakeholders from different sectors so that we are confident that we at least capture essential parts of that spectrum. While the inclusion of a wider range of stakeholders might have introduced richer and alternative perspectives shaped by local priorities and personal experiences, we can reasonably anticipate that some sectors would align more closely with our research-based recommendations—particularly NGOs, conservationists, and segments of the small-scale farming community. In contrast, other actors such as large agribusinesses or representatives of the renewable energy sector might have raised concerns or disagreed with specific proposals. Although our study reflects a bias toward academic expertise and Western European contexts, it provides a solid foundation for cross-sectoral and cross-country dialogue—an essential function of science in fostering inclusive, evidence-based policymaking. Notably, every stakeholder that accepted the invitation was also part of the workshop.

We acknowledge that although our results are European-focused, the cross-cutting recommendations described may still be applicable to steppes outside Europe as the main threats driving steppes' degradation—such as agricultural intensification, development of infrastructures, and land abandonment are shared among regions (Wesche et al. 2016). Moreover, although we used the Eur-SSPs, these were downscaled from the Global-SSPs (see Kok et al. 2019), and both sets are well aligned (Kok et al. 2019; Pérez-Granados et al. 2025). While non-European stakeholders and researchers did not participate in our workshop, we believe the resulting recommendations may still offer valuable insights for other steppe regions facing similar ecological and policy challenges. Our findings indicate that the implementation of the KM-GBF and the conservation of European steppe birds may succeed only under the most environmentally friendly scenario (Eur-SSP1; "We are the World") and would be severely limited under the other three. We attribute the capacity of Eur-SSP1 to attain the KM-GBF targets and the conservation of steppe birds to its strong commitment to sustainable development goals, effective governance, and global cooperation (Kok et al. 2019). Conversely, Eur-SSP3 was identified as the worst scenario due to low public environmental concern, parochialistic policies, and high demand for natural resources (Kok et al. 2019). However, the conservation of steppe birds may deteriorate even further under Eur-SSP5 (Box 2 and Figure 3), which involves severe environmental degradation, agricultural intensification, and a reemergence of investments in renewables, all of which could negatively affect steppe birds (Serrano et al. 2020; Douglas et al. 2023). Only the implementation of societal interventions through the promotion of participatory societies under this scenario may facilitate actions such as land purchase programs or the integration of local knowledge, potentially yielding benefits for steppe bird conservation. In turn, the attainment of most KM-GBF targets and conservation of European steppe birds seem unfeasible under Eur-SSP4, due to increasingly extreme climate conditions, economic crises, and escalating inequalities both across and within European countries, leading to difficulties in implementing societal interventions (Kok et al. 2019). Under Eur-SSP4, the KM-GBF targets would nonetheless be more achievable as compared to Eur-SSP3 and Eur-SSP5 due to a stronger collaboration between the public and private sector, high commitment to innovative solutions, and a shift toward a high-tech green Europe that could promote the implementation of management and research interventions.

To address the challenges envisioned across scenarios, we proposed conservation recommendations suitable for multiple scenarios and whose implementation might be feasible under a variety of future socio-ecological changes, which are much more uncertain than climate projections (see similar approach in Roura-Pascual et al. 2024). We identified six overarching recommendations that best contribute to the achievement of the KM-GBF targets in European steppes. These recommendations, while sufficiently broad to apply to various contexts across steppe systems, provide a starting point for local and regional adaptations that take their specific context (e.g., cultural, institutional, and ecological) into account and thus contribute to the identification of most appropriate resource allocation and stakeholders identifications for their successful implementation (e.g., Perino et al. 2022).

Three of them highlight the important roles and contributions of local communities and participatory societies, as well as the need to consider local ecological knowledge (Joa et al. 2018) and to increase public awareness on the importance of biodiversity conservation, restoration, and sustainable use of resources (Danielsen et al. 2007; Adom 2016). These recommendations are fully aligned with the KM-GBF's goals of living in harmony with nature (CBD 2022). Promoting the engagement of the private sector in biodiversity conservation by fostering business opportunities also emerged as one of the main overarching

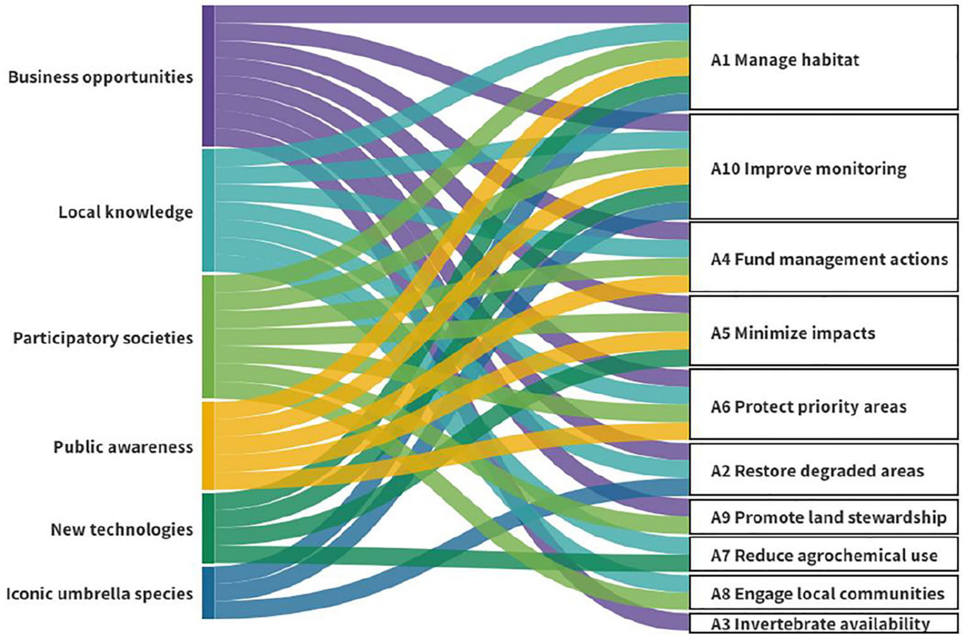

FIGURE 4 | Sankey diagram showing the links between the six overarching recommendations (Box 3) and the ten priority conservation actions (Box 1, Pérez-Granados et al. 2025) tailored for achieving the first eight targets of the Kunming–Montreal Global Biodiversity Framework. The height of the boxes is proportional to the number of actions to which a particular overarching recommendation can contribute (left column) and the number of overarching recommendations contributing to each priority action (right column).

recommendations (Smith et al. 2020), especially vital in scenarios characterized by low environmental awareness and low opportunities to implement actions by the local or regional authorities (e.g., Eur-SSP3 and Eur-SSP5, Kok et al. 2019). This strongly aligns with the novel approach to nature conservation that integrates human well-being and development needs (Kareiva and Marvier 2012), and with the European Green Deal, since it is clear that the European Union budget alone is insufficient to deal with global change drivers (European Commission 2019). The proposed conservation recommendations also align with key European policies, such as the EU Biodiversity Strategy for 2030, which aims to restore degraded ecosystems, increase protected areas, and enable transformative change in society's relationship with nature; the EU Nature Restoration Law, especially those recommendations aimed to restore steppe ecosystems and enhancing ecological connectivity; and the Vision for Agriculture and Food, which aims to revitalize agriculture, with environmentally friendly practices, and rural territories. These tools could be a good opportunity to secure funding and policy support to implement the proposed recommendations at local and national scale.

In this context, it is worth highlighting the low willingness of the private sector to engage with our study. These findings suggest an existing need to enhance the engagement and commitment of the private sector into conservation issues (see Marco-Fondevila and Álvarez-Etxeberría 2023). Its role for the conservation of European steppes might be especially relevant under scenarios of low environmental concern among the local population, where stronger cooperation with private entities will be needed to compensate for a lower involvement from public administrations (Kok et al. 2019; Hausfather and Peters 2020). Overall, our scenario approach contributes to improving our understanding of how socioeconomic drivers can influence the implementation and success of international biodiversity conservation policies, paving the way for the development of innovative adaptive and mitigation measures to counteract adverse impacts (Papadimitriou et al. 2019). Further research may wish to also consider scenarios featuring positive relationships between humans and nature, such as those within the Nature Futures Framework (Durán et al. 2023; Pereira et al. 2020), and scenarios aimed to integrate EU-level conservation targets (D'Alessio et al. 2025). Exploring alternative greener futures could be important to identify pivotal mechanisms required to redirect socioeconomic changes toward a sustainable trajectory where biodiversity conservation and the KM-GBF targets can be achieved. Finally, we would like to highlight that the implementation of some actions (e.g., legal protection of priority area or avoidance of infrastructure development) and recommendations may conflict with other factors not considered in our study, such as social acceptability, local and national strategies for sustainable development, and even the EU's transition toward renewable energies (Nijsee et al. 2023). Likewise, the still broad gap between science and policy may reduce the degree of implementation of certain actions (Pérez-Granados et al. 2025; see the research-conservation gap for a European steppe bird in Pérez-Granados and López-Iborra 2022). Limited funding is also a key constraint, which—as our findings suggest—could be alleviated with support from the private sector.

5 | Conclusions

Our findings show that there is little chance to achieve the KM-GBF targets under scenarios with low environmental concern and low social cohesion, which appear to be the most likely trajectories under current policies (Kok et al. 2019; Hausfather

Description of the six overarching recommendations able to facilitate the implementation of multiple priority conservation actions. Recommendations are ranked by the number of connections with priority conservation actions (Figure 4)

Business opportunities (8 actions)
Private companies and organizations might show greater interest in investing in the preservation, management, and restoration of steppe habitats if they can benefit from showcasing these efforts through eco-friendly/green labels or endorsements for responsible land stewardship. In addition, they could gain tax incentives to support the implementation of habitat management actions. Such business opportunities cannot be used to fund actions harmful to nature, in agreement with other KM-GBF targets. Likewise, the development of new business opportunities, like nature-based tourism, could further contribute to increasing public awareness and social acceptability regarding the implementation of conservation actions. This, in turn, may help minimize infrastructure development within priority steppe habitats and promote conservation initiatives.
Local knowledge (7 actions)
Integrating local knowledge derived from local communities, nongovernmental organizations, and grassroots initiatives, along with cultural heritage, into the conservation of steppes can enhance the implementation and effectiveness of conservation actions. This integration may foster improved spatial planning, restoration, and management of steppes and may lead to the development of better monitoring programs. For example, local knowledge of traditional and resilient crop varieties may play a major role in reducing the use of agrochemicals. Traditional practices may encompass the promotion of sheep grazing on fallow land for weed control and fertilization (agrochemical reduction) or rotation with leguminous crops (fertilizer reduction).
Participatory societies (7 actions)
The development of more inclusive and participatory societies, taking into account various stakeholders, has the potential to improve steppe conservation in various aspects, such as facilitating land purchase programs, integrating local knowledge into spatial planning and protected area management, raising public awareness, and improving monitoring programs based on citizen science.
Public awareness (5 actions)
Greater public awareness would play a crucial role in ensuring social acceptance regarding the planning and management of steppe habitats, potentially minimizing infrastructure development. Improved public understanding would facilitate participation in citizen science monitoring and enhance the economic value of traditional landscapes through the valuation of recreational and cultural services.
New technologies (4 actions)
Adoption of novel (e.g., automated and noninvasive) technologies can significantly improve the quality and integration of monitoring programs, which can also enhance the effectiveness of habitat management actions. Furthermore, the development of new techniques able to maximize energy efficiency and mobility can reduce the impacts of infrastructure developments and promote improved solutions (e.g., bioengineering for crop varieties resistant to pests and diseases, and resilient to climate change).
Iconic and umbrella species (3 actions)
Identifying iconic and umbrella species, such as the little bustard (*Tetrax tetrax*; Morales et al. 2023), can improve monitoring programs by using these species as ecological indicators for the status of steppe birds and habitats. Iconic species, in particular, can play a crucial role in promoting ecotourism activities, which, in consequence, may help increase public awareness and facilitate the implementation of management actions.

and Peters 2020). Eur-SSP1, a scenario that combines high environmental respect, strong global cooperation, and a well-functioning society, is the only scenario that warrants the achievement of the KM-GBF targets and the safeguarding of the European steppes. Moving toward this scenario requires urgent transformative changes if we are to avoid repeating past failures as in previous international biodiversity agreements. Our scenario framework allowed us to identify a series of recommendations, assessed to be feasible under different socioeconomic scenarios, which may contribute to the long-term conservation of European steppe birds. These actions encompass the development of more participatory and empowered societies, make use of the best techniques available, and provide sustainable business opportunities to engage the private sector toward biodiversity conservation. Such an approach may contribute to the global aspiration for a world in harmony with nature—a vision that, while challenging, could be attainable through concerted efforts and strategic interventions.

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Ethics Statement

The authors have nothing to report.

Conflicts of Interest

The authors declare no conflicts of interest.

Data Availability Statement

All data generated during the workshop are included as Supporting Information.

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Supporting Information

Additional supporting information can be found online in the Supporting Information section.

Supplementary Materials: conl13138-sup-0001-SuppMat.docx