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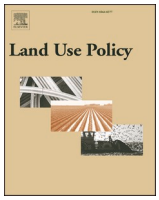

Bridging sustainable game management into land use policy: From principles to practice

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ABSTRACT

Sustainability of land use is a guiding paradigm for natural resource policy in the 21st century and should also be pursued in wildlife management. We have bridged the theoretical sustainability framework with practical policy implementation by defining a certification scheme whereby landowners implement game management systems that are aligned with sustainability standards and audited by accredited bodies. Oversight is provided by a governance committee, comprising scientists, public officers, and certification body representatives, ensuring adaptability to evolving societal attitudes and regulatory changes. Using the Delphi method with a panel of 78 experts we defined key sustainability criteria for sustainable game management following a criterion of consensus. The agreed criteria were structured around three dimensions: game population, habitat, and socio-economic aspects, forming a coherent framework. The seven most important criteria for defining a certification system focused on maintaining or improving: 1) game population abundance, distribution, structure, and behavior compatible with conservation; 2) natural genetic characteristics of game populations; 3) diversity and conservation status of native game species; 4) diversity of native non-game species; 5) conservation status and diversity of habitats; 6) socio-economic functions and conditions of the activity; and 7) customer satisfaction. We discuss how the label derived from this certification could serve as an identity brand with positive effects on the recreational hunting market, but also that the promotion of this system requires the commitment of policy makers as well as the valuing of hunters against other options less respectful of the natural environment.

1. Introduction

Human-nature interactions have resulted in significant environmental impacts on a global scale (Brashares et al., 2014). Game and non-game species are facing new anthropogenic pressures, such as climate change (Parmesan and Yohe, 2003). For game species, an increasingly added factor is intensive management aimed at manipulating populations or habitats, either on public or private lands, which makes it crucial to mitigate their negative effects on ecosystems and biodiversity (Gallo and Pejchar, 2016). Therefore, processes to recognize, protect, enhance, and redefine human-nature interactions are fundamental to shifting the world towards more sustainable and equitable pathways and futures (Bennett and Reyers, 2024). However, although there is broad political and societal support for biodiversity conservation in general, there is considerable disagreement about how to put it into practice (Linnell et al., 2015). Sustainability science is at the core of this vision, and landscapes and regions represent a fundamental domain of scale (Wu, 2013). For many rural dwellers, these landscapes, and the activities with which they are associated are important elements of their cultural identity and sense of place. The people and nature approach emphasizes the importance of cultural structures and institutions in developing sustainable and resilient interactions between human societies and the natural environment (Mace et al., 2014). Therefore, the implementation of the idea of sustainability needs to take into account the vision of decision-makers, society in general and especially the rural population, who will have to live with the consequences, and react to the conservation agenda (Linnell et al., 2015). Thus, achieving more fair and sustainable reforms needs to be complemented by the use of policy instruments to internalize those negative environmental externalities that arise from the discrepancy between private and public values, to reduce overconsumption and overproduction, and to apply indicators of social and ecological progress

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that include sustainability criteria. Moreover, the incorporation of valuation as an element of incentives for pro-environmental behavior in the spheres of production and consumption (including certification, tax rebates, PES, and so forth) offers opportunities for the strengthening of individuals' sustainability-aligned values (Pascual et al., 2023).

Sustainable development is defined as "economic development that meets the needs of the present generation without compromising the ability of future generations to meet their own needs" (WCED, 1987; Brundtland and UNCED, 1988). This concept of sustainability is based on ecological, social and economic dimensions, as stated in its most essential definition (WCED, 1987). Subsequently, the Addis Ababa "Principles and guidelines for the sustainable use of biological diversity", formulated within the framework of the Convention on Biological Diversity, set out a conceptual framework to reflect the complexity of socio-ecological systems and to apply the concept of sustainable use (Addis Ababa: CBD, 2004). In this way, the concept of sustainable use becomes the guiding paradigm for natural resource policy in the 21st century (Hall, 2001).

The application of principles, criteria, and indicators schemes (PCI schemes) has become a widely recognized methodological approach as a suitable tool for assessment, monitoring and adaptive management (Forstner et al., 2006; Reimoser et al., 2021; Salas-Garita and Soliño, 2021). In a PCI scheme, the Principle is considered a fundamental truth or law and is the basis for reasoning or action, providing the primary framework for sustainable management and the rationale for the Criteria and Indicators. The Criteria and Indicators (CI) constitute a hierarchical framework to provide a common understanding of what is considered sustainable management and to frame the monitoring process in adaptive management systems. They consist of a set of broad core values (Criteria) and are supported by a set of measures (Indicators) to assess the status or progress towards realizing these values (Colfer et al., 1995; Shields et al., 2002). The PCI schemes have often been used in natural resources management (Günter et al., 2012), forestry (Rametsteiner and Simula, 2003; Blumroeder et al., 2018; Van Gossum et al., 2011), agriculture (Vogt, 2019), fisheries (Rice and Rochet, 2005) and aquaculture (Osmundsen et al., 2020). Applying PCI framework to ecolabeling has come to center stage in the developed world and is based on independent auditing articulated in third-party certification schemes (Eilperin, 2010; Busch, 2017). Third-party certification schemes are an integrated public and private regime that includes standard setting, accreditation and certification. Through these standards, national accreditation bodies (NAB) and certification bodies (CB) carry out a process referred as 'conformity assessment' (Loconto and Busch, 2010).

In this complex scenario, recreational hunting, which refers to the pursuit and killing of wild animals for leisure and enjoyment (Loveridge et al., 2006; Di Minin et al., 2021), has become an important social and economic phenomenon on a global scale. It encompasses both commercial and non-commercial hunting, involving millions of people in many countries (Sharp and Wollscheid, 2009; McGuigan, 2017; Di Minin et al., 2021). Hunting overlaps spatially with various land uses, given that game species inhabit agricultural and production-forestry landscapes, which are often conducive to their presence (Apollonio et al., 2010; Linnell et al., 2020). The implementation of hunting certification systems is compatible with other land policy frameworks, such as afforestation programs, agricultural activities under the umbrella of the Common Agricultural Policy (CAP), or wildlife protection programs (for example, regarding the Iberian lynx).

However, recreational hunting is also a controversial activity that often sparks debates regarding biodiversity conservation and social conflicts (Thirgood et al., 2000; Bauer et al., 2018; Delibes-Mateos, 2015), arising from stablishing the quotas of hunting, the management tools used and the activity of killing animals itself, among others (Carpio et al., 2021; Moreno-Zarate et al., 2021). Certification schemes can play a critical role in gaining public acceptance and addressing anti-hunting sentiments and governance challenges (Hickey, 2008).

Criteria, Indicators and Guidelines to assess hunting sustainability have already been developed through participatory stakeholder's processes and interdisciplinary experts (Casaer et al., 2006; Reimoser et al., 2021). The resulting schemes vary in purpose, geographic scope and status; some are formulated as guidelines, while others define measurable indicators (Child and Wall, 2009). Noteworthy examples of hunting certification include the Austrian Environmental Agency's Sustainable Hunting Program, the Association of Deer Management Groups Deer Initiative Partnership in the United Kingdom, the Wildlife Estates Label in Europe, and the Quality Deer Management Association (QDMA) in the United States. These certification schemes play a crucial role in gaining public acceptance and governance (Child and Wall, 2009). However, additional proposals are required to formulate a comprehensive approach that simultaneously considers ecological, economic, and social dimensions for different game species and geographical areas (Blumroeder et al., 2018; Van Gossum et al., 2011).

In this context, the PCI approach may help to develop a comprehensive conceptual and methodological framework for the conformity assessment of sustainable game management. Furthermore, it is imperative to develop effective conformity assessment schemes that involve stakeholders to ensure their practical application in real-world scenarios. In this line, this study proposes environmental, economic, and social game management criteria by engagement of experts for a conformity assessment. Additionally, the paper proposes a framework for the development of a third-party certification system as a market-based solution covering the gap between theoretical criteria and actual policy.

2. Material and methods

2.1. Study site

Spain has approximately 32,180 hunting estates distributed along 85 % of the total Spanish land area, representing approximately ~433,627 km^2 (MAPAMA, 2023). These estates are used by 725,298 registered recreational hunters (MAPAMA, 2023), i.e. approx. 1.5 % of the total population.

In Spain the national regulatory framework defines wild animals as res nullius i.e. nobody's property. In this case, public and private hunting managers reserve the right to exclude others from hunting on their lands (Coelho, 2011) but they also have the obligation to manage the territory, hunting and wildlife in general, since many modern laws link the right to hunt with the obligation to manage (Chardonnet et al., 2002). In each region, private or public hunting managers had to implement a Hunting Management Plan (HMP) to obtain hunting rights (Martínez-Jauregui et al., 2011; Piorno et al., 2020; Ruíz-Rodriguez et al., 2022). In the HMP, the holder of the hunting rights has to report on the status of game population and habitats indicators (mainly non-game fauna). Sometimes they also report environmental and socioeconomic indicators. The contents of the HMP vary according to the minimum requirements set out in each region laws, i.e. game population censuses, maximum harvest quota, number of hunting journeys, hunting techniques, non-game species inventories, description of predator control, habitat management actions, supplementary feeding, and details of game restocking actions (Ríos-Saldaña, 2018). The HMP is approved by the administrative provincial game department. Once approved, the landowner receives hunting rights for 4–5 years (Delibes-Mateos et al., 2021). However, they must report on the actions taken and the game harvested annually (Annual Hunting Record, AHR) to regional governments that have the legal responsibility to carry out the control and monitoring of the authorized hunting exploitation. Data on the number of individuals hunted and methods, among other variables collected in the AHR, are reported to the national government, which provides official hunting statistics (Martínez-Jauregui et al., 2011).

In the last decades, some of the 17 Spanish Autonomous Communities proposed a system based on labels certifying sustainable hunting practices (Fig. 1), but no viable and unified system currently exists

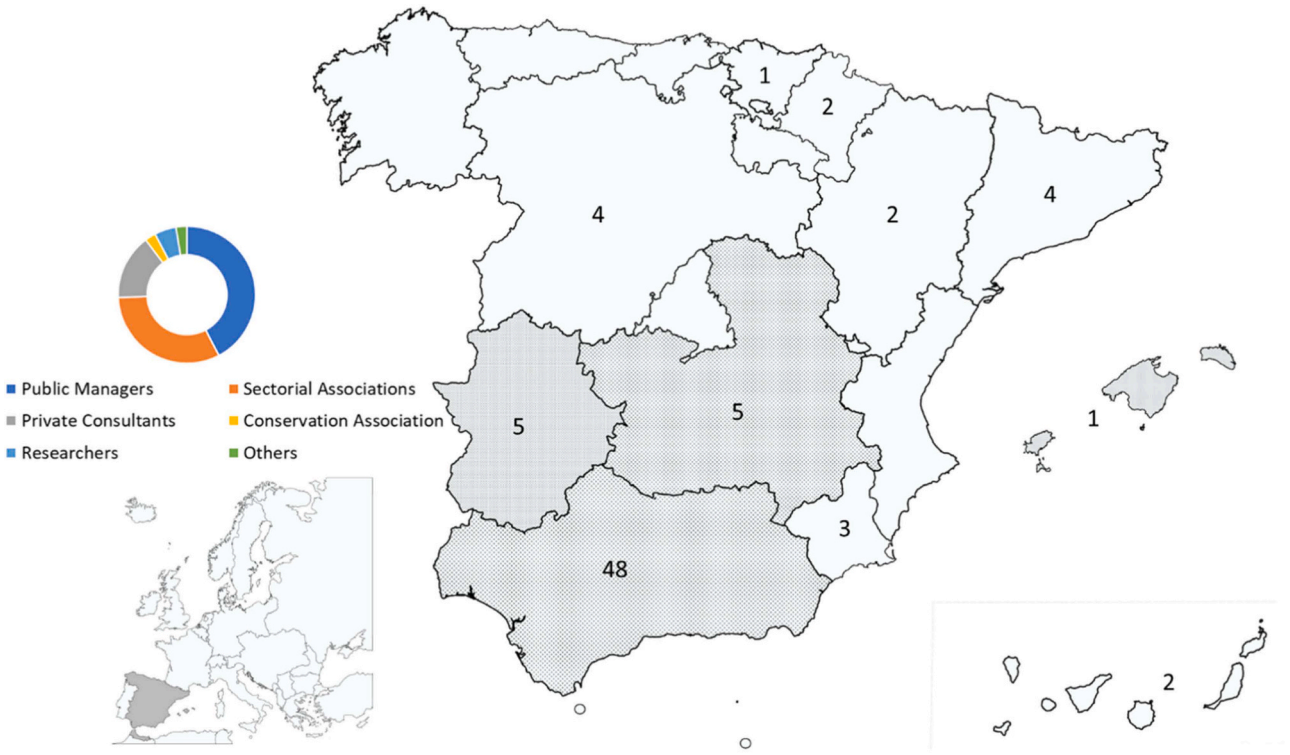

Fig. 1. Pie chart showing the professional profiles of 77 out of the 78 panel members in the 11 regions (one panel member with national responsibilities was not assigned to region). The pie charts shows the percentages of professional profiles and participant counts. Four Autonomous Communities are shaded to indicate that they have labels for hunting certification.

(Fischer et al., 2013a; Linares and Carranza, 2019).

2.2. *Defining criteria by Delphi method*

The Delphi technique was proposed in the 1960s (Dalkey and Helmer, 1963) and allows the analysis of experts' opinions on a topic, and how these can be modified by iteration and knowledge sharing among them. It facilitates participatory decision-making by combining inputs from diverse disciplines and locations within a limited timeframe through an iterative, anonymous, and structured survey (Landeta and Lertxundi, 2023; Mukherjee et al., 2015). The Delphi method allows for adaptations to address specific problems and promotes knowledge sharing (Hasson and Keeney, 2011). It has been used to achieve consensus in situations with polarized opinions and is suitable for policy formulation and evaluation (Lemieux and Scott, 2011; MacMillan and Marshall, 2006; Orsi et al., 2011). Furthermore, it has been applied to develop frameworks of Principles, Criteria, and Indicators (Salas-Garita and Soliño, 2021).

The consensus-based Delphi technique typically involves seven steps: (1) defining the expert group, (2) choosing the statements and design of the first-round questionnaire; (3) 1st round survey; (4) analyzing results from the first round, (5) to provide controlled feedback to experts, (6) 2nd round survey, and (7) analyzing the second-round survey, and iteratively analyzing results until consensus is reached (Landeta, 2006; Hasson and Keeney, 2011; Mukherjee et al., 2015). After all the stages, the Sustainable Hunting Management Criteria can be selected.

A panel of 78 experts was formed, including government technicians and public managers (33), representatives of hunting and conservation associations (27), private consultants (12), researchers (4), and other people involved in hunting-related issues (2). Among these experts, 46 % claimed that they were also hunters (Hussler et al., 2011; Rowe and Wright, 2011). The experts were selected at random through social media announcements and distribution lists. The majority of experts are from Andalusia, one of the few Spanish regions (Fig. 1) that have launched a piloting certification program.

For the selection of the statements and the preparation of the first round of the questionnaire, we carried out an extensive review of literature that provides comprehensive guidelines for sustainable game management (Casaer et al., 2006; Reimoser et al., 2021). Additionally, we examined Spanish regional regulations governing proprietary labels in specific Autonomous Communities, and other relevant documents available in official Spanish administration websites to establish a conceptual framework for PCI in sustainable game management. Finally, we selected a total of 63 input statements, which were categorized into three dimensions: "*Game Populations*" (25 statements focusing on the management of game and predator populations), "*Habitat*" (24 statements encompassing the biological community, including flora and fauna, associated with the game species), and "*Socio-economic*" (14 statements addressing the social and economic aspects of game management).

The survey was distributed to all participants, and we received responses from all the 78 experts in the first round. We calculated the median and confidence interval scores assigned to each of the statements. In the second round, 62 panel members participated. The experts were given feedback by displaying the distribution of the responses from the first-round. Once this information was known, the panel members proceeded to the second-round re-evaluation, and additionally participants were asked to rank the five statements that scored highest during the first round.

The process halted during the second round upon reaching the expected consensus on sustainability indicators for ex-post evaluation. Consensus was reached when the relative interquartile range was less than 0.70, in line with suggestions made by other authors (Soliño, 2003; Salas-Garita and Soliño, 2021). We did not overemphasize the consensus, so as not to lose diversity of opinions and to avoid biases responses towards the majority opinion (Powell, 2003; Rowe et al., 2005).

3. Results

3.1. Ranking of dimensions

The experts rated very highly the criteria presented in each dimension for sustainable hunting management, with mean scores above 8.5. The highest mean score (8.96) was given to the “Game Population" dimension, followed by the "Habitat" dimension (8.77), and the "Socio-economic" dimension (8.57). The scores were similar across the different areas of expertise, with *Game population* dimension receiving consistently the highest scores (Table 1).

3.2. Ranking of statements

The five highest ranked statements in every dimension in Round 1 were prioritized in Round 2 (Table 2). In the target population dimension, the selected statements focused on herbivore population density (wildlife and livestock) (1.12.), genetic integrity (1.5.), prioritization of native game species over non-native (1.22.), health status of managed game populations (1.19.), and the presence of density-dependent diseases in the population (1.15.). In the habitat dimension, the selected inputs were related to management guidelines for maintaining wild vegetation in hedgerows, boundaries, banks, and patches (2.8.), reconciling the conservation of biological communities with the management of game species (2.4.), establishing a network of natural water points (2.24.), responsible use of phytosanitary treatments (2.18.), and maintaining natural vegetation patches and nests (2.17.). In the socio-economic dimension, the focus was on promoting the benefits of hunting to the public (3.6), promoting good practices (3.12.), collaborating on applied research (3.11.), providing training and equipment for the estate managers (3.10.), and assessing hunter satisfaction (3.13.). Several statements in the ranking fall below the pass mark ($\geq$2.5). In the Game Populations dimension, prioritizing health in high densities (1.15.) falls short, while maintaining herbivore abundance within land carrying capacity (1.12.) is the most esteemed. In the Habitat dimension, hedgerow conservation (2.8.) is highly valued, but less attention is given to preserving patches of natural vegetation. In the Socioeconomic dimension, communication, and dissemination to society of hunting benefits (3.6.) and good practices (3.12.) rank highest. However, assessing hunter satisfaction (3.13.) receives a notably low score, being the least valued and far from approval.

3.3. Delphi consensus

Consensus and stability in the Delphi process can be assessed based on calculations derived from the two rounds carried out. As shown in Tables 3, 4 and 5, the interquartile relative ranges (IRR) from the first round were found to be below the threshold of 0.7 (Soliño, 2003; Landeta, 1999). This can be interpreted as a consensus measure, justifying the end of the Delphi iterations at the second round. The use of controlled feedback in the second round increased the consensus since the response dispersion (VAR(IRR)) decreased. This pattern was observed across all expert groups, confirming the achievement of consensus and stability.

Table 2
The five highest scoring statements of each group ranked in round 1, from most to least important. Frequencies and means of the scores assigned in the second Delphi round (from 1 for the least important to 5 for the most important) for each statement. SD: standard deviation.

Statements	Mean *	SD
1. Game Populations:		
1.12. Maintain the density of herbivore populations (wildlife plus livestock) within the carrying capacity.	3.72	0.187
1.5. Maintain the genetic integrity of game species.	3.38	0.178
1.22. Prioritize game local species and native genetic varieties over alien species.	3.03	0.172
1.19. Maintain adequate population structure (sex ratio and age classes).	2.79	0.164
1.15. Avoid health problems in the population due to excess density.	2.49	0.173
2. Habitats:		
2.8. Preserve and avoid the reduction of hedgerows and forests of wild vegetation associated with slopes. ditches. riverbeds. and margins.	3.66	0.168
2.4. Ensure that the management objectives of abundance. distribution. and behavior of the game population are compatible with the preservation of the biological community to which the exploited species belongs.	3.25	0.194
2.24. Adequacy of a network of sufficient water reserve points.	3.11	0.177
2.18. Specific good practice commitments in the use of phytosanitary treatments.	3.02	0.198
2.17. Establish specifics commitments to maintain patches of natural vegetation and respect of nests.	2.30	0.135
3. Socio-economic:		
3.6. Inform the public about the values and benefits of hunting and management for biodiversity and rural development.	3.56	0.169
3.12. Collaboration in the dissemination of good game management practices.	3.51	0.132
3.11. Collaboration in research applied to the management of game species.	3.36	0.169
3.10. Training and provision the necessary equipment to the personnel in charge of the management and maintenance of the estate.	3.20	0.153
3.13. Evaluate the user satisfaction.	1.62	0.154

* Mean is bounded for each statement, between 1 and 5 according to the order assigned in the ranking, with 5 for the first and 1 for the fifth.

Significant consensus progress is evident across rounds, particularly in specific statements within the Game Populations dimension (Table 3). The highest contribution to consensus achieved in the second round is found for the conservation genetic diversity over external characteristics (VAR(IRR)=0.26) and expanding fenced areas for agreements with neighboring lands (VAR(IRR)=0.19). In the Habitats dimension (Table 4), notable consensus is achieved for fallow land management (VAR(IRR)=0.19) and livestock control in stubble, fallow land, and boundaries (VAR(IRR)=0.17). Lastly, in the socioeconomic dimension (Table 5), consensus notably increases for local hunter involvement, and considering land access by other users, including recreational users (VAR(IRR)=0.13).

Table 1
Mean and standard deviation (SD) of the assigned scores for all statements within each block in second round, for the total participants (n=61), participants from the public sector (n=24), representatives of sector associations (n=23), and managers and consultants in the private sector (n=9).

	All Panel Members		Public Managers		Sectorial Assoc.		Private Consultants	
Dimensions	Mean*	SD	Mean*	SD	Mean*	SD	Media*	SD
Game Populations	8.96	1.39	8.93	1.40	8.90	1.40	9.04	1.33
Habitats	8.77	1.32	8.74	1.35	8.72	1.31	8.93	1.12
Socio-economic	8.57	1.53	8.55	1.55	8.54	1.53	8.72	1.48

* Mean is bounded for each statement, between 1 and 10, according to the degree of relevance of the statement for sustainable game management, with 1 being very irrelevant 10 being very relevant

Table 3
Set of essential statements from Game Population dimension (Overall results from the panel and breakdown by the experts' sector of work. Median is bounded for each statement, between 1 and 10, according to the degree of relevance of the statement for sustainable game management, with 1 being very irrelevant 10 being very relevant).

		All Panel Members					Public Managers					Sectorial associations					Private Consultants				
		Round 1		Round 2		VAR (IRR)	Round 1		Round 2		VAR (IRR)	Round 1		Round 2		VAR (IRR)	Round 1		Round 2		VAR (IRR)
Statements		Median*	IRR_1	Median*	IRR_2		Median*	IRR_1	Median*	IRR_2		Median*	IRR_1	Median*	IRR_2		Median*	IRR_1	Median*	IRR_2	
1.	**Game Populations:**																				
1.1.	Mitigate the negative consequences of other human activities on the survival of wild species or on their natural behaviour.	8.00	0.25	9.00	0.11	0.14	8.00	0.25	8.00	0.25	0.00	8.00	0.38	9.00	0.11	0.26	9.00	0.11	9.00	0.11	0.00
1.2.	Avoid focusing exclusively on external phenotypical or behavioural characteristics as criteria for selection to conserve the genetic diversity present in the game population.	8.00	0.38	9.00	0.11	0.26	8.00	0.25	8.50	0.12	0.13	7.00	0.29	8.00	0.13	0.16	6.00	0.50	9.00	0.17	0.33
1.3.	Set a database of management planning (including at least management objectives and measures for each species / group of species).	9.00	0.22	9.00	0.22	0.00	9.00	0.11	9.00	0.19	-0.08	8.00	0.25	9.00	0.22	0.03	9.00	0.31	9.00	0.17	0.14
1.4.	Encourage data recording on hunting bags (where useful. subdivided into sexes and age classes).	9.00	0.22	9.00	0.22	0.00	9.00	0.22	9.00	0.11	0.11	8.00	0.13	9.00	0.22	-0.10	9.00	0.11	10.00	0.25	-0.14
1.5.	Maintain the genetic integrity of game species.	10.00	0.10	10.00	0.10	0.00	10.00	0.10	10.00	0.00	0.10	10.00	0.10	10.00	0.10	0.00	9.00	0.11	10.00	0.20	-0.09
1.6.	Avoid translocations. except for justified biological reasons.	9.00	0.33	9.00	0.22	0.11	9.00	0.33	9.00	0.19	0.14	9.00	0.33	9.00	0.22	0.11	9.00	0.19	9.00	0.11	0.08
1.7.	Avoid the introduction of animals from farms.	9.00	0.22	10.00	0.15	0.07	9.00	0.28	10.00	0.18	0.10	9.00	0.28	9.00	0.22	0.06	9.00	0.22	10.00	0.10	0.12
1.8.	Take specific measures to protect endangered species of wild plants and animals from the impact of game management actions.	9.00	0.22	10.00	0.10	0.12	9.00	0.22	10.00	0.10	0.12	9.00	0.22	9.00	0.22	0.00	8.50	0.35	10.00	0.10	0.25
1.9.	Minimize the control of predation and of predators.	7.00	0.46	7.00	0.43	0.04	6.00	0.50	7.00	0.43	0.07	6.00	0.58	7.00	0.43	0.15	5.50	1.00	8.00	0.38	0.63
1.10.	Ensure the natural origin (reproduction. expansion or migration) of the individuals hunted.	9.00	0.22	10.00	0.10	0.12	10.00	0.20	10.00	0.10	0.10	8.00	0.38	9.00	0.22	0.15	9.00	0.19	10.00	0.10	0.09
1.11.	Avoid releasing as a procedure to increase hunting stock.	9.00	0.22	10.00	0.10	0.12	9.00	0.22	10.00	0.10	0.12	9.00	0.44	9.00	0.22	0.22	9.00	0.28	10.00	0.05	0.23
1.12.	Maintain the density of herbivore populations (wildlife plus livestock) within the carrying capacity.	10.00	0.10	10.00	0.05	0.05	10.00	0.10	10.00	0.00	0.10	9.00	0.22	10.00	0.10	0.12	9.00	0.19	10.00	0.10	0.09
1.13.	Avoid significant impacts from game populations on soils and vegetation.	9.00	0.22	10.00	0.10	0.12	10.00	0.15	10.00	0.10	0.05	9.00	0.22	9.00	0.11	0.11	9.00	0.22	10.00	0.10	0.12
1.14.	Avoid impacts of high densities on reproduction and development in game populations.	9.00	0.22	10.00	0.10	0.12	9.00	0.22	10.00	0.10	0.12	9.00	0.17	9.00	0.22	-0.06	9.00	0.22	10.00	0.10	0.12
1.15.	Avoid health problems in the population due to excess density.	9.00	0.11	10.00	0.10	0.01	10.00	0.10	10.00	0.10	0.00	9.00	0.22	9.00	0.11	0.11	9.00	0.11	10.00	0.00	0.11
1.16.	Avoid health problems in the population due to management practices.	9.00	0.22	10.00	0.10	0.12	9.00	0.22	10.00	0.10	0.12	9.00	0.28	9.00	0.22	0.06	9.00	0.31	10.00	0.05	0.26
1.17.	If supplementary feeding is used. adhere to good practices.	8.00	0.25	9.00	0.22	0.03	8.00	0.25	9.00	0.11	0.14	8.00	0.31	8.00	0.13	0.19	8.50	0.35	9.00	0.22	0.13
1.18.	Encourage vegetal production in the area rather than supplementary feeding.	9.00	0.22	9.00	0.11	0.11	9.00	0.22	9.00	0.11	0.11	9.00	0.22	9.00	0.22	0.00	9.00	0.33	9.00	0.17	0.17
1.19.	Maintain adequate population structure (sex ratio and age classes).	9.00	0.22	10.00	0.10	0.12	9.00	0.22	10.00	0.10	0.12	9.00	0.22	9.00	0.22	0.00	9.50	0.11	10.00	0.05	0.06
1.20.	Do not influence the natural mating arrangement among individuals.	8.00	0.41	8.00	0.38	0.03	8.00	0.44	9.00	0.31	0.13	7.00	0.29	7.00	0.14	0.14	8.00	0.47	9.00	0.17	0.30
1.21.	Implement control measures for non-native species.	9.00	0.22	10.00	0.10	0.12	10.00	0.20	10.00	0.10	0.10	8.00	0.25	9.00	0.22	0.03	9.50	0.21	10.00	0.15	0.06
1.22.	Prioritize game local species and native genetic varieties over alien species.	10.00	0.10	10.00	0.10	0.00	10.00	0.20	10.00	0.10	0.10	9.00	0.11	10.00	0.10	0.01	9.00	0.22	10.00	0.10	0.12
1.23.	In fenced areas: Adequate the perimetral fences to legal normative.	9.00	0.22	10.00	0.20	0.02	10.00	0.20	10.00	0.18	0.03	8.00	0.31	8.00	0.38	-0.06	9.00	0.19	10.00	0.05	0.14
1.24.	In fenced areas: Establish agreements with neighboring lands to extend the fenced area.	8.00	0.63	8.00	0.44	0.19	8.00	0.50	8.00	0.59	-0.09	7.00	0.57	8.00	0.38	0.20	7.50	1.03	9.00	0.17	0.87
1.25.	In fenced areas: Maintain the genetic variability of game populations inside the area.	9.00	0.22	10.00	0.10	0.12	10.00	0.20	10.00	0.10	0.10	9.00	0.22	9.00	0.11	0.11	9.00	0.19	10.00	0.05	0.14

Table 4
Set of essential statements from Habitats dimension (Overall results from the panel and breakdown by the experts' sector of work. Median is bounded for each statement, between 1 and 10, according to the degree of relevance of the statement for sustainable game management, with 1 being very irrelevant 10 being very relevant).

		All Panel Members					Public Managers					Sectorial associations					Private Consultants				
		Round 1		Round 2		VAR (IRR)	Round 1		Round 2		VAR (IRR)	Round 1		Round 2		VAR (IRR)	Round 1		Round 2		VAR (IRR)
Statements		Median*	IRR_1	Median*	IRR_2		Median*	IRR_1	Median*	IRR_2		Median*	IRR_1	Median*	IRR_2		Median*	IRR_1	Median*	IRR_2	
2.	**Habitats:**																				
2.1.	In management actions. take into consideration the conservation status of flora and fauna. including rare or endangered species.	9.00	0.22	9.00	0.22	0.00	9.00	0.22	9.00	0.22	0.00	8.00	0.13	9.00	0.11	0.01	8.50	0.21	10.00	0.15	0.06
2.2.	Only undertake habitat restoration or afforestation with autochthonous plant material of local provenance.	9.00	0.22	9.00	0.11	0.11	9.00	0.22	9.00	0.11	0.11	9.00	0.17	9.00	0.22	-0.06	8.50	0.24	10.00	0.10	0.14
2.3.	When regulating predators. avoid negative effect on the community of predators and on their interactions with other species.	8.00	0.28	8.00	0.25	0.03	8.00	0.50	8.00	0.13	0.38	8.00	0.25	8.00	0.13	0.13	8.50	0.24	9.00	0.22	0.01
2.4.	Ensure that the management objectives of abundance. distribution. and behavior of the game population are compatible with the preservation of the biological community to which the exploited species belongs.	9.00	0.22	9.00	0.22	0.00	9.00	0.11	9.00	0.11	0.00	9.00	0.17	8.00	0.13	0.04	9.00	0.22	10.00	0.15	0.07
2.5.	Seek the balance of the vegetation mosaic landscape pattern in order to fulfill the functions of feeding. shelter. and reproduction of all species.	9.00	0.22	10.00	0.10	0.12	9.00	0.22	10.00	0.10	0.12	9.00	0.22	9.00	0.22	0.00	9.00	0.19	10.00	0.15	0.04
2.6.	Maintain and preserve the advanced stages in the ecological succession of native forest.	8.00	0.16	9.00	0.11	0.05	8.00	0.31	9.00	0.19	0.12	8.00	0.25	8.00	0.13	0.13	8.00	0.22	10.00	0.20	0.02
2.7.	Establish measures for the regeneration of natural vegetation in at least 5m from both banks of riverbeds and streams with continuous and/or sporadic flow.	9.00	0.33	9.00	0.22	0.11	8.00	0.38	9.00	0.19	0.18	8.00	0.31	9.00	0.22	0.09	9.00	0.31	9.00	0.17	0.14
2.8.	Preserve and avoid the reduction of hedgerows and forests of wild vegetation associated with slopes. ditches. riverbeds. and margins.	10.00	0.20	10.00	0.10	0.10	9.00	0.28	10.00	0.08	0.20	9.00	0.11	10.00	0.20	-0.09	10.00	0.10	10.00	0.05	0.05
2.9.	Establish commitments for the regeneration of hedgerows and forests of wild vegetation associated with slopes. ditches. riverbeds. and margins.	9.00	0.22	9.00	0.22	0.00	9.00	0.33	9.50	0.18	0.15	9.00	0.22	9.00	0.22	0.00	9.00	0.22	9.00	0.17	0.06
2.10.	Set a maximum distance from any point on the hunting estate to hedgerows and forests of wild vegetation associated with slopes. ditches. riverbeds. and margins.	8.00	0.38	8.00	0.25	0.13	7.00	0.43	8.00	0.25	0.18	7.00	0.36	8.00	0.38	-0.02	8.50	0.32	8.00	0.13	0.20
2.11.	Establish good practice commitments between neighboring estates.	9.00	0.33	9.00	0.22	0.11	9.00	0.33	9.00	0.22	0.11	9.00	0.11	9.00	0.33	-0.22	8.00	0.25	9.00	0.06	0.19
2.12.	Establish percentages of uncultivated land.	8.00	0.25	9.00	0.22	0.03	8.00	0.25	9.00	0.28	-0.03	8.00	0.31	8.00	0.13	0.19	8.50	0.29	9.00	0.11	0.18
2.13.	Control the appropriate management of fallows.	8.00	0.38	8.00	0.19	0.19	8.00	0.25	8.00	0.22	0.03	8.00	0.31	8.00	0.25	0.06	9.00	0.42	9.00	0.17	0.25
2.14.	Maintain stubble for sowing or fallow.	9.00	0.33	9.00	0.22	0.11	8.00	0.31	8.00	0.22	0.09	8.00	0.31	9.00	0.11	0.20	8.50	0.32	9.00	0.11	0.21
2.15.	Establish specifics commitments for good practices in stubble burning.	8.50	0.26	9.00	0.22	0.04	8.00	0.31	9.50	0.21	0.10	8.00	0.31	8.00	0.25	0.06	9.00	0.22	9.00	0.22	0.00
2.16.	Good practice commitment in the form. date and time of crop harvesting.	9.00	0.22	9.00	0.22	0.00	9.00	0.22	9.00	0.19	0.03	9.00	0.28	8.00	0.25	0.03	9.00	0.19	9.00	0.11	0.08
2.17.	Establish specifics commitments to maintain patches of natural vegetation and respect of nests.	9.00	0.22	10.00	0.10	0.12	9.00	0.17	10.00	0.10	0.07	9.00	0.17	9.00	0.11	0.06	9.00	0.22	10.00	0.10	0.12
2.18.	Specific good practice commitments in the use of phytosanitary treatments.	10.00	0.10	10.00	0.10	0.00	10.00	0.20	10.00	0.08	0.13	10.00	0.10	10.00	0.10	0.00	10.00	0.18	10.00	0.05	0.13

(*continued on next page*)

Table 4 (*continued*)

Statements		All Panel Members					Public Managers					Sectorial associations					Private Consultants				
		Round 1		Round 2		VAR (IRR)	Round 1		Round 2		VAR (IRR)	Round 1		Round 2		VAR (IRR)	Round 1		Round 2		VAR (IRR)
		Median*	IRR_1	Median*	IRR_2		Median*	IRR_1	Median*	IRR_2		Median*	IRR_1	Median*	IRR_2		Median*	IRR_1	Median*	IRR_2	
2.19.	Establish control of livestock use of stubble. fallows and boundaries.	9.00	0.33	9.00	0.17	0.17	8.00	0.25	9.00	0.19	0.06	9.00	0.33	8.00	0.13	0.21	9.00	0.31	9.00	0.17	0.14
2.20.	Establish dates of agricultural activities.	9.00	0.33	9.00	0.22	0.11	8.00	0.25	9.00	0.19	0.06	8.00	0.38	9.00	0.22	0.15	9.50	0.18	9.00	0.17	0.02
2.21.	Comply with the criteria established in the Order that develops the application requirements of the conditionality in the Common Agricultural Policy (PAC).	9.00	0.25	9.00	0.22	0.03	9.00	0.33	9.00	0.22	0.11	9.00	0.22	8.00	0.13	0.10	8.50	0.38	9.00	0.17	0.22
2.22.	Establish specifics criteria for landscape integration of infrastructures associated with management that can generate a significant visual impact.	8.00	0.38	8.00	0.25	0.13	8.00	0.25	8.00	0.13	0.13	8.00	0.31	7.00	0.29	0.03	7.50	0.60	8.00	0.19	0.41
2.23.	Establish mechanisms to control the quantity and quality of water resources and associated habitats in aquatic hunting areas.	9.00	0.22	9.00	0.22	0.00	9.00	0.22	9.00	0.19	0.03	8.00	0.13	9.00	0.22	-0.10	9.00	0.31	9.00	0.17	0.14
2.24.	Adequacy of a network of sufficient water reserve points.	9.00	0.22	10.00	0.10	0.12	9.00	0.22	10.00	0.10	0.12	9.00	0.22	9.00	0.22	0.00	9.50	0.21	10.00	0.10	0.11

4. Discussion

4.1. Relevance of statements

Sustainable Development includes the intentional use of natural resources over time involving the concepts of economic development, social progress, and environmental protection (WCED, 1987). This implies that sustainability is a continuous concept over time and the assessment takes place at a specific point in time where ecological and socio-economic aspects are combined (Osmundsen et al., 2020). Likewise, the sustainability of game management resulted in our approach has three dimensions: the game populations being managed, the biological community to which the game populations belong, and the socio-economic context (Casaer et al., 2006). Upon compared the inter dimension overall average scores from both rounds, it becomes evident that the experts did not indicate significant disparities between them. However, subtle yet significant distinctions emerge when comparing the Game Population and Socioeconomic dimensions, with the Game Population dimension holding greater prominence (Table 1). This underscores the consensus among the experts, as well as other authoritative references, regarding the paramount importance of ecological sustainability. Intriguingly, no significant differences in scores were identified based on participants' profile.

The present study identified 63 statements from Game population (25), Habitat (24) and Socioeconomic (14). The high scores given by all panel's stakeholders, without sectoral differences, to all statements (no average lower than 8 in Rounds 1 and 2), and the strong consensus of the experts reaffirm the relevance of the statements considered in each dimension (Table 1). The participation of a panel of experts in the process of generation of Criteria applying the Delphi method represents great advantage over other techniques, such as workshops and discussion tables, where the leader effect in decision taking is stronger (Mukherjee et al., 2015; Salas-Garita and Soliño, 2021). The smaller variation in median values between survey rounds confirms the homogeneity of the experts' perceptions. Moreover, in the second round, the dispersion of responses substantially decreased, aligning with Soliño (2003). This indicates consensus and response stability, ending the iterative Delphi process.

Priority statements in **Game population dimension** primarily revolved around two key areas: demographics (statements 1.12., 1.19., 1.15.) and population genetics (statements 1.5., 1.22.). There is broad scientific evidence that justifies that these statements were considered relevant by the experts. Population abundance is particularly crucial in the case of big game species, where intensive management regimes favor very high levels of density (Mysterud, 2010), which can cause habitat deterioration (Perea and Gil, 2014) and ecosystem health risks (Abrantes and Vieira-Pinto, 2021; Vicente et al., 2013; Gortázar et al., 2006). In some cases, management can also have notable effects on managed populations in terms of their demographics, age and sex structure (Coltman et al., 2003; Martínez-Jauregui et al., 2005), behavior, mating systems and genetic variability (Pérez-González et al., 2009; Pérez-González and Carranza, 2009; Torres-Porras et al., 2014), which could have evolutionary consequences (Mysterud, 2011) and can result in domestication processes (Mysterud, 2010). Also, small game hunting contributes with additional mortality and can produce population-level impacts (Sandercock et al., 2011; Weinbaum et al., 2013), which in declining species can aggravate their status (Keane et al., 2005; Moreno-Zarate et al., 2021). In addition, the release of captive-bred animals may introduce risks to wild populations and genetic diversity (Villanúa et al., 2008; Díaz-Sánchez et al., 2012; Laikre et al., 2010). Likewise, recreational hunting has been a recognized source of introduction of exotic species into natural ecosystems (Carpio et al., 2017). Climate change also affects hunting species, influencing their distribution and diversity patterns (Levinsky et al., 2007). Moreover, management actions may interact to exacerbate the impacts of other stressors. For example, both herbivore overabundance or excessive

Table 5
Set of essential statements from Socio-economics dimension (Overall results from the panel and breakdown by the experts' sector of work. Median is bounded for each statement, between 1 and 10, according to the degree of relevance of the statement for sustainable game management, with 1 being very irrelevant 10 being very relevant).

		All Panel Members					Public Managers					Sectorial associations					Private Consultants				
		Round 1		Round 2		VAR (IRR)	Round 1		Round 2		VAR (IRR)	Round 1		Round 2		VAR (IRR)	Round 1		Round 2		VAR (IRR)
Statements		Median*	IRR_1	Median*	IRR_2		Median*	IRR_1	Median*	IRR_2		Median*	IRR_1	Median*	IRR_2		Median*	IRR_1	Median*	IRR_2	
3.	**Socio-economic:**																				
3.1.	Maintain or regulate the hunted species so that their abundance. distribution and behaviors are compatible with the interests of other socioeconomic sectors (agriculture. forestry. fishing. traffic. public health…).	9.00	0.22	9.00	0.22	0.00	9.00	0.22	9.00	0.22	0.00	8.00	0.13	9.00	0.11	0.01	9.00	0.28	9.00	0.11	0.17
3.2.	To repay (in kind or in cash) all the participants in the hunting actions.	7.00	0.43	7.00	0.36	0.07	7.00	0.43	7.00	0.29	0.14	7.00	0.57	7.00	0.43	0.14	7.50	0.47	8.00	0.38	0.09
3.3.	Encourage the participation of local hunters.	8.00	0.38	8.00	0.25	0.13	8.00	0.50	8.00	0.38	0.13	8.00	0.38	8.00	0.25	0.13	8.00	0.34	9.00	0.11	0.23
3.4.	Consider the access and use of the land by other users (including recreational users).	8.00	0.38	8.00	0.25	0.13	8.00	0.38	8.00	0.34	0.03	7.00	0.43	7.00	0.29	0.14	8.50	0.32	9.00	0.17	0.16
3.5.	Optimize the use of meat and other products derived from management.	9.00	0.22	9.00	0.22	0.00	9.00	0.22	9.00	0.22	0.00	9.00	0.11	9.00	0.22	-0.11	9.00	0.11	10.00	0.10	0.01
3.6.	Inform the public about the values and benefits of hunting and management for biodiversity and rural development.	10.00	0.10	10.00	0.10	0.00	10.00	0.10	10.00	0.10	0.00	10.00	0.10	10.00	0.10	0.00	10.00	0.08	10.00	0.10	-0.03
3.7.	Consider the opinions and feelings of the general public and in particular those of the local population.	9.00	0.22	9.00	0.11	0.11	9.00	0.17	8.50	0.12	0.05	9.00	0.22	9.00	0.11	0.11	9.00	0.28	9.00	0.17	0.11
3.8.	Preserve cultural. historical. and artistic values related to hunting. game management and wildlife.	9.00	0.22	9.00	0.22	0.00	9.00	0.22	9.00	0.22	0.00	9.00	0.22	9.00	0.22	0.00	9.00	0.19	9.00	0.22	-0.03
3.9.	Recruitment of personnel from the region around the property.	9.00	0.22	9.00	0.22	0.00	9.00	0.22	9.00	0.22	0.00	9.00	0.22	9.00	0.22	0.00	10.00	0.18	10.00	0.10	0.08
3.10.	Training and provision the necessary equipment to the personnel in charge of the management and maintenance of the estate.	9.00	0.22	10.00	0.10	0.12	9.00	0.22	10.00	0.10	0.12	9.00	0.22	9.00	0.22	0.00	9.50	0.21	10.00	0.10	0.11
3.11.	Collaboration in research applied to the management of game species.	10.00	0.10	10.00	0.20	-0.10	10.00	0.10	10.00	0.18	-0.08	9.00	0.17	10.00	0.20	-0.03	9.00	0.22	10.00	0.20	0.02
3.12.	Collaboration in the dissemination of good game management practices.	10.00	0.10	10.00	0.10	0.00	10.00	0.10	10.00	0.10	0.00	9.00	0.17	9.00	0.22	-0.06	9.00	0.22	10.00	0.05	0.17
3.13.	Evaluate the user satisfaction.	9.00	0.22	9.00	0.11	0.11	9.00	0.17	8.00	0.22	-0.05	9.00	0.22	8.00	0.25	-0.03	9.00	0.19	9.00	0.11	0.08
3.14.	Have a service to eliminate dying or injured animals to eliminate as far as possible the suffering of the hunted animals.	7.50	0.40	8.00	0.25	0.15	7.00	0.43	7.00	0.29	0.14	8.00	0.31	8.00	0.25	0.06	7.00	0.50	9.00	0.22	0.28

reduction of population size of seed-dispersing species may have implications for vegetation dynamics, affecting future carbon storage capabilities and resilience to climate change (Ingram et al., 2021). Finally, to streamline these priority statements, we propose grouping them into three criteria related to the *Game Population* dimension (see Table 6): 1) Maintain game population abundance, distribution, structure, and behavior that are compatible with conservation; 2) Maintain the genetic characteristics of the game population that are compatible with conservation; 3) Uphold or improve the diversity and conservation status of game species populations typical of the management unit's area.

In the top five of the **Habitat dimension**, the top-rated priority statements are related to not compromising the diversity of landscapes and conservation status of flora and fauna (statements 2.8., 2.4., 2.17.), and the importance of appropriate management of water points and phytosanitary products in agricultural areas (2.24., 2.18.). Hunting is a consumptive use of biological resources that is highly environmentally effective and actively interferes with many ecosystem processes (Lexer et al., 2005). For example, in forest ecosystems high densities associated with big game recreational hunting can cause damage by browsing of shrubs preventing the natural regeneration of plant species (Perea and Gil, 2014), being necessary to emphasize the importance of moderate pressures (which has positive impacts on ecosystems, Olff and Ritchie, 1998; Fløjgaard et al., 2018; Pringle et al., 2023) or protecting the flora from game population pressures. Another example is that in agricultural ecosystems, the use of herbicides and pesticides, together with the destruction of margins, boundaries, and patches of natural vegetation by land clearing because of agricultural intensification, are endangering the biodiversity of these landscapes (Donald et al., 2006). In these cases, management measures that enhance small game populations remains necessary such as incentivizing scrubland and uncultivated grasslands (Conover et al., 2007; Smith et al., 2008) and can also have positive effects on non-game fauna (Robertson et al., 2001; Hinsley and Bellamy, 2000; Arroyo et al., 2012). Therefore, according to the management guidelines applied, hunting can be associated with the retention of natural habitats (Duckworth et al., 2003; Robertson et al., 2001) and can facilitate the preservation of natural values (Tapper, 1999). Rewilding and restoration (Pettorelli and Bullock, 2023) are strong movements in many regions in Europe and need to be integrated into future wildlife management approaches, including hunting certification systems. The reintroduction of natural predators may contribute to maintaining sustainable populations, improving the diversity of non-game species. The reintroduction of natural predators through wildlife conservation programs is not contrary to a hunting certification system, and hunters may perceive an opportunity to improve the habitat quality towards a more natural system. Future research may deal with restoration and rewilding approaches and their relationship with hunting. In summary, we propose to synopsize these priority statements into two criteria related to habitats where managed game populations occur (see Table 6): 1) Uphold or improve the diversity of non-game species; 2) Uphold or improve the conservation status and diversity of habitats.

In the **Socio-economic dimension**, the top five statements by the experts related to promoting public awareness of the benefits of hunting, game management and biodiversity conservation (3.6., 3.12.), the importance of collaborative research applied to game management (3.11.) and the organization's own management measures, including improving human resources and assessing customer satisfaction (3.10., 3.13.). Hunting and its associated management provide multiple benefits to society, such as food, recreation, employment, cultural identity, and some positive ecological outcomes for biodiversity conservation (Fischer et al., 2013b). Therefore, the improvement of hunting activities, the inclusion of hunters' interests and satisfaction, and the dissemination of good practices to society, are quite important in a sector that faces high social controversy over its activities and that often generates debates about biodiversity conservation and the killing of animals (Delibes-Mateos et al., 2015; Caro et al., 2017; Martínez-Jauregui and Soliño, 2021). Likewise, hunting managers and operators often prioritize maximizing hunter satisfaction by managing wildlife populations and their habitats (Hendee, 1974; Manfredo, 2004; Kerr, 2017; Child et al., 2015). For this reason, we considered two main criteria that compile the different relevant topics in the socioeconomic dimension (see Table 6): 1) Maintain or improve the socioeconomic functions and conditions of the activity; 2) Increase customer satisfaction.

The criteria mentioned above define a useful framework for a common understanding of the sustainability principle itself (refer to Table 6) as they address the main challenge of promoting a unified lexicon and a shared conceptual framework (Gale and Cordray, 1994; Colfer, 1995). Although there is a national legal reference (BOE, 1970; see article 17.7) describing the minimum requirements for game management and ecosystem conservation, the development of an overarching theoretical framework in which consensus criteria are defined by researchers, public sector professionals and private managers is imperative. These consensus criteria will facilitate the creation of a conformity assessment scheme that can be applied to policies governing the recreational hunting sector and game management systems and can shape future market and regulatory standards.

4.2. From criteria to policy

Our research concludes with the proposal of a third-party certification system as a market-driven solution bridging theoretical criteria and practical policy implementation. We present a graphical view of this system in Fig. 2. Landowners would voluntarily implement a game management system according to an established standard in the scheme. Subsequently, auditors from accredited certification bodies would apply rigorous certification audits. Upon successful completion of the audit, the certification bodies provide written confirmation that the game management system aligns with the sustainability standards, granting the landowner the right to display a sustainable game management label issued by the scheme owner, which is valid for five years. The use of the label would be conditional on passing annual monitoring audits throughout the period (refer to Fig. 2).

In the proposed certification system, accreditation is conditional on adherence to ISO/IEC 17021–1, which encompass the essential prerequisites for organizations engaged in the auditing and certification of management systems. National Accreditation Bodies (NAOs) are usually quasi-public entities tasked with overseeing the competence of certification bodies. Accreditation bodies act as a second line of trust assurance by accrediting both certification bodies and their personnel, thus ensuring alignment with the standards set by the certification system (Loconto and Busch, 2010).

The system is overseen by a Governance Committee, consisting of a

Table 6
Criteria containing the key elements considered by the selected statements (3 Criteria in the Population Dimension, 2 Criteria in the Habitats Dimension and 2 Criteria in the Socio-economic Dimension).

Dimensions	Criteria	Statement
Game Populations	1. Maintain game population abundance, distribution, structure, and behavior that are compatible with conservation.	1.12. 1.19. 1.15.
	2. Maintain the genetic characteristics of the game population that are compatible with conservation.	1.5.
	3. Uphold or improve the diversity and conservation status of game species populations typical of the management unit's area.	1.22.
Habitats	4. Uphold or improve the diversity of non-game species.	2.4. 2.24. 2.18.
	5. Uphold or improve the conservation status and diversity of habitats.	2.8. 2.4. 2.17.
Socioeconomics	6. Maintain or improve the socioeconomic functions and conditions of the activity.	3.6. 3.12. 3.11.
	7. Increase customer satisfaction.	3.13.

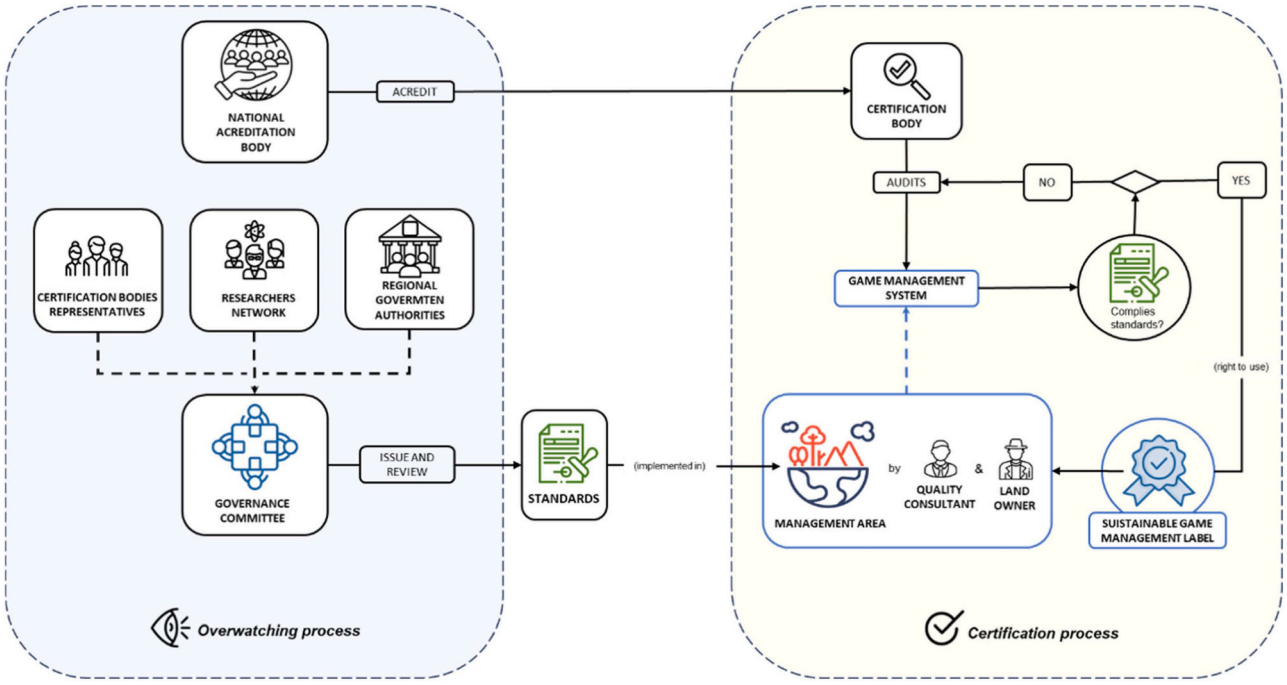

Fig. 2. Description of the conformity assessment system. Governance Committee issues and reviews the sustainability standard document with Criteria and Indicators for the adaptive management of the game and the requirements for assessment. The landowners, assisted by consultant, implements the Game Management System on these lands in accordance with the standard. Certification bodies, accredited by independent national accreditation bodies, audit the Game Management System. If the audit is successfully passed, the landowner obtains the certificate authorizing the right to use the Label for five years. The right of use must be revalidated annually during the validity period of the certificate.

network of scientists, government officials and representatives of certification bodies. Scientists help to establish performance indicators that quantify the level of performance against the seven specified Criteria. Public officers with responsibility in hunting and habitat management in autonomous communities serve to mitigate the excessive influence of regional policies on technical decisions (Child and Wall, 2009), to diminish flexibility and innovation in public certification systems (McCluskey, 2000), to ensure that the standards developed are in line with environmental policies, and to ensure that the misuse of the label is prevented by legal measures and public intentions (Jahn et al., 2005).

Representatives of the certification bodies, duly accredited to operate under the Scheme, actively engage in the committee, contributing their practical field experience gained from audits and other observations that enhance the operational effectiveness of the Scheme standards. In order to operate under this scheme, a certification body must demonstrate its capability to conduct inspections in accordance with the Scheme's standards. In a market-based certification system administered by third-party entities, certification fees are externally set, and certification bodies work to minimize costs. The main role of this governance committee is to act as a monitoring entity, often involving private institutions or public authorities, following the principle of "control-of-the-control" (Jahn et al., 2005).

While a specific set of Criteria serves as a benchmark for sustainability assessment, it is important to acknowledge the potential for future change. The relative importance of different factors may change over time due to shifting societal attitudes or the emergence of new methodologies and technologies that could update existing indicators. Additionally, it is important to consider that global and regional regulatory frameworks change and adapt over time. Committee members will be tasked with periodically reviewing the sets of reference criteria and the associated schemes and standards to customize them according to the specific characteristics of a country, region, or continent. These adaptations should duly encompass shifts in social, economic, ecological, and institutional aspects,

and should be executed promptly to remain synchronized with evolving dimensions. The **scheme owner** bears the responsibility for overseeing the committee's activities, the development and upkeep of the scheme, and the proper execution of tasks by all parties involved in the certification process. Additionally, the owner is accountable for safeguarding the exclusive use of the label, ensuring the impartiality of the process, enforcing requirements, and addressing appeals and complaints (Loconto and Busch, 2010).

5. Conclusions

Certification systems have emerged as tools to evaluate and legitimize sustainable hunting practices, with the goal of achieving a balance between social-economic, ecological, and cultural values associated with hunting populations. The certification of sustainable hunting affects 85 % of the Spanish territory. This certification implies that estate managers will undertake actions aimed at improving the most relevant aspects identified by experts to obtain a label of sustainable game management. These actions can be grouped in three dimensions: game populations (maintaining game population abundance, distribution, structure, and behavior that are compatible with conservation, the genetic characteristics of the game population that are compatible with conservation, and improving the diversity and conservation status of game species populations typical of the management unit's area), habitats (uphold or improve the diversity of non-game species, and the conservation status and diversity of habitats), and socioeconomics (improving the socioeconomic functions and conditions of the activity, and increasing customer satisfaction). This label could also serve as an identity brand, which can have positive effects on the recreational hunting market.

However, policymakers' involvement in a certification system is crucial. This study represents a golden opportunity for the scientific transfer of research results applied to the management of recreational hunting, as well as an opportunity for public managers to be more aware of the need to develop governance mechanisms that certify to society as a whole its commitment to the criteria of sustainable hunting

management. The next step should perhaps be to study how users, that is, hunters, value hunting in certified areas compared to other options that are less respectful of the natural environment.

Ethical approval

The authors have no relevant financial or non-financial interests to disclose. All authors certify that they have no affiliations with or involvement in any organization or entity with any financial or non-financial interest in the subject matter or materials discussed in this manuscript.

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María Martínez-Jauregui: Writing – review & editing, Writing – original draft, Methodology, Formal analysis, Conceptualization. **Olmo Linares:** Writing – review & editing, Writing – original draft, Methodology, Investigation, Formal analysis, Data curation, Conceptualization. **Mario Soliño:** Writing – review & editing, Methodology, Formal analysis, Conceptualization. **Juan Carranza:** Writing – review & editing, Supervision, Funding acquisition.

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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Authors' contributions

O.L., M.M-J., M.S. designed the study; O.L. performance questionaries and collected field data; M.M-J and M.S. performed the statistical analysis, O.L. and M.M-J. wrote a first draft; M.S., and J.C. led the writing of the final version of the manuscript with inputs from the rest of the authors.

Informed consent

Informed consent was obtained from all human subjects prior to the conduction of online questionnaire. The participants were informed about the safeguard of the privacy, confidentiality, and anonymity of all the information they provided, according to Spanish law of data protection and its adaptations to European Union regulations on data privacy. Research was conducted following usual social sciences approaches.

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