

RURAL AREAS AND BIG GAME HUNTING IN SPAIN: ANALYSIS OF PREFERENCES ACCORDING TO HUNTER'S GENDER AND FAMILY INCOME

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Abstract: Hunting is one of the main uses associated with land which, in the current context, has a strong economic significance for rural areas. This work generates knowledge that can be useful for designing strategies that favour the economic dynamisation of rural areas, in a context of population loss and scarce economic diversification. In this sense and based on the results of a survey of hunters (N = 1662), the objectives of the work are first to analyse the territorial distribution and abundance of big game species in Spain and secondly, to examine the existence of correlations, between hunters' income, hunters' gender and preferences for certain big game species. This analysis is based on primary and secondary sources and its characteristics are explained in the methodology section. Univariate and bivariate descriptive statistics were used, specifically the chi-square contingency test, which allows us to determine the relationship of dependence between two variables. We found that female hunters showed greater interest than their male counterparts in hunting big game species, and the same interest was found in hunters with higher income level regardless of their gender. Our results may help to design and develop socio-economic strategies related to supply and demand hunting activities.

Keywords: rural areas, Spain, hunting activity, territorial distribution, hunters' gender, economic income

Highlights

- Big game hunting in Spain has a high potential for the development of dynamization of rural areas.
- Big game species are in full expansion in Spain. They constitute wildlife resources with socio-economic implications.
- Female hunters have a greater interest in big game species.
- Hunters have common preferences for game species, although there are slight differences according to their income level.

1. Introduction

From a spatial point of view, hunting activity has an important role on a global scale, being one of the main uses associated with land (Neumann et al., 2022), for reasons that have changed throughout history. The current figures for the area under enclosure corroborate this assertion. In Spain, for example, hunting land occupies an extension that covers 85% of the total area (Ministry for Ecological Transition and Demographic Challenge, 2022), data that can be extrapolated to other countries such as Serbia (96%) (Matejević. et al. 2023), Czech Republic (87%) (Kalábová and Zikmund, 2023) or Europe as a whole, where 65% of the territory is hunting land under different formulas (Ebner, 2016). As a result, hunting has, in the current context, important territorial, economic, social and environmental connotations from which benefits and conflicts arise, in a situation where hunting is conceived as a service provided by terrestrial ecosystems (Ministry for Ecological Transition and Demographic Challenge, 2020). However, and despite this prominence, as Neuman et al. (2022) point out, this practice has not been considered in land use planning policies. Therefore, under these circumstances, the drafting of strategic plans on a large spatial scale, whose objective is the sustainable use of hunting resources, has been scarce and late. For example, in Spain, the central government has not drafted a National Hunting Strategy until 2022, to promote sustainable hunting through the rational management of the territory and species (Ministry of Agriculture, Fisheries and Food, 2022). Something similar has occurred with the Spanish autonomous communities, which, despite having full competence in this area, tend to lack a strategic vision at the regional or county level, focusing almost exclusively on the technical plans of hunting reserves.

One of the consequences of the absence of large-scale planning is the impossibility of addressing problems and stimulating certain types of benefits, even though it is an activity that affects a large surface

area and therefore has to share the same territory with other land uses because game species occupy agricultural and forest landscapes (Neuman et al., 2022). In this sense, traditional economic activities (agriculture, livestock, forestry) on the one hand, and contemporary (recreational) activities on the other, should be considered.

In this order of ideas, among the benefits derived from the practice of hunting in the Contemporary Age are those of an economic nature, as it is conceived as a recreational practice of a productive nature that generates income (Rengifo et. al, 2022), considering that hunting activity can become a main or complementary use of agricultural and forestry exploitations. This characteristic, which is not recent, began to develop after the industrial revolution of the 19th century, when the countryside gradually took on new functionalities that reached their maximum splendor during the second half of the 20th century. Therefore, it will be from this last period, coinciding with an advance in the means of transport and, consequently, greater ease of travel, when hunting tourism consolidates and becomes an activity that reaches international character (Rengifo, 2008, 2011, Bauer and Herr, 2004, Komppula and Gartner, 2013, Matilainen, 2009, Samuelsson and Stage, 2007, Delgado et. al. 2020). This development of hunting tourism coincides, in the European territorial framework, with the gradual depopulation of the rural environment, a circumstance that is interpreted by the EU member countries as a challenge that must be responded to with different types of measures. In this context, hunting is perceived as an economic activity that contributes to the generation of employment and the development of rural areas. Its relevance as a line of research can be seen in the number of papers published on this topic. In this sense, Di Minin et al. (2021) after comprehensively evaluating the state of knowledge on recreational hunting, through scientific publications over a period of more than 60 years, identified seven thematic blocks, one of them being the so-called "economic, social, cultural, political and ethical dimensions", whose key words were, among others, "benefits, resources, economy, tourism and community". Going deeper into this issue, it is a verifiable reality that studies reflecting the economic impact of hunting have multiplied in different countries such as Spain (Sánchez *et al.*, 2021), United Kingdom (PACEC, 2014), Sub-Saharan Africa (Lindsey et al. 2007), Australia (RMCG, 2019), United States (US Fish and Wildlife, 2018), Canada (Conference board of Canada, 2019), Belgium (PWC, 2022) or European Union (Kenward and Sharp, 2008). As a result of all this, hunting has been transformed into a highly complex activity involving three main elements:

- The offer. It is constituted by two fundamental pillars: the hunting grounds (whose classification depends on the existing regulations in each country) and the hunting species, within which a distinction is made between big game (mammals) and small game (birds and small mammals).
- Demand (national and international hunters). Statistics show that hunting continues to be an activity practiced by millions of people on a global scale. Examples include Europe, with an estimated hunter population of over 6 million (Face, 2010), the United States with 11 million (U.S. Fish and Wildlife Service 2016), Canada with 1.27 million (Conference board of Canada, 2019) and Australia, where hunters number over 640,000 (RMCG, 2020). However, the evolutionary trend in the number of hunters shows signs of decline in a majority of countries. In this direction, Massei et al. (2014) showed that in 12 out of 17 European countries, there is a decline, or their number remains stable, while in five others, their evolution seems to trend upwards. Therefore, generational replacement is one of the challenges that the sector must face in the short term.
- Companies that provide services to hunters (general and specific). General companies are those that provide services to all types of clients, including hunters (lodging, restaurants, catering, etc.), while specific companies are those created to provide services demanded by hunters. The latter emerged when hunting became a commercial activity, a stage that began to develop between the 19th and 20th centuries following the strong demand for safaris in Africa. This would be the case, for example, of the Newland and Tarlton company that began operating in Africa at the beginning of the 20th century (Herne, 1999).

Big game hunting in Spain is an important socioeconomic activity that has experienced an important boom in recent years, in parallel with the evolution experienced by some determining factors of supply and demand. About supply, as this will be explained later, there has been a growth in the number of captures and in the amount of hunting land devoted to big game hunting. Therefore, demand has undergone a series of changes that are manifested in a greater interest in these species, while at the same time a network of companies has developed that provide services to hunters, either directly or as intermediaries. In summary, big game hunting in Spain has a high potential for the development of strategies that favor the economic dynamization of rural areas, in a context of population loss and scarce economic diversification. It can also contribute to stimulate the lack of generational replacement, through the incorporation of young people, especially women. In this sense, the generation of knowledge on the factors that influence the supply and demand of big game hunting is, therefore, a key element for designing strategies that favor the development of this socioeconomic activity. Strategies that can be considered by specialized companies to carry out their activity. Specifically, the spatial availability of hunting resources, as well as the elements that influence hunters' interest in these resources are important issues for the knowledge of the context of supply and demand for big game species.

Against this background, the aim of this article is twofold. First, we undertake the task of framing the results in the territory of Spain, analyzing two quantitative variables from secondary sources: the asymmetric territorial distribution and the abundance of big game species. Secondly, we intend to analyze whether correlations are detected between family income and hunters' preferences for the different Spanish big game species, adjusting for the sex factor since a greater interest is expected from women than from men (Pérez-González et al. 2023). For this analysis, the responses obtained in a survey, whose characteristics are explained in the methodological section, are used as a basis.

2. Methodology

2.1 Study area

The territorial framework of this research is Spain, a nation with a secular hunting tradition, as can be seen in different aspects: the development of regulations that have evolved since the Middle Ages (Quesada, 1980), an extensive collection of artistic representations (Casariego, 1982), the practice of unique hunting modalities in the world such as montería and ojeo de perdiz (Duque de Almazán, 1934) and the existence of a large collection of classic texts on hunting (Fradejas, 1999). This hunting tradition has been maintained to the present day, as evidenced by the figures for the number of hunters and the surface area enclosed. In terms of the number of hunters, hunting is the sport with the second largest number of members at the national level (Ministry of Culture and Sports, 2022), as well as being the second European country with the largest number of hunters, after France (FACE, 2010). However, it should be noted that the evolution of the number of licenses issued in Spain, shown in Figure 1, reflects a steady decline since 2010, from a figure of 1,079,480 to 681,023 in 2021, although this decline began earlier (Herruzo and Martínez-Jauregui, 2013). Therefore, and as this is a dynamic that is registered in other countries (Massei et. al, 2014), the fall in the number of hunters and generational replacement has become one of the main problems facing the sector in the short term.

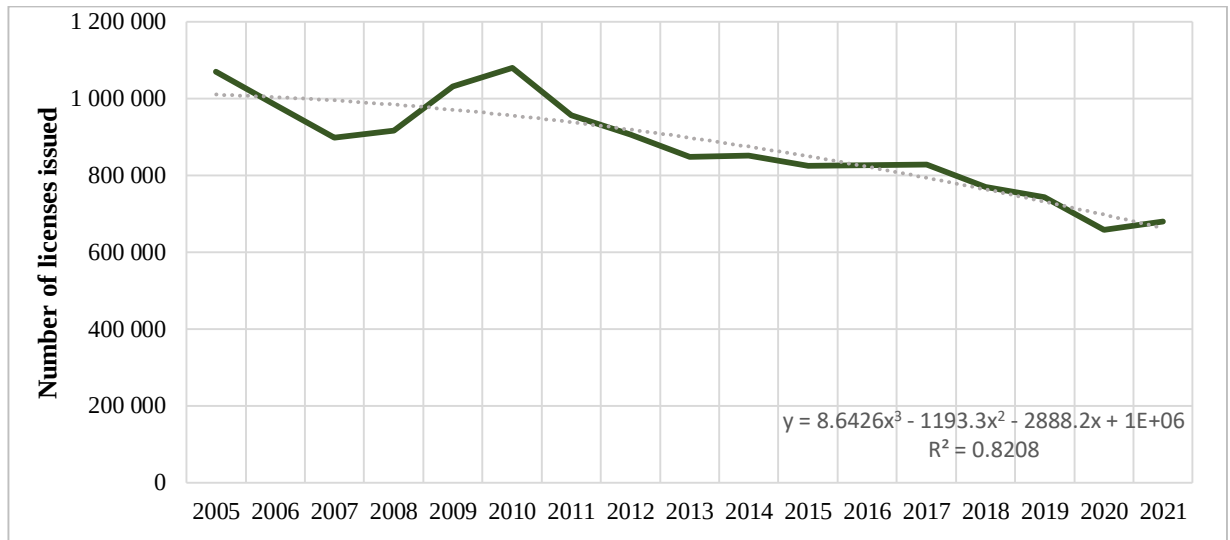


Fig 1. Evolution of the number of hunting licenses issued in Spain. Source: Prepared by the authors based on the Ministry of Ecological Transition and Demographic Challenge (2021)

On the other hand, and about the surface area dedicated to this activity, it covers more than 43 million hectares, equivalent to a percentage close to 85% (Table 1). This surface area is classified in a wide variety of hunting grounds, whose names and characteristics vary according to the regulations of each of the Spanish regions. However, hunting lands can be grouped into two main categories, depending on whether they are managed privately or by public bodies. As the following table shows, most of the surface area is under private management, far exceeding those managed by public bodies and those subject to special planning.

Tab 1. Hunting lands in Spain (2021). Source: Prepared by the authors based on the Ministry of Ecological Transition and Demographic Challenge (2021)

Management	Type of terrain	Number of plots	Surface area [ha]	Total area [ha]
Public	Hunting Reserve	170	1,633,271	2,401,646
	Regional Game Preserve	64	768,375	
Private	Social preserve	771	2,433,482	39,769,816
	Municipal preserve	686	2,508,162	
	Sporting preserve	2,483	6,661,634	
	Intensive hunting preserve	840	582,974	
	Private reserve	26,298	27,583,564	
Special planning	Hunting lodge	44	39,800	978,297
	Controlled hunting area	125	817,477	
	Non-hunting lands (fenced, closed and security zones).	727	121,020	
Total		32,208	43,149,759	

2.2 Sources of information and study techniques

The main sources of information used in this research are of two types: cartographic and alphanumeric. In the first case, the source of information comes from the Ministry of Ecological Transition and Demographic Challenge, specifically, from the Banco de datos la Naturaleza (<https://www.miteco.gob.es/es/biodiversidad/servicios/banco-datos-naturaleza/default.aspx>). This source contains the distribution of different species existing in the Iberian Peninsula by UTM squares. For the present research, big game species were selected, creating an individual database for each of them, which was subsequently linked to the cartography. On the other hand, alphanumeric information is

the main source used in this research, coming from the creation and dissemination of a questionnaire among the hunting population in Spain.

The methodological process was carried out in three phases, which are shown in Figure 5. The first phase consisted of creating a questionnaire using the "Google Forms" platform. Subsequently, it was disseminated among the hunting population in the time frame between January 20 and August 4, 2022. The distribution was carried out with the collaboration of different entities related to hunting activity at national level, including the Artemisan Foundation and hunters' associations spread throughout all the autonomous communities. Finally, a database was created with the information collected and its subsequent statistical processing. At the same time, with the information from the Ministry of Ecological Transition and Demographic Challenge, the cartography that has made it possible to determine the distribution of the big game species analyzed in this study was drawn up, except in the case of the Balearic Biscay, for which there is no information.

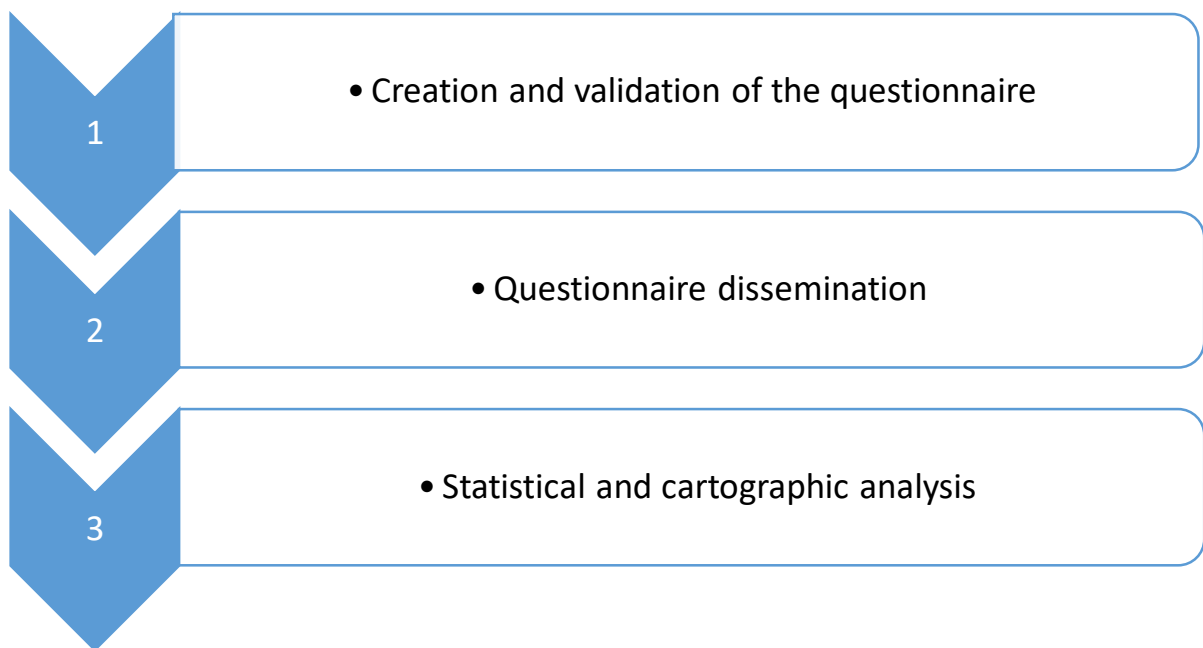


Fig 2. Methodological process. Source: own elaboration

The large study sample obtained, 1662 questionnaires for an estimated population of 751,717 hunting licenses in Spain (year 2021), has made it possible to obtain a high statistical reliability of the data. In this sense, the margin of error is 2.4%, with a confidence level of 95%. To analyze the statistical reliability according to sex, an estimate was made of the representativeness of the number of licenses for men and women, taking as a reference the data on the number of federation licenses by sex in 2021 (Ministry of Education and Culture, 2021). This source indicates that, in 2021, the number of federative hunting licenses stood at 4047, from a total of 333 279 (1.21%). Under this scenario, the statistical reliability of the results obtained is also high, although the margin of error presents an increase in the case of the sample of female hunters (5.33%).

Tab 2. Technical data sheet. Source: own elaboration

Estimated population (total licenses):	751,717
Sample:	1,662
Confidence level	95%
Margin of error	2.40%
Estimated population (male licenses)	740,441
Sample	1,334
Confidence level	95.00%
Sample	1,662
Margin of error: 2.68%.	2.68%
Estimated population (female hunter licenses 1.21)	7,517
Sample	328
Confidence level	95.00%
Margin of error	5.30%
Date of completion	January 20, 2022 to August 4, 2022
Medium:	Questionnaire developed with Google Form

The main tool used in this analysis was statistics. On the one hand, univariate descriptive statistics were used to calculate the mean values that respondents gave in general to the variable "interest in big game species". Subsequently, this calculation was carried out by segmenting the sample by "family income" and "sex". At the same time, bivariate descriptive statistics were applied, specifically, the contingency chi-square test was used to determine the relationship of dependence between two variables, based on the null hypothesis in which it is established that the variables analyzed are independent. After applying this test, a probability value (P-Value) or asymptotic significance is obtained. If the value of this probability is less than 0.05, i.e., the significance level is less than 5%, the null hypothesis is usually rejected and, therefore, it can be determined that there is a relationship between the variables analyzed (Rodríguez, 2004). On the other hand, if the value obtained in the asymptotic significance is greater than 0.05, the null hypothesis can be accepted, i.e., both variables are independent.

Additionally, complementary analyses were conducted to determine whether the results at the species level held after considering hunter interest in all big game species as a whole. To do so, we conducted a Principal Component Analysis (PCA) with the 9 variables related to hunter interest in each of the big game species. The PCA was repeated using only the variables of interest for the 6 species with the largest territorial distribution in Spain (wild boar, red deer, roe deer, fallow deer, ibex and mouflon; see below). In both PCAs, the principal components (PCs) with eigenvalues greater than 1 were selected, according to the Kaiser-Guttman criterion. These PCs with the highest explained variance were used as dependent variables in linear models with sex (Female vs. Male), income level (< €1,500, €1,501–2,000, or > €2,500) and the interaction of both as explanatory variables.

3. Results

3.1 Game species

Big and small game species, together with the territorial base over which they are distributed, are the raw material of this activity. In recent years, there have been changes in the sense that while the catches of small game species have decreased or stabilized, those of big game have increased, as shown in Figures 3, 4 and 5 (Ministry of Ecological Transition and Demographic Challenge, 2005–2021). The reasons for this process are of different orders: alteration and/or loss of habitat, changes in the pattern of agricultural uses, increase in forest area, incidence of diseases in small game species, changes in the behavior of migratory hunting species, expansion of some predators and abandonment of some traditional uses linked to the land (Traba et al., 2019; Villafuerte et al., 2017; Guillemain et al. 2013). As a consequence, the evolution of the number of captures is very different between big game species (increase of more than 100% in the period 2005–2021) and small game species (mammals and birds), as expressed in Figures 2, 3 and 4, in which the drop in captures in 2020 due to COVID can be observed.



Fig 3. Evolution of captures of hunting species: big game species. Source: Prepared by the authors based on MITECO (2005–2021)

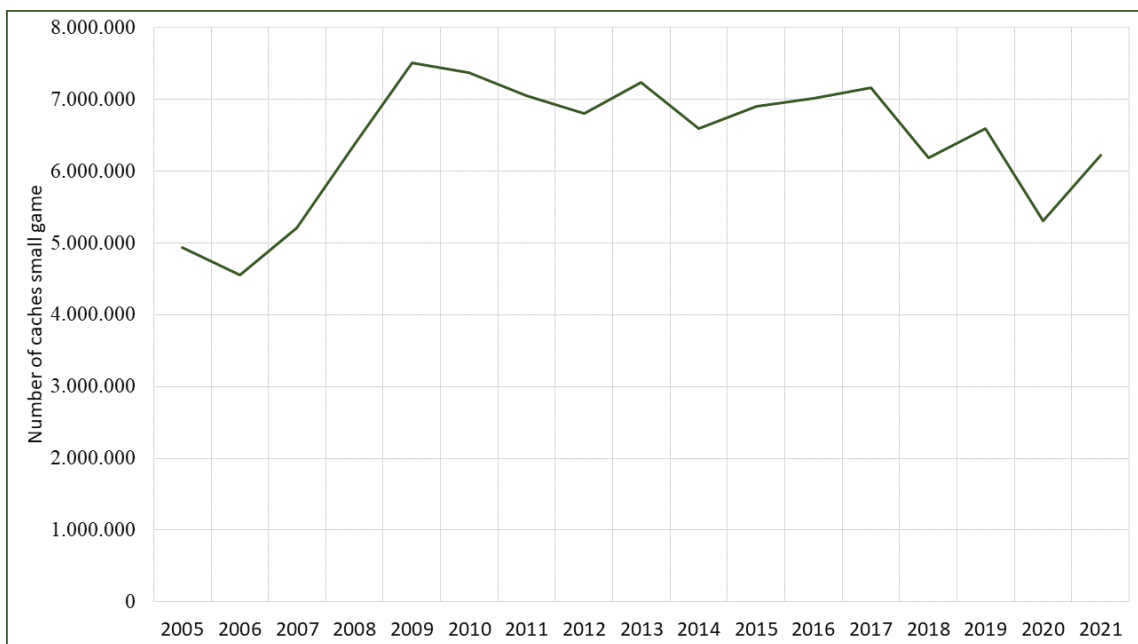


Fig 4. Evolution of captures of hunting species: small game. Source: Prepared by the authors based on MITECO (2005–2021)

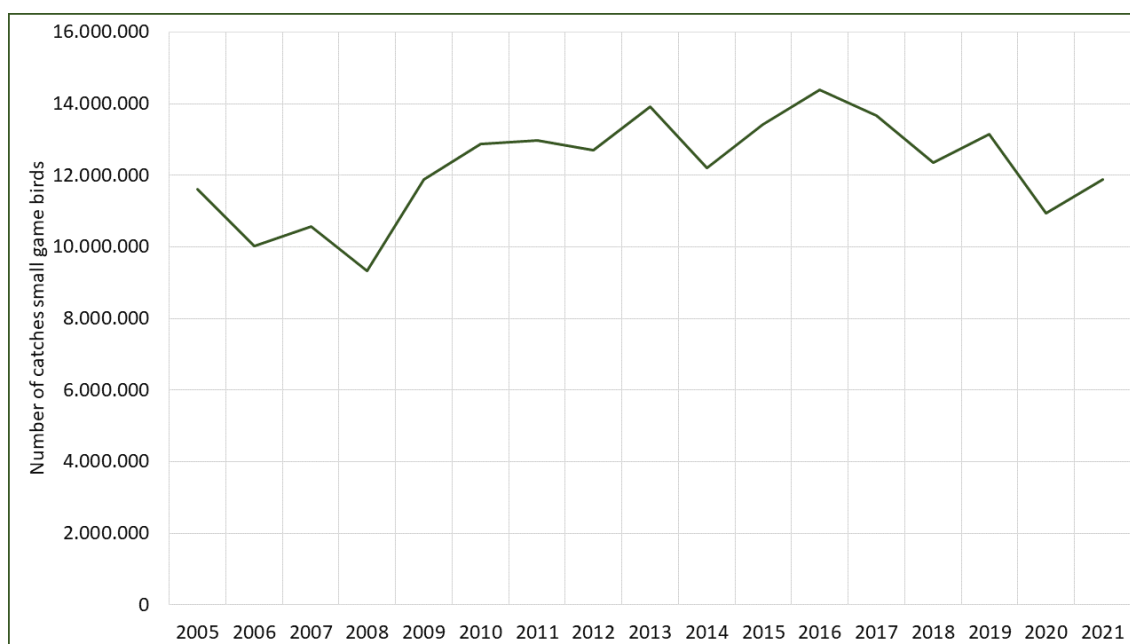


Fig 5. Evolution of captures of hunting species: small game birds. Source: Prepared by the authors based on MITECO (2005–2021)

3.2 Distribution of big game species in Spain

In a work of these characteristics, in which territory plays a determining role, it is necessary to provide knowledge on the territorial distribution of the different big game species in Spain. For its analysis, it is necessary to understand, in the first place, the administrative management model of hunting activity on a national scale. In this sense, the autonomous communities have full competence in hunting matters, in accordance with the Spanish Constitution of 1978. For this reason and depending on different factors such as geographical distribution and abundance, the different regions have a variable number of big game hunting species (Figure 6), as reflected in their own regulations.

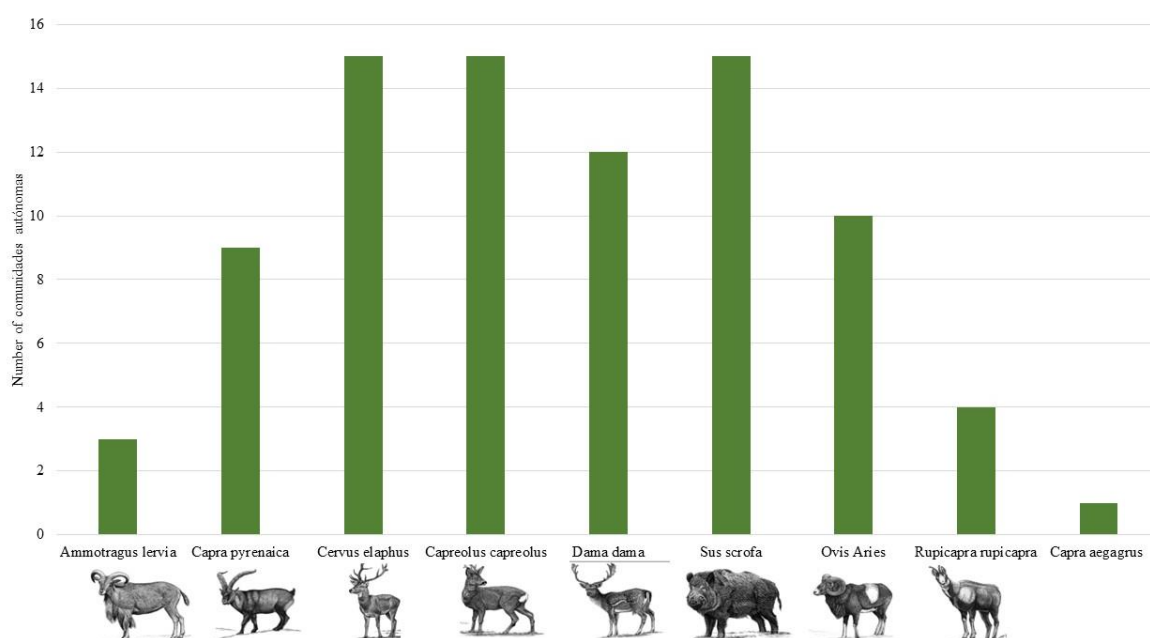


Fig 6. Big game species and number of autonomous communities where hunting is authorized. Year 2022. Source: Prepared by the authors based on the regulations of the autonomous communities

Of the nine species shown in the graph, two were introduced during the 20th century for hunting purposes. These are the Barbary sheep (*Ammotragus lervia*) and the mouflon (*Ovis aries*). Both are listed in the Spanish catalog of invasive species, although in geographical terms, the Barbary sheep is an invasive species throughout Spain, while the mouflon is only invasive in the Canary Islands (https://www.miteco.gob.es/es/biodiversidad/temas/conservacion-de-especies/especies-exoticas-invasoras/cee_mamiferos.aspx). According to Figure 6, three types of groupings can be established:

- Species with a high level of territorial distribution. Three species can be hunted in all the autonomous communities of Spain, except in the two insular ones (Canary Islands and Balearic Islands). These are the red deer (*Cervus elaphus*), wild boar (*Sus scrofa*) and roe deer (*Capreolus capreolus*). The estimated area over which these species are distributed is extraordinary. According to data from the Nature Data Bank (MITERD 2023), the wild boar covers more than 35 million hectares, while the red deer covers 15 million hectares and the roe deer 18 million hectares.
- Species with a medium level of territorial distribution. This group includes the fallow deer (*Dama dama*), mouflon (*Ovis aries*) and, to a lesser extent, the mountain goat (*Capra pyrenaica*), present, respectively, in 12, 10 and 9 autonomous communities. Although these species are distributed over a large number of autonomous communities, the area they occupy is much smaller than that of the previous group. The ibex covers 6.3 million hectares, while the fallow deer covers 3.2 million hectares and the mouflon 3.6 million hectares.
- Species with a low level of territorial distribution. This group is formed by three species with very different characteristics. The chamois (*Rupicapra pyrenaica*) is a high mountain species whose presence is restricted to the autonomous communities of northern Spain, where the mountain systems of the Pyrenees and the Cantabrian Mountains are located. It occupies, at surface level, 1.9 million hectares. As for the Barbary sheep (*Ammotragus lervia*), which was introduced in Sierra Espuña (Murcia) in 1970 for hunting purposes, its status as a hunting species is limited to three Autonomous Communities, covering an area of one million hectares. Finally, the Balearic goat (*Capra hircus*), present on the island of Mallorca, is a wild goat that is well characterized morphologically and genetically, and whose hunting use is included in the regulations of the Balearic Islands. This species restricts its presence on the island of Mallorca, especially in the territorial area comprised of the Sierra de la Tramontana.

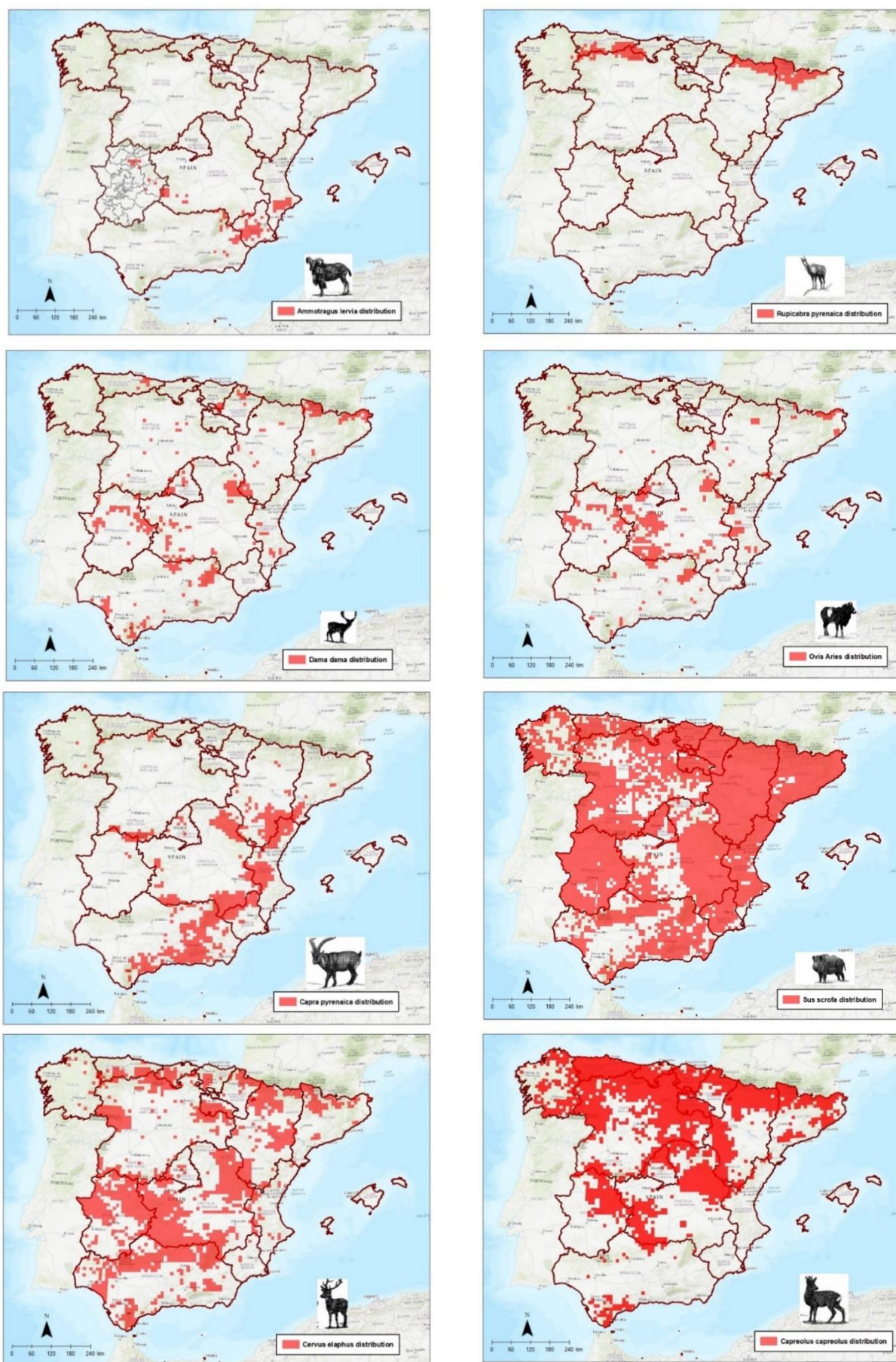


Fig 7. Distribution of big game species by autonomous community. Source: Source: own elaboration based on the Nature Data Bank (Ministry of Ecological Transition and Demographic Challenge, 2023)

However, although the area over which big game species are distributed is a variable of great interest, it is necessary to establish a relationship between the area affected and the number of captures, as this will determine the ratio (captures/km² of distribution).

Species	Distribution area (km ²)	Annual captures	Captures per km ²
<i>Rupicapra pyrenaica</i>	19 129	2035	0.11
<i>Capra pyrenaica</i>	63 266	10 955	0.17
<i>Ammotragus lervia</i>	10 172	2021	0.20
<i>Capreolus capreolus</i>	187 527	78 545	0.42
<i>Ovis aries</i>	36 714	16 145	0.44
<i>Dama dama</i>	32 292	28 478	0.88
<i>Cervus elaphus</i>	159 026	162 356	1.02
<i>Sus scrofa</i>	356 458	434 542	1.22

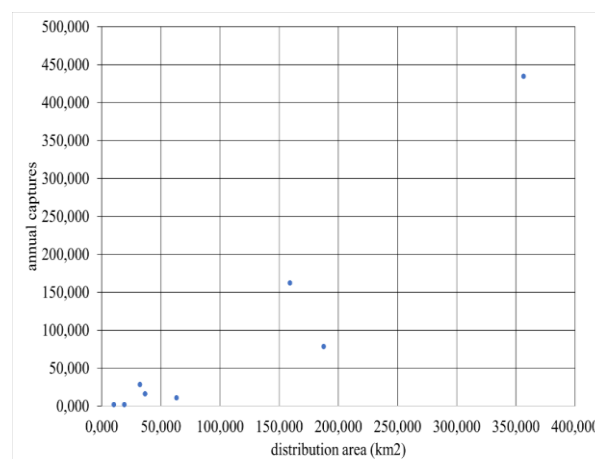


Fig 8. Captures of big game species per km². Source: Own elaboration with data from Forest Statistics yearbook 2021. MITECO

As it can be seen, only two species exceed the barrier of one capture per square kilometer, and they are also those with the greatest surface distribution, as well as those with the greatest volume of captures. Of the 73,5077 total captures, 59% were wild boar (*Sus scrofa*) and 22% were deer (*Cervus elaphus*). The remaining 19% of the captures were distributed among *Rupicapra pyrenaica* (0.27%), *Capra pyrenaica* (1.49%), *Ammotragus lervia* (0.27%), *Ovis aries* (2.19%), *Dama dama* (3.87%) and *Capreolus capreolus* (10.68%). Finally, the two species whose habitat coincides with the high mountains register the lowest ratios with values of 0.10 and 0.17.

3.3 Interest in different big game species according to sex

Currently, big game species are in full expansion. In this sense, the following paper analyzes the interest of Spanish hunters in big game species, segmented by sex and income, to determine if there is any relationship between both variables (interest in the species and sex, as well as interest in the species and income level). To measure this question, in the survey that forms the empirical basis of this research, a scale of 1 to 5 was established, where 1 represented little interest in a given species, and 5 represented great interest. Thus, the data shown in Table 3 present the results obtained. As it can be seen, deer and wild boar are chosen by hunters of both sexes as the species of greatest interest, exceeding the average of 4 and practically reaching 4.5 in the case of wild boar. The interpretation of these data suggests a relationship between the responses and the wide territorial distribution of the two species mentioned. As it has been shown above, the wild boar is the species that occupies the largest area. In second place, also arousing considerable interest among hunters, regardless of their sex, are species such as the roe deer, with a score of 3.84; the fallow deer, to which they give an average score of 3.32; and, finally, the mouflon, with 3.33. Finally, those species of the least interest to Spanish hunters coincide with those that have a greater territorial concentration, as would be the case of the Balearic boc (*Capra hircus*), whose distribution is limited to a very specific area of the Mallorcan mountains, as well as the mountain buck (*Capra pyrenaica*), the chamois, or the Barbary sheep, all of which receive scores below 3.00.

On the other hand, concerning differences according to sex, the asymptotic significance factor, after the application of Pearson's Chi-square statistic, has made it possible to visualize the relationship between interest in big game species and sex in some cases. A clear example of this can be seen with respect to red deer, fallow deer, roe deer, roe deer, mouflon, boc balear and wild boar (although in the latter case with a lower dependence relationship). In this sense, the greater interest of female hunters in this type of species can be appreciated, with the average valuation of these species exceeding that given by male hunters in all big game species.

Tab 3. Mean values of hunter interest in big game species according to gender. Source: own elaboration

Species	Man	Woman	Both	Chi-square	Asymptotic significance
<i>Capra Pyrenaica</i>	2.77	2.88	2.75	4.392	0.355
<i>Cervus elaphus</i>	3.90	4.23	4.00	16.358	0.003
<i>Sus scrofa</i>	4.40	4.45	4.42	9.955	0.041
<i>Dama dama</i>	3.21	3.56	3.32	16.592	0.002
<i>Rupicapra pyrenaica</i>	2.50	2.66	2.55	2.689	0.611
<i>Capreolus capreolus</i>	3.75	4.04	3.84	24.878	0.000
<i>Ammotragus lervia</i>	2.28	2.56	2.37	12.781	0.012
<i>Ovies aries</i>	2.99	3.33	3.09	21.731	0.000
<i>Capra circus</i>	1.77	2.02	1.85	18.682	0.001

3.4 Interest in the different big game species, according to sex and income level

Sometimes double segmentation is proposed in order to deepen the analysis of explanatory variables. Thus, a matrix of comparisons is proposed to detect whether there is a double bias between the hunter's sex and income level with respect to the importance given to the species hunted according to a Likert scale. In this sense, it is possible to deduce that there is a clear coincidence in the preference for hunting species, independently of the sex of the hunters analyzed, although small biases are detected according to the level of income.

From the analysis of the general average, species such as the Balearic boc, the Barbary sheep, and the chamois, which can be joined by the wild boar, are not the most interesting for hunting. This may be related to a reduced distribution of their habitat in the national context, as well as to the high economic valuation of these species. The economic valuation of these species, both in hunting grounds managed by the public administration and in privately owned hunting grounds, is high. In fact, Table 4 shows that, in general terms, interest in these species is higher among hunters (men and women) with a higher level of income. Wild boar, deer and roe deer are recognized as the species that arouse the greatest interest among hunters, regardless of their sex and income. The rest of the species studied occupy intermediate levels. Finally, it should be noted that the level of income introduces nuances that are not too relevant, except for those indicated.

In order to further detail the possible relationship between the hunter's income and his preference for hunting the species considered in the analysis, we chose to use the Chi-square statistic. Its adoption implies taking as the null hypothesis, in a generic way, that there is no clear differentiation in the preference for hunting species according to the income level of the respondents. The contrast of these hypotheses reveals that the asymptotic significance (p) does not exceed the significance level (0.05) in a considerable number of species, so that the null hypothesis must be rejected, something that affects above all the sample of men, in clear contrast to what happens in the case of women. In fact, for hunters, the preference for species such as red deer or roe deer, and, to a lesser extent, wild boar, are very similar regardless of income level. On the other hand, the rest of the species tend to be more interesting when income exceeds 2,500 €. The case of female hunters is the opposite, as mentioned above. Only in the case of wild boar can the null hypothesis be rejected, so there is no appreciable income bias.

Tab 4. Interest in big game species as a function of gender and income. Source: own elaboration

	Species	<1500€	1501–2000€	More than 2500€.	Media	Chi-square	Asymptotic significance (p)
Man	Capra Pyrenaica	2.4	2.4	2.9	2.6	26.282	0.010
	Cervus elaphus	3.8	3.7	3.8	3.8	6.734	0.560
	Sus scrofa	4.2	4.2	4.6	4.3	21.417	0.060
	Dama dama	3.1	2.8	3.1	3.0	16.444	0.040
	Rupicapra Pyrenaica	2.1	2.3	2.7	2.4	40.398	0.000
	Capreolus capreolus	3.5	3.5	3.9	3.6	16.153	0.040
	Ammotragus lervia	2.2	2.1	2.3	2.2	10.189	0.250
	Ovies aries	2.9	2.7	2.9	2.8	22.477	0.040
	Capra circus	1.8	1.6	1.7	1.6	15.913	0.050
Woman	Capra Pyrenaica	2.7	2.8	3.1	2.8	7.951	0.450
	Cervus elaphus	4.1	4.2	4.3	4.2	15.364	0.052
	Sus scrofa	4.3	4.6	4.5	4.4	23.221	0.003
	Dama dama	3.6	3.7	3.4	3.5	4.764	0.783
	Rupicapra Pyrenaica	2.7	2.4	2.8	2.6	10.770	0.215
	Capreolus capreolus	3.9	4.2	4.1	4.0	11.046	0.199
	Ammotragus lervia	2.6	2.3	2.6	2.5	5.437	0.710
	Ovies aries	3.2	3.3	3.3	3.2	2.396	0.966
	Capra circus	2.0	1.9	1.9	2.0	1.396	0.994

Regarding the results for interest in big game species, two PCs (PC1 [62.9% of the variance explained] and PC2 [11.9% of the variance explained]) were selected for the PCA with the 9 big game species and 1 PC (PC1 [67.0% of the variance explained]) for the PCA with the 6 species with the greatest distribution range (Figure S1 in the supplementary material). For the species with the greatest range, both the sex variable and the income variable had a significant effect on hunter interest in big game species (Table 5). Interest in big game species was higher in females and mainly when income was higher than 2,500 € (Table 6, Figure 7). Although the effect of income level tended to be greater in men (Table 6, Figure 7), the interaction was not significant (Table 5). These results were very similar when the models were run with PC1 of the PCA with all big game species (Tables S1 and S2, Figure S2). However, no significant effects were found when PC2 of the PCA was used with all species as the dependent variable (Tables S3 and S4).

Results of the linear model for the joint interest in the 6 big game species with the greatest distribution range (dependent variable: PC1 of the PCA). Df: degrees of freedom. Sq: squares.

Tab 5. Results of the linear model for the joint interest in the 6 big game species with the greatest distribution range (dependent variable: PC1 of the PCA). Df: degrees of freedom. Sq: squares. Source: own elaboration

	Df	Sum Sq	Mean Sq	F	p
Gender	1	142.2	142.205	36.937	<0.001
Revenues	2	158.5	79.255	20.586	<0.001
Gender*Income	2	1.8	0.900	0.234	0.791

Tab 6. Coefficients of the linear model for the joint interest in the 6 big game species with the largest distribution range (dependent variable: PC1 of the PCA). Interaction coefficients are not shown. Std.: standard. Source: own elaboration

	Estimate	Std. Error	t	p
Intercept	1.081	0.133	8.112	< 0.001
Gender Male	-0.823	0.122	-6.734	< 0.001
Income Between 1,501 and 2,500 €.	-0.665	0.118	-5.639	< 0.001
Income < €1,500	-0.635	0.118	-5.394	< 0.001

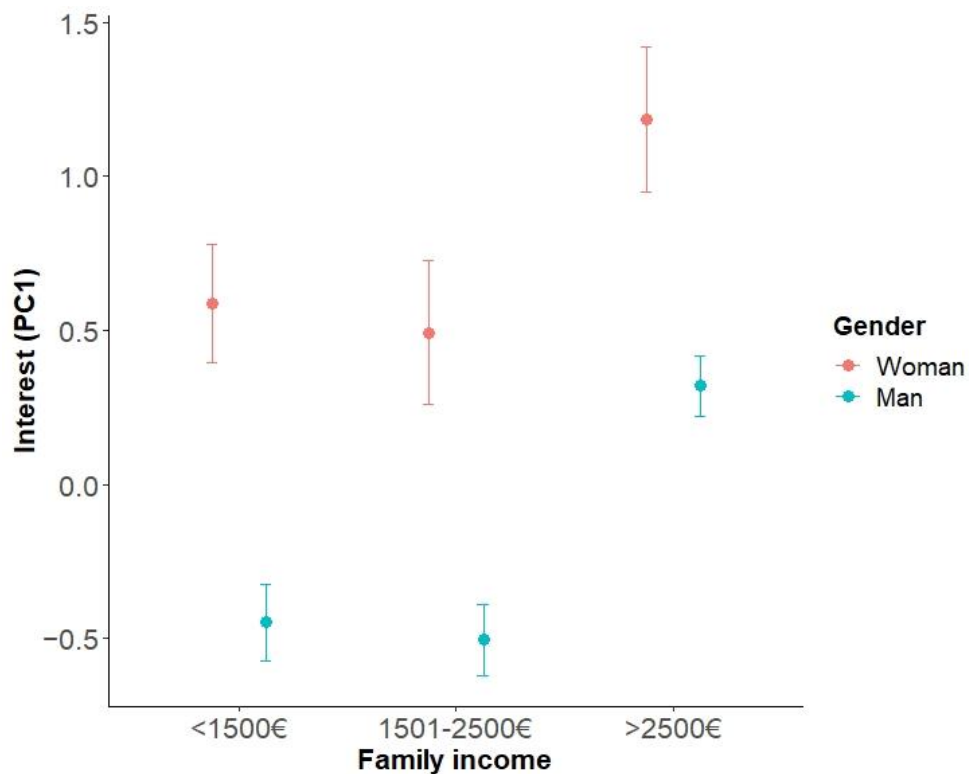


Fig 9. Interest by hunters in the set of the 6 big game species with the greatest distribution range (dependent variable: PC1 of the PCA). The figure shows mean values and standard errors according to gender and income level. Source: own elaboration

4. Discussion and conclusions

Hunting is one of the most important uses associated with the land, if we take into account the extraordinary surface area that has been affected by hunting land since the existence of regulations for its classification and management. This use of hunting resources has had two different purposes throughout history. On the one hand, we should mention the profitable hunting, whose purpose was to control damages and to supply meat or skins. As opposed to this type of hunting, we should mention recreational hunting, practiced in Spain by royalty and aristocracy as a privilege during the Middle Ages and the Modern Age (Rengifo et al., 2022), until profound changes came about in the 19th century and its practice was democratized. In the same way, the arrival of the 19th century meant a greater prominence of recreational hunting, although it was not until the 20th century that it had an almost exclusive character and assumed a role from which undoubted economic repercussions were derived, which have been described in numerous works (Middleton, 2014; Sánchez et al. 2021; RMCG, 2019; U.S. Fish and Wildlife Service, 2018, PACEC, 2018, Lindsey et al. 2007; Ebner, 2016; Conference Board of Canada, 2019). The economic consequences have been interpreted as an opportunity to invigorate the weak economies of rural areas (Sánchez et al., 2021; Rengifo et al., 2022; Kenward and Sharp, 2008), through hunting tourism (Rengifo, 2008, Barceló et al., 2017, Martín et al., 2019 and 2020, Muposhi et al., 2016, Booth, 2010; Matejevic and Markovic; 2023, Matejevic et al., 2022).

In this general context, Spain is positioned as an example of a country with a great hunting tradition, in which there is an important surface area dedicated to hunting and a significant economic impact derived from hunting activities. The results obtained in this work show the existence of nine big game species that make up the raw material of the activity, and whose territorial distribution and abundance is very heterogeneous for reasons related to their natural distribution and adaptation to different types of habitats, as well as to the implementation of various management models. Of the nine game species, deer and wild boar are the most representatives in terms of territorial distribution and number of captures. Likewise, the two species achieve the highest ratios of captures per square kilometer.

This territorial scenario is the basis for providing knowledge on hunter interest in different big game species, according to sex and income. In this sense, the studies that have addressed hunter behavior and preferences, taking into account their sex, are very scarce (Heberlein et al, 2008). The scarcity of works according to sex has been conditioned by the low participation of women in hunting, which some sources put at 10% in the United States (U.S. Fish and Wildlife Service, 2018) and 8% in the combined territory of the United States, Europe and Canada (Heberlein et al, 2008). In any case, statistical sources report a steady growth in the number of female hunters in recent years. In Spain, for example, the number of federal hunting licenses has increased from 1512 in 2007 to 4245 in 2022 (<https://www.csd.gob.es/>). Because of all this, the interest in knowing the profile of women hunters is a field of research of great interest. According to the results obtained in this work, women hunters show a greater interest in the different big game species than men. This aspect is clearly observed in Table 3 with respect to species such as *Cervus elaphus*, *Dama dama*, *Capreolus capreolus*, *Ammotragus lervia*, *Ovies aries*, and *Capra circus*. This is also seen in the case of *Sus scrofa*, although with a lower dependency ratio. These results by species confirm those obtained in a study in which a specific pattern of behavior of female hunters for big game species was detected (Pérez et al., 2023).

Finally, the results show that there is a variation in the level of territorial distribution of different big game species, with deer, wild boar and roe deer being the most widely distributed. On the other hand, a greater general interest of hunters with high levels of family income in hunting big game species was detected, fulfilling the expected result of a greater general interest of women in big game hunting than men. Our results can help in the design of socioeconomic strategies related to supply (species distribution) and demand (factors related to interest). This information can be used by both public entities and companies interested in the hunting sector.

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