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CHARACTERISATION OF WILD RABBIT COMMERCIAL GAME FARMS IN SPAIN

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Abstract: The aim of this research is to characterise the wild rabbit (*Oryctolagus cuniculus*) commercial game farms in Spain using variables related to structure, management and marketing. To this end, a structured survey was administered in 2009 to 21 privately-owned farms. This subsector was an average age of 13. The average size of the breeding stock of the farms was 431 does and 64 bucks. Eighty-five percent of the farms kept all or part of the breeding stock in cages and 38.1% used artificial insemination. All the farms carried out breeder self-replacement, 4.8% by buying wild rabbits from other farms, whereas 38.1% captured wild rabbits for this purpose. Nineteen percent of the wild rabbit game farms also produced other game species, mainly red-legged partridge (*Alectoris rufa*), pheasant (*Phasianus colchicus*) and quail (*Coturnix coturnix*). Fourteen percent of the farms supplied wild rabbits to be used as prey to be released in programmes for the conservation of endangered predators, and 38.1% supplied breeding rabbits to be used by other farms to replace culled animals. Eighty-six percent of the farms offered the service of transporting the animals from the farm to the hunting grounds to their clients, and 14.3% advised customers on how to successfully release and restock hunting grounds. Seventy-six percent of the farms marketed their products throughout Spain, and 38.1% exported wild rabbits to neighbouring countries, mainly Portugal and France. Forty-three percent of the farms advertised themselves in hunting magazines, 19.1% promoted themselves by attending livestock and game fairs, and 38.1% had their own websites. In conclusion, this alternative rabbit production system constitutes a well-established subsector in Spain, despite being only 2 decades old. It also seems that it has not yet reached its development maturity. It shows wide diversity in terms of farm size and structure, as well as marketing and promotional activities.

Key Words: wild rabbit, farming systems, alternative livestock, game farming, marketing.

INTRODUCTION

The wild rabbit (*Oryctolagus cuniculus*) is a game species raised on farms in countries such as Spain, France, and Portugal (Arthur, 1989; González-Redondo, 2006). In Spain, its captive breeding for hunting purposes started recently, at the end of the 80's and beginning of the 90's, after widespread mortalities within wild populations caused by the outbreak of rabbit haemorrhagic disease in 1988 (Argüello *et al.*, 1988; Villafuerte *et al.*, 1995). This fact generated an increase in demand of this species both for restocking of hunting preserves (González-Redondo, 2006) and for its use in recovery plans of endangered species that prey on the rabbit, such as the Spanish Imperial Eagle (*Aquila adalberti*) and Iberian Lynx (*Lynx pardina*) (Ferrer and Negro, 2004; Guerrero-Casado *et al.*, 2013). This demand led to the development of a game farm subsector that is growing rapidly (González-Redondo, 2006). In fact, in 2007 there were 115 registered farms raising wild rabbits in Spain, while in 2011 there were 237 (Ministerio de Agricultura, Alimentación y Medio Ambiente, 2013).

The production systems in wild rabbit farms differ greatly because their establishment has taken place under 2 heterogeneous models. On the one hand, wild rabbits are raised in enclosures of varying dimensions where the animals live in colonies. Although the hunting quality of the rabbits obtained under this semi-extensive system is high

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(Guerrero-Casado *et al.*, 2013), it has disadvantages mainly related to the difficulty of carrying out effective sanitary and reproductive controls. This leads to low productivity in terms of rabbits sold per doe and year (Borrego, 1997; Arenas, 2002; González-Redondo, 2002; Arenas *et al.*, 2006). On the other hand, in an attempt to overcome these problems, wild rabbit are also raised under systems in which reproduction is carried out in cages. These intensive farms use technology and equipment from rabbit meat farming, e.g. cages, balanced feeds, etc. (Borrego, 1997; González-Redondo, 2002, 2006), including batch management and, in some cases, artificial insemination (Dávila *et al.*, 2004). However, several problems derived from the stress-prone behaviour of the wild rabbit arise when this species is raised in cages (González-Redondo, 2002, 2010; González-Redondo and Zamora-Lozano, 2008). In both systems, rearing the weaned kits is carried out in enclosures to achieve maximum escape reaction and hunting quality (Borrego, 1997; González-Redondo, 2002, 2006). For these reasons, the wild rabbit game farms display a wide diversity of sizes, marketing and advertising strategies, geographical areas for marketing their products, and technological levels, which remain to be investigated.

Farm characterisation has been widely used in livestock and game farming systems research (Castel *et al.*, 2003; Pardos *et al.*, 2008; Ruiz *et al.*, 2008; González-Redondo *et al.*, 2010; González-Redondo and García-Domínguez, 2012). This methodology has proven to be a very useful tool to enhance knowledge of the production subsectors and help technicians and the Administration make decisions aimed at better implementation and management of farm support programmes (Pardos *et al.*, 2008). Despite the relevance of wild rabbit game farms in Spain, until recently few studies dealing with the situation of this subsector have been conducted. Therefore, the aim of the present study is to characterise the Spanish commercial game farms that raise wild rabbits, using variables related to structure, management, marketing and advertising. This will provide relevant knowledge on this alternative rabbit farming system and its diversity.

MATERIALS AND METHODS

Study area and sample selection

The study was conducted in Spain, as it is one of the most relevant countries in which the wild rabbit is raised for restocking (González-Redondo, 2006). Searching for farms to take part in the survey was carried out in varying ways: public registers, enterprise databases, press advertisements, web searches and personal contacts. All the farmers found were contacted and invited to participate in the study voluntarily. The sample used consisted of 21 farms, located in 7 regions (Table 1) whose stratified distribution was representative of the current regional distribution of the wild rabbit game farms in Spain (Sánchez-García *et al.*, 2012; Ministerio de Agricultura, Alimentación y Medio Ambiente, 2013). The sample amounted to 10.2% of the 206 registered Spanish farms raising wild rabbits when the survey was conducted (Ministerio de Agricultura, Alimentación y Medio Ambiente, 2013). The study included only privately-owned commercial farms, thus excluding small rabbitries solely devoted to self-supply for hunting preserves that do not market their production.

Data collection and variables studied

The information was obtained by a survey carried out in summer and autumn 2009 by directly interviewing the farmers. The structured questionnaire included 23 qualitative variables and 3 quantitative variables (Tables 2 and 3),

Table 1: Regional distribution of surveyed wild rabbit game farms.

Region	No.	%
Andalucía	5	23.8
Galicia	4	19.0
Comunidad Valenciana	5	19.0
Cataluña	3	14.3
Castilla y León	2	9.5
Castilla-La Mancha	2	9.5
Aragón	1	4.8
Total	21	100.0

Table 2: Age of farm, size of breeding stock and doe-to-buck ratio of wild rabbit game farms (n=21).

Variable	mean±SE	min	max	CV (%)
Age of farm (yr)	12.7±1.7	2	34	61.5
Size of the breeding stock				
Breeding does (n)	431.2±84.5	40	1400	89.8
Breeding bucks (n)	64.2±15.5	8	250	110.7
Doe-to-buck ratio (n)	8.1±1.3	2.5	27.1	75.8

SE: Standard error. CV: Coefficient of variation.

belonging to the following groups: i) year of establishment; ii) farm size and breeding stock structure; iii) reproductive management; iv) breeder replacement practices; v) farmer knowledge of the genetic type of the rabbits they raise; vi) raises game species other than wild rabbits; vii) offers products other than wild rabbits for restocking hunting preserves; viii) additional services offered by the farm; ix) market's geographical area; and x) farm advertising practices. These variables were selected on the basis of a review of previous knowledge of the wild rabbit game farm subsector (Borrego, 1997; Arenas, 2002; González-Redondo, 2001, 2002, 2006; Arenas *et al.*, 2006).

Statistical analysis

The mean, standard error, minimum, maximum and coefficient of variation were calculated for *age of the farm*, *number of does*, *number of bucks* and *doe-to-buck ratio* variables in the breeding stock. For the other variables of the survey, the percentage of farms showing the attribute was calculated. The statistical analyses were performed using SPSS v.15.0 software (SPSS Inc., 2006).

RESULTS AND DISCUSSION

This research provides the first systematic characterisation of the Spanish wild rabbit commercial game farms using variables related to their structure, management, marketing and advertising activities.

Farm size and breeding stock structure

All the farms were complete-cycle. The average number of breeding does at the wild rabbit farms (Table 2) was lower than that of the intensive rabbit meat farms in Spain (n>540 breeding does; Ramon *et al.*, 2003). This moderate size suggests that most of these farms are family run, bearing in mind that a one-man work unit can manage a rabbit meat farm of some 500 to 800 breeding does (Roca, 2009). The distribution of the wild rabbit game farms according to the number of does in the breeding stock (Figure 1) closely fit the stratified distribution of the rabbit meat farms in Spain according to the number of doe cages (Ministerio de Medio Ambiente y Medio Rural y Marino, 2008). The average number of bucks in the breeding stock was 64.2 (Table 2). Although the official statistics are inaccurate and highly variable, the average number of does and bucks in the breeding stock agrees with the census in game farms for the period 2009-2010 (Sánchez-García *et al.*, 2012). The average doe-to-buck ratio was in the same range as that of meat rabbits submitted to intensive or semi-intensive rhythms using natural mating (doe-to-buck ratio of 7-8; Lebas *et al.*, 1996). However, this ratio can be considered low, given that several farms used artificial insemination and that when meat rabbits are submitted to artificial insemination, the doe-to-buck ratio increases (Lebas *et al.*, 1996).

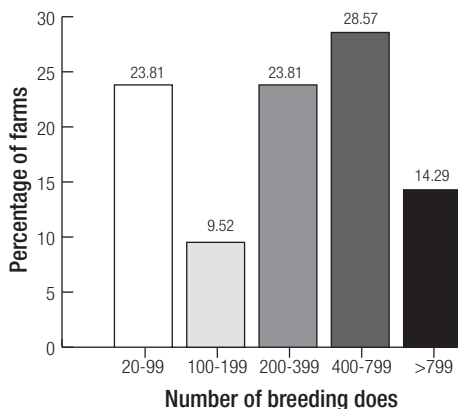


Figure 1: Percentage of wild rabbit game farms according to the number of does in the breeding stock (n=21).

Reproductive management

Wild rabbit game farms kept the breeding stock in enclosures or in cages (Borrego, 1997; González-Redondo, 2002). Rearing in enclosures has disadvantages due to the difficulty of carrying out effective sanitary and reproductive controls (Myers and Poole, 1961, 1962), and the aggressiveness among animals (Myers and Poole, 1961), leading to low productivity in terms of rabbits sold per doe and year (Arenas, 2002; González-Redondo, 2002; Arenas *et al.*, 2006). In an attempt to overcome these problems, wild rabbits are also bred in cages using technology and equipment from rabbit meat farming (Borrego, 1997; González-Redondo, 2002, 2006). Thus, a high proportion of the farms in this study kept all or part of the breeding stock in cages under batch management (Table 3), something that illustrates the intensification experienced by this subsector.

In cage-bred wild rabbit farming, a relevant proportion of breeders remain infertile and natural mating management is difficult due to the stress-prone behaviour of this species (González-Redondo, 2003). In an attempt to overcome this problem, nearly 40% of the farms in this study used artificial insemination (Table 3) either routinely or only experimentally, as this technique has only recently been developed for wild rabbits (Dávila *et al.*, 2004).

Breeder replacement practices

All the farms carried out self-replacement; almost 5% did so occasionally using wild rabbits bought at other farms, and nearly 40% captured rabbits in the wild for this purpose (Table 3). These 2 latter alternatives minimise inbreeding and incipient domestication risks (González-Redondo, 2004).

Table 3: Frequencies of the variables related to management, marketing and advertising and promotion activities of the wild rabbit game farms (n=21).

Variable	Percentage of farms
Reproductive management	
Reproduction in cages	85.7
Batch management	85.7
Artificial insemination	38.1
Breeder replacement practices	
Self replacement	100.0
With breeders from other farms	4.8
With rabbits captured in the wild	38.1
Genetic type	
Know what wild rabbit subspecies is being raised	38.1
Game species other than partridges	
Raises species other than wild rabbits	19.1
Raises red-legged partridges (<i>Alectoris rufa</i>)	19.1
Raises pheasants (<i>Phasianus colchicus</i>)	14.3
Raises quails (<i>Coturnix coturnix</i>)	9.5
Specialised supply	
Sells rabbits for conservation of endangered species	14.3
Sells breeding rabbits for other farms	38.1
Additional services offered	
Offers service for transporting rabbits	85.7
Advises clients on how to restock	14.3
Sells sexed rabbits	52.4
Has own hunting preserve	9.5
Market geographical area	
Full country market area	76.2
Exports wild rabbits	38.1
Advertising and promotion practices	
Advertises its activity in the game press	42.9
Promotes itself at fairs	19.1
Has own website	38.1

Farmers' knowledge of the genetic type they raise

Less than 40% of the farmers (Table 3) know the genetic type of the rabbits they raise.

However, this knowledge is important because the Iberian Peninsula is occupied by 2 subspecies of the European rabbit: *Oryctolagus cuniculus algirus*, distributed in the south-west triangle, and *Oryctolagus cuniculus cuniculus*, present in the north-east area (Branco *et al.*, 2000). To avoid the risk of subspecies mixing when farmed wild rabbits are translocated and released into the wild (Delibes-Mateos *et al.*, 2008), wild rabbit farmers should increase their efforts to clarify the subspecies in their breeding stocks. This will undoubtedly increase customer confidence in the suitability of the rabbits for the area to be restocked.

Wild rabbit farms raising other game species

A fifth of the wild rabbit game farms bred, reared and marketed game species other than wild rabbits (Table 3). Red-legged partridge (*Alectoris rufa*), pheasant (*Phasianus colchicus*), and quail (*Coturnix coturnix*), in this order, were the most widespread species bred on the wild rabbit farms, because all of these are small game species for the same market niche (González-Redondo *et al.*, 2010). However, the proportion of wild rabbit farms in the present study raising game species other than wild rabbits and, in particular, pheasant and quail, was lower than the same proportions found by González-Redondo *et al.* (2010) in the Spanish red-legged partridge farms raising game species other than partridge, as well as by González-Redondo and García-Domínguez (2012) in the Spanish pheasant farms raising game species other than pheasant. This is mainly due to the fact that pheasant and quail are secondary products of the red-legged farms (Empresa de Gestión Medioambiental, 2007) and because the breeding and rearing technologies of these 3 birds in regard to hatchery management, brooding and pen-rearing are similar (Manetti, 1989; Dalmau, 1994; González-Redondo *et al.*, 2010), but different to those of rabbits.

Supply of the wild rabbit farms

All the farms in this study raised and sold wild rabbits for restocking hunting grounds, as these are the typical product of the wild rabbit game farms (González-Redondo, 2002). However, estimates of numbers of wild rabbits reared and released in Spain differ considerably and are inaccurate due to the lack of a reliable, homogeneous recording system in place across regions. Thus, it is estimated that some 38550 wild rabbits are reared per year in Spain (Ministerio de Medio Ambiente y Medio Rural y Marino, 2009). This figure is considerably lower than expected, taking into account that in Spain there are over 200 wild rabbit farms (Ministerio de Agricultura, Alimentación y Medio Ambiente, 2013), the average size of the breeding stock (Table 2) and the average productivity of this species (Borrego, 1997; Arenas, 2002; González-Redondo, 2002; Arenas *et al.*, 2006). In fact, Sánchez-García *et al.* (2012) estimated a production of over 225 000 wild rabbits by Spanish game farms in 2010.

In addition to wild rabbits for restocking as the main product, many farms have diversified their production. Breeding rabbits for other farms are also supplied to the market by almost 40% of the farms (Table 3), as in the 2 last decades many wild rabbits farms have been established which require batches of animals for the foundation of their breeding stocks or to regularly replace culled animals (González-Redondo, 2004). Moreover, several farms (14.3%, Table 3) supply wild rabbits to institutions engaged in programmes for the conservation of endangered species, such as the Spanish Imperial Eagle and Iberian Lynx, both preying preferentially on the rabbit, on which they have become dependent for survival (Ferrer and Negro, 2004; Guerrero-Casado *et al.*, 2013).

Additional services offered by the farms

Transporting, release and restocking are not easy to carry out due to the wild nature and stress-prone behaviour of the wild rabbit (González-Redondo, 1995; Calvete *et al.*, 1997). For this reason, several farms (Table 3) advise customers on how to successfully release and restock their hunting preserves, although in a lower proportion than the red-legged partridge (González-Redondo *et al.*, 2010) and pheasant (González-Redondo and García-Domínguez, 2012) game farms. As in the latter subsectors, almost all wild rabbit farms offer their clients the service of transporting the animals from the farm to the hunting preserves (Table 3). Both of these represent farms' diversification strategies in offering additional services to clients. The relevant issue is that, in a competitive environment, these services attract new, inexperienced landowners and game managers.

Half of the farms sell the rabbits sexed (Table 3), another additional service useful to customers, as in restocking the rabbits must be released in a specific sex ratio which enables successful establishment of a colony (Borrego, 1997). Less than 10% of the farms had their own hunting preserve where a percentage of the rabbits produced were released to be able to sell organised hunts (Table 3). This contrasts with the red-legged partridge and pheasant game farms subsectors, for which more than a third (González-Redondo *et al.*, 2010) and half (González-Redondo and García-Domínguez, 2012) of the farms, respectively, are associated with a hunting preserve that satisfies the demand for intensive shoots. This difference is due to the fact that in game management of wild rabbits their release for carrying out intensive shooting is not usual, as in the case of the red-legged partridge (González-Redondo *et al.*, 2010) and pheasant (González-Redondo and García-Domínguez, 2012).

Geographic market area

A high proportion of farms were marketing their products throughout the Spanish territory (Table 3). According to regulations on the protection of animals during transport (Council of the European Union, 2005), the maximum journey time for rabbits makes the Iberian Peninsula reachable from most of the Spanish wild rabbit farms. Thus, three quarters of the wild rabbit farms sell their products across Spain (Table 3). This closely agrees with previous reports on the Spanish red-legged partridge (González-Redondo *et al.*, 2010) and pheasant (González-Redondo and García-Domínguez, 2012) game farms.

Nearly 40% of the farms exported wild rabbits (Table 3). This activity was carried out sporadically by some of these farms, and the destinations of Spanish wild rabbits were neighbouring countries: Portugal and France. As documented in the literature, throughout history free-living rabbits have been exported from their area of origin and released all over the world, including Australia, New Zealand and to nearly 600 islands (Shipp *et al.*, 1963; Soriguer, 1981; Sandford, 1992). This trend continues nowadays with farmed wild rabbits, although it is now restricted to neighbouring countries with the same fauna and similar game management styles. However, this market niche is constrained by red tape for animal health reasons; e.g., fear of the rabbit haemorrhagic disease spreading limits the export of live rabbits from Spain to restock hunting preserves in France (Gibb, 1990). Export of wild rabbits is also constrained by modern wildlife restoration strategies, which promote restocking using animals from autochthonous populations in order to avoid problems caused by genetic introgression (González-Redondo, 2002; Delibes-Mateos *et al.*, 2008). In addition, the maximum authorised journey time for rabbits limits this particular trade, because it makes part of the potential foreign market out of range for several Spanish game farms, if mandatory transport regulations are followed (Council of the European Union, 2005).

Advertising and promotional activities

Although a significant part of the output supplied by the wild rabbit game farms is sold within their local environment and through direct relations within the hunting sector, promotional and advertising activities become necessary because of increased competition in this specific market (González-Redondo, 1999; González-Redondo *et al.*, 2010), especially in the current context of the economic crisis (Asociación de Criadores y Actividades Cinegéticas Turísticas Andaluzas, 2009). This subsector closely fitted to that described for the Spanish red-legged partridge (González-Redondo *et al.*, 2010) and pheasant (González-Redondo and García-Domínguez, 2012) game farms with regard to advertising and promotional activities. More than 40% of the farms (Table 3) have advertised in the numerous hunting magazines currently published in Spain. Nearly 40% of the farms had their own website (Table 3), which is an efficient tool used to promote themselves and attract potential customers. These websites are usually illustrated with photographs of rabbits and facilities, which help to enhance customers' confidence in the quality of farmed wild rabbits (González-Redondo and Finzi, 2013). Nineteen percent of the wild rabbit farms promoted themselves by attending some of the numerous livestock and game fairs celebrated all over Spain, the lowest proportion in comparison to the other activities (Table 3).

Establishment and outlook of the subsector

The Spanish wild rabbit game farms subsector is only some 2 decades old (Table 2, Figure 2), making them younger than red-legged partridge farms (González-Redondo *et al.*, 2010) and intensive meat rabbit farms (Ministerio de Medio

Ambiente y Medio Rural y Marino, 2008). In fact, almost all the farms in this study have been established since 1988 (Figure 2) as a result of the demand for rabbits to restock as explained in the introduction. Since its beginnings, this alternative rabbit subsector has grown rapidly (González-Redondo, 2006) and nowadays it is well established. We suggest that it might not have reached its maximum development maturity yet, being unlikely to experience a short-term drop, as can be inferred from the constant rate of foundation of farms from 1988 to nowadays (Figure 2). In fact, whereas in 2007 there were 115 registered farms that raised wild rabbits in Spain, in 2011 there were 237. In contrast, during this period the number of farms raising rabbits for meat and fur purposes decreased (Ministerio de Agricultura, Alimentación y Medio Ambiente, 2013).

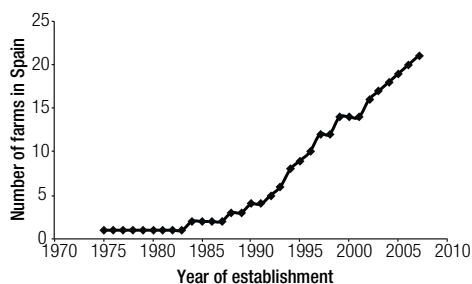


Figure 2: Number of wild rabbit game farms in Spain according to the year of establishment (n=21).

CONCLUSION

This report on the structure, management and marketing of the wild rabbit commercial game farms in Spain shows that it is an alternative livestock subsector which is well established, despite being only 2 decades old. Its characterisation has highlighted the heterogeneity of the wild rabbit game farms with regard to farm size, intensification level and diversification strategies related to services offered to the market.

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