

## Typification and characterisation of the pheasant (*Phasianus colchicus*) game farms in Spain

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### Abstract

This research typified and characterised the pheasant (*Phasianus colchicus*) game farms in Spain using structural and marketing variables. A structured survey was given to 25 private-owned farms in May 2010. A categorical principal components analysis performed to typify the farms yielded two dimensions. First dimension explained 50.5% of the variance and included the variables “number of females in the breeding flock”, and “the farm is of complete-cycle or not”. Second dimension explained 32.3% of the variance and included the variables “age of the farm” and “the farm advertises its activity in the game press”. A cluster analysis differentiated four farm typologies. Farm type 1 included 28% of the farms, being recent (established between 1990 and 2003), complete-cycle and medium-sized (breeding flock of 15 to 300 females), with low advertising activity in the game press and without a hunting preserve. Farm type 2 included 28% of the farms, being the most recent (established between 1994 and 2008), without breeding flock, with low advertising activity, and most have hunting preserve. Farm type 3 included 20% of the farms, being old (established between 1983 and 1992), without breeding flock and with high advertising activity; 40% of them have hunting preserve. Farm type 4 included 24% of the farms, being old (established between 1980 and 1995), complete-cycle and high-sized (breeding flock of 50 to 1,000 females), with high advertising activity; most have hunting preserve. In conclusion, this is an alternative poultry sub-sector consolidated in Spain, despite being only three decades old.

**Additional key words:** advertising; alternative poultry; hunting species; multivariate analysis.

### Resumen

#### Tipificación y caracterización de granjas cinegéticas de faisán (*Phasianus colchicus*) en España

Se tipificaron y caracterizaron granjas cinegéticas de faisán (*Phasianus colchicus*) en España usando variables de estructura y comercialización obtenidas mediante encuesta a 25 granjas privadas en 2010. Un análisis de componentes principales categóricos realizado para tipificar las granjas generó dos dimensiones. La primera dimensión explicó el 50,5% de la varianza e incluyó las variables “número de hembras reproductoras” y “la granja es de ciclo completo o no”. La segunda dimensión explicó el 32,3% de la varianza e incluyó las variables “edad de la granja” y “la granja se publicita en prensa cinegética”. Un análisis de conglomerados subsiguiente diferenció cuatro tipologías de granjas. La tipología 1 incluyó al 28% de las granjas, siendo recientes (fundadas entre 1990 y 2003), de ciclo completo y tamaño medio (15 a 300 hembras reproductoras), con baja actividad publicitaria en prensa cinegética y sin coto de caza. La tipología 2 incluyó un 28% de las granjas, siendo las más recientes (fundadas entre 1994 y 2008), sin reproductores, con baja actividad publicitaria y la mayoría con coto. La tipología 3 incluyó un 20% de las granjas, siendo antiguas (fundadas entre 1983 y 1992), sin plantel reproductor y con elevada actividad publicitaria; el 40% tienen coto. La tipología 4 incluyó un 24% de las granjas, siendo antiguas (fundadas entre 1980 y 1995), de ciclo completo y gran tamaño (50 a 1.000 hembras reproductoras), con elevada actividad publicitaria y la mayoría con coto. Con sólo tres décadas de existencia este subsector avícola alternativo está consolidado en España.

**Palabras clave adicionales:** análisis multivariante; avicultura alternativa; especies cinegéticas; publicidad.

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Abbreviations used: CATPCA (categorical principal components analysis).

## Introduction

The ring-necked pheasant (*Phasianus colchicus*) is a game bird widely raised on farms in many countries for shooting, mainly in Europe and the USA (Ghigi, 1958; Delacour, 1959; Fol, 1961; Torres *et al.*, 1995; Canning, 2005). In Spain it is an exotic species (Ballesteros, 1998) and as such its captive breeding for hunting is mainly aimed at releasing the animals for intensive 'put and take' shooting, rather than for recovery and re-establishment purposes (González-Redondo, 1997; Ballesteros, 1998).

The pheasant production model (Delacour, 1959; Fol, 1961; Béjar, 1995; Canning, 2005; García Martín, 2005; Torres *et al.*, 1995; Krystianiak *et al.*, 2007) is partly similar to other game birds, such as partridges and quails. In complete-cycle farms, breeding pheasants with ages usually ranging from one to four (in some cases, up to seven) years old, are kept, frequently outdoors, in pens in harems or in colonies (in both cases, in a sex ratio of 1:5 to 1:7 male-to-females). A breeding pheasant lays an average of 50 to 70 eggs per reproductive season. This period usually lasts from March-April to June-July. Reproductive performances increase if artificial photoperiod supplementation is applied to the breeders. The eggs are collected on a daily basis and stored before being loaded into artificial incubators, and incubated until hatching occurs 23-24 days later. The newly-hatched chicks are reared for some five to seven weeks in brooder houses where litter on the floor, water and starter mash are provided and infra-red lamps are used for heating. After this initial period, the growing pheasants are reared in large, open-air rearing pens where they exercise their flying ability until they are sold for release in hunting grounds. In addition to complete-cycle farms, there are farms with no breeding flock that are solely devoted to raising the pheasants, starting from day-old chicks.

In 2010 there were 463 registered pheasant-raising farms in Spain (MARM, 2011). Half of these farms raise the ring-necked pheasant for hunting (Sánchez García-Abad *et al.*, 2009; Subdirección General de Sanidad e Higiene Animal y Trazabilidad of the Ministerio de Agricultura, Alimentación y Medio Ambiente, *pers. com.*), while the others produce meat, eggs, and other species of ornamental pheasants. In spite of the wide distribution of the pheasant game farms in Spain, pheasant farming is a recent, little known activity (Torres *et al.*, 1995). To date, only a few, partial studies dealing with the genesis of this sub-sector, as well as

the analysis of its situation and evolution have been conducted (Sánchez García-Abad *et al.*, 2009). For this reason, in Spain the size, technological levels, geographic areas for marketing their products and marketing and advertising strategies of the pheasant game farms remain to be investigated. In this sense, characterising farms and typifying them by multivariate analysis techniques have been widely used in livestock and game farming research (Castel *et al.*, 2003; Pardos *et al.*, 2008; Ruiz *et al.*, 2008; González-Redondo *et al.*, 2010) as tools for enhancing knowledge of a specific sub-sector and for helping governments and technicians to make decisions aimed at a better implementation and management of farm support programs (Pardos *et al.*, 2008). Therefore, the aim of this research is to characterise and typify the Spanish game farms that raise pheasants by using variables related to structure, advertising and marketing. This will provide relevant knowledge about small game farming systems.

## Methodology

### Study area and sample selection

The study was conducted in Spain over April and May 2010. Several sources for finding candidate farms for the survey were used: public and private databases, press advertisements, web searches and personal contacts. All of the farmers found were contacted and invited to participate voluntarily in the study. The sample used consisted of 25 farms located in twelve regions (Table 1). The study included only commercial game farms, therefore excluding farms solely devoted to self-supply hunting preserves which did not sell their production. In addition, hatcheries and farms devoted solely to meat or eggs production, or to producing ornamental pheasant species, as well as unclassified farms, were also excluded from this research. Because only 214 of the 463 pheasant farms registered in Spain were devoted to selling animals for hunting (MARM, 2011; Subdirección General de Sanidad e Higiene Animal y Trazabilidad of the Ministerio de Agricultura, Alimentación y Medio Ambiente, *pers. com.*), the sample used represented about 12% of the target population of game farms under study. Moreover, this sample size was similar to that of other studies aimed at characterising and typifying other game farm sub-sectors in Spain (González-Redondo *et al.*, 2010).

**Table 1.** Regional distribution of the Spanish census (in May 2010) and the surveyed pheasant game farms

Region	Census <sup>1</sup>		Sample	
	n	%	n	%
Andalucía	88	19.0	4	16.0
Aragón	2	0.4	–	–
Asturias	20	4.3	1	4.0
Baleares	10	2.2	1	4.0
Canarias	5	1.1	–	–
Cantabria	17	3.7	1	4.0
Castilla-La Mancha	38	8.2	5	20.0
Castilla y León	68	14.7	6	24.0
Cataluña	43	9.3	2	8.0
Extremadura	124	26.8	1	4.0
Galicia	8	1.7	1	4.0
Madrid	20	4.3	1	4.0
Murcia	1	0.2	–	–
Navarra	4	0.9	–	–
País Vasco	1	0.2	1	4.0
La Rioja	1	0.2	–	–
Comunidad Valenciana	13	2.8	1	4.0
Total	463	100.0	25	100.0

<sup>1</sup> According to MARM (2011).

## Data collection and variables studied

The information was obtained by a direct interview survey performed on the farmers. The structured questionnaire included 22 qualitative variables and four quantitative variables (Table 2), belonging to the following groups: i) age of the farm (year of establishment); ii) size of the breeding flock and reproductive structure and management; iii) raised species other than ring-necked pheasants; iv) offered products other than pheasants for release into hunting preserves; v) additional services offered by the farm; vi) market's geographic area; and vii) farm advertising practices. These variables were selected on the basis of a review of previous knowledge on the pheasant game farms subsector (Manetti, 1989; Béjar, 1995; Torres *et al.*, 1995; Canning, 2005; García Martín, 2005; Sánchez García-Abad *et al.*, 2009).

## Statistical analysis

After analysing the relationships among the initial set of variables, a multivariate analysis was carried out to detect the factors that best characterise and typify the farms. Categorical principal components analysis (CATPCA) was performed on the set of variables in

order to achieve dimension reduction. Using the two dimensions yielded by the CATPCA, four of the initial 26 variables were selected as they were both interesting for classifying and discriminating farm typologies, as well as being representative of other non-selected variables. A K-mean cluster analysis, using the squared Euclidean distance, classified the farms into four typologies (clusters). The analysis of the relationships among variables of the four farm typologies was carried out using one-way analysis of variance when the variables showed homoscedasticity, and Kruskal-Wallis analysis of variance in the case of heteroscedasticity. Tukey's tests and Dunnett's C tests were used, respectively, as post hoc probes to compare values among the clusters within each variable. The statistical analyses were performed using SPSS v.15.0 software (SPSS Inc., 2006).

## Results

Table 2 shows the frequencies of the variables characterising the pheasant game farms. Fig. 1 shows the frequencies of farms according to the year of their establishment. All of the farms were privately owned and reared pheasants but they can be differentiated by their having a breeding flock (complete-cycle farms) or not.

### Nature of the variables and their influence on differentiation farm types

The CATPCA yielded two dimensions (Table 3; Fig. 2) whose eigenvalues were 2.021 for the first dimension and 1.292 for the second dimension. Total variance explained by the solution was 82.8%: 50.5% by dimension 1 and 32.3% by dimension 2. The first dimension, corresponding to the abscissa, included two variables: i) the *number of females in the breeding flock*, that decreases with the abscissa, and ii) the *farm is of complete-cycle production*, these complete-cycle farms being at lower values of the abscissa. The second dimension, corresponding to the ordinate, included two variables: i) the *farm advertises its activity in the game press*, the farms undertaking this activity being at higher values of the ordinate, and ii) the *age of the farm*, that increases with the ordinate. The Cronbach's alpha, based on the total eigenvalue, was 0.931, thus indicating the reliability of the procedure. Table 3 shows the components loading for the two-dimensional solution.

**Table 2.** Values of the variables (mean  $\pm$  SE) for the farms of each pheasant game farming type<sup>1</sup>

Variable	Type 1 (n = 7; 28%)	Type 2 (n = 7; 28%)	Type 3 (n = 5; 20%)	Type 4 (n = 6; 24%)	Total (n = 25)	p
Age of the farm						
Age of the farm (years) <sup>1</sup>	12.3 $\pm$ 1.7 b	8.9 $\pm$ 2.0 b	21.8 $\pm$ 1.6 a	20.5 $\pm$ 2.3 a	15.2 $\pm$ 1.4	< 0.001
Reproductive structure and management						
Complete-cycle (%)	100.0 $\pm$ 0.0 a	0.0 $\pm$ 0.0 b	0.0 $\pm$ 0.0 b	100.0 $\pm$ 0.0 a	52.0 $\pm$ 10.2	< 0.001
Breeding females (n)	142.9 $\pm$ 34.4 a	0.0 $\pm$ 0.0 b	0.0 $\pm$ 0.0 b	416.7 $\pm$ 159.5 a	269.2 $\pm$ 82.2 <sup>2</sup>	< 0.001
Breeding males (n)	32.6 $\pm$ 7.4 a	0.0 $\pm$ 0.0 b	0.0 $\pm$ 0.0 b	149.2 $\pm$ 75.4 a	86.4 $\pm$ 37.3 <sup>2</sup>	< 0.001
Female-to-male ratio (n) <sup>2</sup>	4.7 $\pm$ 0.5	–	–	3.7 $\pm$ 0.5	4.2 $\pm$ 0.4 <sup>2</sup>	0.163
Breeders are kept in harems of one male and several females (%) <sup>2</sup>	42.9 $\pm$ 20.2	–	–	66.7 $\pm$ 21.1	53.8 $\pm$ 14.4 <sup>2</sup>	0.433
Breeders are kept in colonies of several males and several females (%) <sup>2</sup>	57.1 $\pm$ 20.2	–	–	33.3 $\pm$ 21.1	46.2 $\pm$ 14.4 <sup>2</sup>	0.433
Artificial photoperiod supplementation (%) <sup>2</sup>	28.6 $\pm$ 18.4	–	–	33.3 $\pm$ 21.1	30.8 $\pm$ 13.3 <sup>2</sup>	0.867
Species produced						
Raises game species other than pheasants (%)	71.4 $\pm$ 18.4	71.4 $\pm$ 18.4	100.0 $\pm$ 0.0	66.7 $\pm$ 21.1	76.0 $\pm$ 8.7	0.584
Raises red-legged partridges ( <i>Alectoris rufa</i> ) (%)	71.4 $\pm$ 18.4	71.4 $\pm$ 18.4	80.0 $\pm$ 20.0	66.7 $\pm$ 21.1	72.0 $\pm$ 9.2	0.976
Raises quails ( <i>Coturnix coturnix</i> ) (%)	28.6 $\pm$ 18.4	57.1 $\pm$ 20.2	100.0 $\pm$ 0.0	33.3 $\pm$ 21.1	52.0 $\pm$ 10.2	0.079
Raises other game species (%)	28.6 $\pm$ 18.4	14.3 $\pm$ 14.3	60.0 $\pm$ 24.5	33.3 $\pm$ 21.1	32.0 $\pm$ 9.5	0.457
Raises pheasants of species other than ring-necked pheasant (%)	14.3 $\pm$ 14.3	28.6 $\pm$ 18.4	0.0 $\pm$ 0.0	33.3 $\pm$ 21.1	20.0 $\pm$ 8.2	0.515
Products other than pheasants for release						
Sells hatching eggs (%) <sup>2</sup>	14.3 $\pm$ 14.3	–	–	16.7 $\pm$ 16.7	15.4 $\pm$ 10.4	0.915
Sells day-old chicks (%) <sup>2</sup>	28.6 $\pm$ 18.4	–	–	16.7 $\pm$ 16.7	23.1 $\pm$ 12.2	0.646
Sells breeding pheasants for other farms (%)	28.6 $\pm$ 18.4	0.0 $\pm$ 0.0	0.0 $\pm$ 0.0	0.0 $\pm$ 0.0	8.0 $\pm$ 5.5	0.147
Sells pheasants for meat (%)	0.0 $\pm$ 0.0	14.3 $\pm$ 14.3	0.0 $\pm$ 0.0	16.7 $\pm$ 16.7	8.0 $\pm$ 5.5	0.583
Additional services offered						
Offers transport service of the pheasants (%)	85.7 $\pm$ 14.3	71.4 $\pm$ 18.4	100.0 $\pm$ 0.0	100.0 $\pm$ 0.0	88.0 $\pm$ 6.6	0.359
Advises clients on how to release (%)	28.6 $\pm$ 18.4	28.6 $\pm$ 18.4	80.0 $\pm$ 20.0	50.0 $\pm$ 22.4	44.0 $\pm$ 10.1	0.282
Has an owned hunting preserve (%)	0.0 $\pm$ 0.0 b	85.7 $\pm$ 14.3 a	40.0 $\pm$ 24.5 a,b	83.3 $\pm$ 16.7 a	52.0 $\pm$ 10.2	0.005
Market's geographic area						
Full country market's area (%)	85.7 $\pm$ 14.3	42.9 $\pm$ 20.2	40.0 $\pm$ 24.5	83.3 $\pm$ 16.7	64.0 $\pm$ 9.8	0.186
Exports pheasants (%)	0.0 $\pm$ 0.0	0.0 $\pm$ 0.0	20.0 $\pm$ 20.0	33.3 $\pm$ 21.1	12.0 $\pm$ 6.6	0.203
Advertising practices						
Advertises its activity in the game press (%)	28.6 $\pm$ 18.4 b	28.6 $\pm$ 18.4 b	80.0 $\pm$ 20.0 a,b	100.0 $\pm$ 0.0 a	56.0 $\pm$ 10.1	0.021
Promotes itself at fairs (%)	0.0 $\pm$ 0.0	57.1 $\pm$ 20.2	60.0 $\pm$ 24.5	66.7 $\pm$ 21.1	44.0 $\pm$ 10.1	0.059
Advertises its activity on the internet (%)	71.4 $\pm$ 18.4	42.9 $\pm$ 20.2	40.0 $\pm$ 24.5	66.7 $\pm$ 21.1	56.0 $\pm$ 10.1	0.624
Has a proprietary website (%)	42.9 $\pm$ 20.2	100.0 $\pm$ 0.0	60.0 $\pm$ 24.5	50.0 $\pm$ 22.4	64.0 $\pm$ 9.8	0.132

<sup>1</sup> Means in the same row with different letters are significantly different at  $p < 0.05$ . <sup>2</sup> Calculated taking into account only the complete-cycle farms (n = 13).

## Farm type differentiation

Classification of the farms by the two dimensions established four well-defined farm types (clusters) (Fig. 2). Table 2 shows the frequencies for the variables by clusters, and the statistical significances of the differences among these farm types for the variables studied. The four differentiated farm types are described as follows:

— *Type 1: “Young, complete-cycle and medium-sized farms with low advertising activity in the game press”* (n = 7 farms; 28%). Farms in this group are distinguished from the other groups because all of them have a complete-cycle structure with a medium-sized breeding flock (range: 15 to 300 females). These are recent farms (established between 1990 and 2003), and only a low percentage advertise their activity in the game press. None of these farms has an owned hunting preserve.

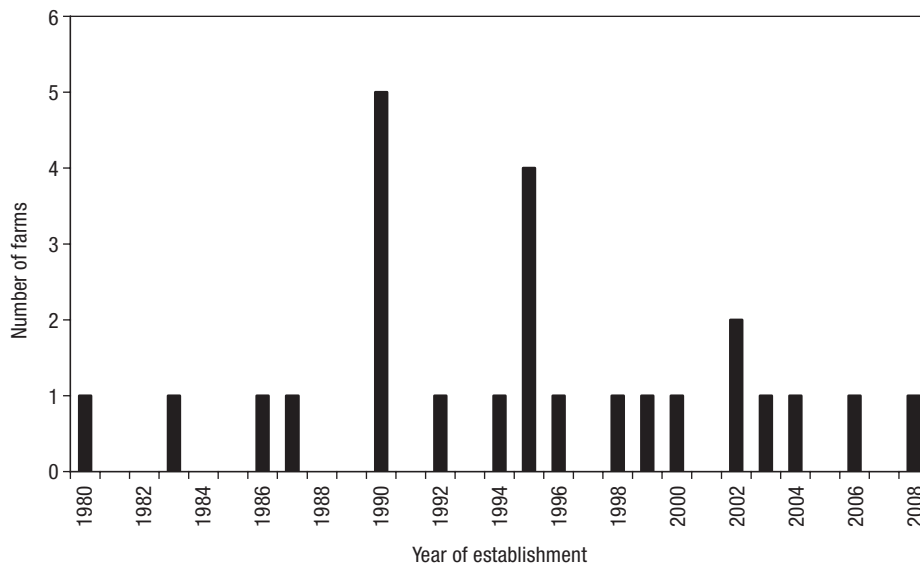


Figure 1. Frequencies of the pheasant game farms according to the year of establishment.

— *Type 2: “Young, without breeding flock farms with low advertising activity in the game press”* (n = 7 farms; 28%). Farms in the second group differ from the other farm types because they are the most recent (established between 1994 and 2008), have no breeding flock, and only a low percentage advertise their activity in the game press. Most have an owned hunting preserve into which they release part of the pheasants produced.

— *Type 3: “Old, without breeding flock farms with high advertising activity in the game press”* (n = 5 farms; 20%). Farms in this group are old (established between 1983 and 1992), have no breeding flock, and most advertise their activity in the game press. Forty percent of these farms have an owned hunting preserve.

— *Type 4: “Old, complete-cycle and high-sized farms with high advertising activity in the game press”* (n = 6 farms; 24%). Farms in this group are old (established between 1980 and 1995), all of them have a complete-cycle structure with a high-sized breeding flock (range: 50 to 1,000 females), and all of them advertise their activity in the game press. Most of these farms have an owned hunting preserve.

The four farm types present the same distribution of farms as a function of: i) game species raised other than pheasants (and, specifically, red-legged partridges, quails, and others); ii) production of other species and varieties of pheasants different to the ring-necked

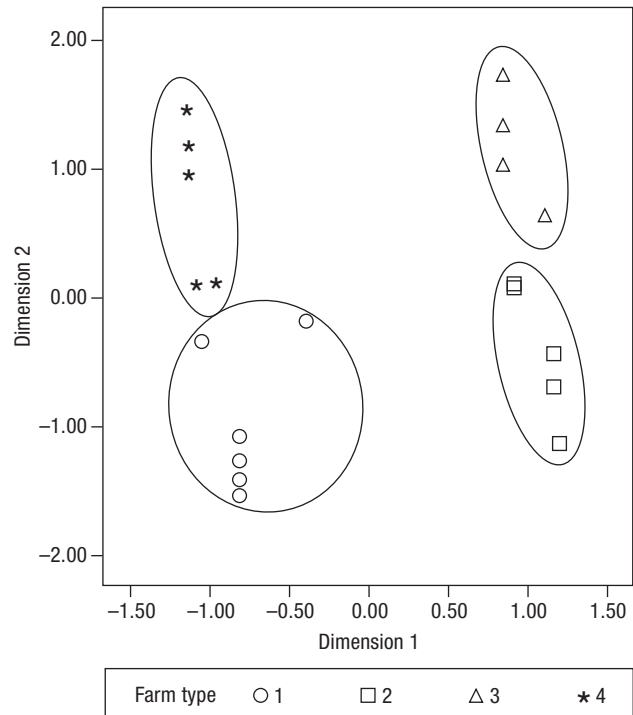


Figure 2. Spatial localisation of the pheasant farms according to the two dimensions obtained from the multivariate analysis. Some points include several overlapped farms. First dimension (eigenvalue = 2.021; Cronbach’s Alpha = 0.674): lower values mean complete cycle farms and a higher number of females in the breeding flock. Second dimension (eigenvalue = 1.292; Cronbach’s Alpha = 0.301): higher values mean that the farm advertised its activity in the game press and that the farm is older.

**Table 3.** Component loading of the variables according to the two dimensions obtained from the multivariate analysis

	Dimension 1	Dimension 2
Number of females in the breeding flock	-0.987	-0.129
Complete-cycle farm	0.983	0.131
The farm advertises its activity in the game press	0.276	-0.760
Year of establishment of the farm	-0.055	0.825

pheasant; iii) offering products other than pheasants for release into hunting grounds (breeding pheasants for other farms, and pheasants for meat); iv) additional services offered by the farm (transportation of pheasants, and advise to customers on how to release); v) market's geographic area; vi) and advertising practices other than advertising in the game press (Table 2). In addition, all of the farms sell the typical product from this kind of game farms: pheasants for release into hunting grounds (Table 2). The two complete-cycle farm types (types 1 and 4) showed the same distribution of farms as a function of: i) size of the breeding flock and female-to-male ratio; ii) how the breeding flock is kept (in harems of one male and several females or in colonies of several males and many females); iii) artificial photoperiod supplementation to the breeding flock; and iv) offering products other than pheasants for release (hatching eggs, and day-old chicks) (Table 2).

## Discussion

### Suitability of the pheasant game farms modelling

Previous studies have only partially addressed the characterisation of the pheasant game farms, both in Spain and other countries, using only descriptive methodologies or informative approaches (Canning, 2005; Sánchez García-Abad *et al.*, 2009). The present research provides the first systematic typification and characterisation of this sub-sector in Spain on the basis of structure and marketing-related variables. The classification of structures methodology (Borbouze, 1995), widely and successfully used for the typification of other livestock and game farm sub-sectors (Castel *et al.*, 2003; Pardos *et al.*, 2008; Ruiz *et al.*, 2008; González-Redondo *et al.*, 2010), has been applied in this research because it enables the farms to

be classified on the basis of their situation, structure, and operation (Borbouze, 1995).

The model fitted to typify the pheasant game farms according to their structure and marketing was satisfactory because total Cronbach's Alpha explained by CATPCA solution was higher than in similar studies using CATPCA (Ochoa, 2008; Quintero *et al.*, 2010). The first dimension was associated with farm size and reproductive structure; the second dimension depended on the farm's age and its marketing strategies (Table 3). Moreover, the interpretation of the cluster solution on farm typologies was clear, as the four clusters were well-defined and mutually exclusive (Fig. 2).

### Regional distribution of the farms

Central and southern Spain, namely the Autonomous Communities of Extremadura, Andalucía, Castilla y León, Castilla-La Mancha, and Madrid, concentrates nearly three-quarters of the pheasant farms registered (MARM, 2011) and surveyed (Table 1). This does not fit the main area of distribution of this species in the wild, which is in the northern and north-eastern parts of the Iberian Peninsula (Torres *et al.*, 1995; Ballesteros, 1998). This supports the fact that the species has successfully settled in the areas where habitat and climate fit its bioecological requirements (Ballesteros, 1998), a factor that seems to be more important than the number of animals released. The strength and level of development of the alternative poultry industry has also favoured the high prevalence of pheasant farms in other Autonomous Communities like Cataluña (Marsal, 2001). The results of the present research closely fit the regional distribution of the Spanish red-legged partridge and wild rabbit farms, sub-sectors previously described (González-Redondo *et al.*, 2010; González-Redondo & Sánchez-Martínez, 2011).

### Age of the sub-sector

By 1963 the ring-necked pheasant was already being raised in captivity in a rearing centre (Dodro, La Coruña province, North Spain) belonging to the Forest Administration (Sánchez García-Abad *et al.*, 2009), and it is possible that during the seventies some pheasant farms started its activity. However, the private sub-sector of game farms raising and commercialising this species is younger. It is only three decades old, with an average age of 15 years (Table 2). It is furthermore more recent than the red-legged partridge game farms sub-sector in Spain, which is four decades old (González-Redondo, 2004; González-Redondo *et al.*, 2010). Commercial pheasant game farms, however, were established a little earlier than those of the wild rabbit (*Oryctolagus cuniculus*), that have an average age of 13 years and most of them have been established since 1988 (González-Redondo & Sánchez-Martínez, 2011). Despite our small sample size, the establishment of pheasant game farms peaked during the first half of the Nineties (Fig. 1), probably as a result of numerous organizations, companies and technicians carrying out large-scale extension of game farming in general during this period (Pagés & García, 1991; González-Redondo, 2004). Since the second half of the nineties to the present day the pace of development of new pheasant game farms has remained constant (Fig. 1). In fact, between 2007 and 2010 the number of registered farms raising pheasants (for all purposes: meat, hunting, eggs, ornamental, etc.) increased by 70% (MARM, 2011), partly as a result of the improvement in the official system of farms registration. This suggest that, today, in contrast to other alternative livestock systems (González-Redondo, 2003), the pheasant game farms sub-sector seems to be well established in Spain. The year of establishment (Fig. 1; Table 2) was a variable discriminating farm types. Thus, the main differences resulted in a lower percentage of younger farms (Types 1 and 2) advertising its activity in the game press, and the younger complete-cycle farms (Type 1) having a slightly little breeding flock and not having an owned hunting preserve nor promoting itself at fairs (Table 2).

### Farm size and reproductive structure and management

The number of females and the number of males of the breeding flock discriminated among farm types

(Table 2). Complete-cycle farms can be differentiated into two groups. Farm type 1 included mainly newer farms having a middle-sized breeding flock with less than 300 breeding females, suggesting that most of these farms were operated as a family business or as a subsidiary activity. Farm type 4 corresponds to old and the biggest farms (up to 1,000 breeding females), many of them probably established as a business entity. The division of farms according to them being of the complete-cycle type or not was also a variable enabling clearly independent discrimination among farm types (Table 2). This study identifies two groups (farm types 2 and 3) of farms without a breeding flock or incubators, devoted solely to rearing pheasants starting from day-old chicks. The specialisation of the pheasant game farms sub-sector into phases with a structure similar to that of the poultry industry (parent stock farms, hatcheries, chicks growing farms) can also be found in the red-legged partridge farms in Spain (González-Redondo *et al.*, 2010). However, in the pheasant game farms sub-sector the proportion of farms without a breeding flock, 48%, is much higher than in the red-legged game farms sub-sector (16%; González-Redondo *et al.*, 2010). The practice of purchasing day-old chicks to start a pheasant raising venture is also widespread in the UK. For the beginner farmers, which in this study corresponds in part to farm type 2 (Table 2), this is a good approach because they will buy chicks at one day-old and rear on, saving the capital outlay and expense of breeding birds, cages, incubators and related equipment and handling (Canning, 2005). Moreover, because transport regulations are followed, the transport time limit of 24 hours for day-old chicks, providing it is completed within 72 hours after hatching, facilitates their distribution (Canning, 2005; Council of the EU, 2005). Another reason explaining the low percentage of complete-cycle farms is that breeding pheasants are reputedly difficult to raise intensively and are prone to welfare problems, such as pecking (Canning, 2005).

The female-to-male ratio in the breeding flock did not differ between the two complete-cycle farm types (farm types 1 and 4; Table 2). Its average value, 4.2, was less than the value previously described for the Spanish (1:5 to 1:7; Béjar, 1995; Torres *et al.*, 1995; García Martín, 2005) and the British (1:7 to 1:10; Canning, 2005) pheasant farms.

Two systems for keeping the breeding flock have been found (Table 2) regardless of the two complete-cycle farm types. Almost 54% of the farms kept the breeders in pens, usually outdoors, in harems of one male and several females at the abovementioned fe-

male-to-male ratio (Béjar, 1995; Torres *et al.*, 1995). This is the most recommendable system for game farms (Torres *et al.*, 1995). The other 46% of the complete-cycle farms stocked the breeding flock in colonies of several males and many females at a similar female-to-male ratio (Delacour, 1959; García Martín, 2005).

An artificial lighting programme for stimulating earlier and increased egg production in the breeding flock (Béjar, 1995; Torres *et al.*, 1995), or for breaking the reproductive seasonality (Béjar, 1995), was implemented by only 30% of the complete cycle-farms (farm types 1 and 4; Table 2). This illustrates the pheasant farms' lower technological level when compared to the red-legged partridge farms sub-sector, where almost 60% of the farms use this technique (González-Redondo *et al.*, 2010).

### Pheasant game farms raising other species

Game species other than pheasants were bred, reared and sold by three quarters of the surveyed farms regardless of typology (Table 2). Red-legged partridges (*Alectoris rufa*) and quails (*Coturnix coturnix*) were the most widespread species, because their breeding and rearing technologies are partly similar to that of the pheasant, particularly those of hatchery management, brooding and pen-rearing (Dalmau, 1994; González-Redondo, 2004). In contrast, only a quarter of the red-legged game farms raise pheasants (González-Redondo *et al.*, 2010). This suggests that the pheasant breeding and rearing is often a subsidiary activity of many red-legged partridge game farms rather than their main activity (González-Redondo, 2005). Breeding and rearing of game species other than red-legged partridges and quails, namely wild rabbits, pigeons (*Columba* spp.), and hares (*Lepus* spp.), was carried out by 32% of the pheasant farms (Table 2). Also regardless of typology, 20% of the surveyed farms raised pheasants of species and varieties other than the ring-necked pheasant (Table 2). These other pheasants were mutated varieties and ornamental pheasants, mainly the melanistic mutant (*P. colchicus* var. *tenebrosus*) and Japanese (*P. colchicus* var. *versicolor*) pheasants that are sold for private collections.

### Supply of the pheasant game farms

All the surveyed farms raised and sold pheasants for release or restocking, due to the fact that this is the main

and the most demanded product of the pheasant game farms (Torres *et al.*, 1995). In Spain, pheasants are widely used in hunting preserves and shoots mainly for intensive 'put and take' shooting, rather than for restocking hunting grounds (Ballesteros, 1998), because they can be released with comparative ease (Canning, 2005) but are poorly adapted to most Iberian habitats (Peiró, 1997). Due to the lack of a proper, homogeneous nationwide records system, estimates of the numbers of pheasants reared and released in Spain vary considerably (Sánchez García-Abad *et al.*, 2009; MARM, 2010). In spite of the above, it is estimated that well over 114,770 pheasants are reared and released in Spain annually (MARM, 2010). This figure is well below the more than 3,000,000 red-legged partridges reared and released in Spain annually (Sánchez García-Abad *et al.*, 2009) and the 20,000,000 pheasants reared and released annually in the UK, a country where this species can be regarded as the main game bird (Canning, 2005).

In addition to pheasants for release or restocking as the main product, many farms have diversified their offer. Hatching eggs and one-day old chicks are sold by a significant proportion of farms (Table 2), similar to the 20% that can be found in the red-legged game farms sub-sector in Spain (González-Redondo *et al.*, 2010). The hatching eggs market is supported by the fact that pheasant eggs can be stored, if necessary, up to four weeks before their incubation (Woodard & Morzenti, 1975). Breeding pheasants for other farms were also supplied by several complete-cycle farms, due to the fact that in recent years numerous pheasant farms have been established, demanding large batches of breeders that usually are sold sexed, and that are born in the reproductive season previous to them being put into breeding. However, this product is supplied only by half of farms that in the case of the red-legged partridge sub-sector (González-Redondo *et al.*, 2010), because in this latter case there are many more complete-cycle farms requiring breeders for replacement of the breeding flock.

At least 20% (Sánchez García-Abad *et al.*, 2009) of the 463 registered Spanish farms raising pheasants (MARM, 2011) are meat-oriented. From this research arose that 8% of the surveyed game farms supplied farmed ring-necked pheasants reared for meat (Table 2). This is due to the fact that birds reared specifically for meat are more attractive to some consumers and restaurants as there is no risk of finding any lead gunshot in the bird (Canning, 2005), when compared to hunted pheasants. Another proportion of these pheasants could be those that remain unsold after the release



season. This particular product is demanded in several Spanish regions with a well developed market for game meats (González-Redondo, 2010).

### Additional services offered by the farms

Due to the wild nature and stress-prone behaviour of the pheasant, game management, and in particular transporting and releasing this species are not easy to carry out (Leif, 1994; Canning, 2005). For this reason, most farms offer customers a transport service of the animals from the farm to the hunting preserves, and almost half of them advise clients on how to successfully perform release, restocking and habitat management in the hunting preserves (Table 2). In a competitive environment, these services attract new, inexperienced landowners and gamekeepers. The transport service was offered in the same proportion as that of Spanish red-legged partridge (González-Redondo *et al.*, 2010) and wild rabbit (González-Redondo & Sánchez-Martínez, 2011) game farms. However, there were great differences between these game farms sub-sectors in relation to the proportion of farms that advise the clients on how to release or restock. Thus, the proportion of pheasant farms offering this service (Table 2) was intermediate between 84% of the red-legged partridge farms (González-Redondo *et al.*, 2010) and 14% of the wild rabbit farms (González-Redondo & Sánchez-Martínez, 2011). This can be explained because red-legged partridges are widely used in hunting preserves and shoots as they adapt well to a landscape shaped by modern agriculture and they can be restocked with comparative ease (Canning, 2005), while pheasants are mainly released for intensive shooting rather than for restock hunting grounds (Ballesteros, 1998), the latter being a more technically complex activity.

More than half of the farms had an owned hunting preserve in which they released part of the pheasants for organised shoots (Table 2). This option has several benefits: it satisfies the demand for intensive shooting by some hunters; it places a significant part of the pheasants reared by the farm in the market, and it increases the added value of these pheasants when compared to those sold directly to customers. The proportion of pheasant farms associated with a hunting preserve was much higher than the 36.5% of the red-legged partridge (González-Redondo *et al.*, 2010) and than the 9.5% of the wild rabbit (González-Redondo & Sánchez-Martínez, 2011) Spanish game farms. In

addition, this variable contributed to discriminating farm typologies. Indeed, none of the farms belonging to type 1 had a hunting preserve, while most of these belonging to types 2 and 4 did it (Table 2).

### Market's geographic area

According to EU regulations (OJ, 2005), transport requirements are not a negative factor for pheasant selling because the maximum permitted journey time for this species makes part of the Iberian Peninsula out of range for only a few Spanish game farms. Therefore, two-thirds of the farms, regardless of their typology, sell their products throughout all of the Spanish territory (Table 2), while in Spanish red-legged (González-Redondo *et al.*, 2010) and wild rabbit (González-Redondo & Sánchez-Martínez, 2011) game farms this proportion reaches three-quarters of the total number of farms.

Only 12% of the pheasant farms have exported partridges, regardless of typology (Table 2), a proportion significantly lower than in Spanish red-legged partridge (González-Redondo *et al.*, 2010) and wild rabbit (González-Redondo & Sánchez-Martínez, 2011) game farms. This activity was carried out sporadically, and the main destinations of Spanish pheasants were the neighbouring countries of Portugal, France, and, to a lesser extent, Italy and the UK. This market niche, however, is constrained by the fact that in many European countries (*e.g.*, France, Italy) there is a well-developed pheasant game farm sector (Ghigi, 1958; Fol, 1961; Torres *et al.*, 1995; Canning, 2005) and because the British market is dominated by a high level of imports from France due to its competitive price (Canning, 2005). In addition, exports are also constrained by red tapes over animal health and by the concern for maintaining the local gene pool (Canning, 2005). Moreover, the maximum permitted journey time for birds renders much of the potential foreign market out of range for many Spanish game farms, and, if transport regulations are followed (Council of the EU, 2005), this limits trade.

### Advertising and promotion activities

A significant part of a pheasant game farm's output is sold in the local market and through direct relationships within the hunting sector. Another part is allocated to self-supply an associated hunting preserve. However, increased competition in this particular market

has made advertising and promotion important activities (González-Redondo, 1999; Vidal & Sánchez, 2002). The four farm types showed the same pattern for advertising and promotion activities (Table 2) and closely fitted to that previously described for the red-legged partridge (González-Redondo, 1999, 2005; González-Redondo *et al.*, 2010) and wild rabbit (González-Redondo & Sánchez-Martínez, 2011) game farms in Spain. The main activity, carried out by two-third of the farms, consisted of maintaining a proprietary website (Table 2), an important tool aimed at promoting the business and attracting potential clients. In fact, these websites are usually illustrated with photographs of the birds and facilities, something that helps enhance customers' confidence in the hunting quality of the farmed birds (González-Redondo, 1999, 2005). The proportion of pheasant farms with a proprietary website was higher than those of the Spanish red-legged partridge (González-Redondo *et al.*, 2010) and wild rabbits (González-Redondo & Sánchez-Martínez, 2011) game farms. Fifty six percent of the farms advertised themselves in the game press, given the numerous specialised magazines currently published in Spain. The same proportion of pheasant farms advertised their activity on the internet (Table 2), while in the red-legged partridge game farms sub-sector less than a quarter of the farms do (González-Redondo *et al.*, 2010). Although to a lesser extent than the other promotional activities, a significant number of pheasant farms also promote themselves by attending some of the numerous game fairs celebrated all over Spain (Table 2). This proportion, however, doubled that of the red-legged partridge (González-Redondo *et al.*, 2010) and wild rabbit (González-Redondo & Sánchez-Martínez, 2011) game farms in Spain.

In conclusion, Spanish pheasant game farms constitute an alternative poultry sub-sector that is now well-established, despite being only three decades old. Its typification has highlighted the heterogeneity of the sub-sector with regard to farm size and age, intensification level and diversification strategies related to advertising practises, as well as with regard to the products and services offered to the market.

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