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## **Factors influencing pheasant *Phasianus colchicus* harvesting in Tuscany (Italy)**

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**Key-words:** Bag record, game-birds, farm-rearing, land use, *Phasianus colchicus*, protected areas, wild population

## **Abstract**

Common pheasant (*Phasianus colchicus*) is one of the most popular game-bird species in Europe. In Italy their populations are commonly managed in order to improve the number of birds for the hunting season. For this reason we have analysed the effect of management strategies, hunting effort, land use and characteristics, on the number of pheasants harvested in the nineteen Hunting Districts (**HDs**) of Tuscany during three years to detect the best strategies.

Results showed that, in addition to the hunter density, protected areas, number of wild pheasant relocated and different years were selected in the final multivariate model which explained the harvested pheasant number. Restocking using wild pheasants captured in protected areas seems to have much more importance than releasing farm-reared pheasants. The key-tool to sustain hunting pressure seems the correct management of the habitat with a sufficient number of protected areas which can safeguard and produce wild pheasants (by capture and relocation or by natural spread).

**Key-words:** *Phasianus colchiucus*, Bag record, land use, wild population, farm-rearing, protected areas, game-birds.

## Introduction

Common pheasant (*Phasianus colchicus*) is the most important non migratory game-bird species in Italy, and in Tuscany too. In the 19 Hunting Districts (**HDs**) of Tuscany (total surface 1,634,000 Ha), between 70,000 and 100,000 pheasants are shot every year by the 120,000 Tuscanian hunters. In addition to this number, more than 150,000 pheasants (estimated value) are harvested every year in the Private Hunting Areas within the same Districts (total surface 170,000 Ha). Pheasant hunting is carried out traditionally with pointing dogs, whereas driving with beaters is uncommon and only few private estates organise this kind of hunting.

In some **HDs** pheasant management is based on protecting this species inside several no-hunting areas (about from 500 to 2,000 ha each) where gamebirds are intensively managed by gamekeeping, habitat improvement, supplemental feeding and predator control. After each hunting season a part of the pheasant population of the no-hunting areas are captured and relocated in the hunting territories where the pheasants have disappeared or their density is very low. Captures are carried out generally with cage traps (using corn as bait). Less common is the use of trammel nets around small woodlands (Burrini *et al.* 1997). The clap nets, the most used method in the past has declined because it is very labour intensive (Bub 1991). An average of 14,650 (s.d. 2,424.9) wild pheasants were captured and released in the **HD** of Tuscany, per year, from 2001 to 2003.

In other **HDs**, releasing farm-reared birds is the prevalent system to sustain hunting pressure. Releases take place in summer directly in the hunting territories or, in some cases, in small open top pens bordered by no hunting areas (100-300 ha) where the pheasants are acclimatised. It is not allowed to release gamebirds after the 31st August (3 weeks before the hunting season start). The birds spread outside the protected areas before and during the hunting season. In some cases, also adult pen-reared pheasants are released in late winter,

in order to enhance reproduction. An average of 125,140 (s.d. 2,382.6) farm-reared pheasants were released in the **HDs** of Tuscany per year from 2001 to 2003.

Many **HDs** adopt both strategies (managing protected areas to produce wild birds and releasing farm reared pheasants) combining them with different ratios.

The aim of the present work is to evaluate the effect of these different strategies and of the land use and characteristics, on the number of pheasants harvested per sq.km, corrected for the hunting effort, in the 19 **HDs** of Tuscany.

Bag records should be a good measure of game-birds population abundance (Cattadori et al. 2003) and can be used to evaluate the better management strategies and/or land characteristics (Schmidt et al. 2004, Vargas et al. 2006).

## **Materials and methods**

The records of the harvested pheasants of the 19 **HDs** of Tuscany from 2001 to 2003 were collected from the optical reading of the personal game registers of the hunters made by the Tuscan Game and Wildlife Office (Fig. 1). **HDs** are active from 1996 but previous data were not available or were incomplete. **HDs** are very large game management units (average  $\pm$  s.d.  $108,300 \pm 54,500$  hectares) managed by a mixed committee constituted by public administrators and members of the hunters, of the farmers and of the environmentalists, often supported by wildlife technicians.

The variables considered were (table 1):

- Land use. The data were obtained by the Italian Institute of Statistics at the official web sites of Tuscan Regional Government ([www.regione.toscana.it/cif/indicato/indsetto.htm#agr](http://www.regione.toscana.it/cif/indicato/indsetto.htm#agr)). Land use were grouped in eight categories: (woodlands, cereals, industrial crops, grass in rotation, grass and pastures, olive tree groves, vineyards, orchards). Surfaces covered by natural parks

(National and Regional, total 4, located in wooded sites) and urban areas were excluded.

- The woodland edge ratio obtained by Corine Land Cover.
- The Shannon index as a measure of habitat diversity.
- The average farm surface (obtained by the Italian Institute of Statistics).
- The percentage of protected areas; every area, located in the countryside where hunting is not allowed (protected for game management).
- The percentage of private hunting areas (according to the Italian rules they can reach, at maximum, 15% of the no-urban surfaces defined as “agroforestral surfaces”). Private hunting areas, whose presence is commonly believed to increase the bag records of the surroundings, include two types of estates: *commercial*, which can release pheasants also during the hunting season, and *non-commercial*, the most common, which cannot release pheasants during the hunting season (after 31 August) and must respect a minimum game density index at the end of the hunting season (after 31 January). Since they are located inside the **HDS**, we wanted to verify if the presence of these areas, - which are managed mainly by releasing farm reared birds - should have a real effect on the bag records of the surrounding areas (spreading pheasants outside their borders).
- The hunting effort expressed as number of hunters per sq.km. This data represents the total density of hunters. Even though pheasant is the most popular game species in Tuscany, we did not know how many hunters really shoot pheasants or others species. For this reason, we preferred to use it as a variable instead of analysing directly catch per unit effort.

- The percentage of mountain (>700 m), hill (between 300 and 700 m) and plain (< 300 m) territories (using the classification of Italian Institute of Statistics).
- The number of farm-reared pheasants released every year and the number of wild pheasants captured in protected areas and relocated in the hunting territories, released per sq.km of **HD**. These data were obtained directly by each **HD**.

A multiple regression model was performed by stepwise selection in order to evaluate every possible effect of the variables on the pheasant bag records. Regressor terms were chosen to enter by forward steps (probability to enter 0.25) then discarded by backward steps (probability to remove 0.10). The hunting effort expressed as hunters per sq.km was forced in the model. Variance Inflation Factors (VIF) was calculated for each predictors to detect multicollinearity. The VIF maximum value resulted 3.2 excluding serious multicollinearity risks (SAS, 2002). The simple regressions between pheasant bags and the selected variables were also plotted.

## **Results**

The multivariate model selected by the stepwise technique is shown in table 2. The number of pheasants harvested per sq.km in 2003 resulted significantly lower than in the two previous years.

No relationship between number of harvested pheasants and habitat traits was selected by the analysis. The only significant selected relationships (positive associations) found were the “year” and the incidence of the protected areas managed for wildlife reproduction, in addition to the hunting effort, which were selected by the final model without forcing. Although the number of wild pheasants captured in protected areas and relocated in the hunting territories per sq.km was only of borderline significance ( $P=0.055$ ), the model

selected also this variable. Both the number of farm-reared birds and the percentage of private game estates, which routinely release reared pheasants, were discarded by the model.

## **Discussion**

Spring and summer 2003, in Tuscany, were exceptionally dry and hot and, probably, affected negatively adults reproduction and chicks survival. The spring and summer mean temperature of 2003 were 1,9° C over the average of the period 1980-2002. Mean rainfall from May to August was reduced by 50% compared to the period 1986-2002 (Meneguzzo et al. 2003). During counting of the pheasants in the protected areas of the Siena Province in fact, either covey density dimension and, after reproduction, poult density was reduced during 2003 compared to the period 2001-2002. The covey density was reduced by 25.7% compared to 2001 and by 29.7% compared to 2002. Covey dimension was reduced by 7.9% compared to 2001 and by 23.7% compared to 2002. Chick density was reduced by 35.8% compared to 2001 and by 48.8% compared to 2002 (Santilli pers. obs.). Pheasant density (lines transects conducted at the end of autumn) in 2003 was reduced by 9.4% compared to 2001 and by 25.2% compared to 2002). In addition, the pheasant density, observed in the protected areas of the province of Pisa during 2003 (lines transects conducted at the end of autumn), was the lowest value observed within 1995-2003 (R. Mazzoni della Stella, unpubl. data). The observations carried out in a sample of the no hunting areas (protected areas) perfectly agree with the reduction of the bag records observed all over Tuscany during that specific hunting season.

The lack of significant effect of the environmental variables is probably due to the fact that **HDS** in Tuscany are very large and hold a lot of different kinds of habitats making it difficult to investigate habitat-species relationships. Therefore agricultural land use data,

obtained by the Italian Institute of Statistics, are not very suitable for this kind of analysis; to many different kind of crops are grouped together. Winter and spring cereals for example are included in the same category as well as sunflowers and sugar beets. The relationship of the density of hunters with the hunting yield showed in Fig. 2 probably means that most of the Tuscan hunters are pheasant hunters.

In the larger scale of the **HD**, the positive effect of the presence of protected areas shows that pheasant hunting depends mainly on the wild populations protected inside these no-hunting areas. Farm-reared birds, released every year, showed a reduced effect on pheasant harvesting and were discarded in the final model. The best pheasant yields are obtained by **HDs** that have a wider network of well managed protected areas, which naturally spread birds outside their borders and where wild animals are routinely captured for restocking the low density hunting territories.

It is interesting to note that the relationship between the pheasant shot and the number of wild pheasants released (Fig. 2) seem to be fitted better by a square relationship than a linear relationship, also with a reduced number of pheasant relocated. In fact, when foreign pheasants are inserted in an habitat, they increase the population and, the “limiting population factors” determined by the carrying capacity of their environment act according to the well known non linear (logistic) relationship.

The releasing of hand reared pheasants, even if carried out using techniques to enhance acclimatisation (open top pen) probably can have only a local effect on harvest, but cannot compensate the shortage of wild populations.

Pheasants that have been raised in a pen do not know how to avoid predators and consequently have a very low survival rate in the wild, giving little contribution to hunting (Brittas et al. 1992, Hill and Robertson 1988a, Mayot & Biadi 1989). Anatomical, physiological and ethological differences which are often observed between wild and

captive-born galliforms (Dowell 1992, Anttila et al. 1995, Putaala & Hissa 1995, Bagliacca et al. 1998, Liukkonen-Anttila 2001, Millàn et al. 2001, Santilli et al. 2002, Bagliacca et al. 2004, Santilli et al. 2004) cause a further reduction of survival and breeding success in captive-born pheasants when released in the wild. Finally, hand-reared birds are often more infested by intestinal parasites than the wild ones, reducing their fitness and consequently their survivals (Woodburn 1995, Draycott et al. 2000, Millàn et al. 2001, Millàn et al. 2004.). In a study, carried out in the province of Siena, pheasant drops collected in areas where farm reared birds were released, showed a higher prevalence of intestinal parasites compared to areas where only wild populations were present (Mani et al. 2001).

The no-effect of private hunting estates could have a similar explanation. Most of them tend to release large numbers of low-quality pen reared pheasants that are shot by the hosts of the estates during the hunting season. The few birds that survive have poor reproductive success (Hill & Robertson 1988b) and so the possibility that a part of this population spreads outside the borders is much lower than that observed in the protected areas managed by the **HDS**.

The shortcoming of released reared birds can be exacerbated by the fact that pheasant releasing often occurs in areas with poor breeding habitat (Sage & Robertson 2000), and the high densities of prey can be a functional and numerical response of predators to the high concentrations of birds at release points (Kenward 1981, Robertson 1988, Gortázar et al. 2000). Poor performance may also be related to body condition in the nesting season. Robertson (1994) noted that released pheasants lost 40% of their April body mass by the time they reached the brood rearing period.

### *Management implications*

The strategy adopted by many Tuscan **HDs** (common in most of North-Italy), consisting in creating and managing a wide network of protected areas that provide pheasants by capture or by natural spreading, even if it reduces the hunting surfaces, seems the better choice to conserve the wild pheasant populations by reducing, in some cases, the request of hunters to release a great number of low quality hand reared birds. One **HD** of the province of Siena, for example, (which scored 4<sup>th</sup> place for number of harvested pheasants per sq.km and 1<sup>st</sup> place for the incidence of protected areas) has completely ceased to release farm reared birds since 2000. In this province the capture of wild pheasants in protected areas has a long tradition and it is documented since 1961 (Fig. 3) (Mazzoni della Stella 2000).

However, an important criticism of this strategy concerns the lack of a seasonal bag limit. Hunters behaviour remains insensitive to change in population consistence and, in the long term, it should represent a threat for game-bird conservation. **A fall of the wild populations due to habitat loss can be exacerbated by an incontrollated hunting pressure as happened for the Grey partridge (*Perdix perdix*) in Italy during the 70' (Matteucci & Toso 1992). In this cases the "production" of protected areas could not be sufficient to compensate the losses caused by the combininig effect of hunting and habitat change.**

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Figure 1. The nineteen Hunting Districts of Tuscany

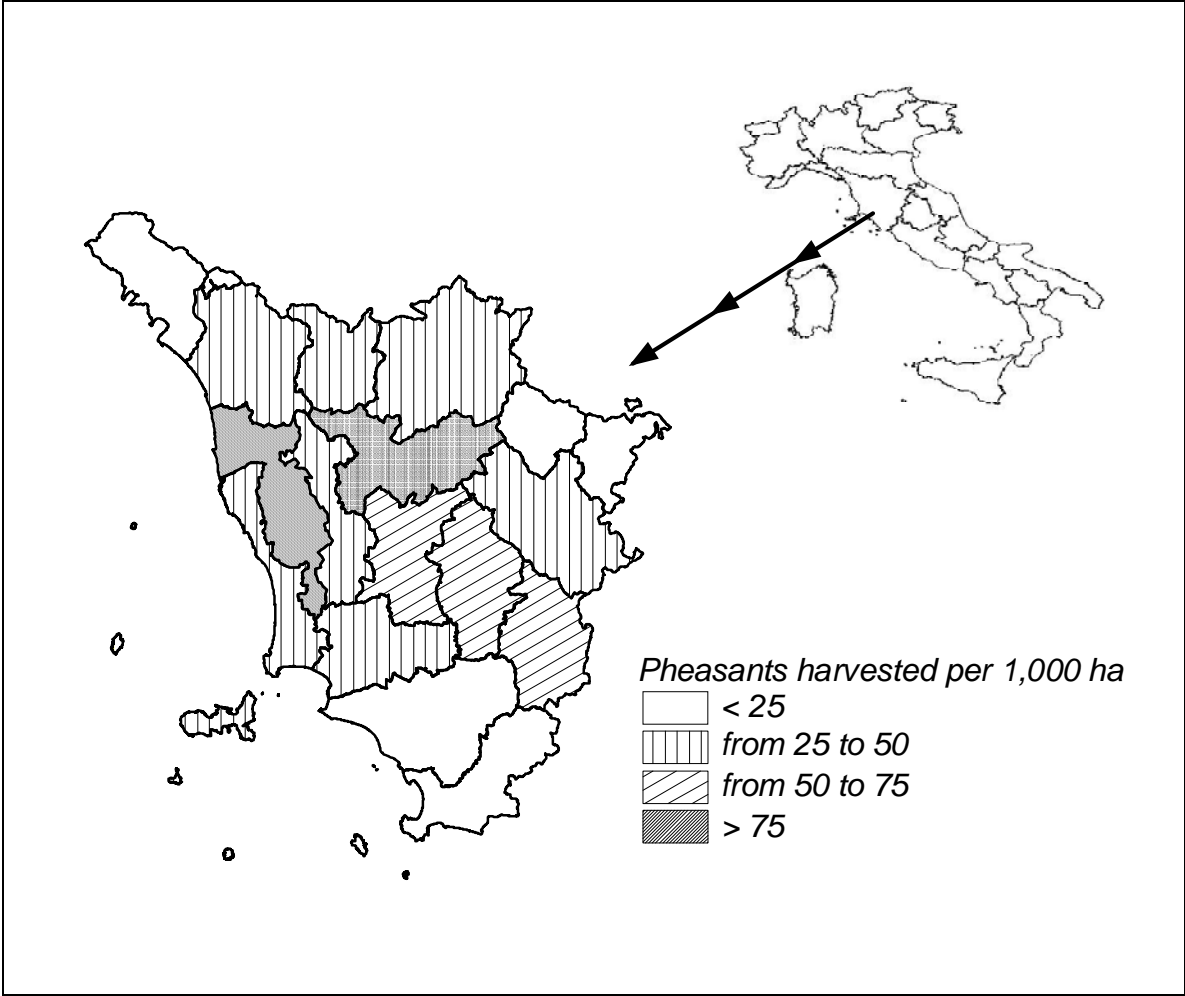


Table 1. Description of model variables used in the analysis of pheasant harvest record from 2001 to 2003

Variable	Description
Woodlands	All kinds of woodlands
Cereals	Winter and spring cereals (wheat, barley, oat, maize and sorghum)
Industrial crops	Sunflower, sugar beet, soybean and colza
Grass in rotation	Grass and green fodder in rotation including grass, clover and lucerne
Grass and pastures	Grass areas permanently out of rotation and grazed pastures
Olive tree groves	Olive tree groves
Vineyards	Vineyards
Orchards	Orchards
Cattle	Cattle reared per sq.km
Sheep and goats	Sheep and goats reared per sq.km
Mountains	Territories > 700 meter <i>a.s.l.</i>
Hills	Territories between 300 and 700 meter <i>a.s.l.</i>
Plains	Territories < 300 meter <i>a.s.l.</i>
Woodland edge ratio	Woodland edge ratio
Shannon index	Shannon index
Farm dimension	Avarage farm surface
Protected areas	Surface occupied by no-hunting areas managed for game species
Private hunting areas	Surface occupied by private game estates
Hunting effort	Number of hunters for sq.km
Farm-reared pheasants	Farm-reared pheasants released per sq.km
Wild pheasants	Wild pheasants captured in protected areas and released in hunting areas per sq.km

Table 2. Regressors selected by Stepwise analysis of the multiple regression model of pheasants harvested per sq.km in the 19 Hunting Districts of Tuscany (Stepwise Regression Control: Prob. to Enter 0.250; Prob. to Leave 0.100; R-Square = 0.789; D.F. 48).

	<b>Coefficient</b>	<b>s.e.</b>	<b>Probability</b>
Intercept	-0.494	1.133	0.078
Regression terms			
Year (2001&2002 vs 2003)	0.4869	0.185	0.011
Hunters per sq.km (*)	0.419	0.053	< 0.001
Protected areas	12.313	4.755	0.039
Wild pheasants released per sq.km	0.636	0.319	0.055

(\*) – Entered in the model without forcing.

Fig. 2) Regression functions of density of pheasants harvested compared to the hunters density and the other management variables.

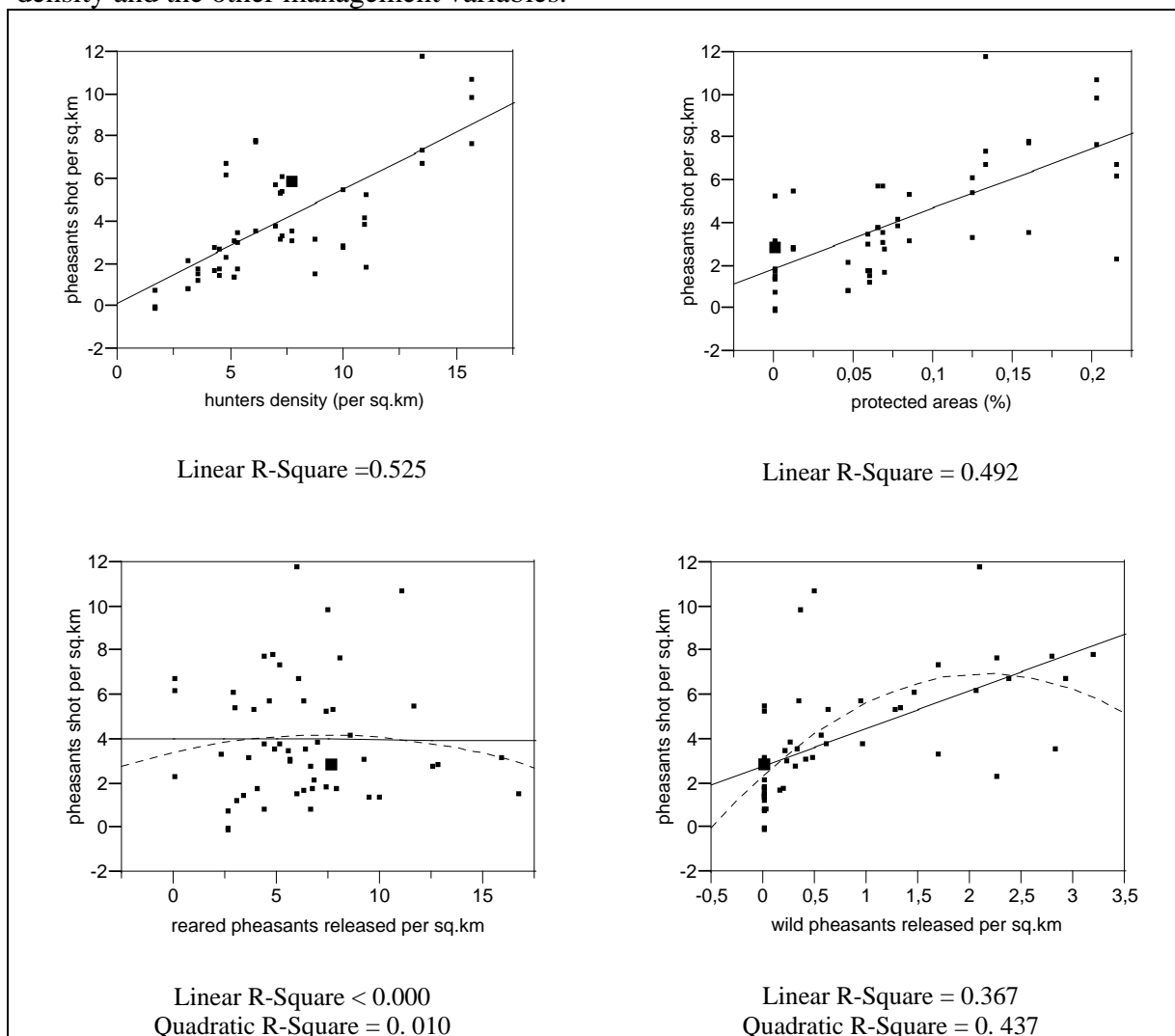


Figure 3. Wild pheasants captured in the protected areas of the province of Siena from 1961 to 2000 (Mazzoni della Stella 2000)

