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FACTORS AFFECTING HARVEST ON A BROWN HARE POPULATION *(Lepus europaeus)* IN CENTRAL ITALY

LUCA GIARDINI*, ALESSIA BALDI* AND GIOVANNI NOBILI*°

* *Sett. Ricerca e Studi Faunistici, Ente Produttori Selvaggina – Lazio, via L. Valerio 69, 00146 Roma, Italy*
° *Corpo Forestale dello Stato, via C. Colombo 21, 48020 Punta Marina (RA),Italy*

ABSTRACT - Bag data (number of Brown hares shot) related to the 1987 - 1993 period were obtained from the hunting preserve management book (1374 hectares, in central Italy, Lazio Region). The correlation between the daily number of hunting teams, shooting days, and non-hunting days for the same period, was performed by means of correlation and ANOVA tests. **A** first analysis shows a significant direct correlation between daily catches and the daily number of hunting teams. Further analyses showed that, although the number of teams did not vary within the year taken into account, the mean number of hares shot decreased over the shooting season. Moreover, when considering the entire 7-year period, data showed that, while the number of teams fluctuate from year to year, the number of hares shot remains quite stable. A positive (direct) correlation was found between the yearly number of non hunting days and the number of hares shot in the same year.

Keywords: Lepus europaeus, management, shooting disturbance.

INTRODUCTION

The Brown hare *(Lepus europaeus)* is an important species in conservation strategy and management. Their intermediate size and great abundance means they can support a community of small to medium-sized predators; large birds of prey, foxes and many others which can benefit from this resource (Chapman and Flux, 1990). General reduction of population size in Europe and in Italy is very important in the management of game and agro-ecosystems (Strandgaard and Asferg, 1980; Barnes and Tapper, 1983; Tapper and Barnes, 1986; Spagnesi and Trocchi, 1992). In the Lazio Region (central Italy) more than 40000 people participate in game shooting. However, the number of specialised hare shooters is lower. The Brown hare is an important small game species in hunting preserves too and restocking through breeding and importing animals into Italy has produced relatively good results (Giovannini *et al.*, 1988; Trocchi, 1990; Angelici *et al.*, 1993). For this reason we decided to study several other aspects related to Brown hare shooting, to establish optimum game management of the wild population, in order to avoid restocking activity. Stoate and Tapper (1993) suggested that the way shooting practice is performed has a different impact on population density. However, the effects of shooting disturbance on the Brown hare has been studied less than in other species, such as birds (Bell and Owen, 1990). This, as well as other game management issues, is related to a correctly planned strategy. A simple question arises from this discussion: Is the increasing shooting activity related to the Brown hare game bags? The relationship was observed in a hunting preserve over a seven-year period.

Table 1 - Correlation values between shot hares per day, and number of teams per year.

Year	Correlation values (r)	Probabilities	N
1987	0.19	N.S.	97
1988	0.53	p<0.0001	99
1989	0.35	p<0.008	100
1990	0.42	p<0.005	103
1991	0.22	N.S.	101
1992	0.47	p<0.0001	103
1993	0.54	p<o.0001	102
since 1987 to 1993	0.31	p<0.0001	705

MATERIAL AND METHODS

The study area (hunting preserve, 1374 hectares) is located in the northern part of the Lazio Region (Central Italy); the altitude ranges from 78 m to 401 m. Woodland (mainly ***Quercus pubescens*** and ***Quercus cerris)*** covers 40 % of the area, while 43 % is used for cereal cultivation and shepherds; 7% of the area is covered by vineyards and olives. About 180 hectares (10.1 % of the total area) are permanently subjected to shooting.

Game data (daily number of shot brown hares) for 1987-1993 were obtained from the hunting preserve management book. Every shooting season started in September-October and ended on December 31. We calculated the daily number of hunting teams, the annual number of shooting days and the annual number of "non-hunting days". Non-hunting days were made up of two days imposed by law, plus the number of shooting days not used by hunting teams in the study area. Each hunting team consisted of 2-4 hunters. Every team hunted using dogs (1 to 3) which were not specialised for searching hare (Stoate and Tapper, 1993). Moreover, each team was not allowed to shoot more than five hares in a single shooting season. The area had not been restocked with hares for the two years preceding the study. The daily hunting data were analysed by means of a parametric statistics test (r Pearson's); the analysis, within and between years, was obtained by a two-way ANOVA, and all the hunting data were grouped in 15-day periods for each year; the overall data (annual) was tested by the Spearman rank test. The relationship between annual non-hunting days and annual number of hares shot, were also analysed by means of linear regression analysis.

RESULTS AND DISCUSSION

The daily number of shot Brown hares is related to the daily number of hunting teams ($N=705$; $r=0.31$; $p<0.0001$). Within the study period (1987-1993), no significant correlations were found for the years 1987 and 1991 (Table 1). Each shooting season was divided into 15-day periods. For each season the number of hares shot decreased from period to period ($F_{6,36} = 6.15$; $P<0.01$) (Table 2). During the same period the number of hunting teams remained constant ($F_{6,36} = 0.6$; $P>0.05$;). The number of shot hares does not show any significant fluctuation (min=14; max=28) over the years in question ($F_{6,36}=0.46$; $P>0.05$) (Table 2), while the number of hunting teams changed ($F_{6,36}=62.5$; $P<0.001$). Correlation between hares shot and total number of teams per year was not significant ($N=7$; $r_s=-0.62$; N.S.) and neither was there any correlation

Table 2 - Hares shot per 15-day period since 1987 to 1993.

Year	15-day periods								Total
	I	II	III	IV	V	VI	VII	VIII (*)	
1987	3	3	1	2		2	3		14
1988	6	5	2	3	3	2	1		22
1989	3	4	1	3	4	5	2		22
1990	4	8	6	1	6	2	1		28
1991	6	7	3	1	5	1			23
1992	7	5	4	3	1	2		1	23
1993	4	7	2	4	7	2			26
Total	33	39	19	17	26	16	7	1	

(*) Period not considered, since shorter than 15 days (i.e., 3-4days).

between the annual number of hares shot and total annual shooting days (N=7; r_s= -0.71; p=0.056). A positive and significant correlation was found between the annual number of non-hunting days and the number of shot hares (N=7; r_s=0.80; $P < 0.05$). The trend was confirmed by linear regression (Fig. 1). The daily number of shot hares increases together with the daily number of teams. Obviously, the chances to meet a hare increase together with the area covered by teams.

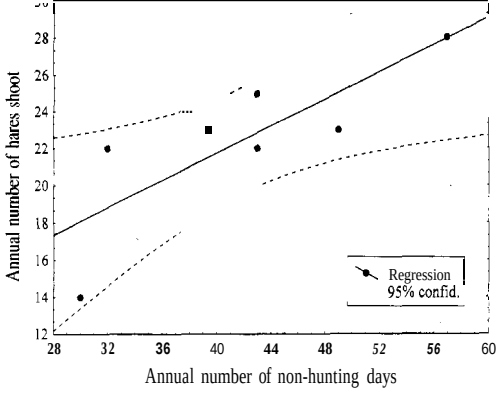

Figure 1 - The regression ($y= 7.1 + 0.4\ x$) (adjusted R^2= 0.6; SE= 6.1)($F_{(1,5)} = 9.1, p<0.05$) (b= 0.4; SE= 0.1, $p < 0.05$) indicates an increasing trend between hares shot per year and annual number of non-hunting days.

However, the correlation index suggests that further factors influence the hare shooting trend. In fact, we have not considered other factors such as: dogs or hunters' ability, weather conditions, population density and so on. The number of hares shot decreased during every shooting season, because of predators, natural mortality, shooting (Spagnesi and Trocchi, 1992), but the number of teams did not vary during the same periods. When considering the whole 7-year period, data show that the number of teams fluctuated over the years, while the number of shot hares stays almost the same. It is possible that restriction of shooting (cf. Material and Methods) prevent an efficient harvest of the brown hare population. Our annual analysis seems to suggest that continuous daily shooting drives the hare away from its chosen territory to other ecological areas which are secondary. A similar phenomenon was observed in large vertebrates (Hill *et al.*, 1997). This was demonstrated through the negative correlation between the number of hares shot per year and the total number of teams per year. On the other hand, when the shooting activity was concentrated in a few days (weekend), the annual number of shot hares increased. During a radio-tracking study on breeding animals, Giovannini *et al.* (1988) observed that, as behavioural adapta-

tion to predators, hares generally do not come back in the same den very quickly. The frequent use of the same area by hunting teams could generate a "shooting disturbance" effect that could magnify this behaviour. This could explain the direct correlation between annual shot hares and annual non-hunting days.

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