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ACCLIMATISATION OF FARM-REARED RED-LEGGED PARTRIDGES (*ALECTORIS RUFULA* L.) IN TWO PROTECTED AREAS OF SOUTHERN TUSCANY

RISULTATI DI UN ESPERIMENTO DI AMBIENTAMENTO DELLA PERNICE ROSSA (*ALECTORIS RUFULA* L.) IN DUE AREE PROTETTE DELLA TOSCANA MERIDIONALE

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SUMMARY

Results of a red-legged partridge (*Alectoris rufa* L.) reintroduction program in two protected areas in southern Tuscany are reported and discussed (7.51 and 7.01 square km each). A total of 2475 farm-reared partridges were released from 2000 to 2005. Spring pair density, pair reproduction success and brood size was seasonally monitored, in order to evaluate the success of the reintroduction program.

The strong correlation ($r = 0.93^{***}$) between the number of the spring pairs and the number of the summer released birds, the constant ($b = +0.00042$) low density (avg. 2.47) of the spring population, and the low level of every population dynamic parameter (always lower than those observed in other studies carried out in Tuscany or other Italian regions) suggests the need of a change in the project strategy.

A reduction in the number linked with an improve of the quality of the released birds (by the use of partridges hatched directly by their own parents in order to improve the reproductive success), a more effective predation control program (in order to protect temporarily the weak reintroduced animals), an habitat improvement with an eventually seasonally food supply (to improve the short time-survival after release), and a hunting stop or, at least, a more strictly regulated harvesting in the areas surrounding the protected areas (bag limit and shorter season), must be attempted to improve the low observed population dynamic parameters.

Keywords: *Alectoris rufa*; Tuscany; red-legged partridge; reintroduction; farm-reared.

RIASSUNTO

Si riportano i risultati di un esperimento di reintroduzione della pernice rossa (*Alectoris rufa* L.) in due aree protette della Toscana meridionale (provincia di Grosseto), una di 7,51 kmq e l'altra di 7,01 kmq. In totale, dal 2000 al 2005, sono state ambientate nelle due aree 2.475 pernici rosse di allevamento provenienti da un centro pubblico di produzione di selvaggina. La popolazione è stata censita stagionalmente al fine di determinare la densità pri-

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maverile delle coppie ed il successo riproduttivo (numero di nidiate e numero medio di piccoli per nidiate). La densità è rimasta pressoché costantemente ($b = +0,00042$) ad un livello inferiore (media 2,47) a quello riscontrato in altre esperienze condotte in Italia ed in Toscana. Inoltre si è riscontrata una stretta correlazione fra il numero delle coppie censite in primavera con il numero di soggetti ambientati durante l'estate ($r = 0,93^{***}$). Per questo motivo si suggerisce di apportare alcuni correttivi alla strategia del progetto. In primo luogo appare necessario sospendere o diminuire il numero di animali allevati annualmente o, in alternativa, immettere soggetti provenienti da allevamento semi-naturale (covati ed allevati dai genitori) in modo da migliorarne il successo riproduttivo e dovrebbe essere inoltre realizzato un più efficiente controllo della predazione. Altre misure gestionali come dei miglioramenti ambientali a fini faunistici ed una integrazione alimentare mirata potrebbero consentire un miglioramento dei parametri della popolazione. Dovrebbe infine essere valutata la sospensione dell'attività venatoria od almeno una più severa regolamentazione della stessa almeno nei dintorni delle aree protette con limitazione dei carnieri e/o del periodo di caccia alla specie.

Parole chiave: *Alectoris rufa*; Toscana; Pernice rossa; reintroduzione; allevamento.

INTRODUCTION

Red-legged partridge (*Alectoris rufa*) is a galliform of the western palearctic region, which is suffering a marked population decline throughout its range due to the agriculture intensification and the related suitable-habitat loss. The species is considered vulnerable (Aebischer & Potts, 1994; Tucker & Heath, 1994; Aebischer & Lucio, 1996; Borralho et al., 1999). In Tuscany red-legged partridge has gone extinct, with the exception of the Elba Island, during the first decades of 20th century (Spanò, 1989; Massi, 1990; Foschi et al., 1996). In Grosseto province the extinction of the species can be related to two main factor, the fact that, in most cases, red-legged partridges occupied shrubby areas, which developed in woodlands as a consequence of farm animal grazing human transfer from high lands to low lands and an increased hunting pressure, which characterised all the Italian peninsula in those years (Aebischer & Lucio, 1996).

In recent years, releasing of farm-reared partridges has become popular in order to re-establish populations and sustain hunting pressure. Unfortunately the released animals seem to show several problems which affect the reintroduction success. Most of the reared populations show signs of hybridisation with other species of the *Alectoris* genus and in particularly with *Alectoris chukar* (Baratti et al., 2005) causing a reduction of survival and reproduction success in the wild (Potts, 1986). Anatomical, physiological and ethological differences were often observed between wild and captive-born galliforms (Santilli et al., 2002; Santilli et al., 2004; Bagliacca et al., 1998; Bagliacca et al., 1999; Bagliacca et al. 2004; Dowell, 1992; Dessì et al., 1999; Putaala & Hissa, 1995; Millán et al., 2001). Nevertheless, the unavailability of wild stocks, makes farm reared birds the only source for the reintroduction programs in areas which can be still considered suitable, or returned suitable. For this reason we report the results of the first 5 years of observations of the population dynamic of an artificial population of red-legged partridges, present in two protected areas of the Grosseto province (southern Tuscany) continuously supported by the release of farm-reared red-legged partridges.

MATERIAL AND METHODS

Study areas

The two releasing areas are located in the high lands of the northern part of Grosseto province. The first area named "Cornacchiaio", 7.51 sq. km surface is mainly cultivated with winter cereals, sunflower and alfalfa (66%), sheep-pastures (7.1%), olive-tree groves and vineyards (8.0%); Wood- and shrub-lands represent the permanent cover (18.9%). Hedgerows always separate fields.

The second area named "Montorsi", 7.01 sq. km surface, is 1.2 km far from "Cornacchiaio". This area is characterised by small estates part-time cultivated. Land use classes include wood- and shrub-lands (19.0%), fallow land and meadows (29,1%), arable crops (winter cereals, sunflowers and alfalfa) (20,8%), sheep-pastures (10.1%), olive-tree groves (18.8%), and vineyards (2.2%).

No predator control is carried out in the two areas with the exception of Montorsi where hooded crow (*Corvus corone cornix*) and Magpie (*Pica pica*) are captured during their breeding season using Larsen traps and letterbox traps. Foxes, monitored using spotlight census, carried out every year in late autumn, is present in both areas with density 1-2 fox/sq. km.

Releases

From 2000 to 2005, a total of 2475 red-legged partridges, aged 90-120 d, were released in the two study areas (2075 in "Cornacchiaio" and 400 in "Montorsi"). The animals came from a game farm where the National Institute for Wildlife (I.N.F.S.) has a program for the selection of a pure strain of *A. rufa* by the elimination of every bird which show introgression with the *A. chukar* (Lucchini et al., 1999).

Releases in "Cornacchiaio" area took place during summer (August) in a 2 hectares acclimatisation enclosure, which contain an aviary of 10x15 m. The birds, before release are kept in the aviary for at least 15 days. Flocks of 20-30 birds maximum (beyond the size of natural coveys) are released each time, in order to avoid that excessively large groups being formed (Meriggi & Mazzoni, 2004). The same aviary (starting from 2001) was used also for the birds to be released in "Montorsi. The birds coming from the "Cornacchiaio" aviary, after a month of acclimatisation, were released by the use of 3 small pens (3x2 m) where the bird remained at least for one week.

Field procedure and data analysis

The populations were monitored every year, mapping spring pairs (from March to May) and summer broods (from July to September). Surveys were carried out during the first three hours after dawn and at the last three hours before dusk, covering a net of transects which crossed the whole study areas. A tape recorder was used in spring to increase pairs detachability (Pepin, 1983; Ricci, 1985; Gibson et al., 1996). The transects were covered every two weeks by two trained observers. Broods census data were integrated by the informations, collected by the interviewed farmers after cereals harvesting; only broods more than 30 days old were

considered. The observations of the pairs and broods in 2002, 2003 and 2005, were used to define the range of the species inside the reintroduction area (Kernel 95%) by the extension “Animal Movement” for Arcview (Seaman & Powell, 1996; Hooge & Eichenlaub, 1997). Reproductive success was studied by χ^2 test and ANOVA was used to compare brood size through years. Pearson correlation coefficient was calculated to investigate the effect of numbers of birds released on spring pairs number censused.

RESULTS

Spring pair density in “Cornacchiaio” area ranged from 2.5 pairs/sq. km in 2001 and 2002 to 3.9 pairs/sq. km in 2003 (Tab. I) and in “Montorsi” area ranged from 1.6 pairs/sq. km in 2005 to 2.3 pairs/sq. km in 2003 (Tab. II). Number of censused

Tab. I. Population dynamic of the red-legged partridge in “Cornacchiaio” area.						
	Year	2001	2002	2003	2004	2005
Partridges released	n.	380	400	595	400	300
Spring pairs censused	n.	19	19	29	22	21
Spring pairs density	n./sq.km	2.53	2.53	3.86	2.93	2.80
Broods censused	n.	6	7	11	8	2
Successfully breded pairs	%	31.6 a	36.8 a	37.9 a	36.4 a	9.5 b
Broods density	n./sq.km	0.80	0.93	1.46	1.07	0.27
Juvenile partridges censused	n.	31	22	58	48	7

Note: means with different letters show significative differences per $p \leq 0.05$.

Tab. II. Population dynamic of red-legged partridge in “Montorsi” area.					
	Year	2002	2003	2004	2005
Partridges released	n.	105	95	100	100
Spring pairs censused	n.	14	16	12	11
Spring pairs density	n./sq.km	2.00	2.28	1.71	1.57
Broods censused	n.	6	5	5	5
Successfully breded pairs	%	42.9 a	31.3 a	41.7 a	45.5 a
Broods density	n./sq.km	0.86	0.71	0.71	0.71
Juvenile partridges censused	n.	38	28	27	18
Brood size	n.	6.3 a	5.6 a	5.4 a	3.6 a
	std.d.	1.51	2.07	1.67	2.30

Note: means with different letters show significative differences per $p \leq 0.05$.

spring pairs resulted strongly affected by the number of released birds ($r = 0.9283$, two tailed P value = 0.0003).

In "Cornacchiaio" area, reproductive success varied from 37.9% in 2003 to 9.5% in 2005. In "Montorsi" area reproductive success varied from 42.9% in 2002 to 31.3% in 2003. Brood size ranged from 3.1 in 2002 to 6.0 in 2004, "Cornacchiaio" area, and from 6.3 in 2002 to 3.6 in 2005, "Montorsi" area. The species range inside "Cornacchiaio" was 746, 436 and 692 hectares, in 2002, 2003 and 2005, respectively. The species range inside "Montorsi" was 5.23 2.15 and 5.10 sq.km, in 2002, 2003 and 2005, respectively.

DISCUSSION

Every population dynamic parameters observed in our study, pair density, successfully reproduced pairs and brood size, was at lower level if compared to those found in other study on the same species carried out in Italy and Tuscany (Meriggi et al., 1992; Mazzoni della Stella, 1995; Meriggi & Mazzoni, 2004). A possible explanation is the lack of predator control. Only crows are controlled in Montorsi area where we observed a higher proportion of reproduced pairs. Predator control, carried out with scientific criteria, should be a valuable management tool in threatened game-birds conservation (Aebischer, 1997). In grey partridge, the experimental application of legal predation control in spring and early summer increased breeding success, post-breeding density, spring density and shooting bag after three years, the autumn stock averaged 3.5 time higher when predation was controlled than it was not, and the breeding stock 2.6 times higher (Tapper et al., 1996). Also habitat suitability should have played a role on this result. The poor reproductive success of 2005 (proportion of successfully reproduced pairs as well as average brood size) could be explained by the rainy spring of that year.

No improvement in spring density ($b = +0.00042$), in reproductive parameter and in population range was observed through the years in both areas. It means that the re-establishing of a self-sustaining population with these parameters could not be reached without any change in the project strategy. In particularly the prosecution of the release of high number of farm-reared birds inside the reintroduction areas could maintain the domestic portion of the population with consequent losses of the breeding efficacy (Dowell, 1992; Duarte & Vargas, 2004; Casas & Vinuela, 2005). In a study carried out in the Siena province, breeding performance of reintroduced population of red-legged partridge improved after the conclusion of the releasing session (Meriggi & Mazzoni, 2004). Since the stop the releasing farm-reared birds is not possible with the actual populations parameters, the improve of the quality of the released partridges is necessary. The restocking technique with the use of clutches with their parents or juvenile birds hatched directly by their own parents (used in Britain in order to counter local grey partridge extinctions) (Browne & Buner, 2004) could guarantee the required minimal number of "artificially immigrated" new birds in the two areas. Moreover the habitat improvement (by the use

of game crops, over wintering stubble, beetle banks etc.) and other management actions as predator control and temporary food supply could improve the population parameters. Last but not least the Stop of partridge hunting outside the protected areas (mainly in the stripe between the two areas) or a more strictly regulated harvesting (bag limit, shortened season etc.) is necessary in order to favour the establishing of a self sustaining population and the natural migration between the two areas. Population Viability Analysis (PVA) carried out on red-legged and grey partridges shows that annual immigration of few pairs greatly improve the survival probability of isolated populations (Merli et al., 1999; Santilli et al., 2003).

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