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Status of rock partridge *Alectoris graeca saxatilis* in Val Troncea Regional Park (Piedmont, north-west Italy)

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Abstract – An eight-year monitoring (2004–2011) of rock partridge *Alectoris graeca saxatilis* was carried out in Val Troncea Regional Park (Piedmont, north-west Italy). Since 2004, standardized counts were performed by playback technique in order to check out rock partridge presence and spring density (males/surface) within an area of 500 ha. Since 2007, the reproductive success (chicks/adults) was assessed during August and September with pointing dogs within an area variable between 300 and 670 ha. From 2008 to 2011, both the spring density (from 2.3 to 1.2 males/100 ha) and the reproductive success (from 3.6 to 0.3 chicks/adults) decreased, indicating a marked decline in the rock partridge population which appeared to be highly related to an increase in yearly snow cover.

Key-words: Western Italian Alps, counts, snow cover, *Alectoris graeca saxatilis*.

INTRODUCTION

Rock partridge *Alectoris graeca saxatilis* is a threatened species included in the Annex I and II of the 2009/147/ECC Directive, and in the Annex III of the Bern Convention on the Conservation of European Wildlife and Natural Habitats.

Rock partridge status was studied more in France (Bernard Laurent & Leonard 2000) and in north-eastern (Meriggi *et al*. 1998, Cattadori 2003) and central Italy (Amici *et al*. 2006, Amici *et al*. 2011, Sorace *et al*. 2011) than in north-western Italy, where little information is available for this species (Bocca 1990, Gaydou & Giovo 2006, Maurino 2007). Moreover, among these studies, only Bernard Laurent & Leonard (2000) investigated the relationships between rock partridge presence and climatic factors like snowfall, which is known to be a limiting factor for winter survival (Bernard Laurent & Leonard 2000). Consequently, the goals of this study were:
I) to perform a middle-term monitoring plan in a high altitude alpine environment in the Italian Western Alps,
II) to check rock partridge population status and dynamics in this area,
and III) to assess the relationships between rock partridge presence and snow cover.

MATERIAL AND METHODS

Study area

The study was carried out from 2004 to 2011 in the Val Troncea Regional Park (6°56'28''E, 44°57'28''N), which is part of the Cotian Alps Protected Areas (Piedmont Region, north-west Italy). The Park area extends for more than 3280 ha and it is characterized by Southeast-Northwest orientation and high average altitude (from 1650 to 3280 m a.s.l.). Land cover is mainly characterized by extensive alpine grasslands (54% of total surface), rocks (15%) and larch *Larix decidua* forests (12%). The climate is characterized by a yearly average precipitation of about 900 mm, 202 of which occurring in summer period. The mean annual temperature is 2.1 °C, with monthly means ranging from -6 °C in January to 10.8 °C in July (Biancotti *et al*. 1998). Hunting has been banned within the Park since 1980, although it still occurs in the surrounding area.

Rock partridge counts

The occurrence of the species was detected by means of playback counts in spring (breeding season) and with pointing dogs in summer (post-breeding season). From 2004 to 2011, playback counts were performed yearly from the mid-May to mid-June, in a sampling area of 500 ha (Tab. 1). Playbacks were conducted in the early morning (5:30-

Table 1. Parameters of spring counts.

	2004	2005	2006	2007	2008	2009	2010	2011
Sample area (ha)	500	500	500	500	500	500	500	500
Count-days	1	1	1	1	1	1	1	1
Man-days	7	7	5	6	5	6	4	5
DOY (days of year)	162	132	144	138	134	160	145	145

10:30) with a standardized method (Bernard Laurent & Laurent 1984, Bernard Laurent & Laurent 1994, Regione Piemonte 2011). Pointing dog counts were carried out between 2007 and 2011 from the beginning of August to the beginning of September to assess the rock partridge annual reproductive success (chicks/adults; Leonard 1992, Scherini 1998, Calladine *et al*. 2002) within a sampling area extending from 330 to 670 ha. Counts were performed in the early morning for 3-4 hours to avoid warm temperatures. Playback and pointing dog counts were performed only once every year, in 1 and 1-2 days respectively, avoiding rainy or windy days. The total number of man-days and pointing dog-hours working yearly was used to assess the research effort in spring counts (Tab. 1) and in summer counts (Tab. 2), respectively.

Data analysis

Daily height of snow records from the "Clot dla Soma" meteo station (6°56'29''E, 44°58'96''N, 2154 m a.s.l., Pragelato, TO) were analysed to evaluate the snow cover in the Park (Regional Agency for the Protection of the Environment 2011). The number of days with the snow higher than 40 cm during the period November 1 - May 31 was calculated, assuming 40 cm as the snow depth necessary to completely cover the study area (Fig. 1). Breeding season counts allowed to compute the following variables: total number of rock partridges, number of males, number of females, number of undetermined rock partridges, male density, and number of breeding pairs.

Post breeding season counts allowed to compute the variables: total number of rock partridges, number of broods, number of chicks, chicks/broods ratio, reproductive success (chicks/adults), number of adults, and number of undetermined rock partridges. All reproductive (spring) count data were analysed with a χ^2 test in order to evaluate the differences among years. For some variables (breeding pairs, females, undetermined rock partridges) the χ^2 test was not performed because the theoretical frequency was less than 5 and the assumptions of the test were not satisfied. The relationship between rock partridge spring density (males/100 ha) and snow cover was tested by means of a linear regression. All statistical analysis were performed by using SPSS 17.0 software package (SPSS 2008).

Table 2. Parameters of summer counts.

	2007	2008	2009	2010	2011
Sample area (ha)	330	330	562	562	670
Count-days	1	1	1	1	2
Man-days	6	9	18	14	20
DOY (day of year)	307	303	305	222	218-222
Pointing dogs	8	9	16	12	15
Dog-hours	31	35	49.5	45	60

RESULTS

During eight-year monitoring, 130 rock partridges were contacted with playback counts with a density ranging from 1.2 males to 4.9 males/100 ha (Tab. 3, Fig. 1). The total number of birds varied significantly from 2004 to 2011 ($\chi^2 = 32.70$, d.f. = 7, $P < 0.001$), as well as the total number of males ($\chi^2 = 27.45$, df = 7, $P < 0.001$). From 2007 to 2011 a total of 123 rock partridges were contacted during post breeding counts, with a marked variation in total number of birds, with a maximum of 49 in 2008 to a minimum of 6 in 2010 (Tab. 4). From 2008 to 2010 the numbers of broods and the reproductive success decreased from 5 to 1 and from 3.6 to 0.5 respectively.

The rock partridge spring density was negatively related to the number of days with a snow cover higher than 40 cm (R^2 0.88, $P < 0.001$, $\beta = -0.022$; Fig. 2).

DISCUSSION

Rock partridge populations are known to be widely declining in the Alps (Cattadori 2003). Our results confirm that snow cover can strongly affect the presence of this species (Priolo & Bocca 1992, Bernard Laurent & De Franceschi 1994, Bernard Laurent & Leonard 2000), which is sensitive to winter snowfall because snow cover limits access to food and increase the risk of predation and starvation mortality (Bernard Laurent 1989). From 2004 to 2007, the

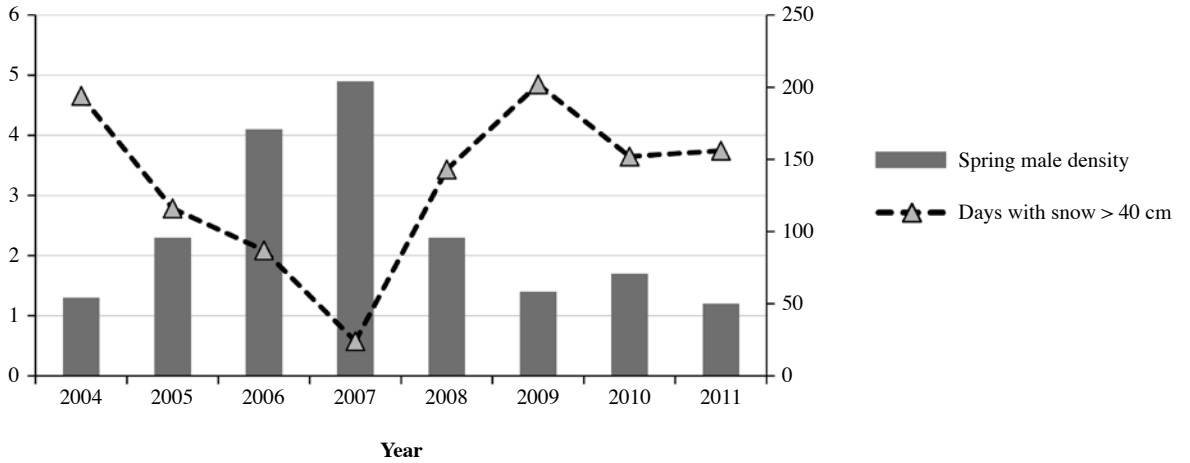

Figure 1. Snow cover and spring density of rock partridges (males/100 ha) in Val Troncea Regional Park.

Table 3. Results of spring counts.

	2004	**2005**	**2006**	**2007**	**2008**	**2009**	**2010**	**2011**
Total rock partridges	10	14	27	32	17	11	11	8
Breeding pairs	2	2	5	6	4	2	1	2
Males	5	11	19	23	10	7	7	6
Females	2	2	5	6	4	4	1	2
Undetermined sex	3	1	3	3	3	0	3	0
Density (males/100 ha)	1.3	2.3	4.1	4.9	2.3	1.4	1.7	1.2

Table 4. Results of summer counts.

	2007	**2008**	**2009**	**2010**	**2011**
Total rock partridges	24	49	14	6	10
Adults	2	5	2	4	8
Undetermined age	16	26	6	0	0
Chicks	6	18	6	2	2
Broods	2	5	1	1	1
Chicks per brood	3	3.6	6	2	2
Reproductive success (chicks/adults)	3	3.6	3.0	0.5	0.3

rock partridge population increased in the study area, with some of the highest spring density values reported in literature for north-western Italy (Bocca 1990, Gaydou 2006, Maurino 2007). Nevertheless, since 2008 the increase in snow cover has caused a population crash, also confirmed by the summer counts. Playback and pointing dog counts are extensively used to monitor rock partridge (Leonard 1992, Bernard Laurent 1994, Cattadori 2003, Amici *et al*. 2011). In our study, playback counts showed a high efficiency due to trained operators, while pointing dog count efficiency improved throughout the years, due to variations in the field work period. In particular, as suggested by Bernard-Laurent in 2008 (*pers. comm.*), changing the date of the count from the beginning of September to the beginning of August, when the size of chicks is clearly smaller than adults, allowed to reduce significantly the number of undetermined birds as well as to determine accurately the reproductive success and the brood size.

The Val Troncea Regional Park is currently the only Protected Area in north-western Italy where rock partridge is monitored in both seasons (breeding and post breeding); in the next years the study will continue by means of the

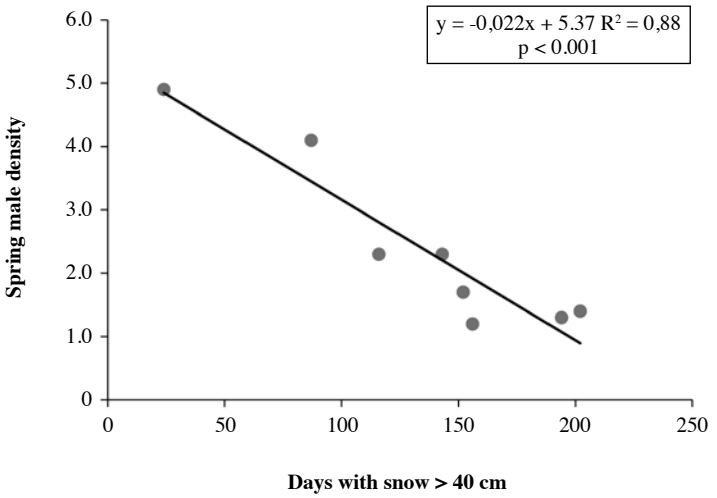

Figure 2. Linear regression between rock partridge spring density (males/100 ha) and the number of days with snow cover up to 40 cm.

same methods to assess the population dynamics and the relationship with snow cover in a long-term time period.

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