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Status and distribution of rock partridge *Alectoris graeca* in Apennine areas

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Abstract – Scarce information is available on the current status of Apennine populations of *Alectoris graeca*. In this paper, data on recent distribution of the species in each Apennine region and data on census in several Apennine areas are reported. In Marche region, the size of population was estimated in 110-137 pairs and maximum density (1.25 pairs/ km^2) was observed in M. Sibillini National Park. In Umbria region, the size of population was estimated in 9-23 pairs. In Lazio region, the size of population was estimated in 171-342 pairs and the highest densities were recorded in the Reatini Mountains (2.02 pairs/ km^2) and in 'Montagne della Duchessa' natural Reserve (1.90 pairs/ km^2). In Abruzzo-Molise regions, the size of population was estimated in 1500-1700 pairs and highest regional densities were recorded in the Maiella National Park (4.2 pairs/ km^2) and Velino Sirente Regional Park (2.10 pairs/ km^2). In Campania region, the specie was present only in Cilento e Vallo di Diano National Park, where the size of regional population was estimated in 84 pairs. In Basilicata-Calabria regions, population was estimated in 55-120 pairs. The Apennine population of rock partridge was evaluated in 1939-2436 pairs. The distribution of rock partridge showed that many Apennine, pre-Apennine and anti-Apennine areas, apparently suitable for the species, were not occupied. Factors limiting the expansion and the growth of populations of rock partridge in Apennine areas are highlighted. A correct management of populations of Abruzzo region, in particular of local hunting pressure, plays a pivotal role for the conservation of Apennine rock partridge.

Key-words: *Alectoris graeca*, distribution, census, conservation, Apennines.

INTRODUCTION

Based on morphological features, Priolo (1984) attributed Apennine populations of rock partridge *Alectoris graeca* to the subspecies *A. g. orlandoi*. Although recent genetic studies do not recognize the subspecific rank for these populations (Lucchini & Randi 1998, Randi *et al*. 1992, 1998, 2003), they have been isolated and demographically independent from all other populations of the species since the beginning of the Holocene (10000 years ago). Thus, some authors (Randi *et al*. 2003) suggest considering the Apennine partridges as a distinct management unit (MU, *sensu* Moritz, 1994). In spite of the conservationistic value of Apennine populations, scarce information is available on their current status. In this contribution, data on recent distribution of rock partridge in each Apennine region and data on census in several Apennine areas are reported.

MATERIAL AND METHODS

The distribution of the species in each region was established on the basis of knowledge of local students of the species, ornithologists, technicians and guards of protected areas and on the basis of data collected for local ornithological investigations (e.g. Bird Atlas).

As far as quantitative data are concerned, they were obtained from studies conducted independently in different Apennine areas, but that followed very similar methods. Surveys of rock partridge were conducted using playback technique in point-counts during the period (March-June) in which pairs are territorial (Bernard-Laurent & Laurent 1984, Bernard-Laurent 1994). In the different areas, the dates of census varied according to the climatic conditions and snow cover. Days with strong wind and/or rain were avoided. Census was carried out in the first four hours of the morning (Bernard-Laurent & Laurent 1984, Bocca 1990). In each point-count, the call of the species (20") was broadcasted four times (towards N, E, S, W). Each call was followed by 20"of listening.

To obtain the density (pairs/km^2) of the species in each study area, we assumed that a singing male was paired with a female (Bernard Laurent & Laurent 1984); therefore 1 point was assigned to a pair or singing male and 0.5 points to an observed individual. In addition, using an optical telemeter (Swarovski Laser Guide 8x30), we established that the maximum distance for species detectability was 200 m as an average of different conditions of species recording. Thus, the investigated surface for each point-count was 12.56 ha.

In each region, the density of the species obtained for the point-counts was multiplied by the surface of habitat suitable for the specie in order to assess the regional population size. In some areas, this procedure was applied to get the local population size. In the regions in which the species was present in protected (i.e., hunting forbidden) or non protected areas with different density, the assessment of population size was carried out separately for the two types of areas successively summing the two obtained values.

RESULTS

Marche region

In the past, some captive-reared birds were released in Emilia- Romagna region, but these attempts were unsuccessful. Thus, in Marche region the northern limit of rock partiridge's Apennine range is found corresponding to M. Catria - M. Nerone Massif. Besides these two mountains, the species is present in M. Fema and M. Fietone and Sibillini National Park (Fig. 1).

Except M. Fema, they are all protected areas (i.e. hunting is forbidden). Sibillini National Park hosts the majority of pairs of rock partridge in the region; in the other areas, few pairs are breeding (Tab. 1).

The size of regional population was estimated in 110-137 pairs. Regional population estimate does not include the pairs living in the part of M. Laga-Gran Sasso National Park belonging to the Marche region. These pairs have been considered in the population estimate of Abruzzo re-

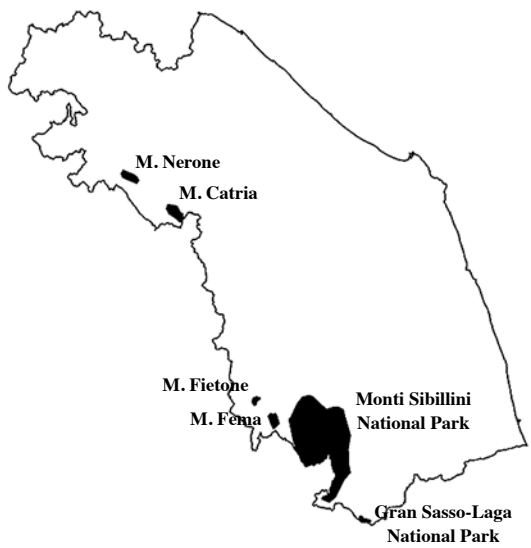

Figure 1. Map of Marche region with highlighted in black the areas where rock partridge is present.

Table 1. Density (pairs/ km^2) and number of pairs of rock partridge in the areas occupied by the species in Marche region.

Area	Year (s)	Authors	Sectors	Density (pairs/km^2)	Numbers of pairs
M. Fema - M. Cavallo	2010	Forconi, Mariani (unpublished data)		0.55	4-6
M. Fietone	2007	Forconi (unpublished data)		0.62	1
M. Catria	-	-		?	2-5 ?
M. Nerone	-	-		?	2-5 ?
Monti Sibillini National Park	2009/2010	Bonanni, Brusaferro, Mangiacotti (unpublished data)	M. Rotondo	1.25	100/200
			M. Vettore	1.07	

gion. In the estimate of Monti Sibillini National Park were included the pairs breeding in the Umbria sector of this Park.

Trend of range: shrinkage;

Trend of population: unknown.

Umbria region

The map shows that the species is present in Sibillini National Park and, with small populations, in other six areas (Monte Cucco Regional Park, M. Alvagnano-M. Pozzoni, M.Aspro, M. Coscerno, M. Fionchi) (Fig. 2). However, for M. Fionchi and M. Aspro very recent data are not available.

The size of regional population was estimated in 9-23 pairs (Tab. 2). Besides these, 10-30 pairs are present in the Umbria sector of Monti Sibillini National Park, but they were not considered here (see above).

Trend of range: unknown;

Trend of population: unknown.

Lazio region

The map shows the areas (M. Reatini, M. Cicolani, M. Duchessa, M. Simbruini, M. Ernici, M. Cornacchia, M. Meta, Mainarde) in which rock partridge was found (Fig. 3).

In the last decennia, the regional range of the species has been reduced. As compared to the data collected for the first regional bird atlas in the '80s and '90s (Boano *et al*. 1995), the data of the new Atlas (Brunelli *et al*. 2011) and the data collected for the species regional Action Plan (Sorace *et al*. 2011) indicate that rock partridge is not more present in pre- and anti-Apennine areas and also in some

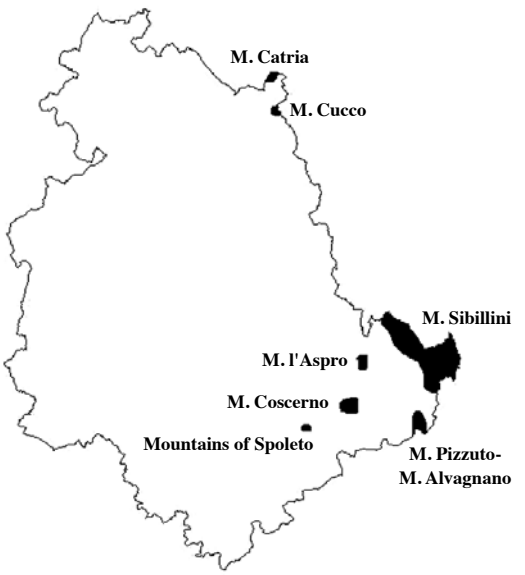

Figure 2. Map of Umbria region with highlighted in black the areas where rock partridge is present.

Table 2. Number of pairs of Rock Partridge in the areas occupied by the species in Umbria region.

Area		Numbers of pairs
Monte Cucco Regional Park	M. Catria (Umbrian side)	1-3
	M. Cucco	1-2
M. Alvagnano-M. Pozzoni (at the border with Rieti province)		2-3
M.Aspro		1-3
M. Coscerno (Protected oasis) - M.Civitella		3-10
M. Fionchi (Protected oasis)		1-2

Table 3. Density (pairs/km^2) of rock partridge in the areas occupied by the species in Lazio region.

Area	Years	Authors	Density (pairs/km^2)
M. della Laga	2008-2009	Sorace *et al*. 2011	1.25
M. Pozzoni and close areas	2008-2009	Sorace *et al*. 2011	Species non recorded
M. Reatini	2008-2009	Sorace *et al*. 2011	2.02
M. Cicolani	2008-2009	Sorace *et al*. 2011	0.12
M.la Duchessa	2008-2009	Sorace *et al*. 2011	1.90
M. Simbruini	2008-2009	Sorace *et al*. 2011	0.84
M. Ernici	2008-2009	Sorace *et al*. 2011	0.41
Abruzzo, Lazio and Molise National Park and close areas	2008-2009	Sorace *et al*. 2011	0.85
M. Lucretili	2008-2009	Sorace *et al*. 2011	Unrecorded species
M. Lepini	2008-2009	Sorace *et al*. 2011	Unrecorded species
M. Aurunci	2008-2009	Sorace *et al*. 2011	Unrecorded species
M. Cairo	2008-2009	Sorace *et al*. 2011	Unrecorded species
M. Passero	2008-2009	Sorace *et al*. 2011	Unrecorded species

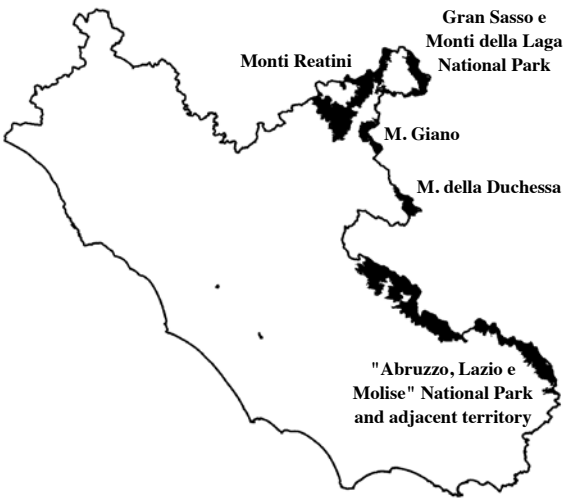

Figure 3. Map of Lazio region with highlighted in black the areas where rock partridge is present.

Apennine areas for example in Monti Navegna e Cervia natural Reserve and in M. Nuria massif (see also Amici *et al*. 2006, 2007).

The highest densities were recorded in the Reatini Mountains and in 'Montagne della Duchessa' natural Reserve, the lowest in the Ernici Mountains and Cicolani Mountains (Tab. 3). These two mountain groups are not protected areas. Based on density of species obtained in the different investigated areas, the size of regional population was estimated in 171-342 pairs.

Trend of range: shrinkage;

Trend of population: unknown.

Abruzzo-Molise regions

In this region rock partridge was found in several areas (i.e. Maiella National Park, Velino Sirente Regional Park, Gran Sasso e Monti Laga National Park, Abruzzo, Lazio e Molise National Park, Monte Genziana Regional Reserve, Gole del Sagittario Regional Reserve, Zompo lo schioppo Regional Reserve, M. Ocre, Roccaraso Mountains; Fig. 4).

Only M. Ocre and Roccaraso Mountains are not protected areas.

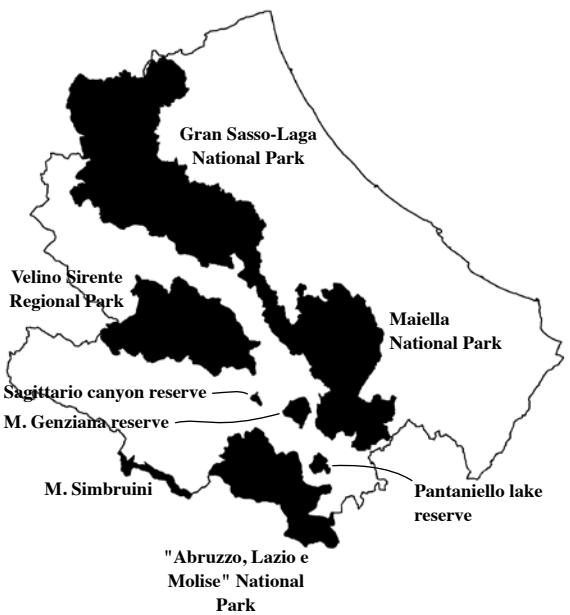

Figure 4. Map of Abbruzzo region with highlighted in black the areas where rock partridge is present.

Table 4. Density (pairs/km^2) and number of pairs of rock partridge in the areas occupied by the species in Abruzzo region.

Area	Year (s)	Authors	Sectors	Density (pairs/km^2)	Numbers of pairs
'Gran Sasso e Monti della	2010	Bonani, Brusaferro, Mangiacotti, Pinchiurri	Gran Sasso	1.61	
Laga' National Park		(unpublished data)	Laga	0.13	200/250
			Monti gemelli	0.76	
Velino Sirente Regional Park	2008-2009	SOA: Artese, Bernoni, Bonani, Fabrizio,	Velino	2.10	
		Pellegrini, Spera (unpublished data)	Sirente	1.80	
			Collarmele	2.01	383
			Ocre	0.49	
			Aterno	0.61	
Maiella National Park	2005-2006	Antonucci, Carafa, Liberatoscioli		4.2	690
		(unpublished data)			
Abruzzo, Lazio e Molise	2010	Bernoni, Latini		0.83	168
National Park		(in press.)			

The species is irregularly observed or absent in areas (es.: M. la Queglia, M. Tre Croci) where it regularly occurred 10-20 years ago.

The highest regional densities of rock partridge were recorded in the Maiella National Park and Velino Sirente Regional Park, the lowest in the Gran Sasso e Monti della Laga National Park and in Abruzzo, Lazio e Molise National Park (Tab. 4). However, in each park the density greatly varied among areas ranging for example between 0.49 and 2.10 pairs/km^2 in Velino Sirente Regional Park (Tab. 4).

Based on density of species obtained in the different regional areas, the size of regional population was estimated in 1500-1700 pairs.

Trend of range: shrinkage;

Trend population: unknown.

Campania region

In the region, rock partridge is present in Cilento e Vallo di Diano National Park. The map shows the areas occupied in this Park (Fig. 5).

Following the release of captive reared birds, few pairs might occur in Matese Regional Park (Fraissinet *et al*. 2009). However, preliminary survey using playback technique did not confirm the presence of the species in this area.

Based on density of species obtained in Cilento e Vallo di Diano National Park, the size of regional population was estimated in 84 pairs (Tab. 5).

Trend of range: unknown;

Trend of population: unknown.

Figure 5. Map of Campania region with highlighted in black the areas where rock partridge is present.

Basilicata region

The map show that rock partridge is currently present in three areas: Pollino National Park; Appennino Lucano-Val d'Agri-Lagonegrese National Park; M. Paratiello and surrounding areas (Fig. 6).

The size of regional population was estimated in 25-50 pairs.

Trend of range: shrinkage;

Trend population: unknown.

Figure 6. Map of Basilicata region with highlighted in black the areas where rock partridge is present.

Figure 7. Map of Calabria region with highlighted in black the areas where rock partridge is present.

Calabria region

The map shows that rock partridge is currently present in Pollino National Park and in Aspromonte National Park (Fig. 7). In the latter area, until 15-20 years ago, the species was present also at low altitude. Now a reduced population occurs only at high altitude.

In '90s, the species was also present in Sila Greca and in the coastal chain of Paola, but recent data are not available to confirm the occurrence in the former area and in the latter it is extinct. The size of regional population was estimated in 30-70 pairs.

Trend of range: shrinkage;

Trend of population: unknown.

DISCUSSION

On the whole the Apennine population of rock partridge was evaluated in 1939-2436 pairs. This estimate is biased by the fact that in some region surveys of the species were not recently undertaken. Nevertheless, as compared to previous estimates of the species (Petretti 1985), for the first time many data from several regions were available in particular about the size of Abruzzo population (about 1500 pairs, the majority of them in four main areas, and 69-77% of Apennine population) that constitutes the bulk of the Apennine partridges. Besides this region, our data highlighted that important local populations are present also in other areas (e.g., M. Reatini, M. Duchessa, M. Sibillini, Cilento) of other regions.

The data relating to the distribution of rock partridge in different regions showed that many Apennine, pre-Apennine and anti-Apennine areas, apparently suitable for the species, were not occupied. Some factors limit the expansion and the growth of populations of rock partridge in Apennine areas.

The role of past bad management of hunting activities on Apennine populations of the species has been long highlighted (Priolo & Bocca 1992, Bernard-Laurent & De Franceschi 1994, Bernard-Laurent & Boev 1997, Meriggi *et al*. 1998, Spanò *et al*. 1998, Bernard Laurent & Léonard 2000, Gramignani 2001). However, other recent data agree with the negative role of hunting pressure. For example, the presence of rock partridge is currently almost limited to protected areas (i.e. where hunting activity is forbidden). Moreover, the density of the species in protected areas resulted higher than in non protected areas (Amici *et al*. 2007, Sorace *et al*. 2011).

Habitat changes (i.e. abandonment of agro-pastoral activities) is another important factor negatively affecting the conservation of rock partridge in the Apennines areas. Tree and shrub encroachment may be particularly dangerous for the species survival, in particular reducing feeding area in the preferred South-exposed areas during cold winter that constitutes a critical season for rock partridge (Gramignani 2001, Cattadori *et al*. 2003, Bernard-Laurent & De Franceschi 1994) and promoting fragmentation of areale with consequent isolation of populations (Cattadori *et al*. 2003, Rippa *et al*. 2011).

Previous studies indicated that hybridization and intro-

gression are not widespread in natural partridge populations (Randi & Bernard-Laurent 1999). However, hybridisation with introduced chukars might threatens the gene pool integrity of native rock (*A. graeca*) and red-legged (*A. rufa*) partridge populations (Barilani *et al*. 2007, Randi 2007). In addition, the massive release of captive-reared birds can produce detrimental consequences to prey–predator equilibria and habitat resources and the diffusion of parasitic and infectious diseases (Lups 1981). In spite of this, the release of captive-reared birds is still carried out in different regions (e.g., Marche, Lazio, Basilicata: recent observations of Chukar individuals; Lazio, Campania, Calabria: release of captive-reared rock partridge).

The parasitic diseases might pose a further threat for rock partridge (Salvini & Colombi 1983, Rizzoli *et al*. 1999, Manios *et al*. 2002). However, no data are available on this matter for Apennine populations.

Following the huge increase of boar *Sus scrofa* populations recorded in recent years (Monaco *et al*. 2010), this species has been indicated as possible source of impact on rock partridge. During *rooting* activities, this mammal might cause the lost of brood and eggs of birds nesting on the ground such as rock partridge. Also hooded crow (*Corvus cornix*) and other corvids can prey bird nests (es.: Cadiou 1999, Grant *et al*. 1999, Drachmann *et al*. 2002, Erlinge *et al*. 2006, Wallander *et al*. 2006, Zduniack 2006, Draycott *et al*. 2008). Priolo & Bocca (1992) reported an attempt of raven *Corvus corax* preying on rock partridge. Also *Vulpes vulpes* and wandering dogs might cause the lost of rock partridge broods. However, the impact of these generalist predators was not yet investigated adequately by specific studies. The only available data arise from an investigation in the Apennine area of M. Cucco (Umbria region) on the predation/destruction of artificial nest containing *Perdix perdix* eggs (Romano 2009). The lost of clutches (75% of 48 nests) was caused by corvids (16,6%), boar (14.6%), fox (6.2 %), dogs (4.1%), Mustelidae (2%), Rodentia (4.1%), indeterminate species (20.8%), agricultural machines (6.2%).

CONCLUSIONS

The past dramatic decline of Apennine populations of rock partridge is largely known, but very scarce information is available on the current trend of these populations. In some regions a further areale shrinkage was observed in the last 10-15 years.

The collected data in Abruzzo, Lazio, Campania and partially Marche regions, reported in the present contribution may be the base for the future monitoring of local populations. For other regions (mainly Umbria, Basilicata, Calabria), the monitoring should follow an in depth investigation on present population size.

Further studies are absolutely necessary to establish the relative importance of different negative factors affecting Apennine populations. In the meanwhile, actions should be promoted to reduce the impact of factors that already appears to affect negatively the species (habitat fragmentation, poaching). A correct management of populations of Abruzzo region, in particular of local hunting pressure, plays a pivotal role for the conservation of Apennine rock partridge. This region, hosting the bulk of Apennine populations, might represents an important source for their expansion and demographic growth.

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