

Status of rock partridge *Alectoris graeca* in Lazio Region, Central Italian Apennine: six years of monitoring

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Abstract – Data on the presence of the rock partridge were collected in suitable areas of Frosinone and Rieti provinces. The field survey lasted from 2005 to 2011. Suitable areas were investigated with a pre-reproductive (playback) and post-reproductive (with the aid of pointing dogs) census. To avoid under- or double-counting, counts in adjacent areas were performed simultaneously by different teams of censurers. Using the technique of playback in the province of Rieti, 153 territorial males were detected. Between 2005 and 2011, the number of territorial males intercepted varied between 4 and 33 per year. The estimated density in protected areas varied between 0.12 and 0.62 territorial males per km² of area suitable for the species. The estimated density in the hunting areas ranged between 0.12 and 0.45 territorial males per km² of area suitable for the species. In the province of Frosinone, 67 territorial males were counted. The estimated density on Private Hunting Farms bordering Abruzzo Lazio and Molise National Park varied from 0.58 to 0.73 territorial males per km² of area suitable for the species. The estimated density in the hunting areas varied between 0.25 and 0.30 territorial males per km² of area suitable for the species. The density of rock partridge in the region was not quite as high. In the early survey years (2005/2007), we highlighted the limiting factors for the presence of rock partridge. This information allowed for the drafting of a specific action plan for the conservation of the species.

Key-words: *Alectoris graeca*, Lazio Region, density, abundance.

INTRODUCTION

In Europe, where the estimated abundance of rock partridge ranges from 40,000 to 78,000 nesting pairs, the species was recently classified as near threatened because it is likely to undergo a moderately rapid population reduction despite its relatively large population and range (IUCN 2012). In Italy, *Alectoris graeca* is present with disjoint populations in the Apennines, Alps and Sicily. Priolo (1984) separated an Apennine subspecies (*Alectoris graeca orlandoi*) based on morphological characteristics. At present, the genetic differences between Apennine and Alpine populations are not confirmed (Randi *et al.* 2003, Randi 2006). However, in view of the Apennine population's reproductive isolation, it should be considered as a distinct management unit (Moritz 1995, Randi *et al.* 2003).

The Directive 2009/147/EC (on the conservation of birds) identifies the need to protect and conserve habitats

in which species mentioned in Annex I (including the rock partridge) live through the establishment of Special Protection Areas. Additionally, the rock partridge is listed in the National Red List (Peronace *et al.* 2012), but it is included in the list of hunting species both in Law 157/92 as well as Law 17/95 of Lazio Region.

Previously, the rock partridge had a wider distribution range and higher population density compared to the present time (Spanò *et al.* 1985, Brichetti & Massa 1998). Today, the Italian population represents approximately 30% of the world partridge population (Brichetti & Fracasso 2004).

Land cover data indicate that during the last century, the Apennines habitat for the species has been progressively reduced and fragmented (Pelorosso *et al.* 2007a, 2007b, Ripa *et al.* 2011). The species is composed of small and locally isolated nuclei (Petretti 1985, Spanò *et al.* 1985, Amici *et al.* 2011, Sorace *et al.* 2011). Although

several surveys have been carried in the last decade (Brunelli *et al.* 2011, Sorace *et al.* 2011, P. Viola *pers. com.*), many study results have not been shared with the scientific community. This reduces the scientific value of the acquired data and does not contribute to the depiction of a complete picture of the status and dynamics of the species.

The rock partridge has a marked selectivity in the habitat requirements for both the winter and spring-summer (breeding season) seasons (Bernard-Laurent & Laurent 1984, Memoli 2003). This has allowed the development of habitat suitability models (Amici *et al.* 2004) that are both generic for the species (Bernard-Laurent & Leonard 2000, Boitani *et al.* 2002, Amici *et al.* 2011) and for the nesting period (Amici *et al.* 2009, in press).

In this paper, we report an upgrade of the status of the species in the Lazio region using information that was obtained through a six-year monitoring project in the Provinces of Rieti and Frosinone. To ensure the comparability of the results obtained in different areas of the region, density was referred to the suitable habitat for the species (Amici *et al.* 2004).

MATERIALS AND METHODS

In Rieti Province, the monitoring program was established in the Reatini Mountains group and Duchessa and Cicolano Mountains. In the Frosinone province, monitoring was performed in the Ernici Mountains (Ambito Territoriale di Caccia - ATC - FR1) and on private hunting farms adjacent to the National Park of Abruzzo, Lazio and Molise (Serrani *et al.* 2007). The investigated areas were chosen on the basis of a deterministic habitat suitability model (Amici *et al.* 2011). This model includes both the generic habitat suitability model for the species (Amici *et al.* 2004) and the spring-summer habitat (suitability of the site for nesting, proposed by Amici *et al.* 2004; 2011). For the Rieti Province, this procedure revealed a suitable area for the species of approximately 229 km² and a suitable area for nesting of 79 km²; the same data for Frosinone province are approximately 95 km² and 26.2 km², respectively. In both provinces, protected (natural reserves) and unprotected areas (free hunting areas, private hunting farms) were investigated.

The count of the territorial males in the nesting period was performed using the playback technique. Family groups were searched for with the aid of pointing dogs during the late summer/autumn (post-reproductive period). Playback technique has been applied in accordance with the guidelines described by Bernard-Laurent & Laurent (1984) with the modifications introduced by Serrani *et*

al. (2005b). This technique is based on call broadcast of the males along transects in suitable areas for the species. Transects were plotted in two different altitudinal belts. A series of transects at higher altitudes and a second set at lower levels (in areas with lower suitability for nesting) were plotted (Amici *et al.* 2007, 2009).

The equipment used for the vocal emission consists of a digital recorder and a digital loudspeaker (50 W power). The vocalizations were emitted along 200-m-long transects and at each change of mountainside (Bernard Laurent & Laurent 1984). In each location, emissions were broadcasted toward the four cardinal points. Each emission lasted 20 sec for each of the cardinal points, followed by 10 minutes of listening. Each site of emission was georeferenced with a GPS. The position of the reactive males was identified with the polar coordinates (0°-360°), and in cases of sighting, the distance was measured with a range-finder.

Playback data were collected between April 20 and June 15 of each year. Each identified transect was walked at least twice within 20 days. According to literature, emissions were made in the early morning (05:00-12:00), with favourable climatic conditions. The data were collected by a variable number of teams depending on the complexity of the area to be investigated (minimum of two teams). Each team consisted of two operators. In 2010, as a result of unfavourable climatic conditions, and then again in 2011, three teams of operators were engaged.

In the study area, 38 transects were georeferenced and plotted (Tab. 1). In 2008 and 2009, monitoring was performed only in some areas to avoid excessive disturbance of the rock partridges due to the presence of other monitoring teams. Some rock partridge sites are separated by short distances, but they are too far apart to access by ordinary roads (e.g., Colle Alto, Serra, Nuria, Nurietta and Monte Giano). Bernard-Laurent (1988) has shown, with the use of radiotelemetry, that a population of hybrids (*A. graeca* x *A. rufa*) within the French Maritime Alps moved within a range of a few hundred meters to 6.3 km. These findings suggest that mobility of the species among these sites is possible. To limit the possibility of missed or double counts of the males, counts were simultaneously performed on both mountain sides.

The onset of the territorial phase of males is dependent on the climatic conditions (Amici *et al.* 2004, Sorace *et al.* 2009), and the period of maximum reactivity varies each year (Cramp e Simmons 1980, Petretti 1985, Amici *et al.* 2004). For these reasons, a few sample areas were chosen (Amici *et al.*, 2007b, 2009) to detect the presence of reactive males before starting the monitoring plan on a wider scale.

Table 1. Covered kilometres (km) for breeding census of rock partridge in each investigated area. Legal status of each area is also reported.

Area	No. transect	Mileage (km)	Protected area
Province of Rieti			
Pozzoni Mountain	2	5.5	No
Reatini Mountains (including "Terminillo oasis")	6	24.9	Yes/No
Giano Mountain	2	6.4	No
Cicolano Mountain	6	25.9	No
Duchessa Mountains	6	26.5	Yes
Total	22	89.2	
Province of Frosinone			
Ernici Mountain	3	11.3	No
Private hunting farm bordering Abruzzo, Lazio and Molise National Park	7	33.2	No
Total	10	49	

In the post-reproductive period, rock partridge numbers were recorded by transects in areas with good/high suitability for the species with the aid of pointing dogs. The investigated areas included summer and winter areas for the species. The former are found at altitudes above 1600 m a.s.l. (Petretti 1985, Bricchetti & Massa 1998) and the latter between 1000 m a.s.l. and 1600 m a.s.l. (Cattadori *et al.* 2003).

Compared to other standardized methods, the application of this technique confers considerable time savings (Warren 2003). The dogs are carefully chosen among those available (adults, well connected to the conductor and with the certification of Ente Nazionale per la Cinofilia d'Italia).

The task of active searching for rock partridges is entrusted with them (Smith *et al.* 2001, Calladine *et al.* 2002), and the task area ranges within a buffer of 50 m transect from the predetermined path covered by surveyor and conductors. Transects were chosen according to the bibliography; for example, those at higher altitudes were run before those at lower altitudes. The execution of the runs took place in the early morning (06:00 - 09:00; Smith *et al.* 2001) and only on days with mostly clear skies and wind of limited intensity (Thirgood *et al.* 1995).

RESULTS

In Rieti province, with playback technique, 153 territorial males were heard/observed (Tab. 2). Between 2005 and 2011, the number of territorial males intercepted varied between 4 and 33. The estimated density in protected areas

varied between 0.12 and 0.62 males per km² of suitable area. The estimated density in the hunting areas ranged between 0.12 and 0.45 territorial males per km² of suitable area.

In Frosinone Province, monitoring was conducted yearly between 2007 and 2011. During the survey, 67 territorial males were observed (Tab. 2). Surveys conducted in the Private Hunting Farm bordering Abruzzo, Lazio and Molise National Park indicated the presence of 12 - 15 territorial males and an estimated density ranging from 0.58 to 0.73 males per km² of suitable area. In hunting areas of Ernici Mountain, the density varied between 0.25 and 0.30 males per km² of suitable area.

The census using pointing dogs showed poor reliability. These results probably also depended on the low densities of the species. Therefore, the results of the post-reproductive censuses are summarised. In the Reatini Mountains, a total of 22 brigades were observed, composed of 3.6 individuals on average.

DISCUSSION

The comparison between the densities of the rock partridge found in protected *versus* hunting areas indicates that the status of the species is positively correlated with the level of protection of that area (Sorace *et al.* 2011). However, the level of protection is not the only important factor (reviewed below).

The values obtained in this study are comparable to those recorded by Bernard-Laurent & Leonard (2000), but they are lower than the maximum value found in the Alps

by the same authors (Tab. 3). The numerical comparison is, however, complicated by the heterogeneity in the identification of areas of investigation (De Franceschi & Odasso 1998, De Filippo *et al.* 1999, Renzini *et al.* 2001). Standardisation is needed for the census method (frequency of the emission, listening time, number of operating units with respect to suitable surface, etc.).

Despite the cited advantages of using bird dogs in a post-reproductive census (reducing the detection time, the direct involvement of locals in management actions, etc.), the technique has some limitations. For example, the efficiency of the dogs is closely related to the climate and the degree of training. This made it difficult to have homogeneous teams (drivers/dogs) and to characterise them by the ability to standardise and provide constant investigation. Therefore, the usefulness of the technique to determine the reproductive success of species (no. of individuals/brigade) should be assessed.

The low densities of rock partridge recorded in this study may be attributable in general to habitat suitability. The preference of sward with low xeric grassland interrupted by rocky outcrops, rocks, and dwarf shrubs (Petretti, 1985) draws the species to the areas of pasture where food availability is higher. The reforestation of the high pastures

in the province of Rieti began after World War II (Pelorosso *et al.* 2007a). The expansion of forests (Van Gossom *et al.* 2010) with the consequent expansion of wild ungulates (Carnevali *et al.* 2009) has reduced the habitat available for other species (Memoli 2003, Pelorosso *et al.* 2007a) as well as the rock partridge.

According to forecasts of medium-long term, this situation should deteriorate further due to the progression of forest in grasslands (Pelorosso *et al.* 2007b, Sorace *et al.* 2011). Variation due by global warming (Bolli *et al.* 2007, Peñuelas *et al.* 2007) should also be stressed. This phenomenon, reducing the food availability for wild (deer, chamois) and domestic animals (cattle and horses in the pasture), will negatively impact bird populations associated with altitude meadows (Laiolo *et al.* 2004, Tellini-Florenzano 2004).

The negative effects of foxes, hooded crows and dogs (Sorace *et al.* 2011) found in investigated areas may be very important. Recently highlighted, the limiting effect may be due to the presence of the wild boar (Amici *et al.* 2007). The monitoring program conducted in the study area allowed us to highlight the major factors limiting the occurrence of the species: progressive reduction of the use of upland areas by livestock, poaching and predators (Amici

Table 2. Number of males of rock partridge recorded with playback and pre-reproductive density (expressed as number of territorial males/Km² of suitable habitat) of the species in each study area.

Area	number of males						pre-reproductive density					
	2005	2006	2007	2009	2010	2011	2005	2006	2007	2009	2010	2011
Province of Rieti												
Pozzoni Mountain	3	3	2	3	3	2	0.21	0.22	0.18	No data	0.24	0.18
Reatini Mountains	16	21	17		18	17	0.48	0.62	0.55		0.57	0.55
Giano Mountain	3	2	4	1	3	4	0.12	0.08	0.16	No data	0.12	0.16
Cicolano Mountain	3	3	3		5	5	0.31	0.35	0.35		0.45	0.45
Duchessa Mountains	2	4	6				0.12	0.24	0.36			
Province of Frosinone												
Ernici Mountain			3	2	3	3			0.25	0.30	0.30	0.30
Private hunting farm bordering Abruzzo, Lazio and Molise National Park			12	15	14	15			0.73	0.58	0.69	0.58

Table 3. Density values reported in literature.

Density	Units	Source
1.85	Territorial males km ⁻²	Renzini <i>et al.</i> 2001
0.3-4.7	males/ km ⁻²	Bernard-Laurent and Leonard 2000 (Alps)
1.4-1.7	pairs/ km ⁻²	Spanò <i>et al.</i> 1985
5.4-8.0	males/ km ⁻²	Bocca 1990*

et al. 2007, 2011, Serrani et al. 2005b, Sorace et al. 2011). These all represent phenomena that are not easily counter-balanced (Serrani et al. 2005b). The investigations have led to the first draft of the management needs for the conservation of the rock partridge in Central Apennines (Amici et al. 2007). This document represents a milestone to set future management decisions that, in addition to the hunting ban, should increase habitat suitability for the species. Finally, the lack of coordination between various working groups that operate simultaneously in the same area should be avoided because it represents a waste of energy and resources as well as the unnecessary duplication of the same investigation.

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