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MONITORING AND MANAGEMENT OF COMMON QUAIL *COTURNIX COTURNIX* POPULATIONS IN THEIR ATLANTIC DISTRIBUTION AREA

SEGUIMIENTO Y GESTIÓN DE LAS POBLACIONES DE CODORNIZ COMÚN *COTURNIX COTURNIX* EN SU ÁREA DE DISTRIBUCIÓN ATLÁNTICA

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Summary.—The common quail *Coturnix coturnix* has suffered a large historical decline. Portuguese, Spanish and French populations remain stable, but some evidence suggests declines in Spain and France. During 2005-2009, we carried out a monitoring programme in Morocco, Portugal, Spain and France to determine the status of common quail populations using a census methodology based on: a) a census of calling males; b) capture and ringing; and c) monitoring during harvesting. Results suggest that during

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the study period populations remained fairly constant. This monitoring allowed us to categorise the sampled areas in three types, with different management and conservation implications.

RESUMEN.—La codorniz común *Coturnix coturnix* ha sufrido un declive histórico. Aunque las poblaciones portuguesas, españolas y francesas permanecen estables, algunas evidencias sugieren una disminución en España y Francia. Se ha efectuado un seguimiento durante 2005-2009 en Marruecos, Portugal, Francia y España para determinar el estatus de la codorniz común con una metodología de censo basada en: a) censo de machos cantores; b) captura y anillamiento; c) seguimiento durante la siega. Los resultados sugieren que, durante el período de estudio, la población permanece estable. El seguimiento ha permitido definir las áreas muestreadas en tres categorías con diferentes implicaciones en materia de manejo y conservación.

The common quail *Coturnix coturnix* is a migratory Galliform species that belongs to the Phasianidae family, with a distribution area encompassing the Western Palearctic, and Western and Central Asia (Gallego *et al*., 1997). Four populations differing in migratory routes have been described (Guyomarc'h, 2003):

a) The flow through the high valley of the Indus.
b) The Arabian flow.
c) The Apeninian flow.
d) The flow through the Atlantic coast (Morocco-Iberian Peninsula-France).

Currently, the species is considered to have an unfavourable conservation status in Europe (SPEC 3), with depleted populations and a large historical decline (Burfield, 2004). In comparison to the 1990s (Tucker and Heath, 1994; Heath *et al*., 2000), populations in Northern and Central Europe have increased, whereas a decline in Southeast Europe has continued. The current total population estimate is probably lower than before the decreases that occurred during 1970-1990.

In terms of the Atlantic population, Burfield (2004) suggested that Portuguese, Spanish and French populations were stable. In agreement with this suggestion, a long Spanish data series of hunted individuals or males censused during the breeding season revealed no significant trends (Puigcerver *et al*., 2004). In addition, no significant trends were found in Portugal during 1993-1997 (Fontoura and Gonçalves, 1998). However, some data from France and Spain are in conflict with these results. The French Office National de la Chasse et de la Faune Sauvage carried out two national hunting surveys, one in 1983 (Ferrand, 1986) and another in 1998. In the first survey, 640,000 (± 2.6%) individuals were shot, whilst in the second only 341,130 (± 5.2%) were shot, representing a decrease of almost 50% in 15 years. In Spain, the SACRE programme (carried out by SEO/BirdLife to monitor the most common breeding bird species in Spain) shows a population decline in the 1998-2006 period, with an annual decline of -6.8% (Del Moral *et al*., 2008). Moreover, distribution data from two Catalan Ornithological Atlas (Northeast Spain) data series covering the 1975-1983 (Muntaner *et al*., 1983) and 1999-2002 periods (Estrada and Pedrocchi, 2005) suggests that the species suffered a significant reduction in its distribution, of 26.5% of the total UTM 10 x 10 km^2 sampled.

Such contradictory data are probably due to the fact that the common quail is an extremely mobile species that shows migratory movements, nomadic movements in search of suitable but ephemeral habitats, and male movements in search of available females

(Rodríguez-Teijeiro *et al*., 2006). It is very difficult to obtain reliable quail population estimates due to this high mobility, which results in a male turnover ratio of almost 95% in less than 15 days in the breeding areas (Rodríguez-Teijeiro *et al*., 1992). Moreover, the breeding cycle activities of the common quail occur in dense winter cereal crops, such as wheat and barley, and are almost invisible to the eyes of the observer.

It is very difficult to determine population status in these conditions. However, the generation of reliable population estimates for bird species is an important step towards determining their conservation status and developing appropriate conservation policies (IUCN, 2001). Moreover, population monitoring is a top priority action recommended by the European Union Management Plan for the common quail (Guyomarc'h, 2003).

The aim of this study was to monitor common quail populations during 2005-2009 in four countries (Morocco, Portugal, Spain and France) considered key to the Atlantic population (Guyomarc'h, 2003). The results were used to determine the current status of common quail populations by providing a new census methodology.

The monitoring programme was carried out in 11 breeding sites (figure 1), located in France (3 sites), Spain (5 sites), Portugal (2 sites) and Morocco (1 site) during the period 2005-2009.

This monitoring programme was based on the collection of three different types of data:

1. Censuses of calling males throughout the breeding season, which was slightly different in each study area. They were carried out once a week at 10 listening points. The aim was to determine the phenology of the species and to estimate the density of individuals, which was expressed as the number of individuals that were censused/sampled days at these ten listening points, together with the maximum number of censused males in one sampling day for every site. At every listening point, the observer waited for two minutes to count the number of males that spontaneously called the tri-syllabic advertising song. After this procedure, the observer used a digital tape decoy to emit a female call for 20-30 seconds, to stimulate any silent males present at the listening point. The advertising call of males can be heard at a distance of 1 km in favourable conditions. Therefore, only the males within the radius that the digital tape decoy could be heard, i.e. the males that could interact with the decoy, are included. Listening points were far enough from each other (500 to 800 m) to prevent overlap in the areas over which the decoys could act and to minimise the number of individuals counted twice.
2. Capture and ringing of some of the censused males that had been detected by the method above. Quails were captured by spreading a 10 x 12 m net horizontally over the cereal plots in which they had been detected acoustically from the margin. Males were called with a tape playing the female call that attracts them. When they were under the net, we forced them to fly so that they were trapped in the net. This method can be used to capture almost 50% of the individuals previously censused, once the researcher has acquired a certain degree of experience (Gallego *et al*., 1993). Individuals were ringed as soon as they had been captured, and the age (following the Euring codes) of the individuals was determined by their moult and throat colour pattern.
3. Monitoring adults and broods during harvesting. As the breeding cycle activities occur inside dense cereal

crops, the only way to find out more precisely how many adults and broods remain inside a plot is to make careful observations during complete habitat destruction by machines during harvesting. One observer is stationed inside the machine and notes how many individuals are lifted by it. Two other observers remain in the plot and note the number of quails that the machine forces to fly that land in the non-harvested part of the plot, as well as those that land on the edge of the plot and enter the non-harvested part again. The aim of these procedures is to avoid double-counting individuals.

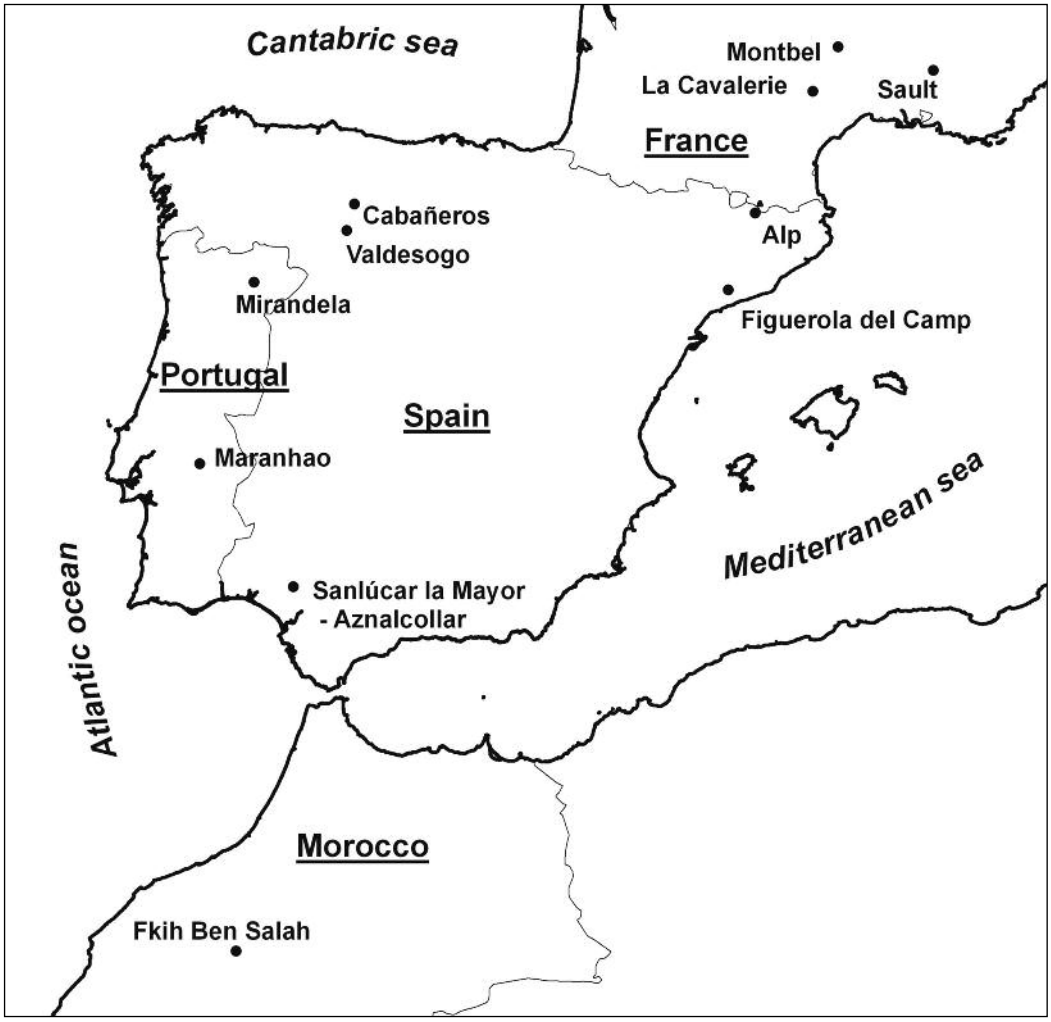

FIG. 1.—Geographical location of the 11 sampled breeding sites.
[Localización geográfica de los 11 lugares de reproducción muestreados.]

The first two data collection methods were employed by all teams in the different study areas, whereas the monitoring of broods and adults during mowing was carried out only in Spanish and French breeding sites.

From these data, we calculated an annual average of the weekly abundance index of male quails throughout the breeding season as well as the maximum number of censused males in one sampling day for every site. Moreover, captures allowed us to verify that constant arrivals and departures of males throughout the breeding season is a general pattern in all the studied areas, and harvesting monitoring allowed us to determine breeding success in different study areas. Linear regression analyses (SPSS v.16) were used in the analyses (dependent variables: abundance index and maximum number of censused males; independent variable: year) to check whether the slope was significantly different from zero.

Table 1 shows the abundance index of calling males and the maximum number of censused males in one sampling day for each site; both variables gave similar results for all

TABLE 1

Average of the weekly number of males detected (first rows), its standard deviation (second rows), maximum number of censused males in one sampling day throughout the breeding season (third rows) and sampled days throughout the breeding season (fourth rows) at each site sampled during the 2005-2009 period. We include an average of this period for each study area, together with a European, and a Moroccan plus European average.

[Media aritmética del número semanal de machos detectados (primer valor de las celdas), su desviación típica (segundo valor de las celdas), número máximo de machos censados en un día de muestreo durante el período reproductor (tercer valor de las celdas) y número de días de muestreo durante la época reproductora (cuarto valor de las celdas) de los lugares muestreados durante el período 2005-2009. Se incluye un valor promedio de este período para cada área de estudio, junto con un promedio general para Europa y para el conjunto de Europa y Marruecos.]

Site	**2005**	**2006**	**2007**	**2008**	**2009**	**Total**
Fki-Ben-Salah (Morocco)	36.8	29.2	33.8	39.5		**34.8**
	5.7	17.6	3.9	15.5		**10.7**
	50	130	93	52		
	6	12	15	13		
Figuerola del Camp (Spain)	0.5	4.5	4.4	8.5	7.7	**5.1**
	0.7	2.8	4.2	6.1	8.8	**4.5**
	2	9	11	17	24	
	11	11	14	19	13	
Alp (Spain)	28	13.4	26.5	18.0	37.9	**24.8**
	5.1	9.6	14.8	10.8	9.1	**9.9**
	40	32	48	31	61	
	10	13	11	13	13	

TABLE 1 (cont.)

Site	2005	2006	2007	2008	2009	Total
Sanlúcar la Mayor-Aznalcóllar (Spain)		21.3	20.9	15.2	8.5	**16.5**
		13.5	7.1	9.6	5.0	**8.8**
		41	35	35	19	
		18	23	11	14	
Valdesogo (Spain)		2.1	12.8			**7.4**
		2.0	11.5			**6.8**
		10	11			
		14	10			
Cabañeros (Spain)			27.4	23.8	7.4	**19.5**
			14.6	8.3	3.5	**8.8**
			53	31	15	
			7	10	8	
Maranhao (Portugal)		14.4	11.5	14.9	10.6	**12.9**
		5.6	5.8	5.8	10.4	**6.9**
		20	19	22	28	
		5	9	9	5	
Mirandela (Portugal)			7.8	10.6	7.0	**8.5**
			3.3	6.2	4.1	**4.5**
			15	19	14	
			8	10	10	
Sault (France)		5.6	9.8	4.27	6.2	**6.5**
		4.9	5.9	2.1	4.0	**4.2**
		15	17	8	14	
		14	9	11	10	
La Cavalerie (France)		4.2	5.2	10	11.1	**7.6**
		1.4	2.6	3.9	6.3	**3.6**
		6	9	18	21	
		9	12	10	11	
Montbel (France)		15.4	12.9	10.7	14.5	**13.4**
		7.6	8.4	5.9	12.8	**8.7**
		24	23	20	44	
		9	9	13	13	
Total: Morocco and Europe						**14.3**
						9.2
Total: Europe						**12.2**
						3.3

the sampled sites; for this reason, only results using the abundance index of calling males are presented. This index was constant throughout the 2005-2009 period, except at Figuerola del Camp (regression coefficient = 1.86, standard error = 0.46, $R^2 = 0.84$, $F_{1,3} = 16.02$, $P < 0.05$) and La Cavalerie (regression coefficient = 2.55, standard error = 0.53. $R^2 = 0.92$, $F_{1,2} = 23.10$, $P < 0.05$). The same stability was found when we calculated an average for each sampled country and an overall average using data from sites sampled for more than two years (representing the Atlantic population as a whole). These data strongly suggest that the Atlantic population has remained fairly constant in recent years, as suggested in Burfield (2004) and in contrast to the findings of Ferrand (1986), Del Moral *et al*. (2008), Muntaner *et al*. (1983) and Estrada and Pedrocci (2005).

The abundance index, which was calculated from the general average for each sampled site, ranged from 5.1 (Figuerola del Camp, Spain) to 34.8 (Fki-Ben-Salah, Morocco). This latter breeding site had an extremely high abundance index, over three times higher than that of the European sampled sites overall (mean ± SE: 12.20 ± 3.20). This may indicate that the irrigated perimeters of Morocco constitute an excellent habitat for the species, although other variables such as hunting pressure, the low level of mechanisation of agricultural practices, geographic location or climate could also have an influence on abundance.

Capture and ringing allowed us to observe that some fully-grown Euring code 3 yearlings were captured in some European breeding sites too early in the breeding season to be born in the site in which they were captured (hereafter precocial yearlings). As the laying period averages 10-11 days, incubation lasts 18 days and the period of chick growth to nearly adult size lasts a minimum of 47 days (see Puigcerver, 1990), yearlings captured in less than 75 days from the date of first arrivals were considered precocial. These data (see table 2), together with the detection of broods during harvesting monitoring, allowed us to define the sampled sites into three categories:

- Passage sites: male quail, including some precocial yearlings, are detected in these areas. However, as in the case of Figuerola del Camp (Spain), reproduction usually does not occur or it is very rare (pers. obs. over the last 28 years). This probably occur because individuals do not have enough time for breeding, as harvesting destroys the ephemeral and suitable habitat needed for reproduction too early in the season.
- Breeding sites: male quails are detected in these areas, reproduction occurs but almost no precocial yearlings are detected. When they are detected, they do not exceed 45% of the total number of captured yearlings. This is the case in Fki-Ben-Salah (Morocco), Sanlúcar la Mayor-Aznalcóllar (Spain), Cabañeros (Spain) and Maranhao (Portugal).
- Breeding and reception sites: male quails are detected in these areas, reproduction occurs and a high percentage of precocial yearlings that have been born in southern latitudes are detected as well. This is the case in Alp (Spain), Mirandela (Portugal), La Cavalerie (France), Sault (France) and Montbel (France).

We consider that categorising specific quail areas has major consequences in terms of management and conservation. Breeding and reception sites deserve special attention, as they hold not only the results of reproduction in the area, but also yearlings born in more southern latitudes. Passage sites in which reproduction does not occur might be easily transformed into breeding sites, which would increase the productivity of the species. This could be achieved by implementing agricultural and environmental policies that delay mowing and lengthen the biological cycle of

TABLE 2

Broods and precocial yearlings detected in the sampled sites. –: no data collected; *: evidence of reproduction with no knowledge of the number of broods, detected by the presence of yearlings born in the study area; P: passage site; B+R: breeding and reception site; B: breeding site. B+R?: likely breeding and reception site in which no precocial yearlings have been captured. In bold type: percentage of precocial yearlings of all yearlings captured.
*[Polladas y jóvenes del año precoces detectados en las áreas de muestreo. –: no se colectaron datos; *: evidencia de reproducción sin conocer el número de polladas, detectado por la presencia de jóvenes del año nacidos en el área de estudio; P: lugar de paso; B+R: lugar de reproducción y recepción; B: lugar de reproducción. B+R?: probable lugar de reproducción y recepción en el cual no se han capturado jóvenes del año precoces. En negrita: porcentaje de jóvenes del año precoces con respecto al total de jóvenes del año capturados.]*

Site	**Broods**					**Precocial yearlings**					**Category**
	2005	**2006**	**2007**	**2008**	**2009**	**2005**	**2006**	**2007**	**2008**	**2009**	
Figuerola Camp	0	2	0	11	8	0	0	1 **100**	2 **13.3**	2 **66.7**	P
Alp	26	19	9	13	38	8 **80**	6 **85.7**	5 **100**	3 **17.6**	57 **64**	B+R
Fki-Ben-Salah	*	*	*	*	–	0	0	2 **7.1**	0	–	B
Sanlúcar la Mayor-Aznalcóllar	–	1	15	6	3	–	0	0	2 **33.3**	3 **42.9**	B
Cabañeros	–	–	13	13	1	–	–	1 **12.5**	0	4 **80**	B
Maranhao	–	*	*	*	*	–	0	0	0	5 **100**	B
Mirandela	–	–	*	*	*	–	–	3 **100**	1 **100**	1 **100**	B+R
La Cavalerie	–	*	*	*	2	–	0	3 **75**	11 **91.7**	22 **84.6**	B+R?
Sault	–	21	7	*	16	–	2 **100**	2 **100**	1 **100**	2 **100**	B+R
Montbel	–	3	4	3	5	–	7 **100**	3 **100**	3 **60**	38 **100**	B+R

cereals. In 2008, meteorological conditions in Figuerola del Camp caused a delay in harvesting and 11 broods were detected, whereas only two broods were found in the previous three years. In addition, the length of stays (usually 50-70 days) exceeded 132 days in 2008, the habitat was much improved in 2009 (with higher and more dense winter cereal crops than usual) and 8 broods were detected, suggesting that habitat management may be an excellent tool for increasing common quail populations.

In conclusion, the results clearly show that the Atlantic population of common quail has remained stable over the past five years, in spite of marked interannual fluctuations. This result, which should be interpreted with caution due to the low sample size, agrees with the lack of trends found in much longer data series (see Puigcerver *et al*. 2004), thus suggesting that the Atlantic common quail population remains stable. Habitat seems to be a key factor for the species, as strongly suggested by the extremely high abundance index for the Moroccan irrigated perimeter, compared to European populations, and the extraordinary change in productivity observed in Figuerola del Camp in 2008 as a consequence of the delay in habitat destruction caused by harvesting. Finally, it is important to categorise common quail areas (as passage sites, breeding sites or breeding and reception sites) in order to design the most suitable management and conservation measures at local scales, based on the agricultural and meteorological conditions found at each site.

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BIBLIOGRAPHY

BURFIELD, I. 2004. *Birds in Europe. Population estimates, trends and conservation status*. BirdLife Conservation Series No. 12. BirdLife International. Cambridge.

DEL MORAL, J. C., ESCANDELL, V., MOLINA, B., BERMEJO, A. and PALOMINO, D. (Eds.) 2008. *Programas de seguimiento de SEO/BirdLife en 2006*. SEO/BirdLife. Madrid.

ESTRADA, J. and PEDROCCHI, V. (Eds.) 2005. *L'Atles dels ocells nidificants de Catalunya 1999-2002*. Institut Català d'Ornitologia and Lynx Edicions. Barcelona.

FERRAND, Y. 1986. Le prélèvement cynégétique de cailles des blés en France, saison 1983-1984. *Bulletin Mensuel Office National de la Chasse*, 108: 43-45.

FONTOURA, A. P. and GONÇALVES, D. 1998. Contribuição para o conhecimento do estaturo da codorniz *Coturnix coturnix* L. 1758 em Portugal. *Ciência e Natureza*, 2: 79-87.

GALLEGO, S., PUIGCERVER, M. and RODRÍGUEZ-TEIJEIRO, J. D. 1997. Quail *Coturnix coturnix*. In, W. J. M. Hagemeijer and M. J. Blair (Eds.): *The EBCC atlas of European breeding birds: their distribution and abundance*, pp. 214-215. T & A D Poyser. London.

GALLEGO, S., RODRÍGUEZ-TEIJEIRO, J. D. and PUIGCERVER, M. 1993. Descripción de la eficacia del método de captura de codorniz (*Coturnix c. coturnix*) con reclamo. *Alytes*, 6: 429-436.

GUYOMARC'H, J. C. 2003. Elements for a common quail (*Coturnix c. coturnix*) management plan. *Game & Wildlife Science*, 20: 1-93.

HEATH, M., BORGREVE, C., PEET, N. and HAGEMEIJER, W. J. M. 2000. *European birds populations, estimates and trends*. BirdLife Conservation Series No. 10. BirdLife International. Cambridge.

IUCN 2001. *Red list categories and criteria. Version 3.1*. IUCN Species Survival Commission. IUCN. Gland.

MUNTANER, J., FERRER, X. and MARTÍNEZ-VILALTA, A. 1983. *Atlas dels ocells nidificants de Catalunya i Andorra*. Ketres Ed. Barcelona.

PUIGCERVER, M. 1990. Contribución al conocimiento de la biología y ecoetología de la codorniz (*Coturnix coturnix*). Tesis doctoral. Universidad de Barcelona. Barcelona.

PUIGCERVER, M., RODRÍGUEZ-TEIJEIRO, J. D., and GALLEGO, S. 2004. Codorniz común. In, A. Madroño, C. González and J. C. Atienza (Eds.): *Libro rojo de las aves de España*, pp. 189-193. Dirección General para la Biodiversidad and SEO/BirdLife. Madrid.

RODRÍGUEZ-TEIJEIRO, J. D., BARROSO, A., GALLEGO, S., PUIGCERVER, M. and VINYOLES, D. 2006. Orientation cage experiments with the European quail during the breeding season and autumn migration. *Canadian Journal of Zoology*, 84: 887-894.

RODRÍGUEZ-TEIJEIRO, J. D., PUIGCERVER, M. and GALLEGO, S. 1992. Mating strategy in the European quail *Coturnix c. coturnix* revealed by male population density and sex ratio in Catalonia, Spain. *Gibier Faune Sauvage*, 9: 377-386.

TUCKER, G. M. and HEATH, M. 1994. *Birds in Europe: their conservation status*. BirdLife Conservation Series No. 3. BirdLife International. Cambridge.

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