

Status, conservation and habitat selection of the Houbara Bustard *Chlamydotis undulata fuertaventurae* on Lanzarote (Canary Islands)

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Summary

A Houbara survey of Lanzarote and the small island of Graciosa, during December 1993, resulted in a total count of 146 birds and an estimated total population of about 400 Houbaras. These numbers are higher than found on most previous surveys of Fuerteventura, considered as the main stronghold of this subspecies, and indicate that the Houbara population on Lanzarote is much more important than was formerly supposed. A study of habitat preferences showed that the species tended to select zones with greater height of shrubs.

Un censo de hubaras efectuado en las islas de Lanzarote y Graciosa, en diciembre de 1993, permitió contabilizar un total de 146 aves y estimar la población en alrededor de 400 hubaras. Estos resultados son superiores a la mayoría de los datos obtenidos hasta la fecha en la vecina isla de Fuerteventura, considerada como el principal refugio de la especie en el archipiélago canario. Lanzarote es pues una isla que mantiene efectivos mucho más importantes que los supuestos hasta la fecha. En cuanto a las preferencias de hábitat, las aves seleccionaron aquellas zonas que presentaban una mayor altura de la vegetación.

Introduction

The Canarian Houbara Bustard *Chlamydotis undulata fuertaventurae* is the most endangered of the three Houbara subspecies. Currently it is restricted to the eastern Canary Islands (Fuerteventura, Lanzarote and Graciosa) but in the past has been reported as occasional on Gran Canaria (Meade-Waldo 1893). Fuerteventura has always been considered the main stronghold of the species in the archipelago (Webb *et al.* 1842, Meade-Waldo 1893, Thanner 1913 *vide* Collar 1983), so that most of the conservation measures recently adopted have been focused on that island.

In 1971 hunting was forbidden. In 1979 an ICBP expedition to Fuerteventura estimated a population of 80–100 Houbaras on that island and perhaps 15–20 on Lanzarote (Lack 1983). In 1985 a previous recovery plan was updated and enlarged (Domínguez and Díaz 1985). Under the plan, several annual censuses on Fuerteventura and one on Lanzarote (April 1991) were carried out

(Ornistudio 1989a,b, 1990, 1991, 1992). A total of 60–67 birds were then observed on Lanzarote. In addition, breeding was confirmed in 1990 on the small island of Graciosa (D. Concepción verbally).

The aims of this paper are to present the results of a new census of Houbara Bustard on the islands of Lanzarote and Graciosa and to describe the habitat preferences of the species.

Study area

Lanzarote, the most eastern island of the Canarian archipelago, lies some 140 km west of Africa at 29°02'N 13°38'W and covers an area of 862 km². It is separated from the small island of Graciosa (27 km²) by a narrow channel hardly 1 km wide.

Lanzarote is quite dry, with semi-arid vegetation (*Launaea arborescens*, *Suaeda* spp., *Salsola* spp., *Euphorbia* spp., etc.). The island is covered by recent lavas and some sandy and stony plains and is very fragmented by intensive cultivation.

Material and methods

Census

The Houbara population of Lanzarote was surveyed between 4 and 16 December 1993. Only one day (10 December) was dedicated to Graciosa.

As a method of census a multiple line transect was employed. Four to six observers, spaced 200 m apart, walked the selected areas, at an average speed of 1.5 km/h, during the first hours of the day. Each person recorded all the Houbaras seen but especially those within 100 m either side of his transect. As every member of the team was equipped with a 1 : 25,000 map and a small radio, the possibility of duplicating records was minimized.

To select the location of the transects we used information from Collar (1983), Ornistudio (1991), local knowledge and experience gained by a member of our team from a previous visit (August 1993). We undertook 11 transects, 10 on Lanzarote and one on Graciosa (Figure 1). Altogether the transects covered a total distance of 43.2 km, so that the surveyed area comprised 45.9 km².

In addition, during the afternoon we prospected some places by vehicle, mainly cultivated and marginal areas.

Habitat

Three main groups of variables were considered: ground structure, vegetation (cover, height and dispersion), and livestock abundance. Random sample sites of the different variables were selected in transverse lines across the Houbara survey transects.

Three main structural ground components were distinguished: large stones (> 7 cm), medium-size stones (6.9–2 cm) and small particles (< 2 cm). Cover of these components was measured by using a quadrat of 1 m². Vegetation cover was studied by the line-intercept method (50 m length) (Kent and Coker 1992). With respect to the dispersion and height of the vegetation, only plants

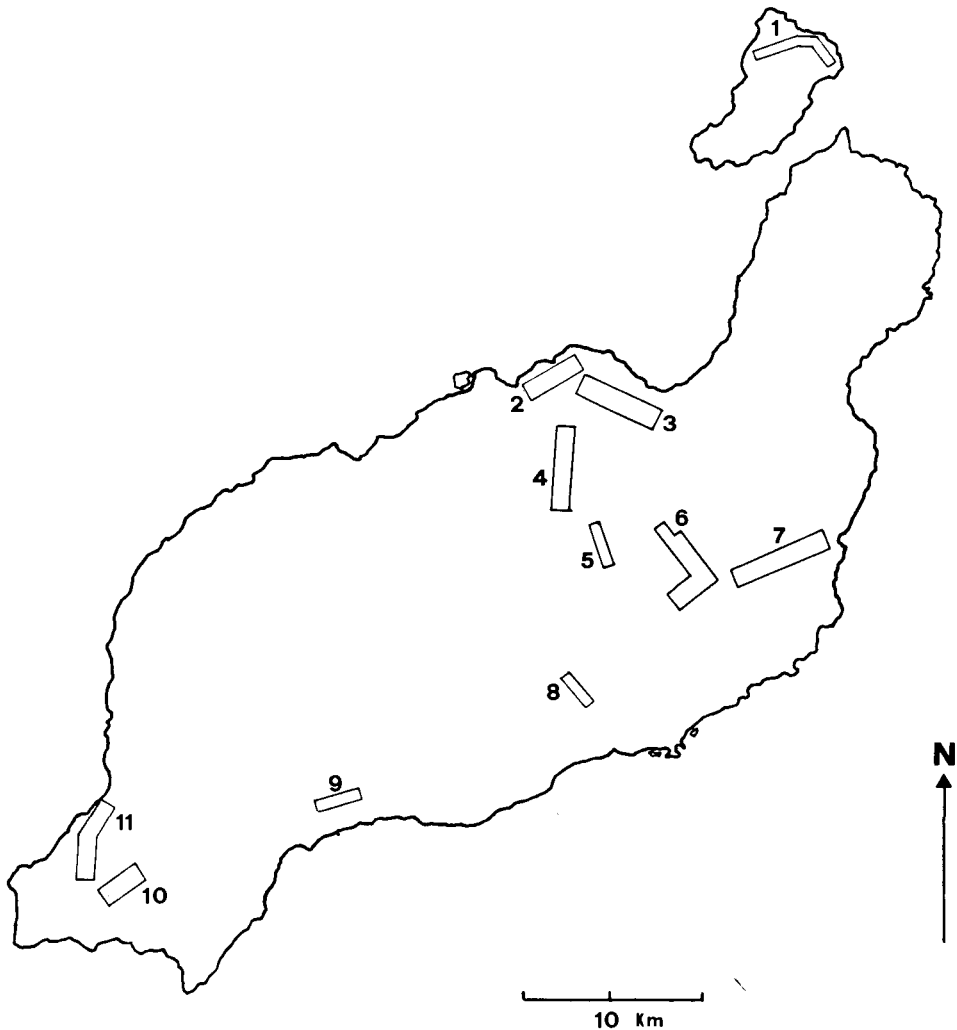


Figure 1. Locations of the transects on Graciosa and Lanzarote. 1, Graciosa; 2, Jable de Caleta del Caballo; 3, Jable de Famara; 4, Jable de S60; 5, Jable de Vuelta Jai; 6, Tahiche-Guanapay; 7, Reserva de Guatiza; 8, Argana; 9, Cortijos Viejos; 10, El Terminillo; 11, Llanos de las Maretas.

higher than 25 cm were considered since this height permits refuge for a Houbara. In units of 200 m, we measured at every 25 m the height of the nearest plant and also distances from this to the other five nearest plants.

Sample sizes of the different variables were proportional to the censused area. In the largest area (~4–5 km long) sample sizes were 40 for ground, 600 m for vegetation cover, 320 for dispersion distances, and 64 for shrub heights. A total of 345 ground samples, 4,800 m of transect line vegetation cover, 2,680 dispersion distances and 586 plant heights were taken.

Livestock abundance was considered as the number of goats and sheep observed while censusing.

Table 1. Area, length, number and densities of Houbaras in each of the transects

No.	Transects	Length (km)	Area (km ²)	No. birds		No. birds/km ²
				Min	Max	
1	Graciosa	5.3	4.2	15	17	3.6
2	Jable de Caleta del Caballo	4.0	4.8	3	4	0.6
3	Jable de Famara	4.0	4.8	15	18	3.1
4	Jable de Sóo	5.1	6.1	7	7	1.1
5	Jable de Vuelta Jai	2.0	1.6	12	12	7.2
6	Tahiche-Guanapay	5.6	6.6	30	33	4.5
7	Reserva de Guatiza	4.7	5.4	17	19	3.1
8	Argana	2.9	2.3	3	3	1.3
9	Cortijos Viejos (Playa Quemada)	2.7	2.2	4	5	1.8
10	El Terminillo (Playa Blanca)	2.9	3.5	2	2	0.6
11	Llanos de las Maretas (Rubicón)	4.0	4.4	10	10	2.3

Statistical analysis

A principal components analysis (PCA) was used to organize the information on the variables (ground, vegetation and livestock) as a function of location.

To determine which structural variables may affect the spatial distribution of the birds, correlations were carried out between each variable and Houbara densities. Because of the small number of localities studied, it was considered inappropriate to use a multivariate regression method (Peña 1992).

Results

Census

The results of the transect surveys are shown in Table 1. Highest densities of Houbara were found in Jable de Vuelta Jai and Tahiche-Guanapay, while the lowest densities were recorded in Jable de Caleta del Caballo and El Terminillo. The minimum number of Houbaras recorded inside the transects was 118 (103 on Lanzarote and 15 on Graciosa) (Table 2). A total of 33 birds was observed from vehicles, of which probably 20 had not been previously counted (19 on Lanzarote and one on Graciosa). In other situations, we detected a further eight different individuals.

To determine the total Houbara population of Lanzarote from the transect data we estimated the total area of suitable habitat. During fieldwork the boundaries of two kinds of area were defined, primary habitat (seemingly the most suitable) and marginal habitat. Table 3 shows measurements of both areas, obtained by using a computer planimeter on a 1 : 25,000 map. The main zones for Houbaras on Lanzarote and Graciosa are marked on Figure 2. On Lanzarote the available habitat for the species was about 160 km², while the transected area comprised 41.8 km² (26.1%). The total estimate of the island population was derived from previous estimates in each of the five areas represented on Figure 2.

Table 2. Total number of Houbaras (maximum and minimum values) recorded on Graciosa and in different localities of Lanzarote

Localities	Transects		Out of transects	Vehicle	Total
	Min	Max			
Graciosa	15	17	0	3(1)	16–18
Jable de Caleta del Caballo	3	4	3	–	6–7
Jable de Famara	15	18	1	–	16–19
Jable de Sóo	7	7	1	–	8
Jable de Vuelta Jai	12	12	2(0)	–	12
Tahiche–Guanapay	30	33	0	7(0)	30–33
Reserva de Guatiza	17	19	0	9(6)	23–25
Argana	3	3	0	0	3
Cortijos Viejos (Playa Quemada)	4	5	0	0	4–5
El Terminillo (Playa Blanca)	2	2	1	–	3
Llanos de las Maretas (Rubicón)	10	10	2(1)	–	11
M ^a Roja (Rubicón)	–	–	0	4	4
La Casilla (Rubicón)	–	–	0	4	4
Casa de Masión–Papagayo	–	–	0	2	2
Hoya del Huerto (Jable de Sóo)	–	–	1	0	1
Llano de Zonzamas	–	–	0	3	3
Llano de Salinas del Río (Famara)	–	–	0	0	0
Llanos de Mala–Arrieta	–	–	0	0	0
Jable del Medio (Mala)	–	–	0	0	0
Tinajo	–	–	0	0	0
Vega de San José (Teguise)	–	–	0	0	0
Güime	–	–	0	0	0
Total	118	130	8	20	146–158

Numbers in brackets represent probable non-duplicated birds

Table 3. Transect areas and potential habitat of the Houbara on Graciosa and Lanzarote

Areas	Primary habitat (km ²)	Marginal habitat (km ²)	Total habitat (km ²)	Transected area	
				(km ²)	%
Graciosa	17.3	0.0	17.3	4.2	24.1
Argana	0.0	9.0	9.0	2.3	25.5
Famara–Sóo–Zonzamas	68.8	9.9	78.7	17.4	22.1
Guanapay–Tahiche–Honduras	23.8	12.7	36.5	12.1	33.1
Playa Quemada	2.1	2.6	4.7	2.2	47.1
Rubicón–Playa Blanca	20.4	10.3	30.7	7.8	25.5

Famara–Sóo–Zonzamas A mean density of 3.0 birds/km² from four transects (Jable de Famara, Jable de Sóo, Jable de Caleta del Caballo and Jable de Vuelta Jai) was applied exclusively to this area of primary habitat, yielding a total of 206 birds.

Guanapay–Tahiche–Honduras A mean density of 3.8 birds/km² for the primary habitat was obtained from the two transects Tahiche–Guanapay and Reserva de Guatiza. For marginal habitat we used a density of 2.1 birds/km² calculated from the last part of transect Tahiche–Guanapay. We estimated 117 Houbaras.

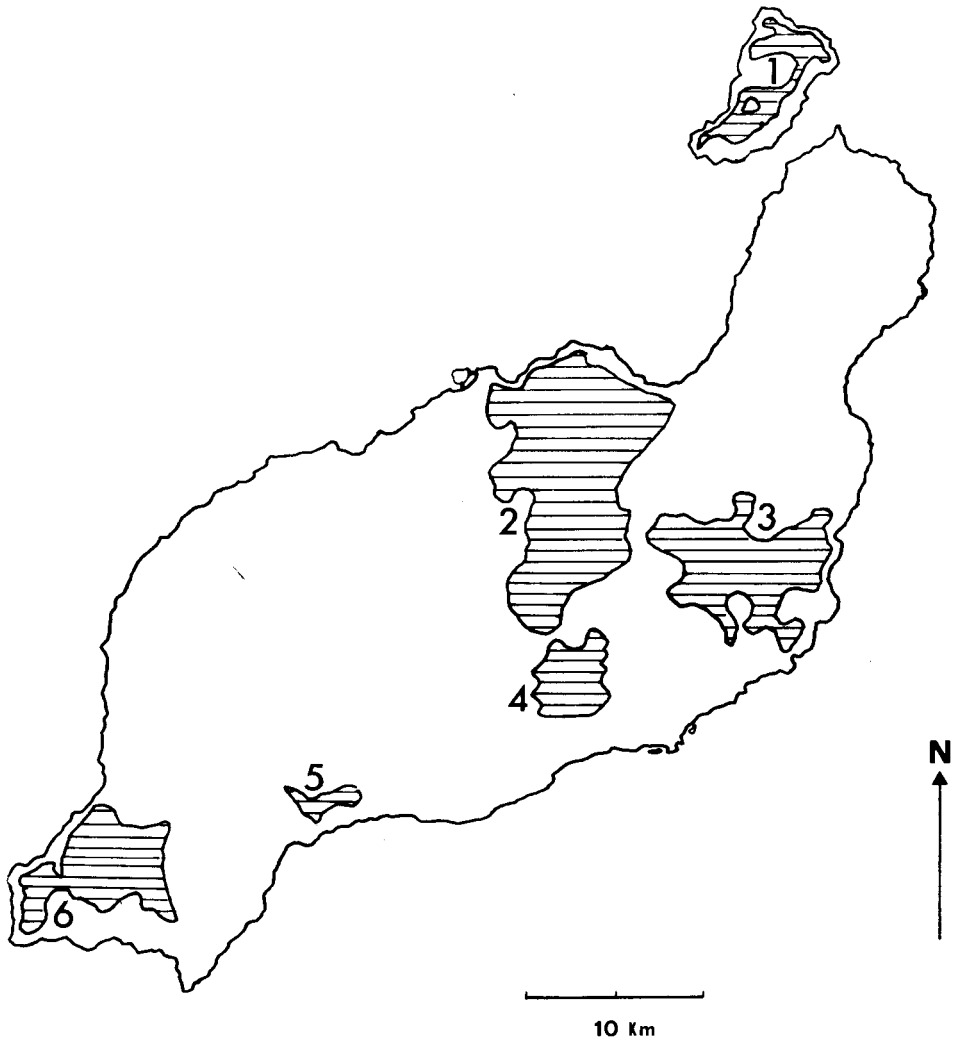


Figure 2. Main areas of Houbaras on Graciosa and Lanzarote. 1, Graciosa; 2, Famara-Sóo-Zonzamas; 3, Guanapay-Tahiche-Honduras; 4, Argana; 5, Playa Quemada; 6, Rubicón-Playa Blanca.

Argana The entire area was considered marginal, so we used a density of 1.3 birds/km² from the only transect and estimated 12 birds.

Playa Quemada We applied the density of 1.8 birds/km² from the only transect (Cortijos Viejos) to the total area, estimating nine Houbaras.

Rubicón-Playa Blanca We used a density of 2.3 birds/km² (transect Llanos de las Maretas) for the primary habitat, and 0.6 birds/km² (transect El Terminillo) for the marginal habitat, estimating 53 birds.

From these calculations, we estimated the Houbara population of Lanzarote at nearly 400 birds.

On Graciosa the only transect (in the northern part) yielded a density of 3.6 birds/km². The estimate of 62 Houbaras seems excessive because the species is apparently mainly distributed in the north but we were unable to survey the south of the island.

Habitat variables

The first two components of the PCA explained 61.7% of the variance (Figure 3). The positive values of Component 1 are represented by the central localities with a northern orientation and more humid environments, characterized by high cover of sand and small stones (>90%), total and herbaceous plants, and shrubs such as *Launaea arborescens*, *Cenchrus ciliaris* and *Ononis natrix* (Table 4). Furthermore, these sites had a high number of livestock. Component 1 gives negative values to the driest localities from the south of the island, with the most abundant cover of large and medium stones (18–22%). In addition, such places show the greatest vegetation dispersion, while the dominant cover was characterized by *Chenoleoides tomentosa*, *Salsola vermiculata* and *Suaeda vermiculata*.

Component 2 separates two localities from the central part of the island, with an eastern orientation, high vegetation, and a dominant cover of *Euphorbia obtusifolia*.

Habitat selection

Houbara bustards tended to select areas with greater height of shrubs ($r_s = 0.75$; $P = 0.023$). No significant correlations were observed for the other variables considered.

Discussion

Census

The results of the present census of Houbara on Lanzarote are surprising. Lack (1983), Osborne (1986) and Ornistudio (1991) observed seven, six and 60–67 birds respectively. We counted a minimum of 130 Houbaras on Lanzarote.

Excluding data from the ICBP expedition, whose main aim was to census Fuerteventura, our results are double those obtained in April 1991 by Ornistudio (1991). Several reasons may explain this marked difference, for example, season, distances between observers (250 m in Ornistudio versus 200 m in present study), time (we did not census during the inactive period of midday), use of radio, etc. Moreover, there could have been a possible population increase on the island, or even an arrival from Fuerteventura. In other areas the species can be migratory or dispersive (Cramp and Simmons 1980, Johnsgard 1991), while in the Canarian archipelago movements within and between the islands have been reported (Polatzek *vide* Bannerman 1963, Ornistudio 1992). D. Concepción (verbally) has observed Houbaras flying between Graciosa and Lanzarote and also between Lanzarote and Fuerteventura.

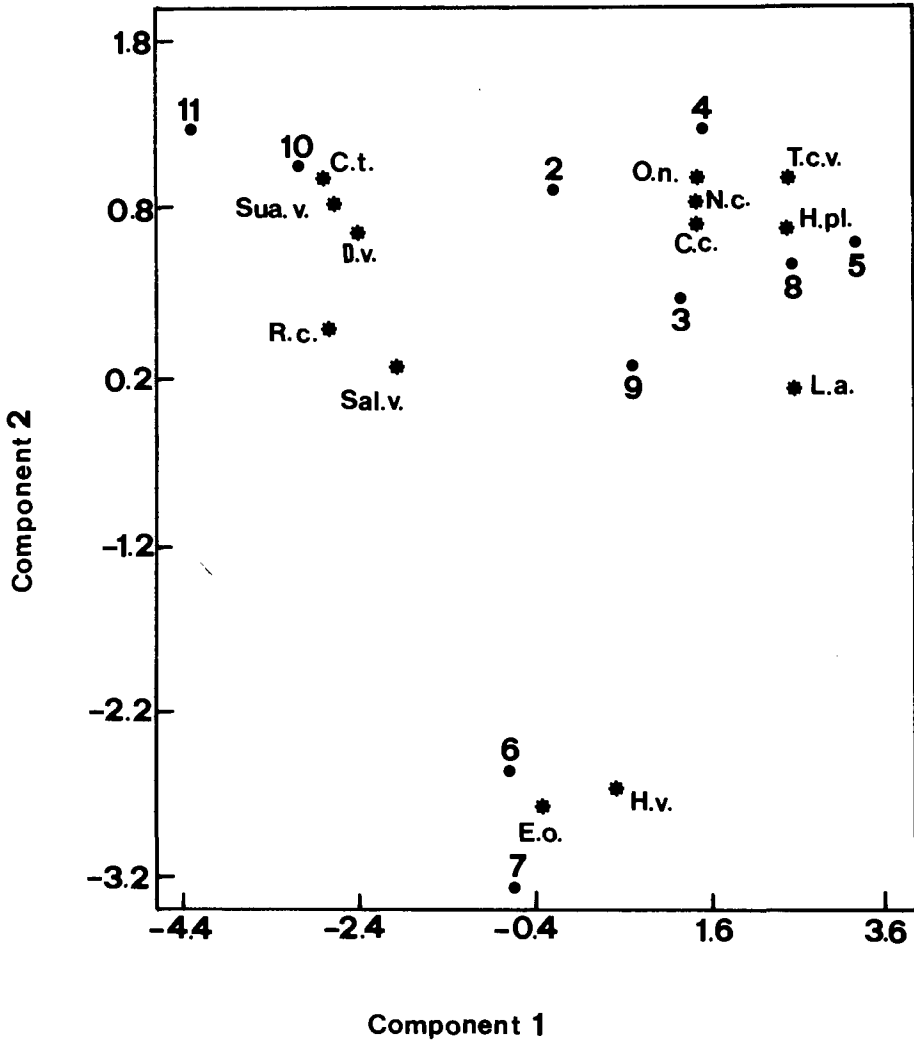


Figure 3. Principal component analysis of the different variables in the study areas of Lanzarote. R.c., rocky cover; D.v., dispersal of the vegetation; H.v., height of the vegetation; T.c.v., total cover of the vegetation. Shrub cover: L.a., *Launaea arborescens*; Sua.v., *Suaeda vermiculata*; C.t., *Chenoleoides tomentosa*; Sal.v., *Salsola vermiculata*; C.c., *Cenchrus ciliaris*; E.o., *Euphorbia obtusifolia*; O.n., *Ononis natrix*. H.pl., herbaceous plant cover; N.c., number of livestock. Zones: 2, Jable de Caleta del Caballo; 3, Jable de Famara; 4, Jable de Sóo; 5, Jable de Vuelta Jai; 6, Tahiche-Guanapay; 7, Reserva de Guatiza; 8, Argana; 9, Cortijos Viejos; 10, El Terminillo; 11, Llanos de las Maretas.

On Graciosa, where breeding was not confirmed until 1990, when three pulli were observed with adults (D. Concepción, verbally), we counted a minimum of 16 birds.

The total number of Houbaras observed on Lanzarote and Graciosa was 146, a figure higher than all previous counts on Fuerteventura, except for December 1989, when 153 birds were recorded. In addition, our estimate of 400 Houbaras

Table 4. Cover, dispersion and height of the different plant species

Localities	Total	Cover (%)						Herb. plants	Others	Mean dispersal (m)	Mean height (cm)	
		L.a.	Sua.v.	C.t.	Sal.v.	C.c.	E.o.					O.n.
Jable de Caleta del Caballo	19.3	0.2	-	1.0	5.7	-	-	1.1	11.1	0.2	3.6	37.3
Jable de Famara	27.6	4.9	-	0.6	1.0	4.2	0.2	1.0	15.8	*	3.0	42.5
Jable de S6o	22.8	6.0	-	-	-	2.4	-	0.4	12.9	0.3	2.6	36.1
Jable de Vuelta Jai	52.0	13.9	-	-	-	0.2	-	0.9	37.0	*	1.0	43.7
Tahiche-Guanapay	13.5	2.8	-	0.8	3.5	0.2	0.7	-	5.5	*	2.3	48.6
Reserva de Guatiza	13.7	7.9	0.3	0.5	2.9	-	0.7	-	2.3	3.4	2.4	53.3
Argana	38.0	17.5	-	-	-	10.0	-	-	10.4	0.1	0.7	41.6
Cortijos Viejos (Playa Quemada)	16.4	6.5	-	-	-	3.3	-	-	6.6	*	1.7	41.0
El Terminillo (Playa Blanca)	19.1	-	1.2	6.3	8.4	2.6	-	-	0.1	0.5	2.1	36.0
Llanos de las Maretas (Rubic6n)	13.3	-	2.2	6.7	1.5	*	-	-	0.9	2.0	6.8	39.0

* values < 0.1%; L.a., *Launaea arborescens*; Sua.v., *Suaeda vermiculata*; C.t., *Chenoleoides tomentosa*; Sal.v., *Salsola vermiculata*; C.c., *Cenchrus ciliaris*; E.o., *Euphorbia obtusifolia*; O.n., *Ononis natrix*.

on Lanzarote is also higher than the maximum estimates (153–378 in December 1989) on Fuerteventura (Ornistudio 1990).

Lanzarote is much more important for Houbara than was formerly supposed. In spite of our results, however, we still consider that Fuerteventura harbours the main population in the archipelago but possibly it has been underestimated. Methodological improvements on previous censuses may explain our results.

Habitat selection

The selection of places with greater shrub height could be related to the need for Houbaras to conceal themselves. The other variables were not important in habitat selection, at least in this season. Collins (1984) observed more Houbaras in the plains that had a higher shrub cover, although this was not statistically demonstrated.

Threats and conservation

The threats and conservation of the species in the archipelago have been discussed by Emmerson (1983) and Lorenzo and Emmerson (1994). In the past eggs were heavily collected and birds were hunted but these activities have recently decreased substantially. Currently the main problem is destruction and alteration of habitat. Many plains, especially those near the coast, are being destroyed through the construction of tourist resorts. New roads, off-road jeep driving and military exercises may disturb Houbaras in some areas. Houbaras are possibly affected by overgrazing by goats and by predation (feral cats and dogs) but there is no confirmatory information.

Furthermore, two dead birds were found under electric power lines. These can be very dangerous for Houbaras, as recently one of us found the remains of at least 12 birds while checking a length of 105 km, which is about 95% of the total inter-urban electric lines of the island.

Conservation measures must include a major development of the recovery plan (Domínguez and Díaz 1985) by the regional government. Recently BirdLife has initiated the production of an action plan for the Canary Houbara Bustard which, if adopted, will assure the survival of the Canarian population.

Acknowledgements

We would like to thank Keith Emmerson for his invaluable information on previous censuses. Pedro Jordano assisted during the data analysis. Nigel J. Collar and an anonymous referee made useful comments on the manuscript. This study was supported by the Viceconsejería de Medio Ambiente of the Canary Government.

References

- Bannerman, D. A. (1963) *Birds of the atlantic islands, vol. I. A history of the birds of the Canary Islands and of the Salvages*. Edinburgh: Oliver and Boyd.
- Collar, N. J. (1983) A history of the Houbara in the Canaries. *Bustard Stud.* 1: 9–29.

- Collins, D. R. (1984) A study of the Canarian Houbara Bustard *Chlamydotis undulata fuertaventurae*, with special reference to its behaviour and ecology. Unpublished thesis of the University of London.
- Cramp, S. and Simmons, K. E. L. (1980) *Handbook of the birds of Europe, the Middle East and North Africa*, vol. II. Oxford: Oxford University Press.
- Domínguez, F. and Díaz, G. (1985) Plan de recuperación de la Hubara Canaria. Unpublished manuscript. Madrid: ICONA.
- Emmerson, K. W. (1983) Actual and potential threats to the Canarian Houbara. *Bustard Stud.* 1: 51–56.
- Johnsgard, E. A. (1991) *Bustards, hemipodes, and sandgrouse*. Oxford: Oxford University Press.
- Kent, M. and Coker, P. (1992) *Vegetation description and analysis. A practical approach*. London: Belhaven Press.
- Lack, P. C. (1983) The Canarian Houbara: survey results, 1979. *Bustard Stud.* 1: 45–50.
- Lorenzo, J.A. and Emmerson, K. W. (1994) Aves en la Lista Roja: Hubara Canaria. *La Garcilla* 88: 22–25.
- Meade-Waldo, E. G. B. (1893) List of birds observed in the Canary Island. *Ibis* 6: 185–207.
- Ornistudio (1989a) Censo de la población de Hubara Canaria (*Chlamydotis undulata fuertaventurae*) en la isla de Fuerteventura (diciembre de 1988). Unpublished manuscript. Santa Cruz de Tenerife: ORNISTUDIO S.L.
- Ornistudio (1989b) Censo de la población de Hubara Canaria (*Chlamydotis undulata fuertaventurae*) en la isla de Fuerteventura (julio de 1989). Unpublished manuscript. Santa Cruz de Tenerife: ORNISTUDIO S.L.
- Ornistudio (1990) Censo de la población de Hubara Canaria (*Chlamydotis undulata fuertaventurae*) en la isla de Fuerteventura (diciembre de 1989). Unpublished manuscript. Santa Cruz de Tenerife: ORNISTUDIO S.L.
- Ornistudio (1991) Censo de la población de Hubara Canaria (*Chlamydotis undulata fuertaventurae*) en la isla de Lanzarote (abril de 1991). Unpublished manuscript. Santa Cruz de Tenerife: ORNISTUDIO S.L.
- Ornistudio (1992) Censo de la población de Hubara Canaria (*Chlamydotis undulata fuertaventurae*) en la isla de Fuerteventura (enero de 1992). Unpublished manuscript. Santa Cruz de Tenerife: ORNISTUDIO S.L.
- Osborne, P. (1986) *Survey of the birds of Fuerteventura Canary Islands, with special reference to the status of the Canarian Houbara Bustard Chlamydotis undulata*. Cambridge, U.K.: International Council for Bird Preservation (Study Report 10).
- Peña, D. (1992) *Estadística. Modelos y métodos. II Modelos lineales y series temporales*. Madrid: Alianza.
- Webb, P. B., Berthelot, S. and Moquin-Tandon, M. A. (1842) Ornithologie Canarienne. Pp.1–48 in Béthune, ed. *Histoire Naturelle des Iles Canaries* Tomo II vol. X. Paris.

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