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DISTRIBUTION, STATUS AND CONSERVATION OF THE HOUBARA BUSTARD *CHLAMYDOTIS UNDULATA FUERTAVENTURAE* ROTHSCHILD & HARTERT, 1894, IN THE CANARY ISLANDS, NOVEMBER-DECEMBER 1994

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SUMMARY.—*Distribution, status and conservation of the Houbara Bustard* Chlamydotis undulata fuertaventurae *Rothschild & Hartert, 1894, in the Canary Islands, November-December 1994*. This paper presents the results of a census of the Canarian Houbara, which covered for the first time the total area occupied by this subspecies. Houbaras were detected only in Fuerteventura, Lanzarote and Graciosa. A total of 379 birds were recorded (33 from vehicles, 16 outside the transects, and a minimum of 330 inside the censusing belt), from which we estimated a total population of 527 birds: 18 in Graciosa, 268 in Lanzarote and 241 in Fuerteventura. Although the species seems to reach in the Canarian archipelago the highest density recorded for its whole geographical distribution, this island population is threathened by current loss and alteration of their habitat.

Key words: Canary Islands, census, *Chlamydotis undulata fuertaventurae*, conservation, distribution, population size.

RESUMEN.—*Distribución, estatus y conservación de la Avutarda Hubara* Chlamydotis undulata fuertaventurae *Rothschild & Hartert, 1894, en las islas Canarias (noviembre-diciembre 1994)*. En el presente trabajo se presentan los resultados de un censo que cubre por primera vez toda el área de distribución de la Avutarda Hubara Canaria. Se detectaron hubaras en Fuerteventura, Lanzarote y Graciosa, contabilizándose un total de 379 ejemplares, 33 desde vehículos, 16 fuera de los transectos y un mínimo de 330 dentro de los transectos. Se ha estimado una población global constituida por 527 aves: 18 en Graciosa, 268 en Lanzarote y 241 en Fuerteventura. Probablemente, la densidad de aves registrada en la población canaria es la más elevada que se conoce para la especie. No obstante, la degradación y la destrucción del hábitat amenazan seriamente la conservación de esta subespecie insular.

Palabras clave: Censo, *Chlamydotis undulata fuertaventurae*, conservación, distribución, Islas Canarias, tamaño de la población.

INTRODUCTION

Like most bustards, the Houbara *Chlamydotis undulata* has suffered a marked reduction throughout its range (Cramp & Simmons, 1980). The Canarian form *C. u. fuertaventurae* is the most scarce and endangered of the three extant subspecies. In the Canaries, the species has traditionally been hunted (Webb *et al.*, 1842; Vernau, 1982), and this practice was still used as a tourist attraction by the Cabildo (county council) of Fuerteventura until 1971 (Domínguez & Díaz, pers. com.). The collection of eggs and the snaring of females at the nest were probably significant in the past (Bannerman, 1963), though Emmerson (1983) has pointed out that tourist development and habitat destruction are nowadays the major detrimental factors for this population. Since 1971 there has been increasing concern about the species, so that hunting was forbidden, and in 1979 an expedition of the ICBP (now BirdLife International) estimated a population of only 80-100 birds in Fuerteventura and 15-20 in Lanzarote (Lack, 1983).

During the last ten years, the Spanish and Canarian governments have paid special attention to the species, establishing a Recovery

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Plan (Domínguez, 1989) including legal protection for the Houbara and its habitat, and a captive breeding programme. In addition, seven partial censuses (mainly in Fuerteventura and Lanzarote) have been carried out, most of them indicating that the species was more common than previously supposed. Also, the censuses added a new island (Graciosa) to its known distribution range. Osborne (1986) reported 69-86 birds in April 1984 in Fuerteventura, while the estimates of Ornistudio (pers. obs.) in December 1989 ranged between 153 and 378. In Lanzarote, 60-67 birds were counted in April 1991 (Ornistudio, pers. obs.) and 130 in December 1993 (Martín *et al.*, 1996). These last authors also recorded 16 Houbaras in Graciosa.

In this paper we present the results of a census of the Canarian Houbara which covered for the first time the total area occupied by the species in the archipelago.

Methods

Study area

The study was carried out in the eastern Canary Islands (28°-29°25′N, 13°20′-4°30′W), comprising Lanzarote (862 km^2), Fuerteventura (1662 km^2) and the islets of Graciosa (27.4 km^2), Alegranza (10.2 km^2) and Lobos (4.3 km^2). These are very low islands, with the highest altitude (807 m a.s.l.) being reached in Fuerteventura. Lanzarote and the islets are mostly covered by historic or prehistoric lavas, their landscapes being thus less affected by erosive-sedimentary processes as compared to Fuerteventura (Betancor & Criado, 1985; Brito & Acuña, 1985). Plains, gentle slopes and U-valleys dominate the general physiography of the areas studied.

The climate is mainly warm subdesertic to desertic with dry summers (Marzol-Jaén, 1984), but is somewhat influenced by the sea spray and the proximity to the African continent (100 km at the closest point). Annual rainfall is less than 140 mm and mean monthly temperatures oscillate between 16 °C (January-February) and 24 °C (August-September) (Brito & Acuña, 1985).

The vegetation is mainly characterized by xerophytic and coastal scrubland with large areas covered by *Salsola vermiculata*, *Launaea arborescens*, *Lycium intricatum* and *Suaeda vera*. Sandy areas are dominated by *Euphorbia paralias*, *Lotus* sp., *Ononis natrix* and some Chenopodiaceae and Polygonaceae species (Santos, 1984). Agriculture and overgrazing by goats have, over the years, altered drastically the original vegetation.

Census

Field work took place between 27 November and 22 December 1994. At this time birds are partially gregarious but some males have already initiated courtship and are linked to their displaying grounds. All the islands and islets where the species was known or suspected to occur were visited. Census were made during one day in Alegranza and Lobos, during two days in Graciosa, during eight in Lanzarote and during 12 in Fuerteventura.

According to the landscape structure and to our experience, two different types of habitat were distinguished. Primary habitats include areas with similar characteristics of vegetation and substrate, which correspond to the best areas for Houbaras according to previous censuses (Martín *et al.*, 1996). Secondary habitats are marginal areas (croplands, altered and disturbed areas, and edges of badlands —«malpaises»—) which are known to be visited occasionally by birds. These habitats were delimited from bibliography, from observations made during a previous three-day trip to Fuerteventura, or while censusing.

The main census effort involved bird counts along a total of 36 transects (Figs. 1 and 2). Appendix 1 summarizes the main characteristics of the different census units. Most transects were made within primary habitat in order to get a reliable minimum figure for the population. Every transect was censused by a team of 2-8 observers (depending on the size of the area) walking in line abreast and spaced 200 m apart. The members recorded the location and movements of all birds detected, communicating the information to the rest of the team by means of a small radio, so that duplicate contacts were minimized. Apart from two transects carried out in the afternoon (16:06-18:00 h, official time) in Graciosa, all censuses were performed in the mornings (7:45-

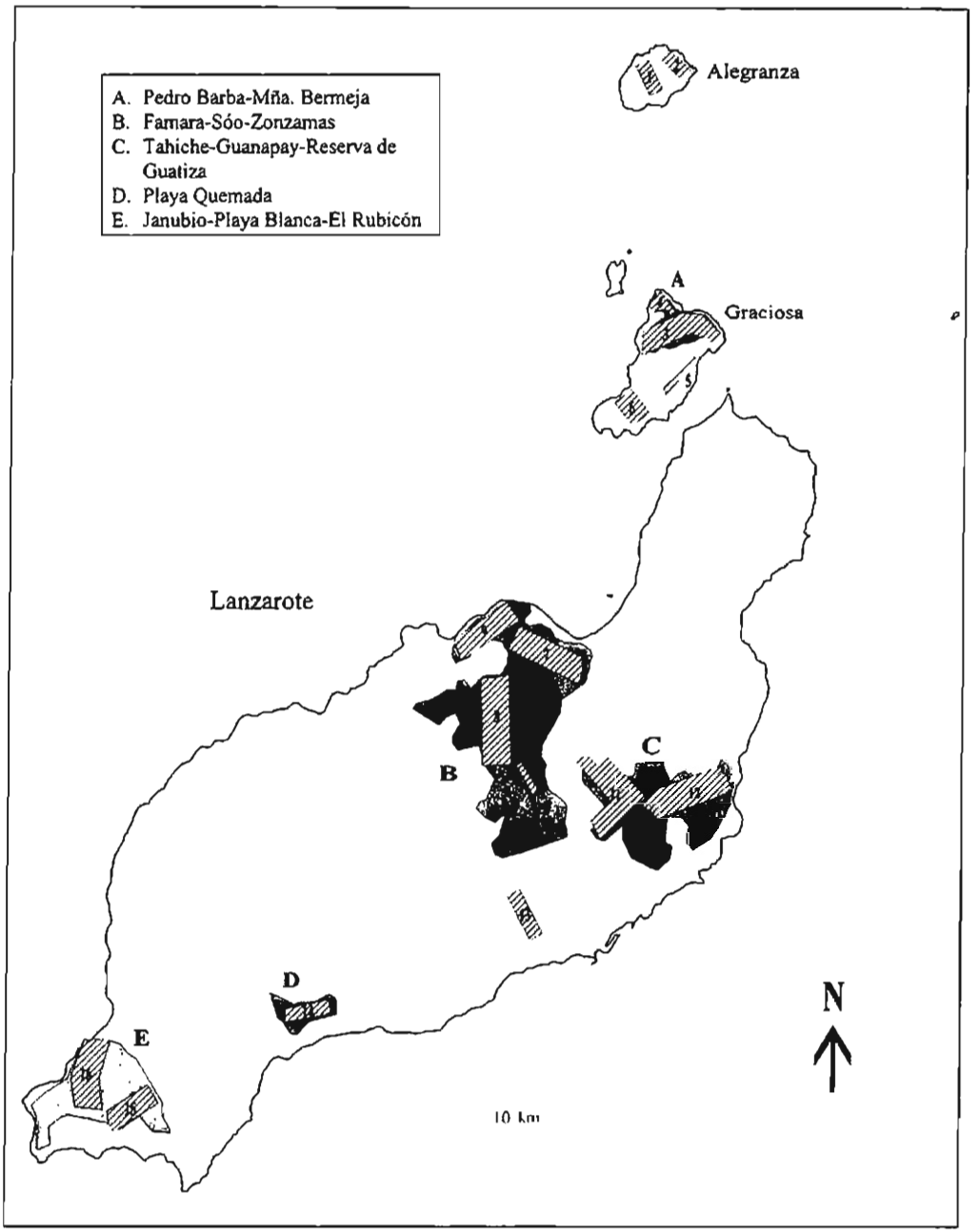

FIG. 1.—Main areas of suitable habitat (letters) for Houbara Bustard and location of transects (numbers) on Lanzarote, Graciosa and Alegranza. Transect numbers correspond to those in Appendix 1.
[Principales áreas de hábitat adecuado para la Hubara (letras) y localización de los transectos (números) en Lanzarote, Graciosa y Alegranza. Los números corresponden a los del Apéndice 1.]

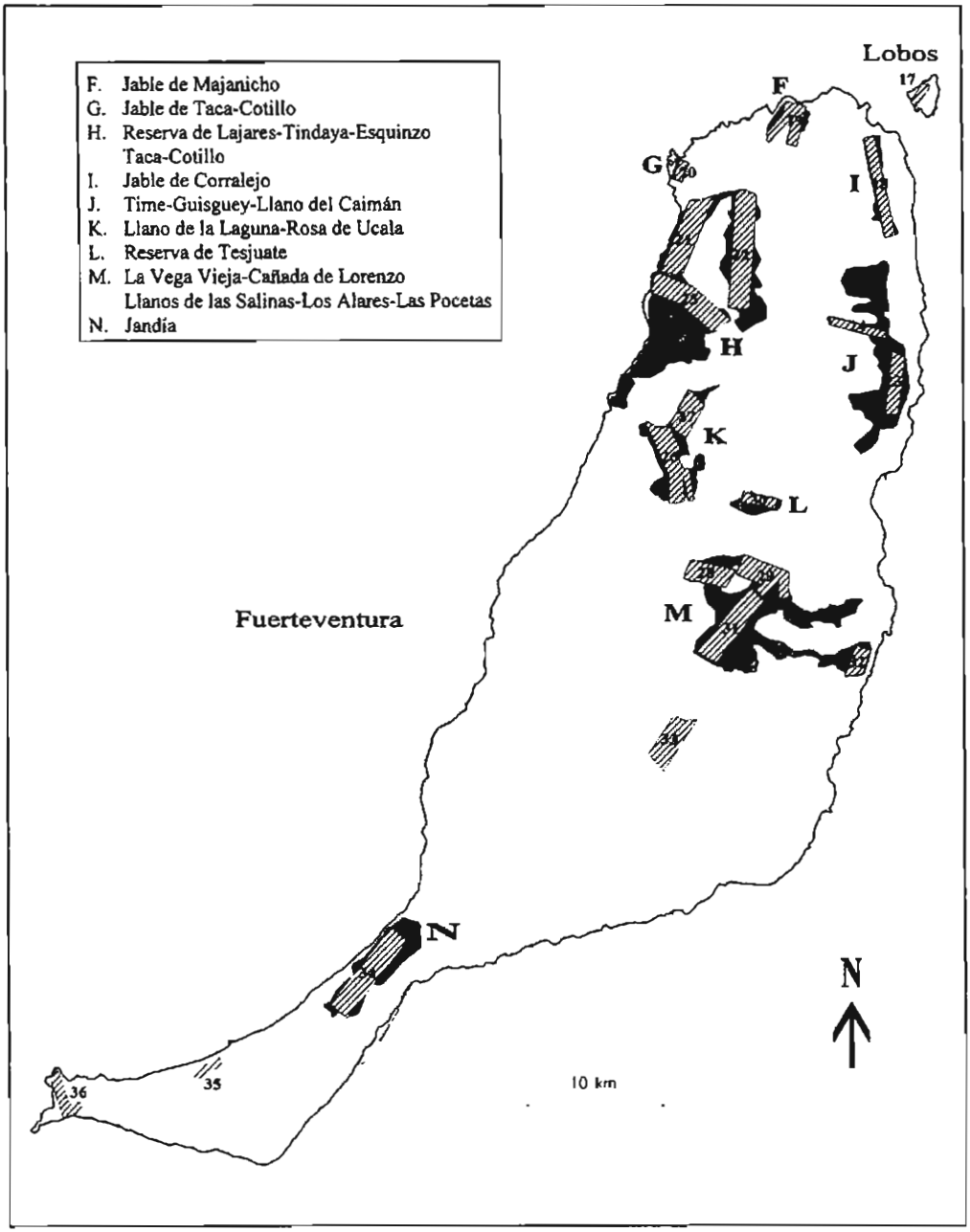

FIG. 2—Main areas of suitable habitat (letters) for Houbara Bustard and location of transects (numbers) on Fuerteventura and Lobos. Transect numbers correspond to those in Appendix 1.
[Principales áreas de hábitat adecuado para la Hubara (letras) y localización de los transectos (números) en Fuerteventura y Lobos. Los números corresponden a los del Apéndice 1.]

12:32 h), when the activity of the species is highest (Collar, 1983; Hinz & Heiss, 1989). In addition, cultivated and marginal areas were covered from jeeps during the birds'evening activity period. The population in the primary habitats was estimated by extrapolating the weighted mean densities of a particular area to the total area of primary habitat of the zone. In cases where the actual number of Houbaras observed in the area was considered to give a better estimate (i.e. when most primary habitats were surveyed and the transect included secondary habitats), this figure was used instead. The population of the secondary habitats of each island was estimated by extrapolation from the average weighted density in marginal areas to the total area of that habitat.

A possible bias derived from the gregarious habits of the species was considered to be low because of the large area of primary habitat censused (about 60%).

Results

Census

Houbaras were detected in Fuerteventura, Lanzarote and Graciosa only. Altogether, at least 379 birds were recorded, 33 from vehicles, 16 outside the transects and 330-335 inside the census belt (Table 1). Details on counts in the transects are given in Appendix 1.

In Alegranza and Lobos no birds were seen although suitable habitat appeared to be present in both islands. The species was reported by Herrera *et al.* (1993) as abundant in Lobos, but they did not present any conclusive data. However, we were told by the lightkeeper that one pair bred during the 1950s, and that he had recently observed one bird. Probably a few Houbaras visit the islet occasionally.

In Graciosa, where at least a pair bred in 1990 (G. Pallarés, pers. com.), a total of 11 individuals were counted in the northern plains of the islet.

The total number of Houbaras recorded in Lanzarote was 179-184 birds, 149-154 of which were detected inside the transects. The highest numbers (about 50% of the birds observed) occurred in two transects only (Tahiche-Guanapay and Reserva de Guatiza).

In Fuerteventura, 189 Houbaras were counted, 171 of which were inside the transects. Four transects (Los Alares-Las Pocetas, La Vega Vieja, Matas Blancas and Reserva de Lajares) accounted for nearly 60% of all birds observed.

Population estimates

The total area of suitable habitat on the eastern islands was estimated at 396.47 km^2 (162.50 km^2 of primary habitat and 233.97 km^2 of secondary habitat). The total area of

Table 1

Numbers of Houbara Bustards recorded during transects or from vehicles in the different islands. Numbers in parenthesis are revised figures after consideration of possible duplications.
[Números de avutardas hubaras obtenidos durante los transectos o desde vehículos en las distintas islas. Entre paréntesis, números corregidos tras considerar posibles repeticiones.]

Island *[Isla]*	Within transects *[Dentro de los transectos]*		Outside transects *[Fuera de los transectos]*	Seen from vehicles *[Vistas desde vehículos]*	Total
	Min.	Max.			
Alegranza	0	0	0	—	0
Graciosa	10	10	0	—	11
Lanzarote	149	154	14(12)	23(18)	179-184
Lobos	0	0	0	—	0
Fuerteventura	171	171	3	19(15)	189
Total	330	335	16	33	379-384

occupied habitat in Fuerteventura (234.01 km²) was much larger than in Lanzarote (144.94 km²), but the two islands harbour a similar area of primary habitat (Table 2).

For the whole study area, the average density was 1.69 birds/km², raising to 1.85 birds/km² if the islets of Alegranza and Lobos were excluded. Mean densities were 1.05 birds/km² for Graciosa, 3.19 birds/km² for Lanzarote and 1.31 birds/km² for Fuerteventura. Details on density values for the different transects are given in Appendix 1.

Population estimates for primary habitats on each island were as follows: we estimated 11 Houbaras in Graciosa using 1.56 birds/km² as the mean pooled density of the transects 3 and 4. Four main areas were considered in Lanzarote (Fig. 1, B-E). In the largest (Famara-Sóo-Zonzamas), the mean transect density was 2.04 birds/km² indicating a total of 88 Houbaras present. In the Tahiche-Guanapay-Reserva de Guatiza and Playa Quemada areas we considered only the actual numbers of birds observed, including five seen outside the transect belts (thus 80 and 13 respectively). For the last area, Janubio-Playa Blanca-El Rubicón, 20 Houbaras were estimated from a mean density of 1.96 birds/km² (Janubio-Playa Blanca transect). The total number of Houbaras in primary habitats in Lanzarote was then estimated to be 201 birds.

The population is more widely dispersed in Fuerteventura, and it was possible to recognize nine main areas (Fig. 2). The estimate for Time-Guisguey-Llano del Caimán (18 birds) was calculated from a mean density of 2.08 birds/km². In the eight remaining areas we used the total numbers of birds observed, both within and outside of transects: 4 at Majanicho, 1 at Jable de Cotillo-Tostón, 45 at Reserva de Lajares-Tindaya-Esquinzo-Taca-Cotillo, 11 at Jable de Corralejo, 8 at Llano de La Laguna-Rosa de Ucala, 4 at Reserva de Tesjuate, 24 at Matas Blancas, and 59 in the large central area (area M). The total population for the primary habitat on Fuerteventura was then estimated as 174 birds.

As transects were selected on areas of primary habitat, the estimation of Houbara numbers in the secondary habitats was more tentative, so that our figures should be taken with caution. For Fuerteventura, a mean density of 0.45 birds/km², derived from counts on six transects (numbered 24, 27, 32, 33, 35 and 36 in Appendix 1), gave a crude estimate of 67 Houbaras. For Lanzarote and Graciosa, a mean weighted density of 0.88 birds/km² was calculated from four transects (numbers 5, 6, 13 and 15), thus giving estimates of 67 and 7 Houbaras, respectively.

The total Houbara population in all habitats was estimated at 527 birds: 18 in Graciosa, 268 in Lanzarote and 241 in Fuerteventura.

Discussion

The results obtained in this first census of the whole population of the Houbara Bustard in the Canaries indicates larger population

Table 2

Estimated numbers of Houbara Bustards in the two habitat categories.
[Número de avutardas hubaras y superficie de cada tipo de hábitat.]

Islands *[Islas]*	Primary habitat *[Hábitat principal]*		Secondary habitat *[Hábitats secundarios]*		Total	
	Area (km²)	N.º of birds	Area (km²)	N.º of birds	Area (km²)	N.º of birds
Alegranza	0	0	1.85	0	1.85	0
Graciosa	6.77	11	8.39	7	15.15	18
Lanzarote	69.25	201	75.69	67	144.94	268
Lobos	0.39	0	0.13	0	0.52	0
Fuerteventura	86.09	174	147.92	67	234.01	241
Total	162.50	386	233.97	141	396.47	527

sizes than previously estimated. In fact, the average density found in suitable habitats (1.85 birds/km^2) was higher than the 0.56 birds/km^2 recorded by Mian (1989) in some zones of Pakistan, which were formerly thought to be the largest densities reached within the species range. Even the lowest density recorded for the Canarian archipelago (1.05 birds/km^2 in Graciosa) is higher than that figure. It must be noted, however, that data from Pakistan were obtained by censuses from vehicles, and this method is known to underestimate real densities, at least in island ecosystems, as we verified in Lanzarote in 1993 (A. Martín, pers. obs.). Densities in the Canaries were in closer agreement with data from the Northwestern Negev (Israel), where Lavee (1988) estimated 2-4 birds/km^2 in two plots.

Our results also support the unexpected conclusions of Martín *et al.* (1996) that the Houbara population in Lanzarote could be larger than that in Fuerteventura. The area of primary habitat in Fuerteventura is larger than in Lanzarote, but we found that mean densities were significantly larger in the later island (Mann-Whitney test, $z = 2.48$; $P = 0.01$). These differences in abundance between Lanzarote and Fuerteventura could be explained by inter-island movements influenced by between-years differences in local rainfall. Furthermore, it is known that the species shows dispersive and migratory habits in other parts of its range (Cramp & Simmons, 1980; Johnsgard, 1991), and that in the Canaries movements occur not only within (Polatzek, *in* Bannerman, 1963; Ornistudio, obs. pers.) but also among islands (D. Concepción, pers. comm.). During the present census, Lanzarote had more developed annual vegetation than Fuerteventura, where the landscape was clearly drier. In 1994, not only the autumn precipitation on Fuerteventura was the lowest recorded there in the last seven years (5.7 mm), but differences in precipitation between the two islands were the largest recorded. Also, the maximum number of Houbaras previously censused in Fuerteventura was obtained in the most rainy year (1989), according to the data provided by the Instituto Nacional de Meteorología de las Canarias Orientales.

Reliable comparisons with previous censuses are difficult to make because of methodological differences. The only possible comparison is with data obtained on Lanzarote in December 1993 (Martín *et al.*, 1996), when the densities found were lower (2.56 birds/km^2) than in December 1994 (3.19 birds/km^2) (Student t-test for matched pairs, $t = 3.93$; $P < 0.01$). Nevertheless, it is important to note the possible effect of utilizing two more observers in the transects made in 1994.

The intensity of fieldwork in the primary habitat (transects covered 61% of this area) makes our estimate of 386 Houbaras a reliable minimun. On the other hand, the figure of 141 birds estimated to be present in secondary habitat is probably affected by a larger bias. At least 33 birds were detected in secondary habitats by means of surveys carried out in the evenings from vehicles. These birds were not considered for our estimates because of the risk of duplication, since birds probably carry out daily movements between primary and secondary habitats.

The species is still threatened by the factors identified by Lorenzo & Emmerson (1993) and Tucker & Heath (1994). Loss and degradation of suitable habitat through building development and overgrazing by goats is very intense. In some areas military manoeuvres, tourist activity and off-road jeeps cause serious disturbance (Emmerson, 1983), and some birds are killed each year by collision with overhead cables (Lorenzo, 1995) or by hunting. In order to preserve this subspecies, vigilance in its main areas should be increased, and two important areas, Tahiche-Guanapay (Lanzarote) and Los Alares (Fuerteventura) are in urgent need for protection.

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Appendix 1

Numbers of Houbara Bustards and main characteristics of the transects carried out in the different islands and islets.
[Número de aves y principales características de los transectos efectuados en cada isla e islote.]

N.º	Transect *[Transecto]*	No. of birds seen *[N.º de aves]*	Density *[Densidad]* (Birds/km²)	Length *[Longitud]* (km)	Area (km²)	No. of observ.	Speed *[Velocidad]* (km/h)
	Alegranza						
1	El Cortijo-El Bermejo	0	0.00	1.87	1.49	4	1.63
2	El Faro-El Jablito	0	0.00	1.20	1.28	4	1.62
	Graciosa						
3	Pedro Barba-Mña. Bermeja	7	1.30	5.17	5.38	6	2.04
4	Llanos de las Majapalomas	3	2.91	3.29	1.03	2	1.86
5	Caleta de Sebo-Pedro Barba	0	0.00	2.45	0.97	2	2.72
6	Mña. Mojón-Mña. Amarilla	0	0.00	1.67	1.99	6	1.49
	Lanzarote						
7	Jable de Famara	14	2.12	4.47	6.61	8	1.80
8	Jable de Sóo	10	1.24	5.03	8.06	8	1.99
9	Jable de Caleta del Caballo	12	2.64	3.89	4.55	6	1.89
10	Jable de Vuelta Jai	5	6.09	2.00	0.82	2	1.63
11	Tahiche-Guanapay	43	5.53	5.14	7.77	8	1.28
12	Reserva de Guatiza	32	4.25	4.72	7.53	8	1.73
13	Argana	0	0.00	2.90	2.30	4	1.76
14	Cortijos Viejos-Playa Quemada	13	5.91	2.74	2.20	4	1.52
15	El Terminillo	8	2.14	3.18	3.73	6	2.01
16	Janubio-Playa Blanca	12	1.96	3.93	6.12	8	1.71
	Lobos						
17	El Marrajo-Morros de la Pila	0	0.00	83.00	0.48	3	0.89
	Fuerteventura						
18	Jable de Corralejo	11	1.79	7.54	6.12	4	2.37
19	Jable de Majanicho	4	0.89	3.29	4.47	7	1.71
20	Jable del Cotillo-Tostón	1	0.67	1.49	1.19	4	1.75
21	Taca-Cotillo	12	1.26	5.02	9.52	8	1.21
22	Reserva de Lajares	21	1.50	8.75	14.00	8	2.69
23	Time-Guisguey-Las Llanadas	9	2.08	4.32	4.32	5	1.68
24	Valle de Fimapaire	7	2.32	4.95	3.01	3	1.01
25	Tindaya-Esquinzo	10	1.09	5.89	9.19	8	2.38
26	Llano de la Laguna (Tefía)	6	0.69	5.75	8.71	8	2.32
27	Llano de Muchichafe	2	0.27	3.06	7.44	8	2.78
28	La Vega Vieja	24	4.46	3.44	5.38	8	2.51
29	Cañada de Lorenzo-El Diviso	2	0.29	4.64	6.92	8	1.88
30	Reserva de Tesjuate	4	1.77	2.77	2.26	4	2.27
31	Los Alares-Las Pocetas	32	3.13	6.32	10.22	8	2.00
32	Los Llanos de las Salinas	2	0.73	2.21	2.73	6	2.28
33	Llano Grande	0	0.00	3.88	6.29	8	2.67
34	Jable de Matas Blancas	24	2.04	7.40	11.75	8	2.40
35	Cofete	0	0.00	2.41	1.33	3	2.00
36	Llano de la Angostura	0	0.00	3.90	3.08	5	3.00