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OUTWARD MIGRATION OF HOUBARA BUSTARDS FROM TWO BREEDING AREAS IN KAZAKHSTAN[1]

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Abstract: We studied the migration patterns of nine Houbara Bustards (*Chlamydotis undulata macqueenii*) from two breeding areas in the Republic of Kazakhstan by tracking via satellite during two consecutive seasons. All the birds from the Taukum desert (east Kazakhstan) migrated southwest towards the Kyzylkum desert and then south-southeast towards Iran, south Afghanistan, and north Baluchistan. All the birds from the Buzachi peninsula (west Kazakhstan) migrated south towards Turkmenistan and Iran and then west towards south Iraq. Houbara followed similar migration routes in 1995 and 1996. All birds bypassed natural obstacles such as seas and mountains. The total distance covered by Houbara during their outward migration ranged from 1,600 to 2,320 km. We observed important interindividual variation in migration timing, duration, and patterns. Migration duration ranged from 14–73 days. Travel rate between the breeding grounds and the wintering grounds was 24 to 151 km day^{-1}, with up to 323 km covered in one day.

Key words: *central Asia,* Chlamydotis undulata macqueenii, *Houbara Bustard, migration, satellite tracking.*

The Houbara Bustard (*Chlamydotis undulata*) inhabits desert, semi-desert, and arid shrublands, and ranges from the Canary Islands across North Africa to the Middle East and Central Asia (Cramp and Simmons 1980, Johnsgard 1991, Collar 1996). The Asian subspecies (*C. u. macqueenii*) is distributed from the Middle East to Mongolia and is the main quarry for Arab falconers. The Asian Houbara is a regular winter visitor in the Arabian Peninsula, the wintering birds arriving in eastern Arabia in September–October and starting their return migration in February–March (Sheldon and Launay 1998).

[1] Received 9 February 1998. Accepted 13 July 1998.

Although no data exist to support any assertions on the number of Houbara in central Asia, Goriup (1997) suggests that the Republic of Kazakhstan may hold the main breeding grounds for the central Asian birds. The exact origin of the Houbara wintering in Arabia remains unknown, but local people commonly believe that the birds migrate from breeding areas in Iran and Central Asia (Henderson 1990). The capture of Houbara on their Arabian winter areas is difficult due to their extremely low density (Seddon and van Heezik 1996, Launay et al. 1997), and only one successful tracking attempt has been reported for a bird caught during the winter in the Abu Dhabi Emirate (Osborne et al. 1997). In order to study the migration path of the Asian Houbara and to try to determine the origin of the birds wintering in the Arabian Peninsula, we decided to catch the birds on their breeding areas in order to follow their outward migration.

We visited two Houbara breeding areas in 1995 and 1996. One on the shore of the Caspian Sea (Buzachi Peninsula, west Kazakhstan) and one in the TauKum desert south of Lake Balkhash (east Kazakhstan). We chose tracking via satellite as the best option to study the migration pattern of Houbara. Whereas the low density and rarity of capture or recovery of Houbara make it impossible to rely on a traditional ringing program to assess the migration routes, the new generation of platform transmitter terminal (PTT) is small enough for a bird the size of an adult Houbara Bustard. This paper reports the results obtained during two successive years (1995 and 1996) from 14 birds radio tagged on their breeding areas in eastern and western Kazakhstan.

METHODS

We initiated this study during spring 1995 and 1996 at two sites in Kazakhstan: the Buzachi Peninsula and the Taukum desert. The Taukum desert is in eastern Kazakhstan (44°N, 75°E). The landscape consists of a flat plain bordered by small vegetated sand dunes (up to 25 m high). The soil is sandy or sandy clay. The Buzachi Peninsula is situated on the shore of the Caspian Sea (45°N, 52°E) in western Kazakhstan. The landscape consists of a mixture of 20–30 m high sand dunes and slightly to gently undulating prairies growing on a sandy soil. In both areas, the vegetation forms a typical semi-arid plant community. Both areas are sporadically inhabited by Kazakh shepherds subsisting off their livestock.

We captured Houbara males on their display sites and the female around its chick. After capture, we banded, blood sampled for subsequent genetic analysis, and took biometric measurements of the birds. When Houbara had adequate weight and body condition, we fitted them with a PTT and released them within 1 hr of capture. We located the birds the following day and irregularly afterwards, using a Gonio receiver (IESM Gonio 400P) to check for any post-release problems.

The Microwave nano PTT (Microwave Telemetry Inc., Columbia, Maryland) used in this study weighed approximately 28 g without a harness and is an improved version of the models described by Howey (1992). We fitted the transmitter to the Houbara following the method described by Osborne et al. (1997). The package weighed around 34 g, constituting less than 2% of the body mass of males and around 3% of female body mass. We used two types of PTT duty cycles in this study. The first duty cycle was 8 hr on/24 hr off for 7 days, and 8 hr on/96 hr off thereafter, and was primarily aimed at studying the postbreeding season. The second duty cycle was 8 hr on/24 hr off for 7 days followed by 8 hr on/336 hr off for 91 days, and 8 hr on/48 hr off thereafter. This duty cycle was aimed at studying the migration of Houbara, normally departing their breeding grounds at the end of the summer.

Bird location data were collected through the Argos system (Taillade, 1992) which classified the locations according to accuracy, coded 3, 2, 1, 0, A, B, and Z from best to worst. In this paper we used only classes 0 and above for mapping and analyzing migration routes.

The area used by the birds during the main stopovers (longer than 7 days) was estimated with the 75% bivariate normal ellipse (White and Garrott 1990). The software Calhome (Kie et al. 1996) was used for calculating home range.

RESULTS

In Buzachi Peninsula, we tagged one male and one female in 1995 and three males in 1996 with PTTs. In Taukum desert, we tagged seven males in 1995 and two males in 1996 with PTTs. All were adult breeding birds. A thorough examination after capture revealed that none of the birds were injured during the capture. From our 14 PTTs, only 9 (5 in 1995 and 4 in 1996) worked long enough to allow us to follow the Houbara to known wintering areas (Table 1). We did not receive data for 67 consecutive days from one Houbara (PTT 24089) and thus discarded it in the calculation of the duration of migration and travel rate.

MIGRATORY PROFILE

We observed large interindividual variability in the migratory profile of the nine Houbaras (Fig. 1).

Two birds (the female from Buzachi Peninsula and a male from Taukum) flew directly 1,600 km (male) and 1,970 km (female) from the breeding to the wintering grounds in 20 and 13 days, respectively. These two birds did not make any stopover longer than 1 day during the course of their migration.

Six birds (five Houbaras from Taukum and one from Buzachi) did stop once for more than a week (long stopover) during their migration. We observed important variation in the distance between the long stopover areas and the breeding ground as well as in the duration spent on the long stopover areas (Table 2). The area used during the long stopovers varied from 151 to 834 km^2 and was independent of the duration of the stay and of the number of locations available to compute the home range estimation.

One male from the Buzachi Peninsula stopped twice for more than a week. This male moved 60 km from its breeding areas on 5 July and stayed in a 587 km^2 area for 51 days. A second flight of 170 km on 1 September led the bird to a second stopover site of 130 km^2 used for 16 days.

TABLE 1. Houbara Bustard IDs, PTT transmission start and end date, number of days of transmission, and location of class 0 and above (Kazakhstan 1995–1996).

Bird ID	Sex	Start transmission (mm/dd/yy)	End transmission (mm/dd/yy)	Transmission period (days)	Number of class 0 and above
24088	Male	04/29/95	11/02/95	187	79
24089	Male	04/27/95	11/20/95	207	80
24093	Male	04/25/95	11/14/95	203	78
24095	Female	05/27/95	11/22/95	179	70
24097	Male	04/29/95	11/20/95	205	60
26706	Male	05/13/96	01/20/97	252	84
26707	Male	05/03/96	01/01/97	243	67
26709	Male	05/13/96	01/29/97	261	74
26710	Male	04/30/96	01/18/97	263	72

PATTERN OF MOVEMENTS

We defined houbara movements as dispersive or migratory according to the travel rate and the distance moved from the preceding location.

Dispersive movements. On the breeding grounds, on the long stopovers (of more than 7 days), and on the wintering grounds, the distances between two successive locations were low (less than 15 km) and the movements dispersive and of short amplitude (3.5 ± 3.9 km day^{-1}).

Migratory movements. Our data suggest two types of migratory movements. The first type was of medium amplitude (80–610 km), was completed with a relatively low daily travel distance (50.8 ± 22.1 km day^{-1}), and ended by a stopover of more than one week (Table 2). These movements were directed to-

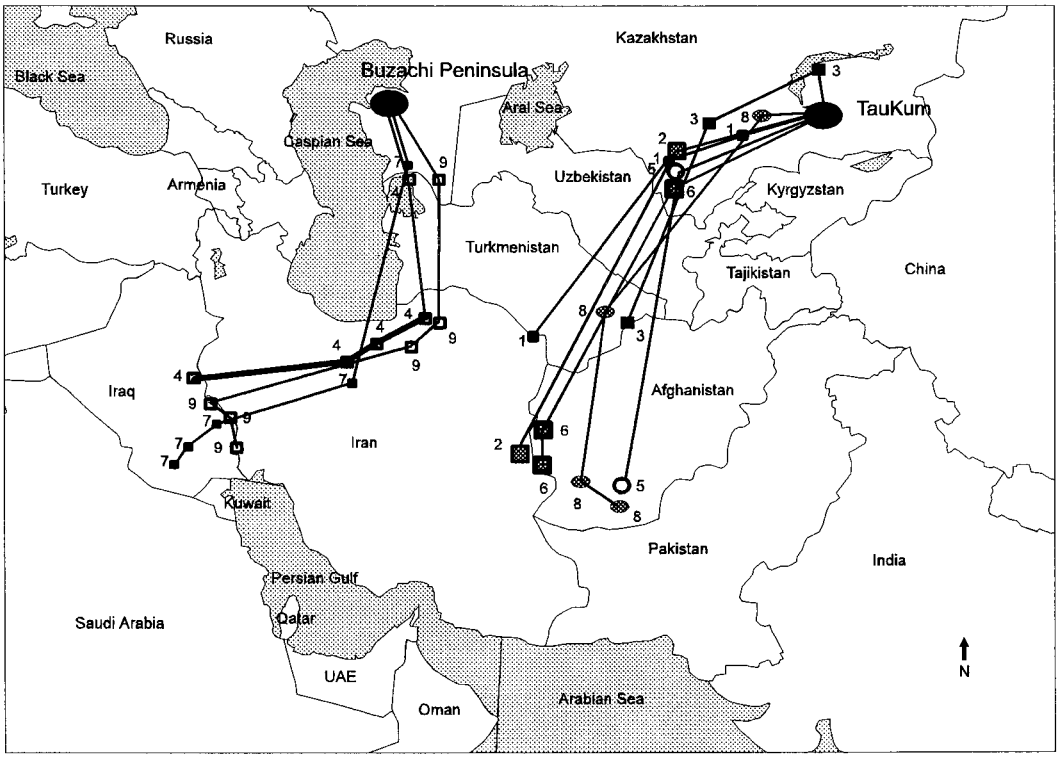

FIGURE 1. Map of the migration routes and stopovers of nine Houbara Bustards tagged in the western and the eastern part of Kazakhstan (spring 1995 and 1996). All boxes and circles with numbers are stopovers. Black ellipses are breeding grounds. The numbers refer to PTT. 1: Ptt 24088, 2: Ptt 24089, 3: Ptt 24093, 4: Ptt 24095, 5: Ptt 24097, 6: Ptt 26706, 7: Ptt 26707, 8: Ptt 26709, 10: Ptt 26710.

TABLE 2. Characteristics of long stopovers (more than one week) used by Houbara Bustards. Only seven Houbara out of nine did make a long stopover (Kazakhstan 1995–1996).

Breeding area	PTT	Year	Distance from breeding grounds (km)	Bearing from breeding grounds	Location	Date range (mm/dd)	Duration (days)	Number of locations	Home range[a] (km^2)
Taukum	24089	1995	600	SW	Kyzylkum	07/30–09/06	38	12	553
	24093	1995	180	N	Sary-Ishikotrau	07/29–09/23	56	42	258
	24097	1995	300	SW	Kyzylkum	08/22–09/22	31	13	834
Buzachi	26706	1996	550	SW	Kyzylkum	09/08–11/03	56	38	619
	26709	1996	220	W	Muyumkum	09/04–09/20	16	6	151
	26707	1996	60	SE	Buzachi	07/05–09/01	51	20	587
			230	S-SE	Mangyschlak	08/25–09/17	16	12	130
	26710	1996	80	S	Buzachi	08/18–09/05	17	12	658

[a] Home range: estimated with the 75% bivariate normal ellipse method (White Garrott 1990).

wards known wintering areas, generally west, southwest, south, or southeast (Fig. 1). In one instance a male went north of its breeding ground.

The second type of migratory movement was of large amplitude (1,280–2,100 km) and started either from the breeding ground or from a long stopover and ended on a known wintering area. They were accomplished over a short period of time (from 11 to 21 days) at the average daily travel distance of 161 ± 31 km day^{-1}. The data suggest that this second type of migratory movement consisted of flights of 146 to 1,375 km and were interrupted by short stopovers lasting from 7 hr to 6 days (Table 3).

TRAVEL RATE

The overall travel rate between the breeding grounds and a known wintering ground ranged from 24 to 151 km day^{-1} (Table 3). The maximum travel rate estimated between the short stopovers showed that up to 323 km could be covered in one day (Table 3).

MIGRATION TIMING

Migration starting date was subject to large inter-individual variation, ranging from the 5 July to 18 September. The arrival dates on the wintering grounds were spread over 2 months (from 14 September to 14 November). The duration of the outward migration of Houbara ranged from 14 to 86 days, depending on individuals and the time spent on stopovers.

On one occasion, PTT messages of class 0 and above were received during a migration period, within a few hours. These data show that the bird moved 111 km in a maximum of 6.7 hr, starting after 21:20 local time on 12 September and ending before 04:06 local time on 13 September, indicating that some migration flights could occur at night in Houbara Bustard.

MIGRATION ROUTES

All birds tagged in the Taukum desert moved southwestwards then south. They followed the border of Kirgizstan and Tadjikistan, crossing east-Uzbekistan and east-Turkmenistan before transmission stopped being received in Afghanistan (Registan desert) or in Iran (Kavir region). The migration routes invariably turned round the high mountains of the Tien Shan, the Pamir, and the Hindu Kush.

All birds tagged in the Buzachi peninsula by-passed the Caspian Sea. Their first move was directed southsoutheastward down to Iran. They then turned southwestward across Iran down to Iraq and crossed the Qahrem Anshahr Mountains which reach an altitude of 2,000–2,500 m. Their wintering ground extended from the northeastern border of Saudi Arabia to the southwestern part of the Iraqi-Iranian border.

STOPOVERS

The long stopovers were not randomly distributed. They were mainly in Kazakhstan (Kyzylkum desert), Turkmenistan (south east Karakum), and Iran (Sahlabad area) for the birds coming from the Taukum region, and western Uzbekistan for the birds coming from the Buzachi Peninsula (Fig. 1). Birds tagged in 1995 and 1996 followed the same routes.

TABLE 3. Characterstics of Houbara Bustard migration tracked via satellite (Kazakhstan 1995–1996). Numbers are minimum–maximum.

Breeding area	Year	n	Departure date from breeding grounds (mm/dd/yy)	Arrival date on known wintering grounds (mm/dd/yy)	Total distance covered (km)	Total duration of migration (days)	Overall daily travel distance[a] (km day^{-1})	Number of long stopovers (>7 days)	Number of short stopovers (<7 days)	Duration of short stopovers (days)	Distance between short stopovers (km)	Maximum daily travel distances between short stopovers (km day^{-1})
Taukum	1995	4	07/25/95–08/25/95	09/14/95–11/12/95	1,600–2,120	20–71	24–80	0–1	0–1	1–6	309–1,375	44–224
	1996	2	09/01/96–09/02/96	10/01/96–11/14/96	1,830–2,320	30–73	25–77	1	2–3	1–6	211–1,024	42–323
Buzachi	1995	1	09/18/95	10/01/96	1,970	13	151	0	4	1	146–614	73–307
	1996	2	08/15/96–08/26/96	09/19/96–10/01/96	2,030–2,050	35–36	58-59	1–2	3–5	0.3–1	111–613	55–306

[a] Calculated from the breeding grounds to the wintering grounds.

DISCUSSION

The tagged Houbara that breed in eastern and western Kazakhstan moved a distance ranging from 1,600–2,320 and 1,970–2,090 km, respectively, to reach their wintering grounds. The population of Houbara sampled in this study completed its outward migration within about 4 months. The duration of migration for individual Houbara ranged from 14 to 73 days. It is thus likely that the waves of arrival of Houbara on the wintering grounds (Sheldon and Launay 1998) do not correspond to the arrival of different populations but are an expression of the high interindividual variability in migration patterns.

We also observed an important interindividual variation in migratory profiles. Single long stopover migrants was the commonest profile (six birds out of nine), direct migrants represented two birds out of nine, and double long stopover migrants, one bird out of nine. The time spent on stopovers matches what is commonly observed in passerines (Dolnik 1990).

The travel rate during migration was in the range (150–200 km day^{-1}) commonly observed for long distance migrants (Alerstam and Lindström 1990, Berthold 1993).

The Houbara from western Kazakhstan winter in southern Iraq, and the Houbara from eastern Kazakhstan winter in the Registan desert (Afghanistan), the adjacent Iranian area of Kavir and north Baluchistan. In addition to the routes described in this study, three Houbara which were banded in Taukum in 1995 and 1996 were recaptured either in south Registan or in north Baluchistan between Washuk and Hurmagai (Pakistan). Thus, Houbara from the two breeding areas studied in Kazakhstan have different wintering areas. The migration paths observed are different from that of the return migration of a male Houbara tracked from the United Arab Emirate to its possible breeding area in the Sarykamysh depression in Turkmenistan (Osborne et al. 1997). The autumn migration route of the birds from the eastern and western populations of Kazakhstan follows the directional trends described by Dolnik (1990) for central Asian passerines, whereas the vernal migration reported for the male wintering in Abu Dhabi (Osborne et al. 1997) does not. The migration routes from both sides of Kazakhstan bend to avoid natural obstacles, i.e., mountains and the Caspian Sea. These very well separated migration routes and wintering areas suggest the existence of two different sub-populations. Genetic studies of Houbara from these two breeding areas are actually being done in the United Arab Emirate to investigate the existence of Asian Houbara subpopulations. These results demonstrate once again the need for international collaboration in addressing conservation issue.

We are grateful to HH Sheikh Khalifa bin Zayed Al Nahyan, Crown Prince of Abu Dhabi and Chairman of the Board, and HH Sheikh Hamdan bin Zayed Al Nahyan, Vice Chairman, for financing this research. We are grateful to Anatoly Kovshar, Victoria Kovshar, and Feodor Karpov for their assistance in Kazakhstan. We also thank Patrick Osborne who initiated the radio-tracking work in NARC, and John Cooper and Paul Goriup for their encouragement throughout the project.

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The Condor 101:164–168

COPULATORY BEHAVIOR OF THE BEARDED VULTURE[1]

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Abstract: We describe copulation activity by Bearded Vultures (*Gypaetus barbatus*) at nesting sites in the Pyrenees, northern Spain, between 1993 and 1995. Pairs copulated for an average period of 67 days (range: 50–90) prior to egg laying. Seventy-five percent of attempts ended in successful copulation. Pairs displayed a daily bimodal pattern of copulation, with copulations occurring most frequently in the evening. Low levels of opportunities for extra-pair encounters (0.02 intrusions hr^{-1}) were obtained despite the high density of reproductive individuals present. The high copulation rate observed may be explained by the potential risk of extra-pair copulations occurring while a member of the pair is away foraging, an activity which takes up as much as 65% of time each day. This species also showed a pattern of pair attention similar to that of other species of raptors in which males guard their females during the fertile period.

Key words: Bearded Vulture, copulations, extra-pair copulations, Gypaetus barbatus, *nesting sites, paternity assurance.*

Vultures differ from other raptors in that both sexes have similar parental roles (Newton 1979). Vultures are either socially organized in colonies or solitary (Donázar 1993). Although information on the characteristics of their reproductive behavior is scarce, in

[1] Received 24 February 1998. Accepted 19 August 1998.