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Investigation Wintering And Breeding Habitat Selection by Asiatic Houbara Bustard (*Chlamydotis macqueenii*) In Central Steppe of Iran

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***Abstract*—**Asiatic Houbara (*Chlamydotis macqueenii*) is a flagship and vulnerable species. In-situ conservation of this threatened species demands for knowledge of its habitat selection. The aim of this study was to determine habitat variables influencing birds wintering and breeding selection in semi- arid central Iran. Habitat features of the detected nest and pellet sites were compared with paired and random plots by quantifying a number of habitat variables. In wintering habitat use at micro scale houbara selected sites where vegetation cover was significantly lower compard to control sites($p< 0.001$). Areas with low number of larger plant species ($p=0.03$) that were not too close to a vegetation patch($p<0.001$) were selected for breeding habitat.

***Keywords*—**Asiatic houbara bustard, Habitat selection, Nest, pellet.

I. Introduction

ASIATIC HOUBARA (*Chlamydotis macqueenii*) is a flagship species, which has recently attracted international conservation concerns. This species is listed as vulnerable on the iucn red list of threatened species (Iucn [3]). there have been several studies on the habitat use of houbara bustard in different asiatic countries through its range [(Saudi Arabia), Combreau and Smith [1]; (United Arab Emirates) , Launay et al [4]; Osborne et al [8]; (Kazakhstan) , Combreau and Smith [1]; (China), yang et al [9]; (Pakistan) Mian [5]-[6]-[7]. however, habitat selection of this species has not hitherto been studied in iran. a few studies have suggested that breeding houbara have a preference on areas with low to very low vegetation density (e.g. Combreau and Smith [1]; Osborne et al [8]; Mian [7]; Yang et al [9] but studies on wintering habitat selection by houbara is rare. launay et al [4] noticed that plant cover, substrate, topography are determinates of wintering habitat use. the study by hingrat et al [2] has shown farms are not use by houbara in winter. the aim of this study was to determine habitat variables influencing houbara habitat selection. hopefully, help the population management and increase the probability of survival for this vulnerable species.

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II. Methods

A. Study Area

The study was conducted in Gharatapeh, south of Yazd province with an area of 8000 ha. The climate is warm and dry with annual precipitation about 100 mm. Plant species such as *Artemisia sieberi*, *Seidlitzia rosmarinus* and *Zygophyllum atriplicoides* are dominant in the area . There are other less frequntly occurring bush species within the study area including: Salsola sp, *Ebenus stellata*, Ephedra sp . The vegetation communities are comprised of a number of large patches intermixed with each other and with farmland. Larger blocks of cultivated lands located in northern and southern parts of the area while smaller farms scattered throughout the area.

B. Sampling

For wintering habitat selection pellets of houbara were used that were larger and easily distinguishable from of other bird species present in the area in winter 2006-2007. Where a houbara pellet was detected, a 10. 10 m plot, centered on the pellet, was established and a number of habitat variables including percent cover and height of each plant species were quantified within it. In this way 118 plots (96 plots in bush-steppe habitat and 22 plots in shrub- steppe habitat) were placed on the detected houbara pellets throughout the study area. For each plot, a paired plot was positioned by walking about 500m from the first plot in the random direction and the same habitat variables were measured within them. No houbara pellet was found in any of the paired plots. Equally, the same numbers of plots were also randomly placed in the two habitats and similar variables were measured within them. These plots were considered as independent plots to give the mean of habitat variables within each habitat.

Search for houbara nests was conducted from March to

june 2004-2007 using vehicles driving with low speed. Whenever a female bird flashed from it nest, the vehicles were stopped and the search was continued by the group by foot across a space of some handreds of meters in diameter near the flight and specially in its contrary direction. Where a houbara nest was detected, a 10. 10 m plot, centered on the nest, was established and a number of habitat variables including number of dominant plant species, distance to the nearest patch(m) and number of insect holes were quantified within it. For each plot, a paired plot was positioned by walking about 500m from the first plot in the random direction and the same habitat variables were measured within them. No houbara nest was found in any of the paired plots. Equally, the same numbers of plots were also randomly placed in the two habitats and similar variables were measured within them.

C. Analysis

To assess micro- wintering habitat use by houbara in each habitat, we compare vegetation variables measured in use plots (plots placed where houbara pellets were detected) with paired plots using paired t- test. Independent sample t- test was applied to compare use plots with plots randomly located within each habitat. For analysis data of breeding habitat use between nest plots (plots placed where houbara nests were detected that were 23 plots) and paired plots Wilcoxon test was used. Mann-whitney test was applied to compare use plots with plots randomly located within habitat.

Results

Table. I. Summarised the results of paired and independent sample t- test comparing vegetation variables between use and paired or random plots in wintering habitat. In each habitat (bush-steppe habitat including: *Artemisia sieberi*, *Seidlitzia rosmarinus* and shrub- steppe habitat including: *Zygopgyllum atriplicoides*), percent cover and height of the dominant plant species and percent cover of total vegetation are compared between use and paired plots. In both habitats, mean percent cover of total vegetation variables were lower in use plots compared to paired or random plots. In the bush steppe habitat , percent cover of *Artemisia sieberi*, *Seidlitzia rosmarinus* , and in shrub steppe habitat percent cover of total vegetation and percent cover of *Zygopgyllum atriplicoides* were significantly differed between the use and paired plots. Comparing vegetation variables in use plots with random plots in each habitat (using independent sample t- test) provided similar results. Table II. Summarised the results of Wilcoxon and Mann- withney test comparing vegetation variables between use, paired and random plots in breeding habitat. Habitat variables did not show significant difference when comparing nest plot with paired plots. However variable such as number of insect holes , density of *Zygophyllum atriplicoides* and distance to nearest patch were significant when comparing nest with random plots. Most of nests were found in bush- steppe habitat (Fig. 1).

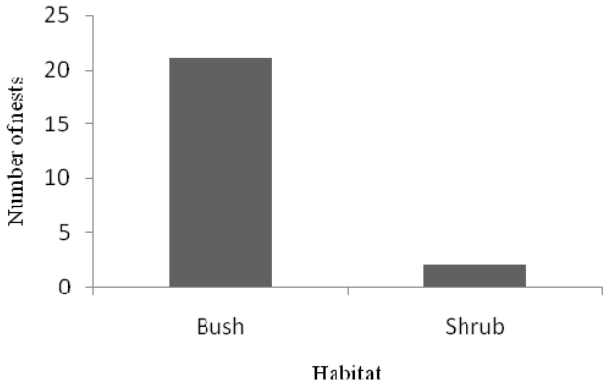

Fig. 1 Number of nests in Bush and Shrub steppe habitat

III. Discussion

Our analyses revealed that total vegetation percent cover and height of species were lower in use wintering habitat. More open sities provide better visibility, which helps houbara to detected approaching predators. Our findings at micro scale was agreement with the results reported by Combreau and Smith [1]; Mian [5]-[6]-[7]; Yang et al [9]; Osborne et al [8]. Most of the studies on wintering habitat selection of houbara bustard have been conducted at micro scale and led to the conclusion that vegetation density is an important factor in determining houbara habitat suitability. Houbara also are largely dependent on farmlands and may be locally sensetive to agricultural development strategies in our study. Shift from cultivation alf alfa and rocket salad to Pistachio may decrease the suitability of habitat for houbaras .

Our results revealed female houbara selected areas with low number of larger plant species and where are not too close to a vegetation patch are also favoured. Number of insect holes in nest- site was more. These results are in harmony with the results obtained by Combreau and Smith [1] in Saudi Arabia and Mian [5]-[6] in Pakistan. Heigh density of shrubs and vegetation patches provide a hiding place for predators and limit range of vision and therefore are avioded by houbara as nesting site. Insect a rich food source for the chicks and it can be another reason for their selection that is agreement with the result obtained by Hingrat et al [2]. Most of the studies on breeding or wintering habitat selection of houbara bustard have been conducted at micro scale . We proffer habitat selection study at macro scale.

TABLE I

MEAN ± SE OF SQUARE ROOT TRANSFORMED PERCENT COVER OF TOTAL VEGETATION AND DOMINANT PLANT SPECIES AS WELL AS HEIGHT OF DOMINANT PLANT SPECIES IN USE, PAIRED AND RANDOM PLOTS. RESULTS OF T- TESTS COMPARING VEGETATION VARIABLES BETWEEN USE AND PAIRED (PAIRED T-TEST) AND RANDOM (TWO- SAMPLE- T- TEST) PLOTS ARE GIVEN.

Habitat	Vegetation variables	Use	paired	Random	Paired t (df)	P	Two sample t (df)	P
		Mean(SE)	Mean(SE)	Mean (SE)				
Bush steppe habitat	Total vegetation	0.28(0.01)	0.38(0.01)	0.44(0.006	7.56(95)	**<0.001**	13.18(161	**<0.001**
	Artemisia	0.14(0.01)	0.20(0.01)	0.23(0.01)	3.94(95)	**<0.001**	3.51(175)	**<0.001**
	Seidlitzia	0.06(0.009	0.12(0.01)	0.17(0.01)	4.06(95)	**<0.001**	5.03(143)	**<0.001**
	Height of Artemisia	1.40 (0.01)	1.37(0.01)	1.42(0.01)	1.11(67)	0.26	0.56(114)	0.57
	Height of Seidlitzia	1.50(0.02)	1.44(0.04)	1.60(0.01)	1.50(31)	0.14	3.60 (41)	**<0.001**
Shrub steppe habitat	Total vegetation	0.12(0.03)	0.17(0.03)	)0.23(0.04	2.49(21)	**0.02**	1.92(37)	0.06
	Zygophyllum	0.08(0.02)	0.11(0.02)	0.16(0.03)	2.04(21)	**0.05**	1.98(37)	**0.05**
	Height of zygopgyllum	1.86(0.03)	1.95(0.02)	1.92(0.02)	1.75(8)	0.11	1.27(16)	0.22

TABLE II

RESULTS OF NONPARAMETRIC TEST COMPARING VEGETATION VARIABLES BETWEEN USE AND PAIRED (WILCOXON TEST) AND RANDOM (MANN- WITHNEY TEST) PLOTS ARE GIVEN

Variables (m^{-2}), (m*)	Presence (n=23) Mean(SE)	Paired n=23 Mean(SE)	Random n=23 Mean(SE)	Wicoxon	P	Mann-withney	P
Number of insect holes	31.08(3.70)	23.52(3.16)	11.26(0.86)	1.68	0.09	4.21	**<0.001**
Density of Artemisia	0.28(0.06)	0.31(0.04)	0.14(0.01)	1.26	0.02	1.92	0.05
Density of Zygophyllm	0.02(0.004)	0.02(0.003)	0.03(0.003)	1.28	0.20	2.35	**0.01**
Density of seidlitzia	0.00009(0000.6)	0.0004(0.0004)	0.01(0.009)	0.57	0.56	1.01	0.31
Density of salsola	0.01(0.009)	0.02(0.01)	0.009(0.004)	0.51	0.60	0.14	0.88
Distance to field*	838956(168.77)	10439.61(3020.54)	5821.29(627.45)	0.50	0.61	1.26	0.20
Distance to closet patch *	44.52(4.38)	57.52(5.32)	20.34(1.81)	1.78	0.07	4.39	**<0.001**

Mann-Whitney U- test, wilcoxon, non –significant difference, P>0.05
Mann- Withney U –test, wilcoxon, significant difference, P<0.05
Mann- Withney U –test, wilcoxon, significant difference, P<0.01

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