

HABITAT PREFERRED AND HOME RANGE OF HAND-REARED AND RELEASED CHUKAR PARTRIDGE (*ALECTORIS CHUKAR* GRAY, 1830) IN SE BULGARIA

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Abstract

Between August 2009 and May 2010 74 Chukar Partridge (25 August to November 2009 and 49 from February to May 2010) were released. Chukar Partridges inhabit different size areas between 31.5 and 65.7 ha, but about 10 % of the area of the habitat. Birds prefer thorn bushes during the day to the other areas ($\chi^2 = 13.185$, $df = 4$, $p < 0.05$). Data show low efficiency of the release and the need to change the practices of resettlement of Chukar Partridges in Bulgaria.

Key words: Chukar Partridge, bird habitat preferences, bird reintroduction, bird habitat selection.

Introduction

In Bulgaria, Chukar Partridge (*Alectoris chukar* Gray, 1830) has a decreasing population trend after 1990 (Stoychev et al. 2007, Delov 2011, Gruychev 2014). The species is missing completely from the suitable habitats of Sakar Mountain (Stoychev et al. 2008, Gruychev 2014) and has disappeared in Western Strandzha Mnt. too where it was nesting in the early 90s of the last century (Milchev 1991, Milchev 2010).

Recovery programs of wild Galliformes with released birds are common hunting practice in Europe (Gortázar 1998, Gortázar et al. 2006). In Bulgaria, the recovery of Chukar by release of farm birds suffered major setbacks over the last decade. After settling the majority of the birds died within the first two weeks (Gruychev

2012). Setting the preferences of birds to certain parts of the habitats brings important knowledge that would determine measures of the recovery of the species as well as the reasons for the losses.

Studies of Chukar habitat in the Kardzhali region associate its distribution with humus-carbonate soils or heavily eroded soils. There are growing many drought resistant grasses and shrubs providing food and shelter for the birds (Ivanov 1985). In other places where Chukar has been successfully acclimatized the main requirements are the presence of cliffs and rocky talus (Christensen 1970). Grazing intensity, the human presence, the burning of the habitat and the lack of permanent water sources are some of the factors determining the distribution, dispersal and surviving of

Chukars (Harper et al. 1958, Kirby and Grosz 1995, Robbins et al. 2002, Bhat-tacharya et al. 2007, Alexis and Powell 2008, Larsen et al. 2010).

The aim of this study was to determine dispersion and habitat preferences of Chukar Partridge in Bulgaria. This can lead to optimization of the release and improve the results of the recovery programs for the Chukar.

Material and Methods

Study area

The study area is located in Southeastern Bulgaria and occupies parts of Thracian lowland and Sakar Mountain. We investigated three habitats near the villages Polyanovo (habitat P), Bulgarin (habitat B) and Levka (habitat L) (Fig. 1). The landscape is hilly with gently slopes and single small cliffs and rock formations in the ravines. The soils are sandy. The area falls within the of Trans-Mediterranean cli-

matic zone (Bondev 1991). The average rainfall is 600–995 mm with a maximum in November and December. The driest period is from August to September.

The Chukar's habitats are characterized by a prolonged drought in the summer, but there are many evenly distributed micro-reservoirs over the entire territory. Maritsa River flows nearby one of the studied areas (Fig. 1). The average annual temperature during the study period was 13.3 °C. The average rainfall was 615 mm (data from nearest weather station Svilengrad). The average altitude near (B) is about 159 m, (P) – 193 m, (L) – 199 m.

The vegetation consists in: trees, single trees from Oaks (*Quercus* spp.), Pear (*Pyrus* spp.) and small mixed groups of Oak and Hornbeam (*Carpinus orientalis* Mill.); shrub, dominant shrub species is Jerusalem Thorn, (*Paliurus spina-christi* Mill.), but there are Roses (*Rosa*), Blackthorn (*Prunus spinosa* L.) and Hawthorn (*Crataegus* spp.); grass, the dominant grass species is *Bothriochloa ischaemum* (L.) Keng, Black beard (*Chrysopogon gryllus* L.) and Bulbous bluegrass (*Poa bul-*

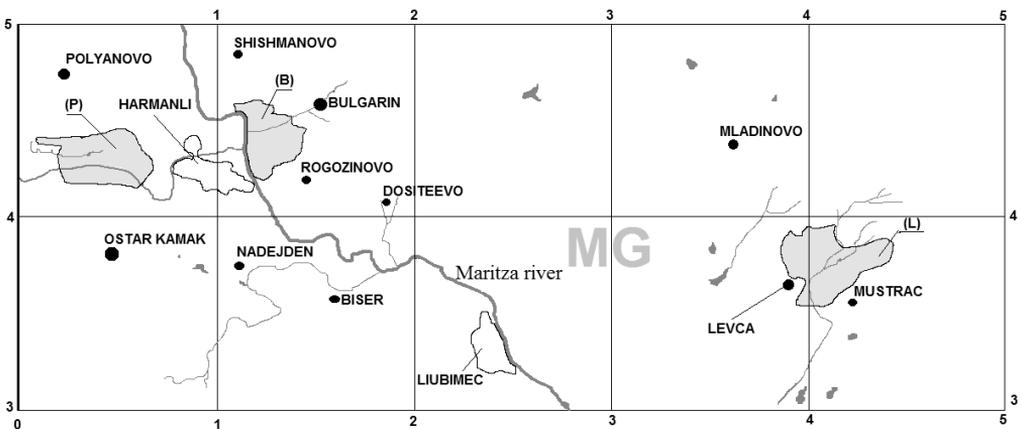


Fig. 1. The location of study site in SE Bulgaria: (P) – study habitat Polyanovo; (B) – study habitat Bulgarin and (L) – study habitat Levka.

bosa L.). Less frequently are found species like hawksbeard (*Crepis sancta* (L.) Babc.), Prickly juniper (*Juniperus oxycedrus* L.), Holy grass (*Anthoxantum odoratum* L.), Duch clover (*Trifolium repens* L.), Volga fescue (*Festuca valesiaca* Schleich ex. Gaudin).

Field methods

The survey was conducted from February 2009 to November 2010. 74 Chukar Partridge (25 August to November 2009 and 49 from February to May 2010) were studied. The birds were adapted in the aviary, adaptation cages and directly released in three habitats within the land borders of the villages Bulgarin (B), Polyanovo (P) and Levka (L) (Fig. 1). In each habitat were released the following numbers of birds: (P) – 27 birds (22 in spring and 5 in autumn); (B) – 20 birds (10 in spring, 10 in autumn); (L) – 27 birds (17 in spring and 10 in autumn).

All Chukars were marked with radio-telemetry transmitters RI-2B (Holohil system Ltd) and located every 7 days with precise GPS coordinates after eye contact. The localization is done at least one hour after sunrise and before sunset, thus avoiding differences in habitat use in terms of time of the day (Swihart and Slade 1985).

The habitats were classified as: 1) Wetlands; 2) Rocks; 3) Grassland; 4) Deciduous forests; 5) Thorn (*Paliurus*) bushes; 6) Acacia forest; 7) Black pine plantations and 8) Farmland.

Data analysis

The bird home range was determined using minimum convex polygon (MCP) (Mohr 1947). Only birds that were seen more than

25 times were included in the determination of MCP (Kenward 2001). There were 5 Chukar Partridge in (L) and 2 in (P). The birds were seen 27 times in (L) and 28 in (P). The total home range was determined using the average home range of each bird in each habitat with Calhome Software (Kie et al. 1996). The area of MCP in (B) was determined as the area of MCP of all localized birds because there were too few sights. It is only used to determine the preferences of habitat and not collated with other MCP studied regions.

The preferred habitats of the birds were determined by dividing the area of the habitat into different categories in MCP 100 % (Table 1) and by calculating the total number of localities of each bird in the respective habitat category. After that a Chi-squared test was used to determine whether the number of locations in one area was significantly higher than the number of locations in the other areas (Fowler and Cohen 1995).

The obtained results were compared and tested for statistically significant differences with nonparametric (Kruskal-Wallis and Mann-Whitney Tests) and Chi-square test. In all statistical tests the significance level was $P < 0.05$. All statistical analyzes were performed with PAST (Hammer et al. 2001).

Results

Distribution of areas in the study regions showed significant occupation of territory habitat of *Paliurus* (Table 1).

Chukars occupy different sized areas (average \pm stdev (min-max) ha). In (P), the area of the MCP (100 %) is 31.5 ± 7.6 (26.2–36.9), in (B) 62.5,

Table 1. Percentage distribution of habitat types in the three study areas and number of localities of Chukar Partridge (*Alectoris chukar*) in each habitat

Type of habitat area	Polyanovo (P)			Bulgarin (B)			Levka (L)		
	habitat, %	100% MCP, %	locations, number	habitat, %	100% MCP, %	locations, number	habitat, %	100% MCP, %	locations, number
Wethlands	9.27	6.65	9	18.82	4.38	2	1.54	0.15	0
Rocks	2.95	5.98	7	0	0	11	7.89	17.75	13
Grasslands	10.65	21.98	22	4.24	11.03	10	0	0	0
Deciduous forest	8.00	1.01	1	3.27	15.56	0	5.08	0	0
Thorn (<i>Paliurus</i> spp.) bushes	68.56	64.38	25	59.22	51.51	16	45.29	45.24	18
Acacia forest	0.49	0	0	0	0	0	0	0	0
Black pine plantation	0.00	0	0	6.28	0	0	25.1	32.9	0
Farmland	0.08	0	2	8.17	17.52	9	15.1	3.96	0

in (L) 65.7 ± 32.7 (24.6–116.2). It was possible calculated MCP (90 %) in (P) and (L) – 20.5 ± 0.01 (20.48–20.5) and 39.6 ± 19.7 (20.2–60.2) ha respectively. There are no significant difference in the average area of MCP (90 %) in both study areas ($H_c = 1.35$, $p = 0.245$). In (P) Chukars occupy 10.1 % of the area of habitat, in (B) 10.7 % and in (L) 9.11 %. The density of the Chukar Partridge in study habitats is different. During the first weeks after release it is 9.3 ind./100 ha in (P), 32 ind./100 ha in (B) and 23.2 ind./100 ha in (L). Spring density of birds in the MCP (100 %) during the first week after the release is: (P) 7.6 ind./100 ha; (B) 16 ind./100 ha; (L) 14.6 ind./100 ha. It decreases in the following 9 weeks, and them remains constant (P) and (L) and in (B) all birds were died after 4 weeks (Fig. 2).

Chukar Partridge in (P) prefer *Paliurus* bushes during the day compared to the other areas ($\chi^2 = 13.185$, $df = 4$, $p < 0.05$). Chukars in habitat in (B) analysis cannot highlight significant differences ($\chi^2 = 9.22$,

$df = 4$, ns). In habitat (L), Chukars prefer from Thorn bushes back to the other areas ($\chi^2 = 12.19$, $df = 4$, $p < 0.05$).

The average distance of birds from permanent water sources in habitats was: (P) 311.03 ± 227.4 (60–138 m), (B) 287.5 ± 235.1 (60–840 m), (L) 412.5 ± 322.2 (60–1120 m). There was no significant difference between the alienation of Chukars of wetlands in the three study areas ($H_c = 1.62$, $p = 0.44$).

Discussion

The results for the home ranges in this study are similar to those in other ones for Chukar Partridge (Lindbloom 1998; Walter 2000, 2002). They show that Chukars inhabit relatively small areas in spring and summer, despite their territoriality during the breeding season. It is unknown, however, whether in winter birds travel to greater distances as a result of persecution or in search of food. Therefore, the habitat re-

mains an important factor for the release of Chukar Partridges. The results of this study indicate that farm Chukar Partridges remain around the places of release. These results showed the need for mosaic location of adaptation cages and aviaries in the habitat when introducing Chukars. This will insure the uniform bird distribution across the habitats. In (B), the spring density is greater than the other examined areas (16 ind./100 ha). Here the losses are 100 % after the fifth week of release. Although there may be a number of factors determining the amount of loss, small size of the habitat in combination with high density of birds leads to unsatisfactory results in a short period of time. In (P) and (L), the density nine weeks after the release is between 1–4.3 ind./100 ha, which again is an unsatisfactory result. With these methods of release it is impossible to create a stable group of Chukar Partridges and to ensure their successful reproduction in the future. Similar results were reported in general for many Galliformes (Sokos et al. 2008). The authors recommend switching to semi-breeding and release or capture and relocation of birds from wild populations. The latter is impossible at the current time in Bulgaria. The density of the Chukar Partridges in the three study areas is different, but they occupy almost the same area of the habitat (about 10 %). These habitats satisfy the requirements of the species, which is why Chukars do not wander or move to other areas. Similar results are also known in the USA (Nevada; Benolkin 1988). In (P) spring density of Chukars, first week after displacement, is nearly twice lower than that in (L). However, in both habitats Chukar Partridges use the same parts.

Chukar Partridges prefer *Paliurus* bushes over other parts of the habitat. In other studies for wild Chukar population in Bulgaria, breeding density increase with increase to percentage of rock outcrop and Chukar Partridge preferred two plant community (*Paliurus spina-christi* - *Poa bulbosa* and *Paliurus spina-christi*-*Eryngium camp-estri*-*Anthoxanthum odoratum*) for nesting (Gruychev et al. 2014). Although coverage of rocks, sometimes up to 50% of the habitats, followed by shrubs and grasses (Jonsgard 1973, Moreland 1950, Galbreath and Moreland 1953) in our study coverage of the rocks is relatively small. This can be predetermined preferences of Chukars into the *Paliurus* bushes. The birds seek refuge in the undergrowth of *Paliurus*, unlike the case, where 30–50 % of habitats are covered with rocks. Also little coverage of rocks can be one of the reasons for the losses after release. The characteristics of the habitats of Chukar in the studied areas are quite different from those in other parts of the species range and this is probably

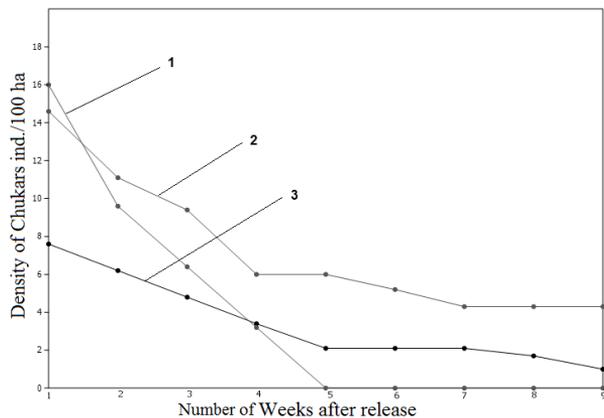


Fig. 2. Dynamics of spring density of Chukar partridge (*Alectoris chukar*) in weeks after the release of the three study areas (ind./100 ha).

Note: 1 – Bulgarian (B); 2 – Levka (L); 3 – Polyanovo (P).

caused of this preferences. This should be taken into account when selecting sites for construction of aviaries and adaptation cages in these habitats.

The average distance to permanent water sources identified by us are relatively short. The distance of birds which moved away from permanent water sources in western Utah was 625 (390–1664 m) (Larsen et al. 2010). In other studies this distance was about 280 m (Lindbloom 1998; Walter 2000, 2002). Red-legged Partridge in Spain established at medium distances from water sources (328 and 285 m) (Boralho et al. 1998). In our study areas there are numerous small permanent water sources (Fig. 1) and this is the likely cause that Chukar Partridges do not stray at long distances in the summer months. The presences of numerous small ponds are not a crucial factor in the distribution of the Chukar in the research area.

The results of this study showed low efficacy of the applied practices for recovery of the Chukar Partridge in Bulgaria. Changes are needed in production practices of farm Chukars and change to semi-breeding in restoring the local native populations of the Chukar Partridge in Bulgaria.

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References

ALEXIS F., POWELL A. 2008. Responses of breeding birds in tall grass prairie to fire and

cattle grazing. *Journal of Field Ornithology* 79(1): 41–52.

BHATTACHARYA T., SATHYAKUMAR S., RAWAT G. 2007. Distribution and abundance of Galliformen in response to anthropogenic pressures in the buffer zone of Nanda Devi Biosphera Reserve. IV International Symposium, Chengobu, China. *International Journal of Galliformes Conservation* 1: 78–84.

BONDEV I. 1991. Vegetation in Bulgaria. Map in M 1:600,000 with explanatory text. Kliment Ohridski, Sofia. 184 p. (in Bulgarian).

BORALHO R., RITO A., REGO F., SIMOES H., PINTO P. 1998. Summer distribution of red-legged partridge *Alectoris rufa* in relation to water availability on Mediterranean farmland. *Ibis* 140: 620–625.

CHRISTENSEN G. 1970. The Chukar partridge: its introduction, life history, and management. Nevada, USA, Department of Fish and Game, Reno. *Biologicalyca l biuletin* 4. 80 p.

DELOV V. 2011. Chukar partridge (*Alectoris chukar*). – In: Golemanski V. (Ed.). *Red Data Book of the Republic of Bulgaria. Volume 2 Animals*. IBEI – BAS & MOEW, Sofia. 384 p.

FOWLER J., COHEN L. 1995. *Statistics for Ornithologists*. BTO Guide No 22. 150 p.

GALBREATH D., MORELAND R. 1953. The Chukar Partridge in Washington. Washington department of Game biological bulletin 11. 55 p.

GORTÁZAR C. 1998. Las repoblaciones con Perdiz Roja. – In: Fedenca-Grupo editorial V. (Ed.). *La perdiz roja. I Curso*. Fedenca-Grupo editorial V. Madrid: 119–134 (in Spanish).

GORTÁZAR C., ACEVEDO P., RUIZ-FONS F., VICENTE J. 2006. Disease risks and overabundance of game species. *European Journal of Wildlife Resource* 52: 81–87.

GRUYCHEV G. 2012. Result from Radio-telemetric Monitoring of Hand Reared and Released Chukar Partridges (*Alectoris chukar*, Gray 1830). *Acta zoologica bulgarica* 64(1): 59–65.

GRUYCHEV G. 2014. Abundance and conservation of Chukar partridge (*Alectoris chukar* Gray, 1830) in Bulgaria. PhD Thesis,

- University of Forestry, Sofia. 128 p. (in Bulgarian, English summary).
- GRUYCHEV G., DYAKOV N., DIMITROV D. 2014. Habitat variables influencing Chukar Partridge decrease in Southeastern Bulgaria. *Folia zoologica* 63(3): 171–179.
- HAMMER O., HARPER D., RYAN P. 2001. PAST: Paleontological Statistic Software Package for Education and Data Analysis. *Paleontologia Electronica* 4(1): 9.
- HARPER T., HARRY B., BAILEY W. 1958. The Chukar Partridge in California. *California fish and game* 44: 5–50.
- IVANOV I. 1985. Status, development and problems of Chukar Partridge in Kardzhali region. *Bulletin of National game and fish association in Bugaria. Kardzhali*. 43 p. (in Bulgarian).
- JONSGARD P. 1973. Chukar Partridge. *Grouse and Quails of North America*. University of Nebraska, Linkoln: 489–501.
- KENWARD R. 2001. *A manual for wildlife radio tagging*. 2nd edition New York, Academic Press. 350 p.
- KIE J., BALDWIN J., EVANS CH. 1996. CALHOME: A program for estimating animal Home ranges. *Wildlife Society Bulletin* 24(2): 342–344.
- KIRBY D., GROSZ K. 1995. Cattle grazing and sharp-tailed grouse nesting success. *Rangelands* 17(4): 124–126.
- LARSEN R., BISSONETTE J., FLINDERS J., HOOTEN M., WILSON T. 2010. Summer spatial patterning of chukars in relation to free water in western Utah. *Landscape Ecology* 25: 135–145.
- LINDBLOOM J. 1998. Habitat use, reproduction, movements, and survival of Chukar Partridge in west-central Idaho. Master thesis. University of Idaho, Moscow. 131 p.
- MILCHEV B. 1991. Ornithocenological studies of Strandzha Mountain in Bulgaria. PhD thesis. University of Sofia, Faculty of Biology. 182 p. (in Bulgarian).
- MILCHEV B. 2010. Expansion of the breeding distribution of Common Redstart (*Phoenicurus phoenicurus*) in SE Bulgaria. *Vogelwelt* 131: 257–259.
- MOHR C. 1947. Table of equivalent populations of North American small mammals. *American Midland Naturalist* 37: 223–249.
- MORELAND R. 1950. Success of Chukar Partridge in the state of Washington. *Transactions 15th North American Wildlife Conference* 15: 399–409.
- ROBBINS B., PETERSON A., ORTEGA-HUERTA M. 2002. Major negative impacts of early intensive cattle stocking on tallgrass prairie: The case of the Greater Prairie-Chicken (*Tympanuchus cupido*). *North American Birds* 56: 239–244.
- SOKOS CH., BRITSAS P., TSACHALIDIS E. 2008. The aims of Galliforms release and choice of techniques. *Wildlife Biology* 14(4): 412–422. DOI: 10.2981/0909-6396-14.4.412.
- STOYCHEV S., BOEV Z., DELOV V. 2007. Chukar (*Alectoris chukar*). – In: Iankov P. (Ed.). *Atlas of breeding birds in Bulgaria*. BSPB Conservation Series Book, 10: 196–197 (in Bulgarian and English).
- STOYCHEV S., DEMERDJIEV D., GERDJIKOV G., BORISOV B. 2008. *Birds of Sakar Mountain*. Astrea Tourist Association Publishing, Haskovo. 56 p. (in Bulgarian).
- SWIHART R., SLADE N. 1985. Testing for independence of observations in animal movements. *Ecology* 66: 1176–1184. <http://dx.doi.org/10.2307/1939170>.
- WALTER H. 2000. Ecology of the Chukar in eastern Oregon. Master's thesis, University of Idaho, Moscow. 132 p.
- WALTER H. 2002. Natural history and ecology of the Chukar (*Alectoris chukar*) in the northern Great Basin. *Great Basin Birds* 5(1): 28–37.