

Results from Radio-Telemetric Monitoring of Hand Reared and Released Chukar Partridges (*Alectoris chukar*, GRAY 1830)

Gradimir V. Gruychev

University of Forestry, Wildlife Management Department – 10 St. K. Ochriski Blvd., 1765 Sofia, Bulgaria;
E-mail: gradi.val@gmail.com

Abstract: The purpose of the study is to define the effectiveness of spring release of Chukar Partridge (*Alectoris chukar*). In the spring of 2010, 49 Chukar Partridges were marked with radio-telemetric transmitters. After the release, the disposal of birds, survivability of the species and the reasons for losses have been established. In the regions studied, the released birds remain around the resettlement place and only single specimen move away at a larger distance. On average, the survivability of the farm resettled Chukar Partridges in natural habitats of the species is 12.24%. The resettled birds gave the greatest losses during the first 20 days after the resettlement – 61.22% (n=49).

Key words: Chukar Partridge, *Alectoris chukar*, radio-telemetry, reasons for losses

Introduction

In Bulgaria, the natural habitats of Chukar Partridge comprise the regions from Asenovgrad – Zlatograd line in the East to Sredets, in the North to Nova Zagora, in the south to our Southern border with Turkey and Greece (BOTEV 1981, SIMEONOV et al. 1991). In the first decades of XX century the species was abundant, in particular in Sakar Mt. and the Eastern Rhodopes (PATEV 1950). After 1960, an intense resettlement of artificially produced birds began. The resettlements cover all typical habitats of the species in Thracian valley, Sakar, the East Rhodopes, etc. The stock of Chukar Partridges in the suitable habitats were about 200 000 birds (DRAGOEV 1971). In the period of 1996-2005, significant decrease of the species, and in some places complete disappearance from traditional habitats in Sakar was observed, where until recently the species has been numerous. The reasons are not known (STOYCHEV et al. 2007). In 2007, the number of Chukar Partridge

for the East Rhodopes was estimated to 1.8 birds per 100 ha in the reproductive and 2.2 birds per 100 ha in the non-reproductive period (GRUYCHEV 2007). Its number continue to decrease, in spite of the yearly release of partridges in hunting regions.

The purpose of present study is to define the effectiveness of spring release of the species before the beginning of egg-laying period. The dispersion of the birds after their release, their survivability and the reasons for losses were determined.

Materials and Methods

For achieving the purpose, sexually matured Chukar Partridges are further bred and released by means of a temporary aviary, adaptation cages and direct release in nature. The birds are one year old. The region of the study falls into natural habitats of the species (Fig. 1).

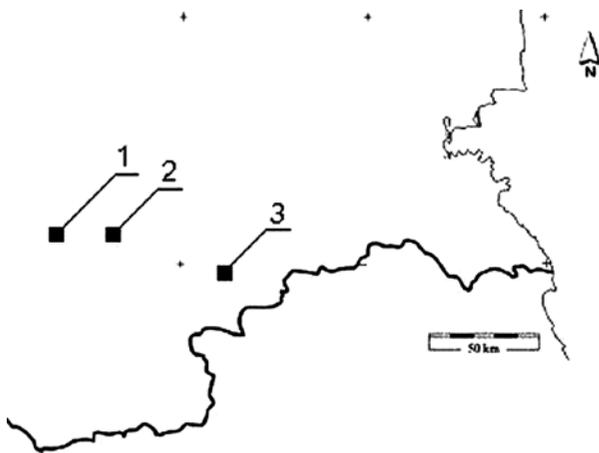


Fig.1. Place of study.

Three regions, which include natural habitats of the species, have been chosen. First area falls within the land borders of the village Polyanovo (Fig.1 p.1 N41 56.320 E25 50.168). The second area is within the land borders of Bulgarin village (Fig.1 p.2 N41 56.810 E25 56.165). Third area is within the land borders of Levka village (Fig.1 p.3 N41 52.778 E26 16.712). On the territory of the village of Levka there exists natural population of Chukar Partridge. A total of 49 birds have been marked (Table 1).

A radio-telemetric transmitter, emitting a signal with frequency of 216-219 MHz, has been attached to each bird. Thus each specimen differs individually on the terrain. Transmitters weighing 10 g and satisfy the requirement not be more than 3% by biomass of the bird (WITHEY *et al.* 2001). The signals have been taken using a radio-receiver with an antenna working in the same range. The birds set in the aviary and the adaptation cages are further bred in the course of 7 to 10 days depending on their adaptation to natural

Table 1. Number of released Chukar Partridges (*Alectoris chukar*).

Area	Date	Number of marked Chukar Partridges		Total
		males	females	
Levka	26.02.2010	9	8	17
Bulgarin	26.02.2010	5	5	10
Polyanovo	26.02.2010	4	6	10
Polyanovo	06.04.2010	6	4	10
Polyanovo	01.05.2010	2	0	2
Total		26	23	49

food and beginning of the reproductive period. The partridges are set in 2 batches. The marked birds have an average weight of 582.66 g. After the release, the regions have been visited totally 17 times, for the period 26. 02-20. 07. 2010. Each bird is localized with its precise location with GPS coordinates.

The reasons for the losses are divided into 4 categories – losses from predatory mammals; losses from predatory birds; losses from people; losses as a result of an uncertain reason. The reason for the death of birds has been established due to the traces left on the transmitter and the remains of feathers and bones around it.

The statistic processing of the information has been done by means of the Past programme (HAMMER *et al.* 2001). The exact coordinates of each marked bird have been established using Garmin mobile XT GPS system.

Results

Disposal of birds after the release.

During the first week after resettlement, partridges occupy a territory with a comparatively small area, as the most distant registered bird is located at a distance of 3 km from the resettlement place (region village of Polyanovo). There exists a statistic reliable difference between the number of birds remote at a distance of up to 500 m and these ones between 500 and 1000 m ($F=20.278$, $p<0.001$). As well as with the birds remote at a distance of over 1000 m ($F=32.966$, $p<0.001$). The partridges remain mainly in the area of further breeding.

During the second week after release, single birds move away from the release point and occupy nesting territories. This has been established during the next observations. Some of the released birds (2 male and 3 female) do not build nests and do not breed, but the reasons are not established. The greatest distance the birds move away from release place has been observed in the region of Levka (on average 576.11 m), Polyanovo – 536 and Bulgarin – 288.86 m. The partridges released in Levka move away at a larger distance than those in the region of Bulgarin (Levka mean 576.11, Bulgarin mean 288.86, $t=2.61$; $p<0.05$). It is due to the total area of habitats and the relief. In the regions studied, released birds remain around the resettlement place and only single specimen move away at a larger distance.

Survivability of the released partridges and reasons for losses

From the 49 Chukar Partridges, released in the three regions studied, until the beginning of August 2010 only six survived (1 male and 5 females). On average, the survivability of the farm resettled Chukar Partridges in the natural habitats of the species is 12.24%. The reasons for the losses are as follow: losses from predatory mammals – 33 birds (76.74%, n=43), losses from predatory birds – 4 birds (9.30%), losses from people – 1 bird (2.33%) and uncertain reasons for the death – 4 birds (9.30%). One bird (2.33%) has been lost and the signal has not been established during the field observations. Among the partridges perished immediately before the date of radio-telemetric monitoring, the species, caused the death, have been established. With the predatory mammals, these are Wild Cat (*Felis silvestris* SCHREBER, 1777) – 6 birds (3 males and 3 females). Representatives of Weasel family (*Mustelidae*) – 3 eaten birds (2 males and 1 female), Red Fox (*Vulpes vulpes* (LINNAEUS, 1758)) – 2 male birds, Domestic Dog (*Canis familiaris* LINNAEUS, 1758) – 2 birds (1 male and 1 female), among the losses of remaining birds it is impossible to establish precisely the species, caused the death of partridge. Interesting is the fact that during the further breeding, the presence of Golden Jackal (*Canis aureus* LINNAEUS, 1758) has

not been established around the aviaries and adaptation cages. After the resettlement, losses of birds from jackals have not been established either. The presence of the species has been established in all the three studied regions by traces and sounds. With predatory birds, one species with 2 eaten birds has been established – Northern Goshawk (*Accipiter gentilis* (LINNAEUS, 1758)) (Fig. 2).

One of the transmitters has been localized in a nest of Eastern Imperial Eagle (*Aquila heliaca* SAVIGNY, 1809) in the region of the village of Levka and in one case the species of predatory bird has not been established. During the first seven days after the resettlement 12 birds have perished. During the next 7 days 8 partridges have perished. During the next 7 days – 10. Until the end of the first month after the resettlement 6 partridges have perished (forth and fifth 7 days). By the end of the study period a total of 6 birds died (Table 2).

The losses during the release are highest (24.5%, n=49) during the first week after partridges have been set free. The resettled birds gave the greatest losses during the first 20 days after the resettlement – 61.22%. There exists no statistically significant difference between the number of perished male and female partridges (male mean 6, female mean 4.5, $t=0.2705$, $p>0.05$). In spite of this fact, the number of perished male birds is a little higher than that of female ones (Table 2). During the reproductive season, male birds



Fig. 2. Skeleton of the chukar partridge eaten by a Goshawk (*Accipiter gentilis*) within the Levka village.

Table 2. Chukar Partridge's losses after release.

Sex	Predatory mammal		Bird of prey		Human		Unknown cause of death		Total dead birds
	M	F	M	F	M	F	M	F	
First 7 days	7	5	0	0	0	0	0	0	12
Second 7 days	5	3	0	0	0	0	0	0	8
Third 7 days	5	3	0	0	1	0	0	1	10
Forth 7 days	1	0	0	2	0	0	1	0	4
Fifth 7 days	0	0	0	0	0	0	0	2	2
At the end of study period	3	1	1	1	0	0	0	0	6
Total losses	21	12	1	3	1	0	1	3	42
	33		4		1		4		42

often sing and give away their presence. This is one of the reasons for the larger number of perished males. Another reason for the losses is non-adaptability of farm partridges to environmental conditions.

The losses from predatory birds are totally 4 partridges. The species is accidental in the food of predatory birds for the region studied. The reason for this is the low number of Chukar Partridges in its habitats in Sakar Mountain and Lower Thracian Valley.

Discussion

Disposal of marked birds after the release

In the case of Rock Partridge (*Alectoris graeca saxatilis* (BECHSTEIN, 1805)), in France marked birds have travelled between 4 and 25 km, depending on the season. Afterwards, they have been observed to come back again to the places where the transmitters had been put. These migrations have risen as a result of the beginning of the reproductive period and the disintegration of coveys into couples (BERNARD-LAURENT 1991). In our study, some of the birds move away more from the resettlement place and build nests. Others remain close to the resettlement point. Here the distances of remoteness of partridges from the resettlement place are considerably smaller. The largest reported remoteness in Levka is 1.3 km, Bulgarian – 0.891 km and Polyano – 3.2 km. The reasons are the small area of habitats and their fragmentation. In our study, unlike other studies, we use farm produced birds. In this case the majority of

birds are not able to adapt to natural environmental conditions.

Survivability of the released partridges and losses

Radio-telemetric studies of Rock Partridge (*Alectoris graeca* (Meisner, 1804)) in some parts of French Alps show that predatoriness is the main reason for losses among this species. (BERNARD-LAURENT 1989). Within the present study we have also found that the predatoriness is the main reason for losses with Chukar Partridge. The losses are chiefly from predatory mammals unlike other similar studies in the USA and France. In USA the losses from predatory birds amount to 30% (ROBINSON 2007). In France, the rock partridge survival of 25% has been established for the birds at the age of over 3 months. In 53% of death cases the reason is Golden Eagle (*Aquila chrysaetos* (LINNAEUS, 1758)). There the number of Golden Eagle in the studied territory have been specified about 30 specimens (BERNARD-LAURENT 1989). In the high parts of Mediterranean Alps, Alpine Marmot (*Marmota marmota* (LINNAEUS, 1758)) is the main prey of Golden Eagle (HUBOUX 1984). In other parts of the Alps, where it cannot be found, a greater quantity of partridges in the eagle's food is observed (BERNARD-LAURENT 1989). In some parts of the Alps Red-legged Partridge (*Alectoris rufa* (LINNAEUS, 1758)) is the second most hunted by Golden Eagle after European Rabbit (*Oryctolagus cuniculus* (LINNAEUS, 1758)) (DELIBES et al. 1975). In

isolated cases of losses in some parts of the studied area, as the reason of death Northern Goshawk has been registered, as well (BERNARD-LAURENT 1989). In our study, 76.74% of the losses are due to predatory mammals and only 9.30% – to predatory birds. These differences are due to the differences in environmental conditions, number of predatory birds and mammals, as well as the number of partridges. These results are logical for the environmental conditions in the region, studied by the authors, because there the number of partridges are high. Hence their significance as food for Golden Eagle. In the region of our study there are no nesting Golden Eagles. For the period 1992 – 2002, in a food analysis of 4 pairs of Eastern Imperial Eagle breeding in the region, including the studied area, Chukar Partridge is absent of the food spectrum (MARIN et al. 2004). In the present study, one bird has been caught by Eastern Imperial Eagle. The reason is the low number of partridge in the regions studied. Chukar Partridge has been established in the food of Eurasian Eagle Owl (*Bubo bubo* (LINNAEUS, 1758)) (SIMEONOV et al. 1998, B. Milchev, pers. com.) and of Long-legged Buzzard (*Buteo rufinus* (CRETZSCHMAR, 1827)) (MILCHEV 2009). In our study, no birds have been found whose death has been caused by Eurasian Eagle Owl. Probably the species is not present in the region studied. At the same time, for Strandzha region occurrence of the partridge in the food of Eurasian Eagle Owl is 21.05%, the domination – 0.58, the percentage of biomass 0.85% (SIMEONOV et al. 1998). Chukar Partridge is rather accidental prey of predatory birds in Bulgaria.

In both telemetric studies of partridges, the losses from predatory mammals are small. In the USA, only 2 birds of totally established 95 death cases have perished from predatory mammals (ROBINSON, 2007). In France, 9% of the annual mortality is due to Red Fox and Beech Marten (*Martes foina* (ERXLEBEN, 1777)) (BERNARD-LAURENT 1989). The same author specifies that partridges are comparatively difficult prey for predatory mammals because of the open relief of habitats in the Alps. In Bulgaria, in the habitats of Chukar Partridge Jerusalem Thorn (*Paliurus spina-christi*, MILL.) bushes dominate, this may facilitate to a certain extent the hunting by some predatory mammals and hampering the hunting of typical gliders by predatory birds. In both studies

(USA and France) natural populations of Chukar Partridge and Rock Partridge have been examined and to some extent these results cannot be compared to ours. The high losses from predatory mammals, established in the present study, are due to the high number of predatory mammals in the studied region or to the lost game instinct of the resettled partridges. The latter is obvious from the fact that in 2 cases of loss the reason is a Domestic Dog. The gallinaceous birds are present to a different degree in the fox's food. In some parts of Sweden, the absence of rabbits has been replaced by European rabbits, mice and pheasants (ENGLUND 1965). In England Pheasants (*Phasianus colchicus* LINNAEUS, 1758), Red-legged Partridges and Grey Partridges (*Perdix perdix* (LINNAEUS, 1758)) are often present but after the participation of Brown Hare (*Lepus capensis* LINNAEUS, 1758). The losses of the gallinaceous birds from foxes are compensated by resettled in nature farm birds (REYNOLDS, TAPPER 1995). The occurrence of gallinaceous birds in the fox's food in the mountain habitats of Czech Republic is 1.65% at the foot of the mountains, 2.06% in the higher parts of the mountains and 1.87% on the ridges (NENTVICOVA et al. 2010). In our country, a study in the region of Sarnena Sredna Gora shows that during the autumn-winter period the dormouse rodents are dominating in the food of Red Fox (RAYCHEV, GEORGIEV 2008). Studies of Wild Cat's food in Mediterranean high mountains show that Red-legged Partridge and carcass play an important role in cat's food, especially in relation to the biomass (MOLEON, SANCHEZ 2003). In Hungary, birds are the second most important food for cats after small mammals (BIRO et al. 2005). In Portugal, remains from birds have been found in low levels all the year round (SARMENTO 1996). The remains from birds in the wild cat's food in Bulgaria have a frequency of occurrence 23.1%. Of them, 66.7% are of passerine order (Passeriformes) and 26.7% Pheasants (PETROV 2003). In the present study, the reason for the loss of totally 6 partridges is the Wild Cat. In two of the cases of loss, the reason is a Red Fox. The influence of the species over the populations of Chukar Partridges varies across the regions. Because of the fact that the share of the found dead birds with an uncertain species of the predatory mammal is great, we cannot state that Wild Cat and Red Fox can affect unfavourably the stock of Chukar Partridge. Chukar Partridges, produced in farm conditions, lose

to some extent their game instinct. After the resettlement, birds which have not adapted entirely to the natural conditions of the habitat may become prey of some of their natural enemies.

A total of five birds have perished because of representatives of the weasel's family and a domestic dog. Probably these are birds, which could not adapt to environmental conditions, because the transmitters of the perished birds were found immediately to the resettlement place. In one of the cases the reason for the loss is human interference (2.33%). In USA the losses from hunters amount to 7.6% (ROBINSON 2007). The difference is well-grounded because the present study has been made outside the period permitted for hunting.

Our results are similar to other researches (DUARTE, VARGAS 2004). The authors establish 15% survivability of resettled farm produced Red-legged Partridges during the first 3 months after resettlement. Farm produced birds are weaker than those in wild populations with respect to their behaviour, anatomy and physiology (CSERMELY et al. 1984; PAGANIN, MENEGUZ 1992; PUTAALA, HISSA 1995). The use of farm birds is a reliable way for recovery of stocks in the wild populations (NADAL 1992, CARVALHO, BORRALHO 1997). The quality of habitats also plays an important role for the survivability of resettled birds and their interactions with wild populations. Thus, before starting the resettlements, the state of habitats and genetic frequency of birds to be resettled have to be taken into consideration (DUARTE, VARGAS 2004).

Conclusions

As a result of our study we have established: 1) released partridges remain in the resettlement area; 2) the main reason for the losses among the released

Chukar Partridges are predatory mammals (76.74%); 3) predatory birds have a relatively small share (9.30%) and cannot affect unfavourably the survivability; 4) birds, further bred for spring resettlement, lose to a significant degree their game instinct and few of them (12.24%) can adapt to environmental conditions; 5) not all released in the spring partridges breed.

For achieving better results while resettling Chukar Partridge in the spring before the egg-laying period, we would make some recommendations to people responsible for taking care of game in the relevant hunting reserves.

Birds to be further bred in temporary aviaries or adaptation cages in order to be able to adapt better to new environmental conditions.

The partridges set for further breeding to be in equal sexual proportion as there is no reliable difference between the losses among male and female birds. It is not necessary for a larger number of males to be set in order to compensate their losses.

The partridges to be resettled not at a time but at several stages, at an interval of a definite period of time, but not after the beginning of egg-laying period. The partridges resettled in this way, at the second and third stage join the birds resettled during the first stage and adaptation of resettled birds improves.

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