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DO HAND REARED GREY PARTRIDGES (*PERDIX PERDIX* L., 1758) SURVIVE AFTER RELEASING IN UPLAND HABITATS OF WESTERN BULGARIA?

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Abstract

Releasing of hand-reared game birds is a powerful tool to increase the population size of wild birds and to lower hunting pressure on their natural populations. Survival and adaptation in the wild of farm game birds is crucial for assessing game farming efficiency. Survival rate of 36 Grey partridges released in the autumn from cages in the harsh environment of Mala Mountain uplands (850 m a.s.l.) (Central Western Bulgaria) was estimated by applying radio-telemetry. The study area was covered mainly by hay fields and pastures, while arable land was below 10 % of the territory. The birds stayed within an area of 70 ha (100 % maximum convex polygon) with dispersion below 770 m from releasing points. Very few birds dispersed in such long distances, while most of them stayed close to the cages. After releasing partridges showed preferences to scrub near hay fields. The highest mortality rates occurred in the first week when almost 80 % of birds died, and only one bird probably survived more than two weeks. The main factor for mortality was predation by Red fox (66.7 %). Synthesis and application: Grey partridge population size in harsh environments could not be increased by releasing of farm birds using traditional methods. Still the use of farm produced birds is reliable way for wild bird populations recovery, but the correct methods and high-quality farm birds have to be used. Habitat quality also plays an important role in the survival of released birds and their interactions with wild populations.

Key words: farm birds, Grey partridge, home range, radio telemetry, survival rates.

Introduction

Grey partridge (*Perdix perdix* L., 1758) occurs throughout much of the Western Palearctic, with a native range encompassing Portugal, Spain, France, the Netherlands, Germany, Ireland, the United Kingdom, Norway, Sweden, Finland, Belgium, Luxembourg, Denmark, Poland, Estonia, Latvia, Lithuania, Russia, Belarus, Ukraine, the Czech Republic, Slovakia, Switzerland, Liechtenstein, Austria, Italy, Hungary, Slovenia, Croatia, Bosnia and Herzegovina, Serbia, Romania, Moldova, North Macedonia, Bulgaria, Greece, Turkey, Armenia, Georgia, Azerbaijan, Iran, Kazakhstan and China. It was introduced and reintroduced to many parts of Europe, including Finland, Britain, Russia and France; also successfully introduced to USA and Canada. (del Hoyo et al. 1994, BirdLife International 2016). In Bulgaria the species occupies almost all the lowland and foothill regions (Simeonov et al. 1990) but can climb up at considerably high altitudes up to 1800 m in

the mountains (Patev 1950). During the winter Grey partridge performs vertical migrations from higher parts of the mountains to foothills or lowlands. Throughout dry summer months it moves towards mountains where it finds more accessible food (Simeonov et al. 1990). The species is listed as 'Least concern' in the IUCN Red List with decreasing population trend (BirdLife International 2016). In Bulgaria Grey partridge is under regime of protection and regulated use (Biodiversity Act, Annex 4). During 1980–1984 Grey partridge population size has increased from 561,100 to 600,240 individuals (Simeonov et al. 1990). Independent ornithological studies report 20,000–30,000 breeding pairs (Nankinov 2004) and 10,000–25,000 breeding pairs (Gerassimov and Mitev 2007). According to official hunting statistics in the period 2004–2012 Grey partridge population varies from 226,000 to 303,000. There is significant difference among the numbers reported by the ornithological researches and the national game census. The breeding density in foothill habitats is considered low, but more research is needed. The aim of this study is to estimate the effectiveness of releasing hand-reared Grey partridges in harsh habitats by using adaptation cages.

Material and Methods

Study area

The study area is part of Mala Mountain in Central Western Bulgaria (Fig. 1). It includes the following types of habitats: thinned deciduous forests – 12.9 %, shrubs – 13.5 % and meadows – 73.4 %. Actions for improvement of habitat quality were not taken before the release of birds. The density of natural Grey partridge population was low. It was not estimated precisely, but the presence of at least two flocks was detected. The main mammalian predators that occur in the area are Red fox (*Vulpes vulpes* (Linnaeus, 1758)), Stone marten (*Martes foina* (Erxleben, 1777)) and Western polecat (*Mustela putorius* Linnaeus, 1758). The data about their population size and hunting bag statistics is missing or are not reliable. From avian raptors Northern goshawk (*Accipiter gentilis* (Linnaeus, 1758)) and Common buzzard (*Buteo buteo* (Linnaeus, 1758)) were spotted in the area.

The average altitude is 850 m a.s.l. The climate is moderate continental. The soils are represented by cambisols and rendzinas, covered with oak forests. The average annual temperatures are 8–10 °C (Kopralev 2002). According to Bondev (1991), most of the study area is covered by xerothermal grass communities with a prevalence of *Dichantieta ischaemi*, *Poaeta bulbosae*, *Poaeta concinnae*, *Chrysopogoneta grylli* and *Ephemereta*, shrub (*Amygdaleta nannae*) and grass (*Artemisieta albae*, *Agropyreta pectiniformae*, *Agropyreta brandsae*, *Brometa riparii*, etc.). The farmlands replace mixed Turkey oak (*Quercus cerris* L.) and Hungarian oak (*Quercus frainetto* Ten.) forests as well. Agricultural areas have been uncultivated over the last 10 years and are covered with patches of shrubs presented by Jerusalem thorn (*Paliurus spina-christi* Mill.), Blackthorn (*Prunus* sp.), Rose-Hip (*Rosa*), Hawthorn (*Crataegus* sp.).

Meadows are predominantly presented by mesophytous grass communities (*Festuceta pratensis, Poatea sylvicolae, Alopecureta pratensis, Lolieta perennis, Agrostideta stoloniferae*, etc.) replacing forests of Elm (*Ulmus*), Raywood ash (*Faraxinus oxycarpa* M. Bieb. ex. Willd.), Pedunculate oak (*Querqus robur* L.), etc.

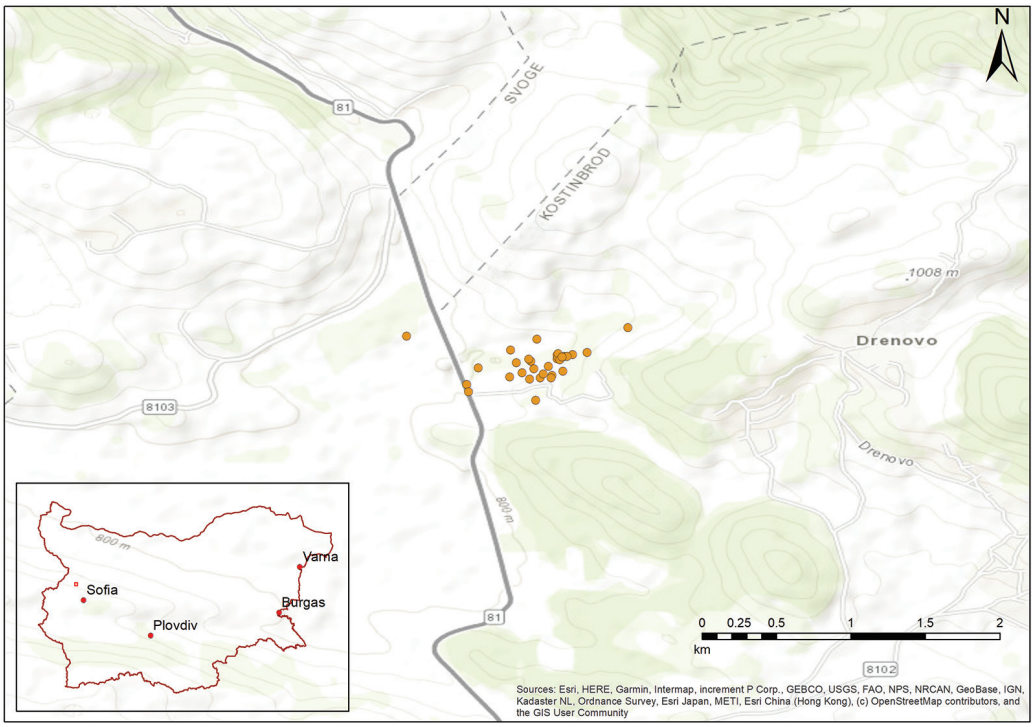

Fig. 1. Study area in Mala Mountain, Central Western Bulgaria.

Note: Points represent dispersion of partridges after release. Most of detections were post-mortal and almost every bird was detected only once.

(Bondev 1991). They are used as pastures and for hay. Agricultural crops occupy less than 10 % of the study area, and the habitats provide low quality of food resources. A part of the study area is covered by thinned oak forests presented by Turkey oak (*Quercus cerris* L.) and Hungarian oak (*Quercus frainetto* Ten.).

Field methods

In 2014 forty-one hand-reared Grey partridges were released – five birds in the spring, and 36 in the autumn (Table 1). Before release the birds were held for four days in pens with dimensions 1.2/1/2.4 m (width/height/length).

Table 1. Number of released Grey partridges (*Perdix perdix*).

Season of release	Date/group	Number of marked birds		
		Male	Female	Total
Spring	21.3.2014	5		5
Autumn	28.9.2014/Group 1	6	6	12
	5.10.2014/Group 2	6	7	13
	12.10.2014/Group 3	5	6	11
Total		22	19	41

Each bird was tagged by 10 g radio transmitter RI-2B (Holohil System Ltd). Partridges were monitored every 3–4 days after release. The location of each bird with exact geographical coordinates was determined after observation by using application Androzic, v. 1.7.9 for Android on a mobile device. For each found dead bird reasons for mortality were identified by using traces left on the birds and radio transmitters and were separated in three categories: mammalian predator, avian raptor and unknown.

Data analysis

Dispersion of the released birds is estimated with Map Source 6.15.11 (Garmin Ltd.).

The home range was defined by minimum convex polygon (MCP) (Mohr 1947) applying CALHOME Software (Kie et al. 1996). Habitat-use of the released birds was estimated by Jacobs index (Jacobs 1974) within the area of the 100 % MCP divided into several habitat types.

Differences in dispersion of the three groups of hand-reared partridges, released in the autumn, were estimated by applying one-way ANOVA. The survival of the birds is estimated by using Kaplan-Meier index (Kaplan and Meier 1958, Pollock et al. 1989) and parametric analysis with Weibull distribution (Pinder et al. 1978, Crawley 2013). Differences between survival rates of the three groups were tested with log-rank test (Krebs 1999) and by parametric model with Weibull distribution (Pinder et al. 1978). Parametrical analysis of the survival curve is less sensitive to small size of samples and accident variance observed at non-parametric analysis (Skalski et al. 2005). The analyses were performed by using *R* software (R Core Team 2019), and package survival, v. 2.37-7 (Therneau and Grabsch 2000, Therneau 2014).

Results

All birds released in the spring were found dead in 20 days' period and their dispersion, home range and habitat use were not analyzed due to insufficient data collected. The birds released in the autumn stayed near the adaptation cage during the whole study. The average distance of dispersal was 203.02 m ±168.22 m (mean, st. dev., min–max: 17.4–770.2 m). We did not find any significant differences between the dispersion of the three groups (F = 0.377, df = 1, 31, p = 0.544). Some individuals moved further from the releasing point due to chasing by predators. The home range, estimated with MCP size, was no more than 100 ha (Table 2).

Table 2. Home range of the released Grey partridges.

Group	MCP 100 %, ha	MCP 95 %, ha	MCP 75 %, ha	MCP 50 %, ha
Group 1	61.9	61.9	24.4	11.1
Group 2	73.9	73.9	13.7	5.7
Group 3	75.9	35.4	18.2	8.7

Hand-reared birds occupied considerably small area near the release pens. The birds preferred shrubs (J = 0.56) than meadows (J = -0.26) and deciduous forests (J = -0.13).

The main part of mortality after releasing occurred in the first two weeks (Fig. 2) and was caused mainly by mammalian predators (Table 3).

Although there were differences in survival rates between groups, almost all birds died in two weeks (Fig. 3). Only one bird with lost signal had unknown fate and probably survived after the two weeks' period.

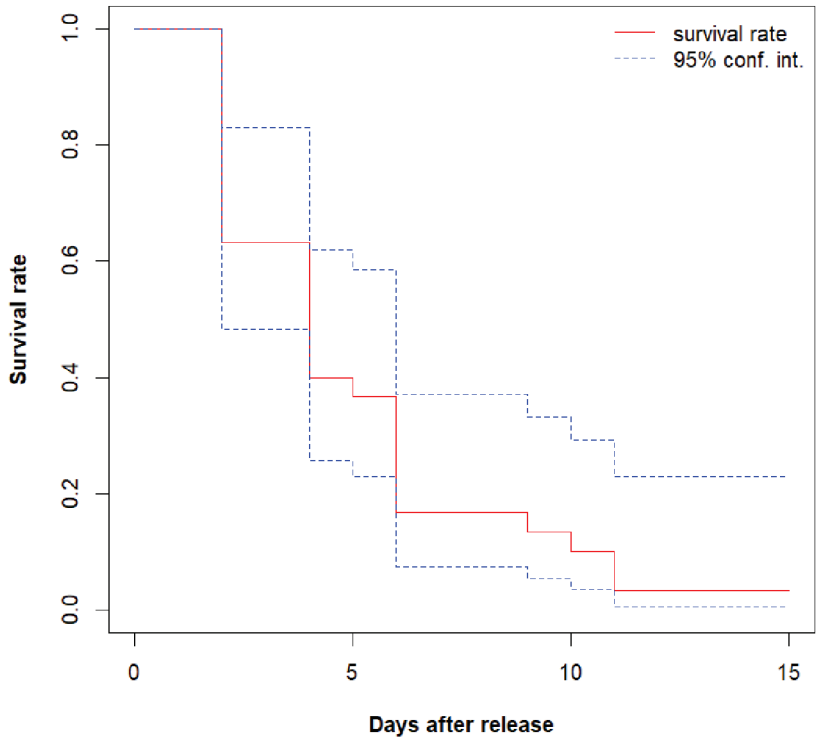

Fig. 2. Grey partridges' survival rates after releasing in the autumn.

Table 3. Reasons for mortality.

Reasons for mortality	Mortality of birds	
	number	%
Adaptation period	3	8.3
After releasing period:		
Red fox (*Vulpes vulpes*)	24	66.7
Other mammalian predators	4	11.1
Stray dogs	1	2.8
Lost signal	4	11.1
Total	36	100

Discussion

Our results showed that hand-reared partridges stayed near the point of release even chased by predators. Similar behaviour of Galliform birds released from farms was reported in other studies as well (Šálek et al. 2002; Gruychev 2012, 2014). Estimated mean dispersion was smaller compared to studies on radio-tracked partridges in other parts of their range (Potts 1986, Birkan and Serre 1988, Putaala and Hisa 1998). We suppose that dispersal range depends on environmental conditions of the habitats, and quality and health status of farm birds. The results provide a clue of how the release points should be chosen in order to reduce birds' movements. Single individuals moved farther away due to chasing by predators, as it was suggested by other studies on hand reared Galliform birds (Homan et al. 2000, Gruychev 2014).

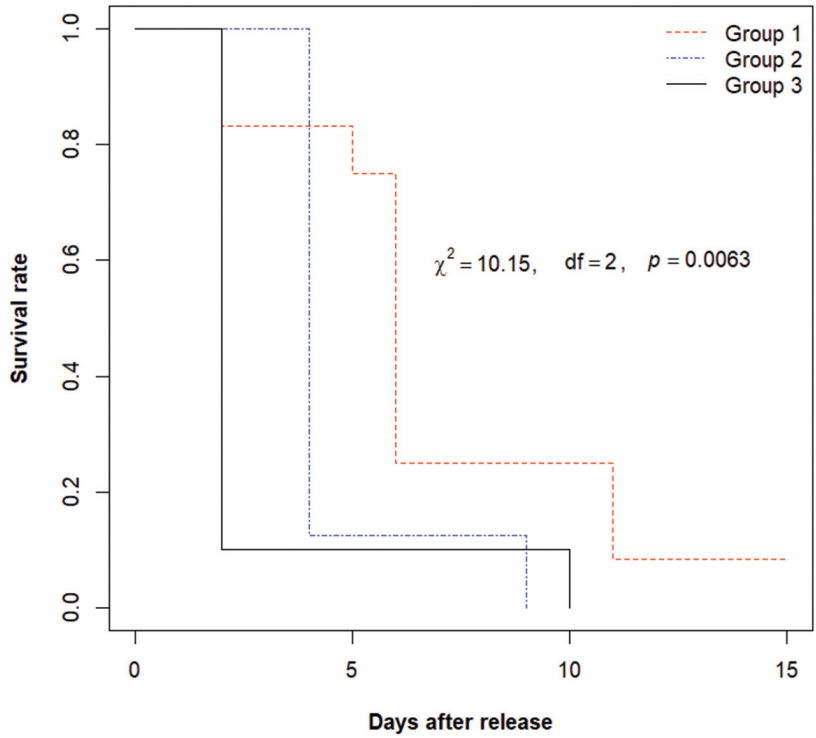

Fig. 3. Differences in survival rates between groups.
Note: See Table 1 for the date of release and the number of birds in each group.

Released farm birds had a very small home range close to the points of release. The home range of Grey partridge varies significantly in different habitats (O'Gorman et al. 1999, Rantanen et al. 2010). In the most suitable habitats with higher densities the birds occupy smaller areas compared to habitats with low quality and densities (Šálek et al. 2002). It was confirmed by our results as well. The hand-reared partridges preferred shrubs and avoided other parts of the area, as reported also for Upper Thracian lowland (Milanov 1991) and around the town of Sevlievo (Botev 1962). The Jacobs index was negative for meadows and thinned deciduous forests. The avoidance of habitats with high moisture was found also in lowland regions in Bulgaria (Milanov 1991). The shrub vegetation is crucial for Grey partridge and should be considered as one of important factors when the release points of farm birds are being decided.

The high mortality in short time after release confirms that it is impossible to rapidly increase Grey partridge's population by using conventional release methods in the harsh habitats. Some studies reported poor survival of older birds compared to young ones (Buner and Schaub 2008), but our results showed that mortality was high in both groups and did not depend on the age. Other researchers also reported the predation as a main reason for the high mortality (Potts 1986, Rantanen et al. 2010). Survival of the farm birds should depend on the survival skills due to the level of experience regarding anti-pred-

ator behaviour (Dowell 1990). When the birds are released in places where a wild population is present then the farm birds take advantage of the anti-predator skills of wild individuals. According to other researchers, the survival of hatched chicks of released farm birds is close to that of chicks hatched in the wild population (Panek 1992, 1997; Potts and Aebisher 1994; Putaala 1997), but despite the presence of wild birds near the release pens the farm birds' mortality was almost 100 %. Game birds reared in farms experience lasting physiological and ethological modifications which subsequently lead to problems during the adaptation (Lucio 1992). Their behaviour differs from that of the wild birds (Gaudioso et al. 2002). These are probably the reasons for the failure of our experiment. However, the releasing of farm birds can be a reliable tool for re-establishing wild populations (Nadal 1992, Carvalho and Borralho 1997). Some very important factors before releasing should be considered: birds' vitality, predation and habitats. Habitats' quality and predator control are crucial for farm birds' survival after release. Spring release, when farm birds are joined by an old pair is more successful. Appropriate release methods and working with high quality birds should be considered for future recovery programs in upland habitats of Western Bulgaria.

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