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# Monitoring the survival rate of released chukars: a case study in Elmalı Cedar Forest, Antalya, Turkey

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**Abstract:** In this study, 50 female and 50 male 5-month-old captive-bred chukar partridges (*Alectoris chukar*) were released in 2012 into nature and monitored in the Çamkuyular Cedar Research Forest, Elmalı, Antalya. All individuals were tagged with colored leg tags and 15 also had radio transmitters attached. Over 4 months, the chukars were hunted by their natural predators, with the last dead bird found in January 2013. Of the 33 dead birds, 60.6% (n: 20) had been killed by large mammals and 39.4% (n: 13) by predatory birds. This study indicates that chukars produced in captivity are unable to successfully adapt to nature following release, primarily because they are unable to protect themselves against their natural predators. This suggests that a strategy favoring protection rather than bird release should be implemented in areas with declining partridge stocks.

**Key words:** Partridge, *Alectoris chukar*, bird monitoring, radio telemetry, survival rate

## 1. Introduction

Partridge species play an important role in the food and hunting industries. However, their natural stocks are rapidly declining due to overhunting, habitat reduction, and environmental pollution. Therefore, partridge production in controlled conditions has become an increasingly common practice to reduce the pressure on natural stocks. In Turkey and several other countries, there have been attempts to release captive-reared birds to support the natural populations. In Europe and Asia, such birds are released either before or after the hunting season (Byers et al., 1979). However, scientists have raised various concerns related to these enhancement programs, including the risk of harming natural partridge populations, which in turn could lead to a further reduction in partridge populations (Randi et al., 2003; Barilani et al., 2007; Randi, 2008). For example, enhancement practices in the United States have been scaled back to protect the wild populations (Sokos et al., 2008).

In Turkey, the Ministry of Forest and Water Affairs has long been releasing partridges into nature, while NGOs and private sector companies have also recently started to release various species, including partridges and pheasants. Although the exact numbers released by the latter groups are unknown, the Ministry estimates that 152,868 partridges and 129,227 pheasants were released between 2001 and 2011 (www.ormansu.gov.tr).

A large part of the red-legged partridge (*Alectoris chukar* Gray, 1830) population is distributed from the Balkans to Middle Asia, where they are intensively hunted (Madge and McGowan, 2002). There are two subspecies of red-legged partridge in the Mediterranean region: *Alectoris chukar kleini* and *A. chukar cypriotes*. The former inhabits South Bulgaria, West and East Greece, North Turkey, and the southern Aegean islands. The latter is found in the southern Aegean islands, South Turkey, and Cyprus (Madge and McGowan, 2002). South Cyprus has the biggest red-legged population in Europe with an annual bird hunting capacity of 250,000–500,000. This population is kept high by releasing cultured partridges into the wild (Panayides, 2005).

There has been no research into how captive-bred partridges adapt to nature in Turkey after being released by the Ministry of Forest and Water Affairs. Therefore, this study aimed to determine the survival rate and reproduction potential of released partridges in order to provide a basis for evaluating the attempts of NGOs and the Ministry to improve wild partridge populations.

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## 2. Materials and methods

### 2.1. Study area

The study was carried out in Çamkuyular Cedar Research Forest, Elmalı, Antalya. The typical tree species of the research forest is *Cedrus libani*. *Juniperus excelsa* M.Bieb. and *J. foetidissima* Willd. can also cooccur with this species from place to place. Apart from the forest vegetation, the shrub vegetation mainly comprises *Quercus coccifera* and *J. oxycedrus* L. (Başaran et al., 2008, Kavgacı et al., 2010a). Frost pits that are apparently temporary lakes are dominated by herbaceous plants (Kavgacı et al., 2010b). There are also alpine meadows and shrubs above the forest areas. The area has a Mediterranean mountain climate. The terrain is generally composed of karst limestone bedrock. The elevation ranges from 1030 to 2611 m a.s.l. across an area of 2616.9 ha (Figure 1).

### 2.2. Materials

The study materials were 50 male and 50 female 5-month-old chukars (*Alectoris chukar*), obtained from a Partridge Production Station of the General Directorate of Nature Protection and National Parks and released into the study area. Sexes of all individuals were determined and given to us as separated groups by the station personal.

### 2.3. Tagging and releasing

Prior to placement in the aviary, the birds were weighed and tagged to monitor and identify individuals in the wild using a maximum of three leg tag colors from 6 different colors. Marking with color combinations was performed by attaching the colored rings to the left legs of females and the right legs of males. An aviary of 36 × 12 × 3 m was set up in an area of trees and shrubs within the research site to adapt the birds to the research area conditions. The birds were kept in the aviary for 10 days and fed each night at midnight. Water was provided continuously using a wooden trough. It was seen that all individuals are healthy and flying inside the aviary during this period.

### 2.4. Monitoring

A research telemetry system (Biotrack) with 1 receiver, a data logger, and 15 transmitters were used for monitoring the birds. The transmitters weighed 13.6 g, with a signal range of 5–6 km and 16 months of battery life. Transmitters were attached to 9 females and 6 males to monitor the distribution range and survival rate of the birds (Figure 2). The data logger was used to constantly track the signals in the study area. Five photo-traps (Bushnell) with day and night shooting capability and 5 MP resolution were used to visually identify predators and individual chukars.

After release, the birds were monitored daily over the first 3 days, then weekly until the 10th week, and then biweekly until the study ended. Radio signals transmitted from the tagged birds were recorded as available or unavailable into the data logger and the records were periodically transferred to a computer (Figure 3).

A photo-trap system for monitoring animal species and population sizes in the wild was also utilized in the present investigation (Kelly and Holub, 2008; Albayrak et al., 2012; Sanchez-Garcia et al., 2012). Photo-traps



**Figure 2**. Attaching transmitters to monitor chukar individuals.

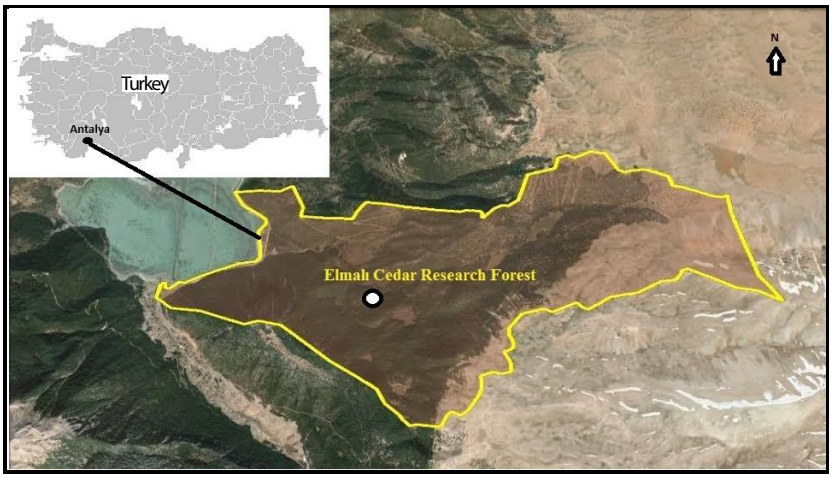



**Figure 1.** Geographical location of the study area.




**Figure 3.** Monitoring station in the research area.

were attached to all sides of the aviary to record the birds' activities during the adaptation period. After release, the birds were monitored with the traps mounted in the water resource and common areas.

Daily monitoring determined the numbers of living and dead birds, causes of death, and tag numbers. In general, a 6-person team conducted the monitoring by determining the birds' locations with radio signals before counting them from a suitable distance. The leg tag numbers on living birds were determined using a high-zoom still camera.

### 3. Results

On placement in the aviary, mean weights of females (N = 50) and males (N = 50) were 426.5 g and 504.12 g, respectively. Two birds were lost during the adaptation period due to an inability to feed and cachexia. Analysis of photo-trap images from the aviary revealed that several partridge predators, including long-legged buzzard (*Buteo rufinus*), lynx (*Lynx lynx*), short-toed snake eagle (*Circaetus gallicus*), red fox (*Vulpes vulpes*), and wild boar *(Sus scrofa*), as well as several unidentified owl and snake species, visited the aviary to hunt the chukars (Figure 4).

After the aviary was removed, the released chukars tended to remain in the scrub around the aviary's former location. They were also eager to approach project team members during the first month (Figure 5), but this behavior later disappeared. When they saw team members after the first month, they hid in the scrub. However, if someone approached to within 2–3 m, they did not fly away and hide.

The birds could fly without visible disease or pathological symptoms before release into the field. In the first 2 days after release, 95 and 85 individuals respectively were monitored and counted in the study area. The number of birds decreased over the study period such that, after 4 months, none of the partridges survived (Figure 6).




**Figure 4.** Natural predators of the chukars that visited the aviary on the first day of the study.



**Figure 5**. Responses of birds to project team members during the first month after release.

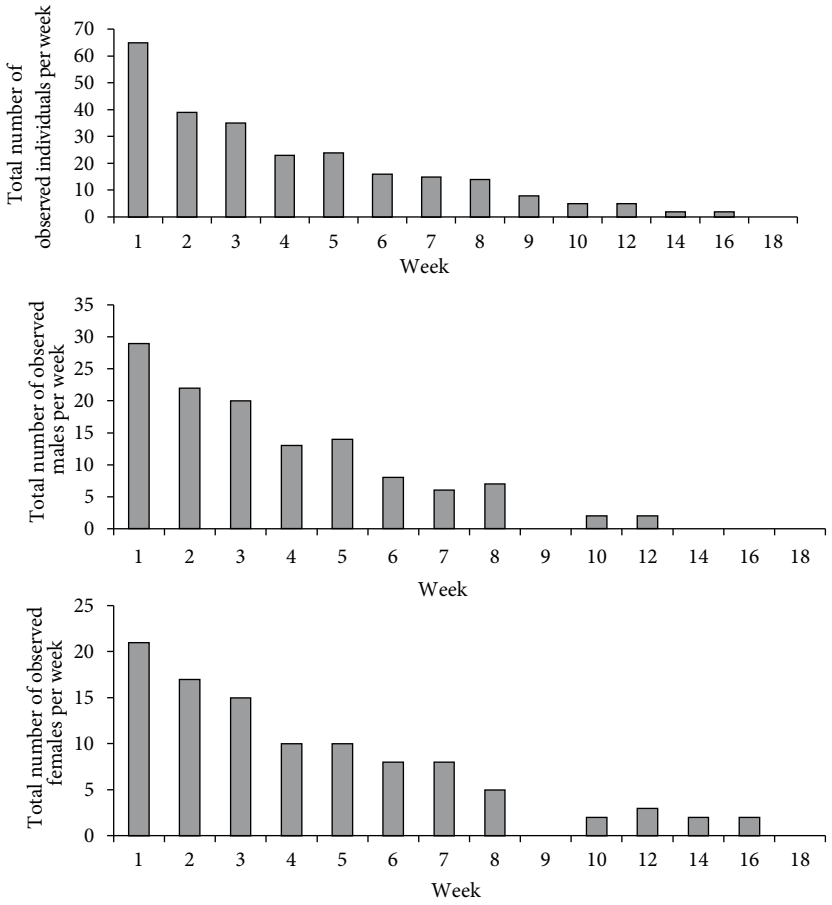



**Figure 6.** Weekly numbers of monitored chukars released into the study area.

A closer look at Figure 6 reveals mismatches between the total number of birds and female/male numbers because not all individuals could be clearly identified due to an inadequate view. In some weeks it was also impossible to clearly identify the sexes due to adverse weather conditions. Thus, only the total number of individuals is given for week 9. Significantly, we noted that the very few surviving individuals in weeks 9–10 were able to interact

with their wild counterparts. We also observed that, while wild birds flew away upon encountering humans, the released birds ran away into the nearest shrubs or scrub. When the latter were approached again, they then ran away to find a more secure place.

Figure 7 shows the weekly distribution of individuals found dead along with the causes of death. It was determined that 39.4% of the dead chukars were killed by predator birds such as long-legged buzzards and owls, whereas the remaining 60.6% were killed by lynxes and foxes. The causes of death for the other 8 hunted individuals could not be determined.

There were noticeable differences between the bird remnants killed by predator birds and mammals. For example, remnants of chukars eaten by long-legged buzzards had the majority of the skeleton and feathers together with the solid tags or transmitters. Some of these remnants were found on the ground and some in trees. The mammalian predators appeared to take the whole birds so that feathers and pinnae were lost during capture, and the crushed ring tags and transmitters remained.

## 4. Discussion

Throughout the study period, the chukars seemed to be very tame and did not escape from humans. This was particularly evident during the first month of the study: when the birds saw project team members or vehicles, they approached, suggesting that the released chukars felt more comfortable in the presence of humans or that they expected to receive food. Alternatively, since they had been hatched and reared in captivity until release, they could have imprinted on the project team members.

After 1 month of monitoring, the chukars neither stayed close to the team nor escaped from them, which indicated that a hunter could catch the birds without even using a rifle. Although this could not occur in the study site as it is a research forest where hunting is forbidden, a nationwide stock enhancement program would need to take this possibility into account. Indeed, several farms currently release thousands of chukars into several regions in Turkey (www.ormansu.org.tr). Since rearing and stock enhancement is costly, it is necessary to evaluate whether this really is an efficient use of resources or a worthwhile investment for this purpose.

Another important point, evidenced by how easily they were predated, is that the chukars do not know their predators and so cannot protect themselves against them. This result forced us to reevaluate both rearing and releasing methods. Previous studies that have reached the same conclusions have suggested that, before release, rearing methods should be implemented that include both familiarization with predators and less human

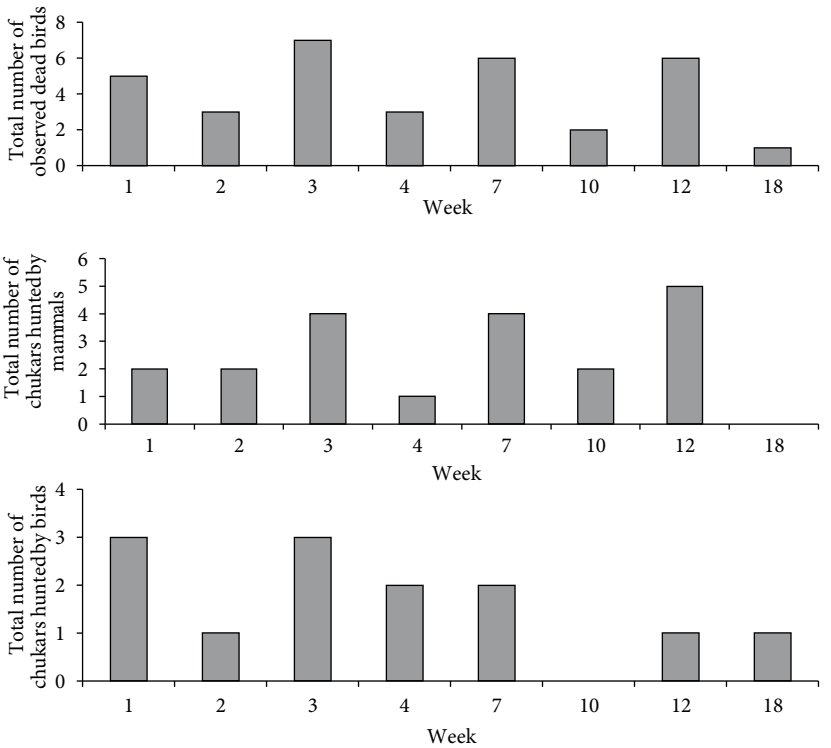



**Figure 7.** Total number of dead birds and predation by predatory mammals and birds per week.

intervention (Putaala and Hissa, 1998; Buner and Schaub, 2008; Rymesova et al., 2013). Another suggestion is that in regions with declining chukar populations, a protection approach would be preferable to stock enhancement (Bro et al., 2000; Walter, 2002; Rymesova et el., 2013).

All birds tagged with rings and transmitters were either killed or disappeared within the 4-month study period. Previous research has found that the mortality rate increases from the first week after release to peak at around 2 months, before falling to zero by weeks 14–16 (Duarte and Vargas, 2004; Duarte et al., 2011). Likewise, in the present study, mortality reached a low point by week 16 with just a few remaining individuals being seen together with wild birds. It was impossible to determine the final fate of these birds, making it possible that they had left the region. Putaala and Hissa (1998) claim that released birds can only minimally contribute to the wild population due to their low survival and reproduction rates. Rymesova et al. (2013), for example, recorded a mean lifespan of 14 ± 1.89 weeks with a minimum of 1 day and maximum of 78 days for 75 released partridges, while Meriggi et al. (2002) reported 36.7 ± 6.0 weeks (min: 3 days, max: 94 days).

While the major reason why released birds fail to survive beyond 18 weeks appears to be exposure to predation, it is also possible that some are recruited into the wild population (Meriggi et al., 2002). Although we did not record such recruitment in the present study, we observed interaction with the wild population during the final weeks of the study and could not detect these birds in subsequent observations. Therefore, we assumed that these individuals had died. Previous studies have also found low survival rates in released partridges and most argued that, even if released birds survived to reach sexual maturity, their reproductive success would be very low (Putaala and Hissa, 1998; Meriggi et al., 2002; Duarte et al., 2011; Rymesova et al., 2013). This provides further support for rejecting stock enhancement as a tool to protect partridge populations.

The fact that the released birds were rapidly hunted by predatory birds and mammals underlines the importance of ensuring that released birds can somehow recognize their predators. Buner and Schaub (2008), for example, reported that 82 out of 85 released birds were killed by their natural predators. They categorized this predation as 46 by mammals (36 red foxes and 10 lynxes), 24 by predatory birds (20 buzzards, 3 sparrow hawks, and 1 hen harrier), and the remaining 12 by unknown predation or other reason. A similar study carried out in the Czech Republic determined that 33% of released partridges were killed by predatory birds, 36% by predatory mammals, and 8% by unknown predators, and 11% died of other causes (Rymesova et al., 2013). In a similar study, Robinson et al. (2009) reported chukar mortality causes as 55% unknown, 33% predatory birds, 8% hunting, and 3% predatory mammals.

In the present study, predatory mammals caused the majority of deaths. However, we should mention that, during the study period, site screenings were only done on the ground within the investigation area, so some dead individuals could have been taken outside of the area by predatory birds and therefore not be counted. Predatory birds may also have consumed some prey in the trees so they were also not counted. Therefore, we can argue that predatory birds may have consumed as many chukars as the mammals did. For instance, we encountered one dead chukar in a tree by chance and two others by using the transmitters. A closer look at bird predation suggests that buzzards were mainly responsible, considering their increasing population in the region.

In conclusion, although few chukars survived in the present study, those individuals that managed to survive until the final weeks had begun interacting with the wild population, suggesting that if they lived together with them for a while, they might develop the ability to protect themselves from predation. This indicates the need to develop rearing systems that are close to the birds' natural conditions with minimum human contact. Further investigations should also be conducted on the effects of different releasing techniques at various ages and seasons. Moreover, brood stock should be selected from those natural populations that are sufficiently large to avoid disrupting bevy dynamics. Until such studies are completed, stock enhancement should only be carried out in regions with low populations of the partridges' natural predators.

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