

*Implementation a Scheme for Individual Tracking with Colour PVC Ring in the Course of the Lesser Kestrel (*Falco naumanni*) Recovery as Breeder in Bulgaria*

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Abstract. For decades, it is considered that the Lesser Kestrel (*Falco naumanni*, Fleischer, 1818), which is one of the smallest species of falcons found in Europe, has disappeared from Bulgaria as a nesting species. In this connection, "Green Balkans" has launched a program to strengthen the population and restore as nesting the species in our country. The method of adaptation and release in nature of translocated chicks from Spain was applied. According to the IUCN requirements, the reintroduction of species requires the monitoring of the process and its results. For that purpose, each of the individuals released in nature is marked with a standard (metal) ornithological ring on one leg and specialized colour PVC ring on the other leg. Considering the international schemes for the marking of Lesser Kestrel indicated by European colour-ring Birding, the team sets a unique colour scheme for Bulgaria - orange PVC ring with black inscriptions, a combination of letters and / or numbers. In 2013 the first release of chicks was made in the Special Protected Area Sakar (BG0002021) which is a part of European network NATURA 2000. For the period 2013-2018, a total of 671 birds were tagged under this scheme. A scheme for marking with coloured rings of Lesser Kestrel was applied for the first time in the country in the course of surveys of this rare and protected species. Marking with coloured rings allows individual tracking of each bird from a close distance without their capture being necessary. Due to the fact, the behaviour of birds, the process of adaptation and stay in the colony area, their migration and the formation of pairs, occupation of artificial nests and other ecological features are tracked. All this, is of key importance in the implementation of direct conservation measures in the process of restoring the species as nesting in the country and the success of the Program.

Keywords: Lesser Kestrel, *Falco naumanni*, tracking, colour ringing, reinforcement, re-stocking, recovery.

Introduction

Until the middle of the twentieth century, the Lesser Kestrel is considered to be one of the most widespread birds of prey in Europe (BIJLEVELD, 1974). Its number is decreasing due to the intensification of agriculture (HAGEMEIJER & IANKOV, 1997) and in recent decades the European

population of this species has reached a rapid decline (TELLA *et al.*, 1998; [Birdlife International, 2004](#)).

At the end of the 19th century, the Lesser Kestrel is described as a nesting species everywhere in Bulgaria (RADAKOFF, 1879). In 1893 only, the colony at Karlovo town numbered about 100 pairs (REISER,

1894). In the mid-twentieth century, it was a widespread species (PATEV, 1950; ARABADZHIEV, 1962). In this period, the species was found even in large cities, such as Plovdiv, where it nests on one of the hills in the city, in a mixed colony with common kestrel (*Falco tinnunculus*).

MICHEV (1982) reports the change in the status of the species for the period from 1950 to 1982 as “nesting” to a “rare breeding” species, included in the Red Data Book of the Republic of Bulgaria in 1985 with the category “endangered species” (BOTEV & PESHEV, 1985). Later the population status of the species in the country is defined as “obscure” (CRAMP & SIMMONS, 1987). In 1990-1995, the population was estimated to be 10-100 pairs (MICHEV, 1982; BIBER, 1996) and no more than 4 colonies (IANKOV, *et al.*, 1994). In a review of the status of raptors (NANKINOV *et al.*, 1991), the size of the species by 1990 is estimated at 50 breeding pairs in the country. For the period 1951-1991, there were 86 breeding habitats, which fell to 65 10x10 km. UTM squares (IANKOV *et al.*, 1994). From 0 to 5 breeding pairs of Lesser Kestrel is the number in 1995-2000 (BirdLife International, 2004; BAROV, 2002). No breeding birds (IÑIGO & BAROV, 2010) or confirmed breeding of the species (BAROV, 2007) are not reported during the period 2000-2010. In surveys conducted in 2012 in the Natura 2000 sites, no breeding of the species has been recorded and its disappearance as a nesting species in them is established (MATEEVA *et al.*, 2013). Measures are needed to restore the species as nesting in Bulgaria.

“Green Balkans” has started a specialized project under the LIFE Program of the European Union - "Recovery of Lesser Kestrel" LIFE11NAT/BG/360 to reinforce the population and restore the species in our country as a nesting one. The “Colonial environment” method of adaptation and release in nature of chicks translocated from Spain was applied (GRADEV *et al.*, 2016). A scheme for individual tracking with colour PVC ring in the course of the Lesser Kestrel

(*Falco naumanni*) recovery as breeder in Bulgaria was implemented.

Materials and methods

The investigation was conducted from 2013 to 2018 in the area of Special Protected Area Sakar BG0002021 which is a part of European network NATURA 2000. Standard metal ornithological rings were used for released birds during the restoration of the Lesser Kestrel (DE BEER *et al.*, 2001) and both standard and specialized PVC coloured rings were used for marking the birds released or hatched in the colony to facilitate their individual identification during the adaptation and independent life of birds. Each of the individuals released in nature is marked with a standard (metal) ornithological ring on one leg and specialized colour PVC ring on the other leg. The metal rings were made in partnership with the Bulgarian Ornithological Centre (BOC), Institute of Biodiversity and Ecosystem Research (IBER) of the Bulgarian Academy of Sciences (BAS). BOC is the official coordinator of ringing in Bulgaria (NANKINOV *et al.*, 2008) At the international level, in consultation with the European colour-ring Birding - EURING and after review of the colour marking schemes used other countries - Spain, Italy, Greece, France etc. (European colour-ring birding, 2018) for Bulgaria is determined the orange colour of the ring combined with black letters and / or numbers. Thus, make it possible identification the country of bird's origin.

The metal rings are closed in accordance to requirements of CITES convention for identification of chicks from captive breeding origin and conform to the physiological features of the species. The rings are developed in cooperation with the project partner DEMA - Spain and has the following dimensions (Table 1), produced by the Spanish company Anillas Talisman, S.L.

Parallel to the metal rings, the Lesser Kestrel are also marked with coloured PVC rings. Made of specialized quality material PMMA which makes them resistant to high

and low temperatures (INTERREX-RINGS, 2017). PVC rings are of the type “Split plastic rings” which makes them easy and convenient to place. Compared to metal rings, the coloured rings are larger in size. Their diameter varies from 9 mm to 12.5 mm and their height is 12 mm. The colour rings are brighter and visible from a larger distance, and allow for easier identification

of each individual subject to direct observations through optic equipment. In Bulgaria similar coloured rings are used to mark and track other rare and protected bird species such as Imperial Eagle (*Aquila heliaca*), Saker Falcon (*Falco cherrug*), Griffon Vulture (*Gyps fulvus*) and others (GRADEV *et al.*, 2018).

During the survey period, the following rings were used in Bulgaria (see Table 2).



Fig. 1. Standard metal ornithological rings (A - Photo archive “Green Balkans”) and pliers for insertion (B - Photo archive – DEMA).

Table 1. Size and dimensions of the metal rings.

Diameter before narrowing	8.00 mm
Diameter after narrowing	5.50 mm
Thickness of the metal	1.00 mm
Ring height	5.00 mm



Fig. 2. Colour PVC and metal rings. Marked Lesser Kestrel. Photo archive: “Green Balkans”.

Table 2. European colour-ring Birding codes scheme for Lesser Kestrel - used ring series in Bulgaria.

Used codes in	Codes	PVC ring	Metal ring
2013	BAA-BJA, BBA-BBZ, BCA-BCZ, BDA-BDZ, BFA-BFZ, BHA-BHZ. BJA, BTF-BTZ, BVA-BVZ, BZA-BZZ	On right leg	On left leg
2014	BJB-BJZ, BKA-BKZ, BLA-BLZ. BNA-BNZ, BTA-BTD, BPA-BPZ, BSA-BSZ, 0A-9A, 0B-9B, 0C-4C	On left leg	On right leg
2015	5C-9C, 0D-9D, 0F-9F, 0H-9H, 0J-9J, 0L-9L, 0K-9K, 0N-9N, 0P-9P	On right leg	On left leg
2016	1T-8T, 0V-8V, 0Z-8Z, SZ, BZ, KAB-KAZ, KBB-KBZ, KCA-KCZ, KDA-KDZ, KFA-KFZ, KHA-KHZ, KJA-KJZ, KKA-KKZ, KLA-KLF	On left leg	On right leg
2017	KLH-KLZ, KNA-KNZ, KPA-KPZ, KSA-KSZ, KTA-KTZ, KVA-KVZ, KZA-KZZ, AB-AZ, BB-BZ, CA-CZ, DA-DZ, FA-FZ, HA-HZ, JA-JZ, KA-KL	On right leg	On left leg
2018	KP-KZ, LA-LZ, NB-NZ, PA-PZ, SA-SV, TA-TK, VC-VZ B00, B01, B02	On left leg	On right leg

Direct observations to identify individuals by reading the code of the PVC rings were conducted in the area of Lesser Kestrel Release and Adaptation Module (LKRAM) in Levka, Special Protected Area "Sakar", where the nesting colony is located. Once the juvenile Lesser Kestrels leave the release boxes, the food is provided on the roof of the aviary with the adult birds, every day in the morning and evening. The feeding time is a suitable moment to monitor the abundance and presence of individuals, their behaviour, relations, etc. Each of these feeds also describes the rings of the observed individuals. The observations are made in close proximity, sometimes less than 50 cm, allowing the identification of individuals with extreme precision. Direct observation through a one-way window enables precise identification of individuals through their colour rings. Also, through these observations the keepers can easily detect the presence of wild, non-banded birds from other colonies. In parallel, when needed, the team implements monitoring of individuals,

pair formation, nest box occupancy, etc. from observation points outside the Module, using suitable equipment such as binoculars and spotting scopes (GRADEV *et al.*, 2016). Such data is also gathered through the video surveillance system comprising 15 cameras and DV-R providing an important advantage, namely storing records that can be checked later (GRADEV *et al.*, 2016). Outside LKRAM in Levka, observations to determine the rings to be run on roosting sites and pre-migration gathering areas located in the area of Sakar, by radio-telemetry of Lesser Kestrel (ZHELEV *et al.*, 2016). Three roosting sites and pre-migration gathering areas of the birds from the colony were identified, located at 5.00 km (2014) and 4.30 km (2015) (ZHELEV *et al.*, 2016), and about 7.00 km (2017, when roosting sites is localized by satellite tracking, Green Balkans, 2017) from their nesting sites. In the overnight observations using suitable equipment such as binoculars and spotting scopes. Observations are conducted every year between 2013 and 2018, starting with

the first kestrel in the colony area. The earliest date of registration of a migratory bird with ring is identified on February 23, 2016 and 2017. Observations continue throughout spring and summer and end in the autumn. Upon the return of the first migratory bird, observations and artificial food are conducted almost daily. Upon the return of the first migratory bird, observations and artificial food are conducted almost daily.

At the end of summer and autumn, they are not of such intensity as during the active breeding season. The latest observations were made on 9 November in the autumn when in 2018 the last bird was observed in the colony area.

Results

In 2013 the first release of chicks was made in the area of Special Protected Area SAKAR Sakar BG0002021 which is a part of European network NATURA 2000. For the period 2013 – 2018, a total of 671 were tagged under this scheme. These are birds that have been delivered for release from the Breeding Centre DEMA in Spain, Wildlife Rehabilitation and Breeding Centre (WRBC) of “Green Balkans” in Stara Zagora, wild caught

birds, as well as chicks hatched in the colony inhabiting Lesser Kestrel Release and Adaptation Module (LKRAM) in Levka, Special Protected Area “Sakar” (Table 3).

Marking with coloured rings allows for individual tracking of each birds from a close distance without their capture being necessary. Due to that fact, is being tracked of nesting sites, types of artificial nests that are a priority for research, as well as the determination of individuals formatting the couples (Fig. 3.) and the activity of individual parents in raising youngsters. By monitoring of individual birds, a correlation between the choice of partner and the individual nesting territory and preconditions for polyandry were described in LKRAM Levka (MIHTIEVA *et al*, 2016).

Marking with coloured PVC rings makes it possible to thoroughly record and track individuals (Fig. 4.), their origin (Table 3), survival rates (Table 4), age structure, daily and seasonal dynamics of numbers, etc. indicators that are directly related to the nature conservation activities carried out during the breeding of the species in the country.

Table 3. Ringed (released and wild Lesser Kestrel in LKRAM Levka (2013-2018).

Year	Chicks from parental flock of “Green Balkans” WRBC	Chick from pairs of WRBC posted to Levka	Resqued egg/chicks originated from Levka breeding colony	Chick from Levka breeding colony	Wild bird captured/ ringed in Levka	Total produced in Bulgaria	Chicks from DEMA Breeding Center Spain	Total Bulgaria n and Spanish chicks
2013							90	90
2014	26	3	9	16	3	57	60	117
2015	19	1	0	17	0	37	45	82
2016	61	2	0	37	2	104	40	144
2017	40	0	0	35	0	82	0	82
2018	47	0	0	35	0	82	0	82
Total	193	8	9	175	10	392	279	671

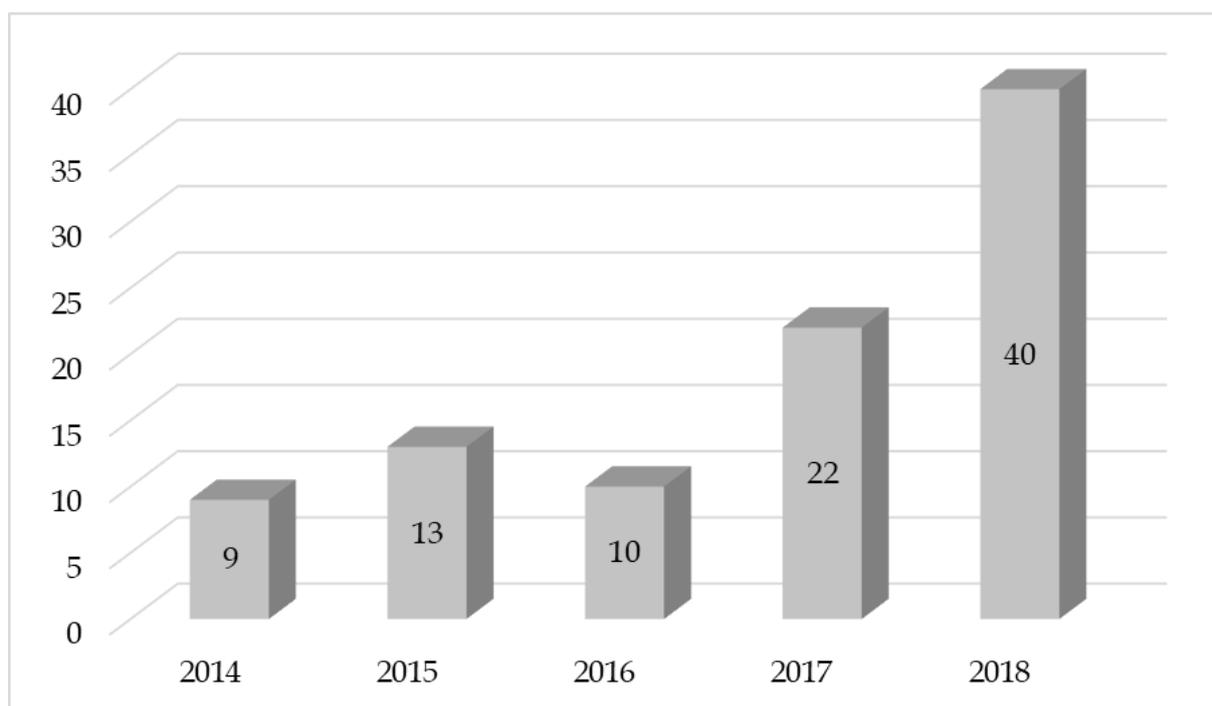


Fig. 3. Lesser Kestrel established pairs in LKRAM Levka registered by observing colored rings (2014-2018).

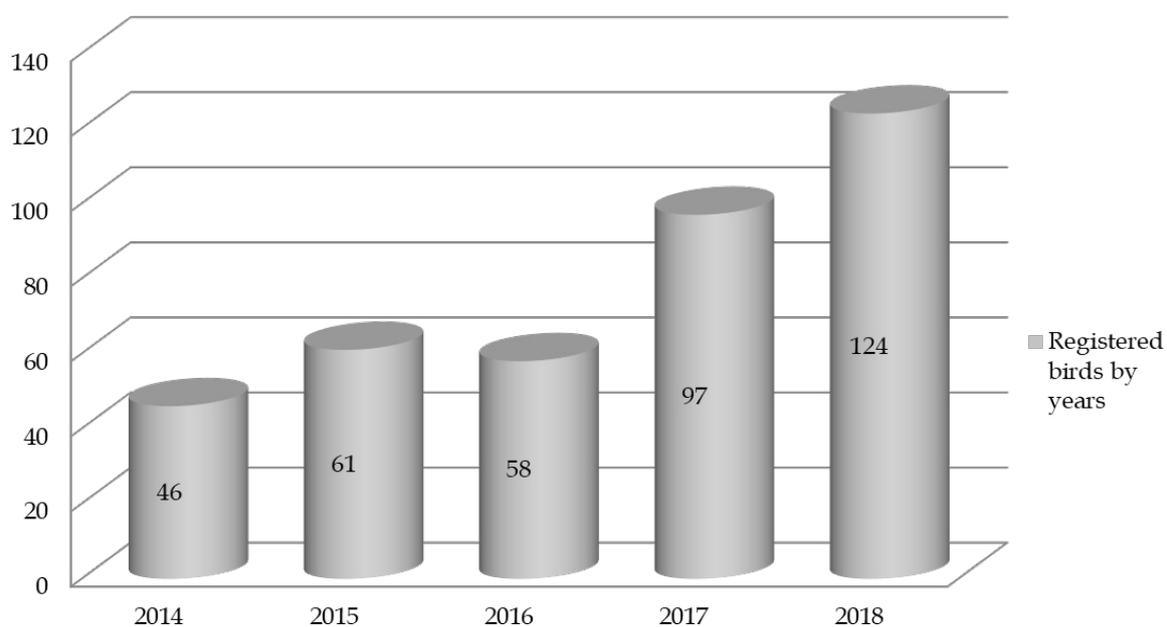


Fig. 4. Registered adult and wild Lesser Kestrel in LKRAM Levka (2014 - 2018).

Table 4. First year survival of the juvenile Lesser Kestrels released at the LKRAM Levka (2014 – 2018).

Year	Released juveniles	Returnees in 2014		Returnees in 2015		Returnees in 2016		Returnees in 2017		Returnees in 2018	
	Ind	Ind	%								
2013	90	42	46.66%	5	5.55%	0	0.00%	0	0.00%	0	0.00%
2014	114			37	32.46%	0	0.00%	0	0.00%	0	0.00%
2015	82					21	25.61%	1	1.21%	2	2.42%
2016	142							53	37.32%	0	0.00%
2017	156									54	34.62%

First year survival of the juvenile (FYS) Lesser Kestrels released at the LKRAM Levka, is estimated as the number of birds marked in the previous year, the number of birds returning from migration in the following year, the rings of which are counted and the individual being determined individually. In 2015 there were also 5 individuals who were released in 2013 but were not registered in 2014. In 2013, these birds may have been in a wandering period and have not returned to the colony of origin.

Thus, the total first year survival of the juvenile released in 2013 increased from 46.66% (n = 42) in 2014 to 52.22% (n = 47) in 2015. Similar dynamics were also found for birds released in 2015, when returning 25.61% (n = 21) in the following year (2016).

In 2017 and 2018, more birds are returned that have not been registered in the first year after their release. Thus, by 2018, FYS for birds released in 2015 reached 29.24% (n = 24). The average FYS found for Lesser Kestrel in LKRAM in Levka for the period 2013-2018 is 37,344% (n = 671 marked birds).

It is fully comparable to the first year of the juvenile Lesser Kestrels in southern France - 39.7% (n = 325 marked birds) for the period 2006-2011. Exactly within the project LIFE TRANSFERT - Reinforcement and conservation of Lesser Kestrel populations in Aude (FR) and Extrémadure (ES) LIFE05 NAT/F/000134, is carried Reinforcement of Lesser Kestrel in methodology (BOURGEOIS *et al.*, 2016), which is very similar to that

applied in Bulgaria to restore the nesting of the Lesser Kestrel (GRADEV *et al.*, 2016).

Discussion

In the monitoring of the already ringed birds during the survey period there were also recorded 9 cases where the colour ring is not available on the leg of the bird on which it is placed. In these cases, the bird probably broke ring with the beak or the ring itself became broken due to aging of the material. We also see broken PVC rings at the very time they were placed on the leg. This should be taken into account when summarizing the data and describing the missing rings, as well as taking care when placing the rings. During the study various combinations between the background of the PVC rings and the colours of the symbols with which they are indicated, applied in Europe. There are 35 different combinations used in 8 different countries across the continent - Bulgaria, Greece, Spain, Italy, Portugal, France, Croatia and Israel, which cover almost the whole breeding area of the Lesser Kestrel in Europe. Information from European Colour-Ring Birding, EURING's partner, which coordinates ringing at European level, has been used to develop the material.

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