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RADIO-TELEMETRY OF LESSER KESTREL *(FALCO NAUMANNI)* IN THE COURSE OF REINFORCEMENT OF THE SPECIES IN BULGARIA

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Abstract: Despite the fact that Lesser Kestrel (*Falco naumanni*) was a common species in Bulgaria, there are no detailed surveys on its biology and ecology like the ones implemented in countries still harboring abundant populations, such as Spain, Italy, Greece, etc. After Green Balkans launched the reinforcement of the species in Bulgaria and the establishment of a new breeding colony in the village of Levka, Sakar SPA, it is now possible to study the species using modern technologies and methods. In order to identify the foraging grounds, dispersal areas, and roosting sites of the birds from the newly established colony, in the period 2014-2015 radio transmitters of 2.38 gr were mounted on 6 birds of different age and sex. Two of these birds were male individuals from pairs breeding in 2014, while the rest of the tagged birds were juvenile and non-breeding birds. The hunting grounds of the two breeding Lesser Kestrels were identified, covering areas of 29.70 and 46.80 sq.km. respectively, and almost overlapping in the field. The habitats these birds used to forage during the study period were cereal fields at harvest-time and the stubbles left after the crops have been harvested. The remotest recorded location of a tagged bird was at a distance of 7.08 km from the colony. Two 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) from their nesting sites.

INTRODUCTION

Although the Lesser Kestrel (*Falco naumanni*, Fleischer, 1818) was a widespread species in Bulgaria (Patev, 1950, Arabadzhiev 1962), there are no detailed surveys on its biology and ecology like the ones implemented in countries still harboring abundant populations, such as Spain, Italy, Greece, etc. After Green Balkans launched the reinforcement of the species in Bulgaria and

its recovery as a breeder in the country (Gradev *et al*., in press), it is now possible to study the species using modern technologies and methods.

Similar Lesser Kestrel research has been implemented through various types of transmitters – radio transmitters in Greece (Vlachos *et al*, 2014), PTT satellite transmitters in Spain (Liminana *et al,* 2012), GiPSy-4 data-loggers (Gustin *et al*, 2014) in Italy, etc., as well as many other surveys in these and other countries. Since this is one of the smallest species of the genus Falco found in the territory of Bulgaria (Simeonov *et al*., 1990), migrating to Africa (Negro 1997, Rodríguez *et al*. 2009, Catry *et al.* 2011), the size of the tracking devices should not impede the birds' long distance migration nor affect their behavior. Therefore, the team launched the first tracking of Lesser Kestrels in the country tagging the birds with radio transmitters. This enabled the identification of their hunting grounds, roosting sites, and pre-migration aggregation areas.

MATERIALS AND METHODS

The survey was carried out in the area of the village of Levka, Sakar SPA (BG0002021), in a low-mountain and hilly region harboring alternating arable and non-arable open areas. The region is situated in southern Bulgaria, near the national borders with Turkey and Greece.

The survey involved birds from the newly established Lesser Kestrel colony. The establishment of the colony began in 2013 through the construction of a Lesser Kestrel Release and Adaptation module intended for juvenile individuals hatched in captivity (Gradev *et al*. in press).

In the period 2014-2015, 6 birds of different age and sex were tagged with radio transmitters, in order to identify their hunting grounds, dispersal areas, and roosting sites. Two of these birds were male individuals from pairs breeding in 2014, while the rest of the tagged birds were juvenile and non-breeding birds.

Detailed description of all tagged birds and the numbers of the transmitters is presented in *Table 1*. Once removed from the initially tagged birds, two of the transmitters (Radio 1 and Radio 4) were attached to other individuals.

Table 1. Detailed description of all tagged birds and the numbers of the transmitters

Individual PVC ring	Date of transmitter tagging	Number of transmitter / frequency MHz	Description of the bird tagged
BCH	12.6.2014	Radio 1 150.049	Sub-adult (1st calendar year) male individual released within the project in 2013, tagged when returned to the colony after overwintering for the first time.
BTD	13.6.2014	Radio 2 150.082	Adult male individual; a bird from the wild population (not released within the project), caught in the colony, banded with metal and PVC rings and tagged with a radio transmitter.
BJD	20.6.2014	Radio 3 150.133	Juvenile male individual tagged with a radio transmitter during its adaptation at the Release and Adaptation Module.
BKA	21.6.2014	Radio 4 150.159	Juvenile individual of unknown sex tagged during its adaptation at the Release and Adaptation Module.
BAD	13.7.2014	Radio 4 150.159	Sub-adult (1st calendar year) female individual released at the Release and Adaptation Module in 2013, tagged when returned to the colony after overwintering for the first time.
BLF	07.7.2015	Radio 1 150.049	Male sub-adult individual (1st calendar year). Released from the Release and Adaptation Module in 2014, tagged when returned to the colony after overwintering for the first time..

The birds were tagged with four 2.38 gr radio transmitters - PIP Ag393 Tag produced by Biotrack. The battery lifetime estimated by the manufacturer was 16 weeks. The devices belonged to the "backpack" type – i.e. attached to the back of the bird (Garcelón 1985). The transmitters were attached through a 4 mm Teflon ribbon with two straps crossed on the breastbone and stitched through the rear loop of the device with polyamide surgical suture. Each stitch knot was fixed with a small amount of super glue. Thus, the weight of the Teflon ribbons reached approximately 1 gram. The total weight of the transmitter along with the entire harness (Teflon ribbons, stitches, glue) reached some 3.4 gr, accounting for 2.8-2.4% of the bird's body weight (varying from 120 to 140 gr.). This was less

than the maximum possible 4% that does not affect the behavior of the migrating diurnal birds of prey (Sergio, 2015). To track to signal in the field, the team used ICOM radio receivers - models IC-R5 and IC-R6, and aligned TVP Y-4FL antennas of 150-152 MHz frequency range. While in the field, the bird tracking teams communicated through YAESU FT-60 radio stations and mobile phones. In order to locate the current position of the bird tracked, the signal direction had to be caught from two or three different positions at the same time, i.e. by two or three teams positioned on elevated places in the region. This simultaneous location of the signal is called bi-angulation or tri-angulation. To communicate to each other, the teams used radio communication and mobile phones. The position of each team was located through the geographic coordinate system WGS84 and target coordinates X and У. GARMIN Montana™ 650 GPS devices were used to determine the geographical location of the teams. The data gathered through the telemetry was filled in a specific field data form. Then, calculations were made based on the location of each team and the angle of the direction from which the signal was received, in order to locate the position of the bird. These calculations and the location of the bird's position were done through the specialized LOAS V 4 software.

The radio tracking of the individuals tagged with transmitters took place in the period from 12.06.2014 to 25.07.2014 and from 07.07.2015 to 22.07.2015. During these two periods, 3 separate teams spent a total of 26 days implementing field surveys.

The team implemented a total of 356 successful recordings of signal from the transmitters mounted on the tagged individuals, most of which sent by the devices attached to BCH, BTD, and BLF.

RESULTS AND DISCUSSION

This was the first Lesser Kestrel survey of this type implemented in Bulgaria with the smallest birds ever tagged with radio transmitters in the country. Such precise data about the species' hunting grounds and pre-migration aggregation sites has never been gathered before.

Two of these tagged birds were male individuals from pairs breeding in 2014, while the rest of the tagged birds were juvenile and non-breeding birds. The hunting grounds of the two breeding Lesser Kestrels were identified, covering areas of 46.80 (bird banded with ring BCH – Fig. 1) and 29.70 sq.km (bird banded with ring BTD - Fig. 2) respectively, and almost overlapping in the field.

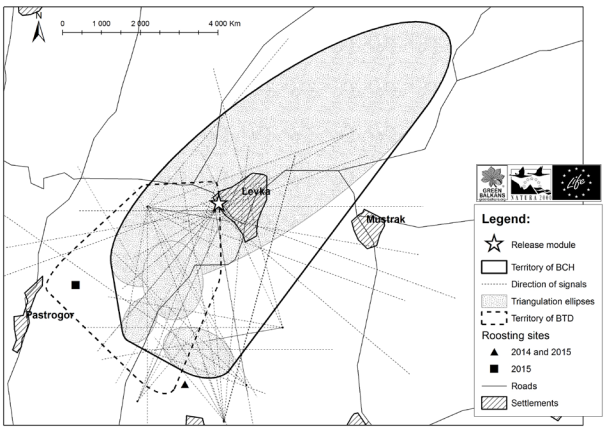

Fig. 1. Hunting ground of BCH with highlighted directions of the caught signal and calculated ellipses of possible triangulation deviation. Overlapping with the territory of BTD

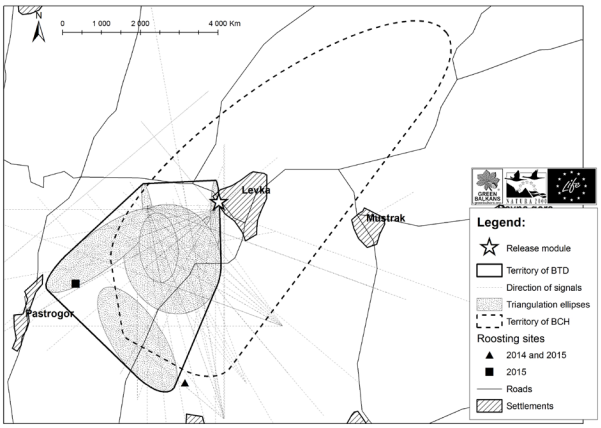

Fig. 2. Hunting ground of BTD with highlighted directions of the caught signal and calculated ellipses of possible triangulation deviation. Overlapping with the territory of BCH

The habitats these birds used to forage during the study period were cereal fields at harvest-time and the stubbles left after the crops have been harvested. The remotest recorded location of a tagged bird was at a distance of 7.08 km from the colony. According to surveys carried out in Italy, the mean distance males strayed from the colony was 6,209 km, while the maximum recorded distance was 18,702 km (Gustin *et al* 2014). Two 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) from their nesting sites.

Data gathered through the tracking of the bird banded with ring BLF was used to identify the location of the Lesser Kestrel pre-migration aggregation site in 2015. Yet, the information gathered through this individual was scarce; hence no other results were recorded. In these two years, the Lesser Kestrels recorded in the pre-migration gathering areas roosted on metal pylons of the high-voltage grid. These electric pylons were also used by Eurasian Hobby (*Falco subbuteo*) and Common Kestrel (*Falco tinnunculus*). Other rare birds of prey were also observed in these areas, including Imperial Eagle (*Aquila heliaca*), Long-legged Buzzard (*Buteo rufinus*), Eurasian Sparrowhawk (*Accipiter nisus*), Common Raven (*Corvus corax*), Common Buzzard (*Buteo buteo*), etc. The identification of the pre-migration aggregation areas enabled the implementation of regular monitoring and observation of other individuals from the colony not tagged with transmitters. Thus, the team recorded the latest dates when Lesser Kestrels were still present in the pre-migration aggregation area, which falls within the territory of the colony; namely, October 10th in 2014 and October 8th in 2015. During this monitoring, the team recorded Lesser Kestrels that did not belong to the newly established colony in Levka, but used the same pre-migration gathering sites. The highest number of such birds recorded at the roosting site was 7 individuals observed on September 1st, 2015. Since all birds released or hatched in the territory of the newly established colony were banded with standard ornithological and color PVC rings, the team could easily identify the different origin of the individuals. The presence of non-ringed birds showed that most probably these individuals originated from colonies in the nearby neighboring countries – Greece and/or Turkey, or even more distant colonies in FYROM.

Summary of the bird tagging results:

BCH: Following the end of the breeding season in 2014 when it was tagged and tracked, the bird left the area of the colony and the pre-migration aggregations. In the spring of 2015, having overwintered, this individual returned to the colony with the transmitter still on its back. The device was in good condition and when the bird was caught the transmitter was removed, equipped with a new battery, and then mounted on another individual in 2015. This proved that Lesser Kestrels could migrate successfully when tagged with this type of transmitters.

BTD: No sightings of this bird have been recorded in the area of the colony since it left the area of the colony and the pre-migration aggregations in 2014.

BJD and BKA: These two juveniles were tagged before fledging. The tracking of the individuals was unsuccessful. **BKA** fell victim to a Northern Goshawk (*Accipiter gentilis*) soon after its first flying attempts. Most probably the same thing happened to the other Lesser Kestrel.

BAD: Once tagged, the bird disappeared from the area of the colony. No data was gathered about this individual.

BLF: The only data gathered through this bird was related to the identification of the pre-migration aggregations and roosting sites in 2015.

The calculations of the hunting grounds of BCH show an area 17,1 sq.km bigger than that of BTD. Fig. 1. clearly illustrates that the territory of BCH includes an ellipse of possible deviation of huge area, shifted from the main concentration of locations of the bird. In our opinion, this ellipse is a result of deviation in the calculation of the signal angles and the real area of the hunting grounds of both birds is similar in size and location.

CONCLUSIONS

In this early stage of the recovery of the Lesser Kestrel as a breeder in Bulgaria, the implemented study proved to be successful, and the acquired information extremely useful for the further implementation of the project activities. The following conclusions can be drawn:

Several individuals should be tagged and tracked at a time to secure more efficient data gathering. Thus, the teams implementing radio telemetry in the field will be able to acquire information about more individuals at the same time;

Lesser Kestrels can successfully migrate tagged with this type of radio transmitters;

Tagging juvenile individuals under this method should be avoided.

In the implementation of such surveys, positions of uncertain quality should be excluded from the general calculations.

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