ABSTRACT

Being abundant, the badger (Meles meles L.) is one of the least concerned and thus one of the least studied animals in Bulgaria. The current paper deals with the first experience on capturing badgers for scientific purposes, the procedure of implanting radio-transmitters and the peculiarity of radio-telemetry on these fossorial animals. It examines the advantages and disadvantages of different capturing techniques on badgers and the use of radio-implants. The paper also presents the first data on radio-telemetry and internal body temperature, acquired through temperature sensor built in the implant for one adult female badger from Kyustendil region during the winter season.

Keywords: badger, Meles meles, radio-implant, radio-telemetry

Introduction

Being abundant, the badger (Meles meles L.) is one of the least concerned and thus one of the least studied animals in Bulgaria. This is the first attempt for a long term study on badgers’ biology and ecology except for a few master thesis (8). The behavioural peculiarities of the species such as being fossorial and crepuscular define the research methods to be used and the integral approach towards the species (3). We used radio telemetry to asses’ habitat use and internal temperature change during the winter season of one female badger in the Kyustendil valley region of South-West Bulgaria.

The results presented are part of bigger research project for studying badger biology and ecology in Bulgaria funded by the scientific research fund of Ministry of Education and Research.

Materials and methods

The study is taking place in two pattern type of habitats: mountainous in Osogovo mountain and lowland habitat in the Kyustendil valley at the foot of the mountain. The current paper will present results from the plain habitat (Fig.1). The Kyustendil valley is situated in South-West part of Bulgaria covering an area around 460 km² and is situated on the Struma river valley in northwest-southeast direction. It is fully surrounded by mountains – Osogovo (in the south), Liseck, Chudinska and Zemenska Mountains (in the west and north), Konjavska (northeast to east). The valley dates to the tertiary period when it was a lake which drained away due to the geological activity. Soils in Kyustendil valley are diverse, but dominated by low podzolized and podzolized cinnamon-brown forest and forest soils. The field is covered by low leached and leached cinnamon soils. The climate is transcontinental. The average annual temperature is 10.7 °C. The inversions are typical for the valley. Rainfall is moderate with an average annual amount of 650 millimetres. Snow holds for 4-5 weeks (9).

Typical flora for the meadows and orchards are the meadow foxtail (Alopecurus pratensis), fox sedge (Carex vulpina), sorrel (Rumex acetosa), grasslike starwort (Stellaria graminea), creeping clover (Trifolium repens). Common are the dog rose (Rosa canina), juniper (Juniperus communis), blackthorn (Prunus spinosa) and the hawthorn (Crataegus monogyna).

Kyustendil valley is one of the major birds migratory routes (via Aristotelis), which determines the rich bird fauna in the region. Of most concern to the conservation are the golden eagle (Aquila chrysaetus), raven (Corvus corone), black woodpecker (Dryocopus martius), stock dove (Columba oenas) and roller (Coracias garrulus). Mammals to be found in the Kyustendil region are the marbled polecat
(Vormela peregusna), badger (Meles meles), wolf (Canis lupus) and European souslik (Spermophilus citellus). In recent years increasing numbers of wild boar (Sus scrofa), lesser mole-rat (Nanospalax leucodon) and marten (Martes foina) are noted.

**Capturing and radio-telemetry of badgers**

During the capturing time different types of traps were used: box traps with sliding doors at the two sites, box traps with one sliding door, leg-hold traps and specially designed snare trap (5). All traps were equipped with a radio alarm system, which shortened the time the badger spent in a trap to 1–2 h. As bait we used fish, meat, corn, honey, fruits, peanuts etc.

The captured animal was immobilized by an intramuscular injection of Zoletil - a fixed-ratio combination of the tranquilizer, zolazepam, with the dissociative anesthetic, tiletamine (7). The sex of the badger was determined and the approximate age (yearling or adult) was estimated on the basis of body mass, date of capture, and tooth wear. We used implantable transmitter IMP/400/L produced by Telonics (U.S.A.) that weighed 90 g, size 9.7 x 3.3 cm. They are equipped with temperature sensor which monitors the body temperature in proximity to implant by changing the pulse period. The signal range is 500 – 2500 m but highly depends from the particularities of the relief and the climate conditions. In the period November 2008 – March 2009 the marked badger was located during the night, from the ground, once per week. We determined the badger’s position by triangulation (4) and measured body temperature through the pulse period.

The badger was marked with plastic ear tag in colour with unique number (2).

**Results and Discussion**

There are two main reasons that make badgers difficult to be caught. First they live near humans settlements and crops and they are used to avoid people. Second they mainly rely on their sense of smell. The Bulgarian practice of catching badgers includes the use of dogs for underground hunt. They are released into the badger’s sett and if they don’t manage to chase the badger out, the hunters dig it out leaded by the bark. This practice often is lethal both for the dogs and the badger, which makes it unacceptable for scientific purposes.

Box traps are more suitable for high density population like in England but in continental Europe, badgers are more “primeval” (Dr. Rafał Kowalczyk, pers. comm.) and a very low percent of them are captured in such traps. If happens these are often old or sick animals. Badgers are also very sensitive to the material the trap is made of. They showed themselves very sensitive to metal and if such traps are used they should be very well treated with no trace of smell left. Badgers are neutral to traps made of natural materials like rope, hemp and wood. From all the tested baits, the most successful proved to be corn.

We concentrated our trapping efforts on a sett that was recognised as main badger sett near the village Sovoljano, Kyustendil region. On the 1st of August 2008 a male badger was caught. Due to its physical condition the animal was considered not suitable for implantation. On the 21st of November 2008 after 46 trap nights on this sett for the period from July to November and three different types of traps another badger was caught in foot-snare trap placed near the sett. It was an adult female badger, 10, 5 kg (Table 1).

The badger was anesthetized and surgically implanted with the transmitter. The intra-abdominal implantation procedure is easier and faster to perform compared with subcutaneous procedures (1). The operation was performed by highly qualified and experienced vet. Implants were preferred to radio collars because badgers weight varies in wide range through the seasons and this may cause collar to drop in spring when they are slimmer. Radio rucksacks are available but we tried one on a tame badger in Sofia zoo and it manages to pull it off with its long claws on the forelegs.

The implanted badger was returned and released in the sett immediately after getting full consciousness from the anaesthesia. During the recovery period the two main entrances of the sett were continuously observed by cameratraps, recording the exit and the entrance of all individuals inhabiting the sett. The implanted badger went out of the sett on the fifth day after the operation. There was no change in her status in the group due to the procedure and
To the marking tag. This conclusion was also done for other cases by Stewart and Macdonald, 1997. After the first emerge, the animal was very cautious and was not moving away from the sett for almost a month.

During the trapping period in attempt to secure the success of the project we had contacted some of the local people from Sovoljano village to make them aware of our work. We hope that the marked animal will be recognized by the ear tag and they won’t persecute her.

Due to the winter months when badgers feed mainly on roots and they don’t forage far away, we were able to record the first location of our mark badger away from the sett in the beginning of March 2009. The farthest point acquired through triangulation was at a distance of 588 m from the sett on the river bank in south-west direction (Fig.2).

### TABLE 1.

<table>
<thead>
<tr>
<th>Total length</th>
<th>Tail length</th>
<th>Chest measurement</th>
<th>Hind foot length</th>
<th>Hind foot width</th>
<th>Fore foot length</th>
<th>Fore foot width</th>
<th>Neck measurement</th>
<th>Head measurement</th>
<th>Head length (to occipital bone)</th>
<th>Length of longest nail (fore foot)</th>
<th>Ear length</th>
</tr>
</thead>
<tbody>
<tr>
<td>850</td>
<td>120</td>
<td>480</td>
<td>51</td>
<td>20</td>
<td>24</td>
<td>290</td>
<td>290</td>
<td>170</td>
<td>left - 25; right - 23</td>
<td>23 (right)</td>
<td></td>
</tr>
</tbody>
</table>

The average pulse period of the implanted badger for the research period is 1241,597 msec (range 494.8 – 1741) which is equal to the temperature of 38.2 (range 36.3 – 40.8°C) (Fig.4).

Highest internal body temperatures are recorded during animal movement when the badger was away from the sett foraging. On the 22 February 2009 was recorded the lowest body temperature ~36.3°C in the conditions of snow cover and -2°C environmental temperature. Still, the animal was active showing off the sett the same day and on the next night - even collecting bedding material at an outside temperature of -7°C. (Fig.3)

The temporary results show that badger internal temperature varies in wide range during the winter season but they don’t fall into lethargy. These are only preliminary results and more research is needed to confirm this.

![Fig.2 Telemetry locations of the marked badger](image1)

![Fig.3 Cameratrap photos recording the activity of the marked badger during the lowest registered internal temperature.](image2)
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REFERENCES
9. Zahariev J. (1963). Kyustendil valley (Geographical and ethnographical study), Sofia (In Bulgarian)