Health monitoring of wild bears in the Nature Park Skakavac, Canton Sarajevo

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Abstract. Many wild animal populations are considered endangered due to anthropogenic activities. Wildlife and nature habitat preservation requires holistic and science based approaches supported by adequate regulations. One of the means for wildlife preservation is undoubtedly health monitoring and investigation of infectious diseases of the wild animal populations, particularly if spillover effects are considered. Even though the theoretical background is well researched, implementation of disease prevention and control measures in wildlife populations entails more challenges than in domestic animal populations. Immediate signs of health disorders in wildlife often become evident when the infectious agent is well established in an area. Additionally, due to unrestricted and often long-range movement of wildlife, diseases are easily spread across borders. Brown bears, indigenous in Europe, are classified by EU regulations as endangered, almost extinct and rare. The wild bear population in Bosnia and Herzegovina shares a genetic lineage with bear populations of neighbouring Croatia, Serbia and Montenegro and is one of the few remaining fragments of bear populations in Europe. The aim of this paper is to describe implemented activities for health and telemetric monitoring of wild bears in the Nature Park Skakavac, Canton Sarajevo, Bosnia and Herzegovina.

1. Introduction
According to many international reports, growing numbers of wild and indigenous animal populations are becoming endangered due to mainly anthropogenic activities, thus posing great risk for global biodiversity [1,2]. Similarly in Bosnia and Herzegovina (BiH), many wild animal populations, particularly large animals, are decreasing in size for reasons such as non-harmonized and lacking hunting management, deterioration and decrease of natural habitats and outdated and loosely implemented regulations [3]. The process of modernizing wildlife management plans and harmonizing with EU standards includes establishing wildlife population sizes and distributions alongside analysis of health status, particularly if spillover effects (emerging zoonotic diseases) are considered.

In Europe, the population of brown bears in the last few decades has rapidly decreased, and the species is classified by EU regulations as endangered, almost extinct and rare [4, 5]. The wild bear
population in BiH shares genetic lineage with bear populations of neighbouring Croatia, Serbia and Montenegro and is one of the few remaining fragments of bear populations in Europe [6]. Nature Park Skakavac (Canton Sarajevo, BiH) is a specific, peri-urban natural habitat for several large wildlife species, some of which are considered close to extinction according to the IUCN/CITES classification (International Union for Conservation of Nature/Convention on International Trade in Endangered Species of Wild Fauna and Flora).

The aim of this paper is to describe implemented activities for health and telemetric monitoring of wild bears in Nature Park Skakavac, Canton Sarajevo, BiH. Besides its scientific contribution, this study falls in line with demands and recommendations of national and international regulations, conventions, strategies and action plans for environment protection including the Plan and Program for Wildlife Preservation in the Canton Sarajevo.

2. Materials and Methods

2.1. Study area
The study area was the Nature Park Skakavac, established in 2002 as the first natural heritage site in the Canton Sarajevo, managed by the Canton Sarajevo Administration for Protected Natural Areas. The park is located in the eastern part of central BiH within the administrative borders of the Canton Sarajevo (https://www.google.com/maps/@43.9033123,18.3453458,12.14z). The park terrain is mountainous (as a subset of the wider Dinaridi area) and spreads across 1,430.70 ha. The entire area is rich in natural water bodies together with a high degree of flora and fauna biodiversity, indicating beneficial conditions for wildlife to thrive. The climate in the area is moderate-continental with influences of mountain climate. Average annual temperature is around 5°C, ranging from -32.5°C to 32°C. One of the landmarks of the Park is the Skakavac waterfall with a height of 98 m.

2.2. Bear monitoring
In this study, different methods of bear monitoring were applied with the aim of acquiring data on population, movement and health of animals in the period 2018 to 2020. These included direct observation (by binoculars), tracking (paw prints, faeces, signs of scratching, food remains and hair), prey analysis (killing method and patterns of carcass consumption), photo traps, telemetric collars, observation of mortality and other health parameters (depending on collected samples: feces, urine, saliva, hair, tissues/blood) (Figures 1, 2 and 3)

An Aldrich photo trap was used with an incorporated SIM card and transmitter, enabling real time notification to the investigators about captured recordings. In a selected locality within the park, based on tracking results and photo trap recordings, an animal was fitted with a telemetric collar that collected data on bear movement from late spring to autumn. To capture the bear for collar fitting, we used tranquilizer guns and blow darting, alongside personal protective equipment for operators, humane immobilization equipment for the sedated animal and standard sample collection equipment.
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Figures 1, 2 and 3.: Different methods of employed bear monitoring: tracking paw prints (left) and collection and analysis of photo traps recordings (middle and right)

We used a Vectronic GPS/GSM telemetric collar that enabled satellite monitoring of animal movement and sent data on changes of location via a mobile network (Figures 4 and 5). Vectronic GPS Plus X software was installed and configured by IT staff from the Veterinary Faculty Sarajevo for the purpose of connecting the server and collar, collar configuration and pilot testing before fitting on a bear.

2.3. Sample collection
During the study period, we collected faecal samples (conserved upon collection in 76% alcohol) for parasitology diagnostics. Samples were examined macroscopically followed by the flotation method to determine the presence of helminths [7] and direct immunofluorescence test (MERIFLUOR® Cryptosporidium/Giardia test (Meridian Bioscience, Inc.) to detect protozoal developing forms [8]. Determination of parasite species was based on morphological characteristics and measurements observed in specimens under the microscope CH20 BIMF200®, (Olympus) and fluorescence microscope BH-2-RFCA® (Olympus), alongside comparison with given parameters specified in the diagnostic method manual [9].

Furthermore, hair and blood samples were collected from the bear fitted with a telemetric collar for dermatologic, hematologic and biochemical testing. All laboratory testing was done in the Laboratory of Parasitology and the Laboratory for Molecular Genetic and Forensic Research of the Veterinary Faculty, University of Sarajevo, which holds BAS EN ISO/IEC 17025:2018 accreditation, and at the Faculty Clinics.
3. Results and Discussion

A telemetric collar was fitted in June 2018 after a photo trap alarm indicated bear location. The animal was sedated using tranquilizer guns followed by blow darting. The sedated animal was given a code (Pasha 003-BH), fitted with a collar, measured and clinically examined (Figure 6). The sedated bear was male, estimated 7 to 8 years of age, in very good body condition. The following body measurements were recorded: weight 220 kg, body length 186 cm, height 130 cm, chest circumference 150 cm, neck circumference 82 cm, head circumference, width and length 88, 24.2 and 42 cm (respectively), tail length 12 cm, canine length 3.2 cm (upper) and 3.1 cm (lower) (no canine/incisor injuries). Body temperature was 40.9°C, respiration rate 13 per minute and heart beat rate 50 per minute. Clinical examination of collar-fitted Pasha 003-BH bear showed signs of dermatitis on more than 1/5 of the body surface, predominantly in the lumbosacral region, and acute purulent inflammation on the base of the right ear. The animal was treated symptomatically and following photo trap recordings showed improvement in general health (better body and hair coat condition).

Upon completion of examination and data collection procedures, antidote was administered for the purpose of minimal and controlled duration of sedation. The field team for collar fitting was comprised of staff of the Veterinary Faculty from the Canton Administration for Protected Natural Areas and from the local hunting association. The first movement monitoring results were available seven days after collar fitting. The collar-fitted bear’s movement was recorded continuously for several months, with GPS coordinates showing location and signal characteristics (length, width and height distance from transmitter to receiver) (Figure 7).

![Figure 6](image1.png)  ![Figure 7](image2.png)

**Figure 6** Bear Pasha 003-BH after collar fitting  **Figure 7** Google Earth view of GPS monitoring of bear Pasha 003-BH’s movement

Telemetric and other employed bear monitoring methods revealed increased migration of bears from/to adjacent habitats during spring and autumn with a greater concentration of animals in known den areas. In addition to the collar-fitted bear, we individually identified in the area one more male bear and a female bear with two cubs.

Parasitological investigation of collected faecal samples was negative, except in one sample in which we established eggs of *Baylisacaris transfuga*, a roundworm parasite species commonly found in bears but with high zoonotic potential [10]. Clinical manifestation of *B. transfuga* infection in bears is mainly as digestive disorders, while in accidental hosts such as other mammals, birds and humans, ingested eggs that remain active in the environment up to several years can lead to ocular, visceral or neural larvae migrans syndrome [10, 11]. The collar-fitted bear in this study was preventively treated against parasites, with later parasitological investigations being negative.

Haematology and biochemical investigation of collected blood samples did not show significant deviations in parameters compared to referent values. Within normal range, but somewhat low haematocrit and minute deviations of white blood cell lines were observed, indicating a stress type
leucogram probably caused by capture stress [12]. Biochemical analysis revealed high levels of alanine-transferases and phosphorus, indicating nutritional disbalance or kidney insufficiency.

Insight into the health of wild animals provides an option for targeted preventive measures and aids in minimising chances for disease transmission. This is particularly important for zoonotic diseases with wild animals as reservoirs. Infectious agents found in bears, besides compromising health and wellbeing of animal and bear populations in the area, could have zoonotic potential. Reported and planned follow up activities have high impact on promoting animal health and welfare as well as promoting the health of protected natural areas that are animal habitats. Our results serve as a base line for future investigations, wildlife management planning and education of staff and visitors to this site. This study meets the requirements of BiH’s international obligations, thus enabling networking with European wildlife and nature protection counterparts alongside conservation of BiH’s natural resources for the future.

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