Movements in the forest during Covid-19 Lockdown in the Czech Republic: Interaction between humans and wild boars

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ABSTRACT

The COVID-19 lockdown limited human activity in certain areas of life, particularly travel and gathering indoors. Consequently, many people spent more time outdoors, penetrating natural areas and potentially putting pressure on wildlife. Increased interest in outdoor recreational activities during the lockdown period of 2020 was observed in the suburban forest near Prague (Czech Republic), where human visitation to the same period of 2019 increased by fivefold. Could this increased human presence alter the spatial behaviour of wildlife? In this study, we present the wild boar's space use and movement patterns during the first Covid-19 lockdown in the Czech Republic and compare them to the same period in 2019 with no Covid-19 restrictions. In total, we equipped 40 wild boars with GPS and biologger devices in the suburban forest "Kostelec nad Černými Lesy" in the Czech Republic. We calculated daily home ranges and step length, turning angle, and net square displacement. Human activity was measured daily using an automatic counter of humans entering the forest by a road. We hypothesised that the increased presence of humans in the forest alters daily movements and daily range of wild boars. Our preliminary analyses from the first lockdown period in spring 2020 show that increased human presence resulted in allocation of movement activity toward nighttime by increasing the distance travelled at night. We provide important insights into how increased human activity due to COVID-19 related restriction affect wild boar's spatial movement and space use.

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CCS CONCEPTS

• Movement Ecology → Interaction between human and wild boar → Spatial analysis during COVID-19 Lockdown

KEYWORDS

COVID-19 lockdown, Spatial behaviour, Anthropogenic Effects, Wild boar

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INTRODUCTION

The development of the COVID-19 pandemic did not affect just human society. Repeated 'lockdown' periods, which limited human activity in certain areas of life, increased interest in outdoor recreational activities. This could affect wildlife populations directly by changed human presence and noise, and indirectly

through possible consequences of changed movement dispersal. Relevant for the initial period of interruption in many human activities (now known as "Anthropause") [1], recorded phenomena of reduced human activity allowed wild animals to use inhabited areas and increase daily activity [2]. In some studies, surprising untypical behaviour of animals was observed, such as the presence of normally shy animals in the streets of populated cities [3]. Additionally, there is much evidence that large amounts of anthropogenic activities affect wildlife and damage their natural habitats, such as urbanisation, agriculture, tourism, and others [4],[5][6]. Recorded changes in animal behaviour suggest that interference from human activities affects their natural behaviour [7],[8][9]. Especially due to the spread of urbanisation, human-wildlife interactions are increasing [10]. Wild boar, with one of the most widely spread native geographic ranges [11][12], show specific traits such as high reproduction rate and opportunistic feeding [13]. These traits, together with other behavioural characteristics, can amplify the human-wild boar conflict in urban and sub-urban areas.

The first cases of COVID-19 were found in Wuhan, Hubei, China, in December 2019. SARS-CoV virus spread rapidly worldwide, causing the World Health Organization (WHO) to declare COVID-19 a global pandemic in March 2020 [14]. Governments around the world have had to take precautionary measures against the spread of the disease. These are mainly mandatory distances, wearing masks, home offices, and closing the entertainment industry such as restaurants, cinemas, clubs, etc. [15],[16],[17][18]. In general, lockdown led to reduced human activity, which is usually considered positive and leads to the restoration of biodiversity [19]. However, in the Czech Republic and other parts of the world, human activity especially in the forest increased. In the Czech Republic, the so-called lockdown began in March 2020. During this period, compared to the previous year, there was an increase in human outdoor recreational activities. This is supported by the excessive attendance in our monitored forest area of Kostelec nad Černými lesy. There, the average daily attendance at Studánka increased distinctly from April 2019 (200 people) to April 2020 (1100 people; recorded by automatic field counter). The pre-and post-lockdown period with lower human activity and the first lockdown period with increased human activity can be used in a semi-experimental setting to further assess the effect of human presence on movement behaviour of wild boar. Our aim was to determine whether this lockdown period with increased human activity affected the spatial activity of wild boars. Our hypothesis stated that the increased presence of humans in the forest leads to an alteration of daily movements and daily range. We predicted a temporal shift in the movement activity of wild boars toward nighttime

METHODS

The study area "Kostelec nad Černými Lesy" is located in the Central Bohemian Region, district Prague-East (N 49.93`- 49.99`, E 14.72 - 14.88, WGS84 UTM Zone 33 N) around 30-55 km away from the capital city Prague (Figure 1). The area covers a size of 6734 ha and consists of a suburban forest. An automatic counter recorded all human activities at the forest entrance (Figure 2). Wild boars were caught by traps baited with corn and anaesthetized using drugs administered with a tranquillizer rifle. We used a mixture of Zoletil, Ketamine and Xylazine for the anesthesia [20]. Wild boars were equipped with a GPS collar from the companies Vectronic Aerospace GmbH and Wildbyte Technologies. The collars sent GPS locations of the animal every half hour via satellite. The wild boar trapping and collaring in Kostelec nad Černými Lesy was implemented in accordance with the guidelines of the Ministry of the Environment of the Czech Republic.

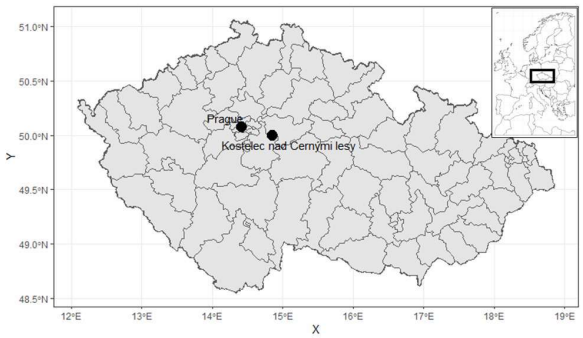

Figure 1: Location of the study area Kostelec nad Černými lesy and the capital city (Prague) are denoted by black circles. In the upper right box, Czech Republic position in Europev is shown.

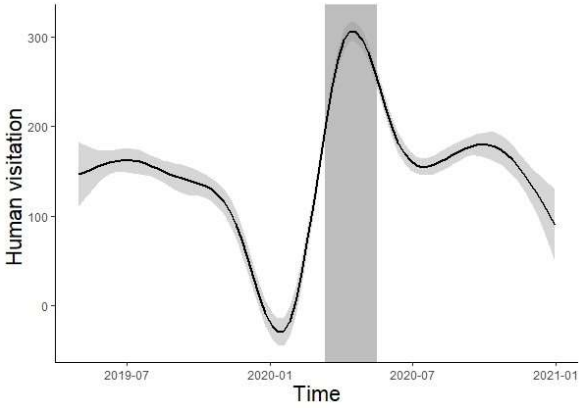

Figure 2. Count of human visitation in Kostelec nad Černými lesy by an automatic count at the forest entrance. Dark grey area indicates the first lockdown period in the Czech Republic. The state of emergency was declared on March 12, 2020 and ended on May 17, 2020 [21].

The handling protocol was approved by the ethics committee of the Ministry of the Environment of the Czech Republic (Nr. MZP/2019/630/361). For the analysis, we used GPS positions with a dilution of precision (DOP) (>= 1 and <=7) downloaded from the GPS Plus X software. All data were analysed within R 4.1.0 (2021-05-18). GPS locations of wild boars and human count data were

collected between 2019 April and 2021 March. In this period, we tested the effect of daily human visitation on the daily movement variables of wild boar Daily home range size was estimated by 100 % Minimum Convex Polygon (MCP) from the package "adehabitatHR" [22]. Step Length (SL), Turning Angle (TA), and Net Square Displacement (NSD) were calculated with the package "amt" with a time distance of at least 30 min. For the variables SL, TA and NSD, we calculated the daily mean. The daily distance was calculated by summarising the total amount of step length per day (24 h period). The furthest flight distance was determined by the highest value of NSD per day. We calculated day and night activity ratio separately using the cumulative step length. Night activity ratio was defined as the time between sunset and sunrise, and daytime was defined as vice versa. Activity ratio ranges between 0 (all movements performed during the day) and 1 (all movements performed during the night). We analysed the effect of human presence on wild boar movement using mixed effect models with the package "lme4" [23]. The final model was developed stepwise, starting from creating models with different response variables. As explanatory variables we used "Human count from encounter" and time variables to account for temporal autocorrelation, such as Julian Date, Month, Season, Week, Month of the Year and Week of the Year, in the data. Furthermore, we included the individual animal as a random effect. As a next step, we checked if the selected variable is autocorrelated with itself at different time lags. We selected the best time variable using Akaike's information criterion (AIC) [24] from the package "AICcmodavg" [25]. Using the package "ggeffect" [26], we created predictions of human effects on wild boar activity based on the best fit model.

RESULTS

The models with the response variables for space use (home range) and movement parameters (SL, TA and NSD) showed no significant change in response to an increased number of people in the lockdown period. Only the activity ratio showed a shift of movement activity toward nighttime in wild boars due to an increased number of people. Temporal autocorrelation in activity ratio was present within a one month time lag. Therefore, the added explanatory variable "month of the year" provided the best fit based on AIC. Following our prediction, we were able to detect a change in movement activity during the first lockdown period. We observed a temporal adjustment in movement behaviour of wild boars in "Kostelec nad Černými lesy" as indicated by the predicted model of the activity ratio at night (Figure 3). The model shows that the wild boars increased their movement activity at night when human presence in the forest was high compared to the low human presence after or before the first lockdown period. The average night activity ratio was 0.92 (corresponding to 0-150 visitors per day) with no human activity and 0.96 at the high human activity (1000-1150 visitors per day). The wild boars moved 42 m more at night per unit of 150 people visiting the forest (Figure 4). Temporal autocorrelation was present within a one month time lag in distance travelled at night and day. The model with the explanatory time variable "month of the year" provided the best fit based on AIC. We found no relationship between increased human presence and distance travelled during daylight by wild boars (Figure 4b).

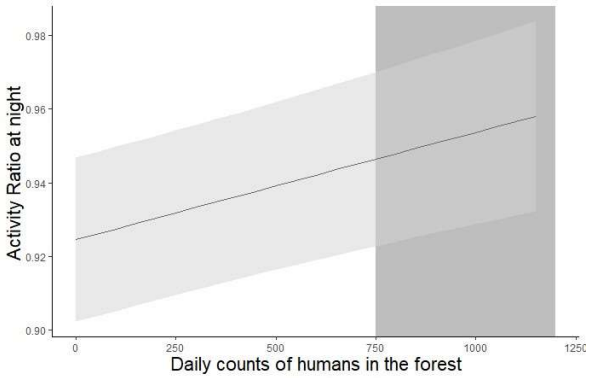

Figure 3. Predicted effect of humans on the wild boar movement activity throughout the day. Dark grey area indicates the number of humans during the first lockdown period in Kostelec nad Černými lesy.

DISCUSSION

The Covid-19 pandemic has changed the activity of human life around the world, subsequently influencing wildlife movement behaviour as a result of altered human presence in nature. Sightings reported an increase in wildlife movement, such as pumas in downtown Santiago, Chile, or dolphins in the port of Trieste, Italy [27]. In the suburban forest Kostelec nad Černými lesy, the lockdown had the opposite effect, and the number of humans increased sharply (Figure 2). In this context, the movement activity of the wild boar shifted temporally. We showed that the animals are more active at night and less during the day when there is an increased human presence in the forest. Our findings agree with the results of other studies, which consistently report how animals become more nocturnal in response to human disturbance [4].For example, wild boars from urban areas [28] or after driven hunts [29][30] show high nocturnal activity. However, in this context, the Covid-19 lockdown, as a human disturbance, is proven for the first time as the reason for increased nocturnal activity in wild boars. This proves that the effect of human activity in response to lockdown situations is versatile context dependent. It is also important, to have extensive and detailed data about human activity. The Czech Republic is a densely human populated area (136 people for squared kilometer) [31], and wilderness areas are limited. Wildlife avoids anthropogenic activities by a shift of space use or reduced movement rate [32][33]. However, if there are no alternative wilderness areas for wildlife to avoid humans, the only solution for wildlife is the temporal adjustment [34]. This could explain that no significant change in space use and movement rates of wild boars over the first lockdown period were found in the suburban forest.

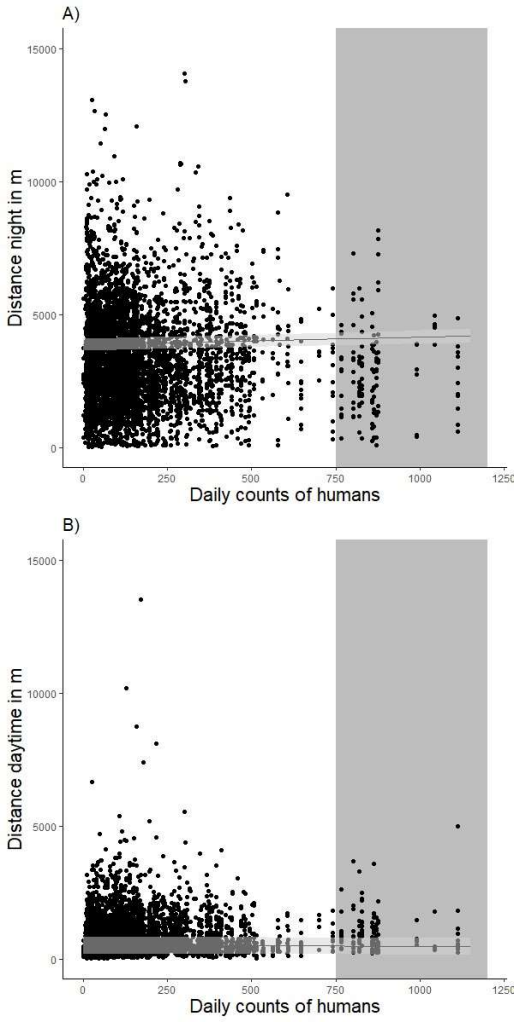

Figure 4. Effect of humans on wild boar cumulative step length (distance travelled): A) Distance travelled over the night. B) Distance travelled over the daytime. Dark grey area indicates the first lockdown period in Kostelec nad Černými lesy.

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