



# COVID-19-induced visitor boom reveals the importance of forests as critical infrastructure

Jakob Derks\*, Lukas Giessen, Georg Winkel

*European Forest Institute, Bonn, Germany*

## ABSTRACT

During the 2020 COVID-19 pandemic, countries around the globe have implemented a certain degree of lockdown, restricting citizens' freedom of movement and freedom of assembly. This article aims to illustrate the impact that the measures against the spread of COVID-19 have on forest recreation, building on a study in an urban context around Bonn (Germany) that was conducted between April 2019 and February 2020. The quantitative and qualitative data on urban forest visits from that study were supplemented with new census data supported by selected expert interviews. We found that visitor numbers since the inception of COVID-19 measures in March 2020 have more than doubled. Visitor patterns have drastically shifted, from an even distribution throughout the day with small peaks before and after office hours to a culmination in the late afternoon. Lastly, the interviewed forestry professionals have noted that a new set of visitors, i.e. young people, families with children and non-locals, has arrived to the forest. This influx of more and novice visitors poses challenges for forest managers and urban forest policy. It is, however, also a unique opportunity for a substantial engagement of forestry with society at large, that has implications for forest policy, especially in urban areas, possibly beyond the COVID-19 pandemic era.

## 1. Forest recreation & COVID-19 lockdown

Forest recreation has been reported as a constantly increasing function of forests as well as an important objective in forest management (e.g. Douglass, 2016; Eggers et al., 2019), especially in urban areas of industrialised countries with a legal framework permitting access to forests for the public. This generally increased use of forests for recreation brings potential conflicts among different user groups (e.g. Wilkes-Allemann et al., 2020). At the same time, however, it is an opportunity for forest owners, administrations and managers to proactively engage with broader parts of societies about the multiple benefits of forest management.

In light of this generally increased demand on forests for recreational uses, the current COVID-19 pandemic situation poses specific challenges regarding forest use, management and policy. Many people share the impression that the number of citizens walking and cycling along rivers, in parks and in forests has strongly increased during the time of lockdown measures related to the COVID-19 outbreak (similar Parnell et al., 2020; Freeman et al. 2020; Rice et al., 2020). This is true at least in countries where citizens were still allowed to go out into nature. Is this just a feeling or can this increased use of forests for recreational purposes be supported by numbers? And what would be implications for forest management and policy? This article aims to provide insights from a long-term ongoing, quantitative visitor monitoring in a peri-urban forest before and during the COVID-19 lockdown

to generate initial implications for forest management and policy.

## 2. Underlying Kottenforst-study (Bonn, Germany)

Between April 2019 and May 2020, visitors were surveyed in the Kottenforst, a large peri-urban forest a large peri-urban forest located on a plateau just west of the German city of Bonn, owned and managed by the state of North Rhine-Westphalia. It is a mixed forest dominated by oak, beech, and spruce. The Kottenforst is characterised by its extensive network of long and straight forest roads, dating back to prince-electors Clemens-August in the 18th century. The forest is mainly managed through a system of selective cuts of high-quality timber, but severe bark-beetle outbreaks in the last two years have caused the return of clear cuts. Recreation is an important function of the forest located on the Southern edge of the Rhein-Ruhr metropolitan area with 11 million inhabitants.

This paper has been written based on data gathered in a study that has been conducted within the framework of the LIFE+ project Vilewälder (<https://vilewaelder.de>), which will here be referred to as "Kottenforst-Study". Specifically, we use two elements of this study: 1) automatised visitor counts and 2) interviews with visitors. The latter were semi-structured interviews on-site asking for forest visitors' motivations to visit the forest, perception of stand beauty and naturalness, and acceptance of forest management measures. A total of 292 interviews were conducted at 15 different locations in the area before the

\* Corresponding author.

E-mail address: [jakob.derks@efi.int](mailto:jakob.derks@efi.int) (J. Derks).

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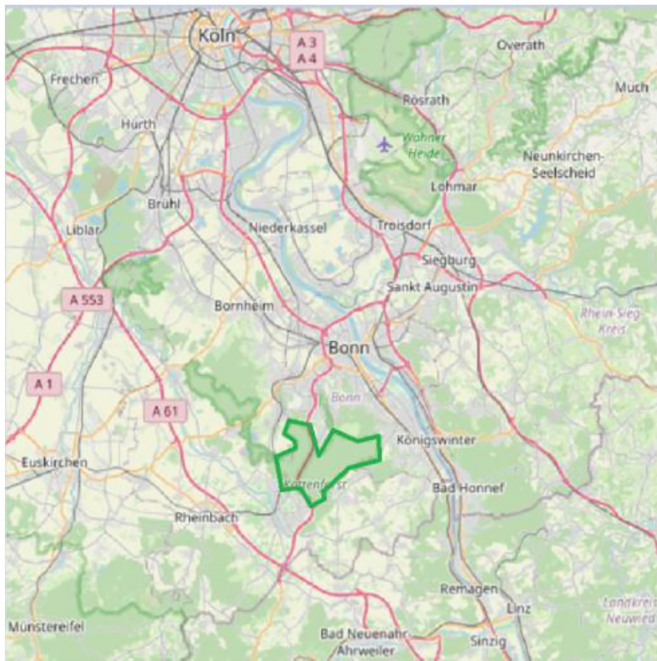


Fig. 1. Location of the Kottenforst, south of the Cologne-Bonn agglomeration.

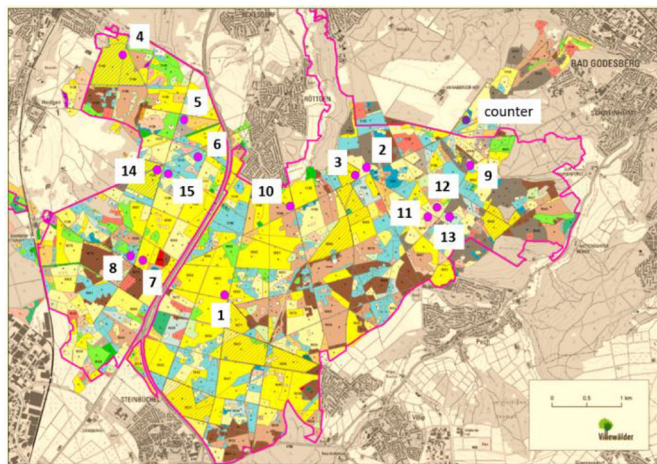


Fig. 2. Stand map of the state-owned part of the Kottenforst, with the numbered interview points and the sensor location indicated.

COVID-19 lockdown. The interview results were analysed and coded using MAXQDA software. During the lockdown, three expert interviews with local forest practitioners were conducted to gather additional qualitative information. Another 53 interviews were conducted in May 2020 (in a time where the lockdown was gradually released), but these interviews have not been analysed and are not used in this paper (Figs. 1 and 2).

The automatised visitor counting was conducted with an infrared pyroelectric sensor from Eco-Counter, strategically positioned on a central spot in the forest (50°40'40.9"N 7°06'31.2"E). This census started in April 2019 and is ongoing, thus allowing a direct quantitative comparison of visitor numbers and distribution before and during the COVID-19 lockdown. The lockdown period in North Rhine-Westphalia started on March 22, 2020. After this date, schools, bars, most restaurants and shops, gyms, and theatres were closed. Additionally, people's social contact with friends and family was heavily restricted, allowing a maximum of two people to jointly meet in the public space, including forests. Despite some measures already predating this moment, 22/03/

2020 is used as the turning point in this article.

### 3. Early results: COVID-19 forcing people out

#### 3.1. Forest visits prior to COVID-19

The local forest visitors' census showed a high constant pre-COVID-19 stream of visitors with an average of 290 counts per day. The data show clear peaks just before and after office hours, suggesting a strong presence of people commuting to and from work during the week, typically by bicycle. The busiest day during the week were Sundays; Fridays and Saturdays were the least busy. The forest was heavily frequented throughout the year, but the busiest season was summer.

The interviews showed that the vast majority of visitors were over 40 years old; people born before 1980 made up over 80% of the surveyed visitors. Most visitors lived close to the forest and stated that they sought calm, fresh air and recreation in the Kottenforst. Many forest visits also had a distinct emotional, spiritual or aesthetic component, with respondents associating the Kottenforst with beauty, memories, home, smells, sounds, and a unique atmosphere.

The respondents generally seemed to be satisfied with the appearance of the forest and perceived most of the stands as being close to nature. Perceived stand beauty and naturalness were closely correlated ( $r_s 0,436$ ). The majority of the respondents (63%) were positively supportive towards forestry measures, with older respondents typically showing higher levels of acceptance than younger ones. Tree harvesting for wood production purposes was evaluated most sceptically by the interviewees.

The overall most common causes for the dissatisfaction of visitors were cyclists on racing bikes (29% of respondents), traffic (15%), forestry vehicles and machinery (14%) and unleashed dogs (6%). The varying uses of the forest showed an important conflict potential, and different user types also reported different desired improvements, mainly related to the road infrastructure in the forest, but there was a clear shared desire for more recreation infrastructure such as benches, road signs, and information panels (44%).

#### 3.2. Changing patterns during the German COVID-19 lockdown

##### 3.2.1. Strongly increasing visitor numbers

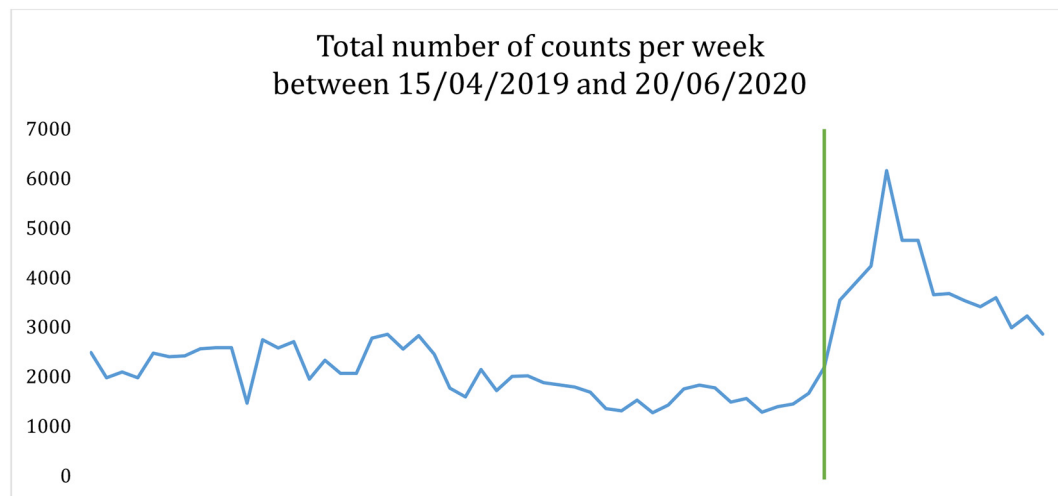
During the period starting from March 22 to end of April 2020 (28/04/2020), the daily average number of visits has risen to 690 counts per day, an increase of almost 140%. The record day before the lockdown was 03/09/2019 with 554 counts, which has been surpassed every single day since the lockdown, culminating with a peak of 1275 visits that were registered on 06/04/2020. In May and June 2020, while the lockdown measures gradually were released, visitor number to the forests gradually decreased again (Fig. 3).

##### 3.2.2. Different temporal distribution of visits

The on-site interviews have indicated that an important share of regular visitors to the Kottenforst are people who commuted through the forest to and from work on a daily basis, usually by bike. This evidence is supported by the counts of visitors. This group has strongly decreased in importance during the lockdown, as many people worked from home. Before the lockdown, visitor peaks during the week occurred just before and after office hours. During the lockdown, visits clearly peak in the late afternoon. In addition, there was no longer a noticeable difference between weekdays and weekends, and Saturday has gone from being the quietest day to one of the busiest (Fig. 2). Presumably the low amount of pre-lockdown visitors on Saturday can be explained by people going to the shops, and on Friday by people working part-time or from home (Fig. 4).

##### 3.2.3. More novice visitors

While the census is continuously updated and therefore can easily



**Fig. 3.** Long-term visitor flow before and after the COVID-19 lockdown. The green line shows 22/03/2020, when the measures were implemented in North-Rhine Westphalia. (For interpretation of the references to colour in this figure legend, the reader is referred to the web version of this article.)

be compared before and during lockdown, this is not the case for the qualitative part of the research. Initially, it was not possible to continue conducting interviews with forest visitors as before during the lockdown, due to distancing measures. Instead, three key experts who work on forest management issues in the Kottenforst were asked about their experiences and encounters with visitors, and how they have evolved since the COVID-19 lockdown. The forestry professionals did not only confirm the observation of a sharp increase of visitor numbers, but also mentioned greater online interaction with visitors. The forest district Rhein-Sieg-Erft has seen the views on its Facebook page increase to an all-time maximum. While presumably several of the “regular” forest visitors have changed their visit patterns and times, there is allegedly also a significant influx of “new” visitors; people who usually do not go visit the forest.

People under 25 represented a mere 3,5% of recorded pre-COVID-19 visitors. During the lockdown –according to the foresters – there were noticeably more parents with children, probably due to schools and kindergartens being closed. The increase in children has been attributed to noticeable differences in the forest, including an increase of camps being built a phenomenon that was not common in the Kottenforst before.

Where the research has shown that the majority of regular visitors (61%) lived in the immediate vicinity of the forest, now foresters and forest workers have reported a remarkable increase of car licence plates from different regions, mostly from the flatter and more urbanised areas in the Rhine Ruhr metropolitan region such as Cologne and Düsseldorf.

#### 4. Discussion and implications

**Key observations** show that under the COVID-19 lockdown in Germany the levels of forest visits have experienced an unprecedented boom, revealing forests as a critical infrastructure for society at large. There are a number of possible reasons for this boom: people have more time available, more flexibility, more pressure at home, but also fewer alternative pastimes. People's visit patterns have shifted to the afternoons and clear difference between the number of visitors on weekdays and weekends has substantially decreased. This strong increase and the novel user groups are strongly related to the specific COVID-19 lockdown situation. What is uncertain is if these changing use patterns will have impacts also after the lockdown, and how this could potentially impact the job of the foresters, as well as the cohabitation of different forest user groups. Given these uncertainties, future qualitative as well as quantitative research efforts, such as those used in this study, will be crucial for drawing conclusions about visitor preferences and

motivations to visit the forest after the lockdown.

The observed novice visitor groups are typically less familiar with the forest itself and with forest management practices. The occurrence of the pandemic during the breeding season could create additional threats to forest biodiversity due to high visitor numbers. Higher absolute visitor numbers reportedly also lead to an increased conflict potential with forest workers. It should be noted that the study was unable to identify a clear link between the frequency of people's forest visits and their acceptance of forest management. The proclaimed increased influx of young people however could have an impact, as younger age groups have been shown to be less tolerant vis-à-vis forestry and notably wood production. In addition, the study identified different forest user groups as potential sources of conflict, with many respondents expressing their dislike for (road) cyclists. The increased number of people with different use preferences may entail an increase in conflicts and clashes (cf. [Arnberger, 2006](#)).

On a more general level, the observations made in this study indicate that in times of often problematic social situations in their homes, people (re-)discovered forests as a recreational space. Urban forest visits are known to positively contribute to human health ([Donovan, 2017](#), [Iwata et al., 2016](#), [Meyer and Bürger-Arndt 2014](#)). Combining the two observations, we conclude that under the pandemic measures forests are substantially serving crucial societal functions regarding physical and mental health, revealing them as thus far undervalued parts of the critical infrastructure in a pandemic.

Many cities around the globe also maintain (peri-)urban forests like the Kottenforst ([Konijnendijk et al., 2005](#)). A large number of those cities have seen comparable measures being implemented, causing people to work from home and look for alternative types of recreation. Similar trends may be observed in different places, or also for similar crises in the future. We now discuss some potential implications of those trends for forest management as well as for forest policy:

**Forest management**, in particular urban forestry, is likely being affected by the observed significant changes in recreational forest use. For example, the decreased flow or workforce in combination with an increase in visitor numbers have made it difficult to harvest the bark-beetle invested spruce which has increased after three subsequent dry spring and summers. The drastic increase in visitor numbers emphasises the need for an integrated forest management strategy ([Aggestam et al., 2020](#)) which directly addresses public demand and is matched to visitor's expectations. This strategy should be informed by an understanding of what management measures are necessary for delivering the different ecosystem services which society demands. Specific strategies may also be required to avoid potential conflicts such as forest



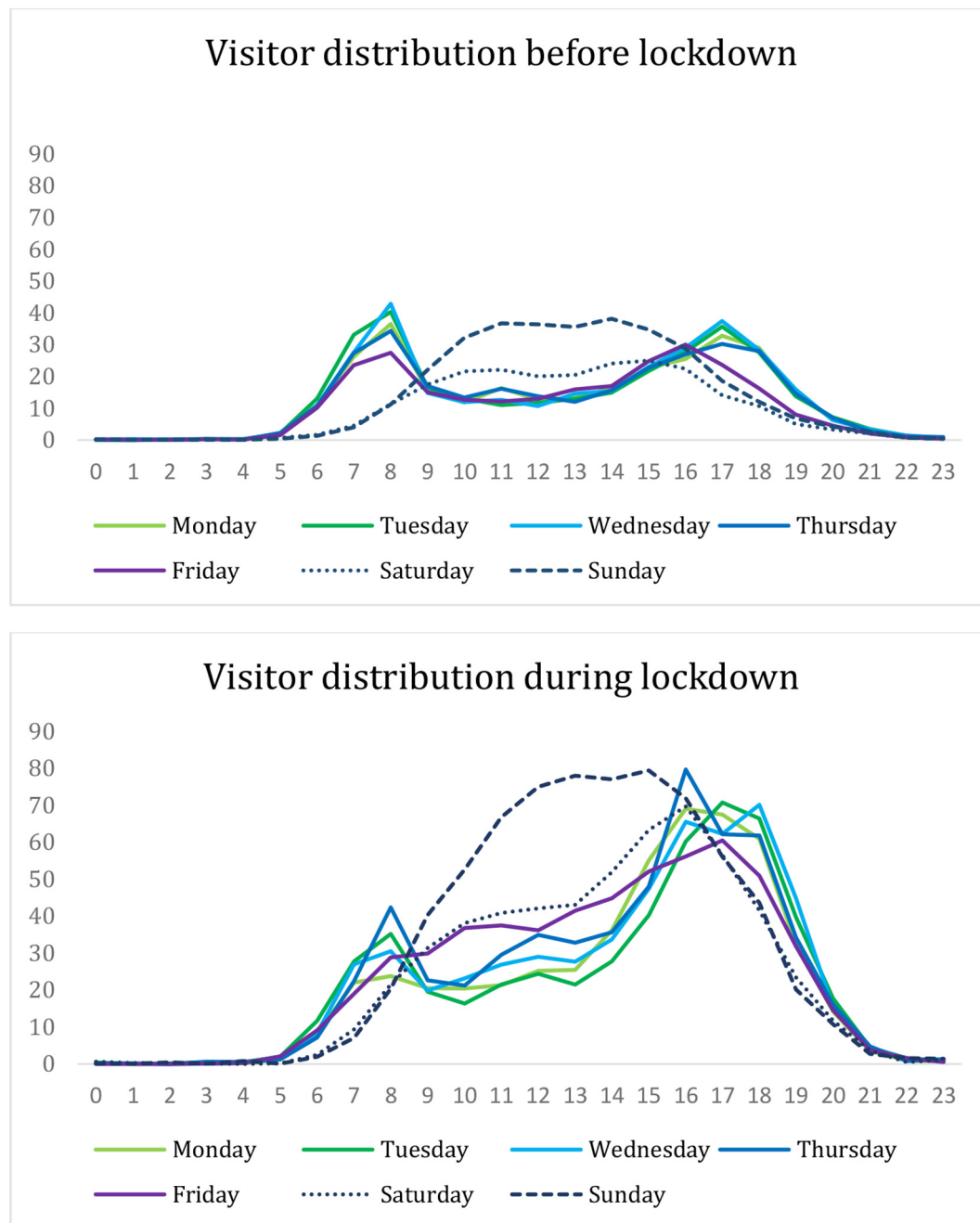


Fig. 4. Average number of counted visits to Kottenforst per hour on the different days of the week, before and during COVID-19 lockdown.

management operations being rescheduled. As counts suggest that the forest is visited most often in the late-afternoon, this time could be avoided for forest management operations. Instead, early morning should be prioritised when visitor numbers are typically low.

Changes to management operations also need to be adapted on a spatial scale. Installing multiple sensors could help to produce a map of the distribution and visit pattern of visitors, which could then help to inform and identify different management strategies in different areas of the forest. Mobile applications, for example the Strava Global heatmap could be combined with forest manager interviews to yield similar results. In addition, a differentiation in forest infrastructure could assist in segregating user groups to avoid or reduce conflicts among different and new user groups.

The exceptional period of the COVID-19 lockdown provided forest managers with opportunities to engage with a greater and more diverse

share of the society, and inform them of different forest related subjects, including forest management and ecology. However, communication with such a large and scattered group requires means and skills that not all forest managers may be able to provide (Jay and Schraml, 2013). New and traditional media platforms were useful tools for forest managers to engage with the new visitor groups, especially as they are often not familiar with the forest and are reportedly less familiar with forest management. The COVID-19 pandemic provides an extraordinary opportunity for communication between forest managers and diverse societal groups on forest related recreation, but also forest management.

**Forest policy** can make use of these findings as well. A policy-related key aspect is the observed importance of forests as a critical infrastructure for the functioning of society and its components. This finding enables forest-related policy actors at international, EU, national or sub-national scales to proactively communicate these societal

functions benefits within political deliberations across multiple policy sectors (Giessen, 2012; Giessen and Krott, 2009). This may include immediate COVID-19 related policy debates as well as future discussions, by drawing on the seminal experiences from the pandemic. In particular, such intensified political deliberations on forests may lead to a strategic coalition among the policy domains of forestry and public health. This point has been previously acknowledged by Meyer and Bürger-Arndt (2014) which argues that this must be addressed to better harness forests for human health.

The societal importance of forests underlined through the COVID-19 recreation boom calls for an updated forest policy framework, paying attention especially to urban forests (Ottitsch and Krott, 2005). A nuanced and supportive policy framework is needed in order to further incorporate the growing demand for forest recreation and its contribution to the peaceful management of extraordinary societal situations into forest policies (Ankre et al., 2016; Mann et al., 2010; Lacaze, 2000), that accommodate a variety of recreational activities (Christie et al., 2007). In this regard, an increase in the visitor-oriented policy efforts may require additional resources as well as investments in new job profiles, focusing on communication and education. Such efforts could ease the work of forest owners, stewards and managers.

The observed trends highlight the policy importance especially of urban and peri-urban forests as a thus far undervalued critical infrastructure for citizens' well-being and the functioning of society at large. Closing off forests to visitors is an option that has been considered or even implemented in some countries during the COVID-19 pandemic, but reduces people's access to outside recreation. The relaxing forest environment and the possibility to be physically active were already the main assets that attracted people before the COVID-19 lockdown. More than ever, forests became the communal environment in urban settings to find diversion, functioning as a decompression valves for accumulated frustrations.

In the early 18th century the depletion of forests as a critical infrastructure, especially for military mining uses, led to the introduction of the sustainable yield concept of wood resources by von Carlowitz (Warde, 2011). In the globalised world we now live in, wood resources are frequently supplied from other parts of the world. However, during the COVID-19 crisis, physically and mentally healthy citizens and workforce cannot be replaced so easily. In addition, forests are to be managed sustainably, and – like wood production – recreation should not exceed nature's carrying capacity. If communicated wisely, this fact might lead to the recognition that forests are still part of the critical infrastructure – not only because of their timber resources, but because of their importance for public health in both physical as well as mental terms.

## Declaration of Competing Interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

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