Since January 2020 Elsevier has created a COVID-19 resource centre with free information in English and Mandarin on the novel coronavirus COVID-19. The COVID-19 resource centre is hosted on Elsevier Connect, the company's public news and information website.

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Impacts of rising COVID-19 incidence and changed working conditions on forest visits in early 2020 of the pandemic: Evidence from Switzerland

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ABSTRACT

The COVID-19 pandemic forced many nations to implement a certain degree of lockdown measures to contain the spread of the virus. It has been reported that recreational visits to forests and green spaces increased in response to the lockdown. In this study, we investigated the effect of the policy-induced changes in working conditions during the lockdown period, as well as the effect of COVID-19 infection rates, on forest visits throughout Switzerland early in the COVID-19 pandemic. We analyzed data from an online panel survey first conducted one week before the government imposed the lockdown in Switzerland and repeated two weeks after the lockdown began. We use a modeling approach to assess the impact of the home-office and short-time working situation on forest visitation frequency, as well as their effects on the length of visits to the forest. For those who visited the forest both before and during the lockdown, the frequency of forest visits increased during the early lockdown phase considered here, while the duration of visits decreased. According to our model, the opportunity to work from home was a significant driver of the increased frequency of forest visits by this visitor group, while COVID-19 infection rates had no effect on their forest visits.

1. Introduction

On March 11, 2020, the World Health Organization (WHO) declared COVID-19 a pandemic, stating that *"If countries detect, test, treat, isolate, trace, and mobilize their people in the response, those with a handful of cases can prevent those cases becoming clusters, and those clusters becoming community transmission."* (World Health Organization (WHO), 2020). As a result, many countries imposed restrictions on public life to reduce the transmission of COVID-19. Most of these countries closed places of social encounters, such as shops, restaurants, bars, and entertainment and leisure facilities. Social gatherings were restricted and the number of people allowed to attend private events was limited. The situation in Switzerland was no different: At the beginning of March 2020 only a few COVID-19 cases were counted, but by mid-March the number of cases had increased significantly (Federal Office of Public Health (FOPH), 2020b, 2020c). Therefore, the Swiss government initiated a lockdown situation. On 16 March 2020, the Federal Council decided to introduced more stringent measures and close places of social encounter. Further, it was strongly recommended that people stay at home and work from home. In addition, the government extended the short-time working regulations (Brülhart et al., 2020; Federal Office of Public Health (FOPH), 2020a).

All of these new restrictions to social life and other pandemic-driven stressors, such as potential health problems and financial risks due to short-time working, but also working from home from one day to the next, led to greater attention being paid to urban green spaces for their recreational function. Forests, parks and other green spaces all have the potential to alleviate stressors by providing places for healthy outdoor recreation (see e.g. Holland et al. (2018), Thomsen et al. (2013), Chen et al. (2018), Chiesura (2004)) and there is international evidence that patterns of visitation to urban green spaces changed during the COVID-19 pandemic (see e.g. Geng et al. (2021); Palm et al. (2020); Ugolini et al. (2020)).

The aim of our study is to contribute to the understanding of the

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impact of the lockdown situation in Switzerland on forest visits and the implications of potential visitation changes on forest management. We are mainly interested in the effects of the increasing COVID-19 incidence and the changed working conditions – in particular the possibility of work from home and short-time work – on the frequency and duration of forest visits. Further, we aim to discuss the implications of changed visitor patterns on forest management as well as political implications. We argue that changing visitor patterns may increase the potential for conflict in forests. It is necessary that policy makers and forest managers are aware of these possible new conflict potentials. Therefore, we discuss possible response strategies.

2. Background literature and hypotheses

2.1. Changes in forest visitation behavior

In most studies, online surveys have been used to analyze changes in patterns of visitation to urban green spaces (UGS) during the COVID-19 pandemic, asking respondents about their behavior before and during the lockdown. Overall patterns varied widely among studies. Weinbrenner et al. (2021) conducted an online survey between 7 April and 29 May 2020 among the visitors to urban forests around Freiburg, a medium-sized city in Germany. Respondents were asked to assess their own behavior changes during the lockdown compared with before it, and they indicated that they visited forests more often during the lockdown. One of the main reasons cited for the increased frequency of visits was easier compliance with social distancing in forests and the need for rest and retreat. They argue that restricting visitors freedom of choice by installing, e.g., visitor guidance systems to avoid crowding, could probably reduce the recreational capacity of forests. Further, they discuss that new visitors will lead to an adaption of all forest visitors and in doing so all visitors will find new ways of being together.

Ugolini et al. (2020) conducted an online survey between March and May 2020 to assess the impact of social isolation on the use and perception of UGS during COVID-19. Respondents were from Croatia, Israel, Italy, Lithuania, Slovenia and Spain. The survey results showed that the need for UGS was mainly attributed to reasons relating to physical exercise. Further, they indicated that reductions in visitations to UGSs during the pandemic were the consequence of changes in motivations for visitation. While necessary activities, such as dog walking, increased, the authors observed a decrease in activities such as meeting people or observing nature. In most countries, physical exercise was one of the main reasons for respondents to visit a green space. Further they argue, that a guarantee of access to UGS within walking distance from all residents' home will be a political task. Similarly, based on an online survey from 28 March to 8 June 2020, Grima et al. (2020) found that respondents (greatly) increased their visits to urban and peri-urban natural areas and parks, mostly for "just getting outside", "exercise", "connecting to nature" and to find "peace and quiet". Yang et al. (2021) found that people living in greener neighborhoods visited country parks more often.

Lopez et al. (2021) surveyed over one thousand New Yorkers regarding their preferences and concerns about UGS during the beginning of the COVID-19 pandemic. Overall, respondents were equally likely to increase or decrease their UGS visits during pandemic. Respondents who were especially concerned about social distancing were more likely to decrease their visits, while those who recognized the importance of UGS for their health were more likely to increase their visits. Ugolini et al. (2021) surveyed residents in Italy living in "red zones," where outdoor leisure activities were limited to a single person within a proximity of up to 200 m from their home, and compared their changes in patterns of visiting urban green spaces with those of people living in "non-red zones," where the rate of infection was much lower. During the lockdown in March 2020, only one-third of the respondents continued visiting UGSs. Visits to parks and other green spaces in close proximity to the residents' homes gained in importance. In regions where access to UGSs was restricted, respondents expressed a feeling of deprivation. Therefore, policy planners and building designers need to consider proximity of green spaces and green corridors in the future to allow more equal access to UGS and landscape views. Likewise, Schioa et al. (2021) found an increase in visits to UGSs in Belgium. Gender, age, access to public green spaces, and caregiving responsibilities were identified as variables significantly affecting the changes in frequency of visits to UGSs during the lockdown. Rice et al. (2020) analyzed the pandemic's impact on recreational behaviors of outdoor enthusiasts across urban and rural communities in the US. The survey was conducted online for two days starting on 9 April 2020. The authors concluded that the frequency of participation in outdoor recreation, the distance travelled to participate in outdoor recreation, and the distance travelled off-road during outdoor recreation decreased significantly during the pandemic among outdoor enthusiasts living in urban areas. In a survey from Kraków, Poland, Noszczyk et al. (2022) found that the number of visitors to UGSs decreased by about 13% during the pandemic (from March to November 2020) compared with before the pandemic. Over 75% of the participants considered the visits to have a very great or great impact in terms of stress level reduction.

Other studies have used mobility data: Geng et al. (2021) analyzed the impact of COVID-19 on urban park visits, using data from Google's Community Mobility Reports and the Oxford Coronavirus Government Response Tracker to track government policies and restrictions at different stages. They used data from 16 February (baseline) to 26 May 2020 from 48 regions in Italy, Spain, South Korea, the United Kingdom, Denmark, Canada and Japan, and they concluded that public information campaigns and restrictions on social gatherings had a significant positive influence on park visitation. The number of park visitors increased in every country in their sample, with the exception of Italy. Geng et al. (2021) found an initial decrease in park visits in Italy, which is in line with the strict political restrictions there (as of 14 March 2020, Spain and Italy imposed the strictest restrictions of all countries in Western Europe, even banning outdoor recreation, so no one could visit UGSs (Ugolini et al., 2020)). They recommend not to restrict any access to UGS during pandemic outbreaks in the future as UGS provide important ecosystem services to mitigate pandemic stress. Further, they stress out the importance of equal access to UGS of all residents. Venter et al. (2020) used mobile phone tracking data from thousands of recreationists in Oslo, Norway, and they estimated a 291% increase in outdoor recreation activity during the lockdown compared with a 3-year average for the same days. For the medium-sized German city of Bonn, Derks et al. (2020) used automated visitor counts and found, likewise, that the number of visitors to forests more than doubled between 22 March and the end of April 2020. In addition, visits accumulated in the late afternoon rather than peaking before and after office hours. Qualitative interviews with forest professionals showed that more young people, families with children, and non-residents visited the forests than before the lockdown (Derks et al., 2020). Therefore, they suggest that forest management operations should be avoided in the late-afternoon, when forests are most visited. Further, they suggest that forest management could make use of social media platforms to engage with new visitor groups that are not familiar with the forest. With rising visitor levels and new visitors, they discuss an investment in new job profiles, that could focus on communication and education, making it is easier for forest owners, stewards and managers to focus on their work.

2.2. Changed working conditions

In many industries, home-office arrangements were not very common before the COVID-19 outbreak. However, during the lockdown, companies all over the world turned to remote working.

In many parts of the world, COVID-19 changed the working conditions of many employees with several implications: E.g., de Fraja et al. (2021) and Althoff et al. (2022) analyzed how working from home during the lockdown shifted economic activity across geographical areas

as the former work-related consumption of goods and services took place in the home area of the workers. There is also a large body of literature on the psychological effects of working from home on employees and on gender equality (e.g. Alon et al. (2020); Jamal et al. (2021); Oakman et al. (2020)).

Spano et al. (2021) analyzed the effects of nature-based elements within the work environment. Based on their online survey, conducted in Italy from 31 March to 7 April 2020, they found that both employees working from home and those in the office benefitted from indoor-outdoor green features, as they promoted workers' well-being during the COVID-19 pandemic lockdown and lessened its detrimental effects on mental health. Preece et al. (2021) conducted interviews across three UK cities and found that respondents living in small homes changed their household routines, as the lack of space led to more time spent outdoors.

In Switzerland, home office arrangements were not common before the COVID-19 pandemic. Only 27% of Swiss employers stated that their employees could decide whether to work from home or in the office (Statista Research Department, 2020). This is similar to the figures from a 2018 survey, where 24% of employees stated that they worked from home for half a day at least once a week. This number doubled during the pandemic, with around 50% of employees being able to work from home (Melian et al., 2020).

In addition, the COVID-19 pandemic imposed barriers to the global trade of goods and services, which was particularly momentous for small open economies like Switzerland. Moreover, overall spending reduced severely. To ease the impacts of this economic downturn on the labor market, the Swiss government extended the regulations on short-time work in March 2020 (Brülhart et al., 2020). Short-time work was originally introduced in response to the 2009–2011 recession in Europe, allowing employers to adjust the working hours of their employees rather than adjusting the size of the labor force. Overall, short-time work in Switzerland increased from around 4000 cases in February 2020 to more than 1,000,000 in April 2021 (State Secretariat for Economic Affairs (SECO), 2020).

The policy-induced lockdown and the change in working conditions altered the lives of many people, including their recreational activities. Overall, considering the case of Switzerland, we aim to investigate the impact of COVID-19 and of the changed working conditions on the frequency and duration of forest visits.

2.3. Hypotheses

Overall, none of the aforementioned studies provided a direct comparison of forest visits before COVID-19 and during the lockdown in early 2020 for the same cohort of people, as none of them involved a survey of the same cohort before and during the lockdown. In most studies, respondents were interviewed about their current behavior during the lockdown and their self-assessed behavior before the lockdown.

We were in a unique position to help close this research gap, as we were able to use a two-wave individual-level longitudinal survey data set to assess changes in the frequency and duration of forest visits in Switzerland between two interview dates: one in the period just before the COVID-19-induced lockdown (early March 2020) and one during the lockdown (early April 2020). As the same respondents were surveyed on both dates, we were able to assess whether increasing COVID-19 cases led to an altered frequency or duration of forest visits. Doing so eliminates the bias that an ex-post fact evaluation may carry (Edmonds and Kennedy, 2017).

Overall, studies analyzing the impact of the lockdown on green spaces have indicated an increase in visits. It seems that everyone was *on their feet in the woods* and that the demand for green spaces increased during the pandemic. In particular, with the closure of sports facilities and gyms, UGSs became increasingly important for public health and social benefits, as these spaces provide places for healthy outdoor recreation (Rice and Pan, 2020; Samuelsson et al., 2020; Twohig-Bennett and Jones, 2018). Although policies around Covid-19 were not the same in all countries and the prerequisites for home office were quite different from country to country, we hypothesized that there would be similar effects in Switzerland:

H1. *There was an increase in forest visits during the lockdown in spring 2020 in response to increasing COVID-19 cases in Switzerland.*

The induced home-office rules have led to more flexible working schedules and to an increase in leisure time, due to less time spent commuting. In Switzerland, 8 out of 10 employees commute to work, with an average travel time of one hour per day (Federal Statistical Office (BFS), 2019). Using automated visitor counts, Derks et al. (2020) found evidence that the number of commuters fell sharply during the lockdown, as many people worked from home. Overall, this led to a decrease in forest visits before and after office hours during the early COVID-19 pandemic. During the lockdown, visits peaked in the late afternoon instead. Further, regarding the increased flexibility provided by home office, Derks et al. (2020) found that there was no longer a noticeable difference in forest visits between weekdays and weekends. In Switzerland, most commuters travel by car or public transportation. Only 8% of the commuters travel by bicycle (Federal Statistical Office (BFS), 2019), often passing through forests on their way to work. Therefore, we did not expect the smaller number of commuters to have an effect on the number of forest visits in Switzerland. On the contrary, we expected home-office possibilities and less time spent commuting to work to have an overall positive effect on the frequency of forest visits:

H2. *Changes in working conditions, in the form of work from home and short-time work, had a positive effect on the frequency of forest visits.*

3. Material and methods

3.1. Sample and data collection

In February and early March 2020, just before the COVID-19-induced lockdown, a nation-wide online survey was conducted on forest visits and respondents' attitudes towards the forest (n = 8064 respondents). The respondents were members of the representative online panel of the Swiss market research institute LINK. LINK's panel comprises around 115,000 panel lists and is therefore the largest and highest-quality panel in Switzerland. It is possibly the internet panel in Switzerland that offers the most reliability in terms of representativeness.

The survey ended on 9 March 2020, at a time when COVID-19 was mainly known from the media rather than from any experience within Switzerland. In order to investigate the impacts of the lockdown and rising COVID-19 infection rates, a second wave of the survey - with 1085 respondents and focusing on forest-recreation aspects only – was conducted from 2 to 9 April 2020. These respondents were recruited from the same sample of 8064 respondents from the first wave, making it possible to study the impacts of the lockdown on forest visits within the same cohort.

There were no major differences between the first and second survey. As we were mainly interested in changes in recreational behavior, we deleted some questions for the purposes of our study (e.g. questions on where forest visitors find information about forests). In addition, a reference to COVID-19 was made in some questions, as further described in Section 3.2. The link to the questionnaire was sent to members of the panel until given quotas regarding language, region, age and gender were filled. The quotas were based on census data of the Swiss population from the Swiss Federal Office of Statistics. Small incentives were given for participation. Respondents were aged 18 or over and could choose to complete the survey in German, French or Italian using a computer, mobile device or tablet at their time of choice. Survey weights were provided by LINK administrators. They were based on base

weights, accounting for the probability of being selected into the sample, and on post-stratification weights, which were consistent with the benchmark distributions from the 2019 Swiss Census Population Surveys (for the importance of survey weights, see Korn and Graubard (1995)).

Table 1 shows the representativeness of our sample: respondents resided in all 26 cantons of Switzerland, and a high proportion of the sample was located in highly populated cantons such as Zurich. In addition, the sample consisted of 47% males (53% females), and the respondents had an average age of 55 years. The average age of the Swiss population over 18 was around 51 years in 2019 (Federal Statistical Office (BFS), 2020). Overall, 21% of the respondents lived in a rural area while 79% lived in an urbanized area or city. Italian-speaking respondents accounted for around 9% of the sample. Around 22% of respondents lived in the French-speaking part of Switzerland.

3.2. Variables

In the first wave of the survey, respondents were asked to indicate the number of visits they generally make to the forest in the spring/summer/autumn seasons, using the following categories: "almost daily", "once or twice a week", "once or twice a month", "less than once a month or never". In addition, respondents were asked to report the frequency of their forest visits as the number of visits per year. In the second wave of the survey, the same categories were used, but the survey asked about the frequency of visits since 17 March 2020, which was the start of the lockdown. From this information we calculated the actual number of forest visits per week for both waves of the survey. In the surveys, the respondents were also asked about the length of time (in minutes) they spent in the forest per visit.

In order to capture the changes in individual work situations, the respondents were also asked about their current work situation. This question was only asked in the second wave of the survey. Therefore, respondents were asked about changes in their working conditions compared with the time before the lockdown, with the following answers as possibilities: *"I still do not work from home", " I now work from home most of the time because of COVID-19", "I am on short-time work or became unemployed because of COVID-19", "I am not employed- regardless of the COVID-19 situation"*).

Further, respondents were asked about their travel distance (in minutes) to the forest, their motivation, and their activities during visits (behavioral variables) - variables that are likely to influence the frequency and duration of forest visits. For further information on the variables, see Hunziker et al. (2012).

Data on cumulative COVID-19 incidences from the first week of March (when the first survey ended) and the first week of April were provided by the Federal Office of Public Health (FOPH) (2020b). Cumulative COVID-19 incidence cases were given as the incidence per population of 100,000 per canton and were merged with the date from the survey waves. Based on this information, we computed the changes in cumulative incidences between the first and the second wave, which was used to represent respondents' exposure to COVID-19 in each canton.

Table 1
Representativeness of our sample.

Proportion of residents/ respondents	Switzerland (Federal Statistical Office (BFS), 2020)	Our sample
sex: male	50%	47%
sex: female	50%	53%
mean age of population over 18	51	55
rural area	76%	21%
urban area or city	64%	79%
Italian speaking part	8%	9%
French-speaking part	23%	22%

3.3. Empirical strategy

To estimate the impact of COVID-19 incidence and changed working conditions on the frequency and duration of forest visits, while controlling for individual characteristics, we used the following specification (see e.g. Allison (1990), Allison (1994) or Finkel (1995)):

$$\Delta y_{ict} = \beta_0 + \beta_1 \Delta W_{it} + \beta_2 \Delta C_{ct} + \beta_3 S_i + \beta_4 B_{i1} + \varepsilon_i \quad (1)$$

where i is the individual in Swiss canton c in wave t. As an outcome measure (Δy_{it}) we use frequency of forest visits before and during lockdown as well as duration of forest visits. The coefficient β_1 then is an estimate of the impact of the changes in working conditions due to the lockdown. Furthermore, we control for the changes in the working conditions (ΔW_{it}) as well as the change in local COVID-19 conditions, measured as ΔC_{ct}, the change in COVID-19 incidence rates at the cantonal level.

We also controlled for a series of socio-demographic factors (S_i) and other predictor variables (B_{it}, $t = 1$), e.g. activities during the forest visits, motives of the forest visits, travel time to forest as well as the extent of feeling disturbed during a forest visit.

As a robustness test, we use a first difference model to capture time-invariant factors between the two waves:

$$\begin{aligned} y_{ic2} - y_{ic1} =& \beta_0 + \beta_1 W_{i2} + \beta_2 C_{c2} + \beta_3 S_i + \beta_4 B_{i1} + \varepsilon_{i2} \\ & - (\beta_0 + \beta_1 W_{i1} + \beta_2 C_{c1} + \beta_3 S_i + \beta_4 B_{i2} + \varepsilon_{i1}) \end{aligned}$$

which reduces to

$$\Delta y_{ict} = \beta_1 \Delta W_{it} + \beta_2 \Delta C_{ct} + \Delta B_{it} + \Delta \varepsilon_{it} \quad (2)$$

as S_i and β_0 drop out (for further discussion see Johnson (1995)). Time-varying and independent variables, such as changes in COVID-19 incidence rates were included as change scores. The changes in behavioral variables (e.g. changes in activities during the forest visits) were included as change scores as well, and the weighted structure of the data was taken into account.

Overall, the model we used is a standard first difference equation model. It is a single cross-sectional equation, but with each variable differenced over time. Differencing two years of panel data is a powerful way to control for unobserved effects and is used to address the problem of omitted variables in panel data (Wooldridge, 2013). The time-varying and independent variables, such as changes in behavioral variables (changes in activities during the forest visit, changed motivations for a forest visit), as well as changes in the recovery level after a forest visit, were included in the model because they were considered likely to influence the frequency and duration of forest visits Hunziker et al. (2012). Further, including the changes in COVID-19 incidence rates and changes in working conditions helped us to answer the above hypotheses.

4. Results

4.1. Frequency and duration of visits

While the overall mean number of days spent in the forest per week did not change, the distribution of forest visits changed. While the overall mean number of days spent in the forest per week did not change, the distribution of forest visits changed (Fig. 1). However, the number of the respondents who visited the forest on a daily basis also increased. Meanwhile, the mean duration of a forest visit decreased from around 80 min to around 60 min.

4.2. Different visitor groups

Based on the frequency of forest visits before and during the lockdown, we identified four different groups of visitors. Table 2 shows the

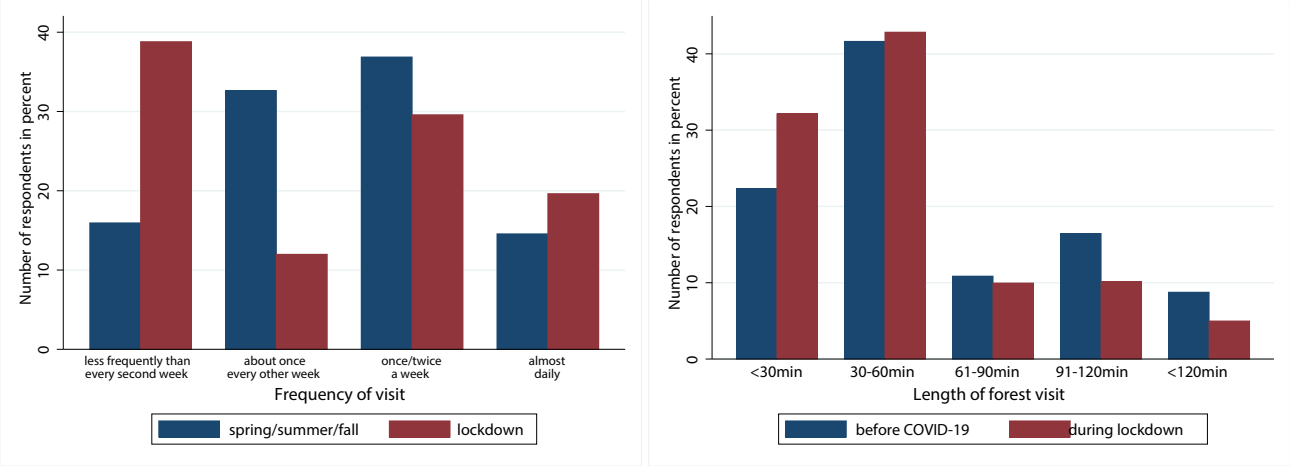

Fig. 1. Frequency and duration of visits before and during the COVID-19lockdown.

Table 2
Descriptive statistics of the mean number of days per week when respondents visited the forest and the duration of forest visits before and during the COVID-19 lockdown.

	constant regular visitors	constant non-visitors	new non-visitors	new regular visitors
n	628	137	284	36
mean days per week in forest **before** lockdown	1.9	0.04	0.8	0.04
mean days per week in forest **during** lockdown	2.4	0.01	0.02	1.3
mean duration of visit **before** lockdown (min.)	76	–	83	–
mean duration of visit **during** lockdown (min)	64	–	–	48

The sign – indicates that respondents were not asked this question.

descriptive statistics of the mean number of days with a forest visit per week before and during the lockdown for these four groups, and the mean duration of visits:

Constant regular visitors: 58% of the respondents visited the forest on a regular basis (at least once every two weeks) during the period from spring to autumn, both before and during the lockdown. They spent a total of 1.9 days per week in the forest before the lockdown and increased their visits to 2.4 days per week during it. However, the average length of their visits decreased from 76 to 64 min.

Constant non-visitors: 13% of the respondents rarely visited the forest before the lockdown (less frequently than every other week, or never); during the lockdown there was a reduction in forest visits even in this group (see also Fig. 1).

New non-visitors: 26% of the respondents visited the forest about one day per week before the lockdown and reduced their visits drastically during the lockdown to almost no visits at all. Further, this group had a longer mean duration of visits before the lockdown than constant regular visitor group.

New regular visitors: Only 3% of the respondents in our sample changed their behavior from non-visitors to regular visitors and started regularly visiting the forests for short visits (around 50 min) during the lockdown.

The new non-visitors and the constant regular visitors were the two largest groups of visitors in our sample.

In the following sections, we present results on the new non-visitor group and the constant regular visitor group, and their changes in behavior, in more detail.

4.2.1. *The new non-visitors*

Table 4 in the Appendix shows the descriptive statistics for the new non-visitors ($n = 284$). A comparison between the constant regular visitors and new non-visitors shows that the change in the COVID-19 cantonal incidence rate was much greater in the new non-visitor group than in the constant regular visitor group. The proportion of respondents from the French and Italian parts of Switzerland, which were more affected by the pandemic than the other parts of Switzerland, was thus higher in the new non-visitor group. Within the second wave of the survey, new non-visitors were asked why they had stopped visiting forests. Table 4 in the Appendix shows that reasons related to COVID-19 were decisive in their behavior: 20% of the respondents were in quarantine or self-isolation, 35% declared themselves as a high-risk group regarding COVID-19 infection, and 42% reduced their time in the forest because they did not want to risk an infection with COVID-19.

4.2.2. *The constant regular visitors*

Regarding respondents who did not stop visiting forests during the COVID-19 pandemic, we were interested in whether they used the forests more frequently during lockdown and how the changed working conditions and COVID-19 infection rates impacted their forest visitation patterns.

The 95% confidence interval for the mean changes in the forest visits per week and the duration of visits (for the group of the constant regular visitors) clearly does not include zero (see Table 3). This suggests that on average, regular forest visitors experienced a significant increase in mean days of visits per week, whereas mean duration of visits decreased significantly. Table 5 in the Appendix shows the descriptive statistics for the group of constant regular visitors ($n = 628$) for the first wave of the survey. In this group, about 27% were assigned home office as a result of COVID-19; 12% became unemployed or had to go on short-time work. In the case of significant changes in the behavioral variables. Table 5 also shows the descriptive statistics for the second wave of the survey in brackets. For example, many of the activities that respondents did when

Table 3
Mean changes of visiting days per week and duration of visits for the group of constant visitors.

Variable	Mean change	Standard Error	95% Confidence Interval	
days per week	0.5467	0.07795	0.39373	0.69964
duration of visit	−11.28903	2.6633	−16.52469	−6.053378

they visited the forest were done less during the lockdown period, such as going for a walk and doing sports in the forest. However, activities that are practiced with several people (e.g. having a barbecue in the forest) were especially less practiced during the lockdown, which shows that rules of social distancing were widely accepted. On the contrary, the activity "walking a dog" and "other activities", such as working in the forest, did not change significantly with the onset of lockdown, which is probably due to the fact that these are "obligatory" activities. Overall, walking or hiking remained the most common activities during the lockdown.

4.3. The impact of rising COVID-19 infections and changed working conditions

For the group of the constant regular visitors, Table 6 in the Appendix shows the results of the models estimating the effect of COVID-19 and changed working conditions on the frequency of forest visits ("frequency models") while Table 7 shows the results of the models for the duration of forest visits ("duration model").

The results of the models are based on ordinary least squares (OLS). For both the frequency models and the duration models, model 1, the baseline model, gives the estimates without controls, while model 2 includes all socio-demographic controls and other predictor variables (behavioral variables) (see eq. 1). In model 3, changes in personal behavior are also included. In addition to the described changes in activities during the forest visits, the lockdown situation had an effect on e. g. the travel time to the forest, which changed significantly. Model 4 is the first difference model 2).

Across all frequency models, the home-office variable had a significant positive influence on the frequency of forest visits. Being in short-time work due to the lockdown, on the contrary, had no influence on the frequency of visits. Further, the COVID-19 incidence rate did not significantly influence the number of forest visits. Including socio-demographic variables such as age or gender, as well as behavioral variables such as activities during a forest visit in period 1 (before the lockdown) did not change this effect (model 2). As described above, individuals changed their behavior between the two waves of the survey: activities during a forest visit and travel time to the forest. This may have influenced forest visits as well. Therefore, we tested for this possibility in model 3 by including changes in self-reported activities, motivations, travel time, disturbance and recovery level that changed significantly from the first wave of the survey to the second wave. Overall, our original results remained consistent (model 3). The first difference model (model 4), considered as a robustness check, did not produce different results either.

For the duration models, the home-office variable had a strong negative significant effect on the duration of visits, and this effect was consistent across all models we considered.

We can conclude that the home- office situation had a positive effect on the frequency of forest visits but that visits became shorter. Being in short-time work due to COVID-19 policies, in contrast, had no effect. The change in COVID-19 incidence had, if anything, a small negative impact on the duration of visits to the forest.

5. Discussion

We studied the impact of rising COVID-19 infection rates and the influence of the lockdown policy on the change in frequency and duration of forest visits early in the COVID-19 pandemic.

While the vast majority of similar studies (see e.g. Geng et al. (2021), Ugolini et al. (2020), Palm et al. (2020), Derks et al. (2020) or Rice et al. (2020)) have indicated an increase in forest visits during COVID-19 lockdown situations, our results are not so clear-cut. On the one hand, we identified a group of survey respondents who visited the forests frequently both before and during the lockdown. For this group, we observed an increase in the frequency of forest visits during the early COVID-19 pandemic. However, the average visit duration decreased in this group. On the other hand, we found that many people who had previously visited forests frequently stopped visiting the forests during the lockdown. In contrast to Derks et al. (2020), who found many groups of novice visitors, in our study very few respondents did not visit forests before the lockdown but did so during the lockdown. A possible explanation is that the Swiss have a strong tradition of visiting forests and only a small proportion of the population never visit the forest at all (Frick et al., 2018; Hunziker et al., 2012).

However, it is difficult to compare the results of our study with those of other studies, as our sampling method and panel data set were unique and differed from other studies that used mobility data, e.g. from Google, or only interviewed respondents during the lockdown phase and/or only during their visit to the forest. Further, our study only included the Swiss population over the age of 18, and the mean age of the respondents was relatively high at 55 years. Thus, the respondents in our study were older than in other studies, such as the study by Derks et al. (2020), which used automated visitor counting and led to the conclusion, based on expert interviews with foresters, that it is mainly young families who started visiting forests during lockdown.

Our study is not without limitations. First, the results may have been influenced by the warm weather at the time of the survey. At the time of the second wave of the survey, temperatures were unusually high for April. However, other studies using mobile phone tracking data or data from the fitness application Strava to assess recreational use of green spaces or outdoor cycling, while adjusting for weather and time of year, similarly indicated significant increases in outdoor recreation activity (Schweizer et al., 2021; Venter et al., 2020).

Another potential limitation is the seasonality of visitation patterns. The first survey wave asked about forest visitation during the spring, summer and fall periods, while the second survey wave focused on early spring. For Switzerland it is evident that visitation patterns in summer and winter differ most (Ciesielski and StereÅczak, 2018). Further, Purves et al. (2020) show how much visitation patterns differ across the seasons for the different regions in Switzerland. Spring, summer and autumn are the seasons with highest visitations but overall, we must state that this is definitely a limitation of or study and our results could be an artefact of spring versus summer visitation rates.

In addition, the initial aim of the first survey was not to investigate the impact of the COVID-19-induced lockdown on forest visits but to understand the relationship of the Swiss population to their forests. Nevertheless, we were able to use some parts of the survey to analyze the effects of the lockdown within the same cohort, as the lockdown was induced a few weeks after the first wave of the survey. We consider this only a minor limitation that does not affect our findings. We were able to use the questions on recreation behavior from the original survey to compare important issues from before the lockdown with the period during the lockdown. Other questions would probably have been included in the first survey if the policy-induced lockdown had been forseen.

Moreover, we can only provide a snapshot of the COVID-19 situation. The study period was limited to the start of the pandemic, and COVID-19 incidences increased dramatically later in the year. Therefore, our results may not be generalizable. Dynamics during the COVID-19 pandemic were evolving and fluid after the strict lockdown phase, and lockdown fatigue had become widespread, which could lead to very different results regarding forest visitation. However, our study shows that visitor patterns are not constant but rather are subject to constant change - it is therefore important for forest managers to keep track of these changes so that management options can be continually adapted to meet the needs of the visitors. Further research is needed to test the robustness of our findings, either in times without COVID-19 restrictions or in times with similar conditions. For now, it remains unclear to what extent changing visitor patterns are permanent.

For now, we can conclude that the policy-induced lockdown had an effect not only on the working conditions of the Swiss population but

also on their behavior during forest visits. Walking or hiking was the main activity during forest visits both before and during the lockdown, while activities involving social gatherings, such as picnics, were reduced during the lockdown. Ugolini et al. (2020) similarly found that people who visited forests before the lockdown for non-essential reasons that could pose a risk of possible infection (e.g. "experiencing nature") visited forests less frequently during the lockdown. Clearly, working from home and short-time work can have ambiguous effects on forest visits. These changes increase the time available for leisure by eliminating commuting time and allowing more flexible working schemes, but they can also be accompanied by a greater overall workload and – in case of short-time work –a decrease in income and job security. For example, Füzéki et al. (2021) found a smaller decline in leisure-time-related physical activity among people working from home during the lockdown than among those not working from home. At the same time, the authors did not find a significant effect on leisure-time-related physical activity for those in short-time work. Similarly, we found that a home-office arrangement was one of the main drivers of forest visits, while being in short-time work was not identified as a driver of changes in forest visits. The fact that the average time to arrive at the forest was about 12 min in the first survey wave and 10 min in the second waves seems to confirm the importance of spontaneity and proximity when people visit forests Meyer et al. (2019). This highlights the role of everyday landscapes or forests that are close to urban areas.

This finding highlights the role of everyday landscapes or forests that are close to urban areas. Further, our study shows the importance of different recreational opportunities in forests. While they can be used for social gatherings, they can also serve as places of rest and isolation. This became increasingly important during the pandemic, when many people used the opportunity to be outside in the forests without violating social distancing restrictions. Sallis and Pratt (2020) also stressed the importance of UGSs in times of closed schools, shopping malls or restaurants in the United States. They observed severe physical and mental health consequences, specially for those living in urban areas when - in some areas - access to parks and green spaces was restricted.

5.1. Political implications

The changes in the behavior of forest visitors described in this study are likely to have an influence on the public infrastructure providers, as well as on the developed and undeveloped recreation infrastructure. With the pandemic and home-office arrangements likely to remain important and it is likely that the changes in visitor behavior observed at the start of lockdown continue to manifest themselves. Against the background of a growing population, societal demands on forests will probably diverge even more in the future. Forests already fulfill several recreational needs, and activities during a forest visit are diverse, including (mountain) biking, (dog) walking, hiking, horse riding, social gatherings, collecting, jogging, and other sports. The natural and social environment is affected by the activities themselves (Hegetschweiler et al., 2009; Liddle, 1997). Further, there is rising pressure on forests (e.g. noise, littering, space on paths, lack of respect) due to the accumulation and intensification of activities. All these factors increase the potential for conflict in forests – between recreational users such as walkers, joggers and cyclists, but also between recreational users and users of other forest functions, such as nature conservation and timber production (Mann and Absher, 2008).For example, in Switzerland it was necessary to delay forestry as too many visitors made it impossible to cut down trees riskless and roadbloacks could not be enforced, like suggested in the study from Derks et al. (2020).

Therefore, stakeholders involved in conflict situations are not only recreational users but also forest owners, forest managers, timber producers and environmentalists. This means that conflicts may arise at the policy and regulatory level steering forest ecosystems but also due to conflicting goals within or between forest functions. Conflicting objectives can also lead to conflicts at the stakeholder level. The potential for conflict therefore increases at both the policy and stakeholder levels (see e.g. Niemelä et al. (2005)).

It is necessary that policymakers and forest managers study changes in visitor behavior to get a clear picture of new challenges and opportunities. It is important to quantitatively assess pandemic-related recreation impacts. Further, there must be a discussion about the interpretation of qualitative changes (Ferguson et al., 2022). New users are likely to bring new problems, e.g. new potential conflicts may arise with more e-bikers. Most recreational users are not well organized (this does not apply to e.g. mountain bikers), and some activities are more regulated than others (e.g. dog walking, biking and horse riding are more regulated; (Brändli, 2010)). In order to avoid a rising level of conflicts, it is important to identify all new stakeholders and to integrate them into the governance process to address their demands and needs. Managing conflict situations helps to reduce negative impacts on nature and wildlife, which is why managing outdoor recreation and visitor management are becoming more and more important. In this respect, steering instruments can vary widely. There are structurally focused techniques, such as bans and prohibitions, that are designed to change the behavioral conditions, e.g. banning mountain bikers from several routes in the forest to prevent conflicts between hikers and bikers. Another approach would be nudging or imposing fees for using a certain infrastructure of a forest. Providing new infrastructure, e.g. special trails for mountain bikers, is such a technique. There are also possible person-focused techniques to change the behavior of visitors. The transfer of knowledge can motivate recreationists to change their behavior. Persuasive argumentation to change behavior is the integration of new norms. Affective persuasion means encouraging visitors to behave in certain ways, sometimes with the help of boards that point out ecological consequences of certain behavior (Mosler and Tobias, 2007). There is evidence that raising awareness of the consequences of one's behavior for nature or wildlife can positively influence recreationists' behavior. In recent years, many Swiss cantons have developed nature conservation programs for the forest. Forest reserves, wildlife rest areas, and wildlife corridors are being designated. Other instruments, such as prohibition signs or barrier tapes, are options that are often disregarded by recreationists. However, signs that additionally show the ecological consequences of certain behaviors can positively guide visitor behavior. Nevertheless, for them to have an influence, the attitude of visitors must be appropriate; otherwise, such signs can even have counterproductive effects (Cornelisse and Duane, 2013; Freuler and Hunziker, 2007; Immoos and Hunziker, 2014; Pretty and Cacioppo, 1986; Zeidenitz et al., 2007).

Monetary contributions per inhabitant in highly frequented forests can be used as a compensation system for additional expenses related to forest recreation. In Switzerland, the canton of Fribourg adopted such a compensation system for highly frequented forests (Wilkes-Allemann et al., 2015). The canton of Solothurn integrated a new tax into their system to support additional expenses (5 CHF per person per year; (Miller, 2016)). Further, the canton of Bern tried to integrate a forest "vignette" (CHF 40 per person per year) to support forest owners in providing recreational services, this vignette is now voluntary because of strong resistance (Schweizer Bauer, 2013). Such additional taxes are controversial because the Swiss Federal Constitution of 1999 lists recreational space as one of the social functions of forests. The Civil Code (Allmend/Forest law) considers recreational aspects important, and the protective or economic function of forests and free access to forests for recreational activities and for picking berries and mushrooms (for non-commercial use) must be given under Article 699. It applies to public and privately owned forests. Visitors therefore have the right to cross forests on foot, on skis, or by bicycle. Only the use of motorized vehicles is not allowed. Overall, it is important that response strategies are in line with Article 699 in order to avoid the further development of conflict situations. It is also important to involve all stakeholders. It can be very helpful to consider insights from other countries to improve the management of conflict situations in urban forests. This especially applies to

Scandinavia and Scotland, where the Right of Public Access has similar legal aspects and consequences (Sandell and Fredman, 2010).

Not all countries have the Right of Public Access, however; in Germany and Austria, for example, the general public is normally only allowed to enter forests and meadows on foot or on skis. Therefore, Baden-Württemberg, a federal state of Germany, was able to change §14 of the Federal Forest Act by the two-meter rule in §37.3 of the State Forest Act BW, prohibiting cycling in the forests on paths less than two meters wide. Such rules can support the management of forest visits, but they do not meet the interests of all user groups and are therefore debated in the coalition agreement of the federal state, with the aim of replacing them (Deutsche Inititative Mountainbike e.V., 2023). Overall, even without the Right of Public Access, it is difficult to meet all the interests of stakeholders.

The lockdown has led to an increased number of visitors – at least in some areas in Switzerland. With increased visitors, forest owners and managers have had to incur additional costs. Therefore, the debate on how to finance these costs is important and necessary. However, the pandemic also showed the importance of (equal) access to UGS. The Right of Public Access guarantees access for all inhabitants, and it is important that in the future no one is excluded from access to UGS because of financial problems.

5.2. Conclusion and policy recommendation

Overall, our study underlines the importance of recreational green spaces during the COVID-19 lockdown, when mobility was restricted and no other opportunities for recreational indoor activities were available. In Switzerland, forests are easily accessible, and most of the population can reach forests with 5 to 10 min by foot (Hegetschweiler et al., 2022; Hunziker et al., 2012). About 85% of the Swiss forests are no more than 100 m from an accessible road (Brändli, 2010).

Due to the home office situation forests became an even more important place for recreation which underlines that forests are a critical green infrastructure for society.

Due to the home-office situation, forests became an even more important place for recreation during lockdown, which highlights that forests are a critical green infrastructure for society. In the future, interactions between forest users will increase not only because of changes in visitation patterns due to the pandemic and home-office situation, but also due to a growing population and, in line with this, increasing demands. This emphasizes the importance of an effective forest management process that includes planning, implementation, operation, finance, resolution of conflicts, and monitoring (Douglass, 2000). In other countries with similar conditions, implications are similar because the pandemic had similar effects on forest visitation behavior in most countries (Derks et al., 2020; Grima et al., 2020; Ugolini et al., 2020; Weinbrenner et al., 2021; Yang et al., 2021).

Our results have implications for forest design and management, highlighting the importance of the recreational functions of forests for society, as well as the potential for strategic coalitions among policy domains of forestry and public health, as Derks et al. (2020) also emphasized in their study.

Healthy forests are important not only because of their timber resources, but also because they contribute to public health, in both physical and mental terms. For forest owners, administrators and managers, the increasing importance of forests as recreational areas brings potential conflicts (see e.g. Wilkes-Allemann et al. (2020) or Derkzen et al. (2017)) but it is also an opportunity to integrate the preferences of citizens in planning proposals and in the management of these spaces in the future (Ryan, 2011). Understanding visitor needs helps to reduce conflicts between visitors and keeps the forests healthy, as recreation managers have recognized (Manning, 1999).

Overall, there are four policy recommendations of this study concerning forest management. First, within the planning phase of the forest recreation governance process, it is inalienable to identify and include stakeholders affected by the recreation action in order to prevent conflicts (see also (Bruna-Garcia and Marey-Perez, 2014; Leskinen, 2004; Newig and Fritsch, 2009; Ruppert-Winkel and Winkel, 2011)). Second, as forest recreation is becoming increasingly important, it is clear that forest managers and owners should offer recreational services, e.g. special trails for mountain bikers. However, such services are costly due to the rising needs, and the infrastructure must be maintained and recreational activities must be monitored. Therefore, we suggest that forest managers and owners should be financially supported in planning and managing forest recreation infrastructure. Such financial support could be in the form of a fund or tax, similar to the system in the canton of Solothurn (Miller, 2016). In this way, the planning and management of recreation infrastructure in frequently used forests could be improved and the conflict potential could be reduced among forest users, including between recreationists and other users, such as timber producers or environmentalists. Overall, we expect that the open-access status of the forests will be increasingly debated. Third, information campaigns can be helpful (Ferguson et al., 2022; Weiss and Tschirhart, 1994) and especially the youngest generation should be educated from the beginning about the rules of behavior in the forest. This has already been done in Switzerland, for example through the Wald-Knigge (Arbeitsgemeinschaft für den Wald, 2018). Finally, in addition to Article 699 of the Swiss Civil Code, there are many other formal rules at the national and the cantonal level, such as forest laws and forest development plans, which are developed at the regional level and guide the planning and implementation of new recreational infrastructure. However, they are only binding for local authorities and not for private forest owners (Wilkes-Allemann et al., 2015)). A standardization of the rules could contribute to a better understanding of them and therefore to better interactions between forest visitors and owners.

Overall, more research is needed on how visitor behavior has changed now that the policy-induced lockdown is over and on how to identify and involve all relevant stakeholders in the planning processes and the whole forest management process.

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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.

Data availability

Data will be made available on request.

Appendix A. Appendix

Table 4
Summary statistics for the new non-visitors ($n = 284$ individuals).
The reported motives were aggregated via principal component analysis (with varimax rotation) which resulted in the given three motives.

Variable	Description of variables	Mean	Std.
Change in home office	Change in an individual's response to being in home office between wave 2 and wave 1	0.2768	0.0272
Change in short-time work	Change in an individual's response to being in short-time work or being hit by job loss between wave 2 and wave 1	0.0911	0.0171
Change in COVID-19 cantonal incidence proportion	Change in cantonal level COVID-19 incidence proportion [i.e., number of COVID-19 reported cases per 100,000 population of the individuals state of residence] between wave 2 and wave 1 interview dates	247	10.9091
Age	Age of respondent at the time of the survey	53.2383	1.0002
Female	Gender is female (=2); otherwise (=1)	1.5864	0.0297
Rural	Respondent is living in a rural area (=2); otherwise city (=1)	1.2226	0.0254
Fully or part-time employed	Respondent is fully or part-time employed at the time of the survey (=1); otherwise unemployed/retired (=0)	0.5946	0.02955
High school diploma	The respondent has a high school education (=1); otherwise (=0)	0.7042	0.0275
Vocational degree/ some college	The respondent has attended some college or a vocational degree (=1); otherwise (=0)	0.2441	0.02597
Number of kids	The respondent has to take care of kids (=1); otherwise (=0)	0.2513	0.0266
Language region: French	The respondent lives in the French language region (=1); otherwise (=0)	0.3132	0.0282
Language region: Italian	The respondent lives in the Italian language region (=1); otherwise (=0)	0.07399	0.0122
Recovery level	level of being relaxed after having visited a forest measured on a scale from 1 (lot less recovered) to 5 (lot more recovered) (only in the first wave of the survey)	4.2196	0.0501
Disturbance level	level of being annoyed by something during a forest visit on a scale from 1 (=not disturbed) to 3 (=always disturbed) (only in the first wave of the survey)	1.5255	0.02210
Time to arrive in forest	travel length in minutes to arrive in the forest in the first wave of the survey	15.6477	0.9095
Having a garden	The respondents has a garden (=1); otherwise (=0)	0.7785	0.0252
Means of transportation to the forest	by foot (=1); otherwise (=0)	0.5598	0.0300
Means of transportation to the forest	by bike (=1); otherwise (=0)	0.0757	0.01612
Means of transportation to the forest	by public transportation (=1); otherwise (=0)	0.07254	0.0157
Means of transportation to the forest	by car/motorcycle (=1); otherwise (=0)	0.2741	0.0271
Means of transportation to the forest	by other means of transportation (=1); otherwise (=0)	0.0177	0.0083
Activities in the forest			
Doing sports	running, biking (=1); otherwise (=0)	0.3089	0.0281
Social gatherings	picnics, barbecue, playing with kids (=1); otherwise (=0)	0.3501	0.02901
Walking	going for a walk (=1); otherwise (=0)	0.8516	0.0214
Experiencing nature	Searching for silence, nature, relaxing (=1); otherwise (=0)	0.7917	0.02479
Walking a dog	going for a walk with a dog (=1); otherwise (=0)	0.1482	0.0215
Other activities	e.g. working, hunting (=1); otherwise (=0)	0.03591	0.01134
Motives for visiting a forest			
Motive health	doing something for staying healthy, doing sports	−0.1560	0.0887
Motive nature	experiencing nature, enjoying good air, relaxing	−0.0783	0.0780
Motive social	being alone, spending time with family/friends, searching for fun	−0.0513	0.06848
Reasons for not visiting a forest after 16*th* of March			
prefer doing something else	if this is a reason =1 if not =0	0.1076	0.01887
no interest for the forest	if this is a reason =1 if not =0	0.0201	0.0089
the way to the forest is too long	if this is a reason =1 if not =0	0.1506	0.0214
I'm afraid of ticks and other animals	if this is a reason =1 if not =0	0.02804	0.00995
I'm having allergies	if this is a reason =1 if not =0	0.0458	0.01271
feeling not comfortable alone in the forest	if this is a reason =1 if not =00.0626	0.0145	
physically challenged	if this is a reason =1 if not =0	0.0579	0.0140
disturbed by other persons	if this is a reason =1 if not =0	0.0829	0.01667
not common in my culture to visit forests	if this is a reason =1 if not =0	0.0171	0.0078
my friends don't visit the forest	if this is a reason =1 if not =0	0.0293	0.0103
my family doesn't visit the forest	if this is a reason =1 if not =0	0.0253	0.0094
preferring other green spaces	if this is a reason =1 if not =0	0.05120	0.0136
having an own garden	if this is a reason =1 if not =0	0.3997	0.0295
being in quarantine	if this is a reason =1 if not =0	0.2028	0.02415
being part of a risk group to COVID-19	if this is a reason =1 if not =0	0.3476	0.02856
do not want to risk an infection	if this is a reason =1 if not =0	0.4169	0.0298

Table 5
Summary statistics for the constant visitors($n = 628$ individuals).

Variable	Description of variables	Mean	Std.
Change in home office	Change in an individual's response to being in home office between wave 2 and wave 1	0.2652	0.0180
Change in short-time work	Change in an individual's response to being in short-time work or being hit by job loss between wave 2 and wave 1	0.1233	0.013
Change in COVID-19 cantonal incidence proportion	Change in cantonal level COVID-19 incidence proportion [i.e., number of COVID-19 reported cases per 100,000 population of the individuals state of residence] between wave 2 and wave 1 interview dates	199.9301	6.037

(*continued on next page*)

Table 5 (*continued*)

Variable	Description of variables	Mean	Std.
Age	Age of respondent at the time of the survey	54.5497	0.632
Female	Gender is female (=2); otherwise (=1)	1.5104	0.02018
Rural	Respondent is living in a rural area (=2); otherwise city (=1)	1.2185	0.01672
Fully or part-time employed	Respondent is fully or part-time employed at the time of the survey (=1); otherwise unemployed/retired (=0)	0.6329	0.01928
High school diploma	The respondent has a high school education (=1); otherwise (=0)	0.6682	0.0191
Vocational degree/ some college	The respondent has attended some college or a vocational degree (=1); otherwise (=0)	0.3048	0.0187
Number of kids	The respondent has to take care of kids (=1); otherwise (=0)	0.2361	0.0174
Language region: French	The respondent lives in the French language region (=1); otherwise (=0)	0.1695	0.0152
Language region: Italian	The respondent lives in the Italian language region (=1); otherwise (=0)	0.0351	0.0056
Recovery level	level of being relaxed after having visited a forest measured on a scale from 1 (lot less recovered) to 5 (lot more recovered) in the first (second) wave of the survey	4.3477 (4.0113)	0.0328 (0.03817)
Disturbance level	level of being annoyed by something during a forest visit on a scale from 1 (=not disturbed) to 3 (=always disturbed) in the first (second) wave of the survey	1.5255 (1.3342)	0.02210 (0.0237)
Time to arrive in forest	travel length in minutes to arrive in the forest in the first wave of the survey	11.8334 (9.9203)	0.5279 (0.2998)
Having a garden	The respondents has a garden (=1); otherwise (=0)	0.7717	0.0171
Means of transportation to the forest	by foot (=1); otherwise (=0)	0.7246	0.0181
Means of transportation to the forest	by bike (=1); otherwise (=0)	0.0995	0.0121
Means of transportation to the forest	by public transportation (=1); otherwise (=0)	0.03272	0.0072
Means of transportation to the forest	by car/motorcycle (=1); otherwise (=0)	0.1332	0.0137
Means of transportation to the forest	by other means of transportation (=1); otherwise (=0)	0.0100	0.0041
Activities in the forest			
Doing sports	running, biking (=1); otherwise (=0)	0.4552 (0.3353)	0.0201 (0.0192)
Social gatherings	picnics, barbecue, playing with kids (=1); otherwise (=0)	0.3536 (0.1015)	0.0194 (0.0125)
Walking	going for a walk (=1); otherwise (=0)	0.8799 (0.7807)	0.0133 (0.0168)
Experiencing nature	Searching for silence, nature, relaxing (=1); otherwise (=0)	0.7740 (0.5784)	0.0172 (0.0200)
Walking a dog	going for a walk with a dog (=1); otherwise (=0)	0.1850	0.0156
Other activities	e.g. working, hunting (=1); otherwise (=0)	0.04530	0.00834
Motives for visiting a forest*			
Motive health	doing something for staying healthy, doing sports	0.2840 (0.0181)	0.0509 (0.0540)
Motive nature	experiencing nature, enjoying good air, relaxing	0.1244 (0.0110)	0.04600 (0.0447)
Motive social	being alone, spending time with family/friends, searching for fun	0.1223 (0.0141)	0.0517 (0.0515)
Motive COVID-19	keeping social distacing easy in forests, doing something for positive thoughts	0.000 (0.0053)	0.000 (0.045)

For variables with significant changes in the levels reported between wave 1 and 2, levels in wave 2 are given in parentheses.

* The reported motives were aggregated via principal component analysis (with varimax rotation) which resulted in the given motives.

Table 6
Regressions modeling the main effects on the change in forest visits.

	Model 1: Change in Forest visits (OLS)	Model 2: Change in Forest visits (OLS)	Model 3: Change in Forest visits (OLS)	Model 4: Change in Forest visits (First Difference)
home office	0.396**	0.492**	0.459**	0.405**
	(0.179)	(0.195)	(0.192)	(0.177)
in short-time work	−0.315	−0.159	−0.179	−0.316
	(0.276)	(0.283)	(0.268)	(0.262)
change in COVID-19 cases	−0.001	−0.001	−0.001	−0.001
	(0.000)	(0.001)	(0.001)	(0.001)
age		0.017***	0.013**	
		(0.006)	(0.006)	
female		−0.067	−0.076	
		(0.166)	(0.169)	
rural		−0.268	−0.269	
		(0.195)	(0.193)	
fully or part-time employed		0.064	0.094	
		(0.172)	(0.172)	
high school		−0.519	−0.591	
		(0.509)	(0.510)	
vocational degree/some college		−0.585	−0.629	
		(0.520)	(0.522)	

(*continued on next page*)

Table 6 (*continued*)

	Model 1: Change in Forest visits (OLS)	Model 2: Change in Forest visits (OLS)	Model 3: Change in Forest visits (OLS)	Model 4: Change in Forest visits (First Difference)
number of kids to be cared for		0.085	0.110	
		(0.089)	(0.096)	
language region: French		0.320	0.284	
		(0.267)	(0.263)	
language region: Italian		−0.167	−0.170	
		(0.558)	(0.555)	
doing sports		0.152	0.168	
		(0.168)	(0.199)	
social gatherings/kids		0.067	−0.168	
		(0.174)	(0.334)	
walking		0.748***	1.050***	
		(0.246)	(0.289)	
experience nature		−0.896***	−0.846***	
		(0.197)	(0.239)	
walking a dog		−0.263	−0.063	
		(0.197)	(0.212)	
working/hunting		−0.636*	−0.472	
		(0.386)	(0.400)	
motive health		0.028	0.100	
		(0.075)	(0.083)	
motive social		0.015	0.046	
		(0.070)	(0.081)	
motive nature		−0.030	−0.025	
		(0.074)	(0.091)	
recovery level		0.029	0.156	
		(0.090)	(0.120)	
disturbance level		0.060	−0.010	
		(0.145)	(0.176)	
time to arrive in forest		0.002	−0.008	
		(0.006)	(0.011)	
having a garden		−0.093	−0.156	
		(0.196)	(0.193)	
arriving by bike		−0.397	−0.421	
		(0.291)	(0.284)	
arriving by public transportation		0.269	0.368	
		(0.321)	(0.315)	
arriving by car/motorcycle		−0.250	−0.112	
		(0.252)	(0.249)	
arriving by other means of transportation		0.007	0.299	
		(0.308)	(0.338)	
time spent in forest		−0.000	0.001	
		(0.001)	(0.002)	
change in length of stay			0.002	0.001
			(0.001)	(0.001)
change in time to arrive in forest			−0.012	−0.005
			(0.011)	(0.006)
change in disturbance level			−0.048	−0.084
			(0.136)	(0.116)
change in recovery level			0.146*	0.095
			(0.078)	(0.062)
change in level of doing sports			0.171	−0.035
			(0.192)	(0.162)
change in level of activity social gatherings			−0.142	−0.053
			(0.307)	(0.159)
change in level of activity experiencing nature			0.038	0.442***
			(0.168)	(0.140)
change in level of going for a walk			0.420**	0.081
			(0.203)	(0.157)
change in motive health			0.140**	0.098
			(0.067)	(0.060)
change in motive social			0.093	0.078
			(0.072)	(0.061)
change in motive nature			0.061	0.075
			(0.084)	(0.072)
Observations	628	628	628	628
R^2	0.0165**	0.1021***	0.1371***	0.0589***

Standard errors in parentheses.
* $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$.

Table 7
Regressions modeling the main effects on the duration in forest visits.

	Model 1: Change in duration of visits (OLS)	Model 2: Change in duration of visits (OLS)	Model 3: Change in duration of visits (OLS)	Model 4: Change in duration of visits (First Difference)
home office	−16.626**	−13.163*	−14.578**	−16.391**
	(6.612)	(7.309)	(7.382)	(6.756)
in short-time work	0.174	5.107	3.992	−0.085
	(7.239)	(7.986)	(7.865)	(7.339)
change in COVID-19 cases	−0.044***	−0.009	−0.000	−0.042***
	(0.016)	(0.025)	(0.026)	(0.016)
age		−0.059	−0.092	
		(0.188)	(0.198)	
female		−5.024	−4.174	
		(5.009)	(5.204)	
rural		4.384	5.363	
		(5.745)	(5.650)	
fully or part-time employed		−5.340	−5.808	
		(5.433)	(5.439)	
high school		3.838	0.275	
		(11.922)	(11.857)	
vocational degree/some college		2.987	1.683	
		(12.922)	(12.985)	
number of kids to be cared for		−4.166	−5.932*	
		(3.537)	(3.514)	
language region: French		−0.335	−7.739	
		(10.211)	(10.517)	
language region: Italian		−30.074	−32.524*	
		(19.622)	(19.565)	
doing sports		4.429	4.745	
		(5.863)	(7.280)	
social gatherings/kids		0.154	6.616	
		(6.938)	(13.283)	
walking		7.453	8.225	
		(7.597)	(9.734)	
experience nature		−2.574	8.134	
		(5.780)	(7.156)	
walking a dog		2.784	4.701	
		(10.138)	(10.710)	
working/hunting		−7.197	−5.944	
		(19.691)	(20.163)	
motive health		−1.799	−5.520**	
		(2.490)	(2.699)	
motive social		0.207	2.980	
		(2.137)	(2.528)	
motive nature		3.097	4.100	
		(2.231)	(2.519)	
days per week in forest		2.993*	5.068***	
		(1.574)	(1.815)	
recovery level		−1.220	0.840	
		(2.943)	(4.082)	
disturbance level		−10.456**	−11.590*	
		(4.210)	(6.794)	
time to arrive in forest		−0.631**	−1.471***	
		(0.312)	(0.462)	
having a garden		8.770	7.057	
		(7.014)	(6.568)	
arriving by bike		−0.482	0.983	
		(7.649)	(7.573)	
arriving by public transportation		−20.630	−17.987	
		(28.035)	(25.420)	
arriving by car/motorcycle		−27.611***	−22.282***	
		(8.252)	(8.173)	
arriving by other means of transportation		−7.539	−8.056	
		(15.378)	(18.405)	
change in forest visits			3.546***	1.362
			(1.340)	(1.136)
change in time to arrive in forest			−0.988*	0.191
			(0.536)	(0.256)
change in disturbance level			−1.235	4.948
			(5.668)	(3.750)
change in recovery level			1.554	1.618
			(3.545)	(2.931)
change in level of doing sports			2.059	−1.697
			(7.724)	(6.469)
change in level of activity social gatherings			9.393	4.735
			(12.611)	(6.134)

(*continued on next page*)

Table 7 (*continued*)

	Model 1: Change in duration of visits (OLS)	Model 2: Change in duration of visits (OLS)	Model 3: Change in duration of visits (OLS)	Model 4: Change in duration of visits (First Difference)
change in level of activity experiencing nature			11.394**	7.644*
			(5.728)	(4.430)
change in level of going for a walk			5.566	2.136
			(6.517)	(5.063)
change in motive health			−5.087**	−2.257
			(2.155)	(1.958)
change in motive social			3.854	3.137
			(2.378)	(2.028)
change in motive nature			1.368	−1.469
			(2.124)	(1.845)
Observations	628	628	628	628
R^2	0.0401***	0.1354***	0.0972***	0.0223*

Standard errors in parentheses.
* $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$.

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