Trees, Forests and People 14 (2023) 100439

Contents lists available at ScienceDirect

Trees, Forests and People

journal homepage: www.sciencedirect.com/journal/trees-forests-and-people

How do forest visitors perceive forest management forms? Public acceptance of coppice-with-standards in urban forests

Johanna Trummer, K. Tessa Hegetschweiler *

Swiss Federal Research Institute for Forest, Snow and Landscape Research WSL, Zürcherstrasse 111, 8903 Birmensdorf, Switzerland

ARTICLE INFO

Keywords:
Forest management forms
Forest characteristics
Perceived visual forest attractiveness
Visitor preferences
Coppice-with-standards
Forest recreation

ABSTRACT

To mitigate climate change consequences, a shift to more renewable energy sources is necessary. The traditional forest management form coppice-with-standards features efficient harvesting cycles and could therefore provide a reliant biomass source. Particularly forests close to urban settlements are popular destinations for outdoor recreation. Therefore, for a well-functioning interaction between recreation and forest management, forest visitors' preferences need to be considered. Even though, coppice-with-standards have been studied scientifically from various points of view, including its cultural and ecological values, little focus was put on the perceived visual attractiveness of this management form. Therefore, this study aims to investigate how forest visitors perceive different forest management forms with a focus on coppice-with-standards in the case study area in Zurich, Switzerland by performing qualitative Go-Along interviews and a quantitative forest visitor survey. The statistical analysis revealed that forest visitors have divided opinions on this management form and prefer even-aged high forest as well as continuous forest management. Therefore, in case of an increasing use of coppice-with-standards management for biomass production, implementation in recreational forests needs to be weighed against less frequently visited areas. However, addressing the visitors with well-targeted communication strategies could result in increased understanding and acceptance and could therefore support the implementation process also in recreational forests.

1. Introduction

Today, society still predominately relies on fossil fuels as the main energy source to meet the needs of the growing energy demand (Kılıç Depren et al., 2022). However, it is proven that the use of non-renewable energy sources is one of the main drivers for the global temperature rise and respectively climate change due to the emitted greenhouse gas emissions (Amjith and Bavanish, 2022). Therefore, the need to develop sustainable energy sources from renewables, such as wind, solar or hydro power as well as biomass, is essential to substitute climate-impacting fossil fuels. Its urgency is also reflected in scientific literature, as since the beginning of the 21st Century, a growing interest in renewable energies could be detected in various research fields with the result of a steady increase of scientific publications (Hansen et al., 2019).

To shift to climate-neutral energy systems and support global decarbonization efforts while meeting the global energy demand, several international targets and policies were phrased. These show that renewable energy sources are key for decarbonization strategies (Nagovnak et al., 2022). The 2015 released Paris Agreement presents the global ambition to perceive the rise of global average temperature well below 2° Celsius above pre-industrial temperatures (Nagovnak et al., 2022; UNFCCC, 2015). The EU climate strategy aims for zero greenhouse gas emissions by 2050 (Ahmad and Nashwa, 2021; European Commission, 2023). The topic is also embedded in the United Nation's Sustainable Development Goal (SDGs) number 7. It targets "affordable and green energy for all" by rising the renewable energy share on a global basis (United Nations, 2023). Russia's invasion of the Ukraine triggered a global energy crisis that emphasized the risks and uncertainties that come along with the dependency on international fossil fuels providers and highlighted the urgency for action even further.

In the process of climate change mitigation forests play a key role (Lefebvre et al., 2021; UNFCCC, 2015). On the one hand, they are known carbon sinks. They enable carbon to be sequestrated in the local biomass and soil (Luyssaert et al., 2008; Valade et al., 2017). On the other hand, they provide wood, a solid biomass that can be processed further into renewable energy supplies (Vass and Elofsson, 2016). Furthermore, it is used as building materials that can replace fossil-fuel-based products

* Corresponding author.
E-mail address: tessa.hegetschweiler@wsl.ch (K.T. Hegetschweiler).

https://doi.org/10.1016/j.tfp.2023.100439

Available online 22 September 2023

(Churkina et al., 2020). The objective to reduce the dependency on fossil fuels, fosters the rediscovery and reintroduction of historic forest management forms with efficient harvesting cycles (Mejstřík et al., 2022).

Coppice-with-standards, a formerly widespread forest management form in Europe belongs to these (Johann, 2021; Kamp, 2022; Kirby et al., 2017). The two-storey system enabled younger stands to be cut regularly in 5–25-year cycles, depending on the tree species present, while the upperstorey consisted of older single trees that were used as building material. The trees' resprouting ability in the understorey provided an efficient firewood source in line with the rotational coppicing cycle (Kamp, 2022; Slach et al., 2021).

This dual-purpose management form was traditionally implemented because of its accessibility with simple tools (Slach et al., 2021). Coppice-with-standards were abandoned or substituted by other management forms predominately in the 20th Century due to the increased accessibility to fossil fuels that replaced wood as the main heating source (Müllerová et al., 2015; Slach et al., 2021).

During the regeneration process the visual impression of a forest maintained with this management form continuously changes. After the coppicing no ground vegetation nor shrub layer are present. Over time, the stumps of the cut trees resprout and develop into a new shrub (Kamp, 2022; Slach et al., 2021). In contrast to other management forms, this altering forest image within a relatively short time period forms an exception. For example, in continuous cover management, only single trees are extracted at a time. So, from a lay-person's point of view this forest's image generally does not change. Similar applies to even-aged high forests, even though clearcuts drastically change the landscape and a forest's visual impression, they are only performed in cycles of approximately three generations (100 years).

Actively managed coppice-with-standards feature diverse ecological preconditions that provide living space for a wide range of different species (Buckley, 2020; Kamp, 2022). Light-demanding as well as shade-tolerant species can both find a suitable habitat within this particular forest ecosystem (Kirby et al., 2017; Slach et al., 2021). Numerous scientists have already highlighted the importance of coppice management for the local species richness (Fuller and Rothery, 2013; Kirby et al., 2017; Müllerová et al., 2015; Weiss et al., 2021). The abandonment of forests managed as coppice-with-standards results in a closed canopy cover, a homogenization of vegetation height and a loss of biodiversity (Buckley, 2020; Kamp, 2022; Müllerová et al., 2015).

Additionally to their ecological value, coppice woods hold a unique cultural and historical heritage (Johann, 2021; Kamp, 2022; Slach et al., 2021). The complete disappearance of this management form would mean the loss of a century-long human-nature synergy. They feature traditionally and historically important socio-ecological systems that still today are evidence for silvicultural activities in the past (Kamp, 2022; Slach et al., 2021).

Several projects that foster the reintroduction of coppice and coppice-with-standards management have been established in Central European countries to restore the biodiversity hotspots associated with this forest management form, preserve its historical-cultural value and also in relation to the fast growing biomass potential (Mejstřík et al., 2022; Müllerová et al., 2015). For a successful and sustainable restoration of coppice-with-standards, forest management plans need to be adapted. However, the recreational use of in particular urban and easily accessible forests is also increasing steadily (Bell et al., 2009). Therefore, it is also essential to examine how forest visitors perceive this management form, as numerous studies have revealed that not all forest types are appreciated to the same extent by society and that certain forest features are decisive for these preferences (Edwards et al., 2012; Filyushkina et al., 2017; Hegetschweiler et al., 2022a; Meo et al., 2014; Wang et al., 2017).

Scientists have already focused their research on the consequences of climate change on biodiversity in forests managed with coppice-with-standards (Johann, 2021; Kirby et al., 2017; Müllerová et al., 2015; Unrau et al., 2018), the forest management type's biomass productivity and resprouting ability in regard to energy production (Ljupco et al., 2009; Mejstřík et al., 2022) the demand of firewood provided by this management form linked to rising oil prices (Kamp, 2022) as well as other topics related to this traditional management form (Becker et al., 2017; Buckley, 2020; Kopecký et al., 2013; Verheyen et al., 2012; Verstraeten et al., 2013). Furthermore, societies' forest preferences have been evaluated in various contexts on a global basis (Barron et al., 2021; Carvalho-Ribeiro and Lovett, 2011; Hegetschweiler et al., 2022b). In the case of Switzerland, the relationship of the population to the forest is even monitored in regular intervals since 1978 (BUWAL, 1999; Hegetschweiler et al., 2022a; Hertig, 1979; Hunziker et al., 2012). Still, a knowledge gap was identified in regard to the visual attractiveness of the management form coppice-with-standards.

Therefore, the goal of the project presented is to investigate forest visitors' perceived preferences regarding this specific forest management form compared with other management forms. To explore this objective, qualitative Go-Along interviews with visitors of the case study area and a quantitative forest visitor survey were performed. Based on this project's aim the following research questions were phrased:

- How do forest visitors perceive the visual attractiveness of coppice-with-standards in comparison to other management forms?
- Which factors determine visitors' preferences concerning different management forms?

2. Materials and methods

2.1. The case study area

This project applied a single case study approach that focused on an urban forest located in Zürich, Switzerland (see Fig. 1). The "Waldlabor" (German for forest laboratory) on Hönggerberg is a well-established destination for recreational purposes mainly used by people living in Zurich. In 2020, the association around the Waldlabor was founded with the main goal to create a space that serves recreation, research and forestry in equal terms (Bernasconi et al., 2019).

With an area of 150 hectares, it offers enough space for numerous research projects related to the topic of forestry and nature. These can partly be experienced by visitors, or they are even actively incorporated in the research process to follow the association's main objective (Bernasconi et al., 2019).

Furthermore, this "real-life laboratory" hosts test plots for the identification of future resilient tree species. Moreover, it promotes the preservation and restoration of traditional forest management practices, including coppice-with-standards management (Bernasconi et al.,

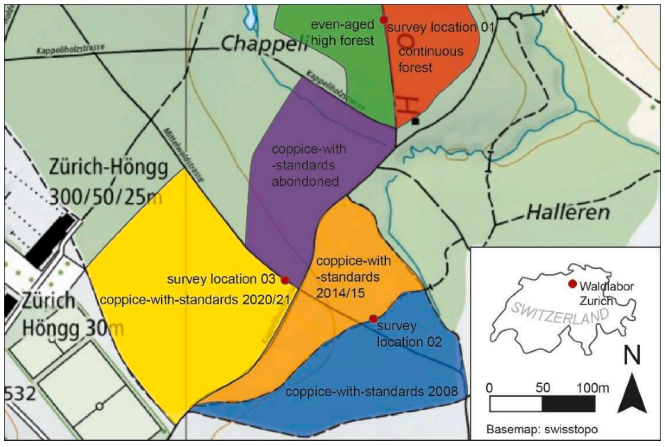


Fig. 1. Location and visual overview of the Waldlabor Zurich in Switzerland. The three survey locations each consisting of two study plots are marked on the map (source: own representation).

2019). This management form was already reintroduced in 1984, after its abandonment in the early 20th Century (GrünStadtZürich, 2006). Four different development stages of coppice-with-standards (broadleaf forest) as well as continuous cover (broadleaf forest) and even-aged high forest management (coniferous forest) are located within a short distance. Due to these preconditions, the Waldlabor served as an appropriate case study area for this project.

Information about the different management forms is provided by the association and can be obtained in various formats. An app gives detailed information on each of the present management forms, guided tours can be booked, and on-site information boards provide insights into the management of coppice-with-standards in particular.

2.2. Selection of the study plots

Six study plots at three different locations were chosen for this project. The six plots represented: (1) continuous cover management, (2) even-aged high forest, (3) coppice-with-standards abandoned more than 100 years ago, (4) coppice-with-standards cut in 2008, i.e., 14 years prior to this study (5) coppice-with-standards cut in 2014/15, i.e., 7 years prior to this study (6) coppice-with-standards cut in 2020/21, i.e., 1 year prior to this study. A photograph of each study plot is attached in Appendix A. At each survey location, two plots were located opposite of each other with the aim to assess two plots from the same point.

At survey location 01, the management forms continuous cover management and even-aged high forest were represented. The continuous forest management features a dense broadleaf forest with an uneven-aged, heterogenous stand structure. Furthermore, ground vegetation and a shrub layer are present. The even-aged high forest was the only coniferous forest represented in this study. Coniferous trees were planted in regular intervals approximately around 1980 and the ground vegetation as well as the shrub layer are almost completely missing. Information about these management forms cannot directly be obtained at the individual plots, but is provided online in the Waldlabor App.

Survey location 02 features two stages of coppice-with-standards management. The two relevant sections were cut in winter 2008 and in winter 2014/15. In both cases the understorey consists mainly of densely grown hazel (*Corylus avellana*), while the stands of the upperstorey are predominately single oak (*Quercus* sp.) and ash (*Fraxinus excelsior*) trees. Ash dieback (*Hymenoscyphus fraxine*us) is a relevant issue in this forest area. Affected ash trees with sufficient distance to paths and roads are not cut, affected ash trees that might endanger forest visitors have already been removed or trimmed for safety reasons. The main visual difference between the two plots is the height of the understorey. Since the trees were coppiced six years apart, the understorey on plot 2008 has grown higher and denser. Therefore, less sunlight reaches the ground and less ground vegetation is present. Boards at this location provide information about the management form coppice-with-standards. Additional information can be looked up online in the app.

At survey location 03, two other stages of coppice-with-standards management are represented. While one is not being actively managed any longer and visually resembles the already described continuous cover management, the other one was coppiced only in winter 2020/21. This results in two completely different images of the forest. At plot 2020/21 the single oak trees of the upperstorey dominate, as the understorey is only sparsely developed. Still, some bushes already started to resprout, and the ground is mainly covered with blackberry (*Rubus* sp.) bushes. Also at this location, on-site information boards provide information about this management form. Further information is available online.

2.3. Data collection

2.3.1. Qualitative interviews

Six Go-Along interviews were conducted with visitors of the Waldlabor in May 2022. This approach was based on the methodological concept of Go-Along interviews described by Kusenbach (2003). Questions were asked according to a prepared semi-structured interview guide that can be combined with the concept of Go-Along interviews (Helfferich, 2014). It had the objective to collect information about the visitors' performed activities, reasons for the visit and to gain first insights into their perception of different management forms as well as forest preferences. In addition, they served as a basis for the development of the standardized questionnaire.

The Go-Along interviews lasted between 10 and 30 min and visitors aged between 20 and 86 years were accompanied on their regular walks in the forest (Table 1). However, it was taken care that the walks led past the predefined survey locations to collect sufficient insights into the visitors' perceptions and opinions regarding forest management forms. The chosen interviewees were based on convenience sampling, but with balanced gender and age distribution. The different lengths of the interviews can be explained by the fact that older people could not visit all six plots during the time of the interview due to the distance between the locations. The plots visited by each interviewee are depicted in Table 1.

With the agreement of the interviewees the interviews were recorded. These recordings were transcribed and further evaluated, so the content could be further processed and used for the quantitative research approach.

2.3.2. Quantitative survey

The derived data from the qualitative interviews served as the main input source for the follow-up method, the standardized questionnaire. The aim of this survey was to investigate the visitors' motives for the visit of the Waldlabor, the frequency, the performed activities, as well as the perceived visual forest attractiveness, and to directly link these responses to the individual study plots, respectively the different forest

Table 1
Overview of the go-along interviews' participants.

Nr	Gender	Age	Visited study plots	Profession	Additional information
B01	male	28 years	all study plots	environmental systems scientist	
B02	female	60 years	all study plots	retired kindergarten teacher	+ two dogs
B03	female	83 years	coppice-with-standards 2008 coppice-with-standards 2014/15 coppice-with-standards 2020/21 coppice-with-standards abandoned	retired office assistant	
B04	male	86 years	even-aged high forest continuous forest coppice-with-standards 2008 coppice-with-standards 2014/15	retired insurance agent	
B05	female	20 years	all study plots	student	scout leader
B06	male	48 years	all study plots	train driver and former photographer	+ baby in baby sling

management forms.

The questionnaire (Appendix B) was structured into four separate sections. First, basic information about the peoples' visits at the Waldlabor (i.e., frequency, purpose and length of the visit, traveling time from their home or workplace, predominately performed activities) was collected. Second, the perceived changes due to forest work were addressed. Third, questions that targeted the individual management forms were added. These covered the first impression of the perceived visual attractiveness of the study plot on a 10-level Likert scale, as well as the preference of specific present forest characteristics (e.g., shrub layer density, ground cover, light incidence) that had been mentioned by visitors during the qualitative interviews. Next, people were asked to rank their satisfaction respectively the personal impression of knowledgeability for the assessed study plots on a 5-level Likert-scale. This third section was included twice in each questionnaire, so participants were able to assess both study plots at the designated survey locations. Finally, socio-demographic information (i.e., age, gender and education) and data about the participants' personal relation to forests were collected.

The predominately applied question format was closed questions with one or more response options. Rankings of preference were done on a 5-level respectively a 10-level Likert-scale. Apart from the output of the qualitative interviews, the applied questions and corresponding response options were partly derived from the Swiss Sociocultural Forest Monitoring (abbreviation: WaMos) (BUWAL, 1999; Hegetschweiler et al., 2022a; Hunziker et al., 2012). The survey was prepared in the online survey tool Sawtooth Software Lighthouse Studio, Version 9.14.0 (Sawtooth, 1998) and made available to the participants as an offline version in German language on tablets.

In June 2022, the survey was performed. It had to be completed at the designated survey locations and it took the visitors between 10 and 20 min. Markers on the left and on the right indicated the width of each study plot, which measured between 10 and 12 m. They served the purpose to ensure that participating visitors used the same section of the study plots for the assessment of the respective management form and to make the results better comparable. It was essential that relevant characteristics of the respective management form were represented within the marked area, such as the visible resprouting of young trees distinctive for coppice-with-standards. Finally, each study plot was assigned a color code to reduce the participants' unconscious influence and enable a neutral assessment as well as to simplify the data processing. These were displayed in the form of colored circles at the survey location during the survey. Each participant could assess the two study plots at one of the three survey locations as depicted in Fig. 1. Limitations faced during the survey and its evaluation are discussed in Section 4.6.

Finally, after excluding incomplete responses, the data of 209 questionnaires was used for further analysis. For more details regarding the participation rate at the individual survey locations, see Table 2. The survey's target group were people using the Waldlabor for recreational purposes or crossing it on their daily routes.

Table 2
Overview of the survey locations of the quantitative survey.

Survey location	Forest management form	Width of study plot	Corresponding color code	Nr. of complete studies
01	continuous cover management	10 m	red	50
01	even-aged high forest management	10 m	green	50
02	coppice-with-standards management 2008	10 m	blue	81
02	coppice-with-standards management 2014/15	10 m	orange	81
03	coppice-with-standards management 2020/21	12 m	yellow	78
03	abandoned coppice-with-standards management	12 m	purple	78

2.4. Data analysis

The survey's data analysis was performed using the software program IBM SPSS Statistics, Version 28 (IBM, 2022). Apart from the conducted descriptive statistical analyses, factor analyses, an analysis of variance, as well as a stepwise linear regression were carried out. The factor analyses aimed at a reduction of variables for motives and the predominately performed activities. As extraction and rotation methods principal component analyses, respectively Varimax rotations were applied.

Motives for visiting the Waldlabor were able to be reduced to two underlying factors: *Relaxing and recovering* (experiencing forest and nature, enjoying fresh air, enjoying the calmness) and *Activities in close-by forest* (using the forest for daily routes, accompanying children at play time, visiting the most close-by forest, doing sports). Three variables (going for daily walks with a dog, using the good access to public transport, going for random walks) failed to achieve adequate loadings on any factor and were therefore dropped from the analysis (Appendix C).

Furthermore, four factors could be derived from the variables related to the performed activities in the Waldlabor*: Social activities* (making a bonfire/BBQ, accompanying children at play time, being outdoors with a youth group), *Sports activities* (jogging, biking, horseback riding), *Going for a walk* (going for a walk, going for a walk with a dog) and *Relaxing and recovering* (reading, watching nature) (Appendix D).

To investigate how the perceived visual attractiveness differed between the six plots, an analysis of variance (ANOVA) with a Bonferroni post hoc test was performed. This process determines the significant statistical differences between the mean values of the individual plots. The perceived visual attractiveness served as the dependent variable.

In order to examine the influencing factors on the dependent variable perceived visual forest attractiveness, a stepwise linear regression was calculated. Due to the great number of independent variables and the comparatively low sample size, variables with p-values < 0.15 were considered as significant and were included in the regression. Variables with a p-value ≥ 0.15 were excluded. The variables were grouped into the following four influencing factors respectively four steps of the regression*: Socio-demographic parameters, Personal relation to the Waldlabor, Forest characteristics, Forest visit behavior*.

3. Results

3.1. Findings of the qualitative interviews

The key statements of the six qualitative interviews revealed that people appreciate visiting the Waldlabor due to the natural shade provided by the forest during the summer months. Since the coppicing performed on plot 2020/21, the paths surrounding this study plot are partly avoided because of the missing shade. Generally, people were not happy or even shocked and showed little understanding of the executed forest work at this plot. People primarily remembered events that changed the forest's visual appearance (i.e., a windfall in summer 2021 and related forest work, coppicing on plot 2020/21), particularly when they happened not a long time ago. Still, reforestation processes and plantings were also referred to by the interviewees. Regarding the different study plots, a contradictory opinion about the perceived visual forest attractiveness of the even-aged high forest was derived from the interviews, as well as that the continuous forest is appreciated due to its

heterogeneous vegetation type and height. Finally, little visual difference between the plots 2008 and 2014/15 was noticed by the interviewees.

3.2. Socio-demographics

Of the 209 participating visitors 63% were female and 37% were male. The average age of the participants was 52.9 years (SD = 18 years). This is seven years older than the average age of the population of Zurich above 18 years (Stadt Zürich - Präsidialdepartment, 2022). The youngest person was aged 19, while the oldest was 86 years old. Regarding the self-reported highest completed education level, the majority of participants (57%) completed a university degree or equivalent, followed by 31% who named vocational training as their highest level of education. The share of people holding a completed university degree or equivalent is comparable to the population of the city of Zurich (56%) (Stadt Zürich - Präsidialdepartment, 2022), but is significantly higher than the Swiss average (33%) (Bundesamt für Statistik, 2023b). This could be explained by the case study area's proximity to a university campus and the agglomeration of institutions for higher education in urban areas.

36% of the visitors stated that they use the Waldlabor for recreational purposes between one and three times a week, whereas 31% visit this forest nearly on a daily basis (four to seven times a week). This category also includes people owning a dog, who might walk their pet more often than once a day. The remaining participants visit the Waldlabor less regularly.

Additionally, according to the collected postal codes, the results show that mainly people from close-by neighborhoods visit the forest. This is also supported by the fact that the majority of visitors (55%) indicated that they reach the Waldlabor in less than 10 min. The time spent in this forest predominately varies between 30 and 60 min according to 43% and 61 and 90 min reported by 29% of the visitors. Based on the socio-demographics, this data can be seen as a representative sample of the urban Swiss population visiting recreational forest and living in urban as well as suburban areas.

The predominately mentioned activities performed in the Waldlabor were going for a walk (72%) or performing other sports activities (jogging (22%), Nordic Walking (14%) and biking (17%)). However, 49% of the visitors also indicated that they watch nature during their time in the forest, an activity that can be combined with any other of the above-mentioned ones. The main motives why people visit this forest are enjoying the good air, experiencing the forest and nature as well as enjoying the calmness.

3.3. Attractiveness of the management forms

The ANOVA showed that perceived visual attractiveness differed between the individual plots ($F_{5,412} = 8.425$, $p < 0.001$). Continuous forest management ranked the highest (mean = 8.1, SD = 1.7), followed by the even-aged high forest (mean = 7.9, SD = 1.9). The four stages of coppice-with-standards did not appeal as attractive. The highest ranking was observed at the abandoned plot (mean = 7.6, SD = 1.7), followed by the plots coppiced in 2008 (mean = 7.5, SD = 1.5) and in 2014 (mean = 7.5, SD = 1.6). At the plot cut in 2020/21 (mean = 6.7, SD = 2.4), the lowest scores were registered. The post hoc test revealed that statistical differences were due to the low ranked evaluation of the plot coppiced in 2020/21 (Table 3).

Table 3
ANOVA showing the correlation between the individual study plots in regard to perceived visual forest attractiveness.

Study plot		Mean difference	Standard error	p
Continuous forest	Coppice-with-standards d 2014/15	0.65	0.329	0.726
	Coppice-with-standards 2008	0.63	0.329	0.863
	Coppice-with-standards abandoned	0.49	0.331	1.000
	Coppice-with-standards 2020/21	1.83*	0.331	**<0.001**
	Even-aged high forest	0.18	0.366	1.000
Even-aged high forest	Coppice-with-standards 2014/15	0.47	0.329	1.000
	Coppice-with-standards 2008	0.45	0.329	1.000
	Coppice-with-standards abandoned	0.31	0.331	1.000
	Coppice-with-standards 2020/21	1.65*	0.331	**<0.001**
	Continuous forest	−0.18	0.366	1.000
Coppice-with-standards 2008	Coppice-with-standards 2014/15	0.02	0.287	1.000
	Coppice-with-standards abandoned	−0.13	0.290	1.000
	Coppice-with-standards 2020/21	1.20*	0.290	**<0.001**
	Even-aged high forest	−0.45	0.329	1.000
	Continuous forest	−0.63	0.329	0.863
Coppice-with-standards 2014/15	Coppice-with-standards 2008	−0.02	0.287	1.000
	Coppice-with-standards abandoned	−0.16	0.290	1.000
	Coppice-with-standards 2020/21	1.17*	0.290	**<0.001**
	Even-aged high forest	−0.47	0.329	1.000
	Continuous forest	−0.65	0.329	0.726
Coppice-with-standards 2020/21	Coppice-with-standards 2014/15	−1.17*	0.290	**<0.001**
	Coppice-with-standards 2008	−1.20*	0.290	**<0.001**
	Coppice-with-standards abandoned	−1.33*	0.293	**<0.001**
	Even-aged high forest	−1.65*	0.331	**<0.001**
	Continuous forest	−1.83*	0.331	**<0.001**
Coppice-with-standards abandoned	Coppice-with-standards 2014/15	0.16	0.290	1.000
	Coppice-with-standards 2008	0.13	0.290	1.000
	Coppice-with-standards 2020/21	1.33*	0.293	**<0.001**
	Even-aged high forest	−0.31	0.331	1.000
	Continuous forest	−0.49	0.331	1.000

$n = 209$ dependent variable: perceived visual forest attractiveness test method: univariate analysis of variance ANOVA $F_{5,412} = 8.425$, $p < 0.001$.
Post-Hoc-Test: Bonferroni. $p < 0.001$ = *.

3.4. Factors influencing perceived forest attractiveness

The stepwise linear regression demonstrated that the main influencing factors consisted of a set of parameters listed in Table 4.

Of the socio-demographic variables, solely *Age* had an influence. Thus, younger people appreciate the forest more than older visitors. Adding the participants' personal relationship to and experience with the forest (included variables with significant influence are listed in Step II of Table 4) increased the explained variance from 0.02% to 9.7%. While visiting forests for *Relaxing and recovering* has a positive influence how the Waldlabor is perceived by visitors, visiting this forest mainly in order to carry out *Activities in a close-by forest* negatively affects the perceived visual forest attractiveness. Additionally, people who actively

Table 4
Stepwise linear regression showing the correlation between the independent variables ($p < 0.15$) and the dependent variable perceived visual forest attractiveness.

Step	Variables	Beta	T	p
I	Age	−0.097	−1.645	0.101
II	Motive: Relaxing and recovering	0.098	1.895	0.059
	Motive: Activities in close-by forest	−0.193	−3.112	0.002
	Forest transformation: planting and reforestation	0.130	2.475	0.014
	Personal satisfaction with forest maintenance	0.183	3.687	<0.001
	Personal impression of being well-informed	−0.176	−3.475	<0.001
III	Predominately coniferous forest	0.176	2.737	0.006
	Predominately broadleaf forest	0.147	2.506	0.013
	Bushes and young trees	0.196	3.418	<0.001
	Fallen and rotten trees	−0.160	−2.842	0.005
	Shady and protected from the sun	0.253	4.822	<0.001
	Light and broad view into the forest	0.101	1.777	0.076

$n = 418$.
Step I: Adjusted $r^2 = 0.002$; $p = 0.279$; $F_{3,410} = 1.286$.
Step I-II: Adjusted $r^2 = 0.097$; $p = <0.001$; $F_{14,399} = 4.185$.
Step I-III: Adjusted $r^2 = 0.232$; $p = <0.001$; $F_{27,386} = 5.631$.
Step I-IV: Adjusted $r^2 = 0.236$; $p = <0.001$; $F_{30,383} = 5.258$.

perceived transformations due to forest work, such as *Plantings and reforestation*, show a more positive attitude towards perceived forest attractiveness. On the one hand, *Personal satisfaction with forest maintenance* has a significant positive impact. People are particularly satisfied with the study plots that scored high in regard to perceived visual forest attractiveness. On the other hand, the parameter *Personal impression of being well-informed* has a negative influence. At first sight, the negative correlation of the latter variable is surprising and therefore needs further investigation.

Visitors feel most informed about plot 2020/21 (mean = 3.8, SD = 1.1) and the abandoned plot (mean = 3.7, SD = 1.1), followed by the other two plots managed as coppice-with-standards (site 2008: mean = 3.2, SD = 1.4; plot 2014/15: mean = 3.1, SD = 1.4). Participants feel the least informed about the continuous forest (mean = 2.8, SD = 1.6) and the even-aged high forest (mean = 2.7, SD = 1.5). The highest mean and lowest standard deviation can be observed at survey location 03, where information boards are provided.

By adding the perceived forest characteristics additionally to the other variables to the linear regression model, 23.2% of the variance can be explained. The majority of these significant indicators have a positive influence on the perceived visual attractiveness (i.e., *Predominately coniferous forest, Predominately broadleaf forest, Bushes and young trees, Shady and protected from the sun* and *Light and broad view into the forest*). An exception forms *Fallen and rotten trees*, which has a negative influence in this context.

4. Discussion

The results revealed that the respondents preferred continuous forest and even-aged high forest management over any stage of coppice-with-standards. To analyze the reasons behind these findings, the influencing factors derived from the linear regression model were further investigated and discussed in the following.

Even though, the stepwise regression model only explains 23.6% of the variance, this number is comparable to results of similar studies. Tyrväinen et al. (2003) explain their r^2 of 21.6% by the assumption that preferences of participators are generally diverse. Hunziker et al. (2012) even describe their explained variance of 29% as a high value in this regard. Additionally, the derived variables show a clear line of argument. Therefore, this model is considered as a valid base for this study.

4.1. Socio-demographics

While some scientific studies show that forest preferences can depend on personal and socio-demographic factors (e.g., gender, age, educational level and personal forest ownership) (Abello and Bernaldez, 1986; Frick et al., 2018; Hegetschweiler et al., 2022a; Rogge et al., 2007), others' results do not support these findings (Chen et al., 2014; Eriksson et al., 2012; Hegetschweiler et al., 2020). In these cases, most socio-demographic variables have little to no impact on the perceived visual forest attractiveness. This study's outcome is comparable with the latter. Of the socio-demographic items only the *Age* of the participants had an influence on the perceived forest attractiveness. A possible explanation is that forest management has developed and changed during the past 20 to 30 years. Older people are still expecting and might prefer the homogenous, even-aged stand structures they grew up with while the transformation in management visually displays several forest development stages within one management form (e.g., continuous cover management). This might be observed as more natural and unmanaged.

4.2. Motives and activities

The results revealed that motives for visiting the forest had a stronger impact on the perceived visual forest attractiveness than the performed activities. It can be argued that this is related to the fact that due to the methodological approach predominately people going for a walk participated in the survey compared to people performing other activities. Therefore, its significance is not as pronounced compared to the derived motives. The positive influence of the motive *Relaxing and recovering* can easily be explained, because people who correspond to this motive appreciate the forest's environment and feel comfortable in its surrounding. Whereas it is more complicated to understand the motive *Activities in the close-by forest*'s negative correlation with the perceived visual forest attractiveness. This could be interpreted that mainly regular visitors from close-by neighborhoods match this motive, as they can access this close-by forest easily for recreational activities. Regular visits and the satisfaction caused by it can lead to the development of a relationship to this forest's environment (Arnberger et al., 2022). This can be referred to as place attachment (Altman, 1982). Through the people's connection to a certain place, their motivation rises to benefit and preserve its environment or even develop more pro-environmental behavior and environmental responsibility (Daryanto and Song, 2021; Soopramanien et al., 2023). Arnberger et al. (2022) study revealed, that an even stronger sense of place attachment is caused by nearly untouched or little developed urban green spaces. Therefore, visitors see it as an "obligation" to be informed about forest transformations performed at their attached place. Single events caused by storms or logging can significantly change people's perceptions in a relatively short period of time (Frick et al., 2018; Wild-Eck et al., 2004) and deviations from the known norms are difficult to be accepted (Purcell, 1992). Even though people following this motive show little understanding for transformations of the visual forest appearance of which they were not informed about personally, they still proceed their visits, because of easy accessibility and convenience.

4.3. Forest transformations due to forestry

Visitors perceive transformations due to forestry with different intensities. Those visiting the Waldlabor more regularly are able to compare the current state with the memories of previous visits. This could explain the perceived visual attractiveness of the plot 2020/21, where the last coppicing was only performed a short time before this project's execution and that resulted in a great visual transformation. Still today, this is clearly visible, particularly for long-time visitors. This plot revealed the lowest appreciation scores and the greatest range in the standard deviation. These statistical figures show that the visitors'

perceptions of this plot varies much more than at other survey locations. Based on the collected data, it is possible to say that while clear cuts are perceived negatively but do not have a significant influence on the perceived forest attractiveness, plantings and regenerations have a positive correlation. This could be due to its positive connotation and potentials for e.g., outdoor recreation due to forest development (i.e., public involvement in regenerative processes) (Pröbstl et al., 2010; Strange et al., 2019).

4.4. Personal satisfaction and feeling informed

The positive influence of *Personal satisfaction with forest maintenance* is obvious, however why a negative correlation exists in regard to *Personal impression of being well-informed* needed further investigation. The results show that a direct link between the provision of on-site information boards and the impression of feeling informed is given. Nevertheless, despite the provided on-site information, these study plots are not appreciated by the visitors (e.g., survey location 03: high impression of feeling informed; low perceived attractiveness), while the lack of information boards at survey location 01 does not lower the high attractiveness of continuous and even-aged high forests' plots. This could be explained by the assumption that being well-informed does not directly link to perceived forest attractiveness and being aware of the transformations initiated through forest management. Furthermore, the boards were installed in April 2008, but no information about the coppicing of 2021 was added. Related to forest work, targeted communication measures are essential to encounter the visitors' understanding (Hunziker et al., 2012). In particular, transparent communication between forest workers and forest visitors in regard to the discussed coppice-with-standards management form could improve the acceptance of necessary forest work (Schenk et al., 2007).

4.5. Forest characteristics

Other scientific publications already showed that specific forest characteristics have a particular impact on how they are visually perceived (Edwards et al., 2012; Hegetschweiler et al., 2020, 2017; Wang et al., 2017). The significant forest characteristics relevant for this study (see Table 4) were in most cases already mentioned during the qualitative interviews, which again underlines the importance of these parameters in the assessment and evaluation of perceived visual forest attractiveness.

First, it is positively influenced by the present vegetation types (i.e., coniferous and broadleaf forest). Why both vegetation types that visually appear so differently, have a positive impact cannot be explained based on this study's data. However, the findings align with the derived forest characteristics influencing visual perceived forest attractiveness by Hegetschweiler et al. (2017), Hegetschweiler et al. (2020) and Frick et al. (2018). Research revealed that forest visitors prefer mixed forest over monocultures (Filyushkina et al., 2017; Hegetschweiler et al., 2022a). However, this forest type is not represented in the case study area.

Second, even though from an ecological point of view dead wood is an essential component for forest ecosystems, it is a controversial topic regarding perceived visual forest attractiveness (Frick et al., 2018; Gundersen and Frivold, 2011; Imesch et al., 2015) and the only negatively influencing forest characteristic derived. This result is consistent with the findings of (Hegetschweiler et al., 2020), but the studies of Rathmann et al. (2020) and Hauru et al. (2014) revealed that it can also be recognized as positive. Today, forest management often encourages the presence of deadwood to benefit from its advantages (Imesch et al., 2015). The qualitative interviews pointed out that visitors are informed about the deadwood's functions and accept it for this reason, but do not see it as visually pleasant. This coincides with the results of Gundersen et al. (2017), as their study revealed that well-formulated information about the function of dead wood improves society's acceptance. The quantitative data revealed that older people find deadwood (i.e., *Piles of branches on the ground*) less attractive compared to younger people. This could be explained by the managed forests' tidy appearance during their childhood.

Third, three of the derived forest characteristics are directly linked to the present light conditions (*Shady and protected from the sun* and *Light and broad view into the forest*) or indirectly influence this phenomenon by vegetation density (*Bushes and young trees*). However, the contradiction that all variables show a positive correlation, creates space for discussion.

If shade is provided by a forest, it is often highly appreciated by visitors. In particular on hot summer days, forests have a pleasant cooling function and therefore reduce the discomfort of heat stress conditions (Lafortezza et al., 2009). This is linked to the presence of a closed canopy cover (Hesslerová et al., 2013; Marland et al., 2003). Already the qualitative interviews revealed this as one reason why people visit the Waldlabor. Therefore, missing shade leads to a lower overall perceived attractiveness. This again could explain the overall low scoring of the plot 2020/21. The lack of a developed shrub layer and young trees at this plot at the time of the project's execution, consequently resulted in hardly any shade on the surrounding paths. It needs to be considered that the availability of shade is not only determined by missing trees but can also be influenced by weather conditions and the position of the sun. Hegetschweiler et al. (2020) as well as Nielsen et al. (2012) target the topic of the sun's perception in the context of forest preferences and characteristics. Both studies demonstrate that sun beams or the presence of sun positively influence the perception of a photograph or site. However, no information related to a potential influence due to the lack of shade was mentioned in these publications (Hegetschweiler et al., 2020; Nielsen et al., 2012).

A shrub layer's presence can positively influence a forest perception. Its importance is also shown by the results of other published projects (Hegetschweiler et al., 2020; Wang et al., 2017). This could be linked to the shrub layer's visual appeal that gives a forest a natural, and untouched look, which is seen as attractive and beautiful (Bauer et al., 2009; Carvalho-Ribeiro and Lovett, 2011; Frick et al., 2018; Kleinhückelkotten et al., 2009). This assumption could support the finding of how the different stages of coppice-with-standards are viewed. The longer the coppicing lies in the past, the more time the shrub layer had to develop and the traces of forest management (e.g., harvester tracks) to disappear, the better the management form is appreciated by the visitors. The continuous cover forest with its dense shrub layer reached the highest perceived visual forest attractiveness scores, possibly because the least traces of active forest management can be detected.

The positive influence of *Light and broad view into the forest* is not as significant compared to the other derived variables. Still, it should not be neglected, because of its close link to the parameters *Shady and protected from the sun* and *Bushes and young trees*, but leaves room for interpretations. This forest parameter dominates at two study plots, the even-aged high forest and the coppice-with-standards 2020/21. While former's appearance is appreciated, latter reached the lowest scores regarding perceived visual attractiveness. On the one hand, the need for security could impact this variable. A feeling that appears when aspects such as a familiar environment or a wide view into the forest are guaranteed (Hegetschweiler et al., 2022a). The vegetation density can strongly influence the feeling of safety, as it decreases with increasing density (Jansson et al., 2013; Wang et al., 2017). On the other hand, a contradiction to this assumption is the preference for a shrub layer's presence, which generally results in a restricted view. Edwards et al. (2012) study pointed out the possibility to better describe this seemingly contradicting correlation with a bell-shaped distribution rather than a linear relationship. This would mean that neither of the two extremes (i.e., high vegetation density and broad view into the forest) gain the highest scores for perceived visual forest attractiveness.

4.6. Limitations

Visitors of the Waldlabor perform different outdoor activities. However, based on the research design predominately people on a walk participated in the survey and therefore, other user groups are underrepresented in the sample. This fact limited the possibilities to further investigate the activities' influence on the perceived visual forest attractiveness. Moreover, the response rate was influenced by the people's limited time capacities during their stay in the forest. Therefore, particularly people crossing the forest on their daily routes did not participate. Furthermore, a methodological challenge was faced, since participants were asked to evaluate two study plots with one questionnaire. It is not transparent to what extent the respondents were influenced by the first study plot's answers, when evaluating the second one. To reduce this limiting factor, the order in which the plots were evaluated was changed for each respondent. Additionally, the survey was conducted on numerous days and different day times in June 2022. This month prominently featured warm temperatures and sunny conditions. However, it is still possible that the weather conditions influenced the results. Next, it needs to be remembered that solely the even-aged high forest featured a coniferous forest, while all other study plots represented broadleaf forest. How this aspect influenced the study is not accountable. Finally, a distortion could have arisen due to the different samples collected at each survey location. However, no notable differences in socio-demography were detected.

5. Conclusion

The forest visitors' divided and critical views on the management form coppice-with-standards and notably its early stages highlights the importance of addressing this issue. Particularly, in case the management form's potential in the context of energy supply increases and turns into a realistic, implementable option, it should be considered whether this implementation needs to be performed in recreational forests or if other forest areas would also suit this purpose. Other forest areas would guarantee less disturbance of the local biodiversity due to the lack of regular forest visitors and the resulting noise (e.g., leaving the designated paths, picking flowers, letting dogs off the leash). Moreover, problems concerning the reduced cooling capacity associated with the lack of shade would not arise. Otherwise, reactions from the forest visitors need to be expected. Targeted information and communication e.g., through articles in local newsletter and up-to-date information boards could help to increase acceptance for this management form, even with the missing appreciation of its visual appearance. Eventually the fact that the cut wood is used for energy production could already lead to a higher acceptance, in contrast to its importance for biodiversity and its cultural value. As latter have no direct benefit for the visitors, former might have a personal impact on them, particularly during an energy crisis.

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.

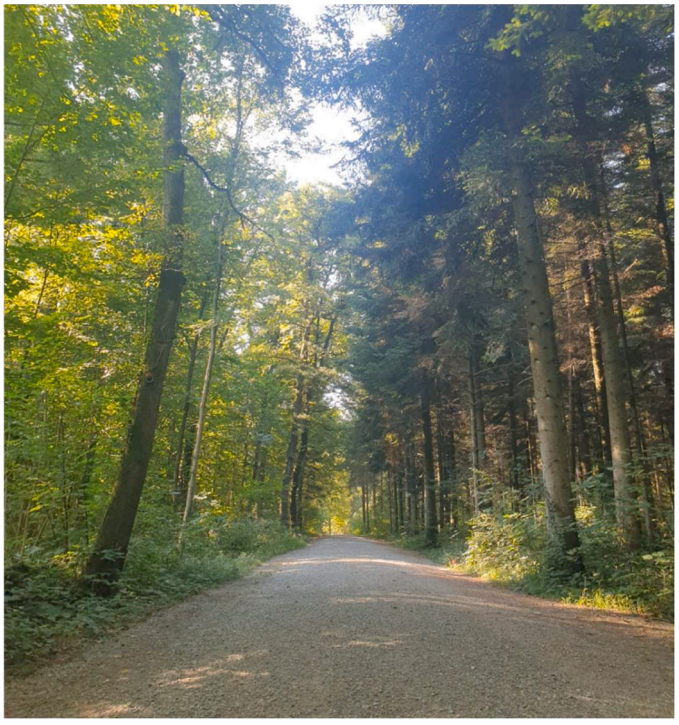
Data availability

Data will be made available on request.

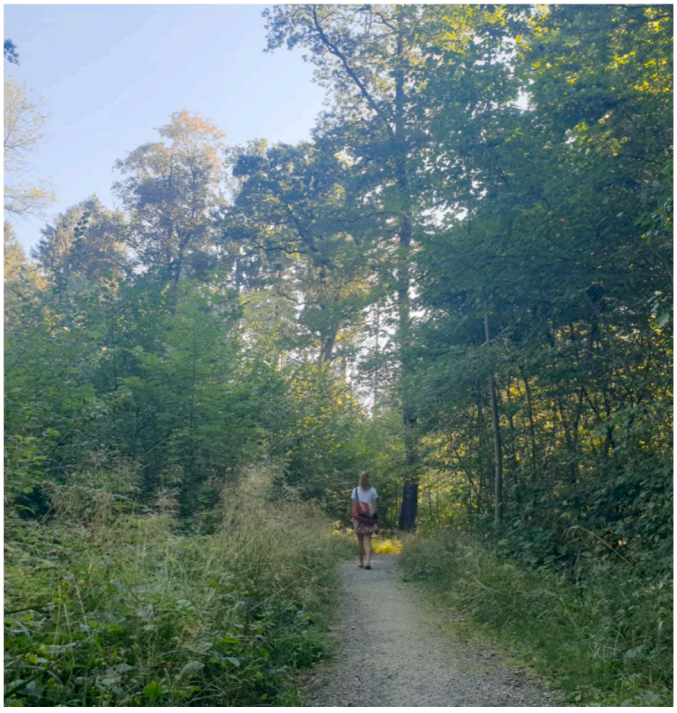
Acknowledgements

We acknowledge the support of Martin Brüllhardt, the managing director of the Waldlabor Zurich for the knowledge he shared about the forest management in the Waldlabor. Furthermore, we thank Marcel Hunziker, Nicole Bauer, Carmen Allemann, Zora Arbenz and Elisabeth Maidl for their support during the different stages of this project and Meinrad Abegg, Laura Haberfellner and two anonymous reviewers for comments on the manuscript. This project was conducted within the Swiss National Forest Inventory and supported by the Swiss Federal Institute for Forest, Snow and Landscape Research (WSL) and the Waldlabor Zurich.

Appendix A: Photographs of the individual survey locations and different management forms



Survey location 1: continuous forest management (left of gravel road), even-aged forest management (right of gravel road).



Survey location 2: coppice-with-standards management cut in 2014/15 (left of path), coppice-with-standards management cut in 2008 (right of path).

Survey location 3: coppice-with-standards management cut in 2020/21 (left of gravel road), abandoned coppice-with-standards management (right of gravel road).

Appendix B: Questionnaire of the quantitative survey (English translation)

Perceived visual forest attractiveness of management forms in the Waldlabor

This project performed by the Swiss Federal Institute for Forest, Snow and Landscape Research WSL and the Waldlabor Zürich investigates how forest visitors perceive the forest management forms represented in the recreational forest on Hönggerberg, Zurich.

Thank you very much for supporting this project!

First, some questions about your visit to this forest will be asked.

1. How often to you visit the forest on Hönggerberg?	Today is my first visit	Less than once a month	1-3 times per month	1-3 times per week	daily
	O	O	O	O	O

2. How long does it normally take you (e.g., from at home or your work) to reach the forest on Hönggerberg?	Less than 10 minutes	10-20 minutes	21-30 minutes	More than 30 minutes	
	O	O	O	O	

3. How long do you normally spend time in the forest of Hönggerberg?	Less than 30 minutes	30-60 minutes	61-90 minutes	91-120 minutes	More than 120 min.
	O	O	O	O	O

4. Why do you visit the forest on Hönggerberg? *For each of the following statements, please indicate to what extent it applies to you.*	Strongly disagree (1)	(2)	Neither nor (3)	(4)	Strongly agree (5)
Visiting the most close-by forest.	O	O	O	O	O
Using the good access to public transport.	O	O	O	O	O
Using the forest for daily routes. E.g., going to walk or univeristy	O	O	O	O	O
Going for daily walks with a dog.	O	O	O	O	O
Accompanying children at play time.	O	O	O	O	O
Experiencing the forest and nature.	O	O	O	O	O
Enjoying the fresh air.	O	O	O	O	O
Enjoying the calmness.	O	O	O	O	O
Going for random walks.	O	O	O	O	O
Doing sports activities.	O	O	O	O	O

5. What activities to you perdominately perform when you are visiting the forest on Hönggerberg?

Multiple responses are possible.

O	Going for a walk with a dog	O	Accompanying children at play time
O	Going for a walk without a dog	O	Being outside with a youth group
O	Nordic Walking	O	Reading
O	Jogging	O	Watching nature
O	Biking	O	Makig a bonfire/BBQ
O	Horseback riding	O	Other: _____

6. In which company do you most frequently visit the forest on Hönggerberg?

O	Alone	O	With other adults
O	With children	O	With a dog

7. Do you listen to music during your stay in the forest of Hönggerberg?	yes	no
	O	O

8. Which sounds do you hear right now?

Multiple responses are possible.

O	Twittering of birds	O	An airplane
O	Rustling of animals in the bushes	O	Construction work
O	Barking of dogs	O	Shooting from the shooting range
O	Passing by bikes	O	Voices of other visitors
O	Playing children	O	Forest work
O	Wind	O	Other: _____

9. What changes have you noticed in the forest on Hönggerberg due to forest work?

Multiple responses are possible.

O	Plantings and restorations	O	Cleanup after storm
O	Clear cuts in the close-by surrounding	O	Other: _____

Please take a close look at the assigned forest area within the markers and answer the following questions.

10.a Which color code was assigned to this forest area?					
O	Orange	O	Purple	O	Green
O	Blue	O	Yellow	O	Red

11.a How much do you visually like the forest in front of you?

Please make this assessment on a scale of 1 to 10.

I do not like it all									I totally like it
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
O	O	O	O	O	O	O	O	O	O

12.a What do you visually like or not like about the forest in front of you? *Please assess each of the following statements on a scale of 1 to 5.*	Strongly disagree (1)	(2)	(3)	(4)	Strongly agree (5)	It does not apply here
Predominately coniferous trees.	O	O	O	O	O	O
Predominantly broadleaf trees.	O	O	O	O	O	O
Tall and high trees.	O	O	O	O	O	O
Many bushes/shrubs and young trees.	O	O	O	O	O	O
Many fallen, dead trees.	O	O	O	O	O	O
Many branches and piles of branches on the ground.	O	O	O	O	O	O
Children can use this forest to play.	O	O	O	O	O	O
Little ground cover.	O	O	O	O	O	O
Dense ground cover.	O	O	O	O	O	O
Shady and protected from the sun.	O	O	O	O	O	O
Light reaches the forest ground.	O	O	O	O	O	O
Light and broad view into the forest.	O	O	O	O	O	O
Many different tree species.	O	O	O	O	O	O
Little difference in tree species.	O	O	O	O	O	O

13.a Would you like to leave the designated paths to walk into this forest in front of you?	yes	no
	O	O

14.a How satisfied are you with the forest management and forest maintenance of the forest in front of you?	Totally unsatified				Totally satified	I do not think this forest is managed.
	(1)	(2)	(3)	(4)	(5)	
Please make this assessment on a scale of 1 to 5.	O	O	O	O	O	O

Please turn around and take a close look at the assigned forest area within the markers and answer the following questions.

10.b Which color code was assigned to this forest area?					
O	Orange	O	Purple	O	Green
O	Blue	O	Yellow	O	Red

11.b How much do you visually like the forest in front of you?

Please make this assessment on a scale of 1 to 10.

I do not like it all									I totally like it
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
O	O	O	O	O	O	O	O	O	O

12.b What do you visually like or not like about the forest in front of you? *Please assess each of the following statements on a scale of 1 to 5.*	Strongly disagree (1)	(2)	(3)	(4)	Strongly agree (5)	It does not apply here
Predominately coniferous trees.	O	O	O	O	O	O
Predominantly broadleaf trees.	O	O	O	O	O	O
Tall and high trees.	O	O	O	O	O	O
Many bushes/shrubs and young trees.	O	O	O	O	O	O
Many fallen, dead trees.	O	O	O	O	O	O
Many branches and piles of branches on the ground.	O	O	O	O	O	O
Children can use this forest to play.	O	O	O	O	O	O
Little ground cover.	O	O	O	O	O	O
Dense ground cover.	O	O	O	O	O	O
Shady and protected from the sun.	O	O	O	O	O	O
Light reaches the forest ground.	O	O	O	O	O	O
Light and broad view into the forest.	O	O	O	O	O	O
Many different tree species.	O	O	O	O	O	O
Little difference in tree species.	O	O	O	O	O	O

13.b Would you like to leave the designated paths to walk into this forest in front of you?	yes	no
	O	O

14.b How satisfied are you with the forest management and forest maintenance of the forest in front of you? *Please make this assessment on a scale of 1 to 5.*	Totally unsatified (1)	(2)	(3)	(4)	Totally satified (5)	I do not think this forest is managed.
	O	O	O	O	O	O

15. Gender	O	female	O	male	O	other

16. Your year of Birth?	__ __ __ __ (year)

17. Your Postcode?	__ __ __ __

18. What is the highest level of school you completed or what kind of vocational training do you have?

O	None	O	Professional college, art school
O	Primary school/secondary school/junior high school	O	University of Applied Sciences, teacher training college
O	Apprenticeship, vocational training	O	University, Federal Institute of Technology
O	A-levels, teachers' trainings, vocational school-leaving certificate		

19. Are you a member of an environmental or nature conservation organization (e.g., WWF, Pro Natura or similar?	yes	no
	O	O

20. Are you an active member of an outdoor sports club that is spending time in the forest (e.g., SAC, mountain biking, trail running clubs or similar)?	yes	no
	O	O

21. Are you or have you been a membe of the scouts or any simular youth group?	yes	no
	O	O

22. Does your job or training habe anything to do with forests?	yes	no
	O	O

23. Do you own any forest?	yes	no
	O	O

24. How important was the forest for you in your childhood?	Completely unimportant				Extremely important
Please make this assessment on a scale of 1 to 5.	(1)	(2)	(3)	(4)	(5)
	O	O	O	O	O

Appendix C: Factor analysis of the motives for a visit of the Waldlabor

Factor analysis (Principal Component Analyses) with rotated (Varimax) factor loadings for the motives for a visit in the Waldlabor.

	Derived factors and factor loading	
Item in questionnaire	Relaxing and recovering	Activities in close-by forest
Experiencing the forest and nature	**0.812**	−0.038
Enjoying the fresh air	**0.891**	0.027
Enjoying the calmness	**0.843**	0.111
Using the forest for daily routes	−0.194	**0.542**
Accompanying children at play time	0.023	**0.429**
Visiting the most close-by forest	0.394	**0.686**
Doing sports activities	0.324	**0.551**
Eigenvalues	2.763	1.374
% variance explained	27.628	13.737
Going for daily walks with a dog	−0.050	−0.048
Using the good access to public transport	−0.112	0.159
Going for a random walk	0.327	0.044

Extraction method: Principal Component Analysis.
Rotation method: Varimax with Kaiser Normalization.
Kaiser-Meyer Olkin Measure (Measure of Sampling Adequacy): 0.676.
Bartlett's Test auf Sphericity: χ^2 (45) = 866.764, $p < 0.001$.

Appendix D: Factor analysis of performed activities in the Waldlabor

Factor analysis (Principal Component Analyses) with rotated (Varimax) factor loadings for the performed activities in the Waldlabor.

	Derived factors and factor loading			
Item in questionnaire	Social activities	Sports activities	Going for a walk	Relaxing and recovering
Making a bonfire/BBQ	**0.778**	0.127	0.083	0.148
Accompanying children at play time	**0.757**	−0.029	0.113	0.037
Being outside with a youth group	**0.437**	−0.017	−0.110	−0.167
Jogging	−0.029	**0.846**	−0.029	0.111
Biking	0.292	**0.606**	−0.102	0.230
Horseback riding	−0.180	**0.522**	0.154	−0.395
Going for a walk	−0.053	−0.152	**0.785**	0.111
Going for a walk with a dog	−0.092	−0.114	**−0.783**	0.049
Reading	−0.203	0.146	−0.127	**0.714**
Watching nature	0.137	0.034	0.247	**0.640**
Eigenvalues	1.743	1.453	1.265	1.107
% variance explained	17.431	14.532	12.647	11.069

Extraction method: Principal Component Analysis.
Rotation method: Varimax with Kaiser Normalization.
Kaiser-Meyer Olkin Measure (Measure of Sampling Adequacy): 0.524.
Bartlett's Test auf Sphericity: χ2 (45) = 307.068, $p < 0.001$.

References

Abello, R.P., Bernaldez, F.G., 1986. Landscape preference and personality. Landsc. Urban Plan. 13, 19–28. https://doi.org/10.1016/0169-2046(86)90004-6.

Ahmad, T.A., Nashwa, A.K. (Eds.), 2021. Design, Analysis, and Applications of Renewable Energy Systems: Chapter 5 - Strategy to Support Renewable Energy Sources in Europe. Elsevier. https://doi.org/10.1016/C2020-0-01946-8.

Altman, I. (Ed.), 1982. Human Behavior and Environment Ser: v.12. Place Attachment, 1st ed. Springer. https://doi.org/10.1007/978-1-4684-8753-4.

Amjith, L.R., Bavanish, B., 2022. A review on biomass and wind as renewable energy for sustainable environment. Chemosphere 293, 133579. https://doi.org/10.1016/j.chemosphere.2022.133579.

Arnberger, A., Budruk, M., Schneider, I.E., Wilhelm Stanis, S.A., 2022. Predicting place attachment among walkers in the urban context: the role of dogs, motivations, satisfaction, past experience and setting development. Urban For. Urban Green. 70, 127531 https://doi.org/10.1016/j.ufug.2022.127531.

Barron, S., Sheppard, S., Kozak, R., Dunster, K., Dave, K., Sun, D., Rayner, J., 2021. What do they like about trees? Adding local voices to urban forest design and planning. Trees, For. People 5, 100116. https://doi.org/10.1016/j.tfp.2021.100116.

Bauer, N., Wallner, A., Hunziker, M., 2009. The change of European landscapes: human-nature relationships, public attitudes towards rewilding, and the implications for landscape management in Switzerland. J. Environ. Manag. 90 (9), 2910–2920. https://doi.org/10.1016/j.jenvman.2008.01.021.

Becker, T., Spanka, J., Schröder, L., Leuschner, C., 2017. Forty years of vegetation change in former coppice-with-standards woodlands as a result of management change and N deposition. Appl. Veg. Sci. 20 (2), 304–313. https://doi.org/10.1111/avsc.12282.

Bell, S., Simpson, M., Tyrväinen, L., Sievänen, T., Pröbstl, U. (Eds.), 2009. European Forest Recreation and Tourism: A Handbook. Taylor & Francis. https://doi.org/10.4324/9780203872079.

Bernasconi, A., Rudow, A., Keller, F., 2019. Das waldlabor heute und in 100 jahren. Züricher Wald (1), 26–30.

Buckley, P., 2020. Coppice restoration and conservation: a European perspective. J. For. Res. 25 (3), 125–133. https://doi.org/10.1080/13416979.2020.1763554.

Bundesamt für Statistik. (2023b). Bildung. Bildungsstand. https://www.bfs.admin.ch/bfs/de/home/statistiken/wirtschaftliche-soziale-situation-bevoelkerung/gleichstellung-frau-mann/bildung/bildungsstand.html.

BUWAL, 1999. Gesellschaftliche ansprüche an den Schweizer wald – meinungsumfrage. Schriftreihe Umwelt.

Carvalho-Ribeiro, S.M., Lovett, A., 2011. Is an attractive forest also considered well managed? Public preferences for forest cover and stand structure across a rural/urban gradient in northern Portugal. For. Policy Econ. 13 (1), 46–54. https://doi.org/10.1016/j.forpol.2010.09.003.

Chen, Y., Sun, B., Liao, S., Chen, L., Luo, S., 2014. Landscape perception based on personal attributes in determining the scenic beauty of in-stand natural secondary forests. Ann. For. Res. 59 (1), 1. https://doi.org/10.15287/afr.2015.440.

Churkina, G., Organschi, A., Reyer, C.P.O., Ruff, A., Vinke, K., Liu, Z., Reck, B.K., Graedel, T.E., Schellnhuber, H.J., 2020. Buildings as a global carbon sink. Nat. Sustain. 3 (4), 269–276. https://doi.org/10.1038/s41893-019-0462-4.

Daryanto, A., Song, Z., 2021. A meta-analysis of the relationship between place attachment and pro-environmental behaviour. J. Bus. Res. 123, 208–219. https://doi.org/10.1016/j.jbusres.2020.09.045.

Edwards, D., Jay, M., Jensen, F.S., Lucas, B., Marzano, M., Montagné, C., Peace, A., Weiss, G., 2012. Public preferences for structural attributes of forests: towards a pan-European perspective. For. Policy. Econ. 19, 12–19. https://doi.org/10.1016/j.forpol.2011.07.006.

Eriksson, L., Nordlund, A., Olsson, O., Westin, K., 2012. Beliefs about urban fringe forests among urban residents in Sweden. Urban For. Urban Green. 11 (3), 321–328. https://doi.org/10.1016/j.ufug.2012.02.004.

European Commission. (2023). A European green deal: striving to be the first climate-neutral continent. https://commission.europa.eu/strategy-and-policy/priorities-2019-2024/european-green-deal_en.

Filyushkina, A., Agimass, F., Lundhede, T., Strange, N., Jacobsen, J.B., 2017. Preferences for variation in forest characteristics: does diversity between stands matter? Ecol. Econ. 140, 22–29. https://doi.org/10.1016/j.ecolecon.2017.04.010.
Frick, J., Bauer, N., Lindern, E.von, Hunziker, M., 2018. What forest is in the light of people's perceptions and values: socio-cultural forest monitoring in Switzerland. Geogr. Helv. 73 (4), 335–345. https://doi.org/10.5194/gh-73-335-2018.
Fuller, R.J., Rothery, P., 2013. Temporal consistency in fine-scale habitat relationships of woodland birds during a period of habitat deterioration. For. Ecol. Manag. 289, 164–174. https://doi.org/10.1016/j.foreco.2012.09.035.
GrünStadtZürich (2006). Mittelwaldversuch hönggerberg: stand frühling 2006.
Gundersen, V., Frivold, L.H., 2011. Naturally dead and downed wood in Norwegian boreal forests: public preferences and the effect of information. Scand. J. For. Res. 26 (2), 110–119. https://doi.org/10.1080/02827581.2010.536567.
Gundersen, V., Stange, E.E., Kaltenborn, B.P., Vistad, O.I., 2017. Public visual preferences for dead wood in natural boreal forests: the effects of added information. Landsc. Urban Plan. 158, 12–24. https://doi.org/10.1016/j.landurbplan.2016.09.020.
Hansen, K., Breyer, C., Lund, H., 2019. Status and perspectives on 100% renewable energy systems. Energy 175, 471–480. https://doi.org/10.1016/j.energy.2019.03.092.
Hauru, K., Koskinen, S., Kotze, D.J., Lehvävirta, S., 2014. The effects of decaying logs on the aesthetic experience and acceptability of urban forests – implications for forest management. Landsc. Urban Plan. 123, 114–123. https://doi.org/10.1016/j.landurbplan.2013.12.014.
Hegetschweiler, T., Fischer, C., Moretti, M., Hunziker, M., 2020. Integrating data from National forest inventories into socio-cultural forest monitoring – a new approach. Scand. J. For. Res. 35 (5–6), 274–285. https://doi.org/10.1080/02827581.2020.1799066.
Hegetschweiler, T., Plum, C., Fischer, C., Brändli, U.-.B., Ginzler, C., Hunziker, M, 2017. Towards a comprehensive social and natural scientific forest-recreation monitoring instrument—a prototypical approach. Landsc. Urban Plan. 167, 84–97. https://doi.org/10.1016/j.landurbplan.2017.06.002.
Hegetschweiler, T., Salak, B., Wunderlich, A.C., Bauer, N., Hunziker, M., 2022a. Das Verhältnis der Schweizer Bevölkerung Zum Wald. Waldmonitoring soziokulturell WaMos3. Ergebnisse der Nationalen Umfrage, 120. Swiss Federal Institute for Forest, Snow and Landscape Research, WSL. https://doi.org/10.55419/wsl:30512.
Hegetschweiler, T., Stride, C.B., Fischer, C., Ginzler, C., Hunziker, M., 2022b. Integrating recreation into National forest inventories – results from a forest visitor survey in winter and summer. J. Outdoor Recreat. Tour. 39, 100489 https://doi.org/10.1016/j.jort.2022.100489.
Helfferich, C. (Ed.), 2014. Handbuch Methoden der Empirischen Sozialforschung: Leitfaden- und Experteninterviews. Springer Fachmedien. https://doi.org/10.1007/978-3-531-18939-0_39.
Hertig, H.-.P, 1979. Die einstellung der bevölkerung zu problemen des waldes und der waldwirtschaft. Schweiz. Z. Forstwesen (130), 591–620.
Hesslerová, P., Pokorný, J., Brom, J., Rejšková – Procházková, A., 2013. Daily dynamics of radiation surface temperature of different land cover types in a temperate cultural landscape: consequences for the local climate. Ecol. Eng. 54, 145–154. https://doi.org/10.1016/j.ecoleng.2013.01.036.
Hunziker, M., Lindern, E.von, Bauer, N., & Frick, J. (2012). Das verhältnis der Schweizer bevölkerung zum wald. Waldmonitoring soziokulturell WaMos 2.
IBM. (2022). IBM SPSS statistics [Computer software]. https://www.ibm.com/analytics/spss-statistics-software.
Imesch, N., Stadler, B., Bolliger, M., & Schneider, O. (2015). Biodiversität im wald: ziele und massnahmen. vollzugshilfe zur erhaltung und förderung der biologischen vielfalt im Schweizer wald.
Jansson, M., Fors, H., Lindgren, T., Wiström, B., 2013. Perceived personal safety in relation to urban woodland vegetation – A review. Urban For. Urban Green 12 (2), 127–133. https://doi.org/10.1016/j.ufug.2013.01.005.
Johann, E., 2021. Coppice forests in Austria: the re-introduction of traditional management systems in coppice forests in response to the decline of species and landscape and under the aspect of climate change. For. Ecol. Manag. 490, 119129 https://doi.org/10.1016/j.foreco.2021.119129.
Kamp, J., 2022. Coppice loss and persistence in Germany. Trees, For. People 8, 100227. https://doi.org/10.1016/j.tfp.2022.100227.
Kılıç Depren, S., Kartal, M.T., Çoban Çelikdemir, N., Depren, Ö., 2022. Energy consumption and environmental degradation nexus: a systematic review and meta-analysis of fossil fuel and renewable energy consumption. Ecol. Inform. 70, 101747 https://doi.org/10.1016/j.ecoinf.2022.101747.
Kirby, K.J., Buckley, G.P., Mills, J., 2017. Biodiversity implications of coppice decline, transformations to high forest and coppice restoration in British woodland. Folia Geobot. 52 (1), 5–13. https://doi.org/10.1007/s12224-016-9252-1.
Kleinhückelkotten, S., Neitzke, H.P., Wippermann, C, 2009. Einstellungen der Deutschen zu Wald und Forstwirtschaft. Forst Und Holz 64 (4), 12–19.
Kopecký, M., Hédl, R., Szabó, P., 2013. Non-random extinctions dominate plant community changes in abandoned coppices. J. Appl. Ecol. 50 (1), 79–87. https://doi.org/10.1111/1365-2664.12010.
Kusenbach, M., 2003. Street phenomenology: the go-along as enthographic research-tool. Ethnography 4 (3), 455–485.
Lafortezza, R., Carrus, G., Sanesi, G., Davies, C., 2009. Benefits and well-being perceived by people visiting green spaces in periods of heat stress. Urban For. Urban Green. 8 (2), 97–108. https://doi.org/10.1016/j.ufug.2009.02.003.
Lefebvre, D., Williams, A.G., Kirk, G.J.D., Paul, Burgess, J., Meersmans, J., Silman, M.R., Román-Dañobeytia, F., Farfan, J., Smith, P, 2021. Assessing the carbon capture potential of a reforestation project. Sci. Rep. 11 (1), 19907. https://doi.org/10.1038/s41598-021-99395-6.
Ljupco, N., Pande, T., Georgi, H., Stjepan, D., Milivoj, V., 2009. Contribution towards energetic potential and possibilities for forestry biomass energy utilization from coppice forests in some countries of south-eastern Europe. Silva Balc. 10 (1).
Luyssaert, S., Schulze, E.-.D., Börner, A., Knohl, A., Hessenmöller, D., Law, B.E., Ciais, P., Grace, J, 2008. Old-growth forests as global carbon sinks. Nature 455 (7210), 213–215. https://doi.org/10.1038/nature07276.
Marland, G., Pielke, R.A., Apps, M., Avissar, R., Betts, R.A., Davis, K.J., Frumhoff, P.C., Jackson, S.T., Joyce, L.A., Kauppi, P., Katzenberger, J., MacDicken, K.G., Neilson, R. P., Niles, J.O., Niyogi, D.d.S., Norby, R.J., Pena, N., Sampson, N., Xue, Y., 2003. The climatic impacts of land surface change and carbon management, and the implications for climate-change mitigation policy. Clim. Policy 3 (2), 149–157. https://doi.org/10.3763/cpol.2003.0318.
Mejstřík, M., Šrámek, M., Matula, R., 2022. The effects of stand density, standards and species composition on biomass production in traditional coppices. For. Ecol. Manag. 504, 119860 https://doi.org/10.1016/j.foreco.2021.119860.
Meo, I.de, Paletto, A., Cantiani, M.G, 2014. The attractiveness of forests: preferences and perceptions in a mountain community in Italy. Ann. For. Res. 58 (1), 1. https://doi.org/10.15287/afr.2015.308.
Müllerová, J., Hédl, R., Szabó, P., 2015. Coppice abandonment and its implications for species diversity in forest vegetation. For. Ecol. Manag. 343, 88–100. https://doi.org/10.1016/j.foreco.2015.02.003.
Nagovnak, P., Kienberger, T., Baumann, M., Binderbauer, P., Vouk, T., 2022. Improving the methodology of national energy balances to adapt to the energy transition. Energy Strategy Rev. 44, 100994 https://doi.org/10.1016/j.esr.2022.100994.
Nielsen, A.B., Heyman, E., Richnau, G., 2012. Liked, disliked and unseen forest attributes: relation to modes of viewing and cognitive constructs. J. Environ. Manag. 113, 456–466. https://doi.org/10.1016/j.jenvman.2012.10.014.
Pröbstl, U., Wirth, V., Elands, B., Bell, S. (Eds.), 2010. Management of Recreation and Nature Based Tourism in European Forests: Good Practice in European Recreation Planning and Management. Springer Verlag. https://doi.org/10.1007/978-3-642-03145-8.
Purcell, A.T., 1992. Abstract and specific physical attributes and the experience of landscape. J. Environ. Manag. 34 (3), 159–177. https://doi.org/10.1016/S0301-4797(05)80149-5.
Rathmann, J., Sacher, P., Volkmann, N., Mayer, M., 2020. Using the visitor-employed photography method to analyse deadwood perceptions of forest visitors: a case study from Bavarian Forest National Park, Germany. Eur. J. For. Res. 139 (3), 431–442. https://doi.org/10.1007/s10342-020-01260-0.
Rogge, E., Nevens, F., Gullink, H., 2007. Perception of rural landscapes in Flandres: looking beyond aesthetics. Landsc. Urban Plan. 82 (4), 159–173.
Sawtooth. (1998). Sawtooth Software Lighthouse Studio (Version 9.14.0) [Computer software].
Schenk, A., Hunziker, M., Kienast, F., 2007. Factors influencing the acceptance of nature conversation measures – a qualitative study in Switzerland. J. Environ. Manag. 83 (1), 66–79. https://doi.org/10.1016/j.jenvman.2006.01.010.
Slach, T., Volařík, D., Madĕra, P., 2021. Dwindling coppice woods in Central Europe – disappearing natural and cultural heritage. For. Ecol. Manag. 501, 119687 https://doi.org/10.1016/j.foreco.2021.119687.
Soopramanien, D., Daryanto, A., Song, Z., 2023. Urban residents' environmental citizenship behaviour: the roles of place attachment, social norms and perceived environmental responsibility. Cities 132, 104097. https://doi.org/10.1016/j.cities.2022.104097.
Stadt Zürich - Präsidialdepartment, 2022. Statistik: Bevölkerung: Alter, Geschlecht. Stadt Zürich. https://www.stadt-zuerich.ch/prd/de/index/statistik/themen/bevoelkerung/alter-geschlecht/alter.html.
Strange, N., Jacobsen, J.B., Thorsen, B.J., 2019. Afforestation as a real option with joint production of environmental services. For. Policy Econ. 104, 146–156. https://doi.org/10.1016/j.forpol.2019.04.015.
Tyrväinen, L., Silvennoinen, H., Kolehmainen, O., 2003. Ecological and aesthetic values in urban forest management. Urban For. Urban Green. 1 (3), 135–149. https://doi.org/10.1078/1618-8667-00014.
UNFCCC. (2015). Adoption of the Paris Agreement (No. FCCC/CP/2015/L.9/Rev.1:), Conference of the parties. https://unfccc.int/process-and-meetings/the-paris-agreement/the-paris-agreement.
United Nations, 2023. Goal 7: Ensure Access to Affordable, Reliable, Sustainable and Modern Energy for All. United Nations. https://sdgs.un.org/goals/goal7.
Unrau, A., Becker, G., Spinelli, R., Lazdina, D., Magagnotti, N., & Nicolescu, V.N. (Eds.). (2018). Coppice forests in Europe: the future of traditional coppice forests in Europe: lessons learned and actions to be taken.
Valade, A., Bellassen, V., Magand, C., Luyssaert, S., 2017. Sustaining the sequestration efficiency of the European forest sector. For. Ecol. Manag. 405, 44–55. https://doi.org/10.1016/j.foreco.2017.09.009.
Vass, M.M., Elofsson, K., 2016. Is forest carbon sequestration at the expense of bioenergy and forest products cost-efficient in EU climate policy to 2050? J. For. Econ. 24, 82–105. https://doi.org/10.1016/j.jfe.2016.04.002.
Verheyen, K., Baeten, L., Frenne, P.de, Bernhardt-Römermann, M., Brunet, J., Cornelis, J., Decocq, G., Dierschke, H., Eriksson, O., Hédl, R., Heinken, T., Hermy, M., Hommel, P., Kirby, K., Naaf, T., Peterken, G., Petřík, P., Pfadenhauer, J., van Calster, H., Verstraeten, G., 2012. Driving factors behind the eutrophication signal in understorey plant communities of deciduous temperate forests. J. Ecol. 100 (2), 352–365. https://doi.org/10.1111/j.1365-2745.2011.01928.x.
Verstraeten, G., Baeten, L., van den Broeck, T., Frenne, P.de, Demey, A., Tack, W., Muys, B., Verheyen, K, 2013. Temporal changes in forest plant communities at different site types. Appl. Veg. Sci. 16 (2), 237–247. https://doi.org/10.1111/j.1654-109X.2012.01226.x.

Wang, R., Zhao, J., Meitner, M.J., 2017. Urban woodland understory characteristics in relation to aesthetic and recreational preference. Urban For. Urban Green. 24, 55–61. https://doi.org/10.1016/j.ufug.2017.03.019.

Weiss, M., Kozel, P., Zapletal, M., Hauck, D., Prochazka, J., Benes, J., Cizek, L., Sebek, P., 2021. The effect of coppicing on insect biodiversity. Small-scale mosaics of successional stages drive community turnover. For. Ecol. Manag. 483, 118774 https://doi.org/10.1016/j.foreco.2020.118774.

Wild-Eck, S., Schenk Zumbrunn, A., & Hunziker, M. (2004). Naturereignisse im spiegel der gesellschaft. https://www.dora.lib4ri.ch/wsl/islandora/object/wsl%3A10331.