Restorative urban forests: a study of nature affordances along forest bathing trails in Northeast Italy

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Abstract

In the framework of newly-emergent forest-based initiatives for health and well-being, *forest bathing* and the benefits deriving from this practice are widely explored in the fields of medicine, psychology, and forestry. However, besides the significant body of research about the impacts of forest immersions on human health and well-being, few studies investigate the physical characteristics of forests that support this activity. In Europe, there is still a lack of knowledge about the place dependency of forest care initiatives on specific forest settings. This thesis studies the use and the perception of two forest bathing locations in Northeast Italy from the perspective of forest bathers. Through the lenses of *affordance* and *restoration* theories, the scope is to clarify what types of human-environment interactions characterize the salutogenic experience of guided forest immersion, in relation to specific forest ecosystem characteristics. Twenty-six adults took part in two forest bathing sessions in an urban and peri-urban forest in Veneto, Italy. Participant observations were carried out and questionnaires were administered to participants during the experience. Results provide insights into the way different forest affordances were perceived. They also show that the assessment of specific forest ecosystem attributes along forest bathing trails could be relevant to design the activities and the setting where these take place.

Keywords: restoration, affordances, forest bathing, wellbeing, Italy

“Smelling scents is like seeing the light with your nose.”

Anonymous

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Abbreviations

ART	Attention Restoration Theory
CBD	Convention on Biological Diversity
CES	Cultural Ecosystem Services
EEA	European Environmental Agency
FAO	Food and Agriculture Organization of the United Nations
MA	Millennium Ecosystem Assessment
POMS	Profile of Mood States
PRS	Perceived Restorativeness Scale
PSD	Perceived Sensory Dimension
SLU	Swedish University of Agricultural Sciences
SRT	Stress Reduction Theory
SUPF	Sustainable Urban and Peri-urban Forestry
UNECE	United Nations Economic Commission for Europe
WHO	World Health Organization

1. Introduction

In recent decades, undergoing global socio-environmental challenges such as urbanization, biodiversity loss and climate change have altered the way people use and perceive forest ecosystems. Forests in Europe cover more than 40% of the land area (Wolfslehner et al., 2020) and have always provided communities with several direct and indirect benefits, including timber supply, food provision, biodiversity conservation, air and water purification and accessibility to places for recreation. The impacts of forests on human health and wellbeing are extensive and diverse and include physical, mental, and social benefits (Mauser, 2021). Under current socio-environmental threats, the attention on forest cultural ecosystem services (CES), namely the non-material benefits people obtain from nature, such as possibilities for recreation, aesthetic enjoyment, physical and mental health benefits, and spiritual experiences, is constantly growing (Andersson et al., 2014). Interest in urban and peri-urban forests for health promotion has also increased during and after the lockdown due to the Covid-19 pandemic when most city dwellers worldwide directly faced the effects of deprivation of contact with nature (da Schio *et al*., 2020)

We witness a shift in communities' mindsets as well as in the academic discourse; the last one focuses on planning and managing forest ecosystems for different values and land uses to support both people and planet health (Stoltz *et al*., 2016; Stoltz & Schaffer, 2018), while new bottom-up forest-based initiatives aimed at health and wellbeing promotion, illness prevention or treatment are emerging on the European scene (Fraccaroli *et al.*, 2021). The umbrella term *Forest Care Initiatives (FCIs)* has been developed to indicate all those organized activities that focus on improving individuals' or communities' physical, mental, and social health and wellbeing through direct contact with the forest's elements and atmosphere (Doimo et al., 2021).

One of these initiatives is called *shinrin-yoku* or *forest bathing*. This term has been introduced in Japan by the national Forestry Agency in 1982 and the practice of forest immersion, or "bathing" in the forest atmosphere, developed as a public health initiative and grew as a worldwide wellness trend to mitigate stress-related symptoms and promote an alternative use of forests for wellbeing purposes (Kagami, 1998). In the same timeframe, environmental psychologists introduced

the term *restoration* to refer to one of the pathways through which exposure to nature can lead to an improved psychological state. This notion originated in the United States at the end of the 20th century, with the emergence of new research about how exposure to tree-dominated environments seemed to benefit people recovering from stress and physical illness and improved people's focus and ability to concentrate (Ulrich *et al*., 1991; Kaplan & Kaplan, 1989). Since then, several psycho-physiological and social health benefits have been attributed to different types of exposures and experiences in forest environments across different ages and social groups (Seeland *et al*., 2009; Roe & Aspinall, 2011; Park *et al*., 2011: Annerstedt *et al*., 2013; Sonntag-Öström *et al*., 2015).

However, while there is growing evidence connecting exposure to forest ecosystems with human psychological health, the factors influencing this pathway are diverse and not always well-understood. On the one hand, research focuses on developing holistic methods to study the complex relations which link forests with psychological restoration (Grahn & Stigsdotter, 2010; Stigsdotter, 2017), including socio-cultural and physical environmental aspects. On the other hand, academicians investigate the characteristics of emerging forest-based initiatives for mental health and wellbeing from an economic perspective (Fraccaroli *et al.*, 2021).

In this thesis, it is proposed to connect the above-mentioned research areas through the application of environmental psychology theories in a forest bathing context. *The theory of affordances* (Gibson, 1979) proposes a possible approach to studying people-forest transactions in the psychological domain. This notion, which was firstly introduced by Gibson (1979) and then revisited in an ecological perspective by other academicians (Heft, 2013; Andersson & McPherason, 2018), defines an ecological property of the human-environment interaction and indicates a possibility for action in the relation between users and spatial objects. Applying this concept to the study of nature for mental restoration means that forest ecosystems can be looked at as a collection of spatial elements and processes, which offer visitors a diversity of possibilities for interaction with the environment, therefore shaping the visitor's physical experience and the potential benefits obtained from it. In this view, trees could be described for their property of being "climbable" and rocks for their property of affording "sitting on" in a forest bathing setting. Such a comprehensive approach to the study of restorative forests allows not only to focus on the salutogenic properties of the physical environment but also on the possibilities, needs, and wishes of its users, depending on the socio-cultural context or individual preference and abilities. In this perspective, understanding what types of cognitive and bodily interactions shape people's lived experience during forest immersions could help to plan and design suitable forest spaces for different land uses, activities and target users given the current growing interest in forests cultural ecosystem services and forest care initiatives.

1.1 Problem statement and research aim

Within the variety of newly-emergent forest care initiatives, the *forest bathing* practice and its derived health benefits are widely researched in different fields including medicine, psychology, and forestry. Research proved forest bathing's positive impacts not only on mood states but also on cardiovascular, immune, and neuroendocrine systems (Payne & Delphius, 2019). Nonetheless, besides the evidence about the health benefits deriving from forest bathing, not many studies have focused on researching the physical environmental properties of forests that support this activity. Most studies until now have been carried out in Japanese and Chinese forest environments and remote areas outside the cities, leaving an important knowledge gap about potentially supportive forests in other parts of the world and in urban and peri-urban contexts, where different greenspace typologies exist (Hansen *et al*., 2019). In European countries, such as Italy, there is still a lack of knowledge over forest typologies that host forest care initiatives in general, as well as the place dependency of these activities on specific forest settings or forest ecosystem attributes (Doimo et al., 2021). Further research is needed about the physical characteristics of forest settings that host forest bathing activities and how these spaces are used and perceived by their users. That could provide a starting point to develop evidence-based and sustainable forest bathing practices in European countries as well.

This independent project in *Outdoor environments for health and wellbeing* aims at taking a first step into the study of restorative forest bathing environments and in particular

- to describe how forest settings are used during guided forest bathing sessions,
- to identify and evaluate forest physical attributes which contribute to the perceived restorative potential of two different forest bathing settings,
- to identify and describe forest physical affordances which support the activity and shape the restorative experience of forest immersion.

1.2 Limits of this study

This research project was designed within an Erasmus+ collaboration for a master thesis between the University of Padova, Department of Land, Environment,

Agriculture and Forestry (TESAF), Italy, and the People and Society Department at the Swedish University of Agricultural Sciences, Sweden. Both departments have shown an interest in investigating the relationship between health and well-being benefits derived from people's exposure to natural environments and the characteristics of these environments. Within this framework, a pilot study was agreed to research urban and peri-urban forests as supportive environments for forest bathing activities in the Veneto Region, in the North-East of Italy. The involvement of an environmental psychology master's student in the activities was aimed at obtaining empirical data and drawing connections between those and environmental psychology theories in the context of nature-based health and wellbeing initiatives which do not yet have proper validation in the psychological academic context in Italy. This thesis does not aim at providing scientific validation for forest bathing activities' health impacts, but rather to offer external insights about potential restorative mechanisms which might arise during forest-people interactions along forest bathing trails depending on the characteristics of the forest sites where they take place.

Within this framework, it is essential to strike the limitations of this study in terms of a limited number of assessed forest sites (2) and the statistically-low number of participants who joined the forest bathing sessions (26) as well as the low number of forest bathing sessions carried out (2). The data obtained do not aim at being considered a representative sample for statistical considerations. Forest bathing sessions were organized *ad-hoc* with the support of the thesis co-supervisor, forest managers, and landowners in parks that are not always open to the public but observe strict opening hours. Nonetheless, taking into consideration all limitations of the study, derived from the need to complete the project in due time, it is hoped that this research will contribute with original data to the newly emergent field of forest-based initiatives for health and wellbeing.

2. Background

The following chapter builds a connection between the concepts of *forest bathing*, *psychological restoration*, and *forest biodiversity* from an environmental psychology perspective. Paragraph 2.1 briefly summarizes the development stages of forest bathing as a salutogenic practice between Japan and Europe, provides reference and insights on the possible correlation between mental restoration mechanisms and forest bathing activities, and defines the concepts of *forest bathing* and *forest therapy*. Paragraph 2.2 draws from forest bathing and restoration theories to discuss the potential of forest-based health interventions in urban/peri-urban environments given current urbanization trends and the case studies chosen for this research. Paragraph 2.3 frames the concept of psychological restoration from an ecological perspective, provides a reference on the connections between forest biodiversity and psychological wellbeing and introduces the notion of *affordance* for the study of forest bathing settings.

2.1 Forests as restorative environments

2.1.1 Walking in the woods as a salutogenic activity

The idea that contact with nature can be beneficial to mitigate the impact of negative environmental stressors on the human body dates back centuries and it is common across different cultures. Already in ancient Rome, visiting rural areas was considered a way to cope with urban noise, congestion, and social unrest typical of city life (Bruegmann, 2006). Since the end of the eighteen-century, walking in the woods as a recreational activity to improve one own's health and wellbeing has been practiced by upper and middle-class city dwellers living in overpopulated European cities, who started to pay visits to country woodlands regularly to breath cleaner air and enjoy quietness (Towner, 1996). This cultural tradition was imported from Europe to Japan in the mid-nineteenth century when the country opened its doors to the influence of western culture. In fact, when in 1982 the practice of *forest bathing* was introduced to Japanese citizens by the local environmental authorities, its aim was mainly to promote tourism and nature-based recreation, rather than health and recovery from illness (Kagami,1998). On the

contrary, at that time the idea of improving one's well-being by walking in the woods was quite unfamiliar to Japanese people, as citizens were used to finding mental comfort through meditation activities in other kinds of man-made green spaces (e.g., gardens, open spaces outside the forest), rather than in remote woodlands (Kagami, 1998), which, according to Shinto religion, represent sacred and intimate places instead (Farkic et al. 2021).

Since then, several studies have focused on highlighting the physiological benefits mediated by the exposure to forest environments and specific chemical substances released by trees (e.g., biogenic volatile organic compounds). Today we know that different aspects of the forest ecosystem can contribute to visitor's health, including the diversity of biogenic volatile organic compounds (BVOC), the diversity of soil microbiome present at the site (Nabhan *et al*. 2020; Antonelli *et al*. 2020), but also specific aspects of the human-forest interaction due to the overall stimulation of the five senses during forest exposure (Antonelli *et al*. 2020). Medical and silvicultural research from different parts of the world is bridging together to study how different kinds of exposure to different forest types can generate positive outcomes for people's health and wellbeing. Nonetheless, the European tradition of taking a walk in the woods to find relaxation and peace of mind is all but forgotten and we witness an overlap between forest bathing as a leisure activity (Farkic et al. 2021) and forest therapy as a type of nature-based therapy (Song *et al.* 2016; Meneguzzo & Zabini, 2020). This conceptual overlapping goes parallel with the development of a global conception of health, no longer focused only on the absence of disease but rather on *a state of complete physical, mental, and social well-being* (WHO, 1948).

2.1.2 Restorative environments

While the forest bathing practice was developing in Japan, the concept of *restorative environment* also emerged from American studies carried out by architects and psychologists, who focused on studying nature-human interactions to design and manage natural landscapes within the urban fabric (e.g., in parks, hospitals) and to understand what environmental features could promote health or a state of mental wellbeing. In 1984, architect Roger S. Ulrich published one of the very first studies on the restorative effects of people's exposure to vegetation: hospital patients having a room's view over a small stand of deciduous trees were recovering faster from surgery and needed fewer analgesics than those viewing a brick wall from their window (Ulrich, 1984). Other several research following this came to generate what is known today as the Stress Reduction Theory (SRT; Ulrich *et al*., 1991), which hypothesizes that people who view scenes containing natural elements can recover faster from psycho-physiological stress than people who view

scenes of man-made spaces, suggesting that cognitive engagement with certain natural elements could have a beneficial effect. In the same years, two American psychologists, Rachel and Stephen Kaplan, who were studying the role of nature on people's life experiences and preferences, described how natural environments appear to contain some characteristics which allow for people to recover from direct attention fatigue, presenting the Attention Restoration Theory (ART; Kaplan & Kaplan, 1989). Both SRT and ART theory originate from the application of an evolutionary approach to the study of human-environment interactions, but while SRT focuses on the fact that certain positive landscape characteristics can trigger a stress-reducing response in our brains, ART points out that human *voluntary attention* is normally subject to depletion in urban, stimuli-full, man-made environments, and that exposure to natural elements can instead activate our *involuntary attention (fascination)* and create the opportunity to restore the capacity for voluntary attention and prevent exhaustion. According to ART, the restorative mechanism originates from four main aspects of the human-environment transaction: 1) the environment provides the visitor a sense of *being away*, that is to be psychologically detached from present worries and demands, 2) it allows for *soft fascination* to emerge, that is it provides scenes which hold people's involuntary attention (e.g. the motion of the leaves in the breeze, sunrise or sunset, water patterns), 3) it provides *extent,* which refers to environmental qualities that encourage the visitor to feel immersed and engaged. This property does not necessarily have to do with greenspace size, rather it might affect the visitor on a symbolic level, by affording, for example, historical artifacts which provide a sense of being connected to other times and places, and therefore to a larger world (Kaplan, 1995), 4) *compatibility*, which has to do with the environment being compatible with single visitors' needs, expectations, and abilities.

If a restorative environment supports the renewal of adaptive resources that people have depleted while trying to meet everyday demands (Lindern *et al*. 2016), we could say that practicing *forest bathing* in suitable forest environments could represent a potential highly restorative activity. First, because leisure activities are usually *per se* intended as a time of enjoyment, of free time, when one is not occupied with work or other demanding tasks. Secondly, the practice consists of a deep immersion into a tree-dominated ecosystem to provide the benefits it aims for, which appears to be an element triggering restoration mechanisms. However, while according to ART the restorative mechanism deriving from exposure to natural environments consists of nature sceneries power to trigger involuntary attention, the benefits derived from forest bathing activity seem to be based on a person's ability to connect with nature by engaging with constant awareness on both internal (personal) and external (natural) processes (see paragraph 2.1.3), while making use of meditation-like techniques. In fact, mindful engagement with nature has also

been considered an alternative strategy supporting attention restoration while actively participating in managing one's attention resources (Kaplan, 2001; Lymeus et al., 2018; Macaulay et al., 2022).

2.1.3 Forest bathing and forest therapy

When it comes to discussing the health benefits derived from the forest bathing activity, it is essential to consider both the environmental characteristics of the site where forest bathers are immersed as well as the target group's abilities and needs. Environmental psychologists talk about *person-environment fit*, to describe the dynamic equilibrium which develops between an individual's abilities and the actions the surrounding environment affords while influencing attitudes, behavior, and therefore the quality of their lived experience (Alexander, 1970). Theories on restoration presented in the paragraph 2.1.2 suggest that the restorative quality of an environment is not an objective measure derived from the combination of setting physical attributes, but rather depends both on the environmental stressors to which forest visitors are exposed during a specific activity or situation, as well as their coping capabilities about the environment where they behave.

In this matter, Meneguzzo & Zabini (2020) explain that today the practices of *forest bathing* and *forest therapy*, even though they might be carried out within the same forest environment, should be considered distinct. According to their study, the main difference between the two practices is that while *forest bathing* consists of unstructured activities, which can be carried out by people independently, *forest therapy* is performed only with the guidance of professional practitioners. In European literature, however, it is possible to find further distinctions between the two practices. *Forest bathing* seems to be intended as a practice of the wellness domain, which targets the general public, that can be independently practiced by individuals but that can also be guided by non-clinical practitioners, such as certified forest bathing guides (Farkic et al. 2021). It involves a deep immersion into a forest environment using all senses and aims at developing personal awareness and knowledge about oneself and the surrounding natural world as well as obtaining immediate relaxation and improving mood (Forestry England, 2019). *Forest therapy*, on the other hand, even though it might have roots within the forest bathing concept, refers to the medical domain. It is guided by clinical practitioners and usually targets people with specific physical or psychological needs while aiming at prevention, treatment, or rehabilitation from illness through reiterative sessions characterized by guided exercises in the forest, usually over a longer period (Sonntag-Öström *et al 2015*; Doimo et al. 2020). The concept seems related to the one of *nature therapy*, which has been introduced by Berger & McLeod (2006) as

an alternative way to carry out therapy outdoor with their patients. However, if the distinction between the two disciplines is making itself clearer and clearer in the European context, it must be pointed out that in other parts of the world, such as the United States, *forest therapy* has been promoted mainly as a practice that can be led by non-clinical practitioners to restore people's attachment to place (Association of Nature and Forest Therapy, 2022) and has much in common with guided *forest bathing* activities which have been developing in Europe.

Both guided forest bathing and forest therapy, even if addressing different target groups and organized in different ways, structure their activity on concepts deriving from the *mindfulness* practice, which are then adapted differently according to the users they address.

Mindfulness is defined by Kabat-Zinn (2003) as "a form of awareness that arises from a purposeful, non-judgmental perception of the current moment". Mindfulness has to do with both what a person attends (e.g., internal, external processes, or both), as well as with how processes are attended (e.g., with different degrees of acceptance, judgment, openness). Macaulay et al. (2022, p. 4) (Fig.1) describe how different types of engagement with our surroundings, including some at the base of restorative mechanisms such as *fascination* or *compatibility*, could relate to the pillars of mindfulness practice. *Fascination*, for example, would be an externally-oriented process that tends toward non-reactivity, in a process that is very similar to that of mindful engagement, while *compatibility* appears as both an internally- and externally-oriented process tending towards reactivity and judgment. Kaplan (2001) discusses the relationship between meditation techniques and restoration and confirms how both active and passive forms of mental involvement with oneself and one's surroundings can be effective measures to avoid attention exhaustion.

Based on these concepts and the framework of Mindfulness-based Stress Reduction (MBSR; Kabat-Zinn, 1990), the Institute of Bioeconomy of the Italian National Research Council (CNR) and the Italian Alpine Club (CAI) have built a *national forest therapy protocol* to be used as a reference by forest therapy

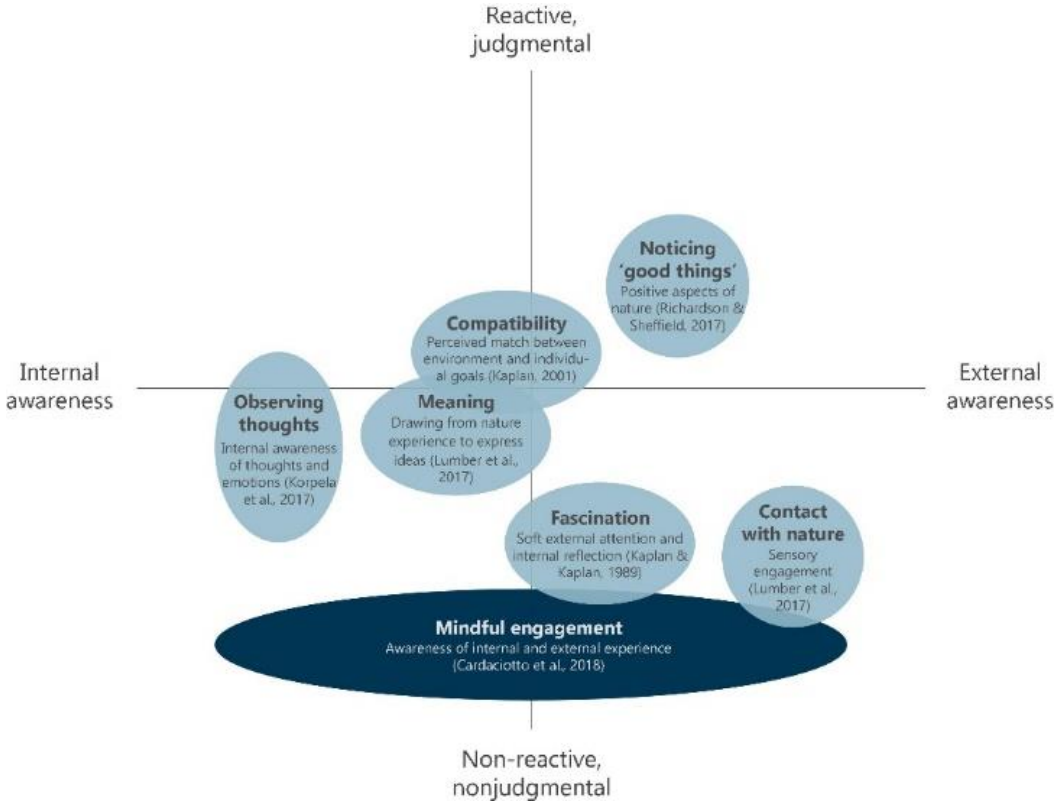

Figure 1 Representation of qualities of mindful engagement with the environment and how other forms of engagement, including fascination and compatibility, relate to these qualities. Retrieved from Macaulay et al. (2022, p.4)

practitioners operating in Italy. Within this document Meneguzzo & Zabini (2020, p. 77) highlight some elements which should characterize a guided forest therapy session and their connection to specific health and wellbeing benefits. These forest therapy "pillars" presented in the study are reported below.

1) *Developing the right attitude before entering the forest*. An important element characterizing a guided forest therapy session is that both guide and forest bathers should be aware of their role as active participants in influencing the overall forest therapy experience and the environment around them. Meneguzzo & Zabini (2020) highlight how it is important to set a tone and aim beforehand starting the session, which is not that of reaching the end of the path or picking up berries along the way, but rather to improve one's wellbeing and develop awareness about oneself in relation to the natural world. This also includes reflection on the impact one might have on the natural environment when entering the forest.

2) *Creating a silent space free from judgments.* Another important element of the activity consists in creating an atmosphere of silence, slowness, and safety which allows participants to listen rather than chat. This also allows to create an environment for acceptance, free from judgments, which offers possibilities for a new enriching experience in the forest and with the rest of the group.

3) *Mindful walking and breathing.* A core aspect that might be an important element in discriminating forest immersions from other forms of meditation is that forest bathers' awareness should not only be focused on their minds but also on the bodily experience. In particular, guides could invite participants to focus their attention on the simple effortless actions one carries out every day, such as breathing and slow walking. This might include, for example, becoming aware of the sounds of one's feet on the ground or the rate of one's breathing.

4) *Use of all senses.* The reawakening of all senses is maybe the most peculiar aspect of forest immersions. Participants should be invited to expand awareness to all of their senses such as smelling, touching, and hearing the surrounding environment. This might include smelling and touching trees, grass, flowers or other natural elements that one's does not normally experience. Meneguzzo & Zabini (2020) point out how using all senses can reawaken old memories and evoke strong emotions and sensations.

5) *Meditation and introspection*. After having explored nature in all its facets, forest bathers might want to go further and take time to develop a deeper spiritual connection with nature. Meneguzzo & Zabini (2020) highlight how the symbolic meaning of natural objects, such as natural archetypes, can be used here by forest therapy guides as a means to develop new perspectives on one's condition. This might include meditation exercises supported by personal identification with natural objects, such as trees.

Even though the protocol presented here represents an important pillar for further research in the fields of forest bathing and forest therapy in Italy, it only consists of very general guidelines, which could be implemented through the application of different exercises delivered by single forest therapy practitioners and/or individually and autonomously. It might include different types of immersion such as simply being still in the forest, engaging in relaxation activities (e.g., visualization techniques) or using external props to induce relaxation (e.g., bibliotherapy, gong baths) (Farkic et al. 2021). Besides, it could be structured differently in other countries than in Italy, depending on the cultural context. For

example, guidelines for forest bathing published by public institutions in other European countries (see Forestry England, 2019) show a very similar mindfulness-based structure to the forest therapy general guidelines adopted in Italy, while generating confusion in communicating the difference between the two practices. A further knowledge gap is represented by the fact that while it is possible to find some scientific material about how forest therapy is delivered as a preventive and complementary medicine practice by clinical practitioners in Europe (Sonntag-Öström *et al.*, 2015), no European study seems to describe how forest bathing practice is carried out when open to the public for wellness purposes and guided by forest bathing or environmental guides (non-clinical practitioners), and what are the differences between forest bathing and forest therapy health effects, a part of target group and scope.

2.2 Can we forest bathe in urban areas?

2.2.1 Forest bathing in constrained environments

In the last decades, the word *forest* has gradually been used in both the public and the academic domain to refer not only to remote woodlands outside the city, but also to different types of vegetated environments scattered in both urban, peri-urban, and remote areas, which are all perceived as an integral part of the urban socio-ecological matrix (Konijnendijk, 2008). Today, cities and metropolitan areas are focusing on improving the green infrastructure present within their boundaries and on promoting actions that allow for a variety of flora and fauna species to develop and coexist in urban settings, while also potentially providing citizens with tranquil, safe, and green spots which were once found at remote sites. The emerging field of Sustainable Urban and Peri-urban Forestry (SUPF) proposes an integrated way of planning and managing forest ecosystems, which includes *all wooded areas, as well as street trees, urban parks, cemeteries, trees in private gardens, and other vegetated sites within and around urban areas, with the aim of ensuring their optimal contributions to the well-being of urban societies* (UNEC & FAO, 2021). In many European cities, we witness processes of re-naturalization of ex-industrial or infrastructural sites which are now transformed into public urban forests while contributing to biodiversity conservation but also providing city dwellers with areas for recreation (some well-known European examples of such processes include Natur-Park Schöneberger Südgelände in Berlin, Prati di Caprara in Bologna, or Corniche des Forts Park in Paris). These urban pattern changes have provided urban dwellers with more spaces to practice nature-based wellness activities and connect to nature close to their homes, as well as witness the health and wellbeing benefits of a more continuous exposure to natural stimuli.

Even though the history of forest bathing practices suggests that visiting remote forests is a precondition to "escape" the busy environment of city life and obtain mental restoration, it is also true that forest bathing as a leisure activity does not necessarily require to be practiced in remote areas, but rather in forest spaces which allow for silence, stillness, and slowness (Komppula & Konu, 2017). However, since not every citizen is allowed such a privilege in current city environments, forest bathing guides are being creative and proposing alternative methods to invite participants to embrace, ignore or replace negative environmental stressors present in the city (e.g., by using headphones, magnifying glasses) (Trost, 2022). In fact, even though possibilities for quietness and slowness remain essential for people's mental and physical health and wellbeing, the mindfulness-based protocol described in the paragraph 2.1.3 suggests that much of the benefits derived from the forest bathing activity depends on an active psychological engagement of participants with the natural elements surrounding them, rather than on the specific characteristics of the setting where the practice takes place. Macaulay et al. (2022) describe how mindful engagement can be used to mitigate negative stressors which constrain human experience of nature, for example in urban settings, where there might be reduced possibilities for psychological restoration. Literature confirms that even small but continuous exposure to natural stimuli can benefit our psychological state. For example, Kaplan (1995) explains that for a restorative environment to provide a sense of *being away* it does not necessarily require being distant, but simple *accessibility* to a natural environment in an urban area can offer possibilities for resting one's direct attention. Meneguzzo & Zabini (2020) dedicate an entire chapter of their forest therapy manual to how forest elements can even be introduced to one's own home via technological means (e.g., virtual reality) or other props (e.g., diffuser for aromatherapy) to generate positive health benefits. Some studies show how forest bathing practiced in urban forests can still be highly beneficial for improving mood and concentration (Guan et al. 2017; Lee et al., 2019)

However, both active and passive forms of engagement with nature, leading to an improved mental state, can be supported or disrupted by environmental stressors. Heavy noises, for example, might negatively impact the possibility of engaging with oneself and the forest environment, especially for people who are inexperienced in the practice of mindfulness. Also, in the case of forest therapy, which targets specific groups with physical or mental difficulties, practitioners might require more attention in choosing the right forest setting to perform therapeutic activities and safeguard the physical and mental health of the participants, depending on their abilities and needs. In this matter, Doimo *et al.* (2021, p.16) show how the substitutability of a forest ecosystem for therapeutic

purposes seems to decrease the more specific the health benefits the activity aims to achieve and the target group's needs (Fig.2). Therefore, it is essential to strike that, regardless of the important contribution of mindful engagement to mood-enhancing, the characteristics of the physical environment can play a key role in promoting or disrupting people's wellbeing.

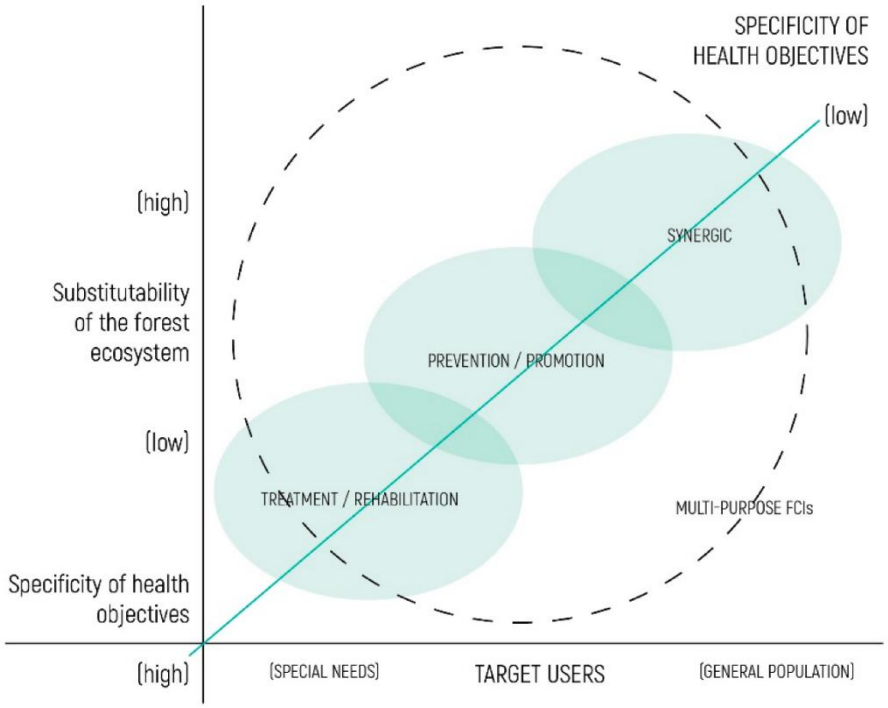

Figure 2 Typologies of forest-based health initiatives classified according to target users, specificity of health objectives, and substitutability of the forest ecosystem. Retrieved from Doimo et al. (2021, p.16)

2.2.2 The potential of nearby nature

Recognizing the value and the health and wellbeing benefits that nature can provide us within our immediate everyday surroundings is essential for the development of sustainable nature-based health practices. 'Nearby nature' can be defined as the set of natural elements and features that people encounter in and around those settings of everyday life in which they spend much of their time, including residential settings, the workplace and schools (Nilsson et al., 2007). Since *forest bathing* activities have originated and developed in the tourism domain, most forest bathing sites that are currently advertised in Europe are located in

remote areas, where it is easier to immerse into a silent environment that allows one to walk at a slow pace and focus on one's sensations. The precondition of a silent, far-away setting has also been reported as significant concerning forest bathers' needs and expectations in European contexts (Komppula & Konu, 2017). Nonetheless, participation in activities at remote sites also requires important efforts in terms of consumed time, resources and energy to reach the destination, and this aspect must be especially taken into consideration when discussing initiatives aimed at promoting health and well-being. UN SDGs Agenda 2030 (SDG 11, target 7) calls for universal access to safe, inclusive, and accessible green and public spaces with special regard to fragile population groups such as children and youths, the elderly, and people with disabilities. These target groups are also those who might benefit the most from activities delivered by nature-care practitioners as well as those who could find it more difficult to organize trips to remote destinations. Therefore, allowing for forest bathing practitioners to operate in urban or peri-urban forest settings, while minimizing anthropic disturbances in these spaces, could contribute to promoting a sustainable use of natural resources in the proximity of urban settlements, while diversifying the user groups of newly emergent forest bathing practices.

Besides being an opportunity for sustainable development of green care practices, the utilization of green areas in the proximity of cities also allows for short but potentially more continuous nature experiences for citizens, which have been proven to produce health benefits with a cumulative effect over the long-term (Konijnendijk, 2008, p.131) and which can go beyond mood and concentration improvements to include also psycho-social benefits such as the development of attachment to places, and the strengthening of community identity (Konijnendijk, 2008, p.122). Proximity and familiarity are also considered important aspects when designing nature-based initiatives for children, as research shows how learning behaviours develop when designed educational contexts are faithful simulations of learners' everyday life environments and built on the identification of learners' constraints about their everyday surroundings (Sharma-Brymer et al., 2018).

A reference to the significance of nature's proximity for forest bathing practices is partially provided by Clifford (2018) who, referencing Japanese culture, reports how the ideal place for forest bathers seems to be the *satoyama*, an area which he defines as "territory that is almost familiar but beyond the boundaries of ordinary experience." At the international policy level, this concept has also been defined and used, as it refers to specific types of landscapes that are known to be mosaics of diverse land uses and ecosystems shaped by human interactions with nature over a long period and which can also play an essential role as buffer zones around natural protected areas (IPSI, 2021).

Planning urban green spaces for mixed uses, including forest-based care activities such as forest bathing, could represent a sustainable way to take a step towards citizens' reconnection to natural ecosystems within their immediate everyday surroundings while providing a diversity of direct and indirect benefits for citizens and planet overall health. As a matter of fact, urban green spaces can usually be accessed by a wide portion of the population, so that implementing nature-based health interventions in cities can impact a significant share of the population's quality of life. This could also protect urban greenspaces from anthropic pressures and provide opportunities for mitigating other environmental stressors such as air pollution and sedentary behaviours, which are considered important pathways linking urbanization to the current diffusion of noncommunicable diseases in European cities (Frumkin & Haines, 2019).

2.3 Restoration and biodiversity affordances

2.3.1 Nature, actual and perceived biodiversity

The academic literature is quite rich in material that discusses the different pathways connecting nature to human health, however, not much of it focuses on the ecological characteristics of nature in relation to human exposure or experience of it (Marselle *et al.* 2021). On the one hand, the lack of knowledge about the place dependency of certain activities on specific ecological contexts is common across the board of nature-based health initiatives, not just those aiming at mental restoration through exposure to forest settings. On the other hand, it is interesting to notice that one of the main challenges for conservation policies today is about communicating what *biodiversity* is and how it differs from *nature (EEA, 2020)*. Similarly, the two concepts often overlap within the environmental psychology discourse, but they indicate different approaches to the study of human-environment interactions. In fact, looking at an environment from a biological perspective requires not only to focus on its spatial extent but also on its ecological attributes, such as biodiversity, while nature, as defined by Hartig et al. (2014, p.208) indicates "the physical features and processes of nonhuman origins so how people ordinarily perceive them" and can therefore acquire highly subjective meanings and values. On the other hand, *biodiversity* is defined as "*the variability among living organisms from all sources including, inter alia, terrestrial, marine and other aquatic ecosystems and the ecological complexes of which they are part; this includes diversity within species, between species and of ecosystems."* (CBD, 2018). Biodiversity can be studied from the point of view of its perceived attributes

but can also be objectively measured via specific bioindicators. In this matter, we can distinguish between *actual biodiversity* and *perceived biodiversity* and the different measurement approaches that could be applied to the study of the two concepts (Fig.3) (Marselle et al. 2021).

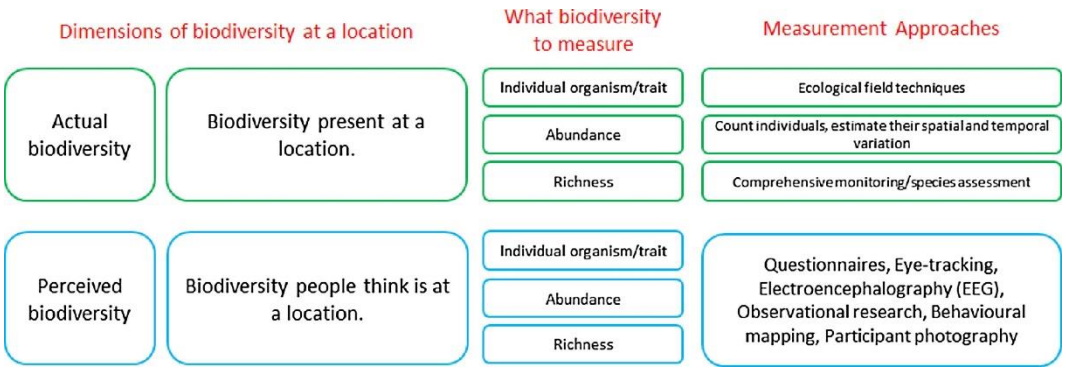

Figure 3 Actual and perceived biodiversity and how they can be measured. Retrieved from Marselle et al. (2021, p.6)

Differentiating between the concepts of *nature*, *actual* and *perceived biodiversity* in environmental psychology research appears relevant to move from a cognitive approach to the study of human-environment interactions, which is still very much used today to explain phenomena such as restorative mechanisms, to a more ecological approach, which takes into consideration how different elements of biodiversity are experienced and used. The fields of environmental psychology and ecology have much in common in terms of approach to the study of human-environment interactions (Andersson & McPherason, 2018), and bridging the gap between the two fields could allow to assess specific nature affordances promoting human well-being while providing important information to professionals who deal with natural resources planning, design, and management.

2.3.2 Vegetation diversity and restoration

Biodiversity is not a concept to which the Stress Reduction Theory nor the Attention Restoration Theory directly refer. Nonetheless, Ulrich (1991) refers to *environmental complexity* as one of the properties which influences arousal and stress response. Some aspects of biodiversity could therefore be included within this category. However, more recent studies are focusing on assessing specific biodiversity elements of greenspaces in both rural and urban contexts and their potential correlation to psychological restoration mechanisms. Wood et al. (2018)

have assessed botanical and faunal diversity in twelve urban parks in the UK and showed that these aspects of park biodiversity could predict perceived restorative benefits for park users. Tomao *et al*. (2018) have researched possible relations between forest stand structure in coastal Italian stone pine forests and perceived psychological restoration of forest visitors, pointing out that attributes such as stand density and shrubs negatively influenced the perception of the benefits obtained. A similar study has been carried out by Stoltz et al. (2016) at different locations across Swedish forests, where forest stand data related to trees age, height and sparsity appeared to be the most important indicators of forest stand restorative quality. Scopelliti *et al.* (2012) have assessed greenspace typologies with different degrees of biodiversity across urban and peri-urban areas in Padova, Italy; here the perceived restorative properties of the sites, as well as the health benefits reported by city residents, have emerged as positively correlated to biodiversity at the setting. The degree of canopy cover and structural heterogeneity in urban parks in Australia have also been associated with higher perceived psychological benefits for potential park users (Schebella *et al*., 2019). A positive physiological response (e.g., reduction in blood pressure) has been attributed to exposure to an intermediate degree of meadow plant diversity by Lindemann-Matthies & Mattheis (2018) and an intermediate degree of biodiversity has also been associated with a positive emotional response to exposure to photos of deciduous broad-leaf forests in southern Sweden (Johansson *et al*., 2014).

Despite the variety of greenspace typologies and vegetation attributes considered by these studies, most of them have focused on acquiring quantitative measurements with the aim of planning and managing greenspaces that have a validated aesthetic value, or which are favored by the public, rather than applying an ecological approach to better understand by who, how and in what behavioral context those biodiversity elements were being or might have been perceived and used. Scopelliti *et al*. have however assessed the influence of various outdoor behaviours on perceived restorativeness and self-reported benefits in urban parks, and Sonntag-Öström et al. (2015) have identified participants' favourite spots across different forest settings during structured forest therapy programs.

In this context, the definition of *affordance* which Gibson (1979) proposed as "what an environment offers the animal, what it provides or furnishes for good or ill" which refers to the environment's functional possibilities that space offers to people, come in useful. It is a property of both the physical environment and of human behaviour as it derives from values and meanings which people attribute to physical objects within a specific behavioural setting. In the context of forest bathing settings, such an embodied approach to the study of human-forest interactions appears even more relevant, since the activities proposed by forest bathing guides are based on a continuous cognitive and bodily interaction with different forest biodiversity attributes and not simply on the contemplation of its

aesthetics. Therefore, this thesis consists of a tentative to apply an affordance-based approach to the study of biodiversity attributes that characterize restorative forest environments designated for forest bathing.

3. Methods

The following chapter presents an overview and explanation of the methods applied in this research project. Section 3.2 introduces the research design and summarizes the methods that were used across the study. Section 3.2 describes the case studies, explains how forest settings were chosen, their main characteristics and provides information about participants' sampling. Section 3.3 presents in detail how methods were implemented in the field and provides references to previous studies which used similar approaches. Section 3.4 discusses ethical considerations about the methods in use.

3.1 Choice of methods

The methods used for this thesis have been chosen to apply a scientific and ecological approach to the study of restorative forest environments and to provide information to both professionals in the field of forestry and environmental psychology. On one side, the scope is to clarify what type of human-environment interactions characterize the salutogenic experience of forest immersion during guided forest bathing sessions, on the other, to provide potentially useful information to plan and design forest bathing trails.

With this scope in mind and by employing a landscape analysis perspective, a research design was adopted to study human-environment interactions at two forest areas object of study both in terms of physical environmental features of the sites, as well as their use and perception. The methods applied included:

i) field visits accompanied by a qualified forest bathing guide at forest settings where forest bathing experiences would have taken place, to assess the characteristics and suitability of trails,
ii) field running surveys of chosen forest settings, based on the identification and qualitative evaluation of specific forest biodiversity attributes,
iii) participant observation rounds during two guided forest bathing sessions,

iv) one questionnaire delivered to participants to assess their personal experience during forest bathing activities in terms of perceived restorativeness, suitability of the site and supportive elements.

3.2 Case studies and sampling

3.2.1 Description of forest settings

The chosen forest sites are located in the Veneto region, in Northeast Italy. This region has been appointed by Doimo *et al.* (2021) as one of the regions in Italy with the highest percentage of currently active forest-based health initiatives. These initiatives include mostly those related to experience-oriented learning in nature for children and youth (38%) and promotion of wellness (28%) - including *forest bathing* initiatives - which are mainly carried out in remote woodlands in rural areas. However, for the scope of this independent project, it has been decided to focus on urban and peri-urban forest bathing settings, to check if and in what way the activity could be supported by forests within and in the proximity of cities and in settings that are being used for a diversity of recreational and leisure activities, including other kinds of nature-based health interventions.

The choice of the settings has fallen upon two urban forests that have already been used or plan to be used by the University of Padova to develop forest-based health and wellbeing initiatives and whose managers and landowners might have been interested and available at integrating structured forest bathing trails within their spaces.

The first setting is the urban forest of Villa Bolasco (GPS coordinates: 45.675149778861446, 11.9322128), located in the city center of Castelfranco Veneto, a medieval city with over 30 thousand inhabitants in the province of Treviso (approximately 40 kilometers from Venice and Padova). The park is part of a monumental complex dating back to the 19th century, including a villa, external courtyards, and gardens. The current park structure was designed between 1868 and 1878 in the English garden style and includes trees but also bodies of water, meadows and underbrush spots, tiny bridges, and artificial hills, as well as architectural elements (e.g. statues). The park extends for about 10 hectares, it is maintained every week by local gardeners, and it includes more than 1,000 trees of 65 different species aged from 50 to 125-year-old, so including several monumental trees. The park is owned by the University of Padova, it is used already as a *healing garden* for the elderly and people suffering from Alzheimer's, and it is one of the pilot sites of the European-funded project *Varcities* (Horizon 2020), aimed at developing nature-based solutions for citizen's health, well-being and city resilience.

The second setting is a private park called Parco delle Frassanelle (GPS coordinates: 45.388549080029, 11.68294778231536), located within the Regional Park of Euganean Hills (about 20 km from Padova), in an area which is renowned for its landscape beauty related to the widespread presence of hills below 600 meters of height, which is all but a common feature in the Po Valley. The whole park consists of a villa, a temple, as well as a golf court and it extends for over 120 hectares. However, since the forest bathing activities took place exclusively in the northern area of the park, around the main recreational facilities, the study focuses on an area that extends for about 30 hectares. Like Villa Bolasco, the park was designed in English style around 1860 and includes waterbodies and meadows but due to its extension, it provides also extensive woodland with a diversity of underbrush spots and natural hills. The park is privately owned but partners with the University of Padova as an internship site for university students and might be hosting a *forest bathing* program for high school pupils in the future. The park is also currently in use for a variety of activities organized by landowners which include hosting private and public events as well as organized educational and sports activities.

3.2.2 Participants sampling

Participants in the two forest bathing sessions were selected by the forest bathing guide (also an academic professor) by convenience sampling, between people present at the workplace and their acquaintances. Potential participants have been reached by email and invited to join voluntarily and for free. Circa 60 people have been contacted and invited to circulate the invitation to their network. The available spots for the forest bathing sessions (up to 15 each) have been filled on a first-come-first-served basis. The final samples included two groups composed of 13 people each, comprising younger and older adults, mainly academicians (doctoral researchers, professors, as well as psychology and forestry master students and some external (Table 1). Several participants did know each other by name or had been working together before. Three people took part in forest bathing sessions at both sites. Over 60% of participants (17) declared to be used visiting forests/woodlands often or very often. Both samples included more women than men. Participants were fit, and no physical or mental difficulties were reported. In total, 26 valid questionnaires have been filled in by the participants and administered for this study.

Table 1. Summary of two samples data.

	Total	**Gender**		**Relationship with university**			**Environmental sciences background**	
		Male	Female	Employee	Student	External	Yes	No
Sample 1	**13**	4	9	6	3	4	8	5
Sample 2	**13**	5	8	6	3	4	7	6

3.3 Application of methods

3.3.1 Accompanied field visits

Before carrying out field surveys and participant observations, a field visit was organized together with the forest bathing guide to assess the feasibility of the activity at the sites. The guide got certified in May 2021 with the Forest Therapy Hub (FTH) (https://foresttherapyhub.com/), one of the international private organizations offering specialized forest bathing and forest therapy training in Europe. During visits, she briefly explained what *forest bathing* is and how it is carried out and this allowed to identify the forest bathing guide's needs in terms of the spatial organization of the setting, safety, and presence of environmental disturbances, especially concerning other anthropic activities, such as maintenance of the green areas, recreational activities, or heavy noises, which might have negatively influenced the experience. Accompanied site visits took place in early March, before forest bathing activities, which instead were carried out on two weekdays, respectively during the last week of March and the first week of April (see paragraph 3.3.3). This initial phase was essential to understand the needs and the perception of the forest bathing guide about the setting, as well as get first insights about how a forest bathing session might look like and what natural features are relevant along the trails. Data from this phase were collected in a field notebook while pinpointing information on a paper map of the park.

3.3.2 Evaluation of forest biodiversity attributes

The first part of the study consisted of an analysis of the two sites to gather general information about the physical environments in terms of aesthetic and ecological characteristics potentially contributing to their restorative quality. The scope of the survey was to assess the presence of some forest biodiversity indicators

along the forest bathing trails, to then observe and study how these might have been perceived and used by participants to engage in re-connection with nature.

Forest biodiversity indicators can be defined as tools to convey and summarize complex information about the status and the trends of forest biodiversity over time and monitor how the forest ecosystem is affected by many natural and anthropogenic factors (CBD, 2007). They consist of measurable forest attributes which might include both the presence of specific animal and plant species as well as active biological processes. They can be measured at different scales and from different angles, depending on what information is to be obtained. For example, forest structure or vegetation diversity is typically measured at the scale of forest *sample plots* (circular areas with a standard diameter), while the presence of specific tree species or forest clearings is assessed on an entire *forest parcel*. Also, vegetation attributes can be measured on both horizontal and vertical planes through the identification of specific forest *transects.*

When it comes to discussing the relationships between nature attributes and perception, on the one hand, studies have traditionally based their approach on participants viewing photographs or videotapes of different forest settings (Ulrich et al., 1991; Kaplan, 2007; Johansson et al., 2014; Wolf et al., 2017). Other studies, on the other hand, have focused on obtaining measurement through the use of remote sensing, for example, to relate neighborhood vegetation cover with local psychological wellbeing indicators (Cox et al., 2017; Luck et al., 2011).

For the scope of this study, forest bioindicators have been selected by matching forest attributes that appeared significant in mental restoration literature with forest biodiversity indicators identified by the project *BIOΔ4 - "New tools for enhancing the biodiversity of cross-border forest ecosystems"* (Table 2), a framework which was developed between 2014 and 2020 in Italy and Austria to promote a sustainable use of forest ecosystem while preventing biodiversity loss (Cassol *et al.,* 2020). Similar tools built on this framework have already been applied by Bonavida (2020) and Todesco (2021) in the study of forest bathing trails in Veneto's rural areas. Its application in this project represents a tentative for improving the tool by including further literature and exploring its implementation in urban and peri-urban context. Nonetheless, since the scope of this thesis is not to provide exact information about the degree of biodiversity present at the sites, but rather to draw a potential connection between forest attributes that appear relevant in terms of psychological restoration in current literature and the measurable indicators used by forest planners and managers, the *BIOΔ4* framework was only used as a theoretical reference for grouping literature findings and describing and assessing the presence or the lack of certain forest attributes at the settings, to provide a qualitative judgment.

Selected forest bioindicators are related to six main themes: i) articulation of forest structure, ii) vegetation diversity, iii) presence of large-sized or old-aged trees, iv) presence of forest clearings, v) presence of deadwood and vi) presence of habitats linked to land morphology and water features. A summary of these indicators and the reference to the source of information in the literature have been reported below and in Table 2 respectively.

i) Articulation of forest structure

The structure of a forest influences greatly its perception and use by its visitors, for example by offering vistas or, on the contrary, by blocking the view and offering "hiding spots". From a forest management perspective, the measurement of this parameter consists in counting the number of layers in which the vegetation is distributed vertically over a defined transect. It is measured at a sample plot scale, and it distinguishes between 4 different layers:

a) tall arboreal layer (above 20m)
b) medium arboreal layer (h 5-20 m)
c) low arboreal/shrubby layer (h 0.5-5 m)
d) herbaceous (including mosses and woody species <0.5 m high)

ii) Vegetation diversity

Measurement of vegetation diversity consists in counting the number of species of both tree and shrubby layers of the forest. It is normally measured at the sample plot scale, where the tree layer is considered as anything above 5 meters of height and the shrubby one between 0,5 and 5 meters of height.

iii) Large-sized or old-aged trees

For forest managers, measuring the presence of large-sized trees consists in counting the number and variety of large trees, evaluated separately (species by species) against specific diametric thresholds. Large-sized trees are often also old-aged trees. For the scope of this study, the assessment of large trees was limited to counting the number and type of *veteran trees* present along the trails, which have an important landscape or natural value because of their size or great age.

iv) Presence of forest clearings

It consists in measuring the incidence of herbaceous or low-shrubby clearings that contribute to the articulation of the horizontal structure of the forest. This parameter is normally assessed at the forest parcel scale where clearings are defined as having a dimension between 400 and 2000 square meters. Together with the indicator *articulation of forest structure,* the presence of clearings can contribute to the overall perception of forest density and the overall spatial heterogeneity of forest sites.

v) Presence of deadwood

This parameter includes both the presence of standing and lying deadwood. It is measured at the sample plot scale and is positively associated with biodiversity at the site. However, it appears as a controversial parameter in restoration literature since it could be sometimes perceived as an indicator of lack of maintenance and unsafety. However, it is worth mentioning that, in environmental health literature, exposure to deadwood-associated processes (e.g., fungi, litter, humus, bacteria) have also been reported to be positively associated with an improved immune system functioning (Mhuireach *et al*., 2016).

vi) Habitats linked to land morphology and water features

These habitats can contribute to the perception of the overall complexity of the environment but also be perceived as landmarks. Assessing them consisted in identifying the presence and type of wet or rocky habitats that contribute to the overall geomorphological articulation of the forest site. This parameter is normally assessed at the forest parcel scale, and it includes a diversity of habitats, such as pools, water streams, wetlands, springs, as well as scattered rocks, and caves.

Table 2 Forest biodiversity indicators used for forest settings assessment and references in mental restoration and wellbeing literature. Source: own elaboration on previous findings by Bonavida (2020, p.16)

Forest bioindicator	**Reference**	**Findings**	**Country**
Articulation of forest structure	Grahn & Stigsdotter (2010)	*Areas enclosed by vegetation contribute to the restorative quality of urban green spaces.*	Sweden

	Sonntag-Öström et al. (2015)	*Forest settings affording shelter with a view were preferred.*	Sweden
	Stigsdotter et al. (2017)	*Forest dense growth should have the appearance of a den and offer experiences of privacy to promote restoration.*	Denmark
	Stoltz et al. (2016)	*Low-density forests with open character are positively associated with perceived restorativeness.*	Sweden
	Tomao et al. (2018)	*Understory layer density and shrubs negatively influence perceived restorativeness.*	Italy
Vegetation diversity	Wolf et al. (2017)	*Trees' species richness is associated with greater positive emotions.*	US
	Scopelliti et al. (2012)	*Trees diversity in urban and peri-urban parks is positively associated with perceived restorativeness.*	Italy
	Johansson et al. (2014)	*An intermediate level of forest biodiversity is associated with a positive emotional response.*	Sweden
	Wood et al. (2018)	*Plant species richness in urban parks is positively associated with perceived restorativeness.*	UK
	Grahn & Stigsdotter (2010)	*Species richness contributes to the restorative quality of urban greenspaces.*	Sweden
Large-sized trees	Stoltz et al. (2016)	*Tree age and tree height are associated with higher perceived restorativeness.*	Sweden
	Kaplan (2007)	*The presence of large trees is one factor leading to a higher appreciation of nature.*	US
Forest clearings	Sonntag-Öström et al. (2015)	*Open forest settings are preferred.*	Sweden

	Stigsdotter et al. (2017)	*Vegetation which balances enclosed dense growth with more open views is optimal for restoration.*	Denmark
Deadwood	Gundersen & Frivold (2008)	*Forest settings with downed or standing deadwood have low preference scores.*	Finland, Norway, Sweden
	Tyrväinen et al., (2003)	*Settings containing deadwood influence how observers perceive the area's safety.*	Finland
Habitats linked to land morphology and water features	Sonntag-Öström et al. (2015)	*Spots with a view of a lake or rock outcrop are preferred.*	Sweden
	Stigsdotter et al. (2017)	*The presence of water in forest settings is important for restorativeness.*	Denmark

After accompanied field surveys, the above-listed forest attributes were assessed along forest bathing trails. The tools used included a tape measure, a laser distance meter, and the app i-Tree (USDA Forest Service) to measure trees' height. For the indicators which were supposed to be measured at the sample plot scale, it was decided to operate evaluations at sites that had been pinpointed by the forest bathing guide to carry out core activities of the forest bathing sessions, while for the others Google Earth was used. To be highlighted is that the identification of sample plots in this thesis does not follow the process used in forest management, where each plot is chosen according to the distribution patterns of forest attributes across the parcel, but rather follows an affordance-based approach where each location represents a specific behavioural setting. A sample sketch of how evaluations were done is reported in Figure 4.

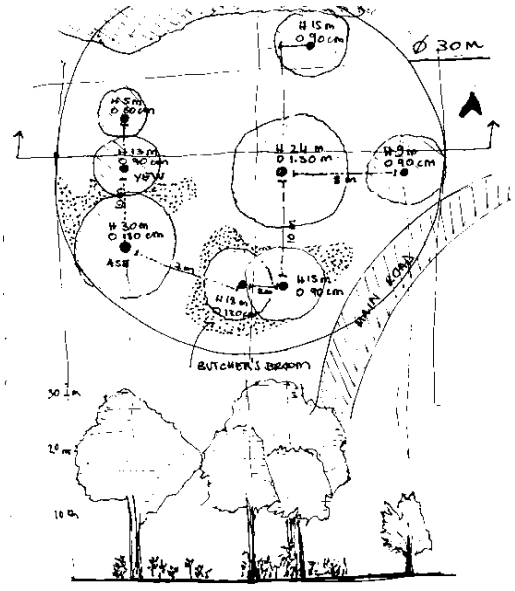

Figure 4 Example of sketch from field running survey to gather basic data about characteristics of forest settings. Source: own elaboration.

3.3.3 Participant observations

Following preliminary site surveys, two participant observation rounds took place on Friday the 25th of March 2022 and on Wednesday the 6th of April 2022, during actual forest bathing sessions. The dates had been set in a way that allowed similar environmental conditions in terms of weather and vegetation composition (spring awakening). Participants have reached the locations by car during work lunch break (about 30 minutes driving) and the forest bathing sessions have lasted for about 2 and a half hours from 12.15 to 2.45 pm. This survey aimed to engage in open and active participant observations while experiencing as much as possible the benefits of the forest bathing activity myself. A track of questions (Table 3) was sketched in advance to focus observations on specific aspects of the interaction between participants and the forest environment. Participants had been informed in advance about my presence and role as a master's student doing research for the final thesis.

Table 3 Track of questions used to inform participant observations.

Track of questions used for participant observations
In which areas of the forest do activities take place, forest clearings, dense growth or other?
How do behaviours differ between spaces with many plant species vs. less biodiverse settings?
How do behaviours differ between spaces with different degrees of vegetation density and forest structure?
What types of behaviour emerge in proximity of water, rocky habitats, and veteran trees?

Figure 5 Example of descriptive narrative and notebook text coding after observations. Source: own elaboration.

A GPS tracker was activated for the whole duration of the visit to assess the length of the route, duration of the session, and uphill and downhill slopes.

About three hours after each session, observations were expanded into a descriptive narrative (Figure 5) which included text as well as maps and sketches of the experience. The text was then analysed following an inductive thematic approach to code for observed behaviours and the environmental contexts where those took place.

3.3.4 Questionnaire

On the one hand, a questionnaire in paper version (Appendix 1, 2) was drawn to obtain information about the experience of forest immersion from a participant's perspective. On the other hand, participant observations served as a check against participants' subjective recordings. The questionnaire aimed to identify perceived environmental attributes which support forest bathing in two different forest settings, as well as to test the methods currently available to assess outdoor environments' restorative potential and provide insights for further quantitative research studies in the field. The questionnaire was redacted in four parts:

i) a POMS survey to assess participants' mood changes before and after the activity,
ii) a Perceived Restorativeness scale (PRS) to confront two different forest settings in terms of participants' perceived restorativeness,
iii) an evaluation of Perceived Sensory Dimensions (PSDs), aimed at assessing sites' suitability for forest bathing activities,
iv) three open-ended questions to gather information about the personal lived experiences of participants in terms of favourite and least-liked moments and supportive environmental features.

Section 1: Profile of Mood States (POMS)

No quantitative nor qualitative studies have been found as regards mood changes following forest bathing activities in Italian urban or peri-urban areas. Taking this into consideration, it was decided to introduce a questionnaire section that could provide insights into how participants' moods changed during the sessions and to use this information as a check against data obtained from other questionnaire sections and participant observations. A Profile of Mood States survey was administered to participants right before and right after the forest bathing activity to assess mood changes in terms of *tension, fatigue, depression, anger, vigour,* and *confusion*. The scale adopted was validated in previous studies carried out during forest therapy programs in Sweden by Sonntag-Öström et al. (2011) and it consisted

of a 10-point Likert scale to assess each mood category pre- and post-activities. Participants were asked the question "*How do you feel right now?*". To point out is that one participant arrived late for the forest bathing session at site 1 (Villa Bolasco gardens) and the total valid POMS questionnaires administered at this site were 12 instead of 13.

Section 2: Perceived Restorativeness Scale (PRS)

The second section of the questionnaire was aimed at assessing participants' perceived restorativeness of the two sites. This part was developed on similar studies carried out before at forest sites in European countries (Bonavida, 2020; Tomao et al. 2018; Stoltz et al. 2016) and in this case it was decided to adopt the Perceived Restorativeness Scale developed by Hartig et al. (1997), which had already been validated for cross-cultural studies in both Italian- and English-speaking countries in its shorter version by Pasini et al. (2014).

The 10-point Likert scale, based on concepts deriving from the Attention Restoration Theory (ART; Kaplan & Kaplan, 1989) allows to assess the restorative elements related to *being away*, *fascination* and *extent* (coherence and scope). A summary of the statements adopted in the questionnaire is reported in Table 4.

Table 4 Perceived Restorativeness Scale (PRS) used for the study. Redacted by Pasini et al. (2014) in its 11-statements version adapted from Hartig et al. (1997).

PRS element	Code	Statement
Fascination	*FA1*	*Places like this are fascinating.*
	FA2	*In places like this my attention is drawn to many interesting things.*
	FA3	*In places like this it is hard to be bored.*
Being away	*BA1*	*Places like this are a refuge from nuisances.*
	BA2	*To get away from things that usually demand my attention I like to go to places like this.*
	BA3	*To stop thinking about the things that I must get done I like to go to places like this.*
Coherence	*COH1*	*There is a clear order in the physical arrangement of this place.*
	COH2	*In places like this it is easy to see how things are organised.*
	COH3	*In places like this everything seems to have its proper place.*
Scope	*SCO1*	*This place is large enough to allow exploration in many directions.*
	SCO2	*In places like that there are few boundaries to limit my possibility for moving about.*

Section 3: Assessment of Perceived Sensory Dimensions (PSDs)

The Perceived sensory dimensions (PSDs) framework (Grahn & Stigsdotter, 2010; Stoltz & Grahn, 2021) had been initially considered as a personal tool to be used during field visits to assess the presence of potentially beneficial environmental qualities before carrying out the activities, and it was not intended to be integrated into the questionnaire and administered to participants. However, after field visits accompanied by the forest bathing guide, she cared to point out how she thought that the PSDs framework, compared to the PRS, was a more intuitive tool to identify more practically environmental aspects which could have impacted the participants' experience during forest bathing sessions. Following this consideration, it was pondered that the PSDs framework had been initially developed for application in urbanized contexts and that it could have been potentially adequate to be integrated into questionnaires about urban forest bathing as well as to discuss the obtained information and its application together with the Perceived Restorativeness Scale. In fact, while the PRS assesses the perceived restorative potential of places from a cognitive perspective while referring to specific restorative aspects of the human-environment transaction, the PSD model allows to assess the perceived restorative potential of specific environmental attributes about a certain place. In fact, compared to PRS, the PSD's scale statements can also be better adapted to a specific behavioural context. In this case, a third section was included in the questionnaire to assess eight perceived sensory dimensions (Grahn & Stigsdotter, 2010; Stoltz, 2020) from two different perspectives: i) how they were perceived at the visited sites ("*the park you visited today affords…")*, ii) how participants thought perceived sensory dimensions were important for forest bathing ("*how important is it for you that forest bathing takes place in a location that affords…"*).

Perceived sensory dimensions can be defined as perceived qualities of the outdoor environment that have been shown important for people's health and wellbeing. These dimensions relate to different aspects of the human-environment interaction and include *social* and *cultural* aspects, *nature* and *biodiversity*, *serenity* and *spatial coherence* in the setting as well as *openness* and the possibility for *shelter*. The questionnaire statements used to assess each dimension are the same reported by Stolz (2020, p. 18) based on studies by Grahn & Stigsdotter (2010) but reinterpreted according to an affordance-based approach.

Even though previous research carried out in forest environments by Stoltz et al. (2016) focuses on the dimensions *serene, nature*, *species richness, space* and *culture*, which have been reported to be linked to mental wellbeing indicators in Scandinavian countries, in this case it was decided to assess all eight perceived sensory dimensions. In fact, this framework seems to have never been applied to an

Italian context before, and all perceived sensory dimensions could have been potentially significant for forest bathers' wellbeing in a geographical setting other than Scandinavia. The eight perceived sensory dimensions statements were translated into Italian. In the statement for assessing the dimension *prospect* the word "picnic" has been removed, since it was not relevant for the forest bathing activity and substituted with the word "group activity". Participants were asked to rate each dimension on a 3-point Likert scale (*low, medium,* or *high*). The dimensions names and the statements used for assessment are reported in Table 5 below.

Table 5 Statements used for the evaluation of the perceived sensory dimensions. Adapted from Stoltz et al. (2016) and Stoltz (2020).

Dimension	**Statement used for the assessment**
Serene	*The natural environment affords peace and serenity, a place free from disturbances*
Nature	*The natural environment affords wild and fascinating nature*
Species richness	*The natural environment affords a large variety of animals and plant species*
Space	*The natural environment affords a large cohesive space, separated from the surrounding world*
Culture	*The natural environment affords traces of human efforts and culture*
Refuge	*The environment affords a safe and sheltered place for relaxation or children's play*
Social	*The environment affords social meeting places, people in motion*
Prospect	*The environment affords views and vistas, open spaces suitable for, e.g., play or group activity*

Section 4: Open-ended questions

The last section of the questionnaire included three open-ended questions aimed at allowing participants to provide personal insights about their experience in the forest concerning the activities proposed and the overall physical context. The three questions of this section were related to preferred activities, challenging activities, and the suitability of the site for forest bathing. The phrases used in the questionnaire are reported in Table 6. Answers were analysed via thematic analysis and used

i) to inform considerations about data from POMS surveys
ii) to identify physical environmental features which supported the activities

Table 6 Questionnaire open-ended questions aimed at assessing preferred and least-liked activities and suitability of the site.

Open-ended questions
What was a highlight during the activities that you particularly enjoyed?
Was there a challenging or nerve-wracking moment for you? If so, which one?
In your opinion, did this place support forest bathing activities adequately? If so, in what ways?

3.4 Ethical considerations

Ethical considerations should be made starting from the research design and context. This thesis aimed to provide information on a phenomenon that still lacks a solid theoretical framework in the environmental psychology and forestry domains. Therefore, the adoption of different data collection methods is justified on one side by the willingness to test currently available research tools within the study of forest bathing environments, while on the other provide further insights about an emerging nature-based activity for health and wellbeing in forests.

Two forest bathing sessions were arranged and run by a qualified forest bathing guide, who is also co-supervisor of this thesis, and professor of forest policy and governance at the University of Padova. Therefore, it is essential to strike the limitations of this study in terms of possible biases deriving from the double role of the co-supervisor as a forest bathing guide, which however have been particularly taken into consideration and discussed below. As purposefully planned, environmental conditions during data collection rounds were optimal (sunny days, parks closed to the public) and do not necessarily correspond to conditions that people would encounter when visiting the forest sites on a weekend or during usual park opening hours. In the same way, the selection of participants was done via convenience sampling and cannot be representative of any specific target group. Also, some participants did know the forest bathing guide personally and this might have interfered with participants' reports and behaviour. Nonetheless, to minimise the risk of bias, a series of measures has been adopted, in particular:

- co-supervisor has deliberately neither assisted with data collection nor data analysis,
- co-supervisor has deliberately neither collected nor read the completed questionnaires,
- the invitation to join forest bathing was accepted by invited persons on a voluntary basis and contacted persons have been encouraged to share the invitation with their contacts, who did not previously know the forest

bathing guide. Therefore, the final sample included both people who did and who did not know the guide from previous encounters.

It is also important to mention that the fact that co-supervisor organized forest bathing activities was not a deliberate choice, but rather a necessity to complete the thesis in due time, as no alternative forest bathing activities were running in the area and the period available.

Participatory observations were carried out via methods presented in paragraph 3.3.3 and aimed at a clear distinction between observation and interpretation of data. Nonetheless, it is essential to strike that observational data are never neutral, but inherently subjective, and proper documentation relies on the memory and diligence of the researcher (Mack *et al.*, 2005). As an external observer, I did not have any contact with participants outside forest bathing sessions and I was not involved in the development and organization of forest bathing activities (which were arranged by the forest bathing guide), but instead, I took note of pre-structured intervention models in use.

Participants were informed in advance - both via email and then in person before starting the activities - about the presence of a MSc student collecting data for the final thesis during the whole duration of the forest bathing sessions. Questionnaires did not report any participant name or private information and data were processed exclusively in anonymous and aggregated form. To match the pre- and post-activity POMS questionnaire, participants were asked to create a personal alphanumeric code and add it to the questionnaire. This allowed me to analyse the data via questionnaire identification codes, instead of names. Names of participants were however collected in anticipation of forest bathing sessions for technical reasons, including the registration process for accessing the parks and safety checks due to the current Covid-19 pandemic.

Ethical considerations must also be made regarding the specific forest bathing activities carried out at the sites. As mentioned in paragraph 3.3.1, the forest bathing guide applied the methods and approach developed by one of the various private organizations providing forest bathing training in Europe. Therefore, the approach she applied is just one of the possible approaches and techniques used for guiding forest bathing sessions, not a standard. Moreover, each qualified guide can choose the trails and adapt the activities according to her/his personal attitudes, capacities, creativity, and contingent conditions (e.g., weather, time slot, group's composition or responses) during the sessions. Consequently, the trails as well as the forest bathing sessions would have been different if the guide had been different. However, despite there might be differences between the approaches and the specific activities proposed by the different organizations and by different guides

qualified within the same organization, the overall structure and key features of a forest bathing session are similar, as reported by the protocol described in section 2.1.3 (Meneguzzo & Zabini, 2020, chapter 5) and retrieved from the various manuals on forest bathing or *shinrin-yoku* available to the public in different languages and countries (e.g. Li Qing, 2018; Cornell, 2018).

4. Results

The following chapter presents the results obtained from the application of methods discussed in the previous chapter. Section 4.1 integrates data collected during accompanied field visits and participant observations to describe the general structure of forest bathing walks. Section 4.2 describes and assesses forest attributes at the two sites using the tool developed in paragraph 3.3.2. Section 4.3 draws from participant observations to present different types of behaviours encountered during the sessions. Finally, sections 4.4 and 4.5 report data collected via questionnaires and identifies physical environmental affordances along forest bathing trails.

4.1 Structure of forest bathing walks

Field visits accompanied by the forest bathing guide allowed to pinpoint forest spaces that are preferrable and usable during a forest bathing session, as well as the reasons behind the choice of the spots regarding space accessibility, safety, and functionality in relation to the phases of the forest bathing program as reported below. This information, integrated with GPS recordings and participation in forest bathing sessions, allowed to build a schematic of the use of the settings.

At both sites, the forest area where the activities took place can be schematized in closed trails, which start and end at the same spot (in the proximity of main facilities) and are characterized by a series of stops along the route. Each stop consists of a setting designated for a specific activity, even though minor structured activities can happen all along the route. Figures 6 and 7 show a simplification of the trails walked during forest bathing sessions at the two sites and the stops taken.

Figure 6 Schematics of forest bathing trail at setting 1 (Frassanelle Park) with entrance/exit and stops along the route. Source: own elaboration.

Figure 7 Schematics of forest bathing trail at setting 2 (Villa Bolasco Gardens) with entrance/exit and sops along the route.

While each forest bathing session was characterized by different guided exercises, which depended on the type of users it addressed and the personal choices of the guide, the general structure of forest bathing walks showed similar use of the space across different phases:

1) **Preparatory phase**

Participants arrived at the settings by independent means (cars) and the first space used was the one in proximity of the entrance, nearby recreational facilities and parking slots. This area was not located within the parks but rather in internal courtyards in near service buildings. During this time (about 15 minutes), participants had the chance to greet/get to know each other as well as change their shoes/clothes and use the toilet if needed.

2) **Welcome phase**

This was the very first phase of the forest bathing activity. It consisted of a first gathering of all participants to explain the scope and the structure of the activities for the day. This phase already made use of a specific forest setting (a wide forest clearing) and it distinguished itself from the preparatory phase, which on the contrary did not take place within the park. In this phase also the first Profile of Mood States questionnaire was administered to participants, right after a short introduction by the guide.

3) **Sensory activation phase**

After the welcome phase, the group walked at a slow pace for about 5-10 minutes and then stopped at a location to carry out the first guided activity, which consisted of different exercises to activate the senses, including proprioception, such as deep breathing with closed eyes and then exploration of space through the sense of smell or touch.

4) **Phase of deep immersion**

In the next phase, carried out after a second short walk, the guide invited participants to develop a deeper bodily and mental connection with nature. In one case this was done through a guided visualisation exercise, while in the second session participants were invited to carry out creative exercises based on the use of natural elements available on the site (e.g., leaves, seeds, etc).

5) **Closing phase**

The final phase was aimed at gathering participants for the last time and providing both the guide and the participants with the opportunity to thank and greet each other, as well as to share thoughts about the overall forest bathing experience and how they felt at the end. In this phase, a small refreshment of tea and nuts was offered to participants, while they were invited to fill in the post-experience questionnaire and ask for questions or clarifications about the study and/or the forest bathing discipline.

Even though both forest bathing programs shared the same structure, which has a similar organization to the mindfulness-based forest therapy protocol presented in paragraph 2.1.3, figures 6 and 7 show how the two trails are quite different in terms of length and type of route: the second trail was about 3 kilometers long including uphill slopes and downhills, while the first one was less than 2 kilometers long on almost completely flat ground. Nonetheless, the number of stops along the route and the overall residence time in the park were the same (stops at four locations over two and a half hours). However, as mentioned in paragraph 3.4, these routes are not necessarily the only possible trails for forest bathing in the two settings; rather, they are those selected by the qualified forest bathing guide who developed and run the sessions for this study.

4.2 Forests biodiversity attributes supporting guided forest bathing

After understanding the general structure of a forest bathing walk and having highlighted activities and core areas within the park, a qualitative analysis of forest attributes has been carried out at different scales:

i) at *forest parcel* scale, to get an overview of the main differences and commonalities between the two settings,
ii) at *sample plots* along the forest bathing trails, at specific locations pinpointed for the activities, as reported in Figures 6 and 7.

The use of two different spatial scales was intended as a measuring method like those adopted in forest management but aimed at analysing nature attributes also at the human scale, to understand how these were used and perceived by forest bathers.

4.2.1 An evaluation at forest parcel scale

The two forest settings are much different in terms of forest type, spatial organization of the site, and land morphology. The first forest setting (Gardens of Villa Bolasco) extends within the very centre of a medieval city, and it is characterized by a rigid compositional structure within the urban fabric, its boundaries are clearly delimited by stone walls, which can be easily perceived by park visitors. On the one side, this contributes to limiting the field of vision from an insider perspective but, on the other side, it allows to create a significant contrast

between the outside busy urban environment and the quietness of the gardens when entering its gates. The forest is characterized by high trees and a great variety of ornamental trees (mostly evergreen), including monumental trees and alien species, and it develops mostly on two or three low-density vegetation layers, without undergrowth. Trees are scattered around the area or form small agglomerates, which creates a constant alternation of dense vegetation and forest clearings of small and medium-size (200 to 2000 square meters). The extensive presence of water, deriving from a lake that occupies the whole central area of the park, also allows for vistas and light penetration. Native tree species present in the park include English oaks *(Quercus robur),* white hornbeams (*Carpinus betulus),* planes (*Platanus hispanica),* holm oaks (*Quercus ilex*), lime trees (*Tilia platyphillos*), while alien species are mainly represented by Himalayan cedars (*Cedrus deodara),* magnolias *(Magnolia grandiflora)* and cyprus trees (*Taxodium distichum).* The area develops on well-maintained, grassy, flat ground and the only differences in altitude are represented by an island at the centre of the lake and by small artificial reliefs in the northern part of the park, which however were not visited during forest bathing activities.

The second forest setting (Frassanelle Park) is located in the Euganean Hills area, at the urban-rural fringe and at site which is renowned for the presence of low-height hills. The park borders with cultivated fields and scattered houses and develops on uneven terrain. The forest type is characterized mainly by coppice with some high trees (mostly broadleaf species) with a complex vegetation structure that develops on multiple layers with dense and varied undergrowth vegetation and herbaceous layers. Tree species include hop hornbeam (*Ostrya carpinifolia*) and manna ash (*Fraxinus ornus*) but also holm oaks (*Quercus ilex*) and various high trees of alien species including cedars (*Cedrus deodara* and *Cedrus atlantica*) and bald cyprus trees (*Taxodium distichum*). Since the park is managed and used also for recreational activities, denser vegetation areas alternate with some wide forest clearings with cut grass (200 to 8000 square meters), designated for picnics. At this site, perceivable water features are absent along the forest bathing trail, even though present in other areas of the park, which were however not visited.

A summary of findings related to forest type, water and land morphology attributes, forest clearings and large-sized trees is reported in Table 7.

Table 7 Information on area extension, forest type and summary of forest attributes assessed on the whole forest parcel at the two sites.

		Frassanelle Park	**Villa Bolasco Gardens**
Extension		About 30 hectares	About 10 hectares
Type of forest		Mixed coppice and high forest with broadleaves	Mostly high, evergreen trees
Forest biodiversity attributes			
iii	**Large-sized, veteran trees**	13	42
iv	**Forest clearings**	Roughly 20% of the area, mostly wide compact clearings	Roughly 35% of the area, scattered, different size clearings
vi	**Water and land morphology habitats**	No perceivable water features but several slopes with visible rock faces and presence of caves.	One artificial lake at the centre of the gardens, no rock formations present.

4.2.2 An evaluation at sample plot scale

A smaller-scale landscape analysis aimed to assess the spatial quality of those biodiversity attributes which are normally evaluated at forest sample plots, and at the same time to identify human-scale biodiversity affordances which could guide and impact forest bathers' experience along the trails. Therefore, three biodiversity attributes (*articulation of forest structure*, *vegetation diversity* and *deadwood*) were assessed at the four spots identified during accompanied field visits (paragraph 4.1), and where forest bathers stopped to carry out forest bathing activities for a longer time.

Welcome phase

Welcome phases took place at sites in proximity of park entrances and facilities buildings at both sites. Spots were both characterized by small-sized clearings and low-dense vegetation structure on two layers which allowed for vistas and a gradual immersion into the forest environment. Arboreal vegetation diversity in these settings was limited to two or three species, deadwood was almost absent, the herbaceous layer was characterized by cut grass and no undergrowth was present (Figure 8).

Table 8 Vegetation structure, diversity, and deadwood at the two sites during the welcome phase.

	Frassanelle Park	**Villa Bolasco Gardens**
Articulation of forest structure	Two vegetation layers including tall and medium arboreal.	Two vegetation layers including tall and medium arboreal.
Vegetation diversity	Dominated by two species including ash trees and lime.	Dominated by two species, including cedar and yew trees.
Deadwood	Few small-sized branches.	No lying deadwood, one standing trunk.

Figure 8 Settings of welcome phase at the two sites (Frassanelle Park on the left, Villa Bolasco Gardens on the right). Source: own photographs.

Sensory activation phase

Exercises which focused on the activation of senses took place at sites where vegetation was denser than at welcome phase. Vegetation was very diverse either on the arboreal or the herbaceous/shrubby layer. The presence of lying or standing deadwood was scattered at both sites. The diversity of vegetation at these spots was particularly supportive of guided sensory exercises that allowed to activate the sense of smell, and sight through the experience of different colours and odours (Figure 9).

Table 9 Vegetation structure, diversity, and deadwood at the two sites during the sensory activation phase.

	Frassanelle Park	**Villa Bolasco Gardens**
Articulation of forest structure	Three vegetation layers including tall, medium and low arboreal.	Two vegetation layers, including tall and medium arboreal.

Vegetation diversity	Few tree species including ash and yew and a wide variety of herbaceous plants including wild garlic (A*llium ursinum*) and buttercups (R*anunculus acris*).	Wide variety of tree species including yew, cedar, plane, and oak trees.
Deadwood	Scattered deadwood including barks and branches.	Little presence of deadwood. One standing trunk, few branches.

Figure 9 Settings of sensory activation phase at the two sites (Frassanelle Park on the left, Villa Bolasco Gardens on the right). Source: own photographs.

Deep immersion phase

Deep immersion exercises were carried out at forest spots which were characterized by dense vegetation structured on three or four layers, with scattered deadwood such as branches, barks as well as leaves and pinecones (Figure 10). This character, with much loose natural material and diverse rooms, allowed for both shady and sunny spots where to sit and supported creative activities such as creating an eco-mandala with a diversity of natural elements. At Villa Bolasco Gardens, a dense agglomerate of holm oaks alternated with a clearing in proximity of an old-aged English oak also supported a guided visualisation exercise based on the identification with tree attributes.

Table 10 Vegetation structure, diversity, and deadwood at the two sites during the deep immersion phase

	Frassanelle Park	**Villa Bolasco Gardens**
Articulation of forest structure	Three vegetation layers including tall, medium, and low arboreal.	Two vegetation layers, including tall and medium arboreal.

Vegetation diversity	Diverse arboreal and herbaceous vegetation including olm oak, ash, butcher's broom (R*uscus aculeatus*) and nettle (L*amium orviala*).	A dense stand of holm oaks with pines, and one veteran English oak.
Deadwood	Scattered deadwood including barks, branches and leaves.	Scattered deadwood including barks, branches, leaves and pinecones.

Figure 10 Settings of deep immersion phase at the two sites (Frassanelle Park on the left, Villa Bolasco Gardens on the right). Source: own photographs.

Closing phase

The closing phase took place in both settings in the proximity of forest clearings which allowed for an open character with some shade, as well as for a comfortable place where to sit. Here, the forest structure was characterized by two vegetation layers with few tree species enclosing the area, the herbaceous layer was characterized by well-maintained cut grass. No lying nor standing deadwood was present at these spots (Figure 11).

Table 11 Vegetation structure, diversity, and deadwood at the two sites during the closing phase.

	Frassanelle Park	**Villa Bolasco Gardens**
Articulation of forest structure	Two vegetation layers including medium arboreal and herbaceous.	Two vegetation layers including tall arboreal and herbaceous.
Vegetation diversity	Two species including olm oak and cedar, cut grass.	Two species, including veteran oaks and magnolia, cut grass.
Deadwood	No lying nor standing deadwood.	No lying nor standing deadwood.

Figure 11 Settings of closing phase at the two sites (Frassanelle Park on the left, Villa Bolasco Gardens on the right). Source: own photographs.

4.3 Participants' behaviour

Descriptive narratives derived from participant observations were used to identify different types of behaviours that characterized people-forest interactions along forest bathing trails. The texts were coded following an inductive thematic approach to identify seven behavioural categories, which are reported below.

Social behaviour and connection with others

The overall experience of a guided forest bathing session according to the approach applied in this study can be described both as a social and individual activity, which focuses on the activation of senses with the support of a guide and the whole group of participants within the forest environment. All along the route, moments of introspection and focus on one's own sensations and emotions constantly alternated to social interactions of different kinds, which included:

i) *structured group activities* when participants and guide gathered to share thoughts and feelings about the activities they carry out,
ii) *close-up voluntary interactions* between participants (usually pairs) who decided or were invited to chat or walk together,
iii) *involuntary and voluntary detached interactions* between participants and guide such as eye contact and smiling, which created an overall sense of connection within the group.

Social behaviour permeated the whole experience, and it was observable during the whole session across different kinds of environments.

Exploratory behaviours

Behaviours related to the exploration of nature were identifiable at two different spatial scales. The first one was related to the *exploration of small natural objects* to examine and understand plants and animals' attributes, such as scrutinizing the colour and shape of leaves, and the texture of barks. The second one was related to the *exploration of space in different directions* to explore what was not yet visible or perceivable such as going to a place because "*I did not go there yet"*, looking at what is hiding behind a dense vegetation growth or moving about to see what bird is tweeting. Exploratory behaviours were particularly supported by the presence of natural loose materials on the ground (e.g., leaves, pinecones, bird feathers) as well as variations in land morphology and vegetation structure (Figure 12).

Figure 12 Area of dense growth supporting exploratory behaviours at Frassanelle Park. Source: own photographs. Source: own photographs.

Contemplative and appreciation behaviours

Contemplating behaviours included all those conscious behaviours which focused on using the five senses to experience pleasure or fascination for nature. These include stopping and standing still to appreciate light filtering through the forest canopy or touching the soil to perceive its texture in one's own hands. Contemplating behaviours were often represented by actions that followed

exploratory activities; for example, first getting close and smelling wild garlic to understand what it is and then lying on the ground to appreciate its smell. Behaviours related to contemplation and appreciation for nature particularly emerged in the proximity of sites with a great number of plant species (Figure 13), with veteran trees or with and an open character (e.g., view of water) suggesting, again, that exploratory and contemplative behaviours seem intertwined, as these types of setting also supported exploration.

Figure 13 A stretch of flowering wild garlic supporting contemplation and appreciative behaviours at Frassanelle Park. Source: own photographs.

Voluntary self-isolating behaviours

Recurrent behaviours were represented by participants finding "hiding spots" where being alone, hiding from the looks of other people or walking alone at the end of the line. These behaviours were allowed by the forest bathing guide who was careful about participants' safety but also allowed them to roam freely as long as they would come back to the group at her call. Forest environments characterized by dense vegetation on the shrubby/low arboreal layers particularly supported this type of behaviour, as people were able to sit behind the bushes and not be seen (Figure 14).

Figure 14 Dense undergrowth vegetation layer supporting hiding behaviours at Frassanelle Prak. Source: own photographs.

Introspective behaviour

Introspective behaviours originated mainly from structured guided meditation activities such as visualization exercises or exercises to focus awareness on one's own breathing and heartbeat. Activities supporting these behaviours were developed through different sedentary exercises and were carried out in different types of environments all along the route. When people were invited to sit at a place

Figure 15 View over small lake supporting introspective behaviours at Villa Bolasco Gardens. Source: own photographs.

to carry out meditation activities, they often reached out to places with vistas over water or wide forest clearings (Figure 15).

Creative behaviours

This behavioural category consisted of participants building or creating new things. It includes mostly behaviours observed during guided structured and creative activities, such as building eco-mandalas together. These tasks were often supported by the presence of lying deadwood and loose materials on the ground as well as natural supports, where to lean (big trees, lying deadwood, or rocky elements) (Figure 16).

Figure 16 Natural loose material and rock supporting creative activities at Villa Bolasco Gardens. Source: own photographs.

Walking

Walking was alternated with more sedentary activities throughout the session, and it was mostly used to reach different locations. Walking never implied a vigorous physical effort, as forest bathing activities were not supposed to tire participants. Walking through the park was supported by designed paths (Figure 17), however, it was observed that participants often walked outside them, for example, to reach areas with denser vegetation growth or test different types of litter.

Figure 17 Designed paths with direct access to nearby vegetation supporting walking but eventually exploration of alternative self-made paths at Frassanelle Park. Source: own photographs.

4.4 Restorative potential of different forest settings

After having assessed the use of the forest space concerning the spatial structure of activities and individuals' behaviours, data collected via questionnaires were analysed to provide information about participants' self-reported experience within different forest settings in terms of mood changes, perceived restorativeness of environments and perception of suitability of the sites for forest bathing activities. This chapter presents: i) how participants mood changed before and after the activities, and what activities supported or contributed to challenge their experience, ii) participants perceived restorative quality of settings according to PRS and PSD models.

Changes in mood states

Data obtained from the first part of the questionnaire, including POMS surveys administered before and after the activities, showed overall positive mood improvements across samples and at both sites (Figure 18). Mood states which showed greater improvement for all participants at both sites were *tension*, *anger*, and *vigour*. While activities at Villa Bolasco Gardens also showed an increase in

self-reported *happiness* across sample, at Frassanelle park this mood aspect did not increase for all participants, as some reported being equally happy before and after forest bathing activities. At Villa Bolasco Gardens, the aspect of *fatigue* showed a much lower improvement after the session compared to the other mood states, as a few participants reported being more exhausted by the end of the forest bathing session than at the beginning. This was also confirmed during observations when some participants declared that they considered meditation exercises with a focus on internal processes a demanding activity and that it would have been hard for them to go back to work afterward. This might be because in this setting the phase of "deep immersion" was characterized by a quite long meditation session.

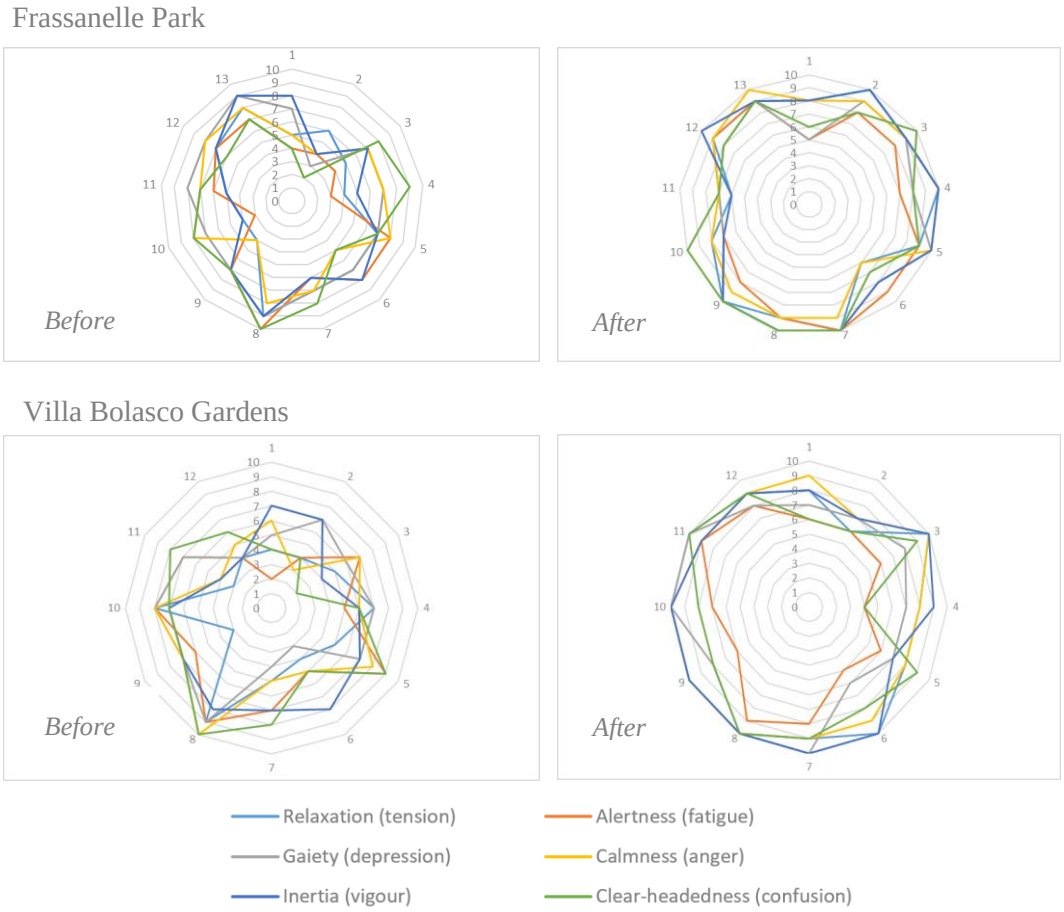

Figure 18 Representation of participant's mood changes across the states of "tension", "fatigue", "depression", "anger", "vigour" and "confusion" before and after forest bathing sessions at the two sites. Source: own elaboration.

Preferred and challenging activities

Answers provided by participants to open-ended questions *"What was a highlight during the activities that you particularly enjoyed?"* and *"Was there a challenging or nerve-wracking moment for you? If so, which one?* allowed inform further considerations over mood changes as well as to gather insights about potentially relevant affordance elements through the identification of situations that challenged participants' skills or personalities and might have influenced their mood and behaviours.

Activities that involved connection and interaction with others

Activities that required gathering with the group and sharing personal experiences and sensations have been reported both among the most liked and the most challenging or nerve-wracking activities in both settings. During the first forest bathing session (Frassanelle park) two participants declared they appreciated "*all moments of sharing*" and "*to share things with others*" while someone defined nerve-wracking the fact that other participants were "*talking too much"* and another declared *"I was feeling uncomfortable to introduce myself to the group at the beginning, but by the end I felt I was part of the group."* During forest bathing at Villa Bolasco Gardens, group activities were also reported among the most liked ones while some participants stated that "*sharing and talking in [group] was a source of anxiety for me"* and that nerve-wracking was *"listening to the words of others and seeing that almost everyone needs even here to take photos".*

Sensory activities

Activities related to nature exploration through the activation of senses have only been reported among the most liked exercises at both sites, and never mentioned in the challenging or nerve-wracking ones, except for one participant who stated that "*I got a bit nervous at first because I had particular criteria in mind that I was struggling to find (I wanted to climb)."*

The most preferred sensory activities were related to the experience of different colours and smells but also to the exploration of space in different directions using these senses. Participants stated between their favourite activities "*smelling the scents and letting yourself be guided by them"* and the fact that after relaxation activities with closed eyes *"the colour contrast [of nature] was stunning"* and they *"could see nature around more vividly."* Again, a clear connection between fascination and exploration mediated by the use of different senses emerged in participants' statements.

Meditation and introspective activities

Like activities that involved connecting with other people, moments designated for introspection and individual reflection about one's own thoughts and emotions (e.g., relaxation or meditation activities) were reported both among participants' favourite and challenging moments. They were described by participants as "*unexpected moments which allowed for letting go of everything with closed eyes"* or moments which allowed to "*think while observing nature*" but also as moments in which "*I felt tense and in "duty" to relax"* or that were *"challenging"* when one feels *"more relaxed, but also more tired."*

Creative activities

Creative and imaginative activities, such as creating an eco-mandala in the forest, were mentioned among the most favourite highlights by five participants at Frassanelle park and one at Villa Bolasco Gardens. Participants stated that the activity allowed them *"to reflect on what elements give me a sense of familiarity and to tune in to the place*" and that it was a "*good time to conclude all previous activities*". However, one participant found this activity to be "*meaningless, and therefore unnerving*."

Activities involving water

After the second forest bathing session at Villa Bolasco Gardens, four participants reported that their favourite activity consisted of different types of interaction with water, including *admiring, touching,* and more generally *connecting* with it. During the forest bathing session at the first site, this type of interaction was not reported since no perceivable water features were present along the trail.

Sites perceived restorative potential and suitability for forest bathing

The data obtained from the application of the Perceived Restorativeness Scale showed a similar pattern at both sites (Figures 19, 20). Participants generally attributed very high scores to the statements related to *fascination* and *being away*, suggesting that both parks were probably perceived as places where to get away from daily worries and demands and to contemplate or explore nature. Intermediate scores were attributed to statements related to *coherence* at both sites. This might be because phrases related to this aspect were not always well-understood by participants, who asked more than once what the meaning of the statements was, and they were not familiar with the phrase "physical arrangement of the place". Statements related to *scope* were rated higher at Frassanelle park compared to Villa Bolasco Gardens, probably suggesting that people did not feel like they could move

around as much in the second setting, maybe due to the smaller park size and visible boundaries.

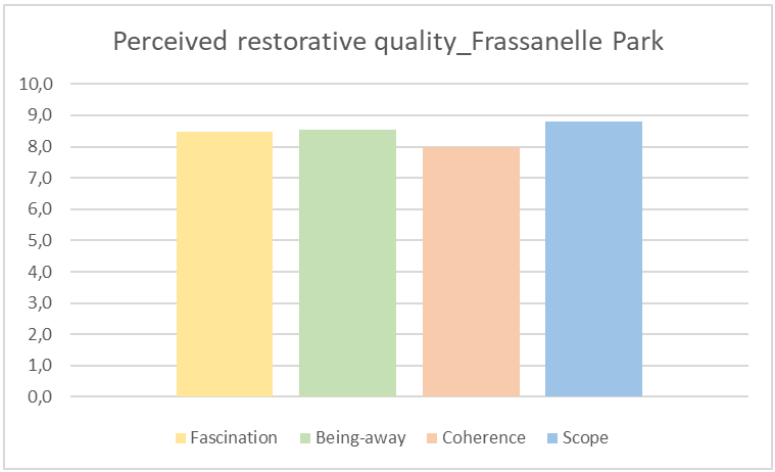

Figure 19 Mean value of ratings attributed to Perceived Restorativeness Scale components at Frassanelle park. Source: own elaboration.

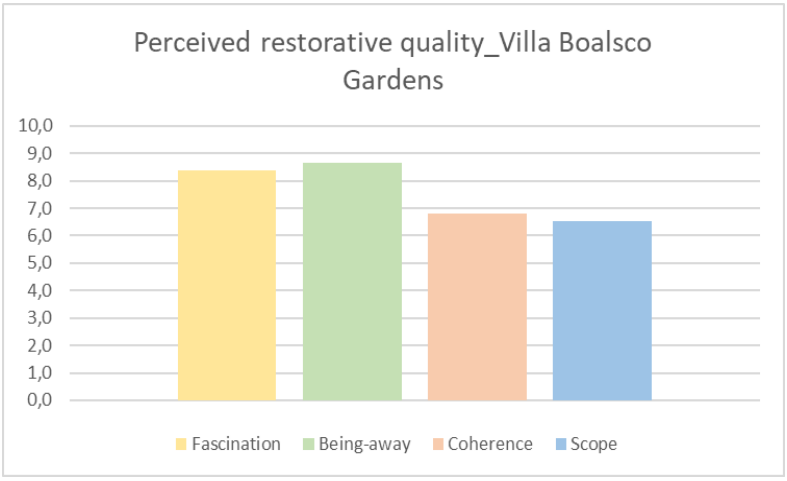

Figure 20 Mean value of ratings attributed to Perceived Restorativeness Scale components at Villa Bolasco gardens. Source: own elaboration.

The assessment of Perceived Sensory Dimensions also showed similarities between applications at the two sites (Figures 21, 22). Participants valued the most the perceived sensory dimensions related to *serenity*, *species richness* and *refuge* when asked what dimensions are most important for forest bathing activities, while *social* and *cultural* dimensions were rated little important for forest bathing

activities by all participants except one at both sites. Four participants at Frassanelle park and seven participants at Villa Bolasco gardens declared *species richness* to be highly important for forest bathing activities and their perception of forest biodiversity in the settings was rated low or medium, therefore probably insufficient to meet their needs and expectations. Similarly, six participants at Frassanelle park and twelve at Villa Bolasco Gardens valued the *nature* aspect not being in line, but lower, compared to the importance they attributed to this dimension for forest bathing activities. This might be explained by the well-maintained character of the vegetation, which was described as very perceptible by several participants as well as by the low density and diversity of the shrubby layer at Villa Bolasco gardens.

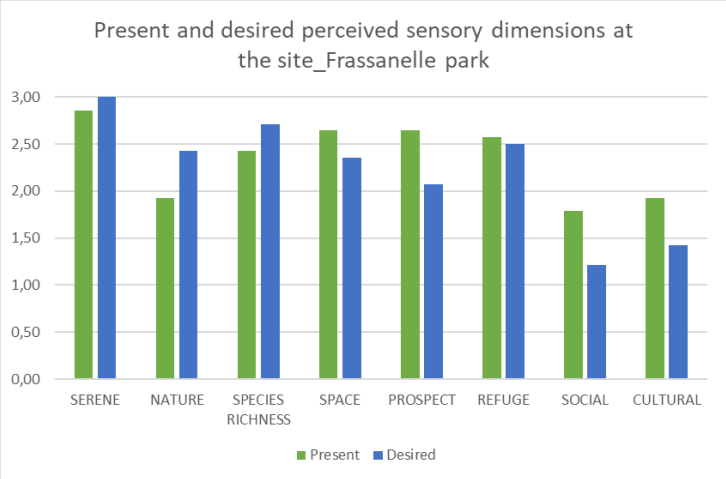

Figure 21 Mean values of ratings attributed to Perceived Sensory Dimensions at Frassanelle park. Source: own elaboration.

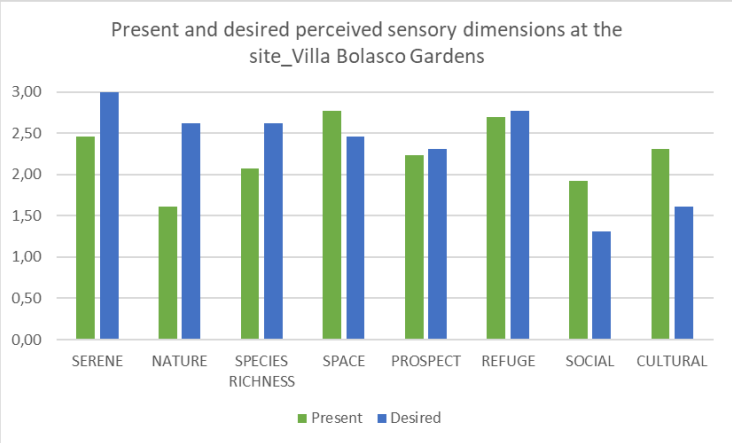

Figure 22 Mean values of ratings attributed to Perceived Sensory Dimensions at Villa Bolasco gardens. Source: own elaboration.

4.5 Supportive elements and nature affordances

Participants' answers to the question *"In your opinion, did this place support forest bathing activity adequately? If so, in what ways?"* allowed to group recurrent topics over environmental characteristics which forest bathers have considered those supporting the most their salutogenic experience in the forest. Analysis of these data followed two steps: i) a deductive thematic analysis and clustering according to PRS and PSD categories, ii) a cross-analysis of reported supportive behaviours with those that emerged during participant observations. The analysis aimed to match Perceived Sensory Dimensions and PRS categories with specific forest bathers' behaviours and eventually forest attributes. An example of how this was done is reported in Table 12 below.

Table 12 Example of coding and clustering of participants' statements according to PRS and PSD frameworks. Source: own elaboration.

Participant statement	**PRS element**	**PSD**	**Behaviour**
"This place offered the possibility to walk and explore the space safely. It is far enough away, sheltered from the noise of the city, to be out of the urban context."	Being away Scope	Refuge Serene	Walking Exploratory

A confrontation between the two frameworks in relation to participants' statements allowed to identify those aspects which were better represented by the application of a scale rather than the other, as well as to pinpoint perceived attributes that did not seem to find reference in any category. The use of both models has also turned useful to highlight different aspects of the same experience which would have been ignored via the application of one method only.

After forest bathing at Frassanelle park, perceived attributes that were mentioned as supportive were those related to *fascination (4), scope (4), being away (3)* (PRS) and the dimensions *nature (6), refuge (4) serene (2), prospect (2)* and *species richness (1)* (PSDs). While aspects related to *coherence, culture, social* and *space* were not identified through coding, in line with data obtained from sections 2 and 3 of the questionnaires. After forest bathing at Villa Bolasco Gardens, perceived attributes mentioned as supportive were those related to *fascination* (5) *being away* (3) (PRS) and *species richness* (4), *nature* (3), *prospect* (1), *serene* (1) and *culture* (1) (PSDs). Aspects related to dimensions *scope*, *coherence*, and *space* were not identified. For the first forest setting, clustering statements according to PRS allowed to identify those aspects of experience which were related to the *"exploration of space in different directions"*, which were not always traceable with PSDs *space* or *prospect*, which seem to be intended as more static properties

of the human-environment interaction. On the other hand, clustering according to PSDs was useful to identify those attributes related to the experience of "*a sense of safety, shelter, refuge or privacy*", which were not traceable in the Italian version of PRS to the aspect *being away,* which focused more on a sense of refuge from disturbances and getting away from daily routine rather than on the experience of *"finding a human-sized and comfortable space".* However, this aspect might have been traced back to the element *compatibility* present in the original version of the scale by Hartig et al. (1997). Similarly, for the second forest setting, *s*tatements clustering according to PRS in its Italian version did not allow to identify those perceived elements which had to do with the experience of "*different types of trees*" or "*immersion into biodiversity*".

Perceived elements that were difficult to classify both according to PRS categories and PDSs were those related

- to the experience of a *"diversity of spaces within the park"* and where *"each room seems specific"* since this aspect refers to spatial diversity of the site rather than to species diversity and cannot be traced back to the elements *of refuge* or *prospect* alone. This perceived feature is however clearly identified by Stoltz & Grahn (2021) in the last PSD model as *a diverse* quality of the outdoor setting.
- to the experience of *"connection with water",* which was reported by four participants as a supportive element. Even though it represents more a physical feature than an affordance category, it is maybe worth mentioning given the importance attributed to the experience of this natural element by several participants.
- to the experience of a space that is *"at hand"* and *"close to the city"* since this specific experiential attribute is not presented in PRS nor PSD models.

Following statements coding and clustering according to the two models, it was possible to match this information with behavioural categories derived from observational data (paragraph 4.3) and identify nine affordance categories that appeared most relevant for forest bathers as well as the relationship between those and the physical environmental attributes supporting participants' behaviours. These categories are summarized below. Most of them find a reference within the Perceived Sensory Dimensions or the ART theories, other categories might require further research and/or discussion.

- **Fascination for nature (Nature)**. The area provided a sense of fascination and appreciation for nature and its processes which was traceable to the presence of natural peculiarities (e.g., veteran or large-sized trees, protected habitats). The presence of this category confirms the restorative potential of

experiencing old-aged and large-sized trees (Stoltz et al., 2016) as well as water habitats (Sonntag-Öström et al., 2015; Stigsdotter et al. 2017).

- **Spatial heterogeneity (Diversity)**. The area provided a variety of rooms, which allowed for both hiding behaviours and social activities. This included an alternation of dense undergrowth vegetation areas and forest clearings. This aspect seems to contradict other quantitative studies that show lower perceived restorativeness in settings with dense undergrowth and shrubby vegetation layers (Tomao et al. 2018), suggesting that studying different behavioral contexts within the same forest environment is essential to assess spaces' restorative quality. This aspect is extensively discussed by Grahn (2011), and Pálsdóttir (2014) in the *supportive environment theory (SET)* and it is also in line with considerations made by Stoltz (2020) and Stoltz & Grahn (2021) about the need for a *diverse quality* in health-promoting settings. However, in this study, it appeared important to separate *species diversity* from *spatial diversity*, since they afforded different experiences and were connected to different forest attributes.
- **Plant species diversity (Species richness)**. The area provided a variety of plant species which allowed the exploration of different colors, smells, and textures across seasons. This is in line with previous studies by Grahn & Stigsdotter (2010), Scopelliti et al. (2012), Wolf et al. (2017) and Wood et al. (2018). However, in the context of forest bathing settings, it appears essential not just the presence of different plant species, but also their proximity and accessibility along the trails (e.g. touching) as well as their variation throughout the year. This last aspect also makes this category different compared to spatial heterogeneity (*diversity*), which might be interpreted as a more static environmental characteristic, or in any case dependent on different types of forest attributes such as the articulation of forest structure rather than the number of species present.
- **Movement (Space).** The area allowed for free and safe exploration of the space in different directions. It provided walking paths without barriers and with direct access to nearby vegetation. This aspect is well identified by Hartig et al (1997). However, it was not found an evident connection between this aspect and forest attributes assessed in this study, rather it appeared more as a landscape attribute associated with the design of paths and boundaries of the parks.
- **Prospect (Open).** The area afforded vistas and panoramas due to variability in land geomorphology. These features were at hand and reachable within a short walking distance. This aspect follows previous findings by Sonntag-Öström et al. (2015) suggesting that spatial variability should also provide altitude differences that offer views over the surrounding.

- **Water**. The area afforded the experience and exploration of water habitats. It afforded sitting by and touching the water. This aspect relates to previous findings by Sonntag-Öström et al. (2015) and Stigsdotter et al. (2017). However, like for *plant species richness*, the proximity and direct accessibility to these features were also important for forest bathers.
- **Creativity**. The area afforded to be creative and build new things by providing diverse natural loose materials on the ground or natural features to lean on (e.g., rocks, lying deadwood). This aspect provides contradictory insights about the experience of deadwood and loose materials on the ground about the perceived restorative quality of greenspaces. The lack of woody material sometimes resulted in a space that was "too well-maintained" for forest bathers. This might be also because both sites were managed parks, where the presence of a guide and other participants might have mitigated the perception of unsafety related to this aspect which was reported in previous findings (Tyrväinen et al., 2003; Gundersen & Frivold, 2008). However, the possibility for a creative active engagement with forest physical attributes, which allows to shape the environment and build something new, does not seem to represent a specific affordance category in the models studied here, however, it could be considered somehow connected to the category *refuge*, when one feels comfortable enough to experiment and play (Grahn & Stigsdotter, 2010)
- **Soundscape (Serene).** The area afforded a space free from anthropic noises, which one can hear at a distance. Soundscape allowed for meditation and relaxation exercises. This aspect was seldom reported as related to the pleasure of nature sounds, rather to the possibility of being sheltered from traffic noise or other people's chatting. Findings are in line with studies by Grahn & Stigsdotter, (2010) and Pálsdóttir (2014) who points out that anthropic noises can be unfamiliar and therefore annoying to people from an evolutionary perspective. In this case, the need for a silent space might have been magnified by the presence of urban settlements and roads nearby.
- **Refuge (Shelter)**. The area afforded a sense of refuge, safety and comfort, also in the proximity of one own's residence. The area was easily reachable by public or private transport means. For forest bathers, this aspect seemed related to what Kaplan (2001) defines as *extent*; that quality of a place that is familiar and where one knows how to deal with things and has the capability of letting go and feeling completely immersed, rather than the concept of *shelter* intended as a sense of enclosure.

5. Discussion and conclusions

The following chapter presents a summary of considerations and conclusions concerning the results obtained and the main objectives of the thesis. The last paragraph is dedicated to the discussion of two potentially relevant themes which emerged during the literature review and the application of methods throughout the thesis.

The purpose of this independent project was to research forest-people interactions in urban and peri-urban forest bathing settings in Northeast Italy and in particular

- to describe how forest settings are used during guided forest bathing sessions,
- to identify and evaluate forest physical attributes which might contribute to the perceived restorative potential of two different forest bathing settings,
- to identify and describe forest physical affordances which support the activity and shape the restorative experience of forest immersion.

Use of urban forests environments for forest bathing

The uses of forest settings for forest immersion activities can vary widely depending on the target group the activity addresses. Forest therapy and forest bathing consist of two different practices, which require different ethical and methodological considerations when planning and designing spaces for these health-promoting interventions. In Italy, the public forest therapy protocol redacted by Meneguzzo & Zabini (2020) proposes general guidelines for forest bathing and forest therapy practitioners to rely on; however, it can be implemented in different ways. In particular, it was recorded that forest bathing walks can follow different programs delivered by single forest bathing practitioners, who are trained by different private for-profit organizations. At the sites object of this study, an approach based on training provided by the Forest Therapy Hub (https://foresttherapyhub.com/) in Italy was adopted. Other organizations, however, do not necessarily embrace the same method. In this case, forest bathing walks required to be planned ahead of time, in agreement with forest landowners and

managers, to ensure optimal environmental conditions, that is to avoid crowding and anthropic disturbances during the sessions. These two conditions were required by the guide to meet the basic needs of the forest bathing activity: a space for free exploration of nature ensuring, at the same time, the guide's supervision and a peaceful soundscape for meditation and introspection. These aspects might be important discriminatory elements when planning and designing forest bathing trails in urban and peri-urban forests compared to rural forests. A place that allows for silence and not many people around was reported as an essential element also by participants during forest bathing sessions. Using forest environments during seasonal public closure to carry out forest bathing activities could be a way to ensure these conditions, while also providing forest landowners a way to diversify activity throughout the year. However, as pointed out by Meneguzzo & Zabini (2020) further studies are needed to research the potential impact of forest immersions across seasons and under different weather conditions. Moreover, accessibility to urban forests could provide that sense of *being away* and "entering another world" while also affording forest bathers to feel safe and not far from home, which also seemed to support the restoration process.

Forest bathing walks were carried out at a slow pace along 2- to 3-kilometre-long closed trails with several stops along the route and lasted overall for two and a half hours. The length of the walk might also impose a minimum requirement on the greenspaces size planned for forest bathing programs, to allow participants to walk around for quite a long time without being bored. This aspect also needs to be specially considered when planning green areas in the proximity of urban and peri-urban settlements.

Forest attributes contributing to perceived restorative quality

This thesis, building on previous work by Bonavida (2020), struggled to develop a framework that connects forest physical attributes reported as influencing mental wellbeing in restoration literature with validated forest bioindicators used in the field of forest ecology. It was found that there are similarities between forest attributes mentioned in mental restoration literature in Italy, Scandinavia, the UK, US, and forest biodiversity indicators used within the project *BIOΔ4 - "New tools for enhancing the biodiversity of cross-border forest ecosystems"*, implemented in Italy and Austria. Potential connections were also found in the assessment methods of these parameters, even though different spatial and temporal scales were encountered.

On the one hand, the assessment carried out in this thesis, based on the above-mentioned framework, showed that all identified forest parameters, namely *articulation of forest structure*, *vegetation diversity*, *presence of forest clearings*,

presence of large-sized trees, *presence of deadwood* and *presence of habitats linked to water and land morphology*, can be relevant in relation to forest bathing activities and forest bathers' behaviour.

On the other hand, the testing of currently available methods to assess the perceived restorative quality of environments (Perceived Restorativeness Scale), did not seem to show an evident discrepancy between the two sites object of this study. Therefore, no considerations can be made regarding the potential contribution of different forest attributes to forests' perceived restorative quality according to this scale. Further quantitative studies with a greater amount of data are needed in this matter. Moreover, developing further research at the intersection between mental health, well-being and forest biodiversity indicators could be relevant to bridging the gap between the two research fields and planning forests for multiple land uses.

Nature affordances in forest bathing

Throughout this writing, it was assumed that forest bathing settings can be studied as restorative environments (chapter 6 for further discussion). Two currently available methods to assess the different attributes contributing to environment restorative quality (Perceived Restorativeness Scale (Pasini et al., 2014) and Perceived Sensory Dimensions (Grahn & Stigsdotter, 2010; Stoltz, 2020)) were tested and discussed in relation to forest characteristics and forest bathers' behaviour. The target group was composed of healthy and fit adults; therefore, the following considerations might have been different if the target group had been different.

On the one side, the application of the Perceive Restorativeness Scale (PRS) showed that several scale statements were not clearly understood by most participants. It appears, therefore, important to revise and test this version of the PRS scale before further application in forest bathing settings. Particular attention in this matter should be put to the statements related to spatial *coherence* (paragraph 4.4).

On the other side, the application of the PSD model appeared more user-friendly and appreciated also by non-experts in the field of environmental psychology. The results from the application of this second method showed that perceived sensory dimensions *serene*, *species richness,* and *refuge* were most valued by forest bathers, while perceived sensory dimensions *social* and *culture* were reported little important by most participants. This appears in line with previous studies carried out in Scandinavia (Stoltz et al. 2016), except for the dimension *culture*, which in this study did not seem to be particularly relevant for forest bathers.

Moreover, it could be particularly interesting to deepen the study of the affordance category related to a sense of *refuge*, in which also the aspects of proximity and familiarity with the place appear to play a key role for forest bathers. This aspect follows arguments by Clifford (2018) on the importance of a familiar character of places designated for forest immersions. This environmental aspect might be particularly relevant given the current widespread of forest bathing activities in remote rural areas as tourism practices.

Another item for possible future research could concern the dimension of *creativity* and the perception of environmental affordances related, for example, to the presence of local natural props. In this matter, it would be interesting to investigate other forest physical attributes which might provide this affordance and how they could support the restoration process during forest immersions in general.

Other elements for further research

The application of an affordance-based approach to the study of forest bathing environments was useful to identify commonalities and differences in behaviours across different greenspace typologies and pinpoint those affordances which might be more relevant for forest bathers. This information could be useful to forest managers and landscape architects to inform their choices when planning and designing forest bathing trails. Nonetheless, some issues in the theoretical and methodological background of this study still need clarification and are presented below as potential themes for further research.

Mindful engagement and attention restoration

A first concern that needs to be reported is the difficulty that has been encountered in providing scientific motivation and reference for the methodological choice of studying forest bathing settings as restorative environments. As previously mentioned, methods measuring the "restorativeness" of outdoor environments are now being used across different contexts and greenspace typologies, often without too much consideration over the activities that those spaces should afford their users. This thesis has built upon previous pilot studies by Bonavida (2020) and Todesco (2021) also to question and improve the tools which were developed. In the case of forest bathing activities here investigated, mindful engagement with nature has been identified as one of the potential mechanisms behind restorative benefits obtained during forest immersions. However, it was also assessed that not all forest bathing programs are arranged in the same way. Moreover, few studies (Kaplan, 2001; Lymeus *et al.* 2018; Macaulay et al. 2022)) were found to formulate a hypothesis of correlation between mindful engagement and attention restoration as described by Kaplan & Kaplan (1989), and no study discussing in specific

Mindfulness-based Stress Reduction (MBSR; Kabat-Zinn, 1990) in relation to ART. Further research is needed to clarify this relationship and confirm whether "restorativeness" measuring tools currently available can be applied to forest bathing settings across different geographical areas. The affordance categories analysed in this thesis build on those tools and highlight some elements which might impact the restoration process when mediated by mindful engagement in natural settings.

The role of the forest bathing guide

Another aspect that was only touched upon in this thesis and needs to be discussed further is the role of the forest bathing guide as a mediator and "affordance provider" during forest visits. Behaviours observed during the sessions were the product of structured activities and the guide's "open invitations". Considering that today self-organized forest bathing walks are also recommended as means to relax and relieve stress, it would be important to assess the types of challenges that independent forest bathers encounter (e.g., perception of unsafety when alone) as well as to identify the role and the competencies which a forest bathing guide needs to provide. This aspect is also linked with the methodological issue presented above since attention restoration is often interpreted as a static process between the forest and its users, while the mediation of a qualified guide would make the process dynamic and context-dependent (e.g., depending on her/his background and personality). The limited data provided by this study show positive mood improvements at both locations and a similar perceived restorative potential of different forest sites. This suggests that, given a certain degree of accessibility, safety, and greenery at disposal of users, mood improvements might derive from people's types of interactions with nature mediated by the guide. Consequently, the guide's competencies in cultivating similar affordances could account for equal suitability of differently planned and designed forests.

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Appendix 1 – Questionnaire Italian

Swedish University of Agricultural Sciences

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QUESTIONARIO MONITORAGGIO ATTIVITÀ DI FOREST BATHING

Codice identificativo questionario:_____

(e.g., prima lettera nome, prima lettera cognome, ultime 4 cifre cellulare)

Numerosi studi dimostrano che l'attività di *forest bathing* può ridurre i livelli di stress e migliorare l'umore. Lo scopo di questa indagine è di monitorare i cambiamenti nell'umore delle persone che partecipano ad attività di immersione in ambiente forestale. Le chiediamo di compilare questo questionario **prima** dell'inizio delle attività.

Come si sente in questo momento?

1. **Teso-Rilassato**

	1	2	3	4	5	6	7	8	9	10	
Teso/a	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	*Rilassato/a*

2. **Esausto-Vigile**

	1	2	3	4	5	6	7	8	9	10	
Esausto/a	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	*Vigile*

3. **Triste-Felice**

	1	2	3	4	5	6	7	8	9	10	
Triste	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	*Felice*

4. **Irritato-Sereno**

	1	2	3	4	5	6	7	8	9	10	
Irritato/a	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	*Sereno/a*

5. **Agitato-Calmo**

	1	2	3	4	5	6	7	8	9	10	
Agitato/a	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	*Calmo/a*

6. **Confuso-Lucido**

	1	2	3	4	5	6	7	8	9	10	
Confuso/a	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	*Lucido/a*

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TESAF

QUESTIONARIO MONITORAGGIO ATTIVITÀ DI FOREST BATHING

Codice identificativo questionario:_____

(e.g., prima lettera nome, prima lettera cognome, ultime 4 cifre cellulare)

Per favore, compili questo questionario **dopo** lo svolgimento dell'attività di *forest bathing*.

Come si sente in questo momento?

1. **Teso-Rilassato**

	1	*2*	*3*	*4*	*5*	*6*	*7*	*8*	*9*	*10*	
Teso/a	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	*Rilassato/a*

2. **Esausto-Vigile**

	1	*2*	*3*	*4*	*5*	*6*	*7*	*8*	*9*	*10*	
Esausto/a	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	*Vigile*

3. **Triste-Felice**

	1	*2*	*3*	*4*	*5*	*6*	*7*	*8*	*9*	*10*	
Triste	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	*Felice*

4. **Irritato-Sereno**

	1	*2*	*3*	*4*	*5*	*6*	*7*	*8*	*9*	*10*	
Irritato/a	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	*Sereno/a*

5. **Agitato-Calmo**

	1	*2*	*3*	*4*	*5*	*6*	*7*	*8*	*9*	*10*	
Agitato/a	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	*Calmo/a*

6. **Confuso-Lucido**

	1	*2*	*3*	*4*	*5*	*6*	*7*	*8*	*9*	*10*	
Confuso/a	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	*Lucido/a*

Ora vorremmo sapere alcune cose riguardo alla Sua esperienza in relazione al parco appena visitato. Le chiediamo di leggere le frasi riportate e poi valutarle su una scala da 0 (per niente) a 10 (moltissimo) in base a quanto ogni affermazione corrisponde alla Sua esperienza. Segni con una crocetta solo uno dei numeri sulla scala posta sotto ad ogni affermazione.

1. **Posti come questo sono affascinanti.**

	1	*2*	*3*	*4*	*5*	*6*	*7*	*8*	*9*	*10*	
Per niente	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	*Moltissimo*

2. **In posti come questo la mia attenzione è attirata da molte cose interessanti.**

	1	*2*	*3*	*4*	*5*	*6*	*7*	*8*	*9*	*10*	
Per niente	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	*Moltissimo*

3. **In posti come questo è difficile annoiarsi.**

	1	*2*	*3*	*4*	*5*	*6*	*7*	*8*	*9*	*10*	
Per niente	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	*Moltissimo*

4. **Posti come questo sono un rifugio dalle preoccupazioni quotidiane.**

	1	*2*	*3*	*4*	*5*	*6*	*7*	*8*	*9*	*10*	
Per niente	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	*Moltissimo*

5. **Per allontanarmi dalle cose che di solito richiedono la mia attenzione mi piace andare in posti come questo.**

	1	*2*	*3*	*4*	*5*	*6*	*7*	*8*	*9*	*10*	
Per niente	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	*Moltissimo*

6. **Per smettere di pensare alle cose che devo fare mi piace andare in posti come questo.**

	1	*2*	*3*	*4*	*5*	*6*	*7*	*8*	*9*	*10*	
Per niente	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	*Moltissimo*

7. **C'è un chiaro ordine nella disposizione fisica di posti come questo.**

	1	*2*	*3*	*4*	*5*	*6*	*7*	*8*	*9*	*10*	
Per niente	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	*Moltissimo*

8. **In posti come questo è facile vedere come sono organizzate le cose.**

	1	*2*	*3*	*4*	*5*	*6*	*7*	*8*	*9*	*10*	
Per niente	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	*Moltissimo*

9. **In posti come questo ogni cosa sembra avere il proprio posto.**

	1	*2*	*3*	*4*	*5*	*6*	*7*	*8*	*9*	*10*	
Per niente	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	*Moltissimo*

10. **Questo posto è abbastanza grande da permettere l'esplorazione in molte direzioni.**

	1	*2*	*3*	*4*	*5*	*6*	*7*	*8*	*9*	*10*	
Per niente	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	*Moltissimo*

11. **In posti come questo ci sono pochi confini che limitano la mia possibilità di muovermi.**

	1	*2*	*3*	*4*	*5*	*6*	*7*	*8*	*9*	*10*	
Per niente	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	*Moltissimo*

Ora le chiediamo di valutare alcune qualità ambientali del parco, così come le ha percepite durante l'uscita. Legga le frasi riportate e poi le valuti "poco", "abbastanza" o "molto", secondo quanto ogni affermazione corrisponde alla Sua esperienza. Segni con una crocetta solo una delle scelte a fianco ogni affermazione.

Il parco che ha visitato oggi offre…	***Poco***	***Abbastanza***	***Molto***
Pace e serenità, un luogo libero da disturbi e rumori	☐	☐	☐
Una natura selvaggia e suggestiva	☐	☐	☐
Una grande diversità di specie animali e vegetali	☐	☐	☐
Un mondo a sé, separato dal mondo esterno	☐	☐	☐
Viste e panorami, spazi aperti adatti, per esempio, al gioco o alle attività di gruppo	☐	☐	☐
Un luogo sicuro e riparato adatto, per esempio, al relax	☐	☐	☐
Luoghi di incontro sociale, o dove è possibile vedere altre persone in movimento	☐	☐	☐
Tracce del patrimonio storico e culturale	☐	☐	☐

Quanto è importante per lei che il *forest bathing* si svolga in un luogo che offre…?

	Poco	***Abbastanza***	***Molto***
Pace e serenità, un luogo libero da disturbi e rumori	☐	☐	☐
Una natura selvaggia e suggestiva	☐	☐	☐
Una grande diversità di specie animali e vegetali	☐	☐	☐
Un mondo a sé, separato dal mondo esterno	☐	☐	☐
Viste e panorami, spazi aperti adatti, per esempio, al gioco o alle attività di gruppo	☐	☐	☐
Un luogo sicuro e riparato adatto, per esempio, al relax	☐	☐	☐

Luoghi di incontro sociale, o dove è possibile vedere altre persone in movimento	☐	☐	☐
Tracce del patrimonio storico e culturale	☐	☐	☐

Qual è stato per lei un momento saliente durante le attività, che le è piaciuto in modo particolare?

C'è stato un momento impegnativo o snervante per lei? Se sì: quale?

Secondo lei, questo luogo ha supportato adeguatamente l'attività di *forest bathing*? In che modo?

Infine, le chiediamo gentilmente alcune informazioni su di lei:	***Si***	***No***
Ha una formazione di tipo forestale o affini (e.g. agraria, scienze ambientali)?	☐	☐

Quanto spesso frequenta:	***Raramente***	***Ogni tanto***	***Spesso***	***Molto spesso***
Boschi e foreste	☐	☐	☐	☐
Parchi urbani, giardini (o altre tipologie di aree verdi)	☐	☐	☐	☐

Grazie per il prezioso contributo!

Appendix 2 – Questionnaire English

Swedish University of Agricultural Sciences

SLU

TESAF

FOREST BATHING ACTIVITIES MONITORING QUESTIONNAIRE

Questionnaire Identification Code:_____

(e.g., Initial first name/Initial last name/last 4 digits of phone number)

Numerous studies show that *forest bathing* activities can reduce stress levels and improve mood. The purpose of this survey is to monitor changes in the mood of people participating in forest bathing sessions. We ask you to complete this questionnaire **before** the start of the activity.

How do you feel right now?

1. **Tense-Relaxed**

	1	2	3	4	5	6	7	8	9	10	
Tense	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	*Relaxed*

2. **Exhaused-Alert**

	1	2	3	4	5	6	7	8	9	10	
Exhaused	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	*Alert*

3. **Sad-Happy**

	1	2	3	4	5	6	7	8	9	10	
Sad	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	*Happy*

4. **Irritated-Harmonious**

	1	2	3	4	5	6	7	8	9	10	
Irritated	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	*Harmonious*

5. **Restless-Peaceful**

	1	2	3	4	5	6	7	8	9	10	
Restless	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	*Peaceful*

6. **Mentally divided - Clearheaded**

	1	2	3	4	5	6	7	8	9	10	
Mentally divided	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	*Clear-headed*

Swedish University of Agricultural Sciences

SLU

TESAF

FOREST BATHING ACTIVITIES MONITORING QUESTIONNAIRE

Questionnaire Identification Code:_____

(e.g., Initial first name/Initial last name/last 4 digits of phone number)

Please fill in this questionnaire **after** the forest bathing activity has taken place.

How do you feel right now?

1. **Tense-Relaxed**

	1	2	3	4	5	6	7	8	9	10	
Tense	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	*Relaxed*

2. **Exhaused-Alert**

	1	2	3	4	5	6	7	8	9	10	
Exhaused	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	*Alert*

3. **Sad-Happy**

	1	2	3	4	5	6	7	8	9	10	
Sad	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	*Happy*

4. **Irritated-Harmonious**

	1	2	3	4	5	6	7	8	9	10	
Irritated	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	*Harmonious*

5. **Restless-Peaceful**

	1	2	3	4	5	6	7	8	9	10	
Restless	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	*Peaceful*

6. **Mentally divided - Clearheaded**

	1	2	3	4	5	6	7	8	9	10	
Mentally divided	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	*Clear-headed*

Now we would like to know a few things about your experience in relation to the park you have just visited. We ask you to read the sentences and then rate them on a scale from 0 (not at all) to 10 (very much) according to how much each statement corresponds to your experience. Please mark with a cross only one of the numbers on the scale below each statement.

1. **Places like this are fascinating.**

	1	*2*	*3*	*4*	*5*	*6*	*7*	*8*	*9*	*10*	
Not at all	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	*Very much*

2. **In places like this my attention is drawn to many interesting things.**

	1	*2*	*3*	*4*	*5*	*6*	*7*	*8*	*9*	*10*	
Not at all	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	*Very much*

3. **In places like this it is hard to be bored.**

	1	*2*	*3*	*4*	*5*	*6*	*7*	*8*	*9*	*10*	
Not at all	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	*Very much*

4. **Places like this are a refuge from nuisances.**

	1	*2*	*3*	*4*	*5*	*6*	*7*	*8*	*9*	*10*	
Not at all	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	*Very much*

5. **To get away from things that usually demand my attention I like to go to places like this.**

	1	*2*	*3*	*4*	*5*	*6*	*7*	*8*	*9*	*10*	
Not at all	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	*Very much*

6. **To stop thinking about the things that I must get done I like to go to places like this.**

	1	*2*	*3*	*4*	*5*	*6*	*7*	*8*	*9*	*10*	
Not at all	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	*Very much*

7. **There is a clear order in the physical arrangement of places like this.**

	1	*2*	*3*	*4*	*5*	*6*	*7*	*8*	*9*	*10*	
Not at all	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	*Very much*

8. **In places like this it is easy to see how things are organised.**

	1	*2*	*3*	*4*	*5*	*6*	*7*	*8*	*9*	*10*	
Not at all	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	*Very much*

9. **In places like this everything seems to have its proper place.**

	1	*2*	*3*	*4*	*5*	*6*	*7*	*8*	*9*	*10*	
Not at all	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	*Very much*

10. **This place is large enough to allow exploration in many directions**

	1	*2*	*3*	*4*	*5*	*6*	*7*	*8*	*9*	*10*	
Not at all	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	*Very much*

11. **In places like that there are few boundaries to limit my possibility for moving about.**

	1	*2*	*3*	*4*	*5*	*6*	*7*	*8*	*9*	*10*	
Not at all	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	*Very much*

We are now asking you to evaluate some environmental qualities of the park as you perceived them during your stay. Read the sentences and then rate them "low", "medium" or "high" according to how much each statement corresponds to your experience. Mark with a cross only one of the choices next to each statement.

The park you visited today affords...	*Low*	*Medium*	*High*
Peace and serenity, a place free from disturbances	☐	☐	☐
Wild and fascinating nature	☐	☐	☐
A large variety of animals and plant species	☐	☐	☐
A large cohesive space, separated from the surrounding world	☐	☐	☐
Views and vistas, open spaces suitable for, e.g. play or group activities	☐	☐	☐
A safe and sheltered place, for example for relaxation	☐	☐	☐
Social meeting places, people in motion	☐	☐	☐
Traces of human efforts and culture	☐	☐	☐

How important is it for you that the *forest bathing* activity takes place in a location that affords...?

	Not at all	***Moderately***	***Extremely***
Peace and serenity, a place free from disturbances	☐	☐	☐
Wild and fascinating nature	☐	☐	☐
A large variety of animals and plant species	☐	☐	☐
A large cohesive space, separated from the surrounding world	☐	☐	☐
Views and vistas, open spaces suitable for, e.g. play or group activities	☐	☐	☐
A safe and sheltered place, for example for relaxation	☐	☐	☐

Social meeting places, people in motion	☐	☐	☐
Traces of human efforts and culture	☐	☐	☐

What was a highlight during the activities that you particularly enjoyed?

Was there a challenging or nerve-wracking moment for you? If so, which one?

In your opinion, did this place support forest bathing activities adequately? If so, in what ways?

Finally, we kindly ask you to give us some information about yourself:

	Yes	*No*
Do you have a forestry/environmental sciences background?	☐	☐

How often do you visit...	*Seldom*	*Sometimes*	*Often*	*Very Often*
Forests and woodlands	☐	☐	☐	☐
Urban parks, gardens (or other greenspace typologies)	☐	☐	☐	☐

Thank you for your valuable contribution!

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