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Green Public Health - Benefits of Woodlands on Human Health and Well-being

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Foreword

By Gerhard Mannsberger,
Head of the Forestry Department of the Austrian Federal Ministry of
Forestry, IUFRO Host Country Representative



Green Care FOREST – diversification as an opportunity for forestry is based on the Vienna Resolution which was developed in 2003 by the Ministerial Conference on the Protection of Forests in Europe (MCPFE). Next to half of the Austrian territory is covered with forests. They dominate our natural scenery and fulfil a variety of functions - the economic function, the protective function, the beneficial function and the recreational function - by law. The opportunity for recreation in nature or the services rendered by forests in terms of the conservation of nature and landscape as well as the protection of soil, climate and drinking water are taken for granted. Thanks to sustainable forest management each tap provides drinking water in Austria. Forests and their managers are not fully appreciated and valued for those benefits. With the request to highlight the fact that forests provide a broad range of social, cultural and environmental values to society and to create revenues from currently non-marketed values the Vienna Resolution was a challenge. Therefore we invited all interest groups of relevance to forests and forest affairs and developed the Austrian Forest Programme in 2005. As a long-term working instrument the Austrian Forest Programme is setting clear standards for balanced securing and optimising of the environmental, economic and social dimensions of sustainable forest management and fits the Europe 2020 strategy.

In times of great socio-political challenges we want to support the Austrian social system by using the inclusive potential of forests for the benefits of the socially vulnerable. Green Care FOREST involves a bundling of all theoretical and practical initiatives and activities to use forests for improving the well-being in society by creating additional sources of income through diversification and by supporting rural development.

Science and research are of crucial importance for the implementation of a long-term approach like Green Care FOREST. The Austrian Research Centre for Forests (BFW) is a perfect partner to analyse the potential of Green Care for the forest sector in Austria. The study "Green Public Health – Benefits of Woodlands on Human Health and Well-being" was commissioned to prove the effects of woodlands on the health, well-being, and quality of life of the population. After the presentation of the study we will invite representatives of relevant interest groups to discuss the potential of study-based training systems for forest managers and health professionals.

Green Care FOREST is a further step for liveability in Austria.

Foreword

By Peter Mayer,
Austrian Research Centre for Forests

The Austrian Research Centre for Forests (BFW) addresses all aspects of forests – from an economic, ecological and social point of view. Based on research, monitoring and training BFW provides its findings and knowledge to different groups of society. Since 2014 Green Care FOREST is a new research project of BFW designed to broaden our scope of activities.

In close collaboration with the existing Green Care project in the agricultural sector we want to analyse the potential of Green Care for the forest sector in Austria. Green Care FOREST is an opportunity to highlight that social sustainability in the concept of sustainable forest management can lead to new opportunities for forest managers. Green Care products and services may become an additional source of income enhancing our health, education and social system.

The study "Green Public Health – Benefits of Woodlands on Human Health and Well-being" was conducted to assess the current state of the art in the field. This was done in a cross-sectoral cooperation between BFW, the Medical University of Vienna and the University of Natural Resources and Life Sciences, Vienna. The aim of the study was to review international scientific literature on the benefits of woodlands on health, well-being, and quality of life. The main results indicate that being in a forest environment may have positive effects on physical, psychological and social health, and on the overall well-being. Interestingly, the study outlines that there is no difference between physical activity or simply enjoying the atmosphere of the woods in this respect. Even short stays may have recreational effects. In general it can be concluded that staying in a forest environment contributes to general well-being, protects against stress related diseases and supports mental health. Especially for the latter, woodlands seem to provide more positive benefits than other environments and settings.

One result of the study also makes clear that the implementation of Green Care activities requires close collaboration between the forest and the health sector. Therefore, BFW in its current activities works together with experts from these fields to identify potential forest-related products and services for Green Care. Examples include Forest-kindergarten, Forest-youth project weeks and educational programs for different age groups.

Green Care FOREST, like all our activities, serve the overall goal of BFW: to provide knowledge-based answers related to forests for the benefit of society.



Foreword

By Alexander Buck,
IUFRO Executive Director



Forests and trees have a great influence on human health and well-being. They provide food and medicinal compounds and generate a range of ecosystem services. They are also part of the aesthetic legacy of mankind and counteract stress in human beings, supporting our psychological capacity and mental health. As the world's population is projected to reach 9 billion by the mid of this century, these health-related goods and services will become even more important. Yet, forests are not fully appreciated and valued for those benefits.

As the leading global network for forest science collaboration, the International Union of Forest Research Organization (IUFRO) has an important role to play in providing policymakers and stakeholders with objective and independent scientific information about the relation between forests and human health. Since 2007, an interdisciplinary IUFRO Task Force on Forests and Human Health, "ForHealth", has been facilitating the dialogue between the various actors in the field, including scientists from different disciplines, forestry and health professionals, policymakers and companies.

The findings of the Task Force to date show that forests, natural plants and microorganisms are a large reservoir of untapped bioactive compounds to be utilized for various purposes including new medicines for common diseases. Yet, from a global perspective, the supply of many of these resources is under threat, and their sustainable utilization requires more attention. Further research and international cooperation is needed also about the potential utilization of forests for improving psychological well-being and relieving stress, especially for urban areas. Accordingly, the IUFRO Strategy 2015-2019 identifies human health, well-being and quality of life as emphasis areas for international science collaboration across disciplines and regions in the coming years.

In this regard, the publication "Green Public Health – Benefits of Woodlands on Human Health and Well-being", supported by the Austrian Federal Ministry of Agriculture, Forestry, Environment and Water Management, makes an essential contribution towards further improving the knowledge base about forests and human health. At the same time, it provides an important basis for further research activities in this

field. By describing and analyzing concrete aspects of projects featured in practice, the study also supports the application of existing knowledge.

The XXIV IUFRO World Congress 2014 with the theme "Sustaining Forests, Sustaining People: The Role of Research" provides a timely opportunity to share the findings of the Green Care project with the global scientific community, exchange lessons learned and develop further international collaboration in this area.

Clearly, the contributions of forests to human health and well-being deserve greater emphasis than has so far been given in national and international forest policy. The Green Care project is a commendable effort towards this end and a model to be replicated.

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Literature Review

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"... More and more, research tells us that, the time that people spend with forests may help them to stay emotionally well, cognitively effective, connected with others, and physically healthy."

Terry Hartig (ForHealth, 2008)



Executive Summary

This study aims to provide an overview of the scientific literature on the benefits of woodlands on people's health, well-being, and quality of life. Its intention is to highlight the advantages of the forest as a place for leisure activities, restoration, recovery from stress and further social and therapeutic interventions. Its aim is to take stock of the current state of the scientific knowledge and provide a knowledge base for projects relating to Green Care in woodlands and Green Public Health. Both scientific and practical projects have been taken into account.

We conducted a comprehensive review of the literature in order to collate and synthesise the findings of studies investigating the benefits of woodlands on human health and well-being. In the process, we surveyed the research published in scientific journals between 1993 and 2013. Reports in books and grey literature supplement the results of our systematic search. Overall, the study includes 149 peer-reviewed

articles as well as 31 landmark publications, originating mainly from Western countries and East Asia, specifically from Korea and Japan. Shinrin-yoku, which translates as "forest bathing", is currently considered a preeminent and hot topic in restoration research. Shinrin-yoku strives at connecting the positive effects of forests for physical and mental well-being.

Generally, the findings of the scientific work we reviewed suggest that the time spent in woodlands can have positive effects on physical, psychological and social health and on well-being. These effects may come about due to the promotion of physical activity or simply on account of enjoying the atmosphere in the woods. More specifically, spending time in forests increases positive emotions, decreases negative emotions and helps in coping with subjectively experienced stressors. This is how woodlands contribute to mental health. With respect to physiological stress indicators, most of

the studies reported positive effects and prevention of stress-related diseases. Social forestry projects make use of the forest's inclusive potential for the benefit of the socially vulnerable. Wilderness therapy programmes as well as therapeutic activities in a healing forest are cited as practical examples that make use of the forest's healing powers. In scientific literature, Nacadia in Denmark serves as the best-documented example for a healing forest garden. Further best-practice examples can be found in a number of different countries in Europe, Australia and Asia.

In woodlands, well-being can be affected by the duration of the stay, the activities undertaken and the physical exercise performed as well as the social context. Even short visits can have recreational effects. Sports activities and exercises can enhance these positive effects. Especially for mental health, woodlands seem to provide more benefits

than other environments and settings. A sense of safety, supported way-finding, accessibility, ease of legibility of the terrain and walkability, but also a certain degree of natural diversity and alternation are important aspects of the beneficial effects. Both crowding and the complete absence of other people are considered negative, with perceived safety being an important aspect of well-being. A well-kept but natural-looking impression, open tree stands and lots of light at the site as well as the absence of noise are further advantages that get people to feel at ease in woodlands.

There are numerous studies on how the monetary value of the benefits provided to the population by recreational forests is calculated. Woodlands furnish precious non-tradable goods such as recreation and health effects. The positive influence of (computer-generated) virtual forests was likewise demonstrated in the medical context, albeit with less intensity. Evaluation studies clearly underscore the importance of collaboration between the woodland sector, health pro-

fessionals, the government and local structures.

We found there to be an ongoing social trend towards visiting wooded areas more frequently. This trend is reflected in the growing number of scientific publications worldwide. Empirical evidence for the positive effects of natural landscapes in general on health and well-being appears to be better researched than that for woodlands in specific. Similarly, empirical evidence for the restorative power and health benefits of woods appears to be better evaluated than therapeutic interventions. As a special natural area, woodland can have numerous positive effects on physical, psychological and social health as well as human well-being. Projects in practice could benefit from the reported findings in three ways. Firstly, from the theoretical and empirical background. Secondly, from the detailed information relating to the planning, development and evaluation of an intervention. Thirdly, from the special layout requirements that wooded areas need to meet in order to satisfy the needs of the

respective user group. This report does not include any cost-benefit calculations and does not cover any issues relating to the legal framework. These should be taken into account in future work, however. Future research should further strive to undertake systematic reviews as well as meta-analyses and be committed to evidence-based practice. Common standards and guidelines on how to evaluate forest-based programmes and interventions are needed to ensure comparability of the results and warrant the quality of the programmes.

Keywords | forest, forest stand, green care, green space, healing landscapes, health, human health, leisure activity, leisure time, landscape planning, natural environments, nature, physiological effect, practical example, psychological restoration, psychological well-being, public health, quality of life, restoration, restorative environments, social inclusion, therapeutic landscapes, well-being, woodland



1. Introduction

1.1 Nature and Health

Nature

Generally, nature's effect on human health is scientifically well studied (Barton & Pretty, 2010; Bowler, Buyung-Ali, Knight, & Pullin, 2010; Health Council of the Netherlands, 2004). The forest is an essential element of nature. Starting out from nature in general, this paper looks into the health-promoting effect of woodland in particular.

The concept of nature in industrial societies frequently distinguishes mankind from nature. Wohlwill (1983) defined the natural environment as the vast domain of organic and inorganic matter that is not a product of human activity or intervention. Nature is often opposed to culture, since it is frequently defined as the environment in which human influence is minimal or non-existent (Clayton & Opatow, 2003). These views primarily refer to wild, untouched natural areas

in North America. In Central Europe, however, nature and culture are closely connected. Nature is cultivated by humans in many areas. Thus the term nature describes a broad concept comprising natural environs such as forests, cultural landscapes and the urban green. It is further understood to include natural elements such as trees and bodies of water (Steg, Van den Berg, & De Groot, 2013). From a qualitative psychological study a broad definition of nature emerged: *"Nature comprises all animate and inanimate objects. It encompasses both untouched as well as cultural landscapes. Nature has both a material and a symbolic character"*. It has been further noted that subjective well-being was closely linked with the leisure time spent in nature (Röderer & Cervinka, 2012).

With respect to health, the following subcategories of nature can be identified: urban nature, agricultural nature, production forest, traditional rural nature,

natural forests and wild nature (Health Council of the Netherlands, 2004).

Health, Health Promotion and Public Health

Health is defined as a *"state of complete physical, mental and social well-being and not merely the absence of disease or infirmity"* (WHO, 1948). *"Attaining the highest possible level of health is a basic right of every human being, regardless of race, religion, political convictions, economic and social status"* (WHO, 1948).

As a term, health promotion comprises all measures and activities that aim to strengthen human health resources and potentials. Unlike preventive health-care, the focus is less on diseases and their development and more on the determinants that contribute to health maintenance (WHO, 1986). Preventive health-care, by contrast, has the aim of avoiding factors that are harmful

to health and preventing diseases from developing. General measures to promote health as well as specific measures to prevent disease aim to maintain the physical, mental and social wellness of humans.

Health promotion and preventive healthcare are the primary concerns of Public Health. Public Health is often described as follows "... *the science and art of preventing disease, prolonging life and promoting health through the organised efforts and informed choices of society, organisations, public and private, communities and individuals*" (Winslow, 1920).

Nature, Health and Well-being

The natural environment, from urban nature to wilderness, has a positive effect on health. The physical and mental health but also the social well-being of humans are positively affected when they come into contact with nature and experience nature. Five factors have been isolated:

- relief from stress and attention fatigue,
- encouragement of exercise,
- facilitation of social contacts,
- stimulation of optimal development in children and
- stimulation of personal development and a sense of purpose (Health Council of the Netherlands, 2004; Bowler, Buyung-Ali, Knight, & Pullin, 2010).

Nature supported healing processes, restoration from attention fatigue, stress reduction and positive emotions (Cimprich, 1992, 1993; Cimprich, So, Ronis,

& Trask, 2005; Abraham, Sommerhalder, & Abel, 2010). The risk of suffering poor mental health could be reduced by ensuring regular visits to nature (Mitchell, 2013). Subsequently, contact with nature was emphasised as a Public Health strategy for the prevention of mental and physical disease (Maller, Townsend, Pryor, Brown, & St. Leger, 2005).

As a salutogenic factor that strengthens individual resources, nature plays a major role in the development of children's competencies and in promoting children's health (Gebhard, 2013). The physical and emotional benefits of visits to nature are strongly reflected in childhood experiences. Whenever there was a lack of exposure to nature during childhood, this was usually associated with infrequent visits to nature during adulthood (Ward Thompson, Aspinall & Montarzino, 2008). Connectedness with nature is a disposition that plays a vital role in well-being, personality development and the development of skills; it appeared to be an essential factor that determines how often people wish to spend time in green spaces and how much they enjoy it (Cervinka, Röderer, & Hefler, 2012). Connectedness with nature appeared as significant protective disposition against excessive sun exposure (Haluza, Simic, Höltege, Cervinka, & Mooshammer, 2014).

Moreover, natural environments are an important element when developing a sense of self, but also in the emergence of a shared sense of pride and social

well-being and thus constitutes an incentive to collaborative action. Tree planting and other environmental projects involving the participation of citizens, for instance, promoted not only a healthy environment but also a healthy social structure (Elmendorf, 2008).

A historical review of "healthy landscapes" and the connection between nature or landscape on health, was provided by Ward Thompson (2011). Additionally, McLain et al. (2012) provided a review of literature on the interaction between humans and plants. Another literature review by Körner, Nagel und Bellin-Harder (2008) provided an overview of the relationship between green space and health in the urban context.

Nature-based therapy

Nature-based therapy has multiple uses and can, for instance, be applied in cases of obesity, antisocial or delinquent behaviour, depression and schizophrenia. The effectiveness of specialised services that make use of natural environments to alleviate symptoms associated with attention deficit hyperactivity disorder (ADHS) in children has been proven (Van den Berg, & Van den Berg, 2010). However, there is as yet insufficient evidence to indicate which natural elements are particularly beneficial for human health and there are no specifications as to which natural elements are effective in the treatment of certain diagnoses (Annerstedt & Währborg, 2011).

Landscape preferences, restorative environments and favourite places

There are basically two large groups of theories on landscape preferences: evolutionary (biological) and cultural (social) preference theories (Arnberger & Eder, 2011a; Bourassa, 1991; Hunziker, Freuler, & von Lindern, 2007; Tveit, Ode, & Fry, 2006). Evolutionary theories are based on the assumption that, in light of human evolution, preference is given to landscapes that ensure survival and that allow humans to find their bearings quickly. These include half-open, diverse environments that offer a clear view and protection, where trees, copses and bodies of water can be found (Appleton, 1975; Orians, 1980; Ulrich, 1983; Kaplan & Kaplan, 1989). Cultural preference theories are based on the premise that the social, cultural and social environment as well as previous landscape experiences, possibly dating back to a person's childhood, have a bearing on how the individual perceives natural environments (Hunziker et al., 2007; Van den Berg & Koole, 2006; Zube et al., 1982). Differences in the landscape preferences of tourists, the local population, farmers and "landscape experts" were demonstrated (Hunziker et al., 2007; Bradley & Kearne, 2007). Generally, natural landscapes and natural elements are preferred to artificial. Whereas urban landscapes have less positive and even negative effects on health, natural landscapes, by comparison, induced positive effects

on health. Three main effects could be made out: short-term recovery from stress or mental fatigue, quicker physical recovery from illness and long-term overall improvement of people's health and well-being (Velarde, Fry, & Tveit, 2007).

Restorative environments are especially well suited to restore a person's physical and mental strengths. There are several reasons for the regenerative effect of environments. The following qualities make environments restorative (Kaplan, 1995):

- they are fascinating (fascination),
- they offer a sense of being away (being away),
- they convey the impression of variety and extent (extent) and
- they are experienced as being compatible with personal intentions (compatibility).

Landscapes to which one can withdraw from everyday life primarily include natural landscapes with water features, snow-covered mountains or woodland. A body of water in the midst of nature or a forest glade hold a particular fascination (Laumann, Gärling, Stormark, 2001).

The being-away factor and the perceived privacy play an important role in the recovery from attention fatigue and stress. Being away is conceived as immersion into another world, both spatially and mentally. *Being away-from* can be distinguished from *being away-to*. *Being away-from* tends to involve the desire to go to a different place, whereas *being away-to* is when a person is drawn to a certain place. For the

purpose of assessing restorative environments, attributes of *being away-to* are more important than attributes of *being away-from*. Visitors to a nature reserve found a significant association between the importance of the being-away phenomenon and the desire for privacy, the level of privacy achieved and the functions as well as the activities that privacy served (Hammit, 2000).

Woodlands are frequently mentioned as favourite places. Favourite places often feature the above-indicated attributes that characterise restorative environments; thus, a favourite place is where people can escape to from everyday life and where it is easier to switch off, regain one's emotional balance and recharge one's batteries (Korpela & Hartig, 1996). Favourite places primarily include places in nature and in areas with trees, e.g. lakes, mountains, the sea or forests. Streets or shopping centres are rarely cited as favourite places.

Restorative nature: regeneration and stress reduction

Natural environments promote well-being and health. This is how natural environments help in the recovery from emotional and cognitive exhaustion (Kaplan & Berman, 2010; Ulrich, 1983). Coastal areas are frequently cited as being more restorative than rural areas, which, for their part, are considered more restorative than urban green and open spaces. A comparison of various natural environments showed that the restorative value of

woodland is similar to that of coastal regions (White, Pahl, Ash-bullby, Herbert, & Depledge, 2013). In addition to mountains, water or the surface texture, trees are especially restorative elements in landscapes (Flade, 2010). The restorative value is only valid, however, if the absence of health hazards can be guaranteed. Only people who feel safe can relax and unwind.

The most important health-related function of natural environments is stress reduction and the accompanying regeneration of cognitive processes. Natural environments, by comparison, were more suitable for recovery from attention fatigue than urban environments (Hartig, Evans, Jamner, Davis, & Gärling, 2003).

However, urban green spaces likewise had a positive effect on how city dwellers experience stress. The more frequently persons visited urban green spaces, the less often they reported about stress-associated diseases. The closer someone lived to public green spaces, the more often they are used. Thereby the time factor appeared to be the most important: the more time spent in public green spaces, the lower the reported stress level. Direct access to a green inner courtyard or a garden of one's own appeared to be optimal for the subjective coping with stressors (Grahn & Stigsdotter, 2003).

1.2 Forests as Natural Habitat

The forest in Austria

The forest constitutes a defining feature of the natural and cultural landscape. Austria ranks among the well-wooded countries of Europe and, as opposed to the global development, Austria's woodland area is growing. Nearly half (47.6%) of the federal territory is covered by forests, which corresponds to just under four million hectares (ha) or 40,000 sq. km (Russ, 2011). The forest has four important functions: the productive function, the protective function, the beneficial function and the recreational function (Federal Act of 3 July 1975 which regulates forestry [Forestry Act 1975 as amended in 2013]). The Austrian forest is characterised by its multifunctionality and is increasingly compelled to satisfy social demands (Austrian Federal Ministry of Agriculture, Forestry, Environment and Water Management, 2009; Ziehaus, 2011). In Austria, the health effects of visits to the forest, the forest as a venue for social and therapeutic activities and the health effects of products from the forest are major topics (<http://www.waldgesundheit.boku.ac.at/index.php?nav=main>).

What is a forest?

In classical ecology, forests are considered one of the three terrestrial biomes of our planet on account of their global presence.

The uniqueness lies in the three-dimensionality of the forest, its vertical structure formation with boughs and branches and, where expedient, its classification into strata: humus, herb layer, shrub layer, understory layer and canopy layer (Spitzenberger, 2011; Nentwig, Bacher, & Brandl, 2011). A special attribute is the dynamics of this ecosystem, which gives rise to continuously changing but also recurring conditions, primarily as a result of the cyclical nature of the development stages, the occurrence of natural disturbances and the supply of course woody debris. The resulting spaces, structures and layers – and, not to forget, the forest floor – offer various groups of organisms manifold opportunities for ecological niches. Over the course of time, they have led to a multitude of adapted life forms and unique forest ecosystems (Scherzinger, 1996; Leibundgut, 1990, 1993). According to Pott (1993), a forest may only be designated as such when the local attributes of a forest with a specific inner climate and a floristically saturated spectrum of species have been established.

Its many different manifestations, the complexity of forest ecosystems, but also the many functions and significations attributed to forests around the world make any consistent classification on the basis of ecological aspects and an international definition difficult (Randrup, Konijnendijk, Dobbertin, & Prüller, 2005; Townsend, Begon, & Harper, 2009). A report issued by

the United Nations Environment Programme (UNEP, 2009) points out the expediency of confining any definitions to the essential and specific properties of a forest. It has become common practice to use physical characteristics that can be found worldwide (e.g. degree of canopy cover, size of area, tree varieties). Forestry laws typically go by this and provide a corresponding definition. The Food and Agriculture Organization of the United Nations provides a case in point (FAO, 2000, p.1):

"Land with tree crown cover (or equivalent stocking level) of more than 10 percent and area of more than 0.5 hectares (ha). The trees should be able to reach a minimum height of 5 meters (m) at maturity in situ."

In the United Kingdom, a similar definition can be found for "woodland", but under this definition an area of merely 0.1 ha, i.e. 1,000 sq. m. needs to be stocked while providing a canopy cover of over 20% (O'Brien, 2005, p. 7):

"land with a minimum area of 0.1 ha under stands of trees, with the potential to achieve tree crown cover of more than 20%"

These definitions make two points clear: on the one hand, more or less closed tree stands comprising different tree varieties and/or woody plants and the resulting three-dimensionality (cover) can be considered characteristics that are shared by forest formations around the globe (Spitzenberger, 2011). On the other hand, however, although these criteria serve to describe a forest and are used

for the examples that have been put forward, the definitions differ fundamentally due to the values that have been chosen. In this regard, Lund (2013) was able to identify more than 1,600 valid "forest" definitions since he started out on his review in 1998, which was launched in the course of the Kyoto Protocol and is subject to ongoing updates. According to Randrup et al. (2005), no consistent and generally applicable definition can actually be found that would be able to comprise the entire spectrum of the term "forest" due to the many different forms that forests take as a result of their global distribution, and the numerous functions they fulfil, but also on account of the interests pursued and the significations attributed to them. They therefore suggest using "forest" as a meta-term, under which positions and definitions would be subsumed and in light of which a discussion could be taken up. Country-specific definitions of forest use the physical characteristics that can be found worldwide as reference points.

Definitions as found in forestry laws only provide a highly reduced acceptance of forests that merely serves the purpose at hand. In the eye of the beholder, a forest is much more than the sum total of its trees. Forest" is a very ambiguous, historically and culturally determined term that invokes the most varied images, ideas and associations in people from the different parts of the world (Harrison, 1992; Braun, 2000; Ritter & Dauksta, 2011). Forests serve as a projection surface for people's own needs and

desires; therefore, they are readily portrayed as untouched nature, as the epitome of "wilderness" and the obverse of civilisation (Piechozki, 2010). This diversity is reflected in the subjective experience of forest visitors (Seeland, 2011). "However, as the following chapter illustrates, the forests visited for recreational purposes are not "primeval forests". Instead, people prefer rather open, reasonably sized and well-kept forest stands that offer a certain variation and produce a natural effect, where human intervention should not be visible.

In social science literature on forests, the terms "forest", "forest stand" and "woodland" are frequently used synonymously with "forest" being used as an umbrella term (Randrup, Konijnendijk, Dobbertin, & Prüller, 2005). This paper employs the term "woodland" synonymously, following the example of English-language papers.

Green Care and the forest

Green Care is a term used to describe nature-based activities for the promotion of health, well-being and quality of life. More specifically, Green Care involves educational, advisory, social and therapeutic interventions in landscapes (Wiesinger, 2011). The aim of the study was to review international scientific literature on the benefits of woodlands on health, well-being, and quality of life. The economic aspects of Green Care activities in forests are already subject of discussions (Johann, 2013).

1.3 Task and Objective of the Literature Review

Supplementing the scientific reviews on the positive impact of nature on health and well-being in general, this paper is dedicated particularly to the health-related aspects of forests. The report fo-

cuses on the forest as a place to visit for recreational purposes during leisure time, for stress reduction, for preventive healthcare, on the one hand, and as a venue for social and therapeutic interventions, on the other. It aims to compile and make available the scientific find-

ings. Furthermore, the aim is to put these findings to practical use by employing them as basis for interventions in Green care and Green Public Health. The forest as a setting (as scenario, as venue, as space), as part of a natural landscape, thus represents this paper's central starting point.



2. Method

Selection criteria for the literature search

The systematic research took its cue from the criteria used for systematic reviews of scientific literature in medical research. The "preferred reporting items for systematic reviews and meta-analysis" (PRISMA: Moher, Liberati, Tetzlaff, & Altman, 2009) served as a guide in the process of documenting the selection of the literature found in systematic reviews and meta-analyses. Health research is increasingly performed in accordance with these. At the same time, formal and content-related criteria determined the selection of the scientific publications that were found. The search was conducted on the basis of the terms listed in Table 1. One hundred eight specialised articles were selected based on the specified categories. These publications had appeared in English and German between January 1993 and October 2013, inclusive. To qualify, the contributions had to be

peer-reviewed and approved by experts for publication in a scientific journal. Studies with qualitative and quantitative study designs, field studies and laboratory studies were included. In addition, 41 publications vetted by experts from grey literature were included as well as 31 articles from textbooks. Selected online content has been added to supplement the scientific research. This content primarily serves to illustrate current international trends. To make the text readable, the results have been divided into content-based categories and presented in the form of tables.

The search was conducted in two runs. The first run focused primarily on the terms as used in the fields of restoration research and Green Care. The second run supplemented this search with terms from Public Health. It should be noted that the search also included negative effects.

No research was conducted with respect to the effect on health of products from the forest (e.g.

wood, food) and the forest's ecological as well as climatic factors.

Databases and search terms

The following databases were used for the research: MEDLINE, PsycInfo, Psynex plus, SCOPUS and Web of Science. The search terms are indicated in Table 1.

Table 1. Terms used in the two runs of the literature survey

	1 st run	2 nd run
Search terms	forest* AND	forest* AND
	tree* AND	tree* AND
	wood* AND	wood* AND
	activit*	inclusion
	adverse effect*	mood
	"Green Care"	pedagogic*
	healing*	"quality of life"
	health*	risk
	intervention*	social
	negative aspect*	
	recreat*	
	relax*	
	restorat*	
	*therapy	
	"therapeutic landscapes"	
	well-being	
wellbeing		
"well being"		



3. Special Aspects of Forests as Natural Habitat

Visits to and activities in forests offered variation, primarily for city-dwellers, and provided them with a source of recreation and well-being (Martens & Bauer, 2010). The section below intends to illustrate what makes the forest so special compared to other near-natural landscapes. The specific structural and substance-related characteristics of forests with a positive effect on humans are highlighted as well.

3.1 Trees and Forests

There are many landscapes other than forests. So what makes forests so special for health promotion and disease prevention? Visits to woodland have been shown to result in significantly a lower salivary cortisol level (a parameter for stress response), lower diastolic blood pressure and lower pulse rate than stays in urban areas (Lee, Park, Tsunetsugu, Kagawa, &

Miyazaki, 2009). Moreover, people felt better in forests, more at peace and more rested. The regular use of wooded land for (sports) activities was also more conducive to mental health than other landscapes (Mitchell, 2013).

Studies further showed that landscapes with water features, including lakes, rivers or coastal regions, always ranked higher in preference and recreational potential (Völker & Kistemann, 2011). However, on comparing different landscapes with each other, it became apparent that woodland was rated similarly to water landscapes in terms of preference, aesthetic impression and the restorative experience. Other landscapes, in contrast, including savannahs, mountain and desert landscapes, achieved lower ratings (White, Smith, Humphries, Pahl, Snelling, & Depledge, 2010; White, Pahl, Ashbullby, Herbert, & Depledge, 2013; Han, 2007; Laumann, Gärling, & Stormark, 2001).

3.2 Forests as Setting for Health-related Activities

Every forest is marked by its individual blend of characteristics and therefore unique.

Large and huge trees as well as vegetation and stand density are essential characteristics of forests and have an effect on preference and restoration. It became apparent that the less dense a forest and the greater the thus enhanced possibility of getting a sense of direction was, the bigger the preference occurred, as well as the physical relaxation and the fun experienced (Staats, Gatersleben, & Hartig, 1997; An, Kim, Jeon, & Setsu, 2004; Hill & Daniel, 2007). Unobstructed views, cleared waysides, signposts for orientation, a level ground suitable to walk on, the impression of being well-kept and trees with high crowns were factors that further contributed to the recreational value and well-

being (Herzog & Kutzli, 2002; Herzog & Leverich, 2003; Herzog & Kropscott, 2004; Herzog & Kirk, 2005; Ward Thompson, Aspinall, Bell, & Findlay, 2005). Preference was also given to spreading, high and roof-like tree crowns (Lohr & Pearson-Mims, 2006). For one, this ensures visibility on the ground. Secondly, a protective overhead roof is provided. The amount of prospect and refuge are two further characteristics that influence preference, regeneration and also the sense of safety (Appleton, 1996). Preference was given especially to a high level of prospect and some refuge from hazards, since this combination promotes stress reduction and is perceived as being the least dangerous and fear-inspiring. By contrast, environments low in prospect but high in refuge lead to increased levels of stress and attention fatigue (Andrews & Gatersleben, 2010; Gatersleben & Andrews, 2013). Furthermore, preference was given to forests that offered lots of daylight and an open terrain (Sonntag-Östrom et al., 2011). Forests harbouring different tree species, such as deciduous and mixed forests, and

offering also the possibility of distinguishing the seasons in nature were likewise given preference (Juan, DeXing, ShaoBo, JiaQiang, & Bing, 2001).

What also appears to be important is whether a forest is rather well-tended or "wild", in terms of a dense and impenetrable state. After visiting managed forests, people felt more restored, more at peace and more upbeat (Martens et al., 2011). In general mature forests, looking natural, vigour and healthy are considered to be beautiful as long as visual penetration and a certain degree of openness is given (Edwards et al., 2010; Ribe, 1990). Therefore tending and managing forests is in most instances unavoidable. In this regard two particularly important characteristics of preferred forest stands to be considered are low amounts of coarse dead wood and the absence of visible traces of active forestry work (Edwards et al., 2012; Koole & Van den Berg, 2005; Korpela, Ylen, Tyrväinen, & Silvennoinen, 2010; Martens & Bauer, 2010; Nielsen, Heyman, & Richnau, 2012; Van den Berg & Koole, 2006). In the visual assessment of forests, fresh, large-scale clear-cuts and harvest

residues, in particular, are met with general disapproval, as well as damages caused by natural disturbances (Edwards et al., 2010; Edwards et al., 2012; Ribe, 1989). The following forms of forest management, by contrast, met with high acceptance: thinning to reduce the forest stand's density, shelterwood cutting, which involves leaving a certain number of trees in the area to be cleared, strip cutting and, in particular, small-area, group-wise removal and single tree selection in continuous cover forest management (Ribe, 1989, 2006, 2009; Gundersen & Frivold, 2008; Edwards et al., 2010).

The design of human recreational infrastructure, including benches in forests, merit due consideration as well. These amenities should be made of natural materials and the shape of the materials should be as little modified as possible. Hence, a wooden bench made of half a tree trunk and resting on stones was preferred over a metal bench (Nielsen et al., 2012). One very important characteristic was the absence of any waste (Ward Thompson et al., 2005).



4. Health Promotion, Health Prevention and Forests: Focusing on Healthy Groups of People

4.1 Forests and Physical Health

Health promotion: strengthening health

Under the hypothetical assumption that the forest environment was no longer available for recreational purposes, people living in woody areas rated their state of health as significantly worse (Norman, Annerstedt, Boman, & Mattsson, 2013). Epidemiological studies likewise report about a correlation between actual availability of woodland and the physical health aspects of inhabitants in adjacent regions. Due to the heavy reduction of large forested areas in response to pest infestation (Emerald Ash Borer) in the period from 1990 to 2007, a rise in the mortality rate relating to cardiovascular disease and diseases of the lower respiratory system was observed among the inhabitants of the regions affected by the loss of trees (Donovan et al., 2013).

An Asian study revealed that people living in areas with lower forest coverage exhibited a significantly higher mortality rate relating to cancer than people in areas with a comparably high proportion of woodland. Significant correlations were observed between the percentage of woodland and the mortality rate on account of lung, breast and cervical cancer in women and prostate, kidney and bowel cancer in men. The effects of smoking and the socioeconomic status were taken into account as intervening factors (Li, Kobayashi, & Kawada, 2008).

Such studies suggest that woodland can contribute to preserving human health. However, particularly in epidemiological studies, the interpretation of results must be viewed critically due to the lack of a comprehensive control of the intervening factors. They may be able to provide a first impression of possible correlations, but the studies need to provide

additional proof that takes into account the effects under controlled conditions.

Field studies examining the effects of forest visits on changes to physiological parameters were conducted particularly as part of the research into Shinrin-yoku. The given studies compared the effects of a woodland visit with a visit to urban areas. The relevant parameters were measured in both settings. Changes in physiological stress indicators that indicate physical restorative and regenerative processes were observed in participants both while they were experiencing the setting in a seated position and as they were performing light physical exercise. In contrast, urban areas did not contribute to such improvements. Measurements of heart rate variability suggest that a forest visit leads to a change in the activity of the autonomous nervous system. Among the study participants, the forest visit reduced a reduction in the sympathetic activities

of the nervous system that prepare the body for increased levels of physical activity and diminish energy reserves. At the same time, an increase in parasympathetic activities, which are associated with the body's restorative and regenerative processes, was observed (Lee et al., 2011; Park et al., 2008; Park et al., 2009; Tsunetsugu et al., 2013). A decline in the pulse rate, an attenuation of blood pressure and a drop in the salivary cortisol level are the physiological signs which indicate a stress-reducing effect of a forest visit (Beil & Hanes, 2013; Lee, Park, Tsunetsugu, Kagawa, & Miyazaki, 2009; Park et al., 2008; Park et al., 2007; Tsunetsugu et al., 2013; Tsunetsugu et al., 2007; Tsunetsugu, Park, & Miyazaki, 2010). The effect of a geriatric centre's roof terrace mimicking a forest was studied by Matsunaga, Park, Kobayashi und Miyazaki (2011). They measured the heart rate variability of people living in the geriatric centre. Consistent with the findings provided by Shinrin-yoku research, a decline in physiological stress parameters was observed after a 15-minute visit to the planted roof terrace.

Laboratory studies primarily investigate isolated effects of individual forest elements, including smells, noises and visual structures. They examine these in isolation under largely standardised conditions. Contact with artificial materials such as aluminium prompted an increase in blood pressure, while contact with wood caused no change in the physiological parameters. The results were the same even when

the temperature of the materials was kept constant. The assumption was that, unlike contact with artificial materials, contact with wood fails to induce any physiological stress (Sakuragawa, Kaneko und Miyazaki (2008). A virtual forest environment likewise had an effect on stress recovery. Thus, the rendition of natural noise represented a key factor in the recovery of parasympathetic nerve activity and, in doing so, contributed to reducing the physiological stress response (Annerstedt et al., 2013).

Health Prevention: avoiding diseases

Making use of forest visits for the prevention of specific diseases has a long tradition. As early as in the 1920s, restorative forest resorts or *Walderholungsstätten* were established especially in the German-speaking regions to make use of the forest's special air quality. The aim was to prevent disease dissemination in children who are at risk for contracting tuberculosis. Grose (2011) describes the development of such natural sanatoria and their significance for disease prevention among children. Today, she sees the forest's therapeutic benefit for children particularly in the promotion of physical exercise and the associated prevention of overweight and other disorders resulting from a lack of exercise. That the forest plays a particularly important role in children's health is supported by findings according to which general morbidity, the prevalence of chronic

illness and the risk of problems in the physical development of children increases with the distance of their home from larger wooded areas and sufficiently planted playgrounds (Kuchma, Sukhareva, & Makarova, 2008).

Forest visits could also strengthen the immune response and thus contribute to specific disease prevention. Various studies observed a rise in the number and activity of natural immune cells after a three-day stay in the forest (Li, 2010; Li et al., 2008). In some cases, the number and activity of what are known as natural killer cells (NK cells) increased. NK cells play a key role in the recognition and destruction of diseased body cells (e.g. cells infected by a virus, tumour cells). Increased NK cells activity was observed even thirty days after the forest visit. By way of comparison, a tourist's three-day visit to a city did not strengthen the immune system. It is assumed that the effects are attributable to specific plant substances, of which larger amounts can be found in forests (for an overview see Karjalainen, Sarjala, & Raitio, 2010). Future investigations are needed to reveal the underlying mechanisms and also, the study would need to be repeated in a non-Asian cultural setting.

Forest walks could further help to improve the quality of sleep and thus make an important contribution to health. On the one hand, the positive effects are attributed to increased physical exercise during the day. On the other hand, they are ascribed to the fact that the improved mood resulting on account of the forest

visits enhances the quality of sleep. People suffering from sleep disorders reported a deeper, longer and more restorative sleep after taking evening walks in the forest (Morita, Imai, Okawa, Miyaura, & Miyazaki, 2011).

4.2 Forests and Mental Health

Mood

Visiting woodland can increase positive emotions and reduce the amount of negative emotions. Positive emotions increased even after short forest visits: people felt more refreshed, more rested and more dynamic (Lee et al., 2011; Mao et al., 2012; Morita et al., 2007; Park et al., 2009; Tsunetsugu et al., 2013; Tsunetsugu et al., 2007) and reported a lower subjective stress level (Beil & Hanes, 2013). At the same time, a decline in negative emotions, including fatigue, irritation and dejection, was observed (Lee et al., 2011; Mao et al., 2012; Tsunetsugu et al., 2013). Woodland also helped to reduce stress levels and fear. After a visit to woodland, people reported that they felt less worried, less unsure and less tensed (Matsunaga, Park, & Miyazaki, 2011; Morita et al., 2007).

Viewing the landscape and taking a walk in the forest were felt to be much more relaxing and agreeable than comparable activities in urban landscapes (Lee et al., 2011; Park et al., 2007; Park et al., 2009; Tsunetsugu et al., 2013). Further studies suggest that the positive effects on a per-

son's mood depend particularly on the specific characteristics of the landscapes and less on the activities pursued there. With respect to mental restoration, no essential differences were observed in the various activities performed in woodland. People showed an increase in positive emotions and a decrease in negative emotions. These effects were independent of the amount of physical exercise and also irrespective of whether the people performed activities that suited their interests or not (Morita et al., 2007).

Even before the actual visit in the forest started, people felt more relaxed and showed positive emotions (Morita et al., 2007). As soon as the edge of the forest was reached, the positive effects on the visitor's mood were observed. The authors hypothesize that these findings might be explained by visual factors in the surrounding landscape. The people in the study were able to see the forest long before they arrived. Another explanation could be the phenomenon known as "affective forecasting" (predicting how one will feel in the future). Emotions that can be triggered by a situation are anticipated even before the situation actually arises. Such an imaginary process can affect the current mood. This assumption is supported by findings on the forest's physiological effects (Park et al., 2008; Park et al., 2007).

To what extent gender influences the effects on mood has yet to be studied. Some results indicate that, with respect to their emotions, women are more susceptible to being influenced

by woodland than men. Hence, women reacted with a greater decline in the stress level in forest areas and showed a stronger increase of negative emotions in urban areas (Beil & Hanes, 2013; Matsunaga et al., 2011; Morita et al., 2007).

Regeneration and subjective perception of stress

The importance of woodland for mental well-being is supported by studies conducted by Shin, W.S., Yeoun, P.S., Yoo, R.W. and Shin, C.S. (2010). In terms of the subjective perception of stress and regeneration, woodland appeared to trump urban environments. Forests do not represent the only restorative environments, but, compared to other environments, they have many advantages. Thus it became clear that even a short forest visit has positive effects on fatigue and exhaustion and leads to regeneration (Shin et al., 2010). The previous stress level also appeared to influence the change in mental parameters. Especially people who had suffered from chronic stress before benefited more from forest visits compared to controls (Hartig & Staats, 2006; Morita et al., 2007).

4.3 Forests and Social Health

According to the definition set forth by the WHO's Ottawa Charter the term health promotion aims at... "enabling people to increase control over, and to improve, their health" (WHO, 1986,

S.1). In this, the strengthening of the health potential of communities and the individual's ability to cope represent key strategies of action.

Social forestry

Social forestry projects can make a major contribution in this context. The term "social forestry" designates structured measures that aim to strengthen the emotional and social skills and to promote health in specific target groups. The activities needed to achieve these objectives are implemented in woodland under the direction of specially trained expert staff. They are geared for user groups whose specific needs must be taken into account when planning and implementing the activities. The potential achievement of such projects is the improvement of the participants' health, self-esteem, self-assurance and ability to concentrate. This could promote the social integration of the participating groups (Small Woods Association, 2010).

The health-promoting effects of forest visits at the physiological and mental level have been explained above. Nevertheless, not all groups of society make equal use of woodland as special recreational and activity areas. The following groups could derive particular benefit from social forestry: people on low income, people with disabilities, women and children, people with an immigrant background, people under 16 and older than 45 (Morris & O'Brien, 2011).

Socially-integrative potential of forests for groups with special needs

For people whose everyday life is subject to restrictions on account of physical and/or mental disabilities, natural landscapes possess a socially-integrative potential. Perception-based impressions of the environment are thereby of key importance. Sensory experience of the environment facilitates social integration, as it forms a basis for shared experiences irrespective of individual skills and capabilities. For people who depend on help in their everyday lives on account of their disabilities, experiencing the independent appropriation of the environment through sensory perception is of particular importance. Due to their manifold structures, woodland offers a rich line-up of the most varied sensory impressions (Nicolè & Seeland, 1999).

Two main effects by which woodland promotes the integration of people with an immigrant background are described in the literature: firstly, forests are visited by many different user groups and thus serve as a locus for social interaction and afford an opportunity for an exchange between different groups. Secondly, forests offer a strong symbolic identification potential, they are able to induce emotions and memories and they mirror a society's values. In order to verify this assumed integrative potential inherent to woodland, Jay und Schraml (2009) asked people living in Germany how they habitually use wooded areas. For people with an immigrant back-

ground, the emotional attachment to nearby forest areas was discovered to play an important role in the identification process with their new home country. The people further reported that the opportunity to a social exchange was essential. The social contacts between the different groups visiting woodland usually remained at the level of mere "small-talk", but even non-verbal communication facilitated the integration process. It is essential that forests are perceived as public spaces where, in contrast to urban settings, individual and cultural differences are of secondary importance. Forests have only few reference points that are marked by specific cultural attributes, such as language, and can thus induce a sense of not belonging. As a consequence, woodland is perceived as a universal place for recreation that is equally available to both people with and without an immigrant background.

Particularly for young people, urban parks and forests offer an essential opportunity for integration. Children and adolescents, in particular, spend a major part of their leisure time outdoors. Urban parks and woodland are popular areas to meet friends and pursue sports activities. In Switzerland, young people with and without an immigrant background were asked what places outside of school they chiefly frequented to make new friends (Seeland, Dübendorfer, & Hansmann, 2009). According to the information provided, urban green spaces, including parks and woodland, are popular sites to make new social

contacts. They offer a venue for social activities and encounters and can thus contribute substantially to the intercultural exchange. However, not all young people use woodland for social activities to the same degree. Urban woodland is visited more frequently, especially by young people from more affluent residential areas where population density is comparably low. One reason may be that these groups have easier access to forest areas, since forest areas are usually located in the direct vicinity of these residential areas (Seeland et al., 2009).

An evaluation study accompanied various projects implemented for under-represented groups within the framework of the "Active England" programme (Morris und O'Brien, 2011). The information provided by the participants and involved people gave rise to recommendations for the development and implementation of wooded areas. An improvement in the structural facilities, such as paved pathways and seating, increased the number of visitors, but was unable to ensure that people with varying needs were equally catered for. What proved to be essential instead were programmes offering the possibility of guided activities in woodland.

Women, for example, frequently reported that they avoided woodland due to the perceived risk. The performance of sports activities in a group and under the guidance of specially trained people, by contrast, gave them the opportunity to overcome previous barriers. Before specific user needs can be taken into account, target groups need to be properly defined. Ensuring sufficient communication with respect to the existence of such programmes is essential here in order to be able to reach out to the relevant target groups. Potential barriers outside the actual planning scope of the activity at hand, including ways of getting to the respective site, also need to be duly considered. In the process, cooperation between the various municipal organisations is indispensable.

To warrant that people with physical and/or mental disabilities are able to use the programmes, Nicolè and Seeland (1999) highlighted specific criteria. Programmes must offer participants the possibility of moving independently through the woodland. To this end, the setting must be designed in such a manner as to be accessible and walkable also for people with physical constraints. Moreover, a sufficient sense of orientation must be ensured by

clearly laid out pathways. However, any specialisation of the green spaces should be avoided for the sake of people with physical and/or mental disabilities. Any programmes addressing the special needs of specific user groups should not be limited to a specific area. This could prejudice the integrative function of woodland. The integration objective should thus be implicit. Neither should project planning limit itself to the landscape at hand, but also take into account the environs (e.g. amenities for overnight stays, indicators for specific offers and services).

Whenever the socially integrative potential of woodland is to be strengthened for people with an immigrant background, specific cultural differences in the use of the landscape must be taken into account. The results provided by Jay und Schraml (2009) indicate that cultural context has a bearing on the activities used in woodland. However, there is a lack of differentiated studies that take a look at people's specific user needs as a function of their cultural background. Further research efforts must cover these needs systematically and they need to be taken into account in a differentiated manner when the respective programmes are planned.

5. Therapy, Rehabilitation and Forests: Focusing on Groups of people with Diseases



This chapter asks what contribution woodland can make to promote the health of people with a medical history. In this context, woodland serves as setting for therapeutic intervention. At the same time, the forest visit itself can represent an intervention that supports the acceleration of the healing process, the alleviation of symptoms and facilitates the re-establishment of physical and/or mental functions.

Asian publications frequently speak of forest therapy or forest medicine. These areas are keen on pursuing an evidence-based approach. Programmes offered at the Healing Forest Garden Nacadia or as part of the wilderness therapy exemplify how recognised therapeutic measures are applied by trained people in suitably designed woodlands.

5.1 Forests and Mental, Physical and Social Symptoms of Disease

High blood pressure

Following reported effects in several studies, the results of Bowler et al. (2010) generally negated any major change in blood pressure on account of activities in natural spaces. Studies examining the influence forest walks have on high blood pressure patients showed inconsistent results. Mao et al. (2012) reported significant blood pressure drops among older study participants. However, Sung, Woo, Kim, Lim und Chung (2011) were unable to substantiate this effect. A Japanese study investigating the long-lasting effects of forest visits was unable to establish any correlation between the frequency of forest visits and blood pressure (Morita et al., 2011).

Sleep disorders

Morita et al. (2011) analysed how forest walks affect people with sleep disorders. Two-hour walks in the afternoon were found to improve both the quality and the length of sleep. The authors attributed the effects to the improved mood and the increased amount of exercise.

Stress-induced illnesses

Sonntag-Öström et al. (2011) discovered that different types of woodland have a positive effect on the mental well-being of patients in a stress clinic. The authors drew the conclusion that forest visits and the performance of therapeutic interventions in woodland can be conducive to the treatment of stress-induced fatigue. A promising project for the treatment of people with stress-related diseases is the Healing Forest Garden Nacadia (see Chapter 8.2).

Depression

Frequent studies investigated the effects of contact with nature on depressive disorders. A meta-analysis by Bowler and colleagues (2010) indicated that visits to nature improves depressive symptoms. Kim and colleagues (2009) studied the forest as setting for therapeutic interventions. They showed that the forest as setting for the application of cognitive behaviour therapies was able to increase the effectiveness of therapeutic measures. Also, in a not primarily medical nor therapeutic context the positive effects of forest walks on the mood of patients with depression were observed in a medical context that was not primarily therapeutic in nature (Berman et al., 2012). A visit lasting several days in a Korean forest in combination with a specially devised therapy improved the depression levels among alcohol addicts (Shin, Shin, & Yeoun, 2012). Townsend (2006) discovered that nature-related activities, such as environmental activism and forest tending, contributed to an enhanced well-being in depressed people. In this case, too, randomised controlled studies appear to be lacking. So far, only few studies have taken a differentiated look at specific woodlands as special natural settings for therapies.

5.2 Wilderness Therapy Programmes

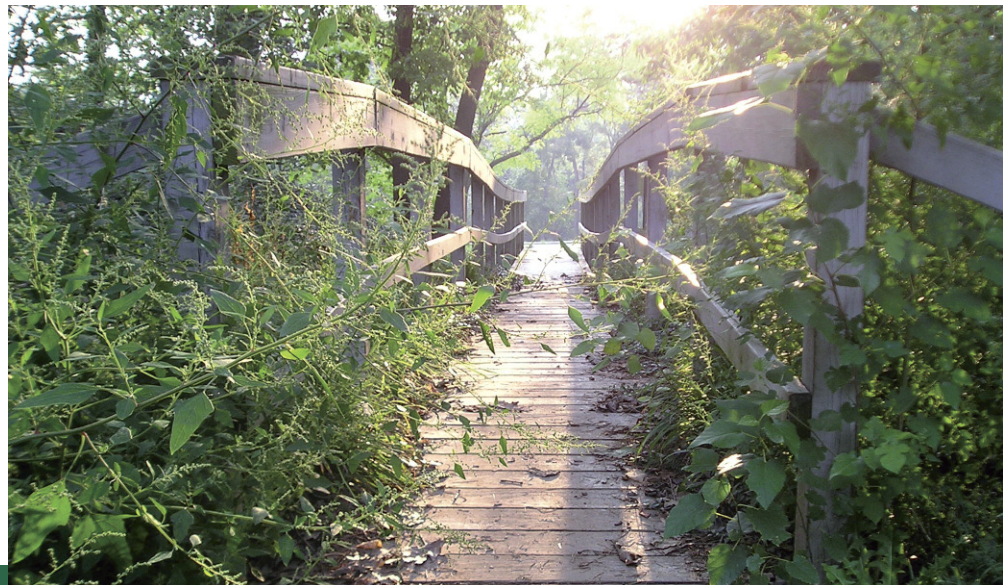
A growing number of wilderness therapy (WT) programmes are being offered, particularly in the US and Australia (Annerstedt & Währborg, 2011). They use woodland as setting for therapeutic purposes. The programmes available in this field vary greatly, however. The various WT programmes have different objectives, for instance. These range from an improvement in mental health to the reduction of overweight (Annerstedt & Währborg, 2011). Out of a large number of definitions and programmes, Russel (2001) was able to identify a shared body of theories by which most of the WT programmes are conceived. A crucial aspect is the use of "natural consequences" as a therapeutic device. These are behavioural consequences experienced as a natural outcome of the patient's own action. The wilderness therapy typically relies on approaches that combine experiences in natural landscapes with various psychotherapeutic measures.

Potentially adverse effects (e.g. injuries) in such programmes have hitherto been given only little attention in systematic research and evaluations (Annerstedt & Währborg, 2011). Javorski and Gass (2013) showed that the incidence of injuries

among (young) clients is slightly higher than in the remainder of the population. The explanation they provide is that, compared to the general population, most of the clients in the studied programme had an above-average risk of injury. Outdoor Healthcare Research Cooperative and other institutions publish the reports on injuries and accidents.

Efforts are underway to establish a joint framework model for the evaluation and research of wilderness therapy programmes (Russel, 2001). Despite these efforts to standardise and professionalise, comparability between the individual therapy approaches has been limited so far. General legislative conditions and clear regulations relating to the responsibilities of therapists are needed in order ensure a consistent line-up of services under the wilderness therapy label (Houston, Knabb, Welsh, Houskamp & Brokaw, 2010; Russell, 2001).

6. Conditions Influencing Health Effects in Forests



6.1 Duration of the Visit

People who visited a forest frequently stayed for shorter periods of time than those who rarely visited forests (Bernath, Roschewitz, & Studhalter, 2006; Arnberger & Brandenburg, 2007). It takes only a short sojourn for the positive effects of woodlands to be felt. Positive effects on physiological and psychological parameters become apparent even after a forest visit of only five to twenty minutes (Beil & Hanes, 2013; Matsunaga, Park, Kobayashi, & Miyazaki, 2011; Matsunaga, Park, & Miyazaki, 2011; Park et al., 2007; Park et al., 2009).

Positive effects on mood can be distinguished directly on arrival (Morita et al., 2007). This could be explained by the effects of what the visitors get to see while travelling to the site and the anticipated restorative effects. However, the duration of a visit to woodland has no significant influence on the mood change in the study conducted by Morita et al. (2007). In the first few minutes, the activities performed at the start of the forest visit bring about strong effects

relating to mental restoration (Barton und Pretty, 2010). The positive effects can be further amplified by extending the visit, but this increase levels off progressively. Hansmann, Hug and Seeland (2007), in contrast, found that people who have already spent a lengthy period of time in woodland tend to report mental restorative effects rather more frequently than people arriving in the woodland just before the survey was conducted.

6.2 Activities and Exercise

Different studies report varying results when it comes to the influence of the amount of physical exercise on the health benefit provided by woodland. In their studies on mood change in woodland, Morita et al. (2007) were unable to establish that the activities performed had any influence on the effects. The increase in positive emotions and the decrease in negative emotions were observed irrespective of what activities were pursued during the forest visit. Research in Shinrin-yoku, too,

made out similar effects on physiological and psychological parameters for various activities (Yamaguchi, Deguchi, & Miyazaki, 2006; Park et al., 2007; Park et al., 2009). These studies have in common that the activity level of participants during the forest visit was rather low. The only difference was that in some studies the participants sat, in some they walked and in others they performed easy physical activities such as taking photographs.

However, studies investigating the influence of sports activities on the health benefits of woodland indicate that the positive effects can be amplified by an increase in the level of physical activity. People using forests for sports activities (e.g. jogging, cycling, playing ball) felt more restored than people who spent their forest visit performing less physically demanding activities (e.g. taking walks, looking at nature) (Hansmann, Hug, & Seeland, 2007).

Studies suggest that sports activities in woodland can make a specific contribution to restoration and health that is unequalled by sports activities in other settings.

Whenever the physical activity performed in the forest is performed with the same intensity in a fitness gym or in an urban environment, specific environmentally determined effects could be observed: people performing sports activities in woodland tended to report an improvement of the inner balance and relief from daily worries more frequently than people using other settings for these activities (Hug, Hartig, Hansmann, Seeland, & Hornung, 2009). Moreover, people who visited woodland on a regular basis for the sake of doing sports reported mental health limitations less often than people using other environments for these activities (Mitchell, 2013).

6.3 Social Context - Alone or in Company

Studies examining the motivation for forest visits agree that people visit the forest in order to escape from the crowds, the hectic rush and the closeness of city life (Shin et al., 2010). Privacy and a sense of solitude appear to be important restorative aspects. Being accompanied by a familiar person may increase the sense of safety, but, as long one's personal safety is warranted, solitude is preferred for recovery from mental fatigue in nature, (Staats & Hartig, 2004). Generally, the presence of several less familiar people during a forest visit is appreciated, but an overcrowding of the area or the complete absence of other visitors is rated rather negatively (Arnberger, Aikoh, Eder, Shoji, & Mieno, 2010a; Arnberger, Haider,

Eder, & Muhar, 2010b; Arnberger & Eder, 2011a, 2011b, 2012).

6.4 Other Influencing Factors

Forests are by all means also places that can be associated with negative experiences and conceptions. These, in turn, would impede the implementation of successful health promotion and disease prevention measures. A forest characterised by tree density and a very confusing terrain, making it very dark even during the day, hardly offers any possibilities of orientation and only poor visibility. Among women, in particular, this leads to feelings of anxiety and fear of sexual attacks, robberies and intimidation, for example (Andrews & Gatersleben, 2010; Jorgensen, Hitchmough, & Dunnett, 2007). Moreover, this setting induces negative feelings such as a lack of safety and a sense of being closed in (Herzog & Leverich, 2003; Milligan & Bingley, 2007). For these reasons, women frequently do not enjoy going into the woods on their own (Ward Thompson, Aspinall, Bell, & Findlay, 2005; Ward Thompson, Aspinall, & Montarzino, 2008; see also 4.3). Furthermore, forests with poor visibility and poor legibility of the terrain are hardly given preference (Andrews & Gatersleben, 2010). They cause negative sensations and do not contribute to mental restoration (Gatersleben & Andrews, 2013).

The question remains, however, whether this experience in and notions of the forest come

about merely on account of the forest's physical appearance. Studies suggest that childhood experiences play a decisive role in determining whether adults visit the forest frequently or infrequently. People who, as children, hardly spent any time in a forest, possibly due to the parent's fear of potential hazards, only very rarely visited forests for recreational or leisure time activities as adults (Ward Thompson et al., 2005; Ward Thompson et al., 2008; Milligan et al., 2007). Media, myths or stories likewise may influence the way the forest is perceived (Milligan et al., 2007). In addition, reports in the media about accidents, attacks or murder in forests have contributed to the negative image. Furthermore, the forest is used as the setting for lots of horror films, further exacerbating the already existing fears.

The state of the forest is more important for people who visit a forest only once weekly or monthly than for people who pay a visit daily. The forest should make a well-kept impression particularly on occasional visitors. This applies to older people as well. Men and women aged 65 and over responded with greater sensitivity to any rubbish and the condition of forests than younger people (Ward Thompson et al., 2005). Arnberger and Eder (2011b) observed different levels of sensitivity in the various age groups, generally with regard to the amenities of a recreational area in general and, specifically with respect to the occurrence of rubbish and dog excrement.

What needs to be taken into account is that people who suffer

from allergies should not visit a forest in just any season. During the times of seasonal pollen distribution, for instance, forests should be avoided for health-related reasons (Morita, Nagano, Yamamoto, Murakawa, Aikawa, & Shirakawa, 2009). Moreover, the occurrence of disease vectors, such as ticks, must be communicated. Mosquitos, poisonous animals and plants can pose a hazard to people in forests as well. The increased occurrence of disease vectors was observed particularly when forest fragmentation or cut-downs had occurred and there was a lack of biodiversity (Karjalainen, Sarjala, & Raitio, 2010).

Among various factors, the duration of a forest visit correlates with the number of other people present and their activities. The presence of many people pursuing different activities at one and the same time, including cycling or jogging and walking the dog without a leash, deter-

mined people to avoid the forest in future (Arnberger & Haider, 2007, Arnberger & Eder, 2011b, Arnberger et al., 2010a, b). Those who do not have the possibility of visiting other woodland will have no choice but to accept a deterioration in their recreational experience (Arnberger & Haider, 2005). This shows that conflicts in use can be detrimental to recreation. Generally, two different types of conflict can be mentioned here (Hunziker, Freuler, & von Lindern, 2011):

- conflicts between recreational use and other land uses, such as forestry and nature conservation;
- conflicts between the people seeking recreation on account of the different recreational activities and reasons for a visit.

Particularly within the urban space, but also in forests located at a city's periphery, adverse

effects resulting from the high levels of use are increasing (Arnberger, 2006, Arnberger & Brandenburg, 2007; Arnberger & Eder, 2012; Arnberger et al., 2010a, b). The nature of existing conflicts led to the conclusion that the requirements sustainable forest recreation management must meet are increasing (Hunziker, Freuler, & von Lindern, 2011). Perhaps individual user groups (e.g. hikers, cyclists) need to be physically separated from one another (Baur, 2006).

For forest workers, the forest is only a limited source of recreation in their free time. This has to do with the work load and the stress they experience in the forest, but also with the low pay they receive for the high-risk and difficult work they perform (Bingley, 2013; Von Lindern, Bauer, Frick, Hunziker, & Hartig, 2013).



7. General Conditions for Nature and Forest Visits

7.1 Social and Personal Conditions

The frequency of visits to local recreational areas is more predictable on the basis of specific social and personal conditions than on the basis of conditions of the residential environment or work conditions. People caring for children under eight used local recreational areas more often than people without children (Degenhardt, Frick, Buchecker, & Gutscher, 2011). The likelihood of dog keepers using local recreational areas more often is likewise higher. Whenever a local recreational area is located further away and the time needed to get there is too long, then the chance that the affected person visits this area is low (Arnberger & Brandenburg, 2007; Arnberger et al., 2010b; Arnberger & Eder, 2011b).

7.2 Reasons for Seeking Restoration in Forests and Activities Undertaken in Forests

People visit the forest in order to escape from the crowds, the hectic rush and the closeness of city life (Shin et al., 2010). A Swiss study assessed the reasons for a forest visit among 3,022 study participants (Hunziker et al., 2011). For the respondents, the most important reasons were "to enjoy the good air", "to experience nature", "to get away from everyday life" and "health", whereas "being alone" and "sports" were considered comparatively less important. The activities pursued in the forest were likewise assessed. Most frequently mentioned was "to take a walk" at 64 percent followed by "sports" (39%), "simply to be" (32%) and "to observe nature" (26%). With 16 percent, "collecting" was well-represented as well. The forest visit was experienced as conducive to re-

laxation by 95 percent of the respondents. In a comparative study done by Arnberger et al. (2010a), Austrian and Japanese people seeking recreation mentioned "health", "experiencing the country", "restoration" and "stress reduction" as the principal reasons for a visit to the forest. Arnberger and Eder (2011b) and Arnberger (2006) found that "to take a walk", "to walk the dog", "jogging" and "cycling" were the activities that were pursued most frequently in forests in Vienna, Austria.

7.3 Monetary Aspects of Restoration in Forests

There are numerous papers on calculating the monetary value of the benefit that recreational forests provide for the population. As there are no markets for environmental goods such as human recreation in forests and thus no prices, various environ-

mental account methods have been used to assess the value of such goods. The contingent valuation method and the travel cost method are primarily used to determine the recreational value of forests. A review was provided by Elsasser (1996), Elsasser and Meyerhoff (2001) Mantau (1994), and Mantau et al. (2001).

When calculating the value of a forest's recreational function using the contingent method a hypothetical scenario is described where an admission fee for forest visits is normally charged, usually in relation to a specific forest area. A survey is conducted to find out how much the visitors would be willing to pay for a one-off admission ticket or for an annual pass. The highest amount that visitors would pay instead of forgoing forest visits is designated the "willingness to pay" (Bernath et al., 2006). Elsasser (1996), for example, found that the average, weighted willingness to pay was around EUR 60 for an annual pass as long as the pass allowed the visitor to visit all forests in Hamburg. Bürg et al. (1999) wrote a paper on the recreational use of the Vienna Woods in which they also determined the value of the recreational function using the willingness-to-pay method. On average, the respondents who favoured admission prices as a matter of principle (52%) were willing to pay approx. EUR 1.30 for each visit. For the forests in Zurich, Bernath et al. (2006) found that the population was willing to pay a price of approx. EUR 90 for an annual pass. This amount was extrapolated to include all people living in Zurich

and visiting the forests in the urban region at least once a year. As a result, the value of the forest as recreational area for the people of Zurich, a city with 2,250 hectares of woodland, was estimated to be approx. EUR 24.5 million a year.

Recently, preference research related to recreational forests assessed the popularity of specific forest stands and their amenities in the population and further seek to determine the willingness to pay for their establishment and management. In Denmark, for example, Nielsen et al. (2007) found the highest willingness to pay for a forest scenario that involves the conversion of a single-layer coniferous forest (five hectares) without course woody debris into a multi-layered mixed forest with some dead trees. Similarly, Upton et al. (2013) found that the Irish population was willing to pay the highest price for mixed forests if these were accessible and had a good infrastructure for recreational purposes and dedicated nature conservation areas. In both papers, researchers underscored that (near-natural) forests, their afforestation and sustainable management as well as recreational use enjoy a special status in the countries Denmark and Ireland which are sparsely forested on account of their historical use of woodland. By contrast, a study from Finland, where the recreational use of forests has a long tradition, showed that an increase in taxes to finance specific management activities in public forests met with little acceptance (Horne et al., 2005). However,

the willingness to pay presumably also correlates to the activities pursued by people in forests (Boxall, Watson, & Englin, 1996; Boxall & Macnab, 2000).

A nationwide study assessed the recreational value of the Swiss forest using the travel and accommodation cost method. In this case, the (estimated) expenses the respondents incurred for a visit to a forest were used as basis. The calculated amount allocated to woodland in Switzerland as recreational site totalled approx. EUR 8.5 million (Ott & Bauer, 2005). Woodland in Switzerland, by way of comparison, covers approx. 1.28 million hectares (Brändli, 2010).

Another method of calculating the monetary value is to assess the losses in timber production caused by recreational use. Forest managers, particularly in densely populated settlement areas, often believe that costs or reduced income from timber production is caused by forest visitors. Various studies conducted in heavily frequented forests in Switzerland reported that, in urban forests subject to extreme use, such losses amount to between EUR 42 and a maximum of EUR 3,265 per hectare and year, depending on the intensity of visits and forest location (Roschewitz & Holthausen, 2007). Rusterholz Bilecen, Kleiber, Hegetschweiler and Baur (2009) calculated the decrease in the value of beech and oak tree trunks due to the damage attributable solely to recreational use in two Swiss, semi-urban recreational forests. Average losses of EUR 19 and EUR 53 per hectare and year were

calculated for the two forests, whereas losses amounted to approx. EUR 500 per hectare and year in strongly frequented areas. In this respect, there is another aspect that is set to gain significance in the foreseeable future: the degradation of a site due to excessive use and the (long-term) effects on a forest's creditworthiness. The existence of negative influences on the vegetation (e.g. reduction of plant density, reduction in leaf biomass, growth height and biodiversity) and on the forest floor (e.g. by compacting) that are caused by the visitors has already been substantiated (Amrein, Rusterholz, & Baur, 2005; Kissling, Hegetschweiler, Rusterholz, & Baur, 2009; Sikorski, Szumacher, Sikorska, Kozak, & Wierzba, 2013). No corresponding economic valuation was found.

On the one hand, it is difficult to compare the results of these

valuation methods. On the other hand, the results within one and the same method vary greatly on account of instrumental factors, including tree variety, forest site, population, interests and intensity of use. Therefore, it is impossible to draw a generally valid conclusion with respect to the recreational value of forests based on this approach. The fact that recreation in forests is extremely valuable but its monetary value is difficult to calculate is borne out by the intense research activity in this field. In order to be able to make conclusive statements, it would therefore appear expedient to conduct site-specific surveys whenever an economic valuation is needed. However, it can generally be assumed that losses in timber production as well as the maintenance and management costs incurred in forests on account of visitors are far less than the value representing the forest's

benefit as a place of human recreation (Tyrväinen, 2001; Rusterholz et al., 2009). Nevertheless, problems do arise, particularly for private forest owners. The losses and the work contributing to the recreational effect are frequently incurred and performed on the side and cannot generally be invoiced on (Roschewitz & Holthausen, 2007).

Publications frequently call for cost-benefit analyses of interventions in forests, but these are only rarely implemented. In a systematic review of the literature, studies relating to forest therapy were subject to a detailed analysis. None of the studies found in the systematic search provided information on the costs of the reported (therapeutic) intervention (Kamioka et al., 2012).



8. Practical Examples

8.1 Developments in Asia, Europe and Australia

Japan: Shinrin-yoku

Shinrin-yoku combines the two words "forest" and "bathing" and is usually translated as "forest bathing". The term was first introduced by the Forest Agency of the Japanese government in 1982 as part of the Shinrin-yoku plan. Shinrin-yoku describes time spent in woodland and immersion into the specific atmosphere of the forest in the hope of achieving a healing and therapeutic effect. Ever since the plan was launched, society has been paying activities in the forest, stress recovery and relaxation greater attention. Projects carried out based on the Shinrin-yoku approach endeavour to explore the positive influences on humans (Park et al., 2009).

Japan: Tree climbing

Tree climbing is a widespread outdoor activity in Japan pursued

not only by healthy but also by physically challenged people. Secured by ropes and in the presence of instructors, people of any age get to climb onto a special part of a tree. People who climbed a tree instead of a cement tower felt more relaxed, more vital - both physically and mentally - and less tired. Moreover, this experience increased their willingness to become active in nature conservation and the protection of nature. Tree climbing is an activity usually associated with a family outing. Just as with many types of sports, the social effects became evident in the development of social communities (Gathright, Yamada und Morita, 2006, 2007, 2008).

Korea: Recreational forests

In Korea, a project for the creation of recreational forests was launched in 1988. By 2009, the Korean Forest Service was operating 133 recreational forests. It also operates therapy forests,

which include visitor centres, forest health trails and simple sports activities. Korea cooperates closely with Japan in matters concerning recreational forest research.

Finland: Task Force on Forest and Human Health

Finland belongs to Europe's heavily forested countries. Over 75 percent of the surface area is covered by forests. The Finnish Forest Research Institute (METLA) is one of Europe's major forest research institutes and administrates the website of the Task Force on Forests and Human Health.

This Task Force has two priorities:

- maximising the health benefit of forests and
- managing the health hazards of forests. The 1/2013 newsletter reports that recreational trails have been installed in four European countries: Finland, France, Luxembourg and Sweden.

***The German-speaking region:
waldwissen.net***

In the German-speaking region, four research institutes active in forest research that are located in Baden-Württemberg (FVA), Bavaria (LWF), Austria (BFW) and Switzerland (WSL) jointly set up the website waldwissen.net. This website offers scientifically validated content on current issues. The section entitled Recreation and Relaxation includes a number of entries. Swiss researchers, in particular, have submitted contributions on health and well-being in the forest. Gasser und Kaufmann-Hayos (2005), for example, conclude that, with respect to the situation in Switzerland, all three forest functions have a bearing on human health. Production forests have a direct economic benefit in terms of health, the protective forest generally protects human life and the forest's welfare function gives rise to effects at the social and interpersonal level. Martens and Bauer (2010) showed that a managed and open forest promotes a sense of well-being better than a "wild" forest. The website also provides twelve thematic fact sheets on leisure and recreation in the forest. The individual topics are: Forest and Health; Forest Visitors and their Recreational Activities; Amenities; Stress Exposure of Forest Ecology; Value, Costs and Price of the Recreational Forest; Legal Aspects; Conflicts and Visitor Management; Specific forests for 'Recreation and Relaxation'; Participation; Performance Agreements; Design and Man-

agement; and Sustainable Development of the Forest for Leisure and Recreation (Bernasconi & Schroff, 2008). Schaffner and Suda (2008) studied the "furniture" in forests and asked 607 people seeking recreation in German forests what their reasons were for visiting. They also asked them to rate the recreational amenities, including seating accommodations. Since motivation and perception among the people seeking recreation were focused on the forest itself, no further recreational amenities appeared necessary except for basic accessibility by means of trails and guidance in the form of signposts.

***United Kingdom:
Forestry Commission***

England, Scotland and Wales have a long tradition of social-science-based forest research. This research aims to develop an understanding about the relationships between forestry and society by concentrating on the social dimensions of sustainable forest management. Over the past decade and even now, the Forest Commission has sought to develop programmes that draw people into the forest. Cooperation between the forestry sector, the health sector and various foundations plays a significant role. Numerous projects and campaigns have been successfully implemented, evaluated and published (Morris & O'Brien, 2011). Online brochures provide practical information and tips. The website also includes a reference to the EU's ongoing research programmes.

***Australia:
Healthy Parks Healthy People***

This Australian initiative endeavours to bring various sectors together. These primarily include the health, environmental, park, community development, tourism and educational sectors. The aim is to combine health promotion and environmental protection. The initiative holds that it has sufficient empirical evidence to view environmental protection as a Public Health strategy. The group cooperates with Deakin University. A current research report presents the benefits of coming into contact with nature for mental health and well-being (Townsend & Weerasuriya, 2010). This report is available online for download.

8.2 Healing Forest Garden Nacardia

The Healing Forest Garden Nacardia was designed by an interdisciplinary team (Corazon, Stigsdotter, Jensen, & Nilsson, 2010). Nacardia offers activities for the treatment of patients with stress-related disorders in a specially devised natural environment comprising forest and garden elements. The project is under the scientific supervision of the University of Copenhagen in Denmark. This facilitates the collection of important findings relating to the practice and theory of nature-based interventions.

Purpose

On the one hand, the aim is to offer patients suffering from chronic stress and associated symptoms of fatigue treatment at Nacadia. On the other hand, the aim is to generate evidence-based knowledge on the effectiveness of the forest therapy garden and the nature-based therapy implemented there. An additional benefit is provided by the development of training programmes for healing garden design and nature-based therapies.

Design

The structure of the Healing Forest Garden is based on evidence-based design standards derived from the experience with therapy gardens, particularly in the Scandinavian region. The Healing Forest Garden is divided into four different sections that place varying demands on patients, e.g. with regard to social contacts. The design of the different sections is based on the assumption that when patients begin their therapy they tend to prefer areas they feel safe in and can be alone in. For this reason, a comparably quiet, wooded area is made available, where contacts to the other patients are rather limited. As the treatment progresses, the patients get to explore the other areas of the Healing Forest Garden. In this manner, social contacts between the patients, as facilitated by the differently designed sections,

gradually increase as the therapy proceeds.

Treatment

The treatment takes about ten weeks. A private hospital specialised in stress-induced diseases is responsible for providing the medical care. The treatment is based on cognitive therapy approaches, and particularly the acceptance and commitment theory (ACT). The guided experience of nature using all senses, garden work and nature-related stories and symbols are activities supported by the ACT techniques using nature-based means. The aim of the treatment is to ensure regeneration of the patients as regards their emotional cognitive resources. At the same time, it endeavours to strengthen their mental health and well-being. Beyond this, the development of abilities that make it easier to cope even with future stress is vital for the promotion of health and the prevention of disease.

Scientific substantiation

To expand the knowledge on the effectiveness of nature-based therapy, the activities at Nacadia are attended by quantitative studies. These permit a comparison with conventional therapy methods. Further basic and application-based research is planned in order to investigate the long-term effects of the

nature-based therapy approach and to further optimise the garden facility.

8.3 The (computer-generated) Virtual Forest

The virtual forest gives people who are unable to frequent a real forest the opportunity to experience some of the benefits of forest landscapes. There are two types of virtual forests:

- the virtual forest on video and
- the computer-generated forest (Valtchanov, Barton, & Ellard, 2010).

Watching videos that simulate a walk in the forest induce physiological regeneration by lowering blood pressure and the skin conductance level. After the viewing, people experienced a more positive mood and developed a higher level of attention, concentration and energy (Van den Berg, Koole, & Van der Wulp, 2003; De Kort, Meijnders, Spouselee, & IJsselsteijn, 2006; Villani & Riva, 2008; Kjellgren & Buhrkall, 2010).

Computer-generated forests afford the possibility of designing a forest according to individual preferences and is therefore very interesting for researchers. Through them, natural noises were identified as an essential aspect of regeneration in forests (Annerstedt et al., 2013). Furthermore, easy access and allowing for a high sense of orientation were shown to positively

influence the mood and to have a calming effect (Staats, Gatersleben, & Hartig, 1997). Moreover, people felt more positive, reinvigorated, more awake, more vital and relaxed after a virtual walk in the forest than before the walk (Ohsuga, Tatsuno, Shimono, Hirasawa, & Oyama, 1998; Oyama, Ohsuga, Tatsuno, & Katsumata, 1999; Valtchanov et al., 2010). Computer-generated realities also appear to alleviate pain and allay fears in the medical context (Hoffman, Patterson, &

Carrouger, 2000; Hoffman, Garcia-Palacios, Patterson, Jensen, Furness III, & Ammons Jr, 2001; Schneider & Workman, 1999; Mosso, Obrador, Wiederhold, Wiederhold, & Santander, 2012).

However, people in a real forest were better able to relax and reflect on problems and they were more energetic, more creative and more upbeat than after visits to virtual forests (Kjellgren & Buhrkall, 2010; Mayer, Frantz, Bruehlman-Senecal, & Dolliver, 2009).

An example for the educational use of the virtual forest that merits mentioning is the "United Paper Mills (UPM) Forest Life" project by The Biofore Company in Finland (w3.upm.com/upm/forestlife/index.html). Here, a virtually guided forest walk provides information on forest products, forest animals, forest work and lots more.

9. Overview of Scientific Reviews and Outlook



All available reviews of the topic Nature, Health and Well-being as well as the topic Forest, Health and Well-being are shown in Tables 2 and 3. Overall, the empirical evidence in terms of na-

ture appears to be more substantiated than in terms of the forest. Consequently, further systematic reviews and meta-analyses relating to the forest theme are necessary.

The reviews in Table 2 draw a consistent picture and support the assumption of the beneficial effect of nature on health. This includes physical, mental and social well-being.

Authors	Method	Subject of the study	Results and Outlook
	Field of study		
Language of publication	Included sources		
	Number of cases		
Abraham, Sommerhalder, & Abel, 2010	Systematic review of literature	Promoting health with the help of natural landscapes	Landscapes as a resource for physical, mental and social well-being. Presentation of a heuristic model.
	Nature		
	Reviews of literature, scientific studies and reports		
English	123		
Annerstedt & Währborg, 2011	Systematic review of literature	Nature-based therapies as Public Health (PH) tools	Effectiveness of and adequate measures of nature-based therapy as PH tool are advocated. Multiple uses (including overweight, anti-social and delinquent behaviour, depression, schizophrenia) are shown.
	Nature		
	Systematic reviews of literature, meta-analyses, randomised controlled studies, non-randomised intervention studies, observational and qualitative studies		
English	38		
Barton & Pretty, 2010	Meta-analysis	Duration and intensity of exercise in nature on self-esteem and mood	A short visit and low intensity show the highest positive effect, irrespective of the landscape.
	Studies with comparable methodology and statistics		
English	10		

continue table 2

Authors	Method	Subject of the study	Results and Outlook
	Field of study		
Language of publication	Included sources		
	Number of cases		
Bowler, Buyung-Ali, Knight & Pullin, 2010	Systematic review of literature and meta-analysis	Comparison between natural and urban environments in relation to health and well-being	Stronger evidence for mental than for physiological parameters.
English	Nature 24		
Elmendorf, 2008	Review of literature	Social relevance of participation in environmental projects	Projects promote healthy environments, social structures and community development.
English	Nature and, specifically, the planting of trees		
Haluza, Schönbauer, & Cervinka, 2014	Narrative review of literature	Physiological health outcomes of direct outdoor nature experiences and its potential for improving Public Health	The majority of studies reported significant positive effects. A harmonizing effect of nature, especially on physiological stress reactions, was found across all body systems. However, in many cases ambiguous effects were reported. Interdisciplinary collaborations on utilizing benefits of nature regarding health promotion, disease prevention, and nature-based therapy should be optimized.
English	Nature, outdoors		
	International, scientific peer-reviewed papers 17		
Health Council of the Netherlands, 2004	Compilation of literature	Wholesome effects of nature on health and well-being	Positive effects in view of stress reduction and attention fatigue. Promotion of exercise, opportunity for social contacts, positive influence on the development of children, influence on personality development and finding a sense of meaning. Further scientific findings regarding the underlying mechanisms are needed to implement applications in the field of health promotion and spatial planning.
English	Nature		
Körner, Nagel, & Bellin-Harder, 2008	Review of literature	Health-promoting factors of urban nature	Empirical substantiation of the health-promoting influence of nature. Nature as health-promoting agency is not taken into account in healthcare. Research and the avoidance of a negative environmental impact are crucial.
German	Urban nature		
		Scientific literature	

continue table 2

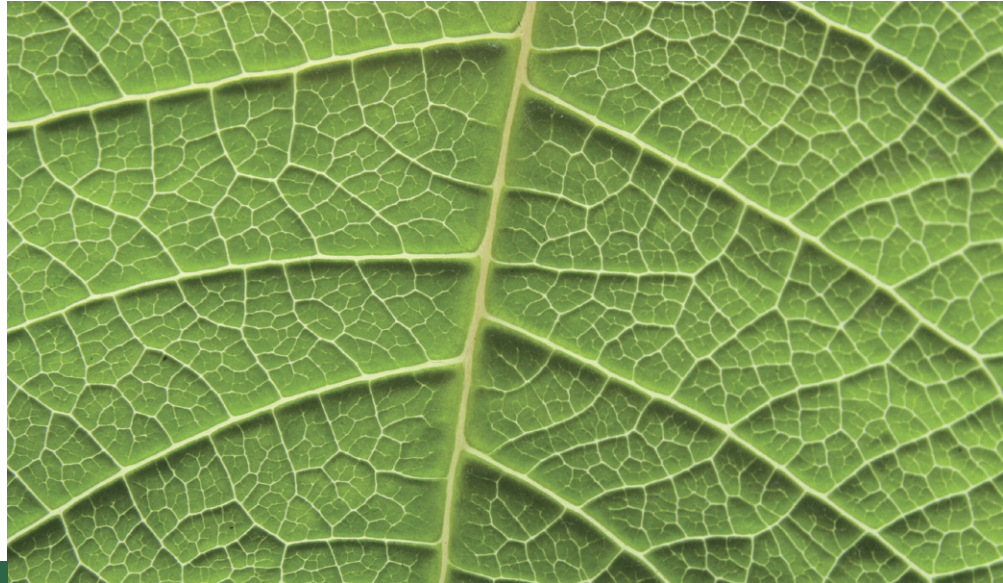
Authors	Method	Subject of the study	Results and Outlook
	Field of study		
Language of publication	Included sources		
	Number of cases		
Maller, Townsend, Pryor, Brown, & St. Leger, 2005	Review of literature	Health benefits of contact with nature	Nature plays crucial role in well-being and health. Contact with nature as PH strategy to prevent mental and physical disease prevention is encouraged.
	Nature		
English	Empirical and theoretical reports as well as case studies		
Martens & Bauer, 2013	Review of literature	Influence of natural and urban environments on restoration and well-being	Natural environments have a stronger positive influence on restoration, self-reflection and well-being than urban environments. High level of access and low density of natural environments is crucial for well-being.
	Nature		
English	Scientific literature		
	32		
Matsuoka & Kaplan, 2008	Review of literature	Which human needs are met in urban nature to what degree (contact to nature, aesthetic preference, restoration, privacy, community identity).	Nearby nature significant for human well-being, since it can contribute positively to meeting the needs that have been studied.
	Urban nature		
English	Reviews of the literature, scientific papers, interviews, observations, case studies		
	90		
McLain et al., 2012	Review of literature	The effects of collecting natural products	Collecting products of nature promotes physical exercise, affinity to nature, knowledge of nature, social relations, cultural identity.
	Urban nature		
English	Scientific literature, websites, handbooks, grey literature		
Townsend & Weerasuriya, 2010	Review of literature	Mental health and well-being in nature	Detailed breakdown of study fields. Conclusion missing.
	Nature		
English	scientific papers, grey literature, specialised books		
Velarde, Fry, & Tveit, 2007	Review of literature	Compilation of different landscape types and their health effects	Compared to urban landscapes, natural landscapes have stronger positive health effects. Negative effects were observed in urban landscapes.
	Nature		
English	Reviews of literature, scientific papers		
	31		

Table 3: Reviews on the topic Forest, Health and Well-being			
Authors	Method	Subject of the study	Results and Outlook
	Field of study		
Language of publication	Included sources		
	Number of cases		
Gasser & Kaufmann-Hayoz, 2005	Review of literature	How forests and trees contribute to human health and well-being	The significant role of the forest as a space for recreation, experience and learning recreational. Special status in society. Increase in educational nature and forest projects has been observed. Nature and forest in the therapeutic context are rarely used in practice; if used, then only in addition to a therapy without being allotted an independent central role. Forest walk as leisure-time activity in a rehabilitation centre serves as an example. Measurement of a forest's effects and evaluation of forest projects are patchy.
German	Scientific literature, projects in practice, research projects in Switzerland, part of COST Action E39		
Kamioka et al., 2012	Meta-analysis	Evidence for the healing and health-promoting effects of forest therapy	There is a lack of well documented, high quality randomized controlled trials. Thus it was impossible to make conclusions about the effects of forest therapy. Suggestions on how to improve the quality of studies on forest therapy are made (e.g. appropriate checklists for research design and intervention method).
English	Systematic review of two basic research papers, randomised controlled studies, scientific literature		
Karjalainen, Sarjala, & Raitio, 2010	Review of literature	Correlation between forest and health (risks and benefits)	Forest visit promotes physical and mental health by reducing stress. More research and cooperation between practitioners, researchers and policy makers is needed.
English			
Shin, Yeoun, Yoo, & Shin, 2010	Review of literature	The forest's positive contributions to health and well-being, describe a theoretical framework for this effects	Forest visits improve emotional, physiological and cognitive health. Recovery from stress, enhanced performance and concentration, lowers blood pressure and heart rate and allays fear.
English			
Tsunetsugu, Park, & Miyazaki, 2010	Review of literature	Effect of Shinrin-yoku (1) on physiological stress indicators and (2) with respect to the five sensory faculties	Both lab studies and field studies suggest a health-promoting effect both physically and mentally.
English			

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Books

Links



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