Forest for Rest
Recovery from exhaustion disorder

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När man haft bråttom länge måste man stanna upp
och vänta in sin själ.

Gammalt kinesiskt ordspråk

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ABSTRACT

Background Exhaustion disorder (ED) is a common mental and behavioural disorder which often leads to severe negative consequences for the individual and the society. Natural environments have positive effects on mental, physiological and attentional recovery in stressed persons, which encouraged us to test if forest visits could improve recovery from ED. The main objective of the thesis was to study if visits to different kinds of forest environments have positive health effects on patients suffering from ED, and if forest visits can be utilized for rehabilitation.

Methods Participants in the MiniRest study (n=20) and the Pilot study (n=6) (Papers I and II) were recruited from the Stress Rehabilitation Clinic (SRC) at the University Hospital in Umeå. Participants in the randomised controlled study, ForRest (n=99) and the Interview study (n=19) (Papers III and IV) were recruited from both the SRC and the Swedish Social Insurance Agency in Umeå. The MiniRest study involved only female ED patients and focused on immediate mental, physiological and attention capacity effects in one urban and three forest environments. The Pilot study investigated the practical arrangements for the forthcoming ForRest study. Participants in the ForRest study were randomised into either a three-month forest rehabilitation group; A (forest visits twice a week/4 hours per day) or to a control condition; B. Both groups received Cognitive Behavioural Rehabilitation (CBR) at 24 occasions/once a week after the three-month study period. Preferences for forest environments, mental state and attention capacity were studied for group A only. Psychological health measurements and sick leave data were compared between the groups after (i) the forest rehabilitation and (ii) the CBR. The Interview study was conducted according to grounded theory methodology and consisted of 19 participants from group A to explore personal experiences from the forest rehabilitation. Data collection was implemented through questionnaires, medical records, physiological measurements, and interviews.

Results Exposure to forest environments was associated with higher preference, more favourable mental state and physiological responses, and increased attention capacity compared to an urban environment (Paper I). Open and accessible forest environments were preferred (Papers I, II and III). Recovery from ED was found in both groups in the ForRest study, but there were no differences between the groups over time. In group A, positive effects on mental state and attention capacity were found during the forest visits. An interaction effect was found with more positive effects on mental state during spring compared to autumn (Paper III). Solitude, feelings of freedom and no demands were important for finding peace of mind during the forest visits. Moreover, easier access to peace of mind, reflective thinking and positive feelings were reported as the forest rehabilitation progressed (Papers II and IV).

Conclusions Forest visits have restorative effects for ED patients through enhanced mental well-being, easier access to peace of mind, beneficial

physiological reactions and increased attention capacity which support the use of forest environments in rehabilitation. However, forest rehabilitation tested in a randomised controlled trial did not improve recovery from ED. Potentially rehabilitation with CBR and forest visits integrated could be more effective and should be further investigated in nature-assisted rehabilitation for ED patients.

ABBREVIATIONS

AAT	Affective – Aesthetic Theory
ANS	Autonomous Nervous System
ART	Attention Restoration Theory
CBR	Cognitive Behavioural Rehabilitation
CIS	Checklist Individual Strength questionnaire
DSM	Diagnostic and Statistical Manual of Mental Disorders
ED	Exhaustion Disorder
HAD-S	Hospital Anxiety and Depression Scale
HPA	Hypothalamus – Pituitary – Adrenal - axis
HRR	Heart Rate Recovery
ICD	International Classification of Diseases
KBR	Kognitivt Beteendeinriktad Rehabilitering
MBI	Maslach Burnout Inventory
NCD	Non-Communicable Diseases
NCPC	Necker Cube Pattern Control task
POMS	Profile of Mood States
PSQ	Perceived Stress Questionnaire
SAS	Statistical Analysis Software
SCB	Statistiska Centralbyrån
SCQ	Self-Concept Questionnaire
SFS	Svensk Författningssamling
SMBQ	Shirom-Melamed Burnout Questionnaire
SOU	Statens Offentliga Utredningar
SPSS	Statistical Package of Social Sciences
SRC	Stress Rehabilitation Clinic
ZIPERS	Zuckerman Inventory of Personal Reactions
WHO	World Health Organisation

SVENSK SAMMANFATTNING

Bakgrund Utmattningssyndrom har blivit ett vanligt tillstånd av psykisk ohälsa, som ofta leder till allvarliga negativa konsekvenser för individen och samhället. Tidigare studier har visat att naturmiljöer har positiva effekter på mental och fysiologisk återhämtning hos stressade men friska individer. Syftet med denna avhandling var att undersöka om vistelse i skogsmiljöer har positiva effekter för patienter med utmattningssyndrom, och om skogsmiljöer kan användas i rehabilitering av utmattningssyndrom.

Material och Metod Deltagarna i MiniRest-studien (n=20) och Pilot-studien (n=6) (artiklarna I och II) rekryterades från Stressrehabiliteringen på Norrlands universitetssjukhus i Umeå. Deltagarna i den randomiserade kontrollerade studien ForRest (n=99), och i Intervju-studien (n=19) (artiklarna III och IV) rekryterades från både Stressrehabiliteringen och via Försäkringskassan i Umeå. MiniRest-studien syftade till att studera de omedelbara effekterna på mental och fysiologisk återhämtning samt förmåga till uppmärksamhet vid besök i en stadsmiljö och tre olika skogsmiljöer. Pilot-studien syftade till att studera lämpligheten av de praktiska arrangemangen inför den planerade rehabiliteringsstudien ForRest. Deltagarna i ForRest lottades till A) en skogsrehabilitering under tre månader (två gånger/vecka, fyra timmar/dag); eller B) en kontrollgrupp. Efter avslutad skogsrehabilitering deltog båda grupperna i kognitivt beteendeinriktad rehabilitering (KBR) vid 24 tillfällen/en gång per vecka. Preferensen för olika skogsområden, det mentala välbefinnandet och förmåga till uppmärksamhet i samband med skogsvistelse studerades för grupp A. Återhämtning från utmattningssyndrom och data om sjukfrånvaro jämfördes mellan de båda grupperna i) efter skogsrehabilitering och ii) efter genomgången KBR. I intervju-studien, som utfördes enligt grounded theory, deltog 19 patienter från grupp A. Syftet var att studera personliga upplevelser från skogsrehabiliteringen.

För datainsamling användes frågeformulär, uppgifter från patientjournaler, fysiologiska tester och individuella intervjuer.

Resultat Vistelse i skogsmiljöer uppskattades i högre grad, resulterade i gynnsammare fysiologiska reaktioner och ökade förmågan till uppmärksamhet jämfört med vistelsen i stadsmiljön (MiniRest, artikel I). De lättillgängliga och öppna skogsmiljöerna var mest besökta (artiklarna I, II och III). Båda patientgrupperna i ForRest (artikel III) upplevde förbättringar i psykisk hälsa och det fanns ingen skillnad över tid mellan grupperna. Den grupp som genomgick skogsrehabilitering hade positiva effekter på mentalt välbefinnande och förmåga till uppmärksamhet i samband med skogsvistelserna. En interaktionseffekt återfanns mellan välbefinnade och årstid då effekten på välbefinnadet var större under våren än under hösten. I de kvalitativa studierna framkom att avskildhet, känslan av frihet och kravlöshet var viktiga element för att finna lugn och ro under skogsvistelsen. Dessutom förbättrades förmågan att finna lugn och ro, att reflektera över sin livssituation och tillgången till positiva tankar ju längre

skogsrehabiliteringen fortskred (Pilot-studie, artikel II och Intervju-studie, artikel IV).

Slutsatser Vistelse i skogsmiljö hade positiva återhämtande effekter på patienter med utmattningssyndrom genom ökat mentalt välbefinnande, lättare tillgång till lugn och ro, gynnsamma fysiologiska reaktioner och en ökad förmåga till uppmärksamhet, vilket ger stöd för användning av skogsmiljöer i rehabilitering. Då skogsrehabiliteringen inte gav någon ytterligare effekt på tillfrisknandet av utmattningsyndrom jämfört med en kontrollbetingelse, borde en integrering av skogsmiljö med KBR studeras vidare, för att undersöka om en sådan behandling kan ge effektivare rehabilitering av utmattningssyndrom.

ORIGINAL PAPERS

This thesis is based on the following studies, which will be referred to by Roman numerals I - IV:

I. Sonntag-Öström E, Nordin M, Lundell Y, Dolling A, Wiklund U, Karlsson M, Carlberg B, Slunga Järvholm L. (2014) Restorative effects of visits to urban and forest environments in patients with exhaustion disorder. *Urban Forestry & Urban Greening* 13: 344-354. http://dx.doi.org/10.1016/j.ufug.2013.12.007

II. Sonntag-Öström E, Nordin M, Slunga Järvholm L, Lundell Y, Brännström R, Dolling A. (2011) Can the boreal forest be used for rehabilitation and recovery from stress-related exhaustion? A pilot study. *Scandinavian Journal of Forest Research* 26: 245-256. http://www.tandfonline.com/doi/full/10.1080/02827581.2011.558521

III. Sonntag-Öström E, Nordin M, Dolling A, Lundell Y, Nilsson L, Slunga Järvholm L. Can rehabilitation in boreal forest help recovery from exhaustion disorder? – The randomized clinical trial ForRest. *Submitted*

IV. Sonntag-Öström E, Stenlund T, Nordin M, Lundell Y, Ahlgren C, Fjellman-Wiklund A, Slunga Järvholm L, Dolling A. ”Nature’s effect on my mind” Patients’ experiences from nature based rehabilitation: A qualitative inquiry. *Submitted*

INTRODUCTION

Mental and behavioural disorders constitute an increasing burden of non-communicable diseases (NCDs) according to the Global Burden of Disease study (Murray et al., 2012). The World Health Organisation (WHO) has urged the world to pay attention and take preventive and rehabilitative measurements against the increasing problems of NCDs and years lived with disability (Murray et al., 2012). This shift of disease burden towards more environmental and lifestyle-related conditions puts pressure on researchers, healthcare professionals and systems, as well as education for future health professionals, to meet the challenges.

Burnout and exhaustion disorder

Stress-related ill health is a type of mental and behavioural disease that has shown increasing prevalence in modern societies. In Sweden, stress-related ill health accounted for the largest proportion of long-term sick leave (40%) due to psychiatric illness in 2012 (Försäkringskassan, 2014). This has negative consequences for society, with loss of valuable workforce and high public costs due to the need for extensive sick leave. The personal consequences are also substantial, leading to restricted participation in social and enjoyable activities (Sonnentag et al., 2008, Suñer-Soler et al., 2013).

Freudenberger (1974) was the first to study problems of feelings of fatigue and exhaustion coupled with other physical and mental symptoms, calling this condition "burnout". The burnout concept has been connected to exhaustion within working environments (Freudenberger, 1974; Maslach, 1976; Shirom, 1989). The initial research concerning burnout focused on professionals working in human services and healthcare occupations. In the 1990s, the research was extended to other professionals than those within human services, and interest in the interrelatedness between the work environment and individual's thoughts and feelings was sparked (Maslach et al., 2001).

The Swedish diagnosis of exhaustion disorder (ED) is related to the concept of burnout, but much focus is placed on the person's overall life situation and often existing long-lasting problems of sensitivity to stress, physical and mental fatigue, disturbed sleep and impaired cognition. The diagnostic criteria (Table I) for ED (ICD-10, F43.8A) were established by the Swedish National Board of Health and Welfare in 2003 and follow the same etiological principals of criteria as the International Classification of Diseases (ICD) and the Diagnostic and Statistical Manual of Mental Disorders (DSM) (Socialstyrelsen, 2003). The illness is believed to be caused by identifiable stressors that have been present for at least six months. Lack of mental energy is considered to be one of the major criteria. Comorbidity, e.g. depression, anxiety, musculoskeletal pain, and cardiovascular diseases are common in people suffering from ED (Melamed et al., 2006; Peterson et al.,

2008; Armon et al., 2010), and recovery from ED seems to be long-lasting (Stenlund et al., 2012).

The Burnout Measure (BM; Pines et al., 1981) and Maslach Burnout Inventory (MBI; Maslach and Jackson, 1981) were constructed several decades ago to measure the level of burnout, of which the MBI has been most frequently used. The MBI was designed to measure the proposed classical aspects of burnout: emotional exhaustion, depersonalization and personal accomplishment. However, the burnout concept has gradually changed, developed and widened to apply to other situations of exhaustion outside working life (Schaufeli and Enzmann, 1998). The Shirom Melamed Burnout Questionnaire (SMBQ) was constructed to measure dimensions of emotional and physical exhaustion, tension, listlessness, and cognitive weariness (Melamed et al., 1992; 1999). The Copenhagen Burnout Inventory (CBI) focuses on measurement of exhaustion and fatigue, and differentiates between personal and work-related burnout (Kristensen et al., 2005). Other recently developed self-rated questionnaires are the stress-related Exhaustion Disorder (s-ED) by Glise et al. (2010) and the Karolinska Exhaustion Disorder Scale (KEDS) by Beser et al. (2014). These two instruments focus on establishing the diagnosis and measuring the level of ED.

Table I. Diagnostic criteria for exhaustion disorder (ED) according to the National Board of Health and Welfare in Sweden. All six statements with capital letters are expected to be fulfilled for establishing diagnosis.

A Physical and mental symptoms of exhaustion during at least two weeks. Symptoms are expected to have evolved as a consequence of one or several identifiable stressors present for at least six months.

B Substantial lack of mental energy manifested as reduced endurance and capacity to take initiative, as well as prolonged recovery after mental strain.

C At least four of the below symptoms present every day during a two week period:

1. Difficulties in paying attention or memorising.
2. Strongly reduced ability to handle challenges or perform under time pressure.
3. Emotional instability or irritability.
4. Disturbed sleep.
5. Substantial physical fatigue or fatigability.
6. Physical pain, chest pain, palpitations, digestive complaints, dizziness or hypersensitivity to noise.

D The symptoms cause significant clinical suffering and reduced functioning at work, in social life or other important aspects of life.

E Symptoms are not caused by any substances (e.g. drug or alcohol abuse, medicine) or somatic diseases/injuries (e.g. hypothyroidism, diabetes mellitus, infectious diseases).

F If ED is simultaneous with a diagnosis of depression, dysthymia or anxiety disorder, it should be reported as a secondary diagnosis.

Stress mediation

Stressful challenges engage both the autonomous nervous system (ANS) and hormonal systems in the body. The activation of these systems is regarded as normal and adequate as long as the activation is temporary and a phase of recovery is guaranteed. However, if these preconditions are violated, the effects can impair mental and physical health. Stress responses are mediated through the Hypothalamus – Pituitary – Adrenal - axis (HPA) together with the ANS by releasing stress hormones (cortisol, epinephrine and norepinephrine) that regulate the cardiovascular, metabolic, brain and central nervous system functions, as well as the immune system. The ANS and HPA are activated during stress in order to adapt and cope with a new situation and attempt to achieve stability (homeostasis) between physiological and behavioural reactions. However, if the stress conditions persist for long periods, the individual's regulation of these systems will change, which is labelled as allostatic load. In the long term, this situation could wear out the individual and eventually lead to exhaustion (McEwen, 1998; McEwen and Wingfield, 2003; McEwen, 2004).

Theories concerning nature's restorative effects

In environmental psychology, restoration is described as a process of recovering resources (e.g. mental, social and physiological) that have been depleted due to daily wear and tear. Thus, the expression "restorative environment" has been used to describe environments that promote restoration.

Jay Appleton (1975), Gordon Orians (1980) and Edward Wilson (1984) have argued that our preferences for nature have an evolutionary origin and are therefore innate. The desire for survival has influenced our preference for environments with rich resources. Appleton (1975) has highlighted the importance of places to hide in and places with a view (*prospect – refuge theory*) for promoting feelings of security in our living places. The *savanna hypothesis* by Orians (1980, 1986) is based on similar arguments as the prospect-refuge theory, but Orians' focus lies on the appropriateness of open and flat landscapes with water from the survival point of view. Wilson introduced his *biophilia hypothesis* in 1984, which claims that humans' instinctive bonds with nature not only stem from a survival point of view but also from nature's ability to please our biological, aesthetic, intellectual, cognitive and spiritual needs. In contrast, the *affordance theory* of Gibson (1977) focuses on the immediately perceived possibilities for action in an environment. In wilderness outings, this could be interpreted as a spruce tree offering shelter on rainy days and during nighttime, whereas a path invites a walk.

In the work described in this thesis, the studies were mainly based upon two theoretical frameworks: the attention restoration theory (ART: Kaplan and Kaplan, 1989; Kaplan 1995) and affective aesthetic theory (AAT; Ulrich, 1979; 1983; 1991) (also called the stress reduction theory or psycho-evolutionary theory). Both ART and AAT centre on restoration through the experience of nature. However, whereas ART focuses on the

promotion of cognitive functioning, AAT is concerned with the promotion of psychophysiological stress reduction.

ART

ART developed by Kaplan and Kaplan (1989; Kaplan 1995) is based in two kinds of attention: spontaneous and directed. Directed attention is under intentional control and operates when we focus or concentrate on tasks. It requires effort as we suppress other competing stimuli and eventually is depleted with prolonged use. The fatigued ability to inhibit competing stimuli has negative consequences, such as irritability and increased failure when performing tasks requiring concentration. A person will experience fatigue and exhaustion if their directed attention gets totally depleted. According to ART, directed attention can be renewed by spontaneous attention. Spontaneous attention consists of two components, hard and soft fascination. Hard fascination can be perceived as pleasurable but requires effort, e.g. watching a football match or film. Soft fascination, on the other hand, is characterised by effortless attention that helps clear the mind and enhances reflection. Spontaneous attention is promoted in environments offering rich but effortless stimuli and aesthetic pleasure - also called restorative environments. Natural environments are considered to be especially suitable as restorative owing to four basic features: being away, fascination, extent and compatibility.

- Being away: a setting that gives psychological or geographical distance from one's everyday environment.
- Fascination: features that evoke effortless interest-driven attention.
- Extent: conceptual or physical environment with coherence and scope to engage one's mind.
- Compatibility: an environment that supports one's inclinations and purposes for actions.

AAT

Ulrich's (1979; 1983; 1991) theory, AAT, focuses on affective and physiological responses to visual stimuli. His theory emphasises that our preferences for natural environments are immediate, congenital and originate from our ancient need for food, water and security. Thus, his theory appears to be inspired by the prospect-refuge theory (Appleton, 1975), the savanna hypothesis (Orians, 1980; 1986) and the biophilia hypothesis (Wilson, 1984). According to AAT, certain visual patterns in environments can elicit rapid affective (e.g. mood states) and physiological (e.g. blood pressure, heart rate) arousal. Moderate depth, moderate complexity and a focal point are important features in unthreatening nature views to hold one's attention, reduce negative thoughts, enhance positive affect and reduce physiological arousal. Views of water and vegetation can especially elicit rapid positive affective responses and enhance restoration. On the other hand, views of buildings and cities are not innate and can therefore lead to negative reactions.

Rehabilitation

The evidence for effective rehabilitative methods for people suffering from burnout and ED has so far been inadequate (SOU, 2011; Korczak et al., 2012). However, rehabilitative measures for people suffering from ED are urgently needed as stress-related ill health can lead to long-term suffering and sick leave. To cope with these negative consequences, a national healthcare guarantee for people suffering from stress-related ill health was enforced by law in 2010 (SFS, 2010). The aim of this law was to provide individuals with early access to rehabilitative measures after being recognised as having stress-related ill health. The Swedish National Council for Rehabilitation recommends a multimodal rehabilitation for people suffering from ED (SOU 2011). These recommendations consist of the following components: i) changes in lifestyle concerning balance between activity and rest; ii) stress reduction by a suitable technique used in clinical practice; iii) Cognitive Behavioral Therapy offered either individually or as group sessions; and iv) work rehabilitation support. Even though there is a lack of evidence regarding the efficiency of multimodal rehabilitation, the Swedish National Council has pointed out that there is a broad clinical consensus about the use of multimodal rehabilitation. Therefore, more research is needed to develop rehabilitation measures. As people suffering from burnout and exhaustion seem to have problems with winding down (Ekstedt and Fagerberg, 2005, Jingrot and Rosberg, 2008), it is also important to help them with recuperation in order to facilitate absorption of the therapy.

Nature and Restoration

Regular recovery from daily wear and tear is essential for maintaining health, and thus it is important to find easily accessible ways to promote this recovery. Nature has been shown to be a valuable environment for offering restoration and recovery (Velarde, 2007). Studies into nature's restorative effects have largely considered views of pictures or videos of nature (Laumann et al., 2003; Gatersleben and Andrews, 2013), views through windows (Ulrich, 1984; Kaplan, 1993), virtual reality experiments (de Kort and Ijsselsteijn, 2006; Annerstedt et al., 2013) and outdoor settings (Hartig et al., 2003; Lee et al., 2009; Tsunetsugu et al., 2013). Many of these studies have reached the conclusion that green environments both aid recovery from mental fatigue and provide chances for reflection and contemplation.

To date, the majority of research on the restorative effects of nature has evaluated the effects of short-term exposure to nature (Ulrich et al., 1991; Hartig et al., 2003; Tsunetsugu et al., 2007; Lee et al., 2011). These experiments have often been implemented on healthy individuals, sometimes with a preceding artificial exposure to stress. In Sweden, increasing interest has developed into studying the salutary effects of nature-assisted rehabilitation of people suffering from severe stress-related ill health. Nordh et al. (2009) found improvements in general health of participants enrolled on a 10-week intervention programme with meaningful activities in a forest. However, the participants' quality of life declined as the rehabilitation programme came to an end, which the researchers suggested

was probably related to the participants' insecure future perspectives. An interview study conducted by Eriksson et al. (2011) highlighted that a safe and undemanding physical environment offering engagement in enjoyable activities during garden rehabilitation can form a bridge between participants' experiences from the rehabilitation programme and their everyday lives and allows an enhanced balance between work and recovery. Adevi and Mårtensson (2013) found in their qualitative study that participants of nature-assisted rehabilitation perceived the garden as a safe and useful arena for recovery from stress-related ill health that afforded physical and psychological well-being and facilitated social interactions. Pálsdóttir et al. (2014) studied participants of a 12-week nature-assisted rehabilitation programme conducted in a garden context and found reduced symptoms of severe stress and enhanced return to work. Währborg et al. (2014) showed that nature-assisted rehabilitation conducted in a garden reduced healthcare consumption for persons suffering from severe stress – compared to a matched population - but it had no effect on ongoing sickness benefits at the end of the rehabilitation.

In the Northern countries, forests provide an interesting environment to study from the restoration point of view owing to the richness of forest environments close to people's living areas. Seventy-seven percent of the land area in Sweden is covered by forests (Anonymous, 2010) and The Right of Public Access (Swedish Environmental Protection Agency, 2013) enables people to access even private land. This Right of Public Access is equal for all citizens and free of charge, which makes forests easily accessible for the whole population. Therefore, forests offer a suitable setting for recovery from everyday wear and tear backed up by convincing evidence of their salutary properties, which might also be beneficial for rehabilitation from ED.

AIMS

The overall aim of the work described in this thesis was to study whether visits to different kinds of forest environments have positive health effects on patients suffering from ED and can be utilised for rehabilitation.
Specific aims:

- To evaluate psychological and physiological responses, perceived environmental restorativeness and attention capacity in female patients with ED during single visits to one urban and three different forest environments (*Paper I*).

- To evaluate possible restorative effects and feasibility of practical arrangements in a pilot study before launching a randomised controlled study of forest rehabilitation for patients suffering from ED (*Paper II*).

- To evaluate changes in perceived mental state, attention capacity and preferences for different forest environments during the forest rehabilitation (*Papers II* and *III*).

- To study recovery from ED, with regard to psychological health and sick leave, of a 12-week forest rehabilitation program (*Paper III)*.

- To describe patients' personal experiences, use and knowledge of forest visits during the rehabilitation process (*Papers II* and *IV*).

- To evaluate preferences for different forest environments in order to develop effective management of future rehabilitation forests (*Papers I-IV*).

METHODS

Settings and participants

All studies in this work were carried out in the municipality of Umeå, located in the county of Västerbotten in Northern Sweden, which is part of the boreal zone (Ahti et al., 1968). The county has approximately 260 000 inhabitants (SCB, 2011), of whom 117 500 live in the Umeå municipality. Umeå has a young population with a mean age of 38 years owing to the presence of two universities, Umeå University and parts of the Swedish University of Agricultural Sciences (www.umea.se).

The studies were based on three samples. For the work described in Paper I and Paper II, two separate samples of participants were recruited from the Stress Rehabilitation Clinic (SRC) at the University Hospital in Umeå. The work in Paper III was based on a sample recruited from both the SRC and Swedish Social Insurance Agency in Umeå. The sample described in Paper IV was retrieved from participants in Paper III. An overview of the baseline characteristics of the study populations is given in Table II. All participants included in the separate studies resided in the county of Västerbotten, suffered from ED according to the diagnostic criteria set by the National Board of Health and Welfare in Sweden (Table I) and were clinically assessed by a physician and psychologist at the SRC prior to participation.

Table II. Baseline information of the participants involved in the separate studies.

	Paper I MiniRest study (*n*=20)	Paper II Pilot study (*n*=6)	Paper III ForRest study (*n*=99)	Paper IV Interview study (*n*=19)
Age, mean (SD)	42 (7)	49 (8)	45 (9)	48 (9)
Sex, women/men	20/0	3/3	85/14	16/3
Education, numbers (%)				
Primary/secondary school	6 (30)		59 (60)	
University	14 (70)		40 (40)	
Months since the onset of significant ED, mean (SD)	45 (42)	53 (31)	36 (38)	
SMBQ, mean (SD)	5.7 (0.6)	5.1 (1.3)	5.5 (0.9)	5.6 (0.7)
HAD, mean (SD)				
Total anxiety score	12.1 (3.9)		11.6 (3.9)	11.2 (4.0)
Total depression score	8.3 (3.3)		8.6 (4.0)	8.4 (4.5)

ED = exhaustion disorder
SMBQ = Shirom Melamed Burnout Questionnaire (cut-off score for burnout: ≥4.0 points)
HAD = Hospital Anxiety and Depression Scale (cut-off score for significant depression and anxiety syndrome >10 points)

Environments

The visits to different outdoor environments took place at Bäcksjön - a forested area outside the city of Umeå (eight test environments), and in the city of Umeå (one test environment). The sizes of the different environments varied from 5000 to 50000 m².

The following descriptions of the different outdoor environments were adapted from Paper I (Sonntag-Öström et al., 2014) and Paper III (Sonntag-Öström et al., submitted).

Forest by the lake — an open forest close to a lakeside (coordinate system WGS 84: 63°56'47.76"N, 20°22'44.19"E) dominated by Scots pine (*Pinus sylvestris* L.) with sparsely distributed Norway spruce (*Picea abies* (L.) H. Karst.), downy birch (*Betula pubescens* Ehrh.) and aspen (*Populus tremula* L.). The ground vegetation mainly consisted of shrubs, e.g. bilberry (*Vaccinium myrtillus* L.), cowberry (*Vaccinium vitis-idaea* L.), and crowberry (*Empetrum hermaphroditum* Hagerup). The view from the forest setting was dominated by a broken shoreline with small forested headlands and a lake (size approx. 3 x 1 km) containing a couple of forested islands. Managed pine and spruce forests without houses or settlements could be viewed in the distance (Figure 1). The walking distance from the shelter/gathering point (Papers II and III) to the forest by the lake was approximately 1 km and from the parking lot (Paper I) to the forest by the lake approximately 500 metres.

Rock outcrop — a sloping non-productive open area (63°58'6.16"N, 20°21'46.47"E) with bare bedrock and old, but small, Scots

pine trees. The ground vegetation was dominated by various lichens, e.g. reindeer lichens (*Cladina spp.*) and scattered mosses. Cowberry and crowberry were sparsely distributed in crevices and lower parts of the bedrock. The rock outcrop was surrounded by a young pine forest in the upper part and an open mire (further described below) in the lower part (Figure 2). The walking distance from the shelter (Papers II and III) and the parking lot (Paper I) to the rock outcrop was approximately 200 metres.

Pine forest — an open, rather light and stony area (63°57'57.92"N, 20°21'46.37"E) with 65-year-old, even-aged Scots pine stand with ground vegetation dominated by cowberry, crowberry, bilberry, some heather (*Calluna vulgaris* (L.) Hull), lichens and mosses as *Pleurozium schreberi* (Brid.) Mitt. and *Hylocomium splendens* (Hedw.) B.S.G. (Figure 3). The walking distance from the shelter to the pine forest was approximately 50 metres.

Spruce forest — a rather shady and dark closed forest (63°57'53.82"N, 20°21'57.62"E) dominated by 85-year-old Norway spruce and scattered fully grown Scots pine. The ground vegetation consisted mainly of bilberry and mosses (Figure 4). The walking distance from the shelter (Papers II and III) and the parking lot (Paper I) to the spruce forest was approximately 200 metres.

Mixed forest — an uneven aged forest (63°58'0.58"N, 20°21'54.15"E) with patchy dense groves and small glades. The tree layer consisted of 65-year-old Scots pine, 125-year-old Norway spruce and birch. The ground vegetation primarily consisted of shrubs of bilberry, cowberry, heather and various mosses (Figure 5). The walking distance from the shelter to the mixed forest was approximately 50 metres.

Forest with a small stream — a gentle slope with dark, mixed forest (63°57'2.96"N, 20°22'27.59"E) along the course of a small ca. 0.5 m wide stream. The forest was dominated by 65- to 75-year-old Scots pine, scattered Norway spruce and birch with mosses, peat mosses (*Sphagnum spp.*), bilberry and crowberry in the field and bottom layer (Figure 6). The walking distance from the shelter to the forest with a small stream was approximately 1 km.

Mire surrounded by spruce forest — a fairly open mire (63°58'5.67"N, 20°21'24.93"E) dominated by peat mosses (*Sphagnum spp.*) and sedge (*Carex spp.*) in the ground and field layer, together with scattered islets dominated by heather (*Calluna vulgaris*) and small slow-growing Scots pine (Figure 7). The walking distance from the shelter to the mire surrounded by spruce forest was approximately 350 metres.

Mire surrounded by spruce forest and rock outcrop — an open mire (63°58'9.99"N, 20°21'53.59"E) dominated by heather and sedges (*Cyperaceae*) as cotton grass (*Eriophorum spp.*) and sedge. The walking distance from the shelter to the mire surrounded by the spruce forest and rock outcrop was approximately 250 metres.

City – a busy urban street (63°49'46.42"N , 20°15'32.80"E) next to a four-way intersection with traffic lights and surrounded by a combination of relatively old wooden houses (approximately 100 years) and younger brick buildings (approximately 40 years). The street was lengthwise encompassed by birch trees (Figure 8). Participants experiencing this environment sat with their back against the wall, facing the street and the buildings on the opposite side. The walking distance from the parking lot (Paper I) to the city test area was approximately 20 metres.

Figure 1. Forest by the lake

Figure 2. Rock outcrop

Figure 3. Pine forest

Figure 4. Spruce forest

Figure 5. Mixed forest

Figure 6. Forest with a small stream

Figure 7. Mire

Figure 8. City

Data sources and inclusion criteria

MiniRest study (Paper I)

Altogether, 49 female patients were invited to participate in an experimental study with a randomised cross-over design at the SRC. All participants had been referred to the SRC by clinical practitioners. The study was carried out between September 2009 and September 2012. Twenty one patients volunteered to participate and 20 (mean age 42) of them completed the study. Only women were invited to participate in the study in order to increase the homogeneity of the study group and because the majority of people with a diagnosis of ED are women. The participants' mean level of burnout was 5.7 on the SMBQ scale (Melamed et al., 1992; 1999), indicating a high degree of burnout (the cut-off score for burnout was set to ≥4.0 points). The participants also suffered from moderate anxiety and mild depression according to the Hospital Anxiety and Depression Scale (HAD; Zigmond and Snaith, 1983).

The inclusion criteria for the study were as follows: 1) diagnosis of ED according to the Swedish National Board of Health and Welfare (Socialstyrelsen, 2003; Glise et al., 2010), 2) female sex, 3) age between 24-55 years, and 4) a mean level of ≥4.0 points on the SMBQ (Melamed et al., 1992; 1999). The exclusion criteria were 1) other diseases with symptoms of fatigue, 2) other diseases in general, treatments or circumstances that might interfere with participation, 3) known abuse of alcohol or drugs, and/or 4) participation in other studies. The participants received compensation of SEK 1,500 after the conclusion of all five test occasions. All participants were native Swedes.

Pilot study (Paper II)

Three women and three men (mean age 49) participated in a pilot-study on restorative effects of forest environments from September to November. Five of the participants had been referred to the SRC from primary healthcare and one was recruited from occupational healthcare. The average length of sick-leave was 53 months, varying in degree from 75 to 100% full-time employment. The participants showed a mean value of 5.1 points on the Shirom-Melamed Burnout Questionnaire scale (SMBQ; Melamed et al.,

1992; 1999). Two participants showed light to moderate depression and five participants light to moderate anxiety according to the HAD (Zigmond and Snaith, 1983). The only inclusion criteria was diagnosis of ED.

ForRest and Interview studies (Papers III and IV)

A total of 375 persons (310 women and 65 men) were screened for participation in the randomised controlled trial entitled Forest for Rest (ForRest) between January 2007 and August 2010. The first 356 persons (291 women and 65 men) were found through consecutive screening of patients referred to the SRC up to January 2009. Thereafter, the remaining 19 persons (19 women and 0 men) were found through registers at the Swedish Social Insurance Agency in Umeå. The change in recruiting policy was due to new governmental rules for sick-leave benefits and a shortened waiting list condition at the SRC which made it difficult for referred patients to allocate time for participation. Participants in the group recruited from the Swedish Social Insurance Agency were compensated with SEK 100 per visit to the forest.

The inclusion criteria for the study were as follows: 1) diagnosis of ED according to the Swedish criteria (Socialstyrelsen, 2003; Glise et al., 2010), 2) age between 24-60 years, and 3) mean score of ≥4.0 on the SMBQ (Melamed et al.1992; 1999). The exclusion criteria were 1) other diseases or disorders that could result in future sick-leave due to fatigue and/or stress related symptoms (e.g., chronic infections, chronic fatigue syndrome, endocrine disorders), 2) other diseases or conditions that could interfere with active participation, 3) need for individual therapy or urgent need of multimodal rehabilitation (CBR), 4) known alcohol or drug abuse, and 5) participation in other intervention studies.

One hundred and fifty-three persons (134 women, 19 men) met the inclusion criteria, of whom fifty-four declined participation (49 women, 5 men). There were no significant differences in age, sex or SMBQ scores between those who participated and those who declined participation. The final study population consisted of 99 participants (85 women, 14 men) with a mean age of 45 years. Sixteen participants in group A and 5 participants in group B discontinued participation during the 1 year intervention.

Paper IV describes a qualitative interview study based on a sample of participants who completed the three-month forest rehabilitation in the ForRest study during September 2008 to December 2010. Participants from the last four consecutive forest rehabilitation groups were asked to be interviewed with the purpose of assessing their personal experiences from the forest rehabilitation. All except one of these participants agreed to be interviewed; in total sixteen women (mean age 49 years) and three men (mean age 44 years) participated.

Six of the interviews were carried out at the Swedish University of Agricultural Sciences and the rest at the SRC. None of the interviewers were involved in the practical arrangements of the forest rehabilitation. A

flowchart showing the number participants involved at different stages of the ForRest study is presented in Figure 9.

Study procedures

Table III summarises the study designs, outcome measures and analyses used in the separate studies.

Table III. Overview of study designs, outcome measures and analyses used in the separate articles.

	Paper I MiniRest study	Paper II Pilot study	Paper III ForRest study	Paper IV Interview study
Design				
Mixed methods (qualitative and quantitative)		x		
Experimental cross-over	x			
Experimental randomised controlled			x	
Qualitative		x		x
Outcome measures				
Preference for environment	x[β]	x	x	x
Mental state	x	x	x	
Psychological health measurements	x	x	x	
Attention capacity	x		x	
HR, BP, and HRR	x			
Sick-leave			x	
Personal experiences		x		x
Analyses				
Repeated measures ANOVA	x		x	
Non-parametric repeated measures	x	x	x	
Independent *t*-test	x		x	
Paired *t*-test	x			
Chi-square test			x	
Wilcoxon signed-rank test	x			
Cronbach's alpha	x			
Grounded theory		x		x

[β] = validation of the environment with the Perceived Restorativeness Scale (PRS)
HR = heart rate
BP = blood pressure
HRR = heart rate recovery

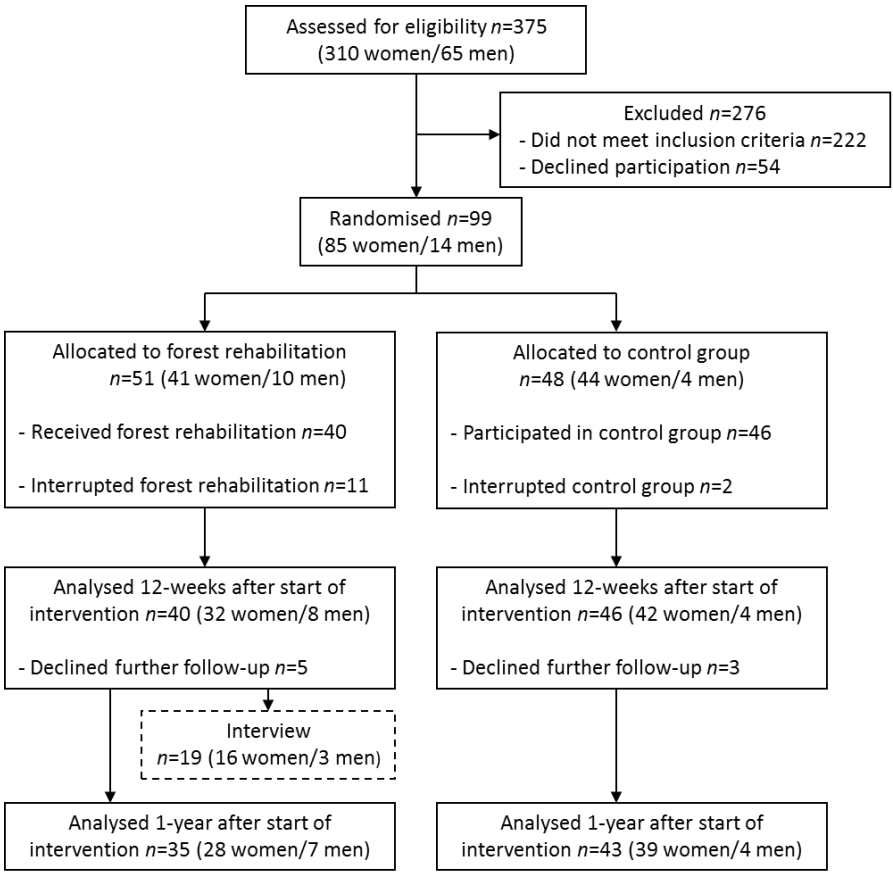

Figure 9. Flowchart showing the number of participants throughout the ForRest and Interview studies

MiniRest – a study of short time exposure to urban and forest environments (Paper I)

Patients who met the inclusion criteria received written information concerning the study, mailed by the research nurse. Patients who agreed to participate in this study had their first baseline measurements recorded in an office at the SRC. At this meeting, each participant was asked to draw an envelope containing a single list of computer-randomised order of outdoor environments, namely *the City, the Forest by the lake, the Rock outcrop, and the Spruce forest*. This individual order of visits was practiced throughout the experiment. Information on perceived restoration, mental state, attention capacity, heart rate, systolic and diastolic blood pressure, and heart rate recovery (HRR) were gathered for each participant on all five occasions in order to compare measurements between the different outdoor

environments. All tests were carried out individually. The experiment was initiated before the participants started CBR at the SRC.

On each occasion, the participants were met at home and their heart rate, blood pressure and attention capacity were measured. The test leader then drove the participant by car to the test environment. The one-way transportation varied between 30 and 60 minutes depending on the distance between the participant's home and the test area. The first 10 minutes in each environment included moving around at a slow pace in order to get acquainted with the environment. This was followed by sitting for 40 minutes to allow evaluation of the effects on heart rate and blood pressure in a stable resting condition. The heart rate and blood pressure were checked every 10 minutes after entering the environment. After the sitting session, the participant filled out questionnaires and then carried out the attention capacity and HRR tests. The heart rate and blood pressure were checked again once the participant had been returned home.

Forest rehabilitation (Papers II and III)

Verbal information regarding the forest rehabilitation study was provided by the physician or psychologist present at the SRC at the time of primary evaluation and screening for the study. Written information concerning the study was then sent by the research nurse and was supplemented with additional verbal information if requested. After having accepted the invitation to the study, a questionnaire was mailed to each participant before the first visit. In the ForRest study, randomisation was carried out after the baseline assessments and enough participants had been recruited to enable randomisation into two groups (one to the forest intervention and one to the control condition). The target was for a maximum of eight participants in each group. An opaque sealed envelope containing equal numbers of lots to the forest intervention and control condition was prepared together with a list of all volunteered participants. An independent healthcare professional carried out the allocation by balloting lots from the envelope and assigning the selected intervention (A= forest, B= control) to the list of participants consecutively. The randomisation was carried out on eight different occasions, approximately two weeks before the start of a new intervention period. The participants in program A and B were compared at baseline, after three months and at the end of the CBR period. The participants in program A (the forest condition) also estimated their mental state before and after each forest visit, and tested their attention capacity before and after forest visits on three separate occasions.

The forest rehabilitation program lasted for 12 weeks. The time period was restricted to spring (March-June) (Paper III) or autumn (September-December) (Papers II and III) due to limitations of snow and darkness during winter and problems with participation during summer because of summer vacations. The time length of the rehabilitation was based on empirical knowledge that recovery from ED usually takes several months and both physical and mental training need to be performed for weeks/months to have a noticeable effect (Dahlin et al., 2008; Hillman et al.,

2008). The first two visits to the forest included practical information, such as use of suitable clothing, meals, transportation, and presentation of the different forest environments. The actual forest rehabilitation was carried out twice a week for 11 weeks, and lasted for four hours each time. The groups were gender mixed or included only female participants. In the Pilot study, the group consisted of 6 persons, whereas in the Forest study, the groups consisted of up to 8 persons. The groups were led by two persons; one with a medical and one with a forestry background. The leaders transported the participants to the forest in two rental cars and entered the forest at 10.00 am. After a simple breakfast by a shelter, the participants carried out short (5-10 minutes) relaxation exercises to provide a tool to control possible anxiety attacks during the time of solitude in the forest. A period of solitude for two hours started at 11.00 am and ended at 1.00 pm in one of the eight predetermined forest environments that were individually chosen. The participants were instructed to spend their time in peace and quietness and were discouraged from being physically active (unless feeling cold) or occupying themselves with leisure activities, such as berry picking, reading, photography, etc. After the two hours of solitude, a simple lunch was served at the shelter by a fire and the group left the forest at 2.00 pm. The same procedure was followed at every visit to the forest.

The interviews (Papers II and IV)

All participants in the Pilot study and the last 20 participants in the ForRest study were invited to be interviewed after completion of the forest rehabilitation for the purpose of studying both experiences of practical arrangements and personal reflections from the forest rehabilitation. All interviews were carried out by a professional within either healthcare or forestry who was not involved in the forest rehabilitation.

Semi-structured interviews with open-ended questions were used in face-to-face interviews. Each participant was interviewed once. In the ForRest study, the themes in the interview guide covered thoughts and feelings about the time spent in solitude as well as together with other participants, practical arrangements concerning the rehabilitation, earlier nature experiences, and the future. The same themes were used in the Pilot study, but questions concerning practical arrangements were prioritised. The interviews lasted for 10 to 70 minutes. They were audio taped and transcribed verbatim. In the ForRest study, the OpenCode 3.6 free software was used for the process of transcription and the later interviews were influenced by the earlier ones to gain further knowledge.

Control condition (Paper III)

The participants in the control group received no rehabilitative treatment initiated by the SRC during the 12-week intervention period, which implied care-as-usual until the start of the multimodal CBR. All the participants in the ForRest study were placed on a waiting list for starting multimodal CBR after the initial 3-month period.

Compliance with forest visits and complementary treatment (Paper III)
The mean attendance in the forest rehabilitation group was 17 forest visits. Five percent of the forest rehabilitation participants and 40% of the participants in the control condition reported complementary treatment during the 12-week intervention.

Care-as-usual (Papers I, II, III and IV)
All participants took part in care-as-usual at the SRC during the studies. This care included follow-up visits to the physician who took care of sick-leave certificates and medical prescriptions. The physician also gave general information on issues such as routines in daily life, sleep, physical activity, the recovery process and work rehabilitation.

CBR (Paper III)
The multimodal rehabilitation program, designated CBR, at the SRC included 24 group sessions and one individual meeting between the patient and the group leader. Each group session lasted for three hours including a 30 minute break. The group consisted of eight patients and a leader specially trained in CBR. Each group included participants from both the forest rehabilitation group as well as the control group. The group met once a week after the 12-week forest intervention period. Each group session started with seated autogenic exercise which was followed by group discussions on specific topics. The topics included discussions on and weekly practise of relaxation techniques, stress management, affect awareness, sleep and sleep therapy, motivation and social support. The aim was to break dysfunctional or destructive daily patterns to enable better coping with daily burdens. The CBR was combined with parallel vocational rehabilitation and advice on physical activity.

Outcome measures

Psychological health measurements

Burnout (Paper III)
Burnout was measured by using the *SMBQ*. The questionnaire contains 22 items, including subscales on emotional and physical exhaustion (eight items), listlessness (four items), tension (four items) and cognitive weariness (six items). The mean of all items, which represents an overall index, was used; higher scores indicated a worse condition (Melamed; 1992, 1999).

Anxiety and depression (Paper III)
Anxiety and depression were measured by using the *HAD*. The HAD is divided into two subscales, anxiety and depression, which contain seven items each. A composite total score was calculated for anxiety and depression respectively; higher scores indicated a worse condition (Zigmont and Snait, 1983).

Fatigue (Paper III)
Fatigue was measured by the *Checklist Individual Strength questionnaire (CIS*). The questionnaire is composed of 20 items measuring four dimensions of fatigue: 1) subjective experience, 2) concentration, 3) motivation, and 4) level of physical activity. The estimated rating of fatigue was related to conditions during a previous two-week period. Each item was rated on a seven-point scale and a total score (20-140 points) was calculated; higher scores indicated a worse condition (Beurskens et al., 2000).

Self-esteem (Paper III)
The level of self-esteem was assessed by the *Self-Concept Questionnaire (SCQ)*. The questionnaire is composed of 30 items measuring seven components of self-esteem: significance, worthiness, competence, resilience and determination, appearance and social acceptability, control over personal destiny, and value of existence. Each item was rated on an eight-point scale and a total score (0-210) was calculated; higher scores indicated better self-esteem (Robson, 1989).

Perceived stress (Paper III)
Perceived stress was assessed by the *Perceived Stress Questionnaire (PSQ)*. The questionnaire relates to conditions during the previous week and is composed of 30 items. Each item was rated on a four-point scale. A PSQ index varying from 0 to 1 was calculated using the formula total raw score-30)/90; a higher PSQ index indicated a worse condition (Levenstein et al., 1993).

Mental state (Papers I, II and III)
Mental state was evaluated by using a simple questionnaire constructed by the research group to minimize the participants' mental effort during forest visits. The questionnaire was based on validated instruments such as the Profile of Mood States (POMS; McNair et al., 1971) and the Zuckerman Inventory of Personal Reactions (ZIPERS; Zuckerman, 1977) and contained six items regarding the participants' perceived tenseness (tense - relaxed), fatigue (exhausted - alert), mood (sad - happy), irritability (irritated - harmonious), restlessness (restless - peaceful) and clear-headedness (mentally distracted - clear-headed) (the last item was called "mentally divided – clear- headed" in Paper I and not included in Paper II). Each item was rated on a 10-point scale and reported separately; higher scores indicated a better condition. In the MiniRest study, the questionnaire was filled out once after visiting each environment. In the Pilot study, the questionnaire was filled out before and after each forest visit starting from the seventh visit to the forest. In the ForRest study, the questionnaire was filled out before and after each forest visit.

Validation of the environments (Paper I)
The properties of the environments that might contribute to restorative experiences were validated with the *Perceived Restorativeness Scale (PRS*; Hartig et al., 1996). The questionnaire focused on the experience of a place

without specific reference to the senses being used. The questionnaire included 26 statements measuring four properties included in the ART: being away (6 items), extent (coherence, 4 items and scope, 4 items), fascination (6 items) and compatibility (6 items). The 27th statement measured the preference of the environment. Each environment was evaluated at the end of the visit.

Preferred forest environments (Papers II and III)
The number of individual visits to different forest environments was calculated and summed to give a picture of preferences for the different forest environments.

Attention capacity (Papers I and III)
Attention capacity was evaluated by the *Necker cube pattern control task* (NCPC), which consists of a three-dimensional picture of a cube that can be perceived in two different perspectives (Figure 10). Each test occasion consisted of looking at the cube during two separate thirty-second periods with a one minute rest in between. For the first thirty-second period, the participant was instructed to look at the picture of the cube and tap on her/his thigh whenever the perspective of the cube changed. For the second thirty-second period, the participant was instructed to focus on one of the two possible perceptual perspectives and hold onto that. Again, the participant was instructed to indicate a change of perspective by tapping on her/his thigh. The frequency of perspective reversals can be expected to either increase or decrease depending on the instruction given (Liebert and Burk, 1985). Each test was carried out individually. In the MiniRest study, the test was carried out once in the participant's home before departure to the outdoor environment and once after 50 minutes in the outdoor environment. In the ForRest study, the test was carried out before and after the two hours of solitude in the forest environment on three occasions: at the beginning of the forest rehabilitation period, six weeks into the rehabilitation and at the end of the forest rehabilitation period (12 weeks).

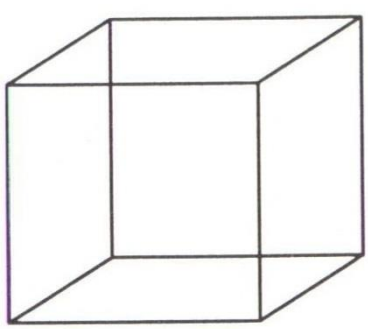

Figure 10. The Necker cube.

Sick-leave (Paper III)
Sick-leave data were collected from the patients' medical journals at baseline and at the end of the one-year rehabilitation. The sick-leave data included different types of compensation, such as sickness benefits, activity and sickness compensation, and rehabilitation compensation.

Physiological measurements

Heart rate (Paper I)
Heart rate was assessed by using a heart rate monitor watch that included a soft chest strap (Polar Electro Oy, Finland). The participant wore the watch and the chest strap from the time they were collected from home until they were returned home after a test occasion. The recordings of heart rate were separately assessed eight times per test occasion, twice at home (before and after visit to an environment) and six times in the test environment.

Heart rate recovery (Paper I)
The HRR test was used to assess cardiac autonomic regulation with emphasis on the reactivation of parasympathetic function (Jouven et al., 2005). The HRR was tested after a sub-maximal exercise test on a step-up platform (Reebok International Ltd, Germany). The physical load was individually adjusted by the three height positions of the platform in combination with pacing the steps with a metronome (Korg Inc., Japan). The participant was instructed to step up and down on the platform until their heart rate reached a steady state of a minimum of 120 beats per minute for three minutes. Immediately after the 3-minute steady state, the participant was requested to sit down in a folding chair for a five minute recovery. The heart rate was measured and recorded using a heart rate monitor watch coupled with a soft chest strap (Polar Electro Oy, Finland) at one minute intervals during both the exercise and recovery phase. The difference between the last heart rate value during exercise and the rate after one minute of recovery was defined as the HRR. Higher scores indicated an enhanced parasympathetic function and better reactivation of parasympathetic function.

Blood pressure (Paper I)
Blood pressure was assessed with a Spacelabs Medical 90217 ambulatory blood pressure monitor (Spacelabs Healthcare Inc., WA, USA). Blood pressure was measured on the right upper arm with the arm in a neutral posture when sitting relaxed.

Data analyses

Statistics (Papers I, II and III)
The Statistical Package of Social Sciences version 20.0 (Paper I) (SPSS Inc. Chicago, IL, USA) and 21.0 (Paper III) as well as the Statistical Analysis Software (SAS) version 9.1 (Paper II) and version 9.3 (Paper III) (SAS

Institute Inc, Cary, NC, USA) were used for the statistical analyses and the alpha level was set at <0.05 in all studies (Papers I-III). Bonferroni corrections were applied for multiple post hoc analyses on mental state and computed by hand in the MiniRest study. Internal reliability of the PRS questionnaire was analysed with Cronbach's alpha. An imputation procedure was carried out in the ForRest study for single missing item values in the questionnaires. The missing value was replaced with the corresponding median value for the group and the procedure was used in 0.25 to 0.64 percent of the items. A per-protocol analysis (including only patients who completed the whole one-year intervention and returned all protocols) was applied in the ForRest study. The repeated measures analyses of variance were used in the MiniRest, Pilot and ForRest studies (Papers I-III). Independent *t*-tests (Papers I and III), chi-square and Fisher's exact tests (Paper III) were used for analyses of differences between groups. When the values were not normally distributed, the Friedman test and Wilcoxon signed-rank test (post hoc) were used in the MiniRest study, whereas non-parametric repeated measure analyses was performed in the Pilot and ForRest studies. Power analyses were carried out before the start of both the MiniRest and ForRest studies.

Grounded theory approach (Papers II and IV)

The grounded theory (Glacer and Strauss, 1967) method of constant comparison was used to study the participants' experiences of the forest rehabilitation. Transcribed interviews were coded by an open coding procedure by two (Paper II) and four (Paper IV) researchers from different disciplines. The codes were then discussed and codes with similar elements were compiled into categories through selective coding. Thereafter followed a process of identifying categories, axes between categories and a core category.

Ethics

All participants received oral and written information regarding the studies and gave a written informed consent before entering each and every study. The participants were guaranteed confidentiality and informed that participation was voluntary, meaning that participants could withdraw from the studies at any time without stating any reasons. The MiniRest (Paper I: Dnr 09-121M), ForRest and Interview studies (Papers III and IV: Dnr 07-016M) were approved by the Regional Ethical Review Board in Umeå. No ethical approval was needed for the Pilot study (Paper II) as it was considered as a development of a clinical treatment.

RESULTS

Quantitative results

Mental state (Papers I, II, and III)

The MiniRest study (Paper I) showed enhanced well-being in the forest environments compared to the City. Significantly higher (more beneficial) ratings of mental state were found for all scales except the exhausted-alert. The Forest by the lake had the most favourable ratings of mental state, and significant positive differences were found in comparison with the Rock outcrop concerning the tense-relaxed, irritated-harmonious and restless-peaceful state.

Significant positive effects were found in the Pilot study (Paper II) by single exposure to forest visits on the irritated-harmonious, tense-relaxed, sad-happy and restless-peaceful states, and in the ForRest study (Paper III) for all the mental state scales used. Significant positive progressive effects during the rehabilitation period were found in the ForRest study for all mental state scales, except the irritated-harmonious. Season and single exposure showed significant interaction effects on the tense-relaxed, irritated-harmonious, and restless-peaceful states. Table IV summarises the effects on mental state described in Papers I – III.

Table IV. Effects on mental state. Paper I describes differences in mental state ratings between the city environment and three different forest environments. Papers II and III describe differences in mental state ratings during single exposure to a forest environment, progress during the rehabilitation period and seasonal differences.

	Paper I MiniRest study	Paper II Pilot study	Paper III ForRest study
Tense-relaxed scale			
Single exposure to a forest environment	+/C	+	+
Progress during rehabilitation period		ns	+
Interaction effect of season			+
Exhausted-alert scale			
Single exposure to a forest environment	ns/C	ns	+
Progress during rehabilitation period		ns	+
Interaction effect of season			ns
Sad-happy scale			
Single exposure to a forest environment	+/C	+	+
Progress during rehabilitation period		ns	+
Interaction effect of season			ns
Irritated-harmonious scale			
Single exposure to a forest environment	+/C	+	+
Progress during rehabilitation period		+	ns
Interaction effect of season			+
Restless-peaceful scale			
Single exposure to a forest environment	+/C	+	+
Progress during rehabilitation period		ns	+
Interaction effect of season			+
Mentally divided-clearheaded scale			
Single exposure to a forest environment	+/C		+
Progress during rehabilitation period			+
Interaction effect of season			ns

+ = significant difference
ns = no significant difference
+/C = all forest environments significantly different from the City
ns/C = not significantly different from the City

Attention capacity (Papers I and III)

In the MiniRest study (Paper I), spontaneous reversals in the NCPC test were significantly reduced when performed in the Rock outcrop and Spruce forest compared to the City environment. Focused reversals were significantly reduced in all forest environments compared to the City. The post- compared to pre-test measurements were reduced for both spontaneous and focused reversals in all forest environments, whereas the opposite pattern was observed for the City environment. In the ForRest study (Paper III), there was an interaction between the rehabilitation period and the single exposure (before and after rest in forest) in spontaneous reversals. The focused reversals showed a significant effect for single exposure. Differences between the results from the MiniRest study and the ForRest study are illustrated in Figure 11.

Physiological health measurements (Paper I)

The participant's heart rate was significantly lower in all three forest environments compared to the City environment. The heart rate was significantly lower in the Forest by the lake compared to the Rock outcrop and the Spruce forest. The diastolic blood pressure was significantly lower in the Forest by the lake and the Spruce forest compared to the City environment. No significant differences were found in HRR in the different environments.

Psychological health measurements (Paper III)

Burnout (SMBQ), anxiety and depression (HAD-S), fatigue (CIS), self-esteem (SCQ), and perceived stress (PSQ) evaluations showed significant improvements from baseline to the one-year follow-up for both the forest intervention and control condition. There were no significant differences between the groups.

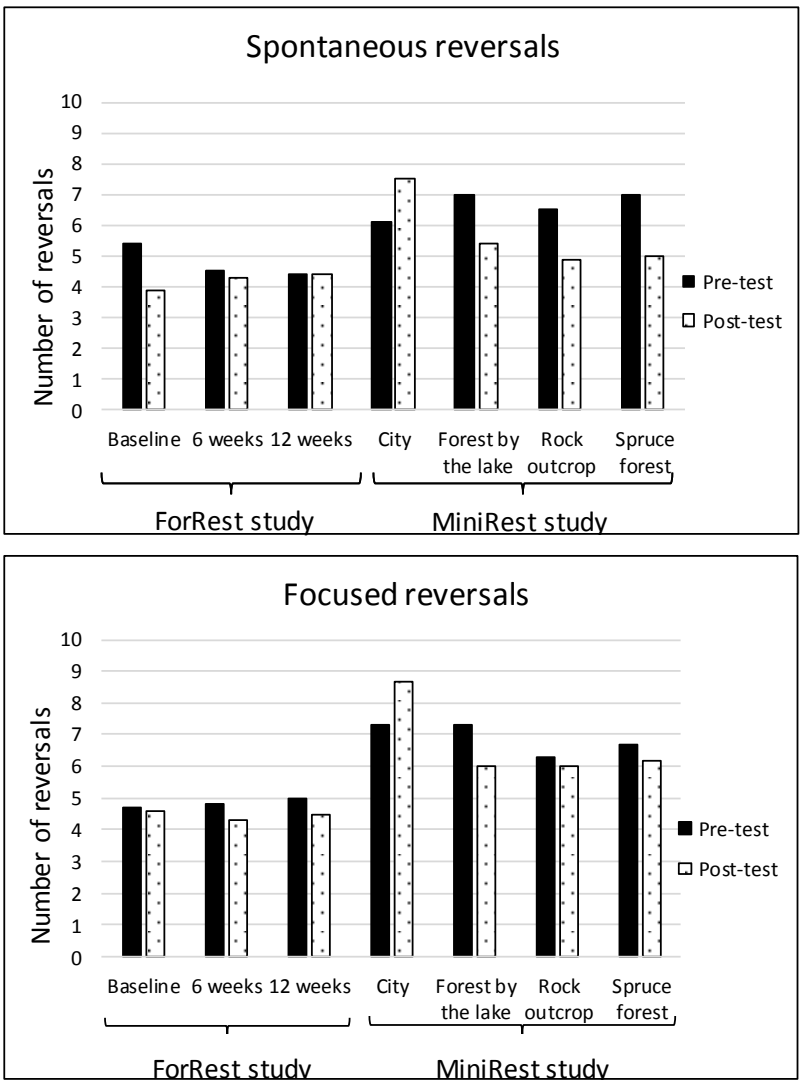

Figure 11. Attention capacity was tested with the Necker cube pattern control task in the ForRest and MiniRest studies. In the ForRest study, pre- and post-tests were executed before and after exposure to a self-selected forest environment. In the MiniRest study, pre-tests were executed in the participants' homes and post-tests in different outdoor environments.

Sick-leave (Paper III)

Sick-leave levels did not differ significantly between the forest rehabilitation and control condition at baseline or at the one-year follow-up.

Preferences for settings (Papers I, II, III, and IV)

All forest environments in the MiniRest study were highly preferred compared to the City (Paper I). The Forest by the lake had most visits in both

the Pilot and ForRest studies (Papers II and III) and was also most preferred in the MiniRest study (Paper I). Darker areas and open spaces without physical or imaginary shelters were less visited (Papers II-IV).

Qualitative results

Experiences of forest rehabilitation (Papers II and IV)
The patients' experiences of the forest visits and rehabilitation were described according to seven different categories in the Pilot study (Paper II): light/darkness, perception, previous experiences, demands, environment, social aspects and freedom. The *light/darkness* category included aspects of light conditions and open/enclosed forest settings, which showed that open and light settings were preferred. The environments' capacity for inducing versatile stimulation of senses was described in the *perception* category. Sensory variation was perceived as important for the stimulation of senses. Both positive and questionable earlier experiences of forest visits were included in the *previous experiences* category. Positive earlier experiences fostered feelings of safety during the forest visits. The *demands* category included perceptions of the forest as a restful place offering peace and quiet, and no demands. The category *environment* described the perception of the different forest settings. Proximity to water was perceived as very beneficial, whereas darker and more enclosed environments were perceived as less beneficial. *Social aspects* dealt with moments shared with other participants as well as in solitude. The time spent in solitude was the most appreciated. Feelings of freedom experienced while spending time in solitude, preferably in open and bright environments, were described in the *freedom* category.

In the Interview study (Paper IV), the core category was named *striving for serenity*, which described the effort that engaged the participants' minds during the rehabilitation period. The mental process during the forest rehabilitation started with *frustration in adaptation to nature,* describing the difficulties of being exposed to idleness for two hours in solitude. *Choosing a favourite place* described how individual mental representations and preferences for physical properties in the forest environments guided the choice of a favourite place. The category *peace of mind* described both the mental and physical relaxation that was required to achieve peace of mind for enabling mental presence and pleasure. The participants perceived more positive thinking and easier access to sense of ease as the forest rehabilitation proceeded, which was described in the *reflective thinking* category. Improved positive thinking led to positive development of personal capacities but was also combined with a fear of failure, as described in the category *hope for a change*. The mental process described by the participants is presented as a theoretical model in Figure 12.

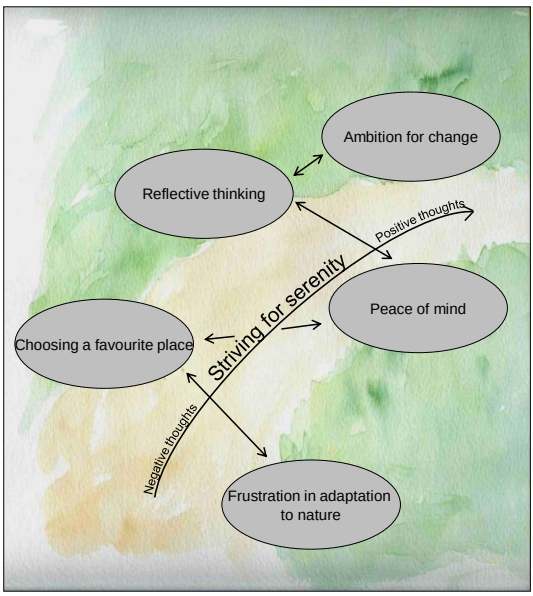

Figure 12. Schematic model showing patients' mental processes throughout the forest rehabilitation period. (Background illustration: Ylva Lundell)

DISCUSSION

The overall aim of the work described in this thesis was to study whether visits to different kinds of forest environments offer positive health effects for persons suffering from ED and therefore could be used in rehabilitation from exhaustion disorder. The results showed that both single and repeated visits over time to forest environments had positive effects on mental well-being. The Interview study (Paper IV) showed that the positive effects on well-being expressed itself in easier access to peace of mind as the rehabilitation progressed. Both quantitative (Papers I and III) and qualitative (Papers II and IV) results indicated that preferences for different forest environments and important features in the forest rehabilitation were associated with the degree of solitude, earlier life experiences, permeability of light, spatial qualities of the forest and sensory input. Participants in the ForRest study (Paper III) who underwent forest visits experienced improved well-being, but there were no significant differences in the psychological health measures between the forest rehabilitation and the control group. The single visits to the forest environments in the MiniRest study (Paper I) showed effects on the ANS, i.e. lowered heart rate and diastolic blood pressure, compared to visits to the city environment.

Recovery from exhaustion disorder

As the participants in the forest rehabilitation group perceived enhanced physical relaxation, ability to reflect, easier access to peace of mind as well as positive thinking, one might have expected better recovery from ED for this group. However, the ForRest study was focused on studying the forest's inherent restorative properties, and therefore all other therapeutic measures during the forest visits and three-month period of forest rehabilitation were discouraged. The good prerequisites for coping with stress behaviour during the forest rehabilitation therefore lacked development of coping tools. This might be one reason why there were no differences in the outcome measures between the forest rehabilitation and the control group. However, this poses an incentive to integrate other types of rehabilitation measures with forest visits in a way analogous to garden therapy (Eriksson et al., 2011; Adevi and Lieberg, 2012; Palsdottir et al., 2014; Währborg et al., 2014). There might also be other contributory reasons for our results. The reassurance of being taken care of, the affirmation given by healthcare professionals at the SRC and knowledge of the oncoming CBR may have been powerful tools for triggering a recovery process. The fitness and appropriateness of psychological health measures used in this study should also be considered. Other studies with different rehabilitative approaches aimed at enhancing recovery from ED (Stenlund et al., 2009; 2009) have shown a similar pattern with lack of significant differences between the studied groups. The SMBQ, PSQ, HAD-S, SCQ and the CIS might be adequate for measuring differences between the aspects of ED but not sensitive enough to detect minor changes in the slow recovery. Stenlund et al. (2009) showed that the level of burnout (SMBQ) did not reach a level of 4.0 until two years after the start of CBR.

The participants in our studies had on average suffered from severe ED for a long time, which might further prolong the time needed for recovery. We might even need to reconsider if a randomised controlled trial is the best way to evaluate rehabilitation programs. Maybe a model based on comparative analysis of persons with good and/or poor outcomes from rehabilitation could help us to develop and customize new rehabilitation models with better results for those suffering.

Effects on mental state and attention capacity

Mental state was sensitive to daily variations, as seen in the Pilot study (Paper II). This was probably partly due to weather conditions as earlier studies have shown that poor weather has negative effects on mental state (Denissen et al., 2008). According to the results of mental-state ratings in both the Pilot and ForRest studies (Papers II and III), the forest visits enhanced well-being, but the ForRest study also revealed a seasonal difference. Single exposure to the forest during spring showed the greatest effects on mental state compared to the same exposure during autumn (Figure 11 in Paper III), suggesting that the participants experienced better recovery during spring. The difference increased towards the end of the seasons as the ratings of being relaxed, harmonious and peaceful were enhanced during the whole spring, whereas the opposite pattern was shown towards the end of the autumn. The estimations of mental state showed decreasing values not only after the rest period in the forest but also before visiting the forest, which could indicate that the participants' general mental state declined towards late autumn. Previous research has shown negative effects on physiology and mental state from cold and hot temperatures (Keller et al., 2005; Modesti et al., 2013), humidity (Howarth and Hoffman, 1984), poor weather (Faust et al., 1974; Denissen et al., 2008) and lack of daylight (Beute and de Kort, 2014; Kööts et al., 2011). Therefore, the results can be interpreted that the participants' mental state evaluations were influenced by all of these elements both before and after visits to the forest. It could also be argued that the positive effects on the mental state could be due to daylight exposure rather than the forest visit per se. These two phenomena are of course closely interrelated and cannot be separated. As the experiments in the MiniRest study (Paper I) were conducted during daylight exposure and showed significant positive effects of visits to the forest compared to the city environment, it is reasonable to interpret the results so that the positive effects in the ForRest study (Paper III) are derived primarily from the forest visits but are also influenced by daylight as well as weather conditions.

Even though the effects on mental state may differ between the seasons, the participants in the Interview study (Paper IV) reported easier access to feelings of ease and tranquillity as the rehabilitation progressed. The participants' mental state increased as the rehabilitation period progressed in both the Pilot and ForRest studies (Papers II and III). This emphasizes the importance of repeated visits to environments that provide positive effects on mental recovery. The forest's salutary effects were also clearly apparent in the MiniRest study (Paper I) when mental state

estimations between forest and urban environments were compared. This is also in agreement with the theory presented by Ulrich (Ulrich, 1983) and other studies testing the restorative properties according to ART (Staats et al., 2003; Berto, 2005).

The attention capacity tested with the NCPC task showed improvements after visits to the forest in both the MiniRest (Paper I) and ForRest studies (Paper III), but there was no effect over time on the attention capacity in the ForRest study, which implies a short-lasting effect such as the effect on mental state. However, Figure 11 shows a difference in the amount of both spontaneous and focused reversals between the ForRest (Paper III) and MiniRest (Paper I) studies. The small differences in the amount of pre- and post-test reversals in the ForRest study (Paper III) might be due to a soothing effect of the forest before execution of the pre-test and the participants' anticipation of the oncoming rest. A plausible reason for the generally higher pre- and post-test values (indicating reduced attention capacity) in the MiniRest study (Paper I) could be the preparation (which could be perceived as detailed) in connection with the pre-test at home and shorter rest (40 min) in the forest when executing the post-test. Cole and Hall (2010) noted that the restorative experiences of nature were influenced by the length of stay. Overall, the participants' mental well-being and attention capacity improved after they visited the forest environments, which is in accordance with the theory presented by Rachel and Steven Kaplan (Kaplan and Kaplan, 1989), but the effect was not long-lasting. Taken together, the results show that the forest has restorative effects on people suffering from ED but weather, seasonal differences and personal circumstances may influence the participants' perception and the degree of rehabilitation outcome. Visits to the forest probably also need to be regular and frequent in order to decrease the suffering and maintain the effects. Maas et al. (2006; 2009), Grahn and Stigsdotter (2003), van den Berg et al. (2010), and Tyrväinen et al. (2014) have also pointed out the need for proximity of green environments in residential areas for inducing good effects on health and the utilisation of green environments.

Environments and effects on physiological measures

The forest environments were described as positive experiences in all studies. The presence of water, perceived openness, variation in topography and places for refuge in the forest environments were highly appreciated. The Forest by the lake environment fulfilled all these requirements and was most frequently visited in the rehabilitation studies (Papers II and III). It also had the highest preference rating in the experimental MiniRest study (Paper I). These results are in accordance with other studies dealing with preferences in the general population and seem universal (Orians, 1980; Ulrich, 1991; Peron et al., 1998; Purcell et al., 2001; White et al., 2010). Also, the reduction of heart rate and diastolic blood pressure in the MiniRest study (Paper I) demonstrated positive effects for the Forest by the lake. Although all three forest environments in the MiniRest study (Paper I) showed a significant reduction of heart rate compared to in the City environment, the reduction of heart rate in the Forest by the lake was significantly different,

even when compared with the other two forest environments. All these mental evaluations and physiological reactions suggest that environments resembling the Forest by the lake do indeed give both mental and physical relief/relaxation from daily wear and tear to people suffering from ED.

The open forest landscape with hiding places provided many positive responses. It was perceived as easily accessible and prompted feelings of security, freedom, progress, and positive physiological responses. The importance of easy access was clearly demonstrated by the preferences of other open areas compared to the Forest by the lake during early spring when accessibility to this environment was reduced. Even though the darker forest environments were not as popular, they still seemed to provide good properties for mental recovery. This was demonstrated by the participants' positive testimonies on the mysterious and snug Spruce forest (Papers II and IV), as well as the positive effects on heart rate, diastolic blood pressure, preference evaluations and mental state ratings recorded during the single visits to the Spruce forest (Paper I). The perceived permeability/openness is associated with our ability to see and move through the environment (Stamps, 2010) and an old, managed, relatively open spruce forest seems to satisfy both these requirements.

We had expected some differences in the HRR as we presumed that the forest might enhance reactivation of the parasympathetic function in the cardiac autonomic regulation. However, no effect on the HRR was detected in the MiniRest study (Paper I) when comparing the different outdoor environments. This might have been due to too short exposure to an outdoor environment, an insufficient physical load during the HRR test or that visits to these test environments are not powerful enough to influence the cardiac autonomic regulation. However, it is possible that other tests on cardiac modulation might have been more effective at showing differences between the environments (Park et al., 2010).

Positive childhood experiences are believed to influence our choices of favourite places (Waite 2007) and the majority of the participants in our studies were native Swedes. Given that Sweden is mostly covered by coniferous forests, has a long coastline and thousands of inland lakes, it seems likely that the participants in our studies had enjoyed and been influenced by visits to such places in early life.

Most patients discovered one or two favourite forest environments during the forest rehabilitation. The choice of favourite place(s) was often connected to the earlier mentioned preferred properties in a landscape. However, the interviews carried out after the forest rehabilitation had ended (Papers II and IV) revealed that the solitude during the two hour rest in the forest was more important for the participants. Even though this time was sometimes perceived as frustrating in the beginning of the rehabilitation period, it turned out to be the most appreciated feature. The time in solitude gave the participants both mental and physical relaxation, and a chance to reflect on their life situation. The ability to reflect is important to enhance coping and recovery from ED (Fjellman-Wiklund et

al., 2010). Therefore, it can be speculated that the outcome of the forest visits would have been more salutary if the enhanced ability to reflect had been combined with learning skills for coping with their ED. Multimodal rehabilitation programs in therapeutic gardens have already shown such effects on persons suffering from severe stress (Eriksson, 2011; Adevi and Lieberg, 2012; Palsdottir et al., 2014; Währborg et al., 2014).

Methodological considerations

We did not obtain the desired number of participants in either the MiniRest or ForRest studies (Papers I and III). The recruitment of participants to the ForRest study (Paper III) was problematic due to new governmental rules for sick-leave benefits that we could not foresee or influence. Also, the implementation of the MiniRest study (Paper I) proved to be very time-consuming due to the study design with individual visits to the environments and limited time for testing during the spring and autumn, which we had not predicted. However, as the results from both the MiniRest and ForRest studies (Papers I and III) as well as the two other studies in this thesis confirm and complement each other, the findings can be regarded as representative and to a large extent generalizable for people suffering from ED. However, the selection of participants might have been biased. It is possible that the majority of recruited participants had positive attitudes to engagement with forest activities, which may have influenced the outcome. On the other hand, this may not be a problem considering that the best rehabilitation results are often achieved by mutual agreement of the patient's wishes and the caregiver's professional opinion of appropriateness of the required measures from a medical point of view. Therefore, the patient's personal preferences should be taken into consideration when selecting rehabilitation measures.

The use of trials is also somewhat difficult to apply on such a complex disease as ED. ED seems to require a long time for recovery (Stenlund et al., 2012), which demands lengthy rehabilitation research studies to evaluate results. In randomised controlled studies, it may be difficult to find an ethically suitable control condition due to the slow progress of recovery. Randomised controlled studies subject the participants in the control group to an unethically long idleness, which may lead them to search for alternative treatments. This in turn makes it harder to interpret the results from a randomised controlled trial. This phenomenon was found in our ForRest study (Paper III) as it was in other studies (de Vente et al., 2008; Stenlund et al., 2009).

Our results from the NCPC task were not in line with what was expected. We chose to use this test because it is simple to perform and practical to use in field conditions and has previously been used to measure effects on attention capacity in green environments (Hartig et al., 2003). Observers are expected to have intentional control over the reversibility of the Necker cube (Pelton and Solley, 1968; Liebert and Burk, 1985), but the participants in our tests did not show such control. Their intention to hold the perceived figure from reversing gave an opposite effect. This could be

due to elicitation of a disproportionately strong response when asked to carry out a task due to sensitivity to mental strain. Other ways to measure attention capacity might therefore be needed in patients with chronic stress and ED.

Practical implications and future research

According to the studies presented in this thesis, the self-reported mental well-being and physiological reactions were positively affected by forest visits. However, no additional effect on recovery from ED in terms of psychological measures was gained. Today, multimodal rehabilitation including CBR is recommended (SOU, 2011) as the most effective rehabilitation for persons suffering from ED. This seems reasonable considering that the diagnosis consists of a complex combination of symptoms which requires multiple measures. Additional research is needed to further reduce the suffering, facilitate the coping process, and enhance recovery from ED.

The studies presented here suggest that forest visits can induce positive mental and physiological reactions. Therefore, it would be interesting to combine forest visits with the recommended multimodal rehabilitation. This could be achieved in different ways. One model could be to accommodate the multimodal rehabilitation sessions in a restorative green environment to enhance peace of mind and creativity during the group rehabilitation sessions. This could be followed by visits to the forest in solitude after the group sessions to give a chance for reflection and integration of the new knowledge gained through the group sessions. Such a strategy is already used in Alnarp, Sweden (Adevi and Lieberg, 2012; Pálsdóttir et al., 2014; Währborg et al., 2014), where cognitive rehabilitation is carried out in garden surroundings.

The forest environments could also be used for physical activity. Physical activity is known to have beneficial effects on depression (Dinas et al., 2011), cognitive impairment and anxiety (Hillman et al., 2008; Zschucke et al., 2013), which are common symptoms among ED patients. Physical activity in natural environments has also been associated with greater beneficial effects compared to indoor exercise. Therefore, forests could be utilised for both tranquillity and activity depending on the individual's needs, motivation and situation. Visits to the forest could be supervised and made available both during and after the rehabilitation period to extend the continuation of good habits.

CONCLUSIONS

Visits to forest environments contributed to enhanced mental well-being, attention capacity and physiological responses as compared to a city environment.

- Forest rehabilitation twice a week for 12 weeks increased mental well-being during the ongoing rehabilitation but had no additional effect on recovery from ED as compared to the control group.
- The participants in the forest rehabilitation and the control group improved their psychological health measures and sick-leave levels after one-year of rehabilitation, but there were no differences between the groups.
- Solitude, feelings of freedom and no demands during the forest visits are important features for finding peace of mind and tranquillity.
- The forest itself has restorative properties and can contribute with easier access to peace of mind and reflective thinking.
- Visible water, openness and accessibility of the landscape are important features for preferences for different forest environments.
- Access to several different kinds of forest environments enhances the chances of finding a preferred environment in solitude.
- Intensity of daylight, sensory input, season, and weather conditions may influence the experience of nature and have consequences for the outcome on perceived well-being.
- Forest rehabilitation could be utilised to enhance patients' mental well-being and the effects may be enhanced if this rehabilitation is integrated with CBR.
- Further research is needed to evaluate the benefits of combining CBR with forest visits.

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