1. PUBLIC HEALTH

Agnes van den Berg
Wageningen University and Research Centre
P.O. Box 47
6700 AC Wageningen

1.1. Introduction 1
1.2. Health benefits of nature 2
1.3. Ecosystem qualities and human health 5
1.4. Implications 7
1.5. Literature 8

1.1. Introduction

In 1998, the Dutch Ministry of Nature, Agriculture and Food Quality launched a campaign titled “Operation Treehut”. The aim of this campaign was to give the social values of nature a more prominent position in nature policy. The importance of contact with nature for people’s health and well-being was one of the social values that was given high priority in the campaign. In particular, it was assumed that contact with nature would provide an effective means to prevent and decrease diseases and problems that are typical of a stressful urban life-style such as obesity, asthma, chronic stress, heart diseases, and diabetes. However, during a conference on this theme, held in May, 1999, it became clear that there was, at the time, insufficient evidence from rigorous scientific work to support these assumptions.

Almost a decade later, health benefits of nature have become one of the “hottest” issues in Dutch nature policy. Several reviews of the scientific literature have been published, including the Alterra-essay " Van buiten word je beter" (Van den Berg & Van den Berg, 2001) and an influential advice by the Health Council of The Netherlands (Health Council/RMNO, 2004). The general conclusion of the latter review was that there is increasing evidence that contact with nature promotes restoration from stress and mental fatigue. In addition, the Health Council found consistent clues that nature may promote health through other mechanisms, such as stimulation of physical activity and social contacts, encouragement of the development of children, and providing opportunities for personal development and a sense of purpose. The review of the Health Council does not cover more physical pathways by which nature may influence health (e.g., air-cleaning effects of plants and trees, life-support functions of ecosystems). However, it is noted that such effects are plausible and should be given consideration in future reviews.

In conjunction with the increasing scientific evidence, there has been a growing interest to put health functions of nature to practice in recreational, therapeutical and other settings. The advisory council for research on spatial planning, nature and the environment (RMNO) has recently listed more than 100 “best practices”. These practices vary from the creation of healing gardens near hospitals to the development of “health

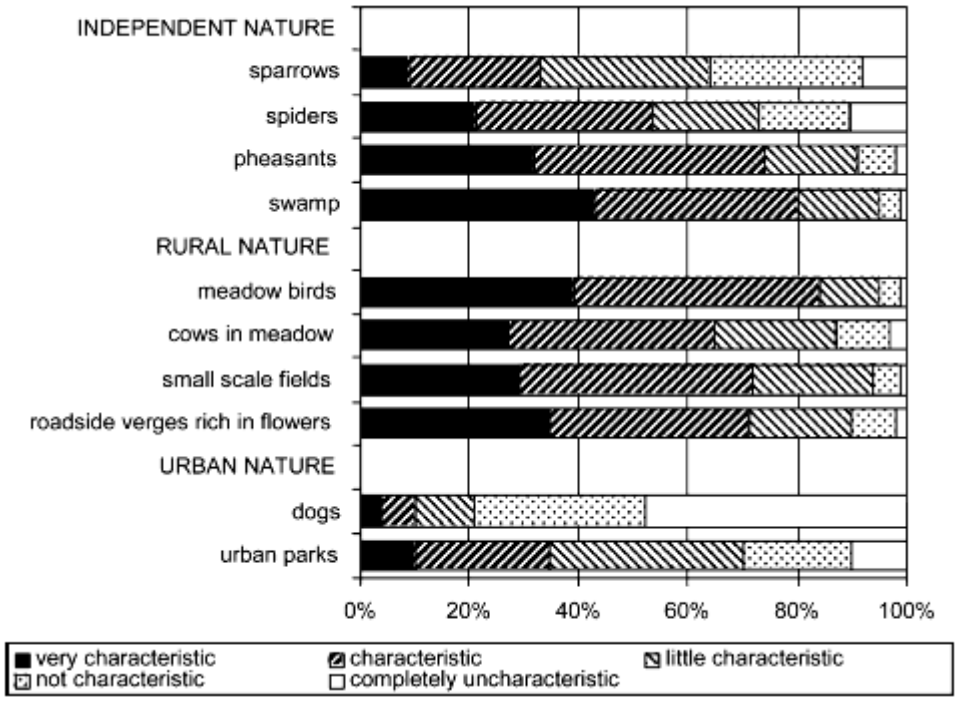
routes” in recreation areas for people with coronary disease and the transformation of farms into care-centers for mentally handicapped and burned-out persons.

This chapter gives an overview of this changing context and its implications for landscape and urban ecology. It starts with a brief review of research on health impacts of nature in general, followed by a discussion of the values of various ecosystem qualities for human health. It concludes with the implications of these insights for landscape and urban ecology.

1.2. Health benefits of nature

People in the Netherlands and other urbanized societies tend to believe that contact with nature provides them with restoration from stress and fatigue and improves their health and well-being. For example, in a nation-wide survey among inhabitants of The Netherlands, 92% of the respondents indicated that they agreed with the statement “a visit to nature gives me a healthy feeling” (Frerichs, 2004). According to the respondents, the primary causes of this healthy feeling were the confrontation with fresh air and the pleasant smell of it (49%), the possibility to cycle, walk or otherwise be physically active in nature (44%) and the relaxing atmosphere and the feeling of “being away” (26%).

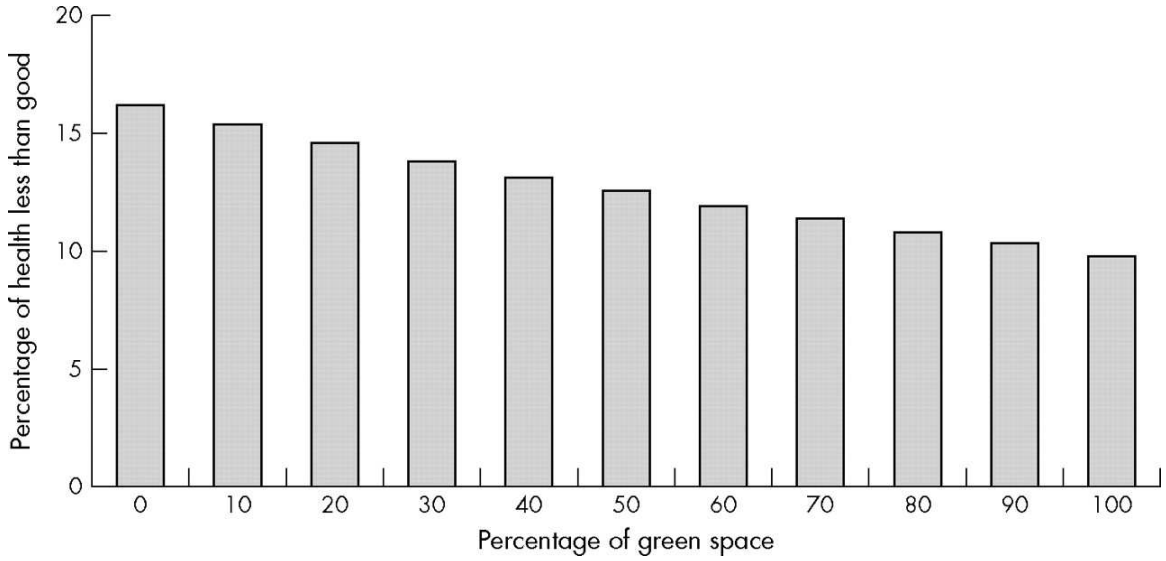
In the survey by Frerichs (2004) the concept of nature was defined in a broad way, as “*not only woods, moors, lakes, dunes, beaches, rivers, wetlands, etc., but also green facilities in and around the city. The latter include not only public gardens, parks, and meadows in your nearby living environment, but also nature areas and greenery meant for recreation, such as a cycling route”* (p. 6). Such broad definitions of nature are very common in social-science research. They reflect the finding that most lay people possess a broad image of nature that includes natural as well as cultural landscapes (Buijs, Pedroli & Luginbühl, 2006). In one study on people's nature images, even rather isolated types of vegetation like flowers along road sides were seen as nature by more than 70% of a sample of Dutch city dwellers (Buijs, 2000).



Source: Buijs, Pedroli & Luginbühl, 2006, adapted from Buijs, 2000

Fig. Degree to which Dutch city dwellers rate elements as characteristic for nature. These results show that lay people have a broad image of nature.

The widely held belief that contact with 'nature' (in a broad sense) is beneficial for one's health is supported by two large-scale epidemiological studies in the Netherlands (De Vries, Verheij, Groenewegen, & Spreeuwenberg, 2004; Maas, Verheij, Groenewegen, De Vries & Spreeuwenberg, 2006). These studies have revealed that the percentage of green space (including urban green, agricultural green, forests, and nature conservation areas) within a 3-kilometre circle from people's home was, on average, positively related to self-perceived health. In both studies the positive link between green space and health was found to be relatively marked among the elderly, housewives and people from lower socio-economic groups. The researchers attribute these findings to the fact that these groups spend a relatively large amount of time in the residential environment.



Source: Maas e.a., 2006

Fig. 1 Relation between amount of green space (in a 3 km radius) and self perceived health (percentage stating their health is less than good)

The results of the Dutch epidemiological studies allow for several interpretations of the mechanisms underlying the relationship between green space and health. These mechanisms may include restorative or stress-reducing influences that result from the contemplation of greenery, health benefits of physical activity (because presence of greenery may stimulate residents to walk or cycle), and better air quality or climate control in greener environments.

Thus far, restorative functions of nature are best supported by scientific evidence. In a recent review, Van den Berg (2005) discusses more than 30 controlled studies that speak to the restorative effects of contact with real and simulated nature. In a typical experiment, healthy volunteers first receive a stress-induction treatment (e.g., watching a scary movie or performing a mentally fatiguing task). Next, they are randomly assigned to conditions of viewing or visiting natural versus built environments. Stress is assessed before and after the stress manipulation, and after viewing the natural or built environments. Results of such experiments have consistently shown that stressed individuals who are exposed to natural environments show more positive mood changes, perform better on concentration tasks, are more tolerant to pain, and display more physiological symptoms characteristic of stress recovery than stressed individuals who are exposed to built environments.

Although the benefits of physical activity for people's health are well-known, the importance of nature in establishing these benefits has not yet been directly demonstrated. A recent study by Vreke e.a. (2006) showed that, after controlling for influences of socio-economic and ethnographic variables, the percentage of children

(ages 4-18) with overweight and obesitas in green neighborhoods was about 15% smaller than in barren neighborhoods. However, because activity levels were not measured in this study, alternative explanations of these findings, e.g. in terms of different food intake patterns in green and barren neighborhoods, cannot be ruled. Nevertheless, a recent study by De Vries (in press) suggests that it is plausible that the relationship between percentage of green space and overweight found in the study by Vreke e.a. (2006) was at least partly caused by higher activity levels of children in green neighborhoods. De Vries e.a.(in press) found that the percentage of green space and presence of water in neighborhoods is positively related to children's physical activity levels. Taken together, the findings of these two studies strongly suggest that the presence of nearby nature plays an important role in stimulating children to become more physically active, which may reduce their risk of becoming overweight, and all the health problems that may follow from this condition.

With respect to air quality it has been found that trees and other vegetation can lower local concentrations of particulates and other forms of air pollution by means of their filter function (see Beckett, Freer-Smith & Taylor, 1998, for a review). However, the actual health benefits of such filter functions for residents have not yet been demonstrated. Moreover, the small differences in air pollution between urban and natural environments suggest that the filter function of trees and plants does not have a major influence on air quality at a regional level. The only places where trees and other vegetation may partly account for a positive correlation between nature and health by improving air quality are at local level and directly along busy roads and motorways (e.g., Tonneijk & Blom-Zandstra, 2002).

1.3. Ecosystem qualities and human health

There is no doubt that the degradation of ecosystems may in the long run have serious consequences for the health and survival of the human species. The Millenium Ecosystem Assessment (2005) has shown that approximately 60% of the benefits that the global ecosystem provides to support life on Earth (such as fresh water, clean air and a relatively stable climate) are being degraded or used unsustainably. In the report, scientists warn that harmful consequences of this degradation to human health are already being felt and could grow significantly worse over the next 50 years. Thus, from a global perspective, the quality of ecosystems is extremely important for human health and well-being.

On a personal scale, there is some evidence that ecosystem qualities play a role in people's perceptions of healthy environments. For example, Ogunseitan (2005) asked a sample of 369 American respondents to rate various environmental characteristics according to their effectiveness in making one feel refreshed or experience restoration. Respondents were also asked to rate their quality of life (including a measure of their physical health) and their current level of restoration. Results revealed four domains of restorative environmental characteristics: ecodiversity (e.g., presence of trees, forests, flowers, animals), synesthetic tendency (e.g., colors, smells, sounds), familiarity (e.g., identifiability, privacy), and cognitive challenge (e.g., complexity, mystery). Of these four domains, ecological diversity was most strongly associated with quality of life and the current level of restoration. These findings suggest that individuals tend to believe that certain types of natural environments, in particular environments with a high ecodiversity, have more to offer in terms of health and well-being than others.

However, there is as yet little evidence from national, regional and local studies to support the notion that health benefits of nature vary as a function of objectively measured ecosystem qualities such as biodiversity, stability, land cover type, degree of organization, and levels of immigration and invasion. A study conducted in Rome (Bonnes, Carrus, Bonaiuto, Fornara & Passafaro, 2004) found that residential satisfaction towards urban green spaces can be directly linked to the overall quantity/availability of these but are somewhat independent from their overall quality/typology in terms of biodiversity richness. Apparently, the Romans are more concerned for having more green spaces available and less concerned for having green spaces of higher ecological quality. This notion is consistent with results of the Dutch epidemiological studies on relations between urban greenery and health by De Vries e.a. (2003) and Maas e.a. (2006) which also showed that self-reported health was dependent on the amount of green space but not on the type of greenery.

Type of greenery does seem to matter in physical pathways. In particular, it has been found that conifers are more efficient at absorbing pollutant particles than broadleaved species (Beckett, Freer-Smith & Taylor, 2000). The value of conifers at absorbing pollution comes from a variety of factors including their evergreen habit, their speed of establishment, very high surface areas, and their particular effectiveness at absorbing particles (Beckett, Freer-Smith & Taylor, 1998). In the Netherlands, most conifers are exotic species and typically regarded as a threat to ecosystem functioning. This illustrates that ecosystem values are not necessarily relevant for, or compliant with, public health values.

By contrast, there are reasons to assume that some characteristics of healthy ecosystems, such as a high biodiversity, may even have adverse effects on public health and well-being. Natural areas with a high degree of biodiversity are typically quite wild and dense. Such areas may not only arouse intensely positive emotions in people, but also intense fears (Koole & Van den Berg, 2005). This fear-evoking capacity of wild nature appears to be a product of evolution; for early humans who had to survive in wild, natural environments that contained many dangers a quick and strong fear response was crucial for the activation of appropriate defensive actions (Öhman & Mineka, 2001). Especially individuals who are in a vulnerable position, for example because they are ill or mentally unstable may experience confrontations with wild nature in a negative way. (cf. Van den Berg & Ter Heijne, 2004). Indeed, evaluations of school field trips and other mandatory nature programs have consistently shown that a small but substantial number of individuals are unable to overcome their fear for wilderness environments and transform it into a positive experience, even after spending prolonged periods of time in these environments (see Bixler et al*.,* 1994, for an overview).

Contact with wild nature may also be unhealthy in a more physical sense. Biodiverse areas often contain many dangerous elements, such as untamed large animals that can attack humans, broken trees that can fall on people's heads, and swamps filled with bacteria that may spread contagious diseases (Van den Berg, 2004). Of course, these are exactly the same types of dangers that have motivated people throughout history to cultivate "unland" and build cities as safe places to live in. Even in the Netherlands, a country that is often assumed to have tamed nature and banned out all dangers, there is growing concern for such negative health impacts of nature (Van Winsum-Westra & De Boer, 2005). In particular, the occurrence of several accidents with wild cows and horses in newly developed natural areas that are part of the National Ecological Network (Cf.

Jongman & Veen, Chapter 9, this volume) has stimulated a new awareness of the dangerous side of nature.

There appears to be a discrepancy between the perceived dangerousness of nature and the actual risks of getting hurt or killed in nature (Van Winsum-Westra & De Boer, 2005). Because of our innate tendency to react fearfully to natural threats, the actual risks of contact with nature are typically overestimated. Moreover, the actual impact of natural dangers on physical health is to a large extent dependent on the individual's fitness and coping skills. For people with adequate coping skills, confrontations with natural dangers provide excellent opportunities for improving their mental and physical resilience; for individuals with insufficient coping skills, however, such confrontations may result in injuries and disease.

1.4. Implications

In recent years, human health and well-being has become an important criterion for assessing the quality of natural areas and urban ecosystems besides ecological and environmental criteria. Unfortunately, as pointed out in the previous paragraph, it is becoming increasingly clear that human values and ecological values are not interchangeable. The growing recognition of health functions of nature thus seems a mixed blessing for ecologists. On the one hand, it strengthens the case for the importance of nature in society. On the other hand, it weakens the relative importance of biodiverse ecosystems as compared to other types of nature.

The widely held belief that contact with 'nature' (in a broad sense) is beneficial for one's health is supported by two large-scale epidemiological studies

How should landscape ecology deal with this changing context? First, there is an urgent need for more research on the health impacts of different types of nature. Landscape ecologist may stimulate this research by asking social scientists to collaborate in their research project. In particular, future research should try to identify health benefits that are specific to contact with wild, biodiverse nature. Most likely, these benefits lie in the domain of personal development and the enhancement of mental and physical resistance. In conducting such research, attention should be paid to individual differences and possible underlying mechanisms, such as coping skills and personality styles.

Furthermore, landscape ecologists should become more aware of the potential conflicts between the health of ecosystems and human health. What is healthy for nature, may not always be healthy for people. Nevertheless, there remain remarkable commonalities in global aims for sustainable ecosystems and their importance for human health and well-being. By being more aware of potential negative health impacts of biodiverse nature on a personal level, the public support for strategies to protect and enhance biodiversity on a global level can be strengthened. The promotion of wild nature, as an answer to the degradation of ecosystems need to be considered in relation to people's personals need for healthy experiences with nature and the suitability of wild nature for meeting that need.

1.5. Literature

Beckett, K.P., P.H. Freer-Smith, & G. Taylor (1998). Urban woodlands: their role in reducing the effects of particulate pollution. *Environmental Pollution*, 99(3), 347-360.

Beckett, K.P., Freer-Smith, P. & Taylor, G. (2000). Effective Tree Species for Local Air-Quality Management. *Journal of Aboriculture,* 26(1):12-19.

Bixler, R.D., Carlisle, C.L., Hammitt, W.E., & Floyd, M.F. (1994). Observed fears and discomforts among urban students on school field trips to wildland areas. *Journal of Environmental Education, 26,* 24-33.

Bonnes, M., Carrus, G., Bonaiuto, M., Fornara, F., & Passafaro, P. (2004). Inhabitants' environmental perceptions in the city of Rome within the framework for urban biosphere reserves of the UNESCO programme on man and biosphere. *Annals of the New York Academy of Sciences* 1023, 175-186.

De Vries, S.I., Bakker, I., Van Mechelen, W. & Hopman-Rock, M. (in press). Determinants of activity-friendly neighborhoods for children: Results from the SPACE Study*. American Journal of Health Promotion*.

De Vries S., Verheij R. A., Groenewegen P. P., & Spreeuwenberg P. (2003). Natural environments -healthy environments? An exploratory analysis of the relationship between green space and health. *Environment and Planning A*; 35: 1717-1731.

Frerichs, R. (2004). *Gezondheid en natuur; Een onderzoek naar de relatie tussen gezondheid en natuur* [Health and nature; a research into the relation between health and nature]. 's Gravelande: Vereniging Natuurmonumenten.

Health Council of the Netherlands (2004). *Nature and health. The influence of nature on social, psychological and physical well-being.* Publication no. 2004/09. The Hague: Health Council of the Netherlands and Dutch Advisory Council for Research on Spatial Planning.

Koole, S.L., & Van den Berg, A.E. (2005). Lost in the wilderness: Terror management, action control, and evaluations of nature. *Journal of Personality and Social Psychology*, 88(6), 1014-1028.

Millennium Ecosystem Assessment (2005). *Ecosystems & Human Well-being: Synthesis*. Washington DC: Island Press.

Ogunseitan, O.A. (2005). Topophilia and the quality of life. *Environmental Health Perspectives,* 113, 143-148

Öhman, A., & Mineka, S. (2001). Fears, phobias, and preparedness: Toward an evolved module of fear and learning. *Psychological Review, 108*, 483-522.

Tonneijck, A.E.G. & Blom-Zandstra M. (2002). Landschapselementen ter verbetering van de luchtkwaliteit rond de Ruit van Rotterdam. [Landscape elements for improvement of the air quality around the area "de Ruit van Rotterdam".] Wageningen: Plant Research International.

Van den Berg, A. E. (2005). *Health impacts of healing environments: A review of the benefits of nature, daylight, fresh air and quiet in healthcare settings*. Groningen: Foundation 200 years University Hospital Groningen.

Van den Berg, A. (2004). *De verborgen angst voor natuur: Essay en verslag debat* [The hidden fear of nature]*.* Rapport nr. 04.2.089. Den Haag: InnovatieNetwerk Groene Ruimte en Agrocluster

Van den Berg, A. E., & Ter Heijne, M. (2005). Fear versus fascination: Emotional responses to natural threats. *Journal of Environmental Psychology, 25* (3), 261-272.

Van den Berg, A.E. & Van den Berg, M.M.H.E. (2001). *Van buiten word je beter; een essay over de relatie tussen natuur en gezondheid.* [The outside heals; an essay on the relationship between nature and health].Wageningen, Alterra, 55 blz.

Van Winsum-Westra, M. & De Boer, T.A. (2004). *(On)veilig in bos en natuur? Een verkenning van subjectieve en objectieve aspecten van sociale en fysieke veiligheid in bos- en natuurgebieden.* [Unsafe in the woods and nature? An exploration of subjective and objective aspects of social and physical safety in forest- and natural environmetns] Alterra rapport 1060. Wageningen: Alterra.

Vreke, J., Donders, J.L., Langers, F., Salverda, I.E. & Veeneklaas, F.R. (2006). *Potenties van groen! De invloed van groen in en om de stad op overgewicht bij kinderen en op het binden van huishoudens met midden- en hoge inkomens aan de stad.* [Potentials of greenery! The influence of green in and around the city on overweight and obesity and on the commitment of households with middle- and high incomes to the city]. Report 1356. Wageningen: Alterra.