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Proceedings of the European Conference "Biodiversity and Health in the Face of Climate Change – Challenges, Opportunities and Evidence Gaps"

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Proceedings of the European Conference "Biodiversity and Health in the Face of Climate Change – Challenges, Opportunities and Evidence Gaps"

Bonn, Germany, 27 - 29 June 2017

Organised by the German Federal Agency for Nature Conservation (BfN) in co-operation with the European Network of Heads of Nature Conservation Agencies (ENCA) and the Helmholtz-Centre for Environmental Research (UFZ) / German Centre for Integrative Biodiversity Research (iDiv) Halle - Jena - Leipzig

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Preface

Climate change poses significant challenges to biodiversity and human well-being in Europe. On the other hand, biodiversity in urban as well as in adjacent rural areas can provide health as well as climate change mitigation and adaptation benefits. Thus, the German Federal Agency for Nature Conservation (BfN) in co-operation with the ENCA Interest Group on Climate Change and the Helmholtz Centre for Environmental Research (UFZ) / German Centre for Integrative Biodiversity Research (iDiv) organized the conference on "Biodiversity and Health in the Face of Climate Change – Challenges, Opportunities and Evidence Gaps", which took place from 27-29 June 2017 in Bonn, Germany. The conference formed part of the series of European Conferences on Biodiversity and Climate Change (ECBCC). This time, it was co-sponsored by the World Health Organisation (WHO) Regional Office for Europe.

The aim of the conference was to discuss the positive and negative effects of biodiversity on human health in a changing climate. In this context, health was considered in its physical, psychological and social dimension, including socio-environmental equity.

On behalf of the organizing team, I would like to thank all attendees, in particular the speakers, poster authors, and session chairs, for their active participation and stimulating inputs. The vivid discussions between scientists with various backgrounds and practitioners from all over Europe gave this conference a truly inter- and transdisciplinary character.

The conference proceedings contain abstracts of oral presentations and posters. In addition, summaries of the discussions held during parallel sessions and in plenary are given. Based on these outcomes, the ENCA Interest Group on Climate Change elaborated conclusions for taking forward the evidence of the links between biodiversity and health in the face of climate change during a meeting which was held back-to-back to the conference. They were endorsed by the ENCA network at its 21st plenary meeting in Lithuania. These recommendations are meant to be used by European nature conservation agencies, health agencies/institutions, municipalities, decision makers on several political levels, non-governmental organizations as well as applied science. They focus on ways forward to promote the evidence of the links between biodiversity and health in the face of climate change and will help to foster the wider application of nature-based solutions complementary to already established medical or technical measures.

Prof. Dr. Beate Jessel
President of the German Federal Agency for Nature Conservation (BfN)

1 Introduction

The joint BfN/ENCA European Conference on "Biodiversity and Health in the Face of Climate Change" was held in Bonn, Germany on 27-29 June 2017 to highlight the important contribution of green spaces and biodiversity to human health in a changing climate. It was the fourth event in a series of biannual "European Conferences on Biodiversity and Climate Change" (ECBCC), which started in 2011[1]. The German Federal Agency for Nature Conservation (BfN) organized the conference in co-operation with the Interest group on Climate Change of the Network of Heads of European Nature Conservation Agencies (ENCA), the Helmholtz-Centre for Environmental Research – UFZ and the German Centre for Integrative Biodiversity Research (iDiv) Halle-Jena-Leipzig. The 2017 conference was co-sponsored by the World Health Organisation (WHO) Regional Office for Europe.

A wide range of European experts from science, policy and practice convened to discuss the importance of biodiversity's contribution to human health in the face of climate change. Further emphasis was placed on the potential of nature-based solutions to meet the challenges and create multiple benefits in relation to climate change, human health and nature conservation. Some of the latest scientific findings on impacts of climate change on European biodiversity and human health were presented in the plenum sessions. This was followed by interactive sessions focusing on eight specific themes ranging from the "Psychological effects of nature and biodiversity on human health and well-being", "The benefits of green space for enhancing human health – Lessons learned from urban interventions" and "Health and protected areas in a changing climate". More specific discussions were held on "Biodiversity or Green Space?" and "Allergenic plants and vector borne disease – Relevance to human health in a changing climate". In addition, policy and practice orientated themes were addressed such as "Linking Initiatives in biodiversity, health, climate change in policy and practice", to "Nature-based solutions for climate change adaptation and their role in fostering health and socio-environmental equity " and "Planning and managing urban green spaces for health and biodiversity in a changing climate – Concepts, experiences, practice".

Structure of the conference

The three-day event, which was attended by about 220 participants from 31 countries, comprised twenty-one keynote presentations with time for questions and discussion, a poster session, eight parallel workshop sessions and a final plenum discussion. Overall, 57 presentations were given in plenary and the interactive workshop sessions, complemented by 46 posters that were displayed during the conference.

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[1] The first conference held in Bonn in 2011, explored options to enhance communication and co-operation between science, policy and practice and identified research priorities (see: https://www.bfn.de/themen/klimawandel-und-biodiversitaet/veranstaltungen/european-conference-on-biodiversity-and-climate-change-science-practice-policy-1213-042011-in-bonn.html). The second conference, held in 2013, focused on adaptation of main European ecosystems and led to recommendations for climate change-adapted nature conservation in Europe (see: https://www.bfn.de/themen/klimawandel-und-biodiversitaet/veranstaltungen/climate-change-and-nature-conservation-in-europe.html). The third conference, held in 2015, focused on and developed recommendations regarding nature-based solutions for climate change adaptation in urban areas (see: https://www.bfn.de/en/activities/climate-change-and-biodiversity/events/european-conference-on-biodiversity-and-climate-change-ecbcc-2015-in-bonn.html).

The conference was opened by Beate Jessel, President of the BfN, and Ruth Waters, ENCA Climate Change Group, who warmly welcomed the participants and provided an overview of the scope and background of the conference. A welcome address was given by Elizabet Paunovic, Head of the European Centre for Environment and Health at the WHO Regional Office for Europe. Following this, Ronan Uhel, Head of Programme on Natural Systems and Sustainability at the European Environment Agency, gave a keynote presentation on harnessing biodiversity's natural capital to benefit human health and climate change adaptation. He emphasized the inter-dependences and interlinkages between nature, biodiversity, climate change and health – as well as the multiple co-benefits nature-based solutions have for responding to human health and well-being challenges from climate change, whilst promoting nature conservation and green infrastructure. These two presentations were followed by eleven scientific keynote presentations. Terry Hartig, Upsala University, gave an excellent introduction to the psychological understanding of nature and health. He explained the concept of 'constraints to restoration' in which changing environmental conditions hinder the opportunity for psychological restoration: Climatic changes and biodiversity loss are constraints to restoration as they reduce both the opportunity to use nature for psychological restoration, and the restorative quality of the natural environment. This keynote was complemented by Kevin Gaston, University of Exeter, who introduced the importance of nature conservation in the context of biodiversity and human health relationships. He concluded that the loss in wildlife and biodiversity result in reduced opportunities for nature interactions, which are related to a reduction in our own well-being. As such, nature conservation is invaluable for human health and well-being. Catherine Ward Thompson, University of Edinburgh, gave an excellent overview of how the design and planning of urban nature can affect the well-being and quality of life of city residents – especially older people or individuals who live in economically deprived areas. She argued that the quality of green space is important for human health and presented research on the aspects of the design of the natural and urban environment that can encourage or hinder use.

Tuesday's afternoon keynote session included contributions from Ruth Müller, PoloGGB, Italy and the University of Frankfurt, and Stephanie Gilles-Stein, University Clinic Augsburg, discussing the 'dark side' of biodiversity and health. These speakers focused on the health impacts of climate change and urbanisation on the spread of disease vectors and allergenic plants to new regions of the World. Both presenters discussed the importance of prevention and management of these environmental risks. Sarah Lindley, University of Manchester, discussed how urban green space can influence human health by reducing the risk of heat stress that occurs in urban areas from the urban heat island effect and climate change. Using data from Manchester (UK), she demonstrated the reduction in temperature from urban green space and retrofitted green infrastructure. Roderick Lawrence, University of Geneva, presented an overview of the findings from the EU-funded PHENOTYPE project on the positive health effects of outdoor environments in Europe[2]. The research found that nature-health relationships may differ by local context and population, that access to nearby nature may not be a good predictor of use, but that perceived quality of one's local green space may be a better predictor of use. He concluded his talk by outlining the six policy recommendations from the PHENOTYPE project. In the second afternoon session, Payam Dadvand, IS Global, Spain, illustratively presented the evidence on the effect of green space on childhood devel-

[2] The PHENOTYPE Report Summary can be found here: http://cordis.europa.eu/result/rcn/188092_en.html

opment and physical health. He summarized that there was convincing evidence for the effect of green space on children's birth weight, attention deficit disorder and cognitive development, and inconsistent evidence on the effect of green space on children's asthma, allergies and physical activity. Sjerp de Vries, Wageningen Environmental Research, presented the preliminary results from the HappyHier[3] project, a mobile phone app to capture an individual's *in situ* mood. The app also captures contextual information like who the participant is with and what they are doing, whilst the phone tracks participant's location. Preliminary results show that context – the environment, the activity (leisure activity, at work), and the amount of green space in the garden – matters for happiness. The final scientific keynote session on the first conference day focused on the social effects and implications of planning and development. Taking this up, Richard Mitchell, Glasgow University, addressed the interrelationships of social inequalities in health, climate change and green space. He presented how green space might be able to create health equality by reducing the gap in health between rich and poor. He advocated a systems thinking approach to nature and health interactions. As an example, he highlighted the many variables that influence use of a woodland such as, personal psychology, maintenance and design aspects of the woodland, and context of the local area. Thomas Elmqvist, from the Stockholm Resilience Centre, discussed how urban green space could help make cities resilient and sustainable in a time of climate change and population growth. Whilst, resilience and sustainability are two different concepts, he argued that they are linked, and provided innovative examples of urban green space developments, such as pocket parks and linear parks. Finally, Thomas Claβen, North Rhine Westphalia Centre for Health, completed the scientific keynotes and discussions with a presentation about legislation in North Rhine Westphalia, Germany, requiring local health authorities' involvement in planning applications. This legislation has led to the creation of Healthy Urban Development Guidelines. The first conference day ended with an evening reception hosted by BfN, which took place after a public evening lecture by Wouter Poortinga, Cardiff University, who discussed public perceptions and engagement with climate change messages.

In order to enrich the conference programme by actively applying theoretical findings, optional guided walks were offered in the mornings of day two and three.

The second conference day was opened with a launch of the WHO Action Brief on Urban Green Spaces[4] by Elizabet Paunovic, Head of the European Centre for Environment and Health at the WHO Regional Office for Europe. She introduced WHO's perspectives on health, biodiversity and climate change, which includes among others the "Ecosystems and Human Well-being health synthesis", the "State of Knowledge Review on Biodiversity and Human Health", the "Urban Green Spaces and Health review of evidence" and the "Urban Green Space Interventions and Health review". This presentation was followed by a keynote talk by Karsten Mankowski, Political chair of the German National Healthy Cities Network. He presented the inter-relationships between urbanization and human health and well-being, and the role that local governments have for health promotion of its citizens. For the remainder of the day, the focus was on eight parallel workshop sessions and a poster session at midday. The eight parallel workshop sessions are summarised in section 2. The main mes-

[3] http://www.wur.nl/nl/Onderzoek-Resultaten/Projecten/HappyHier/Wat-is-HappyHier.htm

[4] The 2017 WHO Regional Office for Europe action brief can be found here: http://www.euro.who.int/en/health-topics/environment-and-health/urban-health/publications/2017/urban-green-spaces-a-brief-for-action-2017

sages from the workshops were presented in plenary in the late afternoon and informal discussions and networking continued at the conference dinner that evening.

The third conference day was dedicated to policy and business issues for the implementation of nature-based solutions (NBS) for human health and climate change adaptation. Birgit de Boissezon, Director of Sustainable Management of Natural Resources, DG Research and Innovation, European Commission, started with a keynote discussing the contribution of the EU research and innovation policy agenda for environment and health (including the health impacts of climate change) and nature-based solutions. In particular, she introduced the future Horizon 2020 (WP2018-2020 SC1; SC5) calls relating to the environment, nature and health. Stefan Leiner, Director of Biodiversity, DG Environment, European Commission, complemented the discussion of DG Environment's perspective on the contribution of nature and biodiversity to health and well-being, and the effect that climate change will have on this relationship. He referred to current European Commission policy documents supporting these inter-relationships, for example: 7th environment action programme; the EU biodiversity strategy; Birds and Habitats Directive; and the Natura 2000 network. He highlighted the need for integrated policy implementation for green infrastructure and NBS to promote the health agenda, as current EU Directives do not mention the link between environment and health and well-being. Cristina Romanelli, Secretariat of the Convention of Biological Diversity (CBD), argued that biodiversity loss exacerbates the impacts of global environmental change on human health. She outlined the opportunities to link biodiversity, health and climate change through the CBD and WHO interagency liaison group on biodiversity and health[5], the UN Sustainable Development Goals, and research projects on One Health, Ecohealth and Planetary Health. Luc Bas, Director of the International Union for Conservation of Nature (IUCN) European Regional Office, referred to IUCN's perspective on the use of NBS for nature conservation, as well as climate change adaptation, and benefits for human health and well-being and biodiversity. He outlined IUCN's interest in nature and health as it highlights the importance and value of ecosystems for human health, happiness, and psychological restoration. The IUCN hopes that such awareness-raising of the importance of nature for human health will help raise awareness for environmental protection. The two final keynote talks focused on the health and social benefits of protected areas. Carol Ritchie, Executive Director of EUROPARC Federation, discussed the potential of protected areas to support human health and well-being – in addition to nature conservation and climate change adaptation goals. EUROPARC's health and protected areas working group and the 'Healthy Parks, Healthy People[6]' movement assist park managers in advocating the use of protected areas for human health and well-being. Patrick ten Brink, Institute for European Environmental Policy (IEEP), presented results from the IEEP report on the *'Health and Social Benefits of Nature and Biodiversity Protection[7]'*. He concluded by outlining the work different actors from the international level to science, NGO's and the citizens can do to realize the potential of nature, biodiversity and health. All presenters highlighted the need to break up silo-thinking.

[5] For more information, see www.cbd.int/health/ilg-health/default.shtml

[6] For more information, see http://www.hphpcentral.com/

[7] IEEP reports on *'Health and Social Benefits of Nature and Biodiversity Protection' available here:* https://ieep.eu/publications/new-study-on-the-health-and-social-benefits-of-biodiversity-and-nature-protection

The conference ended with a lively plenum discussion on options and future challenges to put forward the implementation of NBS for climate change adaptation and health promotion. Panelists were: Thomas Graner (BfN); Matthias Braubach (WHO Regional Office for Europe); Birgit de Boissezon (European Commission, DG Research and Innovation); Stefan Leiner (European Commission, DG Environment); Catherine Ward Thompson (University of Edinburgh); Rik Röttger (Province of Antwerp); and Luc Bas (IUCN). The plenum discussed how nature-based solutions could be implemented for health promotion and climate change adaptation with recommendations for policy, practice and science. One of the major discussion points focused on the need to emphasize the co-benefits of NBS – how NBS can contribute to climate change adaptation, biodiversity conservation and human health and well-being. For policy, this means advocating NBS as a cost-effective solution to achieve international policy goals related to health, climate change or green space. For practice, this means collecting case studies on the multiple benefits of NBS. For research this means robust monitoring and evaluation to evidence the effectiveness of NBS for human health and well-being, biodiversity conservation and climate change adaptation. Additional research is required to understand what exactly it is about biodiversity and nature that contributes to health and well-being, and who exactly benefits in which way.

This issue

This BfN-Skript presents the major outcomes of the 2017 ECBCC conference with an overview of the discussions in the workshop sessions (section 2) and the plenary (section 3). The core of these proceedings form the abstracts of the oral and poster presentations, which the majority of presenters have kindly contributed (section 4 and 5). Most authors have included their contact details as well as key literature and useful web links. Building on information presented in talks, posters, workshops and panel discussions during the conference, this volume also presents a set of conclusions and recommendations for taking forward the evidence of the links between biodiversity and health into action in urban and protected areas. These recommendations were endorsed by the ENCA network at its 21st plenary meeting in Lithuania (Annex 1). The slides of most presentations, as well as an online version of the conference proceedings, can be downloaded from the conference documentation website at https://www.ecbcc2017.com/european-conference-on-biodiversity-and-climate-change-ecbcc/downloads-presentations/

2 Outcomes of the conference workshop sessions

2.1 Session I: Biodiversity or green space? Evidence for contributions to health in a changing climate

Session Chair: Rebecca Lovell

European Centre for Environment and Human Health, University of Exeter Medical School, UK

There is a now a substantial body of evidence which demonstrates linkages between exposure to greener environments and a variety of health and behavioural outcomes. However, there are still questions regarding the role of the *type* and *qualities* of green spaces in promoting health. This session focused on exploring these questions. Four presentations were given by researchers and practitioners from across Europe: Marcus Hedblom, from the Swedish University of Agricultural Sciences, spoke about his research on urban woodlands and their importance for both biodiversity and human well-being; Assaf Shwartz from Technion, the Israel Institute of Technology argued that 'one size does not fit all', his research has demonstrated that relationships between well-being and biodiversity are complex and vary between people; Leonie Fischer from the Technische Universität Berlin spoke about her research which has shown that across the diverse cultures of Europe there is consistent appreciation for biodiversity; and, finally, Ruth Waters, Deputy Chief Scientist from Natural England (an agency of the UK Government) discussed what the English Monitor of Engagement with the Natural Environment survey can tell us about what motivates people to visit natural environments.

The following discussion built on the presentations to consider three key questions:

1. **What is the actual contribution of biodiversity to health?**
2. **How can we assess the health impacts of biodiversity within a changing climate?**
3. **How can the health impacts of biodiversity inform conservation and health management and policy development?**

Around thirty conference attendees, spanning research, policy and practice and from across Europe, took part in the discussion.

1. What is the actual contribution of biodiversity to health?

A key issue for the groups related to the use of terminology. Many participants questioned whether we are using our terminology (e.g. 'biodiversity' and 'health') in a coherent way and if we aren't (as was suspected) what are the implications of this? The term 'biodiversity' has an accepted meaning ('Biological diversity means the variability among living organisms from all sources including, *inter alia,* terrestrial, marine and other aquatic ecosystems and the ecological complexes of which they are a part; this includes diversity within species, between species and of ecosystems'[8]) however it is used in a multitude of different ways (e.g. to refer to the natural world in a general sense). It was suggested that this can confuse both our understanding of the links with health, but also decision making.

[8] Convention on biological diversity, Article 2, Use of terms (https://www.cbd.int/convention/articles/default.shtml?a=dod-02)

Despite these issues, many argued that 'biodiversity' makes a fundamental contribution to health. Biodiversity underpins all ecosystem services to some degree meaning that our health and broader well-being are therefore dependent on biodiversity. Biodiversity has direct and indirect effects on both physical and mental health and the effects can be both positive and negative (dis-benefits). Some noted the tradeoffs in the relationships: biodiverse places may promote a healthy microbiome, reduce stress and increase quality of life but may result in exposure to potential allergens and zoonotic disease.

There was less certainty as to how biodiverse a place needs to be to confer different benefits. Some argued that composition and structure is likely to be more important than degree of diversity, while others questioned whether the perception of (as opposed to the 'actual') ecological quality was the important factor. There was a consensus that there is not yet enough evidence to clarify the *actual* contribution of biodiversity to health.

2. How can we assess the health impacts of biodiversity within a changing climate?

It was suggested that the complexity of the relationships between biodiversity and health necessitates a systematic approach to future research. For example, it might be beneficial to undertake a coordinated mapping, then exploration, of the relationships and dependencies in order to better understand the many ways biodiversity contributes to health.

A key recommendation was that efforts should be made to develop and agree upon on a common set of tools for the analysis of the relationships between biodiversity and health. These should be standardised and validated and reflect the multiple dimensions of the states and qualities of the environment as well as exposures, pathways and outcomes.

Research strategies should: recognise the interconnected nature of the environment and health (as reflected in onehealth approaches); build on early research findings that exposure to and use of biodiverse spaces has multiple, interrelated impacts on health (mental, emotional, physical, behavioural etc.) and that those impacts may vary through time, between groups, and according to exposure type; recognise that perceptions and experiences mediate the health values of biodiverse spaces; and consider how the relationships between biodiversity and health may respond to both a changing climate and to shifts in demographics and populations.

3. How can the health impacts of biodiversity inform conservation and health management and policy development?

The groups identified a number of actions which could inform conservation and health management and policy development.

First, there appears to be a need to find a common language so that the linkages can be expressed and understood between the very different worlds of health and environment. There needs to be greater understanding of the pressures, needs and drivers of action between and across sectors. The identification of 'synergies' and co-beneficial options between sectors is key. One potential approach is to 'educate the educators' (e.g. to raise awareness in through teacher training, in medical schools, and in university departments).

Second, the greater use of horizon scanning and scenario building tools and approaches should be promoted. Similarly, there is scope to better recognise the linkages between biodiversity and health processes such as health and environmental impact assessments. In the case of the latter, the potential of the environment to have a differential effect on social

groups should be recognised, particularly the suggestion that certain environments may be 'equigenic' (contribute to reduced social and health inequalities).

Third, as noted above, the evidence base is still very limited. Key questions relate to: 1) which aspects of biological diversity are related to specific outcomes; 2) how to accurately derive monetary values of the linkages between biodiversity and health; and 3) identifying which actions should be taken, by whom and in what contexts, to maximise benefit while minimizing harms.

Fourth, there needs to be clear inter-sectoral leadership. This could come from bodies such as the WHO or UNEP. However, leadership should be appropriate to the context and more local leadership would be needed.

Recommendations

The participants agreed on three key actions and points:

1. Produce (and communicate to health and environment sector) a more comprehensive evidence base (clarifying the terms 'biodiversity' and 'health') that 1) considers more dimensions of the linkages between biodiversity and health, 2) is suitable to inform key decision-making processes (e.g. Environmental Impact Assessment and Health Impact Assessment) and 3) can be used to produce monetary values. This should be done with a consideration of equity and contextually.

2. Identify the components of biodiversity (compositions, structure, function etc.) that provide health benefits (including psychological, immunological and other physiological benefits).

3. Develop integrated tools of analysis and key metrics that bring together different disciplines, sectors and areas of expertise e.g. one health, ecohealth, planetary health.

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2.2 Session II: Health and protected areas in a changing climate

Session Chair: Veikko Virkkunen
Metsähallitus, Parks & Wildlife Finland

The greatest challenges faced today are loss of biodiversity, environmental degradation, climate change and various human health issues that derive largely from inequality (Parks Victoria 2015). However, through integration of nature conservation in international and national policies and utilization of various nature-based solutions these challenges can be addressed in an economical and powerful way. While protected area network's primary function is biodiversity conservation, the network contributes effectively to promotion of health and well-being by offering diverse possibilities for outdoor recreation, enhancing connection to nature, promoting healthy lifestyle and providing potential for income. Aim for the session was to generate an overview on the contribution of protected area network on health and well-being.

Three presentations provided input and inspiration for the interactive discussion covering issues from national park visitors' experienced health benefits, modelling health benefits provided by exposure to green areas, to potentially health-enhancing biogenic volatile organic compound (VOC) emissions from forests. Participants then explored three questions in a following workshop to provide further insights on the subject matter:

1. What is the contribution of protected areas and biodiversity on health and well-being on individual, community and society levels?

2. How can the protected areas' benefits on health and well-being be measured, quantified and valued?

3. Which new programmes help to connect people to parks to improve their health?

1. What is the contribution of protected areas and biodiversity on health and well-being on individual, community and society levels?

Protected areas provide several ecosystem services related to health (e.g. recreation experiences). On individual level, protected areas inspire and fascinate, enable experiencing relaxation, solitude and wildlife which is crucial in terms of mental health. Easy access to healthy nature enables lifelong connection to nature which, as part of a healthy lifestyle, is preventive healthcare on societal level. Personal experiences of health benefits of protected areas (physical, mental, social) foster motivation to conserve nature and in long term lead to an increased impact of communication in favour of nature conservation policies. Thus, removing barriers that prevent access to nature is a way to influence national policies by shifting the public opinion. Communities, on the other hand, benefit from improved social cohesion, better access to jobs and livelihoods provided by nature tourism and stronger cultural identity and sense of place. Similarly, stronger local ownership of a protected area contributes to social capital of the community.

As a conclusion, there is already a critical mass of research on benefits from contact with nature to support activities that increase visitation to nature. Those activities should be focused on the passive target groups who benefit most from activation and contact with nature.

2. How can the protected areas' benefits on health and well-being be measured, quantified and valued?

Overall, health and well-being should be assessed in a holistic manner, considering physiological, psychological and social aspects. While clearly targeted case studies with very specific research setups are necessary to produce profound insights, on (inter)national scale it is vital to have unified and standardized methodologies which produce comparable results across time and space. Research organizations should be deeply involved in setting up research and monitoring programmes in protected areas since generally this is often outside the scope of protected area management capacity.

It was agreed that different environmental qualities (such as biological diversity, species richness, landscape metrics) of protected areas should be identified as controlling variables because they most likely have significant underlying impacts on the eventual health and well-being benefits. Methodologies quantifying benefits should be based on continuous monitoring with big sample sizes. Influencing decision making requires also emphasis on quality communications. Key messages identified in the research and monitoring mechanisms should be clearly conveyed to politicians, officials and other relevant audiences.

3. Which new programmes help to connect people to parks to improve their health?

The workshop identified a wealth of existing or potential pilot projects that target i.e. families, children, the disabled, volunteers and seniors. Overarching the identified concepts was that as a basis, very strong cooperation and partnerships between protected area managers, health, education and third sectors are needed to have more stakeholders involved in the health promoting practices. These partnerships require support from cross-sectoral policies; for example those that target in physical activation of citizens. As good practice, the workshop identified Junior Ranger -initiative by EUROPARC, volunteering holidays in parks, social group walks like Scottish NHS prescriptions.

Investments in know-how - practically increasing awareness among professionals in healthcare, education and nature conservation - are beneficial to disseminate successful pilot projects and good practice. For example, professionals benefit of learning the health benefits of nature, different nature-based solutions available and identifying locally available green spaces and their outdoor recreational services.

Lastly, the workshop agreed that introduction of new programmes requires efficient communication cross-sectorally and between operators and end-users. Communication should be also matched with the selected target group's professional language to make barriers for cooperation lower. Additionally, different incentives could be applied to motivate passive target groups. New means of communication (social media, visual and digital storytelling) offer novel ways to motivate and inform target groups: for example, social media facilitates easy launching of health-promoting community and volunteering activities where reaching the applicable target groups is convenient. Modern technology enables health monitoring programmes that can be included in those activities to reinforce their impacts on lifestyles. Ultimately, all activities and communications should target to connecting people with nature.

References

Parks Victoria (2015) A Guide to the Healthy Parks Healthy People Approach and Current Practices. Proceedings from the Improving Health and Well-being: Healthy Parks Healthy People stream of the IUCN World Parks Congress 2014. Melbourne.

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2.3 Session III: Linking initiatives in biodiversity, health, and climate change action in policy and practice

Session Chair: Hans Keune
Belgian Biodiversity Platform, Research Institute for Nature & Forest (INBO), Brussels - Faculty of Medicine and Health Sciences of the University of Antwerp

Subgroup discussion moderators:

- An Van Nieuwenhuyse (Scientific Institute of Public Health, Belgium)
- Julie Garnier (Odyssey Conservation Trust)
- Dirk Vandenbussche (Agency for Sustainable Environment and Nature Policy - Province of Antwerp, Belgium)

This session focused on practical initiatives regarding biodiversity, health, and climate change, both in policy and practice in general. The session thus looked at bridging different professional communities and practices as well as integrating the three topical foci of the conference. There were approximately 35 attendees; attendees' backgrounds were a mix of scientists, policy representatives and other practitioners.

Presentations

We had a mix of 4 longer (10 min) and 5 speed (2 min) presentations. The latter were related to posters presented after the session in the poster lunch session. An overview of the presentations:

10-minute presentations from:

- Dave Stone (Natural England) presented how a socio-ecological conceptualisation of the combined climate change, human health and biodiversity challenges can provide mutually supportive integrated solutions.
- Martha Betson (Royal Veterinary College (RVC), London) presented the Network for Evaluation of One Health (NEOH), with a particular focus on the development of new methodologies for quantitative evaluation of One Health activities, which is the core activity of the network.
- Julie Garnier (Odyssey Conservation Trust) presented how the implementation a One Health approach in transfrontier conservation areas will help build resilience to climate change. This was also supported by a short movie about participatory work in Africa.
- Doreen Montag (Queen Mary University of London) presented how a needs-based approach to health assessment can capture ecosystem services and their impact on peoples' health. She introduced comparative literature analysis on integrated approaches such as One Health and EcoHealth.

2-minute ‘speed presentations’ of posters from:

- Kerstin Friesenbichler (Der Umweltdachverband / The Environmental Umbrella Organisation, Austria) presented work on biodiversity and health collaboration and communication initiatives in Austria.
- Lieve Janssens (Agency for Sustainable Environment and Nature Policy – Province of Antwerp, Belgium) presented the project Green Light in which the province collaborates with the Faculty of Medicine and Health Sciences of University of Antwerp on embedding knowledge about nature – human health linkages in primary health care.
- Snezana Jovanovic (WHO Collaborating Centre for Housing and Health) presented initiatives of the State Health Office Baden-Württemberg, Germany. The presentation focused on stating the climate change challenges for health and the action plan “Health” for Adaptation strategy of Baden-Württemberg.
- Hans Keune (Belgian Biodiversity Platform, The Research Institute for Nature and Forest (INBO)) presented the outcomes of the European OneHealth/EcoHealth workshop which was held in Brussels in October 2016. In close collaboration with NEOH this will form the basis for a European OneHealth/EcoHealth Community of Practice. Starting conference September 2018 in Bologna.
- An Van Nieuwenhuyse (Scientific Institute of Public Health, Belgium) presented the Belgian NAMED project which investigates the relation between (nature, air quality, noise) characteristics of the living environment of inhabitants of the Brussels region and their mental health status.

Discussion of leading questions

The session had the following leading questions for inspiration for contributors:

1. Treatment and prevention measures aimed at lowering the (partly biodiversity/nature related) health burden linked to climate change may partly blind the potential health impact of climate change. This may result in underestimation of the health burden of climate change. How can we tackle this dilemma in both science and policy, finding a balance between on the one hand treating & preventing health problems while on the other also taking the full extent of the causal factor climate change seriously?
2. What can be the role of health arguments in the debate around climate change action, in general and specifically in relation to biodiversity?
3. What are good examples of linking knowledge, policy and practice - why do they work or not? How can we find indicators to assess effectiveness of such initiatives?

1. What is the role and evidence of health arguments in the debate around climate change action in relation to biodiversity?

Main discussion outcome: emphasize the contribution of biodiversity in tackling our main health problems; show the facts and synergies, both regarding benefits and risks to health; focus on concrete local case studies involving all stakeholders to put it into practice: e.g. inclusion in health insurance.

2. What are the indicators to assess effectiveness of initiatives linking knowledge, policy and practice?

Main discussion outcome: search for a common ownership for collaboration on biodiversity, health and climate change issues: develop a common agenda together, with all stakes and agendas integrated; combine SDG type of indicators with process indicators on collaboration. Add the economic imperative as an indicator for success and sustainability.

3. What are good examples of linking knowledge, policy and practice - why do they work? Why do they not work?

Main discussion outcome: communicate simple messages making the linkages on health benefits from biodiversity and using the right tools, e.g. social media, e-platforms. Awareness at local level is key. Communication needs to be involving local stakeholders.

2.4 Session IV: The benefits of green space for enhancing human health – Lessons learned from urban interventions

Session Chair: Matthias Braubach
World Health Organisation European Centre for Environment and Health

The session discussed the lessons learned from recent practical interventions on green spaces and their benefits, and was initiated by four introductory presentations focusing on the assessment of health impacts of green space actions across Europe. The opening presentations also focused on interventions in specific settings (such as schools and residential areas) and for specific target groups (children, elderly, disadvantaged groups), and debated on the challenges to assess the benefits of these projects.

Discussion was centered on three questions and benefitted from inputs of all session participants, representing a wide range of disciplines and backgrounds (nature conservation, environment, urban planning, landscape architecture, public health, climate change, research and academia, etc.):

1. What actions are implemented on the local level to improve access to green space and what are the lessons learned?
2. What are the environmental impacts and health benefits of urban green space actions? How may they change in a changing climate?
3. How to measure impacts of urban green spaces and how can unintended consequences be identified and avoided?

1. What actions are implemented on the local level to improve access to green space and what are the lessons learned?

Local practice shows a wide variety of green space actions, from small local greening initiatives to large-scale investments. The discussion of these actions revealed that – across the various types of green space – it is important to plan and design them as multi-functional spaces that provide offers for a range of user groups, and support a variety of events and activities that may also help to connect between different user groups or cultures. This helps to ensure that green spaces are widely used, provide a maximum of benefits to all population groups without excluding specific users.

Yet, it was also agreed that establishing green space infrastructures may not be sufficient per se, as practice and evidence showed that there is a need to promote the green spaces to engage people in its active use, and to involve local communities in planning, design and maintenance as well in order to increase local engagement and the feeling of ownership. This is especially important for user groups that may traditionally be less engaged in outdoor activities, and thus may need to be engaged through special campaigns or events in order to realize the added value of green spaces.

Finally, it was concluded that green spaces can be used to connect places and thereby not only enable active mobility by local residents, but also promote biodiversity, wildlife and nature to further thrive in these areas.

2. What are the environmental impacts and health benefits of urban green space actions? How may they change in a changing climate?

The discussion distinguished between the positive impacts (ecosystem services, local climate buffering, social benefits, health benefits) and negative impacts (such as spread of allergens, UV exposure, ozone or injury risk). Yet, the session participants agreed that there is no universal recipe for successful implementation of green spaces, as any green space project would need to be adapted to the respective local context. This is necessary to take local situations and needs into account, and to maximize the benefits while preventing potential risks. Also, local adaptation of good practices that have proven to be effective may be helpful in creating co-design benefits by embedding green spaces and nature interventions into larger policy frameworks on planning and infrastructure.

Regarding the influence of climate change, the session discussion raised the changing risks of natural environments (e.g. heat and UV exposure or vector-borne diseases) and respectively the need to communicate these changes to the public, raising risk awareness and cooping capacities. It was also hypothesized that an increased demand on nature and ecosystem services due to climate change may potentially lead to an overburdening of nature's capacities, and thus reduce the total scope of benefits.

3. How to measure impacts of urban green spaces and how can unintended consequences be identified and avoided?

Regarding the measurement of urban green space benefits, there was consensus that more consistent approaches as well as international standards and protocols are needed to (a) assure the reliable and comparable assessment of green space benefits and (b) provide guidance for green space assessments to support local green space projects that may not have respective capacities and skills. Next to such methodological support, the allocation of resources for evaluation within green space projects is necessary, as well as an early consideration of evaluation needs (in terms of methods, designs and the requirement to provide baseline data to compare intervention impacts with). However, there was a range of outcomes that were considered applicable (biodiversity impacts, climate impacts, environmental impacts, health effects, and equity-related consequences), with a specific call for more work to be done on economic assessments of nature interventions.

Regarding the need to identify and avoid unintended consequences, a key aspect was the need to be transparent about the potential risks and provide guidance on how to manage and prevent such risks – acknowledging that overall, there are much more benefits than risks. Also, the limitations of green space and natural interventions need to be acknowledged, as they are only one of many factors contributing to quality of life, health and well-being. Again aspects of community engagement were considered important in making sure that the local actions match the needs.

Across all questions, the discussion clearly showed the benefits of cross-sectoral action, and the added value of evaluation of green spaces – and nature-based solutions in general – against not only environmental, but also health and social dimensions. To further this work, many session participants indicated the need for an increased participation of health actors in that process, and the provision of health-specific arguments for urban nature.

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2.5 Session V: Psychological effects of nature and biodiversity on human health and well-being

Session Chair: Dörte Martens
Eberswalde University for Sustainable Development, Germany

The session started with three input presentations:

- Dörte Martens and her colleagues from the Eberswalde University for Sustainable Development addressed the influence of nature for children's development, introducing the concept of nature experience areas. These provide nature without artificial play elements for free play of children. Results show that compared to conventional playgrounds, nature experience areas arouse more complex play behaviour.
- The second presentation, held by Liqing Zhang from the National University of Singapore, gave an overview of 70 studies focusing the salutogenic effects of urban green spaces and showed three key domains in the relationship between nature and humans: dose, mechanisms and response. While most studies consider quantity of green space only, the authors advise to consider the usage of urban green space as well as the attributes of urban green space.
- Karla Locher Krause from Helmholtz Centre for environmental Research UFZ, in behalf of Barbara Livoreil and her team from the Foundation for Research on Biodiversity in France, presented EKLIPSE, a program to support mechanisms for evidence-informed policy on biodiversity and ecosystem service. Integrating bottom-up self-organising processes, the first step was to identify types of urban and suburban blue and green space and their specific components influencing health and well-being in a literature review. Currently, a call for experts has been introduced.

The interactive work included almost all participants of the session. We addressed the following three questions and answered them in a three-stage procedure with rotating participants and lively discussions:

1. What are the psychological effects of urban and rural nature on human health and well-being?
2. How can we assess changes in health and well-being and develop indicators and guidance for management and planning?
3. What nature-based solutions for climate change adaption can foster positive psychological health effects?

1. What are the psychological effects of urban and rural nature on human health and well-being? (Facilitator: Karla Locher Krause)

The three groups identified psychological aspects from attention restoration theory (such as fascination, being away, coherence and compatibility), psycho-evolutionary theory (stress reduction, mood enhancement) and social approaches (social contact and participation). Additional positive aspects such as "creativity and wondering", "freedom" and "mindfulness" as well as negative aspects such as insecurity and unease were collected.

The most important factor identified for the effect of nature was accessibility: in order to have an impact on people, nature needs to be public and for free. Thus, it can contribute towards quality of life in a holistic perspective rather than specific indicators.

Further research needs to be done on specific groups, especially facing the question whether nature effects people who are not interested or with a negative attitude towards nature.

Concluding question 1: There is the strong need to consider different socio-demographical groups in order to assess the impact of nature. Services need to be public and free in order to address all groups and aiming the holistic concept of quality of life.

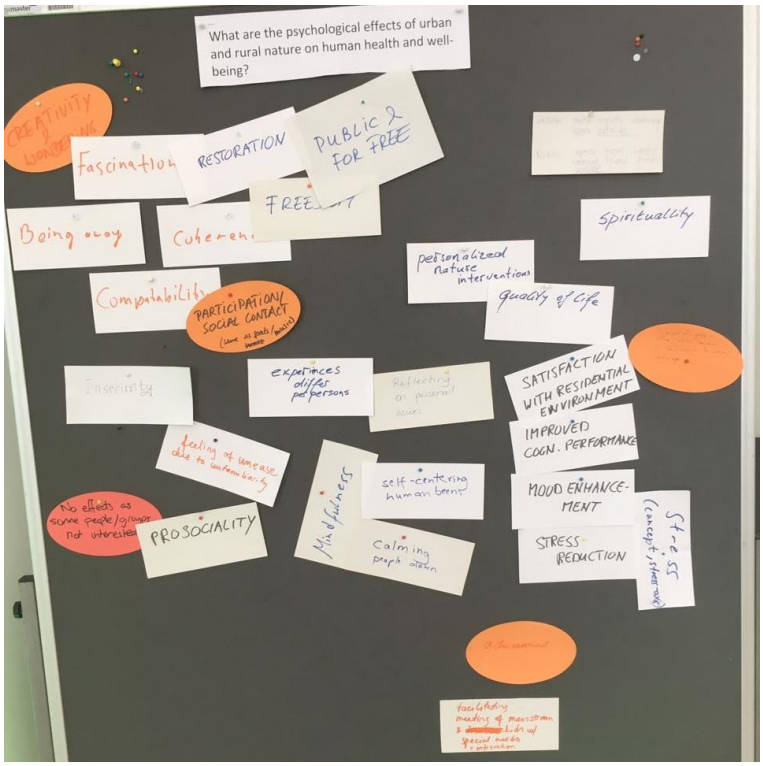

Fig. 1: Pin board results of Question 1, (Source: ECBCC conference)

2. How can we assess changes in health and well-being and develop indicators and guidance for management and planning? (Facilitator: Liqing Zhang)

This question led to some difficulties since we have been listening to presentations in the plenary sessions addressing specific indicators already. Mechanisms and pathways need to be analysed in order to identify best indicators, integrating self-reported measures as well as objective measures and monitoring procedures. Easily measurable metrics and psychometric scales assessing well-being were found to be oppositional. Pre-post designs were identified to be a good procedure. Additionally, healthcare costs could be calculated per geographical unit.

The groups discussed guidance for management and planning, identifying the need to facilitate participation, e.g. by co-creation and asking what do people need, the need to provide (multifunctional) space to enable the contact to nature. Good practise examples should be followed, such as therapeutic gardens with different health indications (dementia, depression, burnout etc.).

The conflicts of interest with buildings are important to be addressed, thus a diversity of offering green spaces needs to be provided, e.g. cumulative opportunities to experience nature might be more important than the proximity to green space.

Concluding question 2: Self-reported and objective measures and monitoring are needed to assess health. We should know about local preferences of people, and green space should be developed multifunctional. Guidelines for planning should be understandable.

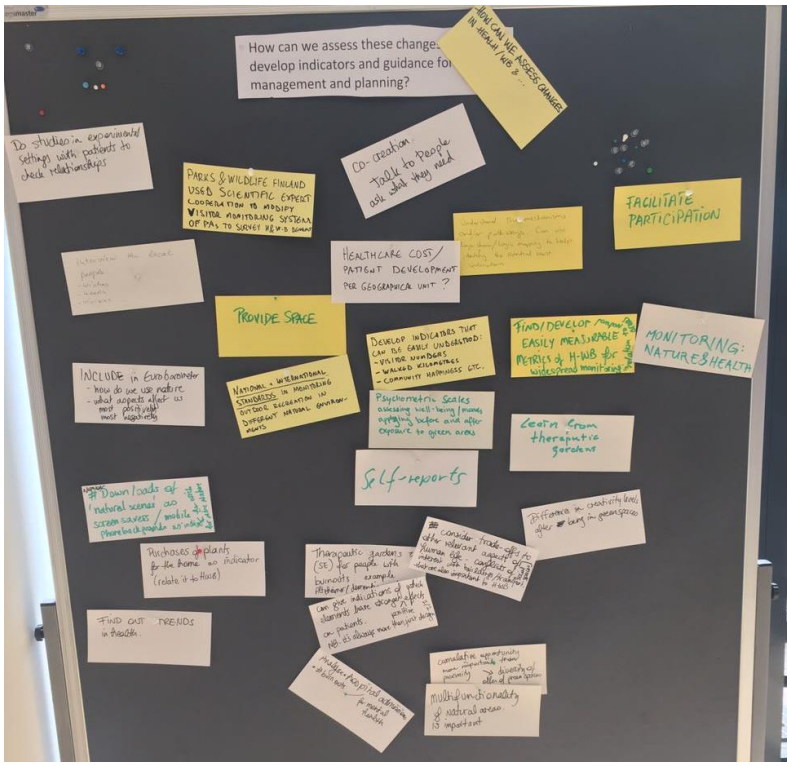

Fig. 2: Pin board results of Question 2, (Source: ECBCC conference)

3. What nature-based solutions for climate change adaption can foster positive psychological health effects? (Facilitator: Kerstin Ensinger)

Discussions on this question faced the fact that most adaptation and mitigation efforts have a positive effect on (mental) health due to being involved in processes. These often start at a very low threshold on a daily base, such as biking to work, planting trees, greening the garden and perceiving blue space. Thus, enhanced green infrastructure offers opportunities for mental health promotion.

Nature based solutions to climate change adaption should include space for nature as a buffer in case of strong rain, to prevent heat islands by providing shade and to allow a better microclimate (e.g. green plants on house walls). Nature based solutions often address health in a direct or indirect way (e.g. green route connections enabling biking and thus provoking physical activity). Positive and negative effects need to be identified. A holistic approach is needed to involve different groups of people and enable social interactions to discuss and share fears.

Concluding question 3: Climate change is about people, we need a holistic approach. People have to be involved in the solution, including coping with anger and fear. Perceive social opportunities of climate change: getting together and getting involved.

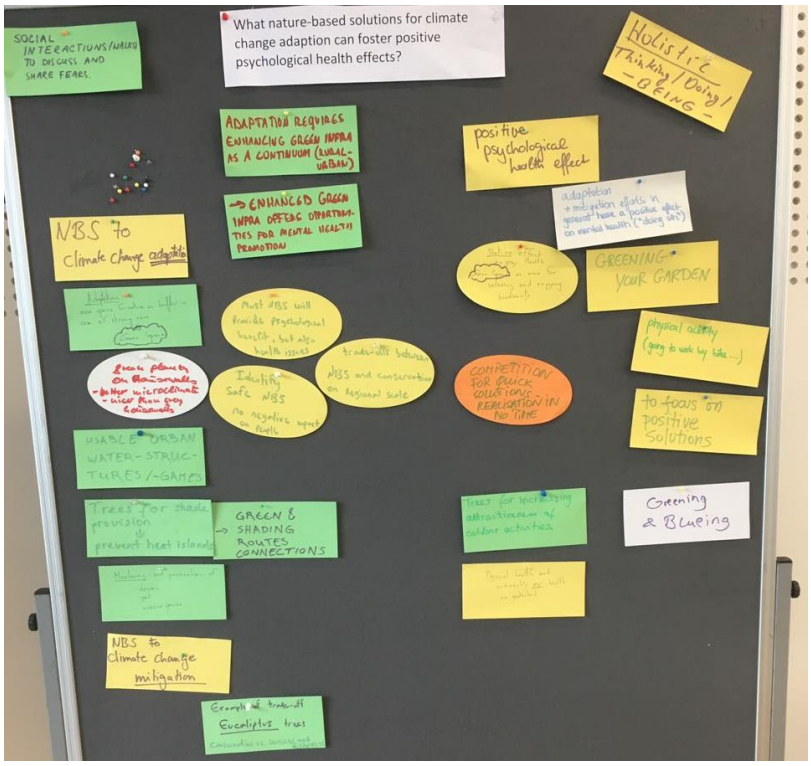

Fig. 3: Pin board results of Question 3, (Source: ECBCC conference)

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2.6 Session VI: Allergenic plants and vector borne disease – relevance to human health in a changing climate

Session Chair: Regina Treudler
Universitätsmedizin Leipzig

The session started with four introductory lectures:

1. Vladimir Kendrovski (WHO European Centre for Environment and Health) presented the European WHO operational framework on climate change, health and vector-borne diseases.
2. Astrid Kleber (Ministry for the Environment, Energy, Food and Forestry of the Rhineland Palatinate, Germany) reported on the assessment of health risks from allergenic plants, animals and vector borne diseases in Rhineland-Palatinate.
3. A talk from Dania Richter and Boris Schröder-Esselbach (Technische Universität Brauschweig) reviewed the role of ticks in transmission diseases.
4. Stefan Schindler (Environment Agency, Austria) presented alien species and their impact on human health

Within a second session part, a group discussion addressed the following issues:

1. What are the effects of climate change on allergenic species and vector borne diseases?
2. How can the clinical and socio-economic effects of altered allergenic species and (re) appearance of vector borne diseases in Europe be measured?
3. How can epidemiological and self-reported health studies or other approaches inform management?

1. What are the effects of climate change on allergenic species and vector borne diseases?

Climate change impacts on alien species and vector born diseases (VBD) by direct (e.g. changes in life cycle, metabolism, distribution) and indirect (e.g. changes in landuse, micro-habitat, species composition) mechanisms. Climate changes may have positive and negative effects on human health and behavior. In Germany, increased UV exposure goes along with more outdoor activities and more Vit. D production. In contrast, there is an increased risk for UV induced skin cancer. In other parts of the world, drought may lead to migration from South to North. With regard to plants and animals, there may be a spread of alien species (e.g. ragweed, mosquitos, tics), leading to new spatiol distributions of certain diseases (e.g. Borreliosis, Dengue, Chikungunya fever or malaria fever). The spread of oak processionaries bears the risk of partly severe toxic and/or allergic reactions. In Germany, due to longer flowering periods, there is a sustained pollen season. Allergenicitiy of pollen is subject to temperature, humidity, ozone or other pollutants. Ragweed allergy was discussed as an alien plant species eliciting severe reactions (asthma) already at low pollen concentrations.

2. How can the clinical and socio-economic effects of altered allergenic species and (re)appearance of vector borne diseases in Europe be measured?

There is a chain of cause and effect between climate, VBD and allergenic plants and their ultimate health and socioeconomic impacts. To quantify these we need the following: climate models to determine the likely scenarios affecting VBD and allergenic plants, infectious disease modelling of the spread of VBD, estimation of the health burden of VBD and allergenic plants, health economic and socioeconomic modelling of the financial impacts of these. We need also to identify several SMART indicators which will capture these impacts, including e.g. attributable cases, dalys, days of work lost, etc, per year. At each stage there are multiple causes and effects, for example, a bite from an infected vector can result in asymptomatic infection or none at all in addition to a case of VBD; and some infections can be transmitted in other ways in addition to vectors; or some changes in disease rates may not be due to changes in climate. It is for this reason we must concentrate on attribution of cause and effect to determine impacts.

3. How can epidemiological and self-reported health studies or other approaches inform management?

The participants stated that intra- and interdisciplinary communication and engagement should be enhanced through proactive science and policy fora. The following instruments were highlighted: self reports, health insurance data, citizen science, cohort investigations, patients cohorts, pollen/vector monitoring. Data collections should include identifications of relevant diseases, data on prevalence/incidence, spatial and longitudinal surveillance. There is a need for building a common language and to integrate data from different sources. Spreading of information will need conferences, media reports and websites. Creation of of risk maps, climate models and risk modelling is needed. Patients, physicians, biologists, public health scientists as well as politicians should work together to manage the climate related issues.

Conclusion

Climate changes have severe impact on human health and behaviour. With regard to plants there is a longer flowering period and a spread of alien species (i.e. ragweed), leading to pronounced pollen related diseases (e.g. asthma). Spreading of mosquitos and/or tics may lead to (re-) appearance of certain VBD (e.g. Dengue fever. Allergic and vector born diseases result in reduction in quality of life (burden of the disease) and lead to increase of health related costs (e.g. for diagnosis, treatment, absenteeism/presenteism). Data collection, spreading of information and interaction of different stakeholders is needed to manage the climate related health issues.

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2.7 Session VII: Nature-based solutions for climate change adaptation and their role in fostering health and socio-environmental equity

Session Chair: Melissa Marselle
Helmholtz Centre for Environmental Research (UFZ) and the German Centre for Integrative Biodiversity (iDiv)

The session started with three input talks:

1. Chris Skelly (*Public Health Dorset and University of Southampton*) reported on the developing research area of soil microbiomes in green spaces and human health.
2. Minka Aduse-Poku (*University of Cologne)* presented his research on the potential that a cheap retrofitting a nature-based solution of ivy walls could have on household temperature, CO_2-assimilation, and air quality.
3. Tatiana Minayeva (*Wetlands International)* discussed peatland restoration as a vital means for prevention of peat fires and improving public health in Russia.

The second part of the session was a lively group discussion to answer the following 3 questions:

1. What is the evidence that nature-based solutions for climate change adaptation can foster human health and/or environmental justice?
2. How do existing case studies/projects measure the impact of nature-based solutions on health and/or environmental justice?
3. How can nature-based solutions be integrated into overarching municipal goals and strategies?

1. What is the evidence that nature-based solutions for climate change adaptation can foster human health and/or environmental justice?

Nature based solutions (NBS) for climate change adaptation increase the quantity and quality of ecosystem services, which in turn influence human health and environmental justice. Evidence of the impact NBS have on human health and environmental justice should be measured through ecosystem service assessment (Everard and Waters, 2013). Such an assessment can determine the ecosystem services arising from the NBS, its associated ecosystem service benefits and societal value. For example, a NBS of creating urban green space to reduce the urban heat island results in regulating (e.g. temperature reduction of land and water, shade) and cultural ecosystem services (e.g. use of the urban green space). These ecosystem services have impacts on human health (e.g. reduce infant mortality rate, reduced risk of heat stress, increased air quality, psychological restoration) and social equity (opportunity for poorer people to access and use green space; shadow from trees may help facilitate elderly people in the Mediterranean to leave their home, walk outdoors and experience the restorative benefits of nature).

The group provided a few examples of nature-based solutions that contribute to both human health and environmental justice:

- Native trees saved a village from deadly fire in Portugal in June 2017;
- Agricultural near-to-nature planting decreases pest disaster, compared to the single-species planting;
- Prof Catherine Ward Thompson's "Woods in and Around Towns" project (Openspace, 2017) in Scotland assesses the benefits that new and regenerated woodlands can have on the mental health of individuals living in deprived communities. The project thus addresses if reforestation can contribution to social equity.

2. How do existing case studies/projects measure the impact of nature-based solutions on health and/or environmental justice?

The EKLIPSE impact evaluation framework (Raymond et al., 2017) on NBS should be consulted for future evaluations of NSB projects. Session participants recommended that future assessments of the health and environmental justice impacts of NBS projects should use an array of biological, environmental, and social health techniques to compare the effects of NBS with other alternatives (e.g. pre-post NBS implementation; epidemiological case-control study). Toolkits, such as TESSA[9], INVEST[10], were mentioned as a way to access ecosystem services before and after implementation of NBS.

Subjective and objective measures of the health and environmental justice impacts of a NBS should be assessed, such as:

Objective measures:

- Improved physical health (Doctor visits)
- Insurance costs
- Distance to accessible green space
- Number of visitors to a NSB, how it is used by people, the socio-economic profile of users
- Temperature
- Air quality
- Water quality
- Reduced risk for flooding (e.g. reduced amount of storm water that reaches the wastewater plant)
- Field studies on biodiversity, monitoring species migration

[9] http://tessa.tools/

[10] https://naturalcapitalproject.org/invest

Subjective measures:

- Media attention
- Acceptance by local population
- Cognitive tests to assess attention restoration; academic performance in schools
- Emotional well-being
- Reduction in stress

The session participants found it difficult to identify existing case studies or projects that measure the impacts of a NBS for health and environmental justice. It appears that NBS are often implemented without evaluation. A NBS will be implemented based on the academic research that says such a NBS will be beneficial, as such practitioners do not feel it is necessary to evaluate the NBS after it has been implemented because the evaluation of the NBS was already established by the academic research. The WHO report (2017) on green space interventions found a similar problem in their review of the effectiveness of urban green space interventions. The WHO report conclude that due to the limited number of intervention studies, there is inconclusive evidence on the effectiveness of green space interventions (p8).

3. How can nature-based solutions be integrated into overarching municipal goals and strategies?

A locally co-designed framework plan for nature-based solutions was recommended by the session as a way to integrate NBS into municipal goals and strategies. Irrespective of whether the political pressure for NSB is top-down (e.g. national government, or the mayor) or bottom-up (local communities), the group believes that a co-designed framework involving politicians, civil servants and local communities and businesses should be successful. This means that law makers and government officials should work with local communities and businesses to integrate and implement NBS. Support from local community and businesses can motivate political for support of NSB. A starting point is communicating the multiple, personal, benefits of the NBS to the local communities (e.g. lower insurance premiums, improved health and well-being). Co-designing the NBS with the community helps to get the local community to buy-in and ownership. One could demonstrate the value of NBS to local government by using pilot projects based on community volunteers. Politicians should be invited to visit the NBS. The pilot project should be evaluated and the results communicated to the community, businesses and local government.

Of course, it is helpful if there is local political will from the mayor – this will certainly help get NBS into municipal goals and strategies! One could exploit the local government's 'election style of thinking' by 'selling' NBS as a way to promote the city as 'innovative'. Communicate how NBS align with current local municipals goals and strategies. A return on investment (ROI) analysis should be created as there needs to be convincing financial evidence and incentive to invest in NBS. The ROI report should emphasize the multiple co-benefits and cost-savings for each government departments and demonstrate other successful NBS and their cost-saving.

References

Everard M and Waters R. (2013). *Ecosystem services assessment: How to do one in* practice (Version 1, October 13). Institution of Environmental Sciences, London. www.ies-uk.org.uk/resources/ecosystem-services-assessment

Openspace. (2017). *Woods in and around towns (WIAT).* http://www.openspace.eca.ed.ac.uk/research-projects/woods-in-and-around-towns/

Raymond, C.M., Barry, P., Breil, M., Nita, M.R., Kabish, N, et al., (2017). *An impact evaluation framework to support planning and evaluation of nature-based solutions projects*. Report prepared by the EKLIPSE Expert Working Group on Nature-based Solutions to Promote Climate Resilience in Urban Areas. Centre for Ecology & Hydrology, Wallingford, U.K.

WHO (2017). *Urban green space interventions and health. A review of impacts and effectiveness.* http://www.euro.who.int/en/health-topics/environment-and-health/urban-health/publications/2017/urban-green-space-interventions-and-health-a-review-of-impacts-and-effectiveness.-full-report-2017

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2.8 Session VIII: Planning and managing urban green spaces for health and biodiversity in a changing climate – Concepts, experiences, practices

Session Chair: Stefan Heiland
Technische Universität Berlin

The integration of different sectors, disciplines and actors into planning and management of urban green spaces is crucial if these shall fulfill a variety of purposes for humans and biodiversity, regarding a changing climate as well as changing societal demands and framework conditions in an urban context. But: This has not yet been realized in general as the political, legal, administrative and scientific framework does often not comply with the requirements of such a common approach.

Against this background the following questions were discussed:

1. How can health promotion be integrated into instruments of nature conservation and environmental planning (landscape planning, environmental assessments, management plans of nature reserves) in an urban context?
2. Which sectors and actors from administrations and civil society have to be involved into health-related planning processes and decisions? Which experiences exist so far?
3. Supporting biodiversity, health and climate change mitigation and adaptation: Which conflicts and synergies have to be considered? How could conflicts be minimized and synergies created?

Four presentations from different countries (Netherlands, UK, and Germany) set the scene for the discussion. They demonstrated the wide array of possible approaches to tackle the challenge of doing justice to different important requirements of urban green spaces considering not only present needs but also future changes of natural conditions (climate change) and the societal framework. Still, they also showed how difficult it is to consider all three “aspects” related to green spaces (biodiversity, health, climate change) and their relation instead of only two of them – which seems to be the rule.

1. How can health promotion be integrated into instruments of nature conservation and environmental planning in an urban context?

There exists a broad range of topics and spaces which allow health issues to be attached to environmental planning, e.g. to highlight and enhance the health effects of walking and cycling trails, urban forests and other green spaces, the use of anti-allergenic plants, bioclimatic studies and so on. To use those opportunities effectively and efficiently, it is necessary to provide a regulatory, institutional and financial framework, which allows or makes it easier to integrate not only health prevention, but also health promotion into planning documents and processes, including public participation. So far health issues, especially health promotion, only play a minor or even no role in many instruments of nature conservation and environmental planning. To improve that situation practice and science are both important and asked to look for and to use respective possibilities.

2. Which sectors and actors from administrations and civil society have to be involved into health-related planning processes and decisions? Which experiences exist so far?

A broad variety of actors should be involved in urban planning processes in order to ensure a healthy urban green environment. This includes representatives of politics, administration, NGOs and civil society. According to the specific requirements of each single case they should cover different disciplines and sectors to find the best appropriate solution, including inter alia: ecologists; landscape planners; landscape architects; urban planners; water, soil and climate experts; health experts; educational staff; and economists. The main problem to be solved (but also an opportunity!) is the fact that all those actors come from different backgrounds, have different values and different understandings of a question and speak different "languages", which lead to a high risk of misunderstandings. To find a "common language" might not be a realistic aim, but the willingness to try to understand one another's language is basic for a successful cross-sectoral collaboration, which allows to plan systematically, to use synergies and to minimize conflicts. Experiences or case-studies which successfully include biodiversity, health and climate change issues at the same time could not be reported by the participants.

3. Supporting biodiversity, health and climate change mitigation and adaptation: Which conflicts and synergies have to be considered? How could conflicts be minimized and synergies created?

Certainly there are some conflicts between biodiversity, health and climate change mitigation and adaptation, such as the use of allergenic plants for biodiversity reasons or the conflict between combating urban sprawl by densifying cities on the one hand side, and allowing for enough green spaces for recreation and climate change adaptation on the other. But in most cases, there will be more synergies than conflicts between the different sectors and interests. Possible conflicts between different land uses can be minimized by creating multi-use or multi-functional areas which serve different purposes at the same time. Major conflicts might derive from external financial interests and / or financial constraints of municipalities which make it difficult to implement or even to find appropriate solutions on local level. To minimize that problem, it could be helpful to highlight the different (financial and non-financial) values of the urban green infrastructure and its elements and to use social trends (e.g. healthy living) as arguments for maintaining and enhancing green spaces

Overarching the three leading questions it has been regarded as very important that the appropriate actors are involved, that they have a shared vision, that political commitment is ensured and that the planning and decision-taking process allows to facilitate cross-sectoral and cross-disciplinary collaboration.

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3 Conference plenum discussion summary

The final plenum discussion focused on options to put forward the implementation of nature-based solutions (NBS) for health promotion and climate change adaptation. Related to this topic, the following questions were addressed in order to later feed into recommendations for science, policy and practice developed by the ENCA interest group on climate Change (see Annex 1):

1. Recommendations to European policy-makers:
   - How can NBS for health promotion and climate change adaptation be integrated in other policies / cross-sectoral policies?
   - What are finance opportunities?
2. Recommendations for European public health and nature conservation practitioners:
   - How can we share best practice?
   - How can we address barriers to implementation?
3. Recommendations for scientists and research funding institutions:
   - What is needed to provide better evidence of the effectiveness of NBS for health promotion and climate change adaptation?
   - How can research findings be better communicated to foster implementation?

Horst Korn (BfN) chaired the panel. Panelists included: Thomas Graner (BfN); Matthias Braubach (WHO Regional Office for Europe); Birgit de Boissezon (European Commission, DG Research and Innovation); Stefan Leiner (European Commission, DG Environment); Catherine Ward Thompson (University of Edinburgh); Rik Röttger (Province of Antwerp); and Luc Bas (IUCN). Here we summarise the main points.

To get NBS into polices, panelists recommended focusing on the multiple co-benefits of NBS – specifically the human health and well-being benefits of NBS. The term multiple co-benefits was used to show that positive effects of NBS for climate change adaptation and mitigation, as well as for the conservation of biodiversity, and the improvement of human mental, physical, and social health and well-being exist. To get NBS into policies, panelists suggested 'piggybacking' on other, similar policy agendas (e.g. climate change and green space agendas). Through these agendas, policies on the use of NSB for health and/or climate change adaptation can be established. The biodiversity and nature conservation aspects of NBS could then be a part of these bigger agendas. NSB or green infrastructure should be advocated as an innovative, cost-effective solution to achieve local, national or international policy targets, such as Sustainable Development Goals. The EU-funded project "Think nature"[11] is a platform for supporting, understanding and promoting NBS that could be beneficial.

Regarding the financial opportunities, the panel recommended focusing on investment rather than cost. Sustainable development involves investing in the future and preventing ill health – both of which can be done with NBS. Due to the multiple benefits, NBS for climate change can be considered as no-regret measures, which means that even if climate change does not happen as projected, then there are all these other benefits for health, cultural ecosystem services, nature conservation, etc. It is important to provide evidence on the return on investment (ROI) when investing in NBS. Natural capital accounting is, thus, required to accurately acknowledge the economic value of the benefits of natural environments and the ROI.

[11] http://www.think-nature.edu

Examples of this have been done in other EU countries (e.g. value of ecosystem services of protected areas in Finland; social and health values of UK woodlands).

In order to share best practice about NSB for health promotion and climate change adaptation, panelists emphasized the need to create a repository of good practice case studies. Case studies should demonstrate what has been done, how it was done (governance structure, which government departments or community groups were part of the implementation project, who finally took the decision to implement), and evidence of any co-benefits. Such case studies may help to convince the public, practitioners and politicians to support NBS for health and climate change adaptation. The German Federal Agency of Nature Conservation, in order to gain political awareness and support, developed a repository of local best practice examples all over Germany.

Barriers to implementation of NBS for health and climate change into the public health and nature conservation sectors are lack of knowledge and skills. Continued professional development (CPD) and capacity building training are required. Protected area managers require CPD to understand nature-health relationships and how to promote their protected area as a health hub. Public health professionals and General Practitioners require formal training on the use of nature for health promotion and prevention. The University of Antwerp has a professor of public health and greenery to achieve just this goal. Recognition of the health benefits of nature by a large EU medical union or council would help to advocate implementation. A conference or workshop involving the nature conservationists, protected area managers, urban planners and medical and public health officials was recommended. This event should find the critical entry points on how to get health promotion and nature conservation into urban planning decisions regarding NBS. Another barrier to the implementation of NBS is the reluctance or lack of inter-sectorial collaboration. NBS are cross-cutting, inter-disciplinary interventions that require individuals working across different sectors and government departments. Thus, implementation of NBS for health, biodiversity conservation and climate change will only occur where there is inter-sectorial collaboration at all levels, in particular the local level. To facilitate such collaborations partnership working is key. Already successful inter-sectorial partnerships – like the WHO Regional Office for Europe's work linking transport and health or housing and health, or the English Crime and Disorder Reduction Partnerships – could be a starting point.

The panelists also had recommendations for future research on the effectiveness of NBS for health promotion and climate change adaptation. Firstly, there needs to be robust monitoring and evaluation of the effectiveness of NSB in order to evidence the co-benefits for human health and well-being, biodiversity, ecosystem services – as well as climate change adaptation. There simply is not enough research on the impact NBS have on human health and well-being. Secondly, researchers should start to tease apart the aspects of 'nature' and 'biodiversity' that contribute to health and well-being. Landscape designers need this information to help them make decisions about the choice of species, vegetation structure, and topography. Thirdly, more research is needed to understand how different socio-demographical groups are affected by contact with the natural environment or biodiversity. Who benefits and who does not? Are there different health impacts from contact with nature/biodiversity based on gender or social-economic status? What kinds of natural environments, and the design of those environments, are appropriate for communities who do not have previous experience of nature? Finally, research could investigate the relationships between different types of environments, use of the environment, and biodiversity. Where

can biodiversity thrive or not thrive? Where are people accepting high biodiversity and why? Such analyses could be seen through the lens of person-environment fit (compatibility) in environmental psychology, and could help both landscape architects and natural resource managers. For example, public parks, which have many users and uses, may require simple vegetation, which might result in low biodiversity, whilst green corridors may be a place where biodiversity thrives because the planting and management is compatible with the location and what the people do there.

To help implementation of biodiversity and health research findings into practice, panelists recommended emphasizing the human health and well-being effects from the natural environment, and the contribution of biodiversity in tackling our main health problems. The health effects from biodiversity loss and climate change and its relationship to the environment is *the* issue that links many different sectors. Climate change will negatively affect the environment, which will negatively affect human health. The personal health impacts from the environment should be communicated as the headline issue. A positive way to do this is to discuss nature as a 'health clinic' by highlighting its benefits for human health and well-being. Communication of the health benefits of nature and biodiversity at the local level will help make the relationships between the environment and health more relatable and significant to one's own life. Researchers should engage with the media, social media, and environmental charities to communicate the benefits of nature to the public. For example, a tweet from the Friends of the Earth containing a link to a The Guardian article about the 2016 IEEP report '*Health and social benefits of nature and biodiversity protection'* was retweeted 50,000 times!

4 Abstracts of oral presentations

4.1 Opening address

Biodiversity and Health in the Face of Climate Change – Activities of the German Federal Agency for Nature Conservation (BfN)

Beate Jessel, Jutta Stadler, Beate Job-Hoben, Burkhard Schweppe-Kraft, Alice Schröder, Katharina Dietrich
German Federal Agency for Nature Conservation (BfN)

Nature and biodiversity provide relevant ecosystem services for all dimensions of human health. There are several positive effects on physical health, mental well-being, and social cohesion, which gain more and more importance in the face of climate change. But due to climate change biodiversity may also increasingly influence human health in a negative way through the spread of vector-borne diseases or allergenic plants.

The German Federal Agency for Nature Conservation (BfN) provides the German Federal Ministry for the Environment, Nature Conservation, Building and Nuclear Safety (BMUB) with professional and scientific assistance in all nature conservation and landscape management issues on the national level and in international cooperation activities. In these contexts the BfN plays a central role as "science-policy interface" since it links science and policy at the national, the European, and the international level. Being one of the government's departmental research agencies, the BfN furthers its objectives by carrying out own research which is dedicated for certain practical and political purposes. In this light the BfN has been active in the field of biodiversity and health for almost 15 years, trying to cover the physical, mental and social dimensions of health.

Hereinafter some selected examples of BfN's activities related to biodiversity, health and climate change are briefly described.

BfN research and development project: "Nature Awareness Study 2015"

Since 2009 every two years the German Ministry for the Environment and the BfN carries out the representative German Nature Awareness Survey. In the fourth study (BMUB & BfN 2016), health-related aspects of nature formed part of the questionnaire. Out of a representative sample of German citizens 59 per cent strongly agreed and 33 per cent somewhat agreed to the statement "For me, nature means health and recreation". These figures perfectly match the responses in relation to urban nature, which was a focus of the study. When asked "How important to you personally is urban nature with regard to the following aspects?" 62 to 60 per cent of all respondents named "recreation and relaxation", "quality of life" and "health" as "very important" and 29 to 31 per cent as "somewhat important". This clearly shows that the general public links nature to all dimensions of health.

BfN research and development project: "Green-natural-healthy"

To support the inclusion of health promotion aspects in planning practice the BfN-funded study „Green, natural, healthy" (Rittel et al., 2014) developed recommendations and information materials. These include firstly information on different user groups and their needs, secondly criteria to determine health-promoting potentials of urban green spaces and thirdly a list of good arguments for planners concerning the positive effects of green spaces on human health. These scientific findings support municipalities with helpful arguments to safe-

guard and enhance the positive benefits of “green spaces” on human health against the background of climate change, demographic change and environmental justice.

Further BfN research and development projects for example on the “Economic effects of ecosystem services of urban green” investigated the effects of urban land use on well-being, on mental and physical health (Krekel, Kolbe, Wüstemann 2015 and 2015a; as well as their contribution to this volume). Another related project supervised by BfN explores appropriate indicators for the provision and accessibility of green spaces in German cities (Grunewald et al., 2017).

Transfer of Results

One of the main tasks of the BfN is to mediate between science and decision makers on various levels. One prominent example in this context is the national follow-up of the international study “The Economics of Ecosystems and Biodiversity” (TEEB). The ”Natural Capital Germany – TEEB DE” report on “Ecosystem Services in the City - Protecting Health and Enhancing Quality of Life” contains comprehensive sections of the current knowledge of the nexus between urban green, human health, climate aspects and social cohesion (Naturkapital Deutschland – TEEB DE 2016).

For the last 3 years the German Federal Ministry for the Environment has fostered the initiative “Green in the City”. The BfN was involved in the process and contributed significantly to the results and products of the initiative, for example the Green Book on urban green (BMUB 2015) and the White Book on urban green (BMUB 2017). The latter provided a plan of action for urban green on the national level. Together with stakeholders from municipalities, nature conservation NGOs and the German association of landscape architects the BfN published a brochure on the definition, aims and implementation of urban green infrastructure (BfN 2017). Here again, it turned out that public health and living quality belong to the most important issues connected with urban green infrastructure.

Communication related to the topics of “Biodiversity, Health and Climate Change“

Next to BfN’s activities as a mediator between science and policy it provides information. One example is the web portal “NatGesIS” – short for “nature conservation and health information system”[12], a tool to communicate the interlinkages between nature conservation and health. The portal contains a comprehensive compilation of information about nature related health courses and treatments, wellness, and nature experience with children as well as specific data on natural resources, health and climate change.

Another example of communication activities are nation-wide hiking events, organised by the BfN every year since 2010. In addition to a prominent opening event, local and regional organisers can join in and promote their hiking activities on a central web platform. This format has been a great success. In 2016, more than 1.600 tours were offered throughout Germany.

The examples given above show an extract of joint activities of BfN with various actors from science, policy and practice to find synergies and to create alliances between nature conservation, public health activities, and adaptation to climate change by promoting nature-based solutions.

[12] NatGesIS (in German only): https://natgesis.bfn.de/index_naturschutz-gesundheit.html

Literature

BfN (2017): Urbane Grüne Infrastruktur - Grundlage für attraktive und zukunftsfähige Städte. Hinweise für die kommunale Praxis (https://www.bfn.de/fileadmin/BfN/planung/siedlung/Dokumente/UGI_Broschuere.pdf)

BMUB (2015): Grün in der Stadt – Für eine lebenswerte Zukunft, Grünbuch Stadtgrün. (http://www.bmub.bund.de/fileadmin/Daten_BMU/Pools/Broschueren/gruenbuch_stadtgruen_broschuere_bf.pdf)

BMUB (2017): Weißbuch Stadtgrün „Grün in der Stadt – für eine lebenswerte Zukunft“ (http://www.bmub.bund.de/fileadmin/Daten_BMU/Pools/Broschueren/weissbuch_stadtgruen_bf.pdf)

BMUB & BFN (2016): Naturbewusstsein 2015. Bevölkerungsumfrage zu Natur und biologischer Vielfalt. Berlin, Bonn (https://www.bfn.de/fileadmin/BfN/gesellschaft/Dokumente/Naturbewusstsein-2015_barrierefrei.pdf). English version: https://www.bmub.bund.de/fileadmin/Daten_BMU/Pools/Broschueren/naturbewusstseinsstudie_2015_en_bf.pdf

Grunewald, K.; Richter, B.; Meinel, G.; Herold, H. & R-U. Syrbe (2017): Proposal for indicators regarding the provision and accessibility of green spaces for assessing the ecosystem service “recreation in the city” in Germany. International Journal of Biodiversity Science, Ecosystem Services & Management, 13:2, 26-39.

Naturkapital Deutschland – TEEB DE (2016): Ökosystemleistungen in der Stadt – Gesundheit schützen und Lebensqualität erhöhen. Hrsg. von Ingo Kowarik, Robert Bartz und Miriam Brenck. Technische Universität Berlin, Helmholtz-Zentrum für Umweltforschung – UFZ. Berlin, Leipzig (http://www.naturkapital-teeb.de/publikationen/projekteigene-publikationen/bericht-3.html). English version: http://www.naturkapital-teeb.de/fileadmin/Downloads/Projekteigene_Publikationen/TEEB_Broschueren/170904_UFZ_TEEB_Broschuere_KF_Bericht3_Stadt_engl_gesamt_web.pdf

Rittel, K; Bredow, L; Wanka, E.R.; Hokema, D.; Schuppe, G.; Wilke, T.; Nowak, D.; Heiland, S. (2014): Grün, natürlich, gesund: Die Potenziale multifunktionaler städtischer Räume. Bundesamt für Naturschutz (Hrsg.), BfN Skripten 371, 178 Seiten, Bonn 2014 (https://www.bfn.de/fileadmin/BfN/service/Dokumente/skripten/Skript371.pdf). English version: https://www.bfn.de/fileadmin/BfN/service/Dokumente/skripten/Skript371_EN_barrierefrei.pdf

Krekel, C.; Kolbe, J.; Wüstemann, H. (2015). The Greener, The Happier? The Effects of Urban Green and Abandoned Areas on Residential Well-Being. SOEPpapers on Multidisciplinary Panel Data Research, Nr. 728-2015.

Krekel, C.; Kolbe, J.; Wüstemann, H. (2015a): The greener, the happier? The effect of urban land use on residential well-being. Ecological Economics 121, S. 117-127.

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4.2 Plenary presentations

Urban nature, health and climate change

Sarah Lindley
University of Manchester

Urban nature takes many forms and has strong connections to human health and well-being, as an integral element of a good quality of life. In cities, nature is often thought of as essential urban green infrastructure - the means through which vital biodiversity functions (e.g. habitat provision and landscape connectivity) and most nature-derived human benefits are delivered. There is good evidence of positive associations between urban nature and health, with benefits for physical exercise, mental health and social cohesion as well as for moderating pollution and mitigating extreme weather. In view of the latter function, green infrastructure is also a cornerstone of urban climate adaptation.

This paper synthesizes evidence for Manchester, UK and teases out some of the interconnections between urban nature, health and climate change from the perspective of high temperatures and heat waves. Heat waves are well known to be associated with excess deaths particularly in older people, people with pre-existing health problems and people living in urban areas. The Urban Heat Island (UHI) effect (whereby cities and towns are often much warmer than rural areas, particularly at night after sunny days with little or no wind) can exacerbate human exposures during periods of high temperature.

An analysis of temperature records for Manchester has shown that UHI intensities have been increasing over time (Levermore et al., 2017). If trends continue to the end of the century, increases will be similar to those expected with climate change (medium emissions scenario). This is significant not only due to impacts on human health, but also due to the implications for energy demand for space cooling. Even in relatively cool Manchester, modeling studies suggest that the summer UHI increases air conditioning loads by ~7–8% (Skelhorn et al., 2017). One of the drivers of increasing UHI is urban densification and associated losses of green cover. For example, green cover around the city's urban weather station has reduced by ~11% between 2000 and 2009. Impacts are corroborated by separate modeling, showing that replacing all vegetation with asphalt would lead to air temperature increases of up to 3.2 ˚C in parts of the city (Skelhorn et al., 2014).

In addition to green space losses, there is also the issue of degradation. Inappropriate management of a large, aged green roof (30 year old) increased both air and surface temperatures. Peak air temperatures above a damaged green roof exceeded those above an adjacent bare roof during some of the hottest periods of an experimental study (Speak et al., 2013). In this case, impacts were exacerbated by the removal of vegetation (largely grasses) during an extended drought. Clearly, for green spaces to be able to retain their beneficial functions, it will be necessary to adapt associated management practices too. Fortunately, a relatively modest 5% increase in mature tree cover in suburban areas (e.g. *Acer pseudoplatanus* (Sycamore) & *Quercus robur* (English Oak)) can reduce surface temperatures by ~1 ˚C. In turn, there are positive impacts for climate mitigation. Together, this evidence may provide a useful exemplar for cities with similar climatic characteristics and a comparator for those in different climate zones.

References

Levermore, G., Parkinson, J., Lee, K. & Lindley, S., 2017 (in press). The increasing trend of the urban heat island intensity. Urban Climate.

Skelhorn, C. P., Lindley, S. J. & Levermore, G., (2014). The impact of vegetation types on air & surface temperatures in a temperate city: A fine scale assessment in Manchester, UK. Landscape & Urban Planning, 121: 129-140.

Skelhorn, C. P., Lindley, S. J. & Levermore, G., (2017) (in press). Urban greening & the UHI: Seasonal trade-offs in heating & cooling energy consumption in Manchester, UK. Urban Climate.

Speak, A., Rothwell, J., Lindley, S. & and Smith, C., (2013). Reduction of the urban cooling effects of an intensive green roof due to vegetation damage. Urban Climate 3: 40-55.

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Urban green spaces and health - Launching a brief for action

Elizabet Paunovic
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In 2012, the WHO European region has adopted “Health 2020”, the European Policy for Health and Well-Being. Health 2020 provides a strategic framework for action to address the major challenges and opportunities for improving health in the 21st Century, and includes a strong focus on the determinants of health, considering action on the social, economic and environmental conditions. Creating resilient communities and supportive environments therefore is one of four priorities of Health2020, and is much related to natural environments and their relevance for human beings.

Still, the reality is that In the WHO European region at least 1.4 million persons die prematurely due to polluted environments each year. This corresponds to at least 15% of Europe’s total deaths. This environmental burden of disease, however, is not equally distributed within national populations, as most often disadvantaged population groups are more affected by environmental hazards. Action on environmental determinants of health remains paramount.

A variety of WHO products are available to support action by national and local stakeholders. One category of products provides evidence for action, describing the health impacts of certain environmental conditions and setting guideline levels. Another category are tools and practical guidance documents, aiming to support action by providing methods and validated examples or case study reports.

Although the relevance of biodiversity for health and well-being may not be directly obvious to many, these links are not new and have already been observed by the Greek physician Hippocrates (c.460-c.377 B.C.). In his famous book “On Airs, Waters And Places”, he discussed the natural elements in relation to medicine and medical care. Nowadays, biodiversity is an integral part of various concepts and approaches, such as ecosystem services, nature-based solutions, Ecohealth or Planetary Health.

The Millennium Ecosystem Assessment, carried out at the beginning of the new millennium, featured a wide range of health dimensions, as summarized in the health synthesis report (2005). These health aspects include provision of food, water, fuel and materials, as well as regulation of climate, flooding and infectious disease. Furthermore, functional natural environments support waste management and pollution reduction. Preservation of ecosystems and more research into our dependency on their services is therefore of high relevance.

The environment and health work of the Regional Office for Europe provides a range of linkages to nature and biodiversity, which is a basic requirement for health. Good examples are the work on

- climate change: climate conditions can have differential impacts on food security, temperatures, natural disaster risk, the spread of vector-borne diseases, and water supply;
- urban green spaces: green spaces represent an essential component of biodiversity and are one of the main contributors of eco-system services.

WHO hast started work on green space already in 2011 in response to the WHO Ministerial Declaration on Environment and Health (2010), which included a commitment by Member States *“to provide each child with access […] to green spaces in which to play and undertake physical activity”* by 2020. The results of this work have been published by two WHO reports focusing on urban green spaces:

- a review of evidence on urban green spaces and health (WHO Regional Office for Europe 2016), describing in detail the health impacts of urban green spaces and the related pathways and mechanisms.
- a review of the impacts and effectiveness of urban green space interventions (WHO Regional Office for Europe 2017a), concluding practical action steps that have been successfully implemented.

To make the conclusions of the WHO work on urban green spaces more useful to practitioners, WHO has summarized the two reports on urban green spaces in an action brief (*WHO Regional Office for Europe* 2017b) to inform and support:

- practitioners at the local level involved with the design, planning, development and maintenance of urban green spaces;
- local decision-makers, politicians and public authorities with responsibility for urban development, environmental management, social affairs and public health; and
- civil society organizations concerned with the quality of urban settings and the quality of life at the local level.

This action brief emphasizes one example of how natural and diverse environments can provide healthy settings for life, and how important nature is for physical, social and mental health and well-being.

References

WHO Regional Office for Europe (2012): Health 2020. European Policy for Health and Well-Being. Copenhagen: WHO Regional Office for Europe.

WHO Regional Office for Europe (2016): Urban green spaces and health. A review of evidence. Copenhagen: WHO Regional Office for Europe.

WHO Regional Office for Europe (2017a): Urban green space interventions and health. A review of impacts and effectiveness. Copenhagen: WHO Regional Office for Europe.

WHO Regional Office for Europe (2017b): Urban green spaces: a brief for action. Copenhagen: WHO Regional Office for Europe.

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Healthy Cities Network Germany

Karsten Mankowsky
German National Healthy Cities Network

The presentation elaborates on the foundation of the German Healthy City Network, which is embedded in the historical and social context.

In view of the demographic change in Germany, investment in human health and healthy living environments has to increase.

This has consequences for political decisions in all areas of life. Health issues have to be considered in all of these decisions.

The German Healthy Cities Network is a growing network of more than 74 municipalities. These members represent more than 20 million inhabitants. In addition, the German Healthy Cities Network is part of the movement of European healthy cities.

Within the network, members have the opportunity to exchange ideas with other cities. This can help to avoid many mistakes that are commonly made at the beginning.

The nexus between "climate change and health" is still a new topic in the German Healthy Cities Network. As will be shown, there are many activities regarding "climate protection" within the Network, but only occasionally is "climate protection" linked to human health.

Finally, examples from the city of Dresden and the Rhein-Kreis Neuss will be presented. Dresden is currently undertaking an analysis of the public green, which in the long-term should serve to improve the accessibility of green areas for people. At the same time, a survey about protective housing devices for heat periods, the use of the existing green areas as well as the issue of social status and health conditions is conducted.

Moreover, the example of a municipal climate partnership between Rhein-Kreis Neuss and a municipality in Colombia shows how “climate protection” and “development cooperation” can be linked in practice. Within this partnership, a value chain of cocoa is being established and the power supply and the reorganization of waste management is being improved.

4.3 Session I: Biodiversity or green space? Evidence for contributions to health in a changing climate

Urban woodlands and their importance for biodiversity and human well-being

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Urban woodlands and biodiversity

Humans have disproportionally settled in areas with ecosystems that on a global level are considered to be biodiversity hotspots. Remnants of naturally occurring forests may provide the highest perquisites for biodiversity found in urban green areas. Here we investigate these urban remnants defining them as urban woodlands structurally equivalent to a natural forest stand with a field layer not managed as in a park. In Sweden, urban woodlands on average covers 20% of cities with large variation e.g. 1% cover in Malmö, 13% in Uppsala and 20% in Stockholm (Hedblom et al., 2010). Dead wood is an important indicator of diversity and are more common in the urban fringes than in the landscape surrounding the cities (and center of cities; Hedblom et al., 2010). The same woodlands has been shown to have an equal numbers of bird species along an urban to rural gradient indicating high diversity in urban woodlands. Further, urban and suburban woodlands in Gothenburg revealed higher diversity of birds and tree species than residential areas (Gunnarsson et al., 2017).

Our aim is to review how biodiversity in urban woodlands is linked to human perception and stress reduction. We compare three studies;(i) psychological self-evaluation in questionnaire (N= 1,347) (ii) psychological self-evaluation using bird song and urban setting on a visual screen (N= 227) and (iii) psychophysiological measures of stress reduction using multisensory responses of visual, sound and smell features (N= 154)

Urban woodlands and perception: Self – evaluation

Our research suggests that urban woodlands (areas with high naturalness) are more common, and have higher aesthetical values, than parks (areas with lower naturalness; Ode-Sang et al., 2016). The perception of an urban green area varies with gender and age. Women and older people use and perceive urban woodlands at a higher extent than younger (middle aged and men). Further, based on self-reported movement, women tend to move in the fringes while men in the interior of woodlands (Ode-Sang, in prep). People subjectively rated areas having higher biodiversity (based on field measures) as areas with highest biodiversity (Gunnarsson et al., 2017). In other words, perceived positive values of urban greenery were highest where biodiversity was highest. Not only gender and age affected perception, individuals considering themselves as “nature oriented persons” rated biodiversity higher than individuals considering themselves as “urban oriented persons”.

Studies on biodiversity perception seem to be highly related to visual perceptions although humans perceive their surrounding with all senses. Urban settings were ranked higher if respondents heard bird song (Hedblom et al., 2014). Thus, even the chattering of a House

Sparrow (*Passer domesticus L*.) increased ratings. Interestingly, the more species heard, the more positive the perceptions were rated as (Hedblom et al., 2014).

Urban green as stress-recovery environments: psychophysiological measures

Most studies on biodiversity perception are based on visual self-evaluations. In a study (Hedblom et al., in prep), measures of physiological stress recovery was compared between different multisensory virtual environments that included odors. Participants were randomized to either a city, park or forest environment. Stress was induced by mild electrical shocks, and skin conductance was measured as an indicator of physiological stress. The results showed a significantly faster and larger recovery in the park and the forest than in the urban environment, where no significant recovery was found. No difference was revaeled between parks and woodlands. Further, the results in this study showed that self-evaluated perceived comfort of an environment mediates the physiological stress response; thus, the more comfortable an environment is, the weaker the stress response. This link could be demonstrated for the smell and sound but not the visual stimuli.

Planning consequences

Urban woodlands are being constantly fragmented, removed or replaced by less diverse parks and lawns. Approximately 55% of them are smaller than 2ha in size (Nielsen et al., 2017) and lack informal protection making them vulnerable for exploration. Further fragmentation and loss of urban forests is likely to result in crowding effects in the remaining green spaces and exacerbate the impacts of climate change on local ecologies and populations. Finally, urban planning should aim to prioritize and preserve easily accessible and health promoting natural areas and plan for all senses, not only visual features.

References

Gunnarsson, B., Knez I, Hedblom M, Ode Sang Å. (2017): Effects of biodiversity and environment-related attitude on perception of urban green space. Urban Ecosystem.

Hedblom, M. And Söderström, B. (2010): Importance of urban and peri-urban woodlands for the avi-fauna in urban forest fragments: an analyses of 34 Swedish cities. Biogeography.

Hedblom, M., Heyman, E., Antonsson, H., Gunnarsson, B. (2014): Bird song diversity influences people´s appreciation of urban landscapes. Urban Forest & Urban Greening.

Nielsen, A.B., Hedblom, M., Stahl Olafsson, A., Wiström, B. 2017): Spatial configurations of urban forest in Denmark and Sweden. Urban Ecosystems

Ode-Sang, Å., Knez, I., Gunnarsson, B., Hedblom, M. (2016): The effects of naturalness, gender, and age on how urban green space is perceived and used. Urban Forestry & Urban Greening.

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Getting Outdoors: What motivates people?

R.D. Waters, D. A. Stone
Natural England

Introduction

Evidence demonstrates multiple links between the natural environment and human health and well-being, ranging across mental health to reduced incidence of inflammatory diseases such as asthma (Sandifer et al., 2015). Being outdoors in nature may support or enhance health and well-being, but what motivates people to use their outdoor spaces? Are users of the outdoor spaces more engaged and exhibiting pro-environmental behaviours in other aspects of their lives? What are the implications for health and the environment policy?

Method

The Monitor of Engagement with the Natural Environment (MENE) survey provides a comprehensive dataset on people's use and enjoyment of the natural environment in England. The survey focus is on visits to the natural environment, but MENE also captures relevant information on people's attitudes towards the natural environment and participation in pro-environmental behaviours (Natural England, 2017).

The survey has run continuously since March 2009 with at least 800 weekly interviews with a representative sample of adults (aged 16+) living in England. This analysis uses MENE data from the period March 2009 to February 2012. The total cumulative base for this period was 142,031 interviews. The analysis was conducted in a cross-sectional manner, with the three years of survey responses handled as one data set. Time series analysis wasn't undertaken. A range of analytical techniques was used to explore and understand relationships in the data including Spearman Rank correlations and Associative Network Mapping.

What motivates people to use their outdoor space?

Analysis of outdoor visit patterns showed behaviour is skewed. The majority of people undertake visits to the natural environment between "once or twice a month" to "once a week" (40% of people). Only 33% take visits frequently (several times a week or more). 26% of people visit infrequently no more than once every 2-3 months or never.

There are 2.7 billion annual outdoor visits. The results show a large proportion of these is undertaken by a small proportion of the overall population. Just 11% of people undertake 53% of all natural environment visits, whereas almost a half of people (46%) only take 6% of all visits. Characteristics such as exercising, car ownership, owning a dog, and higher social grade correlate with visit frequency.

Are users of the outdoor spaces more engaged and exhibiting pro-environmental behaviours in other aspects of their lives?

The analysis showed a weak relationship between people's broader concerns for the environment and their visit frequency (ρ=0.12). There is a moderate relationship between visit frequency and personal attitudes such as 'time outdoors being an important part of my life (ρ=0.28). These relationships also exhibit the same demographic skewing as visit frequency. These results indicate that frequency of outdoor visits are more to do with personal benefits and personal feelings than any environmental concern *per se*.

What are the implications for health policy in relation to green spaces?

Exposure to or use of the natural environment differs between social and demographic groups. This study has shown that the majority of regular visitors to the outdoors are of higher social grade, an already privileged group that we would not want to target for health improvements. Improving health benefits for more deprived social groups through improving access to the natural environment doesn't appear to be a major driver for environmental and health policy. A policy shift to focus on distal health benefits through ecosystem co-benefits from improving the quantity and quality of our green spaces for urban cooling, flood control, disease control, mitigation of noise, better air quality is more likely to benefit target social groups and deliver a supportive resilient natural environment.

References

Sandifer, P.A., Sutton-Grier, A.E., Ward, B.P (2014) Exploring connections among nature, biodiversity, ecosystem services, and human health and well-being: Opportunities to enhance health and biodiversity conservation. Ecosystem Services 12 (2015)1–15.

NATURAL ENGLAND (2017) MENE Technical Report to the 2009-16 surveys. Natural England Joint Report JP023

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4.4 Session II: Health and protected areas in a changing climate

The health benefits of experiencing “wilderness” in the National Park

Kerstin Ensinger
Black Forest National Park

Introduction

One of the main tasks of national parks is protecting the natural processes through which diversity is indirectly preserved and promoted. But the contribution of national parks also goes beyond nature conservation and has a potential impact on human health and well-being.

In the summer of 2016 the Black Forest National Park conducted a field study exploring the restorative effects of nature for human health and well-being by measuring the effect of a walk through different types of landscapes on 111 participants. The route comprised the characteristic of the National Park (c.f. photo): a cultivated forest of spruce (1), a small trail with blueberry vegetation (2), a structurally diverse forest with dense ground vegetation, deadwood components and uprooted trees (3) and an open heathland (4).

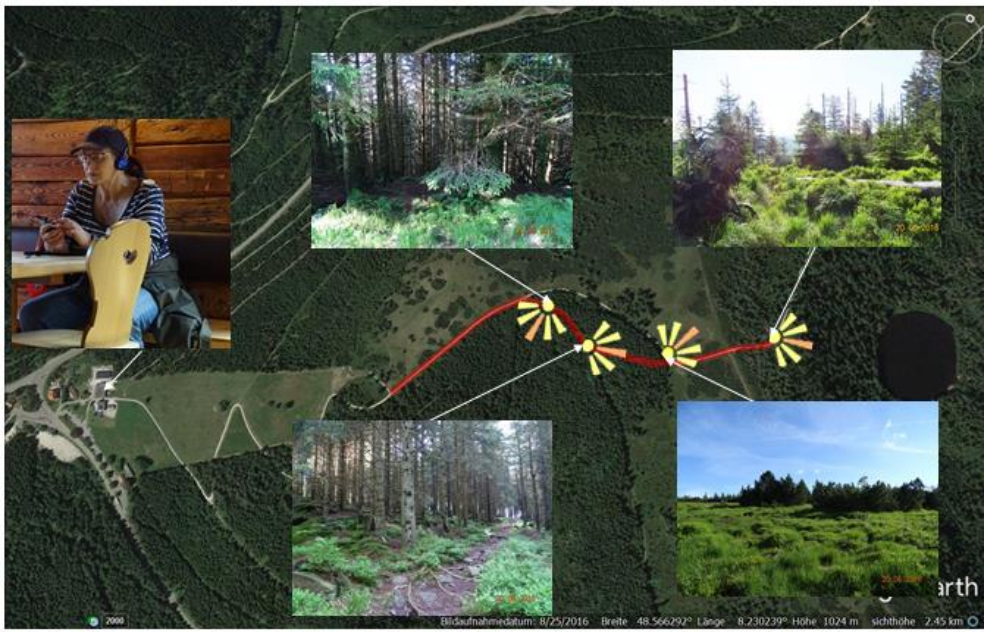

Fig. 1: Route and different types of landscapes (Source: Black Forest National Park)

An additional component of the study explored the effects of an intervention that aimed to direct participants’ attention to the present (Kabat-Zinn, 1990). Therefore, the participants were randomly assigned to one of two experimental conditions: mindfulness training before or after the walk.

Methods

A sensor wristband measured skin conductance and skin temperature in order to assess each person’s psychophysiological reaction (Papastefanou, 2013). A GPS device tracked the participants’ geographical position during the entire walk; therefore an “emotional map” could

be generated. People further underwent different psychological pre- and posttests via a smartphone app and answered questions about their perception of the different landscapes.

Experience of the Black Forest National Park

The results of the study highlight the benefits of a walk through different types of landscapes. The walk as a whole promotes self-perceived restorative experiences: both participants of the intervention and the control group reported substantial improvements in their well-being after the walk (M = 3.41, SD = 0.56; min = 1 (no improvement), max = 4 (substantial improvement)). Most striking was that the different landscapes were all rated equally positive in terms of restorative characteristics; only landscape 1 (cultivated forest) was rated slightly less restorative compared to all other landscape types (F(2.504) = 23,364, p =.00).

Participants who received mindfulness based training before the walk reported to be able to stronger let go their thoughts and troubles during the walk (t = 1.994, p = .05; 95% bootstrap corrected CI [0.03;0,06]). Further, their average physiological arousal levels were more even and mostly uncorrelated with the different types of landscape, whereas participants who received the training after the walk showed stronger associations between positive and negative arousal in relation to different landscape types.

Conclusion

On different levels the study underlines the restorative effect of a walk in the Black Forest National Park. The results support the importance of nature conservation, not only for the sake of nature itself, but for its crucial contribution to public health (Ensinger, 2016).

Furthermore, the results highlight different aspects of mindfulness: mindfulness practice improves the restorative effect of nature. On the other hand it might also reduce the effect of different landscape types on physiological arousal by improving resistance towards external stimuli. Therefore mindfulness could be considered as a resource for health in the face of climate change. It supports people to deal with constraints for restoration in a changing world.

References

Ensinger, K. (2016): Mindfulness, natural environment experience and recovery experiences. *Umweltpsychologie, (39*/2), 95-111.

Kabat-Zinn, J. (1990): Full catastrophe living: Using the wisdom of your mind to face stress, pain and illness. New York: Delta.

Papastefanou, G. (2013): Experimentelle Validierung eines Sensor-Armbandes zur mobilen Messung physiologischer Stress-Reaktionen. *Gesis-Technical Reports 2013*/07.

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Exposure to green areas: Modeling health benefits in a context of study heterogeneity

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Though green areas are recognized to have beneficial health effects and are key adaptation measures in a climate change context, epidemiological studies show mixed results with significance varying considerably by study, context and health outcome, indicating that there is no unique and clear evidence of their impact on health. This relationship is influenced by multiple factors - environmental, socio-demographic, economic features - and is characterized by high levels uncertainty.

The present study proposes a new application of the Heckman selection model to identify the determinants affecting health risk reductions associated with exposure to green areas, by aggregating outcomes of different studies while discriminating between significant and non-significant results extracted from the literature in order to correct for the unobserved selection bias. The proposed model combines an outcome equation including factors affecting the relationship health-environment, and a selection equation to identify factors influencing the probability of observing statistical significance.

Results show significant health benefits associated with increased exposure to green environment. Higher risk reductions are observed for morbidity outcomes and specifically for cardiovascular, respiratory and mental health diseases, for the elderly and middle age population, and for lower-income groups. The probability of observing significant results is higher in studies carried out in urban green areas and higher-income countries and looking at mortality outcomes.

Our findings show that studies' samples might suffer from selection bias on unobservable variables, and that there is a need to systematize information to allow the transfer of knowledge in other contexts to facilitate the use of existing data in environmental health programmes and adaptation appraisal.

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4.5 Session III: Linking initiatives in biodiversity, health, and climate change action in policy and practice

Climate change, human health and biodiversity: how a socio-ecological conceptualisation provides for integrated solutions.

Dave Stone
Natural England

Introduction

Changing climate presents challenges to both human health e.g. heatwaves, flooding, allergens and vector-borne diseases, and biodiversity, e.g. species and habitat loss, and changing regulatory services. Many authors have identified challenges to human health, while different authors have identified challenges to biodiversity. These different world views are equally valid. Increasingly there is recognition that the complex systems that drive human and biodiversity health are inter-related and inter-dependent.

Socio-ecological conceptualisation

Reis et al. (2013) proposed a modified DPSEEA model that recognised two pathways, proximal and distal, through which drivers influence human health. The proximal pathway recognises the traditional perspective whereby local environmental change effects health. The distal pathway recognises how remote environmental systems influence health. In doing so, the model integrates social and ecological complexity in the relationship between environment and health at different scales. By approaching this model from an ecological perspective, it also provides insights on how social system changes may influence biodiversity health.

Applying the framework

The FRESH project (EEA, 2015) explored how the socio-ecological conceptualisation of public health could be used to articulate the relationships between health and environmental systems, particularly in urban areas, with a particular focus on human health outcomes. Figure 1 illustrates how the FRESH project applied the modified DPSEEA model to the climate challenge of urban transport systems. The bottom of the model captures the human health and well-being outcomes linked to effects from urban transport systems. Here we see increases in morbidity, mortality, and stress, which add up to diminished health and well-being of individuals and communities. For illustrative purposes, figure 2 takes the same urban transport climate challenge in the modified DPSEAA model but looks at the exposure/experience and health outcomes through a biodiversity or ecological lens. This examines the same system but seeks to understand the health and well-being effects on the plants and animals of our urban areas. Using this approach, we can see that the health and well-being effects for human and non-human species are remarkably similar. Similarly, the actions that would benefit human health would also benefit non-human health.

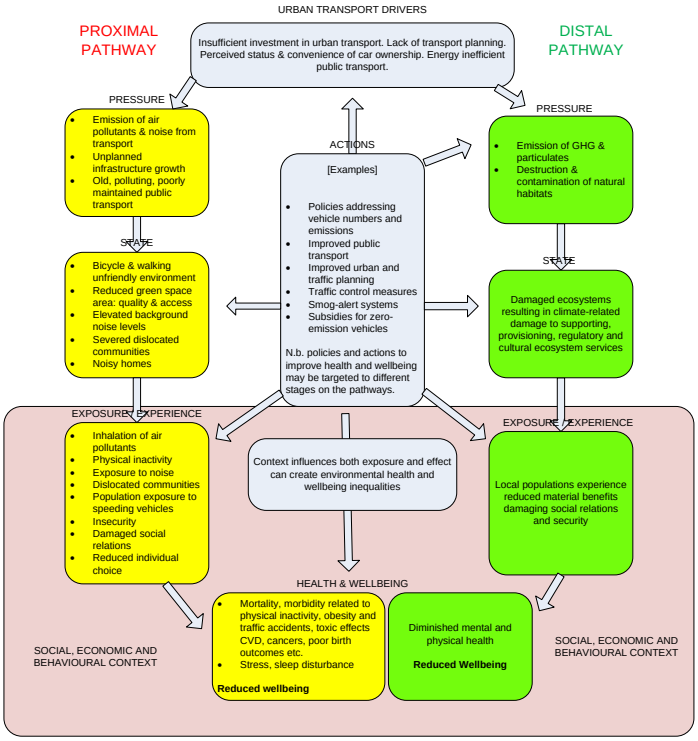

Fig. 1: Human health effects of actions of transport through mDPSEEA model (Source: FRESH, 2015)

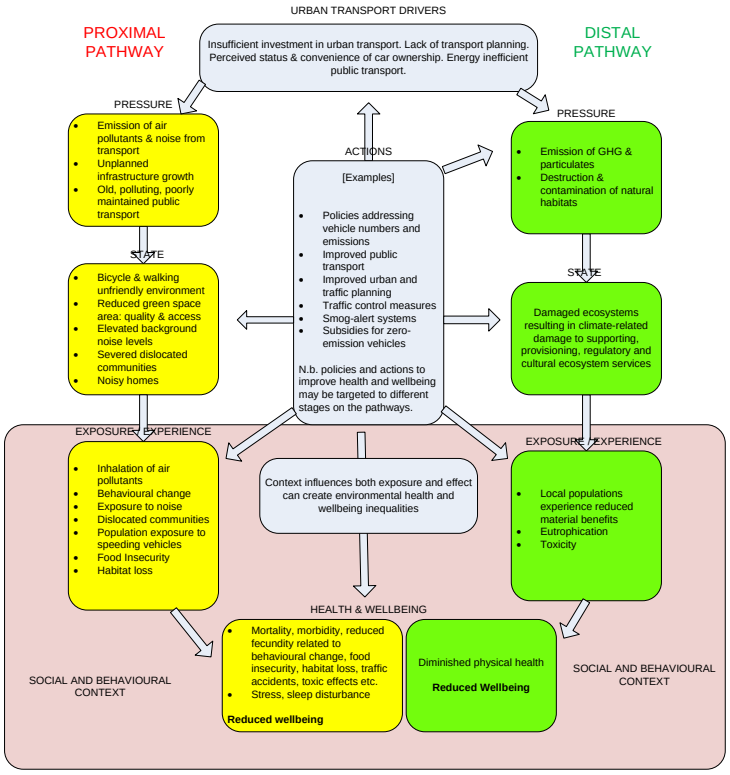

Fig. 2: Biodiversity health effects of actions of transport through mDPSEEA model (Source: D. Stone)

Conclusions

The modified DPSEAA model encapsulates a socio-ecological integration of the complex relationship between environment and health through recognising both proximal and distal pathways. Using this conceptualisation drivers of poor health outcomes can be explored from a human and biodiversity perspective, enabling common actions to be identified that benefit the health and well-being of all species. This enables us to move away from an anthropocentric view of health to a conceptual space where we can identify health benefits for individuals and communities of any species that can be delivered through common actions. This notion of co-benefits and integrated solutions can be used to drive policy and interventions that improve health outcomes for both biodiversity and people.

Acknowledgement: Thank you to the European Environment Agency and FRESH consortium for allowing me to draw upon their work.

References

EEA (2015) A Europe to thrive in – environment, health and well-being: a summary of the work by the FRESH consortium. https://www.eea.europa.eu/articles/a-europe-to-thrive-in (accessed 10 June 2017)

FRESH (2015) Why Healthy Transport? EEA, Copenhagen. https://www.eea.europa.eu/articles/a-europe-to-thrive-in (accessed 10 June 2017)

REIS. S. et al., (2013) Integrating health and environmental impact analysis. Public Health V129(10)

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Implementing a One Health Approach in Transfrontier Conservation Areas Will Help Build Resilience to Climate Change

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The creation of Transfrontier Conservation Areas (TFCAs) in southern Africa is based on the integrated objective of biodiversity conservation, ecosystem function and sustainable economic development. Uniting adjacent conservation areas in different countries is meaningful in order to restore ecological and socio-cultural continuity across borders while allowing for using nature capital as an engine for economic development. Such a holistic vision fits in well with the recently established 2030 Agenda for Sustainable Development which recognizes that human health and well-being are dependent on healthy ecosystems. These socio-political objectives in future land management are rights-based, affording fairness of access to resources between different socio-ecological compartments but are difficult to realise on the ground. The fact is that many local communities living on the fringe of TFCAs across Africa suffer from a relatively high burden of poverty and serious health concerns mainly due to their remoteness and poor infrastructures. The challenges that these marginalized communities face include: infections (zoonotic and neglected tropical diseases) and non-communicable illnesses emerging at the interface between human, animal and the environment. In addition to limited health care, there is restricted access to resources e.g. water, fuel wood, NTFPs, herbal medicines, non-crop food sources etc, leading to malnutrition, human and wildlife conflict which are exacerbated with climate change.

As a means to address these inequities in TFCA implementation, we present a One Health programme which seeks to mitigate some of these challenges by addressing zoonotic diseases surveillance and control, health education, water and cattle management in some Shangaan communities living around the Great Limpopo-TFCA. We suggest that adopting a One Health approach will begin to change the rethoric into a practical realization of the concept while contributing to build resilience of communities to climate change.

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4.6 Session IV: The benefits of green space for enhancing human health – Lessons learned from urban interventions

Benefits of urban green space interventions: lessons from the field

Matthias Braubach
Technical Officer, WHO Regional Office for Europe

Urban green spaces are important for health and well-being, and also have a strong association with social cohesion as they provide settings for exchange, communication and social activities.

Many policy frameworks, such as the Sustainable Development Goals, the New Urban Agenda of the UN, and the WHO Health2020 policy, have referred to the relevance of public spaces and especially green areas for urban development and the quality of life in cities. A range of evidence reviews is available to document the magnitude of health impacts associated with green space, quantifying both negative and positive impacts on health and well-being. Yet, much less evidence is available on how urban green spaces can be best exploited to achieve a maximum of health benefits while minimizing potential adverse effects on health and well-being as well as negative impacts on social equity in urban settings.

To address this gap of knowledge, a WHO project aimed to compile and review urban green space interventions to better understand the type of urban green space interventions implemented on local level, and to derive a better understanding of what works on the ground.

Following a European call for case studies, 48 local intervention projects were selected and explored in more detail. Most of these projects represented interventions related to parks and large open spaces, but the case studies also included projects related to institutional settings (school yards and hospital grounds), linear green spaces (next to rivers or train tracks) or green spaces created for specific activities (sport, gardening, playgrounds etc.).

For most of the case studies, the main objectives were reported to be the improvement of urban environments and the promotion of active lifestyle, while equity and health benefits were less often reported as the project goals.

For projects reporting environmental conditions as the main objective, biodiversity conservation was one of the top priorities (mentioned by 21 case studies) which is only exceeded by the maximization of area attractiveness (23 case studies). This suggests that biodiversity and the protection of natural habitats are embedded in urban planning and often associated with the development of open natural spaces, linking urban and societal benefits with nature benefits.

Case studies aiming at the promotion of active lifestyle mostly focused at the maximization of time spent outdoors by providing nice and welcoming green spaces (15 case studies). The provision of green spaces was also often seen as a means to provide better urban equity and services to all, aiming at the improvement of urban quality in disadvantaged areas (8 case studies) and the provision of equal access to green spaces (7 case studies). Although health aspects were usually not the main objective of the case studies, seven case studies still reported that one of their aims was the improvement of health-related quality of life in general. Yet, only very few case studies provided specific aims such as the promotion of mental well-being (5 case studies) or the prevention of diseases (2 case studies).

While most case studies were targeted in spatial terms (focusing on individual neighbourhoods), they tended to benefit the whole population and only few projects focused on specific target groups.

Regarding the evaluation of intervention outcomes, the first finding is that many case studies had no reliable monitoring and evaluation framework – there were either no information available, or only very vague self-reported or observational data that do not allow strong conclusions on the impacts of the interventions. Quantitative data were almost exclusively collected for active lifestyle and environmental outcomes, and negative impacts were largely ignored.

In summary, the project showed that urban green space interventions implemented across Europe

- can be very diverse in terms of size and setting,
- are often used to upgrade disadvantaged or deprived areas,
- create environmental benefits and promote active lifestyle, with indirect benefits for health and well-being and social cohesion,
- are most effective when environmental action is combined with social action to promote the use of urban green space,
- tend to be insufficiently evaluated.

The results of the project are available in a WHO report and an action brief (WHO Regional Office for Europe 2017a;b).

References

WHO Regional Office for Europe (2017A): Urban green space interventions and health. A review of impacts and effectiveness. Copenhagen: WHO Regional Office for Europe.

WHO Regional Office for Europe (2017B): Urban green spaces: a brief for action. Copenhagen: WHO Regional Office for Europe.

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Edible Playgrounds: functional food-growing in schools

K. C. Sheldon
Development Director / Deputy Chief Executive, Trees for Cities

Trees for Cities is an independent charity that engages local people to plant urban trees. We have seen increasing demand from schools to create a suitable resource to grow food.

In the UK, almost 20% of children leaving primary school are obese(1). Since 2014, the National Curriculum requires schools to teach the principles of nutrition and healthy eating. Key stage(2) children need to understand where food comes from, seasonality, and where and how a variety of ingredients are grown.

Food-growing in schools has a positive impact on pupils' nutrition, attitudes towards healthy eating and physical activity(2). In response to demand, we created our first Edible Playground at Rotherfield Primary in Islington, London: the practical, functional solution that Head Teachers craved.

Since 2010 we haved tested and refined the model to define what works well. Lessons include:

1. Leadership from school senior management is vital to drive the project forward with class teachers and build the Edible Playground into the school curriculum.
2. Teachers need the skills and confidence to teach through gardening (not to become gardeners themselves). This approach also ensures that the Edible Playground is maintained through regular use.

Edible Playgrounds takes a whole school approach and offers a comprehensive service; design, build, planting, teacher training and planning support throughout the academic year. The uniqueness and value of the programme lies in embedding food-growing into the school curriculum across all subjects.

Impact evaluation

To date we have created 50 Edible Playgrounds, particularly in areas of deprivation measured by pupil premium. We have monitored twelve schools that we worked with since 2014, comprising 1,600 pupils and 206 teachers. Key findings on the health and well-being impacts are as follows:

93% teachers stated that Edible Playgrounds had a positive impact on pupils' attitude towards healthy eating. 77% said that it had moderate/significant impact on the children's willingness to try fruit and vegetables (n=54). 83% pupils said that they enjoyed eating the food that they grew "a lot" or "a bit" (n=1074).

75% teachers said that the Edible Playground had positive impact on the development of social skills. 71% head teachers say that Edible Playgrounds has assisted their work with children with special educational needs or challenging behaviour.

91% pupils said that they like working in the edible playground "a lot" or "a bit" (n=1074). The top emotions that pupils said they feel in the Edible Playground were "happy", "excited", "interested" and "calm" (n=1074).

Head teachers also stated positive benefits on behaviour, attendance and the amount and quality of time spent outdoors, but these findings were not conclusive and require further work.

Eating well in childhood is not only important for for growth and development but to establish patterns of behaviour, helping to prevent illness such as heart disease and diabetes in later life. Diet-related illnesses cost the NHS £10 billion each year1 and yet 70,000 premature deaths a year could be prevented with modest changes to eating habits(3).

Schools are in a unique position to promote healthy eating to children through provision of healthy meals and teaching about food and nutrition. Studies have shown that children who eat well perform better at school(4). There is evidence that practical gardening lessons help to develop children's understanding(5) about the importance of healthy eating.

A balanced, nutritious diet and access to nature are fundamental components for mental health and well-being. Regular access to nature through outdoor learning in schools enables children to develop their understanding and capacity to deal with the world around them5, learning and applying social skills such as empathy and creativity, which have long-term impact on quality of life.

Case Study

Whilst 68% teachers surveyed agreed that pupils benefit from learning outdoors, disappointingly we found that lessons in the Edible Playground only occur <6 times per year at most schools (n=206). Further work is needed to understand how to overcome this barrier with teachers.

Hitherfield Primary in Lambeth best demonstrates how schools can use an Edible Playground. Teachers have integrated the Edible Playground into their plans and used it as a resource to teach maths, science, design & technology, personal, social and health education (PSHE), literacy and art. The Edible Playground has built teachers‘ confidence, "broadening ideas" for outdoor teaching, which "can be challenging without focus and support". Hitherfield was recently awarded silver Primary Science Quality Mark where inspectors commended the Edible Playground for its "experiential, hands-on approach to science".

References

(1)Dimbleby, H. & Vincent, J. (2013) The School Food Plan. Available online: http://www.schoolfoodplan.com/wp-content/uploads/2013/07/School_Food_Plan_2013.pdf

(2)Anon. (2010) A New Deal for School Gardens. Report published by the Food and Agriculture Organization of the United Nations. Available online: http://www.fao.org/docrep/013/i1689e/i1689e00.pdf

(3)The Strategy Unit, Food Matters: Towards a Strategy for the 21st Century, Cabinet Office, July 2008

(4)For example, Alaimo K, Olson CM, Frongillo EA Jr, 'Food Insufficiency and American School-Aged Children's Cognitive, Academic and Psychosocial Development', Pediatrics 2001;108(1):44-53. For full list refer to appendix 3 in the School Food Plan.

(5)Malone, K. and Waite, S. (2016) Student Outcomes and Natural Schooling. Plymouth: Plymouth University. Available online: http://www.plymouth.ac.uk/research/oelres-net

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Associations of surrounding green space with cardio-metabolic disease

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Introduction

Surrounding green space has been associated with decreased morbidity and mortality risks. Several pathways by which surrounding green space may affect health have been suggested. Higher levels of surrounding green space, for example, tend to go together with lower levels of air pollution. In this study, we evaluated whether surrounding green space is associated with cardio-metabolic diseases. Additionally, we studied whether decreased levels of air pollution is a possible pathway underlying the effects of surrounding green space on cardio-metabolic outcomes.

Methods

A Dutch national health survey of 387,195 adults was used to investigate the associations of surrounding green space with self-reported doctors' diagnosis diabetes, hypertension, heart attack and stroke morbidity. The survey data were linked with surrounding green space, assessed by the Normalized Difference Vegetation Index (NDVI), and annual average air pollutant concentrations. We assessed surrounding green space in buffers with a 100, 300, 500, 1000, 3000 meter radius.

Logistic regression models were used with adjustments for a range of individual and lifestyle variables. We used natural splines to test whether the effect of surrounding green space on cardio-metabolic outcomes is linear and to plot exposure-response curves. To quantify the effect of surrounding green space we used quintiles of the exposure variables. A mediation analyses was performed to decompose the total effect of surrounding green space into direct and indirect effects (see Fig. 1).

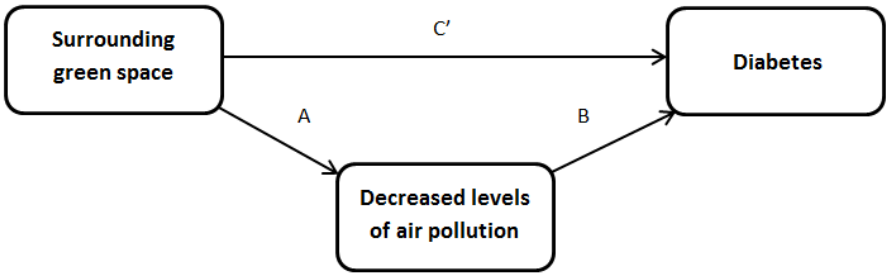

Fig. 1: Schematic overview of the direct (C') and indirect effect (AB) of surrounding green space on diabetes. (Source: J. O. Klompmaker et al.)

Results

Surrounding green space was non-linearly associated with the odds of self-reported doctors' diagnosed diabetes. The exposure-response curves of surrounding green space with diabetes showed an inverse J-shaped pattern (see Fig. 2). The odds ratio (OR) of surrounding green space on diabetes was significantly lower in the fourth (NDVI 300m, OR: 0.91, p-value <0.005) and fifth quintile (NDVI 300m, OR: 0.80, p-value <0.005) compared to the first quintile, in each buffer. The mediation analyses showed that the total effect of surrounding green on diabetes is partly (10-40%) explained by decreased levels of air pollution (NO_2 or OP^{DTT}). Surrounding green space was not associated with the odds of hypertension, stroke or heart attack.

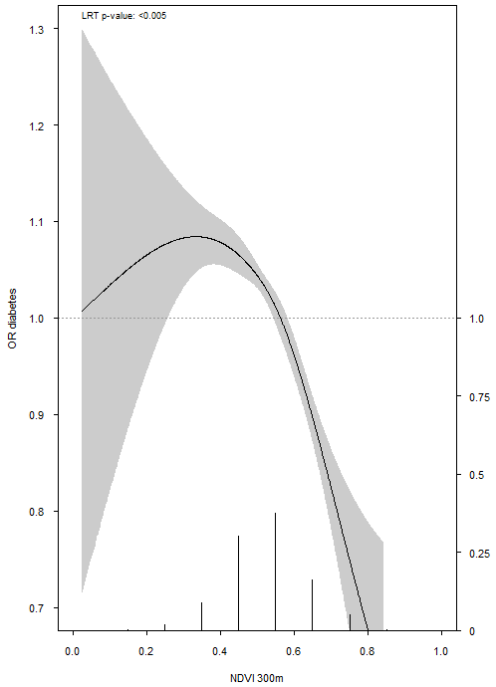

Fig. 2: Estimated exposure-response curves (solid line) and 95% CIs (grey area) for the odds of diabetes for NDVI in a 300m buffer. At the left x-axis the OR is shown, at the right x-axis the probability distribution of the NDVI is shown. (Source: J.O. Klompmaker et al.)

Conclusion

Surrounding green space was associated with decreased prevalence of diabetes but not with hypertension, heart attack and stroke. The effect of surrounding green on diabetes could partly be explained by decreased levels of air pollution.

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4.7 Session V: Psychological effects of nature and biodiversity on human health and well-being

Nature experience areas providing biodiversity and childrens' quality of life – compatible or contradictory aims?

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Natural environments play a key role in restoration, not only for adults, but particularly for children. They restore physical, psychological and social resources that have been diminished by daily demands: concentration, physical condition and social inclusion increase while the stress level is lower after the perception of natural compared to urban environments (Lee & Maheswaran, 2010). However, a recent trend shows that the cruising radius of children decreases constantly (Kytta et al., 2015), thus limiting opportunities to perceive natural elements especially in an urban context. An opportunity for children to perceive natural environments on a daily basis is provided by Nature Experience Areas. They provide a widely naturally developing space accessible for children in the close neighbourhood to play freely with little or no assistance by adults. At least half of the area develops without human influence, while the other half is extensively managed (Schemel, 2009). Thus, nature experience areas could, besides contributing to the quality of life of children, also provide habitats for species and support biodiversity in the urban context.

In an interdisciplinary approach, the effects of a newly formed nature experience area in Berlin have been analysed by both an ecological and a psychological perspective.

Fig. 1: A pile of wood or a hut? Impression of a Natural Experience Area (Source: D. Martens)

Methods

In an interdisciplinary approach the Nature Experience Area was analysed by 1.) identifying the environmental characteristics of the area (Ode et al., 2007), 2.) observing the preferred areas of children to play and 3.) linking these data.

The whole area of 0,56 hectares was divided into 14 distinct locations. In each of these, diversity of vegetation structure was measured by tree-, shrub- and herb cover. Structured observations at randomly distributed times investigated play behaviour of children aged 4 to 12 years (n = 244) for six weeks in summer 2016.

Results

The characteristics of the ecological infrastructure has an effect on the play behaviour. Children preferred locations with high values in mystery and naturalness, and medium to low complexity at the same time. Apart from that, the most frequented and thus preferred areas show rather different appearances, some representing possibilities to climb, others enable hiding or easy orientation.

Fig. 2: Climbing is one of the favourite activities (Source: D. Martens)

The ecological development of the Nature Experience Area will be analysed after a longer timespan usage by children and show effects of children play in these areas.

Discussion

Results show some consistency with landscape aesthetic theories, expanding the field to children. Mystery is an important characteristic of Nature Experience Areas, which attracts children, indicating that children need hiding places to be explored without the company of adults. Activities such as building huts are rather frequent.

At the same time complexity does not attract children much. This might be due to the fact that the location is rather new and not yet familiar to the users. Research in the following seasons in the longitudinal approach will reveal further evidence concerning this possibility.

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The greener, the happier? The effects of urban green and abandoned areas on residential well-being and health.

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There is a growing body of literature highlighting a positive effect of green urban areas on residential well-being and health (see for example White et al., (2013), Ambrey and Fleming (2014) and Mitchell and Popham (2008)). We extend these approaches by incorporating cross-section data on different categories of urban land use from the European Urban Atlas (EUA) for the year 2006. Land use categories include urban green areas, forests, waters and abandoned areas (land without current use). Linking data from the EUA with panel data from the German Socio-Economic Panel (GSOEP) yields a sample of over 6,000 individuals in 32 German major cities. We reduce concerns about endogeneity by employing fixed-effects (within) estimators, with individual and city of residence fixed effects, while controlling for a rich set of observables.

Using a Geographical Information System (GIS), it calculates the distance, measured as the Euclidean distance in 100 metres between households and the border of the nearest patch of land belonging to a certain land use category, and the coverage (with land belonging to a certain land use category), measured as the hectares in a pre-defined buffer area of 1,000 metres around households, as the most important determinants of access to them. It shows that, for the 32 major German cities with more than 100,000 inhabitants, access to urban green areas, such as parks, is significantly positively associated, whereas access to abandoned areas, such as brownfields, is significantly negatively associated with residential well-being, in particular with life satisfaction, as well as mental and physical health. The effects are strongest for residents who are older, accounting for up to a third of the size of the effect of being unemployed on life satisfaction. We calculate the marginal willingness-to-pay of residents in order to have access to green urban and abandoned areas in their surroundings, as well as the life-satisfaction maximizing amounts of them. Households are willing to pay 23 Euro of monthly income for one additional hectare of green space, given a asmpe mean coverage of 23 hectares. Ceteris paribus, the optimal value of coverage of green urban area in the pre-defined buffer of 1,000 metres is, on average, 33 hectares, whereas the optimal value of abandoned areas is 0 hectares.

References

Ambrey C.L., and Fleming, C.M. (2014): Public green space and life satisfaction in urban Australia. Urban Studies 51(6): 1290-1321.

Mitchell, R., and Popham, F. (2008): Effect of exposure to natural environment on health inequalities: an observational population study. Lancet 372(9650): 1655-1660.

White, M.P., Alcock, I., Wheeler, B.W. and Depledge, M.H. (2013): Would you be happier living in a greener urban area? A fixed-effects analysis of panel data. Psychological Science 24(6): 920-928.

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A Conceptual Framework to Better Understand the Dose-Response Relationships between Urban Green Spaces and Health

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The associations between urban landscapes and health have long been used as a basis for using urban green spaces (UGS) to create salutogenic environments for urban dwellers' health (Coutts, 2010). However, the scientific evidence for specific mechanisms and outcomes of UGS-health relationship contains much inconsistencies. We suggest that to direct research towards generating knowledge that facilitates developing generalizations, a holistic framework that links the multiple facets in the association of health with green space will be valuable. The aim of this work is to develop a novel framework to better understanding UGS-health relationship from a dose-response perspective.

To develop such a conceptual framework, we conducted a review for more than 70 empirical studies covering about 40 cities in 17 countries published between 2001 and 2015. We also referred to key theoretical frameworks proposed by Lachowycz and Jones (2013), Hartig et al. (2014), James et al. (2015), and Hegetschweiler et al. (2017). Based on these analysis, we identified 'dose', 'mediators', 'moderators', 'response' and 'spatial scale' as five key domains involved in such relationships and developed a conceptual framework linking these five main domains to better elaborate the causal pathways of how UGS affect health.

The majority of studies only consider the provision of green space, such as quantity, accessibility, and quality, as the independent variable. This framework goes beyond emphasizing the effects of UGS provision on health outcomes but proposes that both people's exposure to UGS and UGS attributes are important. It emphasizes the dependence not just on green space, but also the role of humans themselves in the influencing the extent of health benefits that can be obtained from exposure to green spaces.

Using this conceptual framework as a detector, we identified four main remaining knowledge gaps in the existing studies: (1) Which attribute of UGS dose has the largest effects on health is not fully understood; (2) What is the appropriate spatial scale for analysis is not clear; (3) The roles of different mechanisms remain marginally tested; (4) Whether green space-health relationship changes according to social-cultural, climatic context is unclear.

To address these knowledge gaps and guide urban greening to achieve better public health in the context of climate change, we suggest future studies should be prudently designed to fit in certain positions in this framework to obtain a comprehensive understanding of UGS-health relationship and more evidence-based knowledge and theory-informed design guidelines.

References

Coutts, C. J. (2010). Public health ecology. Journal of environmental health, 72(6), 53.

Hartig, T., Mitchell, R., De Vries, S., Frumkin, H., (2014), Nature and health, in: Annual Review of Public Health, pp. 207-228.

Hegetschweiler, K. T., de Vries, S., Arnberger, A., Bell, S., Brennan, M., Siter, N., Olafsson, A. S., Voigt, A., Hunziker, M., (2017), Linking demand and supply factors in identifying cultural ecosystem services of urban green infrastructures: A review of European studies, Urban Forestry and Urban Greening.

James, P., Banay, R. F., Hart, J. E., Laden, F., (2015), A review of the health benefits of greenness, Current epidemiology reports 2(2):131-142.

Lachowycz, K., Jones, A. P., (2013), Towards A Better Understanding Of The Relationship Between Green space And Health: Development Of A Theoretical Framework, Landscape and Urban Planning 118:62-69.

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4.8 Session VI: Allergenic plants and vector borne disease – relevance to human health in a changing climate

Assessment of health risks from allergenic plants, animals and vector borne diseases in Rhineland-Palatinate under climate change conditions

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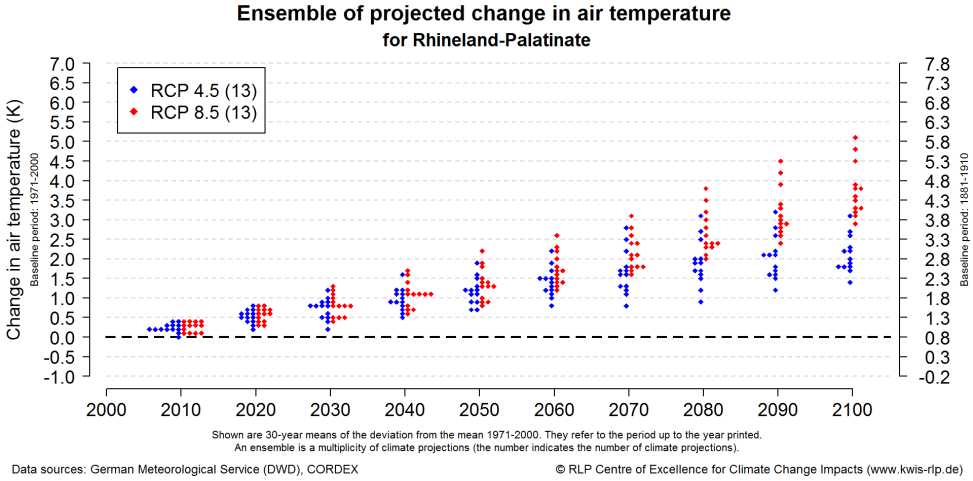

Fig. 1: Ensemble of projected change in air temperature in the calendar year, (Source: German Meteorological Service, CORDEX, © Rhineland-Palatinate Centre of Excellence for Climate Change Impacts)

Climate in Rhineland-Palatinate

Global Warming has resulted in noticeable effects on the local climate in Rhineland-Palatinate: The average annual medium temperature is today 1.5 K higher in comparison to 1882-1911. According to state of the art climate projections the temperature is expected to rise by further 1.5-5 °C until the end of the 21st century, while altered seasonal distribution is predicted for precipitation rates, mainly resulting in more humid winters. Due to variations in topography, the climate in Rhineland-Palatinate is riddled with strong spatial disparities. Notably the Rhine, Lahn, and Moselle valleys are prone to strong thermal burden while the uplands of Eifel, Westerwald, Hunsrück and Palatinate Forest are characterized by a fresh climate. Besides human activities, climate change is believed to be an important factor for the appearance and spread of new allergenic plants and animals as well as new vector animals in Rhineland-Palatinate.

Allergenic burden

The common ragweed (*Ambrosia artemisiifolia*) has been found at more than 250 sites in Rhineland-Palatinate. However, wide areas of the federal state are not yet colonized which is also true for nature reserves. The most affected sites are the borders of larger streets. Approximately 4 % of grazing areas for game are actually colonized by the common ragweed but the populations do not seem to spread further (Dr. C. Buhk, research project, University of Koblenz and Landau). It is believed that especially the longer vegetation period facilitates the seed maturation of this neophyte. Modelling of climatic conditions and potential land use until the end of the 21st century suggests an extensive increase of the suitability for *A. arte-*

misiifolia in the state. Since 2005, the occurrence of the oak processionary (*Thaumetopoea processionea*) is surveilled in Rhineland-Palatinate by the Forstliche Versuchs- und Forschungsanstalt Baden-Wuerttemberg (FVA BW). Since now, its caterpillars were exclusively reported from rural districts in the south-east of the state mainly with a distribution of lower than 30 ha.

Vector borne diseases

The land surface of Rhineland-Palatinate is covered to 42 % with forest and displays a rural character. The tick *Ixodes ricinus* is widely spread over the whole federal state with a high prevalence (20 %) of *Borrelia* (Mehlhorn *et al.,* 2016). Infections with the tick-borne encephalitis are infrequent, merely one administrative district (Birkenfeld) is considered as risk area. Since now, the Rhine seems to function efficiently as natural border for tick-borne encephalitis (TBE) as many adjacent districts from Baden-Wuerttemberg are risk areas according to the Robert-Koch-Institute (RKI). Nevertheless, new ticks have been recognized in the last years. For example the ornate cow tick *Dermacentor reticulatus* and the ornate sheep tick *Dermacentor marginatus* have been found at various places in the Rhine valley. Similarly, new mosquitos seem to establish in Rhineland-Palatinate: *Aedes japonicus japonicus*, *Aedes albopictus* and *Anopheles daciae* were found in some areas – mainly in or close to the warmer river valleys (Kampen *et al.,* 2012; Schaefer, 2014).

References

Mehlhorn H., Mehlhorn T., Müller M., Vogt M. AND Rissland J. (2016): Tick survey for prevalent pathogens in peri-urban recreation sites in Saarland and Rhineland-Palatinate (Germany). Parasitol Research 115 (3): 1167-1172.

Kampen H., Zielke D. And Werner D. (2012): A new focus of *Aedes japonicus japonicus* (Theobald, 1901) (Diptera, Culicidae) distribution in Western Germany: rapid spread or a further introduction event? Parasites & Vectors (2012), 5:284.

Schaefer M. (2014): A survey of the German mosquito fauna (Diptera: Culicidae) and identification of associated pathogens. Dissertation, Rheinische Friedrich-Wilhelms-Universität Bonn.

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Ticks and the city

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The wood tick, *Ixodes ricinus*, serves as vector for diverse pathogens. This ubiquitous tick most frequently transmits the agents of Lyme borreliosis and, thus, poses a risk to people across Central Europe. Diagnosis and treatment of Lyme borreliosis cost an estimated 80 Mio € per year in Germany. The vector tick requires vertebrate hosts to acquire blood meals for its development and reproduction as well as, at least temporary, high levels of relative humidity for its survival. Such biotic and abiotic requirements are generally fulfilled in the ecotonal sylvatic environment. Because urban green infrastructure offers suitable habitat and hosts, too, people appear to be frequently exposed to ticks in parks and private gardens. Faunal diversity affects the transmission cycle of Lyme borreliae, because particular tick hosts support the pathogen as reservoir and others eliminate it. Due to the tick's humidity requirement, the local microclimate affects its host-seeking activity and subsequent risk for city dwellers. In an interdisciplinary team, we aim to evaluate hosts that establish and sustain urban tick populations for their pathogen competence and to identify characteristic habitat structures providing a suitable microclimate in order to optimize measures of prevention and devise intervention strategies.

Biotic interactions

Ixodes ricinus ticks do not inherit Lyme borreliae, but acquire them as subadults during a blood meal from a competent reservoirs host, such as rodents or certain birds (Richter et al., 2012). These reservoir-competent hosts contribute profoundly to the prevalence of ticks infected with pathogenic Lyme borreliae. Lizards support solely a non-pathogenic species (Richter et al., 2013). Wild and domestic ruminants, on the other hand, eliminate any Lyme borreliae in ticks that feed on them. The presence of such so-called zooprophylactic hosts reduces the risk of infection (Matuschka & Spielman, 1986; Richter & Matuschka, 2011). The local composition of animals serving as tick hosts that either support or eliminate Lyme borreliae, thereby, directly affects the risk of infection for people. These effects occur on a small spatial scale, because lateral movement of wood ticks is very limited and mainly determined by the host's movements. In an urban environment, the diversity of tick hosts varies from that in the rural setting and the contributory or zooprophylactic effect of only a few urban tick hosts, including synanthropic species and companion animals, has been determined. We must understand which hosts establish and drive the transmission cycle in the urban context in order to minimize the infection risk at our doorsteps.

Abiotic requirements

In addition to the availability of hosts for their blood meal, *I. ricinus* ticks require a suitable abiotic environment for survival and interstadial development. In Germany, these ticks actively quest for hosts generally from March through October with a reduced activity during July and August. Because they must maintain a sensitive water balance, they appear to thrive better in vegetation that provides a humid shadowy micro-environment than in sun-exposed, cropped vegetation. The complexity of various microclimatic parameters influencing their

questing activity still mostly prevents reliable predictions of seasonal tick activity. Thus, effects of climate change on tick abundance remain rather speculative. The microclimatic conditions, such as high relative humidity, mild soil temperature and the presence of a snow cover during November through February positively affect the questing activity of nymphal *I. ricinus* during their spring peak of activity (Vollack et al., 2017). A winter that provides continuous or frequent snow cover may, thus, permit higher survival rates for overwintering ticks.

We will not be able to eliminate ticks transmitting pathogens entirely from the environment. With an enhanced knowledge about the urban transmission cycle, we can, however, aim to limit the abundance of infected ticks in our immediate vicinity by carefully designing the green infrastructure in our urban landscapes.

References

Matuschka, F.-R., and Spielman, A. (1986): The emergence of Lyme disease in a changing environment in North American and Central Europe. Experimental and Applied Acarology 2: 337-353.

Richter, D., and Matuschka, F.-R. (2011): Differential risk for Lyme disease along hiking trail, Germany. Emerging Infectious Diseases 17: 1704-1706.

Richter, D., Debski, A., Hubalek, Z., and Matuschka, F.-R. (2012): Absence of Lyme disease spirochetes in larval *Ixodes ricinus* ticks. Vector-borne Zoonotic Diseases 12: 21-27.

Richter, D., Schröder, B., Hartmann, N. and Matuschka, F.-R. (2013): Spatial stratification of various Lyme disease spirochetes in a Central European site. FEMS Microbiology Ecology 83: 738-744.

Vollack, K., Sodoudi, S., Névir, P., Müller, K., and Richter, D. (2017): Influence of meteorological parameters during the preceding fall and winter on the questing activity of nymphal *Ixodes ricinus* ticks. International Journal of Biometeorology DOI 10.1007/s00484-017-1362-9

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Alien species and human health impacts: Evidence syntheses and the role of climate change

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Alien species are increasingly recognized for causing impacts detrimental to human health. We used several approaches of knowledge and evidence syntheses on this topic: (i) In a systematic map of the European literature we identified evidence for any change in occurrence, frequency or severity of impacts of alien species on human health. Relevant studies often reported specific cases and rarely link ecology, distribution or spread to public health impact. (ii) In a systematic review we assessed the effectiveness of management options to control of common ragweed *Ambrosia artemisiifolia*. Effects of herbicides are evident, but articles hardly assessed side effects on biodiversity or human health. Effects of physical management and biological control options are promising and may allow eradication of A. artemisiifolia in areas where substantial future spread has to be expected. (iii) A questionnaire and in-depth interview among Austrian stakeholders revealed that alien allergenic plants and vectors of disease are considered to be highly health relevant and that future increases in their impacts are troublesome for the public health system but can largely be mitigated by awareness raising and preventative environmental measures. (iv) A review on climate change (CC) impacts on invasions of health relevant alien species showed differences among invasions stages. Introduction of the species can be facilitated by CC, but its role is moderate compared to increased trade and mobility. For species establishment and spread, however, CC is crucial and resulting shift and increase in distributions might cause increasing health impacts, particularly in temperate, polar and mountainous areas.

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4.9 Session VIII: Planning and managing urban green spaces for health and biodiversity in a changing climate – Concepts, experiences, practices

Assessment of the Bioclimatic Risk as Base for Resilient Urban Climate Adaptation Strategies: Case Study for the City of Chemnitz, Germany

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Background and Project Motivation

Having about 249.000 inhabitants, Chemnitz is the third-largest city in the Free State of Saxony, Germany. Located in the northern foothills of the Ore Mountains, it is part of the Central German Metropolitan Region. The city's economy is based on the service sector and manufacturing industry. In 2008, the city council of Chemnitz initiated an Integrated Climate Protection Program (ICPP), based on a long term environmental strategy. Chemnitz introduced the first Urban Energy Concept in 1993 setting the basis for future planning, followed by a biannual Climate Protection Report between 2000 and 2007. The ICPP was finalized in 2012 and published after the permitting process in 2013 (Stadt Chemnitz, 2013), with a regularly update of the data base. It consists of the „Climate Protection Concept“, and the „Climate Adaptation Concept”. Project motivation is the regional need for action, resulting from the consequences of the climate change in Saxony.

Methodology

The urban climate forecast forms a special challenge, as natural (geographic location, relief, land use, elevation, etc.) and anthropogenic factors (type and density of buildings, the building materials heat storage capacity, percentage of soil sealing, etc.) must be considered. A GIS-based methodology was developed for the urban climate prognosis, using historical data (1950 – 2000), validated with data of the current state (2001-2010, climate diagnosis, update 2015), and resulting in the prognosis (2011 – 2020, 2041-50). Using the data of the climate model WEREX, which was elaborated for Saxony, and the classification of ecotopes (regional sectors whose climatic factors are equal and formative) was developed a GIS-based method for further regionalization of the climate prognosis at the mesoscale of the city. The recent investigation results confirmed the climate change trend through a significant decrease of days with snow and frost, as well an increase of summer days and hot days.

In order to address potential impacts of the prognosticated climate change on human and environmental health, a risk assessment methodology was developed based on the risk matrix developed by Nohl & Thiemecke (1988). In parallel, the bioclimatic situation was assessed using the bioclimatic index as a tool for the determination of the risk intensity. It describes the impact of all bioclimatic factors which have negative effects on organisms, and considers predicted- mean-vote-index (PMV), heat index (HI) we well as wind chill (WC). The risk assessment of vulnerable urban zones has been carried out using of GIS-visualisation of the data of sensitive objects in the urban area (e.g. hospitals, schools, landscape conservation area, nature protection area, wetlands, hydro soil…). In this way the climate effected areas have been visualized.

Results

The classification according to risk levels allowed for a prioritization of urban areas at risk. The results indicate a heat increase in the inner city as main future challenge. The adaptation strategies in the frame of the City Development Concept have been designed accordingly. The obtained data on vulnerable urban zones have been considered in the City Development Concept in order to implement green and blue infrastructure elements, namely inner-city green belts and the ecological re-design of the formerly channeled Chemnitz river. The approach enhances urban ecosystem services and is in line with the EU Strategy "Green Infrastructure - Enhancing Europe's Natural Capital" as of 2013 (European Commission, 2013). Further, the implementation of Green Energy solutions have been fostered (Schneider et. al., 2012). In the frame of the dissemination of the climate adaptation concept have been performed workshops for public participation.

References

European Commission (2013): Green Infrastructure (GI) — Enhancing Europe's Natural Capital, SWD (2013) 155 final, COM(2013) 249 final.

Nohl, J.; Thiemecke, H. (1988). Methodology for Risk Assessment (in German). Bremerhaven: Wirtschaftsverlag NW (Schriftenreihe der Bundesanstalt für Arbeitsschutz Fb 536 - Volumes on Occupational Health and Safety).

Schneider, P.; Gottschalk, N.; Scharbrodt, T.; Kühnel, C. (2012). Potential analysis of renewable energy for targeted policy intervention: Example Chemnitz, Germany, *in: ICLEI-IRENA Renewable Energy Policy in Cities: Selected Case Studies, November 2012 RiS 2012.12.07, www.irena.org/Publications/RE_Policy_Cities_CaseStudies*

Schneider, P.; Gottschalk, N; Löser, R.; Scharbrodt (2011). Integrated Climate Protection Program for the City of Chemnitz - Climate Diagnosis, Climate Change Prognosis and Conception of Adaptation Measures in the Urban Area, *in: Resilient Cities: Cities and Adaptation to Climate Change - Proceedings of the Global Forum 2010, Local Sustainability 1, pp. 299 – 310, DOI 10.1007/978-94-007-0785-6_31, © Springer Science+Business Media B.V. 2011*

Stadt Chemnitz, Umweltamt (2013). Integriertes Klimaschutzprogramm für die Stadt Chemnitz, online available: http://www.chemnitz.de/chemnitz/de/die-stadt-chemnitz/umwelt/klimaschutz/klimaschutzprogramm/index.html

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Biodiversity, human health and climate change at the RSPB

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The Royal Society for the Protection of Birds (RSPB) is the largest nature conservation NGO in the UK. RSPB started in 1889 and has a long history of action to protect and restore threatened biodiversity. As an organisation with over 220 nature reserves and 1.2 million members, it is important for us to remain true to our biodiversity conservation priorities. We are increasingly aware of the connections between human health and nature and are exploring how this aligns with our efforts to conserve biodiversity and responses to climate change. We are currently engaging with this agenda through our science, policy and practice, whilst simultaneously exploring implications of this new dimension for our modus operandi. The presentation outlined a number of our initiatives which are now described.

Nature reserves – a place for health and well-being benefits?

RSPB nature reserves are usually designated for their biodiversity priorities, however they also have priorities around people engagement. One potential benefit of nature reserves is the health and well-being benefits visitors can gain from being in biodiversity rich surroundings. This project uses GIS data layers on indicators of public health and deprivation (e.g. prevalence of conditions such as dementia and depression) to identify reserves whose local populations have particular health challenges. The project is conducting a feasibility assessment to explore opportunities for developing engagement approaches which could support health and well-being of local communities.

Mental health support on nature reserves

As an example of the types of engagement which can be offered on nature reserves, this project piloted an approach where 12 people with mental health conditions took part in weekly half day visits to an RSPB nature reserve. This was a collaboration between RSPB and a local mental health service provider. Whilst at the reserve, participants took part in activities such as habitat management, biodiversity monitoring, guided walks and photography. All participants reported benefits, including mental and physical well-being, social and personal benefits. Additionally, an unanticipated benefit was a boost in morale for the reserve staff was recorded.

Biodiversity rich housing – delivering benefits to people?

In partnership with Barratt Homes, a large housing developer, RSPB are investigating ways to increase the biodiversity of housing and assessing whether this has any effect on residents. Around 2,500 new houses are currently being built at a site 50 miles from London. Wildlife friendly interventions such as swift bricks, bat boxes, wildflower planting, and large areas of green space are being included. In 2018, RSPB will begin interviewing residents to measure health and well-being, connection to nature and pro-environmental behaviours. This long term project has the potential to measure decadal change and assess the impact of living and growing up in a biodiversity rich environment.

Challenges and opportunities

The links between human health and biodiversity create a number of challenges and opportunities for those working in the nature conservation sector. A major challenge is the scale of effort required to address the threats to biodiversity: this alone requires considerable attention. The approach of protecting biodiversity for its human health benefits adopts a much stronger utilitarian value than many in the conservation sector would like to see. Engaging with human health issues requires skills and approaches which may not traditionally be found in the sector of nature conservation. In terms of opportunities, nature conservation engages a large audience, and these people have diverse motivations and values – health will be important to a huge proportion of them. There is a potential that collaborations between health and nature conservation could engage new audiences with biodiversity which has the potential to strengthen support for its conservation through sharing new perspectives. As mentioned, nature conservation requires considerable effort; the innovation which is an inevitable element of the collaboration between these two sectors could lead to unanticipated benefits for both parties. Biodiversity interventions already have societal benefits, often as a by-product rather than a driver. Greater appreciation of the connections between human health and biodiversity presents considerable opportunities to amplify benefits to people and nature.

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The Influence of Park Features on Park Satisfaction in a Multi-Ethnic, Deprived Urban Area

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The relationship between green space and health is increasingly recognised, with four suggested mechanisms: increased physical activity, improved air quality, reduced stress and increased social interaction (Hartig, Mitchell, De Vries & Frumkin, 2014). As a result, parks are considered a valuable environmental resource for health promotion and growing research is being conducted to establish the determinants of park use in order to promote this behaviour.

Much research has examined the role of park proximity and park size, and now interest is turning to the influence of park quality. The number of features appears to be related to use; it is suggested the number of features may be linked to park satisfaction, which is related to use. US-based research has found the presence of playgrounds, paved trails, basketball courts, water features, shelter and picnic areas are related to increased park use and park-based physical activity. On the other hand, incivilities such as litter, vandalism and unclean washrooms have been shown to deter use and park-based physical activity. It is not clear to what extent the presence of incivilities might impact on park satisfaction.

Some evidence suggests the relationship between park features and park use may be moderated by ethnicity and socioeconomic status (Kaczynski et al., 2014). It is not known whether the relationship between park features and park satisfaction differs between ethnicities and across the socioeconomic spectrum.

I will present the results of our work, which aimed to:

- Explore the influence of park size, proximity and quality on park satisfaction and park use
- Explore whether park satisfaction mediated the relationship between park features and park use
- Examine whether ethnicity and socioeconomic status moderated the relationship between park features and park satisfaction and park use

The study makes use of (1) the Natural Environment Scoring Tool (Gidlow, in review) to audit park quality in Bradford (2) GIS tools to establish park size and park proximity and (3) existing survey data from a sub-sample (n=620) of the Born in Bradford cohort (Wright et al., 2012) on park satisfaction and socioeconomic and demographic variables (ethnicity, education, financial status, marital status, Index of Multiple Deprivation). Parks were audited on: access, recreational facilities, amenities, natural features, significant natural features, non-natural features, incivilities and usability. Significant predictors of park satisfaction and use were identified using multilevel linear regressions. Multilevel mediation was used to explore the mediating role of park satisfaction in the relationship between park features and park use. Interactions between ethnicity and socioeconomic status and park features were explored.

Our findings showed that the number of amenities, number of activities available (usability) and level of incivilities present significantly influenced the degree of park satisfaction. Incivilities also appear to negatively impact on park use. This suggests park quality is important in encouraging park satisfaction and park use. Individual level variables did not influence park satisfaction or park use. It is therefore recommended that environmental interventions may be more effective than individual interventions to encourage satisfaction and use.

References

Hartig, T., Mitchell, R., De Vries, S., & Frumkin, H. (2014): Nature and Health. *Annu. Rev. Public Health*, *35*, 207–28. http://doi.org/10.1146/annurev-publhealth-032013-182443

Gidlow, C. J., van Kempen, E., Smith, G., Triguero, M., Kruize, H., Gražulevičienė, R., Ellis, N., Hurst, G., Masterson, D., Cirach, M., van den Berg, M., Smart, W., Dėdelė, A., Maas, J., Nieuwenhuijsen, M. J. (2017): Development of the Natural Environment Scoring Tool (NEST) In review.

Wright, J., Small, N., Raynor, P., Tuffnell, D., Bhopal, R., Cameron, N., … West, J. (2013): Cohort Profile: the Born in Bradford multi-ethnic family cohort study. *International Journal of Epidemiology*, *42*(4), 978–91. http://doi.org/10.1093/ije/dys112

Kaczynski, A. T., Besenyi, G. M., Wilhelm Stanis, S. A., Javad Koohsari, M., Oestman, K. B., Bergstrom, R., … Reis, R. S. (2014): Are park proximity and park features related to park use and park-based physical activity among adults? Variations by multiple socio-demographic characteristics. *International Journal of Behavioral Nutrition and Physical Activity*, *11*. http://doi.org/10.1186/s12966-014-0146-4

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5 Abstracts of poster presentations

A review of the urban green portrait in health studies

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Lately, many studies have analyzed the bonds between urban green spaces and human health. There seems to be a positive relation amid the proximity and accessibility to green spaces and a portion of human health. As an example and amongst others illnesses, some of these studies focus on stroke mortality, self-reported health, reported stress or birth weight. Whereas compressive health data is included and the population socioeconomic context is well defined, green spaces remain poorly characterized. It resembles that green spaces are portrayed as homogeneous or almost homogeneous areas, incorporating almost no characteristics beyond size and accessibility. Contrarily, green areas are broadly diverse and go far beyond idealized gardens. This can lead to possible bias in the results.

This study aims to delve into how urban green areas are defined and how their heterogeneity is portrayed in health studies.

Methods

After a compressive search of all papers regarding urban green spaces and human health the most relevant publications were selected. These articles have been classified by: their definition of urban green spaces and by how do they categorize the urban green spaces. Concurrently, a keyword search was conducted in each one of the papers.

Results and discussion

On the one hand, the analysis of the articles showcases that the definition of green urban space diverges amongst studies. On the other, the majority of the articles did not have any kind of differentiation amongst spaces and no article did a comprehensive characterization that could portrait the complexity of the sites.

Urban green space definition must be thoughtfully agreed upon to avoid the Babel Tower effect and its consequent difficulties in results comparability. At the same time, heterogeneity amongst green spaces has to be compressively included in these studies in order to avoid the possible bias generated by the differences amongst areas.

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Let's Go – Hiking for Families, Kids und Pre-schools

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Together Outdoors

Let's go is the health initiative of the German Association of Hiking Clubs "Deutscher Wanderverband (DWV)", which includes 58 member clubs with over 600.000 individuals.

Let's go – families, kids and pre-schools fosters the cooperation of hiking clubs and pre-schools. A family hiking group and a local pre-school form a tandem in order to offer hikes for kids and parents.

Participants take a class on how to prepare hikes that meet the diverse interests of kids and parents equally. Pre-schools are supported by their tandem hiking groups in organizing weekly hikes for their pre-schoolers. Hiking groups offer monthly walking tours for the whole family.

In Motion

Hiking with *Let's go – families, kids und pre-schools* includes playing, experiencing nature, enjoying time together with other kids and families! The fun aspect is most important since fun activities are most likely to be repeated and to become part of people's life. With *Let's go – families, kids and pre-schools* kids and parents can discover their love for hiking and ideally keep it for a lifetime.

As an incentive, the DWV awards the Deutsches Wanderabzeichen – a recognition certificate for ambitious hiking. Additional information can be found on our website: www.deutsches-wanderabzeichen.de

Discovering Nature

The hikes help to build an integrated understanding of biodiversity by fostering outward bound activities, increasing the range of action for the families and kids, playing games to deepen the sensual perception and learning about the natural environment. The tandem partners of pre-schools and hiking groups involve experts like foresters, nature park staff or ornithologists to share their specific knowledge during the hikes.

Let's go – families, kids and pre-schools is a pilot project funded by the German Ministry of Health (BMG) and is part of the IN FORM Initiative.

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Ecology and biodiversity in cities under climate change – How students can be enabled to understand, evaluate and communicate adaption strategies

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Introduction

Climate change is one of the heaviest social and ecological challenges currently. Cities are particularly affected by climate extremes because of their exposure (Endlicher, 2012). Besides the broad field of climate change prevention, research on adaption strategies receives increasing attention (Bundesumweltamt, 2015). For the social acceptance and implementation of adaption strategies a raising awareness of the effects of climate change among the population is necessary (BfN, 2006), especially among young people as actors and decision makers of the future.

A concept to develop students' evaluation and action competencies

The project „Klimawandel findet Stadt" ("climate change meets city") supports the development of students' evaluation and action competencies concerning climate change consequences and sustainable adaption strategies. The part of the project developed at the Department of Geography at Heidelberg University of Education focusses on the design of learning modules with emphasis on urban ecology and biodiversity, which are important factors in climate change (BfN, 2006; Endlicher, 2012). The modules consist of a triad of observation space, laboratory space and space of action. The photos (Fig. 1 & Fig. 2) show the observation and documentation of urban greenery during different excursions in Heidelberg.

Fig. 1: Observation and documentation of urban greenery (Source: Neumann 2017)

Fig. 2: Students identifying ruderal plants (Source: PHHD / P&K 2016)

Triad of observation, laboratory analysis and action

The observation of selected green spaces in the city serves the acquiring of knowledge, e.g. the mapping of inner-city brownfields provides knowledge about ruderal plants, which can even exist under extreme climate conditions. In the laboratory, the students apply scientific methods to explore a variety of adaption strategies of plants from different climate regions and evaluate the results of their investigations. For example they examine with the help of

growth trials which plants prevail under dry and warm conditions. In a final step, the students implement sustainable urban green space planning in a city's territory self-reliant or communicate their acquired knowledge in a workshop.

References

Bundesamt für Naturschutz (BfN) (2006): Biologische Vielfalt und Klimawandel – Gefahren, Chancen und Handlungsoptionen (BfN-Skripten 148). https://www.bfn.de/fileadmin/MDB/documents/service/skript148.pdf (accessed 12.06.2017)

Bundesumweltamt (2015): Monitoringbericht 2015 zur Deutschen Anpassungsstrategie an den Klimawandel – Bericht der Interministeriellen Arbeitsgruppe Anpassungsstrategie der Bundesregierung. https://www.umweltbundesamt.de/sites/default/files/medien/376/publikationen/monitoringbericht_2015_zur_deutschen_anpassungsstrategie_an_den_klimawandel.pdf (accessed 12.06.2017)

Endlicher, W. (2012): Einführung in die Stadtökologie. Stuttgart: Ulmer/UTB.

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“Make me a willow cabin at your gate”: How works in protected areas connect people and improve well-being - Model System Estuarine Forest, Hamburg, GER

Heike Markus-Michalczyk
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Introduction

In metropolitan regions, many inhabitants are alienated from nature remaining as relicts in protected areas. In condensed settlements, some people nor have access to biodiverse green infrastructures neither to tools for greening to improve well-being in urban environments. In parallel, NGOs, who contribute to maintaining protected areas in good conservation status (EU Habitats Directive), need help in nature conservation maintenance actions. Willows are valued as trees for the society and the environment. Thus, willow serve as model system on biodiversity conservation and sustainable use of an estuarine willow forest, and the related improvement of well-being at an urban secondary school is illustrated.

Methods and Results

1. Evidence for willow softwood forests along the Elbe estuary and Salix tolerance to increasing tidal flooding and salinity was found.
2. Pupils demand for working with nature was evaluated based on previous projects.
3. A protected area with willow softwood forest was determined, NGO was consolidated, need for help in maintenance measures on the willow in tidal forest was expressed.
4. Ministry for environment was contacted, authority for nature conservation was involved, agreement on application of action plan and permission for action was given.
5. Green classroom at school was planned in cooperation of participants.
6. Together, willow coppices in protected area were maintained and rods were harvested.
7. Big rods were prepared, green classroom built with willows was evolved at a school site.
8. Small rods served for pupils’ basketry, supervised by an environment educator.
9. During growing season, the protected area was revisited and tidal forest was studied.
10. Green classroom is used by individual pupils and school classes enhancing well-being.

Fig. 1: Health and protected areas in a changing climate (Source: H. Markus-Michalczyk)

Conclusion

The willow - a disturbance adapted keystone species in temperate tidal forests in a changing climate - is associated with humankind since antiquity as a consequence of both preferring floodplain habitats. Today, the willow may contribute to both, conservation and restoration of biodiversity and ecosystem services in floodplains, and in education for sustainable development and evolving wood designs in urban heat islands to enhance human health.

Fig. 2: Health and protected areas in a changing climate
(Source: H. Markus-Michalczyk)

References

FAO (2014). Poplars and Willows - Trees for Society and the Environment. Food and Agriculture Organization of the United Nations (FAO) and CAB International; Rome, Italy.

Markus-Michalczyk, H., Hanelt, D., Ludewig, K., Müller, D., And Jensen, K. (2014): Salt intrusion in tidal wetlands : European willow species tolerate oligohaline conditions. Estuarine Coastal and Shelf Science 136: 35-42. Doi: 10.1016/j.ecss.2013.11.008.

Markus-Michalczyk, H., Hanelt, D., And Jensen, K. (2015): Effects of Tidal Flooding on Juvenile Willows. Estuaries and Coasts 7: DOI:10.1007/s12237-015-0014-8.

Markus-Michalczyk, H., Hanelt, D., Dehnstorf, J., And Jensen, K. 2016. White willows sexual regeneration capacity under estuarine condition in times of climate change. Estuarine Coastal and Shelf Science 180: 51-58.

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Potential health benefits of marine resources in a protected area: the example of Cape Creus

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It is well known that omega 3 fatty acids, which are present in seafood in the form of docosahexaenoic acid (DHA) and eicosapentaenoic acid (EPA), are important to human health. However, the omega 3 fatty acids in the catch brought to consumers are seldom evaluated. In the frame of a project that studies the potential health benefits arising from the marine resources in the marine protected area (MPA) of Cape Creus (north-western Mediterranean), we studied how much the marine resources of this MPA and surrounding area constitute a source of healthy omega 3 fatty acids for consumers.The two small pelagic fish, sardine (*Sardina pilchardus)* and anchovy (*Engraulis encrasicolus*), followed by the demersal species *Conger conger*, provide to the local consumers with the highest amount of omega 3 fatty acids (Fig. 1). However, the seasonal differences in omega-3 storage are very important in species like *Sarda sarda*, where the omega-3 storage in muscle (the edible part) decreases during the spawning season (Fig. 2) because lipids are mobilized towards the gonads for reproductive purposes. Therefore, the total amount of omega 3 fatty acids caught changes considerable from month to month (Fig. 3). Therefore, it would be better to catch and eat those fishes outside the spawning season, to let them spawn, thus ensuring the sustainability of the stock, and to obtain the maximum omega 3 for consumers.

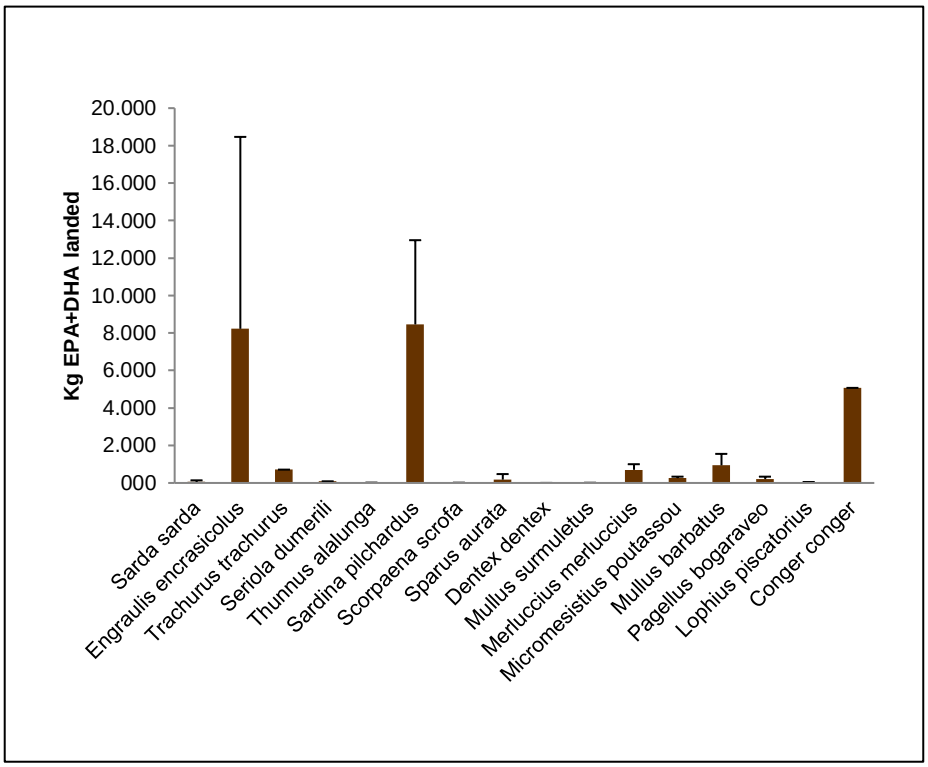

Fig. 1: Total EPA+DHA landed by species in the Roses harbor (Source: J. Lloret, M. Alcaide)

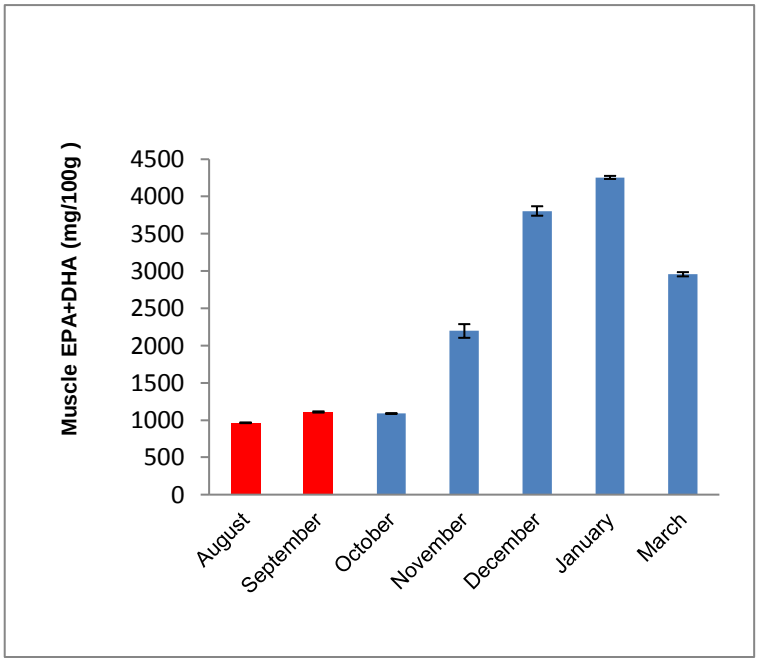

Fig. 2: Seasonality in EPA+DHA in the muscle of *Sarda sarda,* 2008-2009. Red (August-September: spawning season. Blue (rest of months): not spawning (Source: J. Lloret, M. Alcaide)

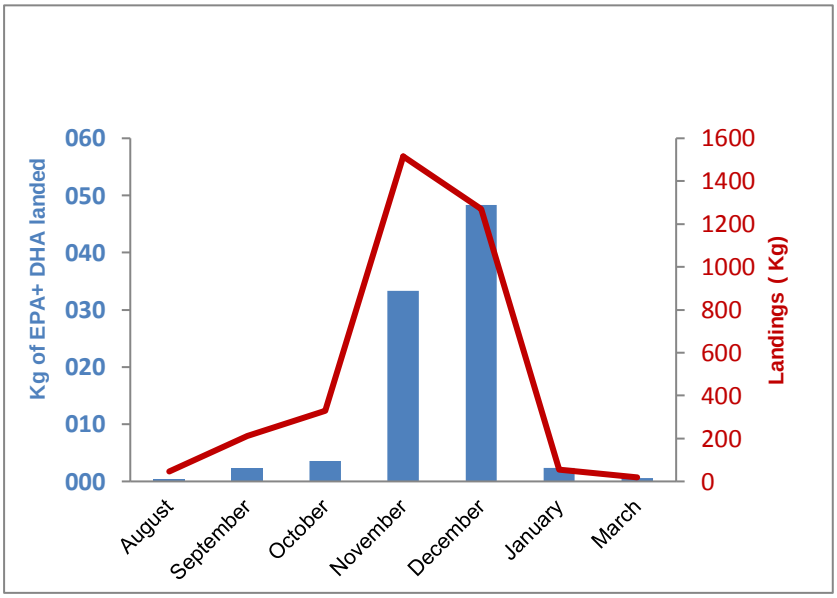

Fig. 3: Total EPA+ DHA of *Sarda sarda* landed, 2008-2009. Red line: landings. Blue columns: kg of EPA+DHA landed. (Source: J. Lloret, M. Alcaide)

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Use of an activity tracker to motivate engagement of inactive adults with health walks in a national park: A mixed-methods feasibility study

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Background

The Active Cairngorms Strategy is an outdoor physical activity and recreation strategy that aims to promote use of Scotland's Cairngorms National Park. A central challenge is motivation of physically inactive adults who live within the park's boundaries. We report here on a feasibility study of a 12-week activity tracker-based group outdoor health walk and use of a multi-dimensional holistic health measure, the Self-Assessment of Change scale (SAC).

Method

Walker-level data included: self-report responses completed at two time points (before 1st walk; at end); daily step counts; and interviews with two walkers. A Walk Leader Weekly Checklist and their written reflections provided programme delivery information.

Results

Thirteen individuals (age 63 to 81, 10 women) joined the programme; all completed. Weekly step counts trended upwards with all walkers achieving 30 minutes of physical activity 5-7 days a week by programme end. Clinically significant changes occurred for several aspects of health: sleeping well, experiencing vibrant senses, feeling energised, focused, joyful, calm and whole (Fig. 1). One walker described the experience as providing '*a whole new lease on life*'.

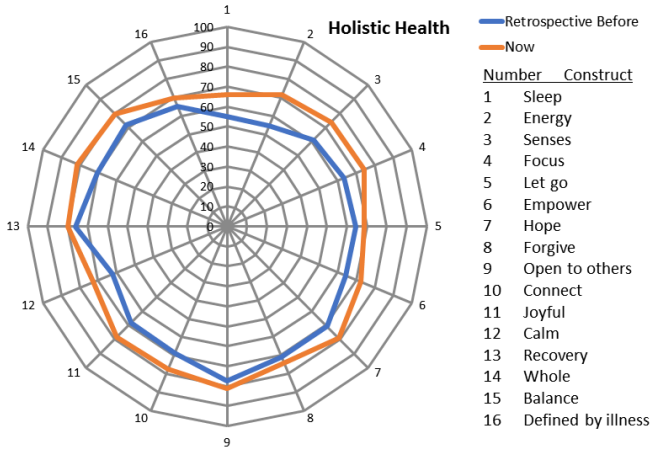

Fig. 1: Mean response for holistic health items illustrating participants' perception of where they were before the activity tracker-based group outdoor health walk started (Retrospective Before) and at 12 weeks later (Now). Higher numbers indicate higher levels of perceived health. Changes of >/= 10 units are clinically significant. (Source: Author created)

Conclusion

Activity tracker use aided management of the group by the walk leader and motivated walkers to be more active – through feedback on number of steps walked and interaction in the group. The SAC was simple to implement and outcomes align conceptually with measures used in nature-health research, while highlighting a little investigated benefit of improved sleep. The study demonstrates the feasibility of using activity trackers to motivate engagement in outdoor health walks in national parks.

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ESIKOTO project, Finland: Health and well-being for asylum seekers through nature-based activities

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Nature can significantly improve asylum seekers' quality of life. It can play a crucial part in the pre-integration process by enhancing their understanding of the local culture and human-nature relationship, improving their personal well-being or increasing their knowledge about livelihoods connected to nature. However, local nature is usually unfamiliar to asylum seekers, and they can sometimes see it as frightening. For this reason, ways of promoting the health and well-being impacts of nature amongst asylum seekers are needed. One way is through voluntary work in protected and outdoor recreational areas.

Fig. 1: Voluntary clearance work in winter (Source: Metsähallitus/ Rolf Graber)

Good deeds and meaningful activities

Launched in Oulu, the ESIKOTO project (2016-2018) is intended for asylum seekers living across Northern Ostrobothnia Region. The main aim of P&WF in ESIKOTO project is to involve asylum seekers in meaningful nature-based activities. As an advocate of voluntary work, P&WF sees engaging asylum seekers in voluntary conservation work as a win-win situation in nature-based integration.

In ESIKOTO project, asylum seekers helped to maintain hiking trails in some protected areas on a voluntary basis, as well as participated in biotope restauration in Natura 2000 areas. This type of work helps asylum seekers learn about nature and the Finnish outdoor culture, allowing them to spend time with local people and feel that they do meaningful work.

Activation for well-being

The pre-integration period is currently not utilized effectively and the asylum seekers participate little in society. For Finnish people, a diverse and clean natural environment is not only an important place for leisure activities but also a crucial part of their culture and livelihoods. In the ESIKOTO project, P&WF will identify effective ways to utilize the natural environment as part of pre-integration. Best-performing practices will be collected to create a tool for use by professionals. An information package about the Finnish nature will also be developed for asylum seekers. The project activities are organised in close cooperation with the voluntary sector.

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“Biodiversity and health”: an ambitious Austrian project brings it together

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The initiative “Biodiversity and health” led by Umweltdachverband (Austrian NGO, environmental umbrella organization) in cooperation with several partners started in 2012. Aim of the Austrian project is to raise awareness for the benefits of biodiversity resp. nature for human health and well-being. Another objective is to bring together the various stakeholders across all relevant sectors in order to enable mutual regard for their interests and to integrate biodiversity conservation in other sectoral policies.

Fig. 1: Title frame of the video clip – Translation: “Biodiversity. The diversity of life (Source: Perez Ramerstorfer Studio)

Establishing a platform

A **“biodiversity and health” forum** was established in 2015 as a cross-sector platform. It consists of stakeholders of various fields such as science, nature conservation, health, medicine, psychology, education as well as representatives from authorities. The forum meets annually and discusses key measures and priorities for cross-sector collaboration. As an outcome, an **action plan** has been drafted with active support of the Austrian Federal Ministry of Agriculture, Forestry, Environment and Water Management (BMLFUW). It includes recommendations for measures relating to the promotion of biodiversity conservation linked to its various benefits for the health sector as well as other parts of society.

Get people engaged: Short video and book

Another important part of the project is to inform the general public on the topic in order to encourage as many people as possible to include actions for biodiversity conservation in their daily life. This was realized by producing an animated **short video** that explains biodiversity and its benefits for human health and well-being (https://www.youtube.com/watch?v=oZrcDh2NA4s) and by publishing the **book** “Good for you and me. How Biodiversity promotes our health.”

“Biodiversity and health III” is a project that is funded within the campaign vielfalt**leben** by the Austrian Ministry of Environment and the European Union.

References

Falter Verlag (eds.) (2017): Gut für dich und mich. Wie Biodiversität unsere Gesundheit fördert. Wien, 112 S.

Umweltdachverband GmbH (2015): Biodiversität & Gesundheit - Biologische Vielfalt erhalten heißt Gesundheit schützen. Wien, 48 S.

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The emerging need for a European OneHealth/EcoHealth Community of Practice.

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In October 2016 the European OneHealth/EcoHealth (OH/EH) workshop (http://www.biodiversity.be/health/58) aimed at facilitating reflection, exchange, mapping future avenues and supporting collaboration of working on the linkages of biodiversity and human health, or linkages within a OH framework. Given the similarities in their objectives of creating synergies between health benefits for humans, animals and the environment, One Health and EcoHealth (OH/EC) concepts appeared to be supported by converging communities, working towards a shift from narrow and restricted framings towards systems approaches.

Fig. 1: Header of the European OneHealth / EcoHealth Workshop (6-7 October 2016, in Brussels). (Source: Belgian Community of Practice Biodiversity & Health - Belgian Biodiversity Platform)

The general objective of the workshop was to build bridges between OH/EC and related concepts and communities that endeavour to combine ecosystem, animal and human health, and to build bridges between science, policy and practice active in the domain of nature and health. Elaborating from the workshop it was suggested that a European Community of Practice could be initiated which can support and nourish several concrete networking initiatives that emerged from the different workshop sessions as well as existing initiatives. Some concrete examples of such emerging initiatives are:

- A network on transdisciplinary One Health education.
- A network implementing inputs from social sciences in One Health/EcoHealth actions and networks
- A network directed to translate research findings on the Environment-Microbiome-Health axis into policy making, with a view to make healthy ecosystems a cost-effective disease prevention healthcare strategy.

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Impact of nature on mental health disorders in Belgium: the NAMED project

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Introduction

Mental illnesses are a growing problem in modern societies (World Health Organization, 2016). While the impact of demographic or socioeconomic factors on these pathologies is acknowledged (Alonso et al., 2004; Merikangas et al., 2010; Regier et al., 1993), the interaction with urbanised environment is little understood (Hartig et al., 2014). This recently launched study (NAMED) intends to investigate the impact of the (non-)built environment on mental health in Belgium, one of the most urbanized countries in Europe.

Methods

Methods will combine quantitative and qualitative research and focus on the country capital Brussels. First, an epidemiological study will be carried out based on the coupling between data from the national health surveys and specifically developed indicators describing each participant's surroundings in terms of (non-)built environment, quality of air and noise. Second, civil society, stakeholders and local or scientific experts will be consulted by means of multiple case studies, focus groups and extended peer evaluation.

Results

Expected results are numerous. Quantitative and qualitative approaches will complement each other in order to better understand the impact of urban environment on mental health and the multiple underlying determinants involved at the individual level (age, gender, education, income, cultural, lifestyle, stress, social network factors, etc.) or environmental one (type, quality, aesthetic, accessibility, safety, labelling, etc.). This research will be more generally informative on the question of the health/environmental injustice/equity.

Conclusion

By gathering experts in social, geographical, medical and epidemiology sciences, this project intends to get a comprehensive overview of the impact of the (non-)built environment on mental health. Conclusions will be relevant for a wide audience and will have various impacts for society. They will notably permit to inform decision makers and suggest concrete, evidence-based actions significant for public health, urban planning and management of nature.

References

Alonso, J., Angermeyer, M.C., Bernert, S., Bruffaerts, R., Brugha, T.S., Bryson, H., de Girolamo, G., de Graaf, R., Demyttenaere, K., Gasquet, I., et al., (2004): Prevalence of mental disorders in Europe: results from the European Study of the Epidemiology of Mental Disorders (ESEMeD) project. Acta Psychiatr. Scand 109: 21–27.

Hartig, T., Mitchell, R., de Vries, S., and Frumkin, H. (2014): Nature and health. Annu. Rev. Public Health 35: 207–228.

Merikangas, K.R., He, J., Burstein, M., Swanson, S.A., Avenevoli, S., Cui, L., Benjet, C., Georgiades, K., and Swendsen, J. (2010): Lifetime Prevalence of Mental Disorders in U.S. Adolescents: Results from the National Comorbidity Survey Replication–Adolescent Supplement (NCS-A). J. Am. Acad. Child Adolesc. Psychiatry 49: 980–989.

Regier, D.A., Farmer, M.E., Rae, D.S., Myers, J.K., Kramer, M., Robins, L.N., George, L.K., Karno, M., and Locke, B.Z. (1993): One-month prevalence of mental disorders in the United States and sociodemographic characteristics: the Epidemiologic Catchment Area study. Acta Psychiatr. Scand. 88: 35–47.

World Health Organization (2016): Mental disorders l Fact sheet.

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Nature in primary health care. How better integrating knowledge on nature-health link in primary health care?

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The Department of Primary and Interdisciplinary Care – University of Antwerp and the Agency for Sustainable Environment and Nature Policy – Province of Antwerp, are investigating **how primary health care practice and natural environment can be better connected**.

We focus on knowledge about nature – human health linkages as it gains more and more attention in international scientific and policy arenas. We focus on the potential for primary health care because in the organization of health care, primary care is a vital backbone for linking knowledge and practice.

Scoping – project Green Light (2016 - 2018)

The project Green Light entails several activities, resulting in an **integrated agenda for future research and practice**; (1) scientific literature scoping review, (2) opportunities and constraints relevant for the broader topic of the project (discussed with stakeholders), (3) available data on nature and health & well-being, (4) roadmap with recommendations for practice relevant research, (5) communication of the outcomes of the project.

We work towards an integrated approach, in a science-practice-policy and inter- and transdisciplinary network.

Implementation - Chair Health Care & Natural Environment (2019 - 2021)

The Chair will focus on **research, education and networking**.

The research project will be built on the results of the project Green Light. Activities: (1) literature reviews on translating general and specialist knowledge to practice, (2) action research in a primary health care setting (pilots), (3) set up of a knowledge center Health Care & Natural Environment.

We will also be investing in education and service provision to society: (1) courses for students and professionals, in primary health care and nature, and (2) an (international) Summer School.

Finally we aim to strengthen the network built during the project Green Light; the local network as well as the connection to the international network (the European One-Health/Ecohealth Community of Practice).

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#DokterBos #DoctorWoods - a SocialMedia campaign to raise awareness on the impact of nature, forest and green on public health and well-being (Flanders, Belgium)

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#DokterBos (#DoctorWoods) is a social media campaign by the Flemish (Belgian) environmental NGO BOS+. Through postings on Twitter, Facebook and our website www.bosplus.be we raise public awareness on the positive impact of (urban) green, forest and nature in people's health and well-being. We bring news stories, facts and summaries of research output in a temptative way for the general public. Through the campaign we also bring the theme (higher) on the political agenda, and on the agenda of other sectors and actors (including the medical sector).

In the presentation we bring the story of the campaign, and we show the #DoctorWoods infograph.

Link

www.bosplus.be/dokter-bos

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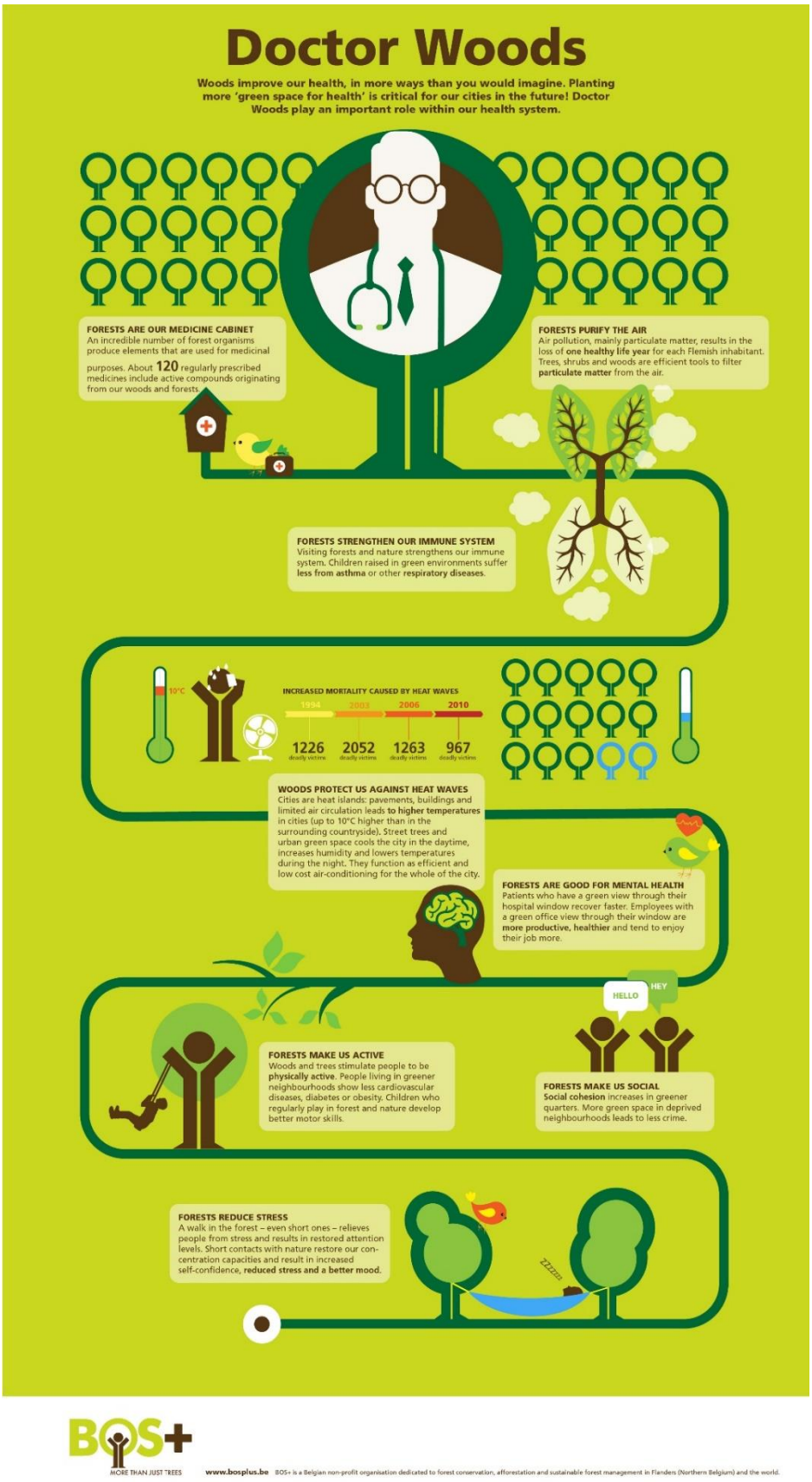

Fig. 1: DoctorWoods infograph (Source: © BOS+)

Practical and accessible environmental education for all: a national priority in Estonia

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The poster presentation focuses on different possibilities to go outdoors in Estonia: hiking trails, nature centres, educational programmes and financing of this cooperation network.

The network of nature centres and hiking trails

In Estonia there are more than 100 nature centres that provide curriculum based environmental education programmes for students. Every year more than 70% of students of general education attend these outdoor programmes. The programmes are financed by national funds via simple applying system.

State Forest Management Centre of Estonia provides opportunities for hiking. There are 309 campfire spots, 214 nature trails, 60 campsites, 40 forest huts. Long distance hiking trails take the visitor from one side of the country to the other- the longest trail is more than 800 km. The number of visits outdoors has doubled within the last 5 years. In 2016, there were 2,3 million visits to hiking trails and other recreational objects.

From the past to the future

The poster introduces the timeline since establishing the first protected area in 1910 through the Soviet occupation to nowadays, where the country is part of EU. Estonian state policy is based on the strategy Sustainable Estonia 21.The key words of the strategy are ecological balance, coherent society, vitality of the Estonian cultural space, growth of welfare.

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Urban Biodiversity in the Context of the UN Sustainable Development Goals (SDGs): The City of Bonn and its peri-urban area as a Case Study

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The German biodiversity network Bonn (BION) conducts a "Local assessment of ecosystem services and biodiversity in the Bonn urban area: a pilot study on the implementation of the Sustainable Development Goals". The aim is to identify status and trends of biodiversity and ecosystem services in the City of Bonn and its peri-urban area as well as potential qualitative and quantitative indicators. We are also looking into the region as a socio-ecological system, attempting to identify challenges such as climate change and aspects of well-being and future urban planning.

Therefore, we are compiling biodiversity data from a wide range of distinct sources and organise them into a fully referenced data base as a basis for a spatially and temporally assessment of biodiversity and ecosystem services. So far, 108 data sets from 43 sources in 32 institutions have been gathered. A standardisation of data sets was not given which poses one major challenge.

Sustainable Development Goals

Few indicators of SDGs 6 (clean water), 11 (sustainable cities), 13 (climate), and 15 (life on land) matched indicators of our data sets. We used those data to exemplarily visualise individual targets of the SDGs in the Bonn/Rhein-Sieg region on maps and analysed them with regard to their application in urban areas. By generating maps on land use, air pollution and biodiversity it was evident, that besides conformity with the targets also gaps between the often very general descriptions of the SDG indicators and the corresponding very detailed datasets in our project exist. Thus, crucial aspects of urban nature, biodiversity and ecosystem services cannot be easily linked with the SDGs, especially aspects regarding to health and well-being.

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Using ‘perspectives on nature’ to find a common agenda for biodiversity, climate change and health

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Halting biodiversity loss is an important and persistent problem. Taking the variety of people’s perspectives on nature into account could increase their level of engagement and that of businesses, and could make policies on nature, climate adaptation and health more effective. It may tap into a completely new reservoir of possible solutions and lead to coalitions of citizens, businesses and public institutions.

Four perspectives on the future of nature

For the report ‘European nature in the plural – Finding common ground for a next policy agenda’, researchers developed scenarios representing four main perspectives on nature. In each perspective, people connect with nature in different ways:

- Allowing Nature to Find its Way – for its intrinsic value;
- Working with Nature – as an essential basis for a sustainable society;
- Strengthening Cultural Identity – through love for the local landscape;
- Going with the Economic Flow – for its contribution to individual lifestyles.

The perspectives have been elaborated in storylines, maps, videos and artist impressions (Fig. 1)

Accessible nature at the doorstep and nature-based solutions

Combinations of perspectives can be explored, linking caring for nature with other societal goals, such as human health improvement and climate change adaptation. The four perspectives include spatial strategies that increase the amount of accessible nature at the doorstep and introduce nature-based solutions. Coalitions of various actors, such as private citizens, real-estate developers, healthcare professionals, water managers, spatial planners and researchers can use these strategies to tackle urban challenges. The composition of such coalitions may vary, depending on circumstances and the strategy pursued.

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Fig. 1: Artist impressions of four perspectives on a city park in 2050
(Source: PBL)

Estimating the access to urban green space on household level in German cities

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Access to urban green spaces (UGS) is a key contributor for human well-being and health in urban environments. So far, investigations measuring the provision of UGS on household level in Germany are missing. We analyse the provision of UGS by merging geo-coded household data from the German Socio-Economic Panel (GSOEP) and German Census Data (GCD) with land use from the European Urban Atlas (EUA) which are available for 53 German cities with more than 100,000 inhabitants. The GSOEP is a representative panel study of German households including geographical location of the households. The GCD provides small scale population data on 1 ha grid cell level for all German cities. Based on open green space standards applied in European urban city planning we define two variables measuring access to UGS: a) Distance to UGS measured as the Euclidean distance between the household and the nearest UGS in m and b) Per capita UGS availability in m². Around 93% of the German population has access to green space within a 500 m around the place of residence. Results of the distance analysis based on the GCD show a median distance to green space of 182.9 and (mean=221.3 m) and 8.1 m² per capita green space availability as a median (mean=22.3 m²). We further identify disparities in urban green space provision across the city sample and an unequal distribution of urban green within cities. Heterogeneity analysis of the socio-economic background shows differences in UGS access depending on the socio-economic background. We found considerable differences indicating that households with higher income have better access to UGS. Results can be used to inform urban policy and planning to ensure an adequate UGS provision which encourages the well-being of urban dwellers.

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Effects of Tree Species Richness on Fascination and Coherence

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Urban nature positively affects psychological restoration. Species rich urban nature is beneficial for both ecosystem health and psychological well-being. The latter may be explained by species richness increasing fascination. However, species richness may deteriorate the restoration component coherence, since it reduces the number of repeated elements and uniformity of texture. An approach to simultaneously provide fascination and coherence may be to establish various, similar-looking tree species in cities. In order to test this hypothesis, a laboratory study was conducted. Participants from the city of Dresden (n = 110) evaluated fascination and coherence of computer-generated green space images. Each participant was randomly assigned to evaluate one out of ten images. Five images showed green spaces covered with a single tree species and five images showed green spaces covered with various, similar-looking tree species. Mann-Whitney U-tests revealed no differences in fascination and coherence between the two participant groups. This suggests that tree species richness in urban green spaces can be increased without decreasing restorativeness. Increasing species richness in cities would contribute to ecosystem health, as it enhances resilience of urban trees to pests and diseases. The finding that the most fascinating green space was covered with a single species which was characterised by an irregular crown architecture suggests that the latter is more important regarding fascination than species richness. Thus, tree selection and management that promotes development of irregular crown architectures may increase fascination. However, this approach may come at the price of coherence and road safety. Further research could investigate the effects of other green space features on restorativeness, for instance variation in tree size within stand or management regimes. Additionally, blood pressure, heart rate, or attention test performance could be used as restoration indicators. Applied in urban landscape planning, findings may contribute to increase residential satisfaction and well-being.

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Links between Contact with Nature, Environmental Literacy, Pro-Environmental Attitudes, Pro-Environmental Behaviours and Well-being.

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With humans now being considered an urban species (Kuo, 2011) and the shift towards life in the indoors, children are more likely to have virtual rather than direct nature experiences, leading to human estrangement from nature. The lack of opportunities for direct contact with nature in urban areas - "nature deficit disorder" (Louv, 2008) - has profound influences on all aspects of children's well-being. Additionally, with one's attitudes towards environmental degradation being influenced by his/her experience with nature as a child (Wells and Lekies, 2006); "extinction of experience" (Pyle, 1993) can be considered as a fundamental obstacle towards addressing global environmental challenges (Soga et al., 2016).

It was suggested that play in natural landscapes triggers both nature literacy and intimacy with nature, thus concern and desire to conserve (Pyle, 2002). However, it remains uncertain whether and if so, how contact with nature and in particular different biodiversity levels can influence nature literacy, environmental attitudes and behaviours but also child well-being. How do different types of nature experiences and forms of environmental learning influence environmental knowledge, attitudes and behaviours? How does biodiversity influence the role of contact with nature for children's development and in particular affection towards nature and environmental values? Does biodiversity influence one's place attachment, if so, how does this influence environmental attitudes and behaviours? Do pro-environmental attitudes and behaviours enhance children's well-being directly? How does culture influence such relationships?

Given the current environmental pressures, the global biodiversity crisis and the worsening of child well-being, there is a high need and urgency to address such knowledge gaps. Through an ecological approach towards well-being, I will illustrate how I aim to address such research gaps through a comparative study between Scotland and Cyprus.

References:

Kuo, F.E., 2011. Parks and Other Green Environments: 'Essential Components of a Healthy Human Habitat'. *Australasian Parks and Leisure*, 14(1), pp. 10.

Louv, R., 2008. *Last child in the woods: Saving our children from nature-deficit disorder*. New York: Algonquin Books.

Pyle, R.M., 1993. *The Thunder Tree: Lessons From an Urban Wildland*. Boston: Houghton Mifflin.

Pyle, R.M., 2002. Eden in a vacant lot: special places, species, and kids in the neighborhood of life. In: Kahn, P.H., Jr. and Kellert, S.R., eds 2002*. Children and Nature: Psychological, Sociocultural, and Evolutionary Investigations*. London: MIT Press. pp. 305–327.

Soga, M., Gaston, K.J., Yamaura, Y., Kurisu, K. and Hanaki, K., 2016. Both Direct and Vicarious Experiences of Nature Affect Children's Willingness to Conserve Biodiversity. *International journal of environmental research and public health*, 13(6), pp. 529.

Wells, N.M., and Lekies, K.S., 2006. Nature and the Life Course: Pathways from Childhood Nature Experiences to Adult Environmentalism. *Children, Youth and Environments,* 16(1), pp.1-24.

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Subjective perception of noise exposure in relation to urban green space availability

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Noise pollution has been recognized as one of major threats to health and well-being of urban residents. Increasing green space availability can create natural buffer to adverse effects of living in cities. These positive effects of urban green space can be directly related to objective reduction of noise levels or – indirectly – to subjective perception of noise exposure. In our study we explored relationship between objective noise levels and a subjective perception of noise exposure (annoyance) by urban residents in relation to urban green space availability. We found out that direct effect of objectively measured noise levels, education, presence of noisy neighbours and building characteristics were the most important variables influencing self-reported perception of noise by inhabitants of Lodz. Captured indirect effect of green space availability was not very strong, yet statistically significant. We used spatial probit model to differentiate often neglected in literature association between objective and subjective noise indicators. Results might specify type of noise perception – green space availability relationship, which is mostly psychological and therefore might be more difficult to describe in a quantitative way.

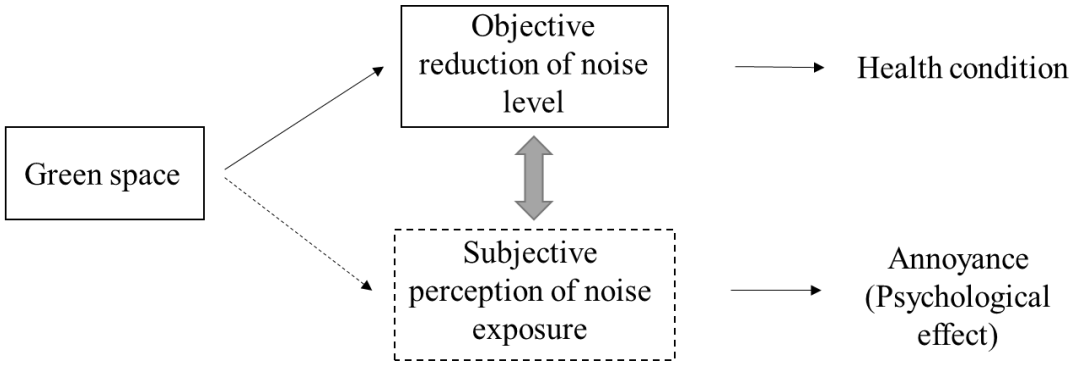

Fig. 1: Objective (direct) and subjective (indirect) effects of green space on noise (Source: Own elaboration)

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Wetlands' impact on mental well-being – a case study from Uganda

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Wetlands, like swamps, shore zones, etc. provide livelihood for subsistence farmers in East Africa. Due to high population growth and rapid development of these regions, these ecosystems are often degrading. Wetlands need to be protected and their tangible and intangible values determined. This study aims to gain evidence on the healing character of an inland wetland for locals in Uganda.

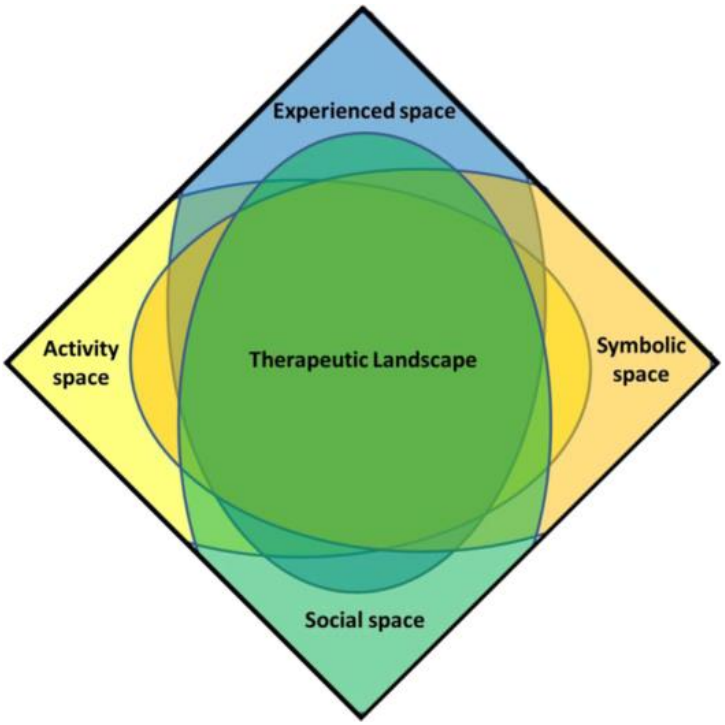

Fig. 1: Dimensions of a therapeutic landscape
(Source: Völker & Kistemann 2015)

Personal experiences, social fabrics onsite, as well as activities in space create an individual perspective of a landscape. The wetland was regarded as multi-dimensional therapeutic landscape (Völker & Kistemann, 2015) and the activity, experienced, symbolic and social space were brought together with local people's mental well-being.

A Ugandan wetland was investigated regarding its therapeutic character and its influence on mental well-being of the residents. Qualitative and quantitative data were combined in a mixed-methods approach (survey n=235; group interviews n=48; semi-structured interviews with key informants n=7). Wetland-attributed associations were analysed as well as the historical development of a sense of the wetland was established.

The results show, that the wetland provoked feelings of pleasure and displeasure. Due to its provisioning and cultural ecosystem services, the residents felt deeply attached to the landscape. The availability of water and food from the wetland made them calm and happy. In

contrast, the wetland caused tense regarding the social fabric and land distribution. Additionally, the wetland has changed its symbolic meaning and became more attractive over time.

Wetlands are perceived through their symbolic character and as activity space. Understanding the influence of wetlands on mental well-being requires the consideration of local definitions of well-being as well as the social-cultural and historical context. These aspects trigger wetland-attributed emotions and further the acceptance as well as motivation of locals to protect these ecosystems.

References

Völker, S. & Kistemann, T. (2015), Developing the urban blue: Comparative health responses to blue and green urban open spaces in Germany. Health & Place 35, 196-205.

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The benefits of urban medicinal gardens for human health

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Traditionally medicinal plants are seen as provisioning ecosystem services for phytopharmaceuticals or semi-synthetic medicines and play an important role in disease treatment and health promotion. However with increasing urbanization, economic, environmental and societal changes, as well as broader understanding of the concept of human health (as a total state of physical, mental and social well-being), medicinal plants tend to play a much bigger role in urban societies.

Our study analysed where medicinal plants can be found in urban green environments and what benefits they provide for human health. It was carried out using literature search, visits to the relevant sites, organising meetings with professionals working in the field, representatives from the competent authorities, following the activities of nature organisations, practitioners, creative artists and ecologists working in cultivation, foraging, use and protection of medicinal plants.

The study results showed that wild and cultivated medicinal plants are largely present in public green spaces and specifically designed private, collective, school, university, museum and library gardens as well as city farms. Besides well-known provisionary and regulating services, medicinal plants gardens contribute largely to the development of cultural ecosystem services. They very often serve as spaces for garden therapy, mental relaxation, physical activity and social integration for immigrant communities. School gardens are used as tools for an integrated, child centred, ethnobotanical and environment-based education. Medicinal plants are used in transdisciplinary and urban greening projects to create therapeutic landscapes and healthy built environments in order to improve mental health and social well-being.

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Introduced Medicinal (aromatic) Plant Diversity Enhancement and Research Value to Human Lifestyle in Lithuania

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According to the Global Strategy for Plant Conservation adopted by the Convention on Biological Diversity the issue of enrichment of biological and medicinal (aromatic) plant diversity and their rational consumption for healthy lifestyle optimization is being debated.

In recent years a lot of attention has been paid towards growing of medicinal (aromatic) plants, creation of medicinal and aromatic gardens, and professional usage of raw material.

In seeking for the harmony of nature and human activity, introduction, researching and rational usage of medicinal plants receives a new quality.

A new scientific activity promoted the development of medicinal plant farming in rural areas, where United Nations Development Programme Global Environment Facility Small projects were carried on: Growing and Protection of Rare and Medicinal Plants in Babrungas, as an example of medicinal plant farming; A Farm of Medicinal Plants in Panara, as an example of environmentally friendly farming in Dzukija National park. The collections of medicinal plants, which are managed there, have cognitive-practical and scientific-educational value.

Introduction methodology and technology is applied in the research.

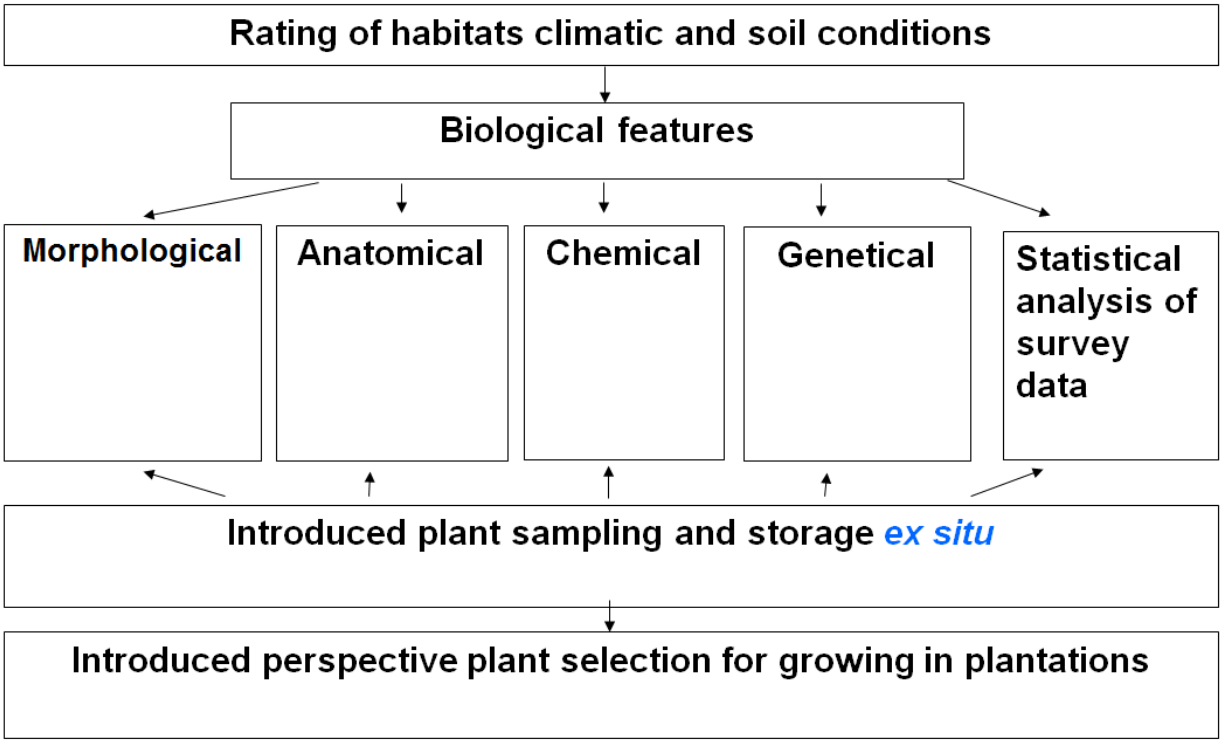

Fig. 1: Research methodology of medicinal (aromatic) plants. (Source: O.Ragažinskienė).

Object of the research

Perspective medicinal (aromatic) plants adapted to growing in Lithuanian climate conditions.

Aim of the research

The introduction of plants and selection of viable farming and restocking diversity, the creation of green spaces and revealing medicinal, spice (aromatic) plant diversity collections, cognitive importance of public education activities, personal natural sciences competences, respect to human health, operational safety and environmental interaction.

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Green Learning Environments for Children with Learning Disabilities

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Non-formal (and formal) learning in natural environments results in better learning outcomes, especially for children with learning disabilities. Outdoor learning enables physical activity and improved learning opportunities for those who learn through movement. Finally, contact with nature promotes physical health and improves mood.

We will present the project “Green Learning Environments” (funded by the Erasmus+ scheme) that is developing innovative educational materials and methods by collecting best practices throughout Europe and compiling them in a Toolbox. To collect knowhow from education as well as nature, the project consortium includes schools and green partners from the participating countries (UK, Belgium and Slovenia).

Results so far suggest that many of the current activities rely on the enthusiasm and dedication of the personnel who develop activities in the green environments, since materials and resources dedicated to green learning environments are scarce for the specific target audience. Simultaneously, programmes exist for regular students, and these programmes are adapted in cooperation to fit the needs of special needs children. Professionals developing materials for their audience are the keepers of important knowledge, which the project aims to compile. We have witnessed differences through different European countries in the readiness and availability in funding for this cause. Therefore, we call for a more concentrated approach and structural support for creating and facilitating programmes, and supporting children with learning disabilities in creating optimal learning possibilities in green learning environments.

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Leptospirosis and climate change

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Background. Leptospirosis is a bacterial zoonosis caused by pathogenic members of genus *Leptospira*. Wild and domestic animals can be infected but rodents are the main reservoirs and the most important source of infection for humans. Leptospires excreted with urine of infected animals can survive in the environment for several months if certain conditions of temperature and humidity are met. Aim of this study was to correlate climatic changes with population density of small rodents and incidence of leptospirosis in humans in Croatia.

Material and Methods. We compared archive data on incidence of human cases with rodent population density and average monthly precipitations and air temperatures in a period from 2009 to 2014. Small rodent population density was assessed using constant trapping sites. Data on the average monthly precipitation amounts and air temperatures were obtained from Meteorological and Hydrological institute of Croatia.

Results. Results revealed annual and seasonal variations of leptospirosis cases that were mainly influenced by weather conditions. During 2010 and especially 2014 higher average precipitation was correlated with significant increase in leptospirosis incidence (IR of 2.15 and 3.23 respectively). Strong and multifactorial link of climate conditions and rodent population was also noted.

Table 1. Data on leptospirosis incidence rate in humans, number of positive rodents and annual average of precipitation and temperature (Source: J. Habus et al. as well as Meteorological and Hydrological institute of Croatia)

YEAR	INCIDENCE RATE (IN HUMANS)	POSITIVE RODENTS (%)	PRECIPITATION	TEMPERATURE
2009	0,68	0	63,22	11,98
2010	2,15	16,7	95,95	10,87
2011	1,64	13,8	42,64	11,58
2012	0,84	4,5	64,33	12,13
2013	0,63	7,4	82,67	11,7
2014	3,23	25,4	105,5	12,49

Discussion. Climate extremes in 2014 were followed by increased rodent population density, high percentage of infected rodents and finally extremely high incidence of human leptospirosis. In January and February 2014 we had average temperature above 4.5°C compared to usual temperatures about or below the freezing point. Mild winter led to *reduced winter mortality of rodents*. Abundant rainfall and warm spring flushed vegetation growth resulted in high reproduction and increase in number of small mammals. Conditions for *Leptospira* survival in the environment were also favourable. All of these factors created high environmental burden and consequently extremely high leptospirosis incidence in humans. In conclusion, due to the climate change and global warming a further increase in leptospirosis incidence in humans can be expected.

Long-term dynamics of rodent species relevant to human health: Impact of climate, land-use and biodiversity

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Rodents are important reservoirs for zoonotic pathogens that cause severe zoonotic diseases in humans. Recent investigations revealed that factors like climate, land-use and small mammal biodiversity have the potential to mitigate the underlying transmission processes on various levels. While these factors are crucial to estimate potential future changes in human infection risks, they remain poorly understood.

The current project will therefore study the effect of biodiversity as well as the combined effect of climate and land-use on the population dynamics of rodent species relevant to human health. The latter are recorded in long-term time series (> 60 years), generated by various pest species monitoring programmes. Time series have greatly advanced the knowledge of potential effects of climate change on human infection risk. For example, under future climate scenarios we predict that high densities of the bank vole (*Myodes glareolus*), host of the Puumala hantavirus, will become more frequent due to bottom-up regulation of food availability. Years with high abundance of bank voles are always associated with a stark increase in human cases.

Biodiversity is hypothesized to be more closely related to pathogen prevalence on the population level, through direct mitigation of transmission rates. This will be investigated in a large field experiment where we quantify the relative impact of small mammal biodiversity on species specific as well as ubiqitary rodent-associated pathogens. As a result, this study will generate a better understanding of natural pathogen-host dynamics, allowing public health recommendations and policy advice for predicted future climate and biodiversity scenarios.

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Spatial modelling of malaria incidence in South Sumatra, Indonesia using Geographically Weighted Regression

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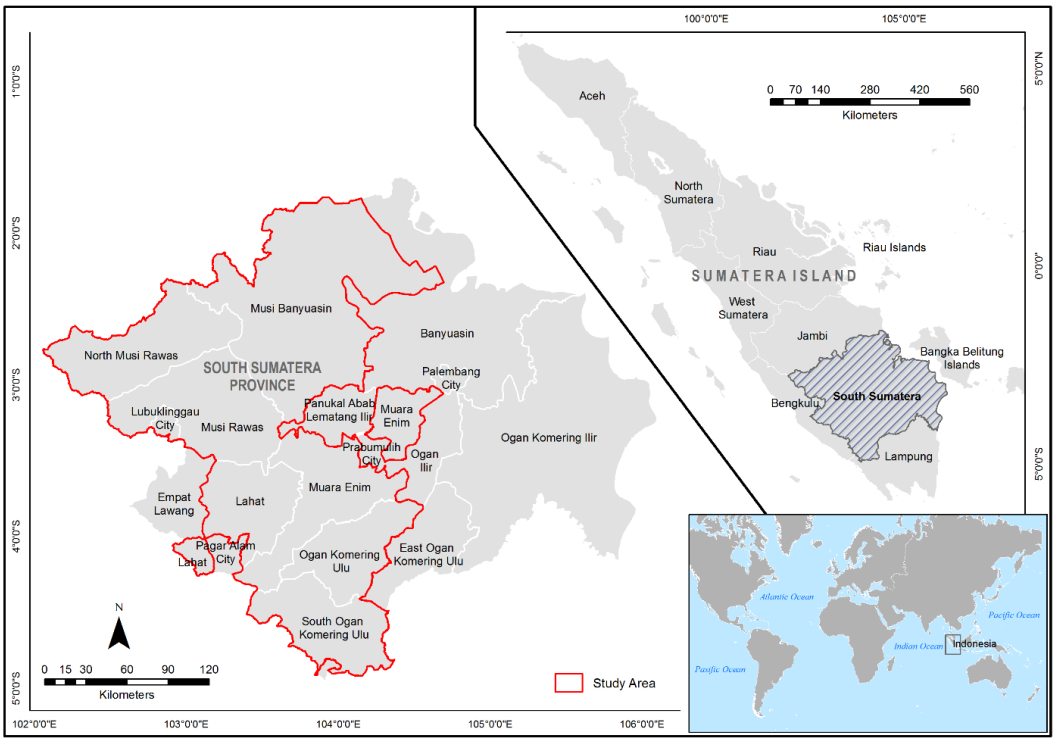

Fig. 1: The studies area (Source: The map derived from the Geospatial Information Agency (BIG)

Background

Malaria is still a major public health problem in some areas in South Sumatra Province, Indonesia. Since every region has different geographical conditions, the disease risk has been suspected to vary with geographic variation. The aim of this study is to identify environmental factors that influence the incidence of malaria. Modelling malaria incidences in relation to geographical influence could be used as a predictive tool and as such would provide an important tool for disease control.

Methods

In a spatial analysis, relationships between malaria incidence (Y) and six physical environmental factors (explanatory variables) were tested: altitude (X1), aspect (X2), the distance from the river (X3), the distance from lakes and ponds (X4), the distance from the forest (X5) and rainfall (X6).

Results

The distribution of malaria incidence in the study area varies in South Sumatra, Indonesia. In this study, the number of confirmed malaria cases reaches 3,578. The cases were spread over 436 villages.

The global regression model using OLS explains 5% variation in malaria incidences by physical environmental factors. The coefficient of determination (R^2) is 0.05. Prediction regression values remain constant because local variations are not taken into account in the model. The local regression model using GWR explains 60% variation in malaria incidences by physical environmental factors. The coefficient of determination (R^2) is 0.60.

The OLS (global regression) showed two conditions, that the rainfall and distance from the forest significantly influence malaria incidence. While the GWR (local regression) revealed that almost all independent variables are significant at certain locations at the village level.

Discussion

After rainfall, developing puddles can serve as mosquito breeding grounds for *Plasmodium falciparum and P. vivax* vectors(1.) In accordance, malaria incidence increased during the rainy season in Senegal(2.) Similarly, monthly total rainfall has a significant effect on the transmission of malaria in Ethiopia(3.)

In accordance to our study, malaria risk in East Africa is associated with households within close proximity to forest and swamp border(4), most probably due to better environmental conditions for malaria vectors. Highest malaria incidence was observed in the Lahat District which is covered by coffee, rubber and palm oil plantations and characterized by tropical climate with high moisture and frequent rainfall. The frequency of deforestation for plantations is high and many puddles are produced by mining industry.

Conclusions

Climate, along with many other factors, can affect infectious diseases, particularly with respect to malaria transmission. The effect of environmental factors on the incidence of malaria varies with locally associated geographical elements as has been shown here for South Sumatra.

The ability of the GWR model explains the contribution of the explanatory variables to the response variable by 60%. This understanding can help, not only for malaria elimination but may also be useful for developing sustainable programmes for malaria control.

References

(1) Hasyim H, Camelia A, Fajar NA. Determinant of Malaria in the Endemic Areas of South Sumatera Province. *Kesmas: National Public Health Journal* 2014; 8: 291-4.

(2) Ndiath MM, Cisse B, Ndiaye JL, et al., Application of geographically-weighted regression analysis to assess risk factors for malaria hotspots in Keur Soce health and demographic surveillance site. *Malaria Journal* 2015; 14(1): 463.

(3) Alemu A, Abebe G, Tsegaye W, Golassa L. Climatic variables and malaria transmission dynamics in Jimma town, South West Ethiopia. *Parasites & Vectors* 2011; 4(1): 1-11.

(4) Ernst KC, Lindblade KA, Koech D, et al., Environmental, socio-demographic and behavioural determinants of malaria risk in the western Kenyan highlands: a case–control study. *Tropical Medicine & International Health* 2009; 14(10): 1258-65.

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Ragweed allergy in Leipzig

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Background: There is a spread of ragweed plants in Germany but little is known about its clinical relevance (hay fever, asthma). We aimed at investigating sensitization rates against ragweed and its clinical relevance.

Methods: Subjects from LIFE Health Care Study (population based group, 40-79 years) underwent skin prick test (SPT) with inhalative allergens (ALK-Abello, Deutschland). 70 subjects with positive SPT to ragweed had a follow-up investigation with nasal provocation (NP), specific IgE for mugwort/ragweed (Phadia-ThermoFisher).

Results: 5750 subjects with valid SPT (51% female; 64% of 8979 subjects included) showed the following sensitizations: Birch 15.1%, grass 13.1%, mugwort 9.0%, ragweed 3.5%. Ragweed sensitization was most frequently seen in 40-49 years old (4.5% [confidence intervall 3.7-5.6]), was 3.0% in group of 50-59 years [2.3-4.1], 3.0% [2.2-4.0] in 60-69 and 3.1% [2.3-4.3] in 70-79 years old. At follow up, 53/70 (75.7%) were sensitized against mugwort (cosenisitzation mugwort/ragweed n=51/59 (86.4%)). Specific IgE investigations gave the following sensitization rates: A.artemisiifolia: 36/58 (62,1%), Mugwort: 37/58 (63,8%); Amb a 1: 3/58 (5,1%), Art v 1: 18/58 (31%), Art v 3: 6/58 (10,3%); sIgE Mugwort/ragweed: 31/36 (86,1%). NP was positive in 21/70 (30.0%).

Discussion: Age dependent sensitization rates were lower than reported from German Health Study of Adults (DEGS; 8.2%) which also included adults below 40. Cosensitization of ragweed and mugwort was very frequent. In every third subject with ragweed sensitization we found clinical relevance at NP. Follow-up investigations ask for any changes in sensitization rates over time. Also, ragweed pollen monitoring starts in Leipzig this year.

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Current and future areas at risk for autochthonous transmission of Aedes associated arboviruses in Germany

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The ongoing global spread of the Asian tiger mosquito *Aedes albopictus* leads to an increasing health risk for the human population and a loss of diversity of mosquito species which have not shown disease vector competence up to now. In Europe, Germany is currently at the invasion front. If the climatic conditions for the establishment of the mosquito as well as the transmission of diseases are fulfilled, autochthonous infections in Germany can no longer be excluded. Hence, areas at risk of vector establishment and disease transmission need to be identified to support monitoring and surveillance measures.

Material and Methods

We applied correlative species distribution models to assess the current and near future climatic suitability for *Ae. albopictus* in Germany. We further analysed the incidences of Dengue and Chikungunya in Germany between 2011 and 2015. Based on both information we developed risk classes for the autochthonous transmission of Dengue and Chikungunya in Germany under current climatic conditions. Models were fitted using European occurrence records and bioclimatic variables taken from Worldclim (2.5 arcmin resolution). Model projections for Germany were done with Euro-LST satellite data with 250 m resolution.

Results

Mainly, three areas within Germany could be identified as being currently climatically suitable for *Ae. albopictus*: parts of Baden-Württemberg, Saarland and North Rhine-Westphalia. Future projections indicate a massively increasing suitability in Germany. The highest disease incidences are mainly located in larger cities as well as in the surrounding counties. Hence, the currently highest risk of autochthonous disease transmission appears in Baden-Württemberg and Nordrhine-Westphalia. With the projected increase in suitable areas, the vast establishment of the vector becomes more likely in the near future, therewith increasing the risk of autochthonous virus transmissions.

Current and future areas at risk of *Aedes albopictus* establishment are highlighted. Based on this together with the recent incidences of Dengue and Chikungunya areas for monitoring and surveillance in Germany can be identified to support public health authorities with climate and climate change based information.

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The Heat Health Warning System in Germany - Applications and Lessons learned

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Heat stress is a major risk factor for human health (Fig. 1). The German Heat Health Warning System (HHWS) was implemented after the heat summer 2003 to issue warnings of extreme heat stress situations for the general public and public health authorities (Matzarakis, 2017). In the context of climate change HHWS provide an important measure to reduce the expected increase in heat related mortality (Muthers et al., 2010). The HHWS combines the meteorological weather forecast with human-biometeorological approaches to estimate the heat stress for human beings. Therefore, the Perceived Temperature (PT, Staiger et al., 2012), which is based on the energy balance of the human body, is calculated up to 7 days in advance. A 12 UTC PT above ~32°C (38°C) classifies the day as a day with strong (extreme) heat stress. To allow for short term adaption within a summer the 32°C threshold is not fixed but varies depending on the thermal conditions of the previous 30 days (Koppe and Jendritzky, 2005).

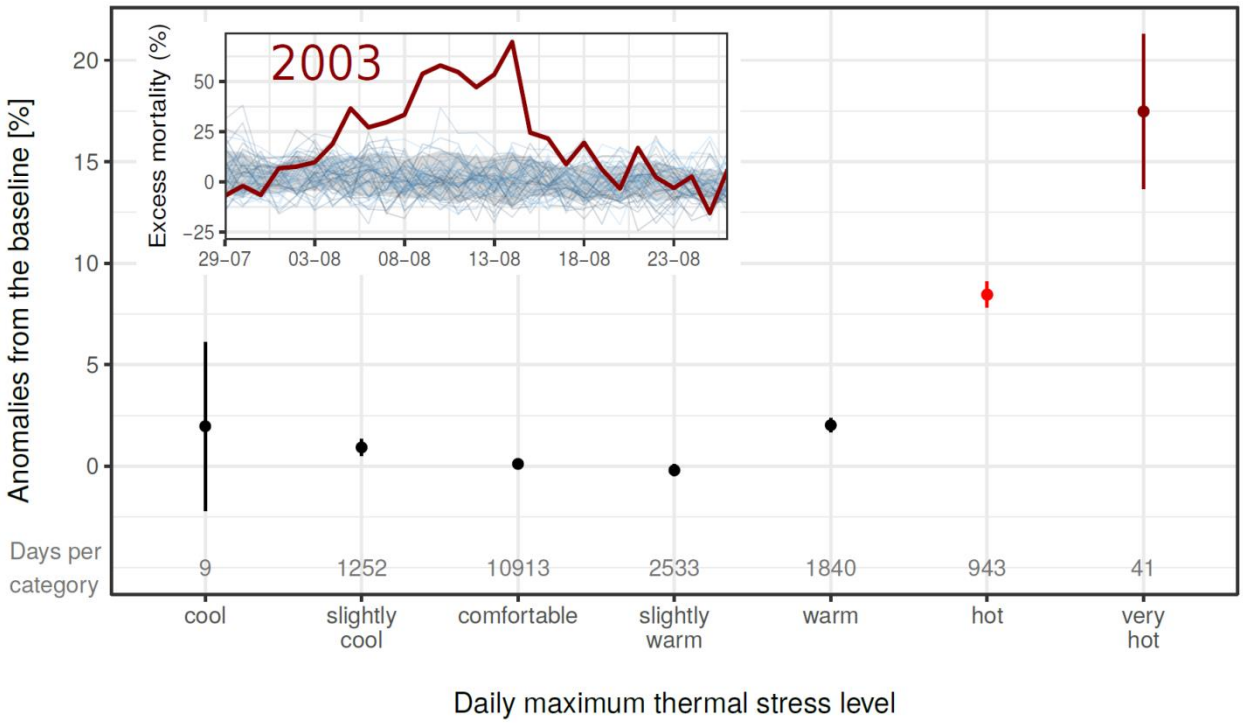

Fig. 1: Relationship between the daily maximum heat stress (Perceived Temperature) and mortality in Baden-Württemberg (South-West Germany) for the period 1968-2015. Subpanel: Mortality time series for Baden-Württemberg during the August 2003 heat wave. Thin lines and shading: Individual years and background variability 1968-2015. (Source: German Meterological Service)

Additionally, nocturnal conditions (recreation) are an important factor for the health impact of a heat wave. Therefore, a building simulation model is applied to calculate the nocturnal heat stress inside buildings (e.g., nursing homes). A warning is raised when the condition of at least strong heat stress during the day and warm indoor conditions are met for at least two consecutive days. New developments to the HHWS allow for a specific consideration of the elderly and of heat stress in urban areas due to the urban heat island effects.

References

Koppe, C. & Jendritzky, G. (2005) Inclusion of short-term adaptation to thermal stresses in a heat load warning procedure. Meteorol Z, 14(2), pp.271–278.

Matzarakis, A. (2017) The Heat Health Warning System of DWD - Concept and Lessons Learned. In: Karacostas Perspectives in Atmospheric Sciences. Springer Atmospheric Sciences, pp. 191-196.

Muthers, S., et al., (2010) Climate Change and Mortality in Vienna - A Human Biometeorological Analysis Based on Regional Climate Modeling. IJERPH, 7(7), pp. 2965–2977.

Staiger, H. et al., (2012) The perceived temperature – a versatile index for the assessment of the human thermal environment. Part A: scientific basics. Int. J. of Biomet., 56, pp. 165–176.

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INHERIT your future: changing lifestyles and behaviours in the areas of living, moving and consuming, to protect the environment and improve health for all

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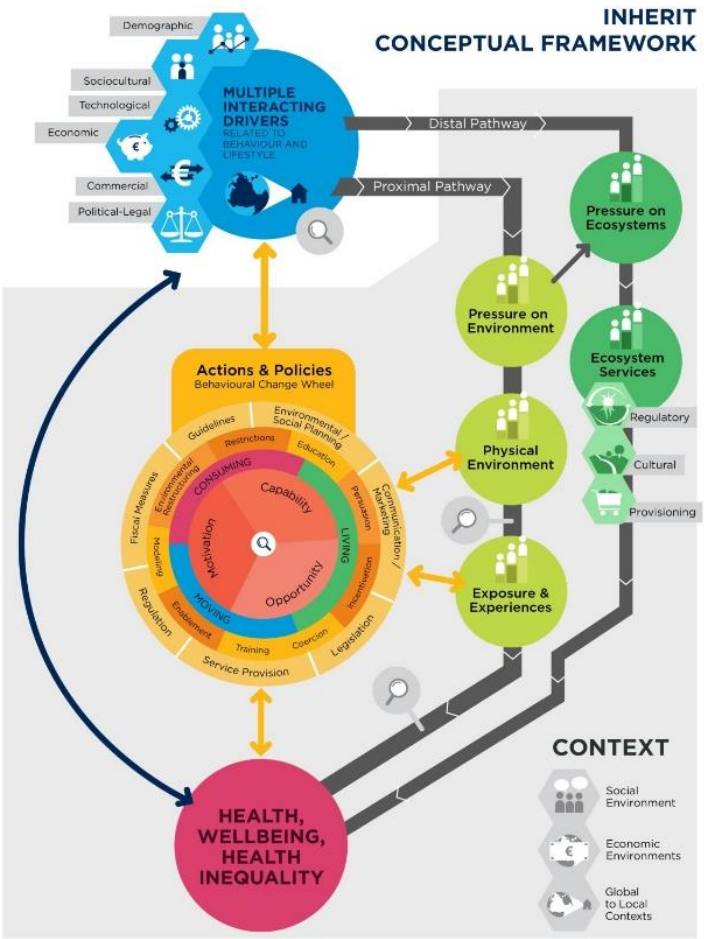

Fig. 1: INHERIT Model (Source: INHERIT Baseline Review)

INHERIT objectives

Current systems of production, transport and consumption in Europe are unsustainable, unhealthy, and contribute to persistent health inequalities. Our lifestyles and behaviours are shaped by and help to maintain these systems.

The INHERIT project (2016-2019) focuses on identifying policies, practices and innovations in the areas of living (green space, housing) moving (active transport) and consuming (food, food waste) that encourage people to adopt 'triple-win' behaviours. These are behaviours that simultaneously protect the environment, improve health and reduce health inequalities. The project, funded under the EU Horizon 2020 research programme, brings together 18 partners from across Europe and working across disciplines (public health, environment) and sectors (research, public, private) to contribute evidence, knowledge and tools to encourage change.

INHERIT activities and outcomes

To date, INHERIT has produced a baseline review with the existing evidence, including information on the INHERIT model that underpins the project. Promising policies, practices and innovation from across the EU that can deliver a 'triple-win' have been identified and will be available in a database on the INHERIT website. Partners are in the process of selecting 12 of these initiatives for further evaluation and possible adaptation and scale-up/transfer. In addition, a visioning and forecasting exercise has begun to identify future trends and possibilities. Through these and more activities, INHERIT will identify and encourage the uptake of effective measures to change behaviours for more sustainable societies.

References

Staaten, B., van der Vliet, N., Kruize., H. et al., (2017), Exploring triple-win solutions for living, moving and consuming that encourage individual behavior change, protect the environment, promote health and health equity. EuroHealthNet, Brussels

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Biocrust moss-dominated green roofs for a changing climate

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Green roofs have been increasingly required in urban areas due to the recognition of the services they provide which include improving urban aesthetics, improve thermal regulation, attenuate flash floods due to intensive rain events, and contribute to the reduction of the urban heat island effect. Furthermore, they contribute to biodiversity conservation, increase carbon sequestration improving air quality, buildings' soundproofing, increase roof durability, and lag spread of potential fires.

MedMossRoofs: Moss-dominated biocrust green roofs

In northern regions (e.g., Germany, The Netherlands, Canada), with colder and humid climates, green roofs have a lower cost maintenance when comparing to the Mediterranean area which is characterized by a hot climate with dry summers, and the use of classical green roofs requires high levels of irrigation due to survival reasons and/or aesthetic ones.

Therefore, looking at nature we found a solution that may overcome this problem: biological soil crusts (biocrusts). Biocrusts thrive in dry areas and are composed of a complex mosaic of microorganisms, lichens and mosses. These communities can photosynthesize when water is available, but under extreme drought, they cease their metabolism and remain under these conditions for long periods of time (months to years), resuming its normal activity after rain/dew events. Furthermore, mosses retain water, contributing to the attenuation of flood effects in urban centres. Therefore, biocrusts appear as an innovative solution to urban landscape since they do not have a root system, thereby reducing substrate thickness, decreasing installation costs and weight load on the structure on which they are applied, without using irrigation systems.

First preliminary results using the moss *Pleurochaete squarrosa* showed that this species has the potential to be used in green roofs (Brandão et al., 2017), recovering from completely dryness in a very short time and benefiting from periodic desiccation cycles (Fig. 1).

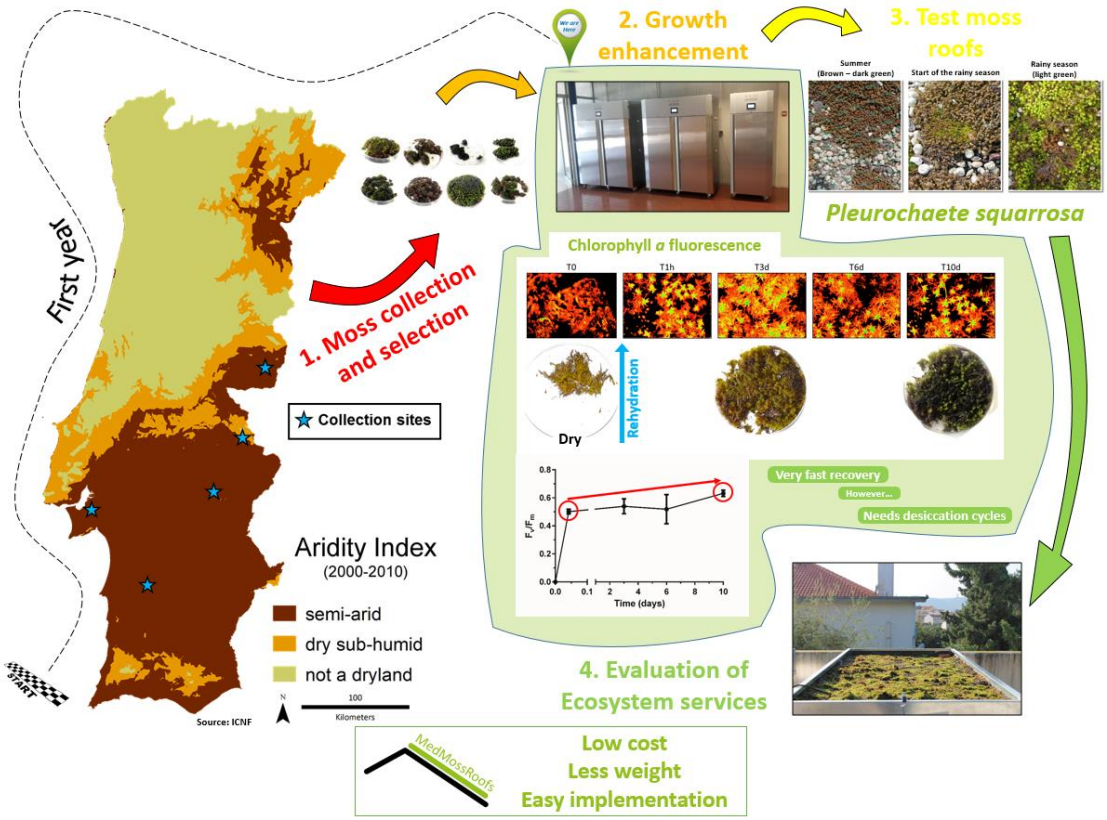

Fig. 1: MedMossRoofs - Biocrust moss-dominated green roofs (Biocrusts). (Source: Cruz de Carvalho et al.)

References

Brandão, C., Cameira, M.R., Valente, F., Cruz de Carvalho, R., Paço, T.A. (2017): Wet season hydrological performance of green roofs using native species under Mediterranean climate. Ecological Engineering 102, 596–611.

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Boosting our power to detect vulnerability to high temperatures

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Forecasting species Climatic Vulnerability (FCV) constitutes a central step for attaining Europe's horizon 2020 objectives facing climate warming. Up to now, mechanistic models that combine species' thermal tolerance thresholds with predictions of exposure of these species to future temperatures constitute the state of the art for FCV. Still, those models typically rely on a single combination of temperature and time of exposure that leads to population damage (e.g. instant damage whenever air temperatures go over species' critical thermal maximum, or around 2 months of daily exposures of at least 3h to air temperatures over preferred body temperatures to damage a population). However, there are myriads of combinations of time and temperature levels that can damage populations and are not accounted by those models. Here we show that using the thermal death time curve and the voluntary thermal maximum enhance our power to detect vulnerable populations to thermal damage. Apart from shedding light over previous debates on latitudinal gradients of species climatic vulnerability, our data also uncover a much worse climatic scenario for small ectothermic species than expected from traditional studies. We suggest including these parameters into monitoring programmes.

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Impacts of heat waves on health in Moscow and implications for the city green space development

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Moscow, with a population over 12 million people, has been suffering several heat waves. The most extreme one occurred in July-August 2010 with longevity of 44 consecutive days and 19 temperature record days. Total excess mortality during the wave was 11041 cases (from cerebrovascular, respiratory, and nervous system diseases) [1].

Green space imbalances are one of the reasons of such a negative impact. Moscow has 54% of territory occupied by green space, but it is concentrated in large parks and protected national areas. Good quality green space is located in parks and near-building territories, while green space in public gardens, avenues and territories along roads is of medium and poor quality. The average green space rate of 15 most populated Moscow sleeping areas is 62,1% (60,1 sq.meters per capita), while in the city center it is only 28,3% (24,4 sq.meters per capita), leading to the forming of heat islands.

Economic losses of the heat wave under consideration have been estimated between $3,2 billion and $4 billion or 1,2-1,6% of Moscow's GDP [2]. Current plans of Moscow's green space development to 2020 are insufficient and should be intensified.

References

1. Shaposhnikov D., Revich, B., Bellander T. et al., (2014) Heat Wave and Wildfire Air Pollution related Mortality in the Summer of 2010 in Moscow. Epidemiology, 25, 3:359-364.

2. Porfiriev B.N. (2013). Economic assessment of population loss in emergency situations. Questions of economics, Issue 1, pp. 48–68.

Acknowledgement

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ArboCityNet – A cross-sectoral and transdisciplinary Swiss Urban Forestry Network

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Urban forestry is confronted with many social and ecological interactions in and around cities. Thus, overcoming typical disciplinary and sectoral thinking may help to meet these challenges and promote transdisciplinary and inter-sectoral decision-making concerning green urban infrastructure.

Subsequently and in accordance with the European Forum on Urban Forestry (EFUF), a group of Swiss Research Institutes and associations (HAFL, ETH, WSL, ZHAW, HSR, hepia, Plante & Cité Suisse) with the support of the Swiss Federal Office for the Environment founded ArboCityNet in Berne in 2016.

The aim of the network is to bridge a) different research fields such as landscape architecture, arborists, forest engineers and social scientists, and b) research fields with expertise in cities, including political decision-makers and public servants. The founders and members of ArboCityNet come from different sectors and from different regions in Switzerland. The Network therefore helps to overcome typical language boundaries in the country and different constituent-state practices. On-going knowledge exchange is maintained via annual conferences and events.

We think that presenting ArboCityNet in a poster presentation at ECBCC will enable an exchange with experts working in the same domain. Moreover, we could contribute by serving an example of how such inter-sectoral cooperation can help to shape and inspire the green urban infrastructure in cities.

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Quantification of the effect of green spaces on heat stress – Application of micro scale models

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Introduction

In order to analyze urban climate and bioclimate several meteorological input parameters are required (air temperature, air humidity, wind conditions and radiation fluxes) and also thermo-physiological information (metabolism and clothing). All the known thermal indices, e.g. the Physiologically Equivalent Temperature (PET) require the same input parameters. In urban areas all the input parameters are modified, because of the different morphological characteristic and physical properties of the surfaces within a city. In this context the strongest modifications occur in the wind conditions and radiation fluxes. Radiation is modified mostly by the aspect ratio (height and width of streets or obstacles), orientation and physical properties (albedo, permeability and heat storage) and they have to be known for the estimation of the mean radiant temperature as well as short- and long wave radiation fluxes in general. In addition urban areas modify wind speed and direction because of increased roughness and distribution of obstacles. These two highly volatile and important factors modify the thermal comfort conditions strongly. They can be easily modified by urban planning and architectural measures at the micro scale.

Methods

Modelling can be performed by RayMan model, which can calculate mean radiant temperature and thermal indices (PMV, PET, SET*, UTCI and PT) for one point in an urban environment, or the SkyHelios model, doing spatial calculations. For the calculation of mean radiant temperature both models are able to calculate short and long wave radiation fluxes based on several methods of and spatial input, (e.g. fish eye photos, geometrical characteristics of obstacles, free- drawing) and can provide output of mean radiation temperature, shade, sunshine duration and thermal indices. In contrast to RayMan, SkyHelios allows for spatial calculations of thermal comfort conditions (PET, UTCI, PT) and several input and influencing parameters. Various common spatial data formats can be used as input for the SkyHelios model. Calculations can be performed spatially resolved in high resolution (e.g. 1 to 1 m).

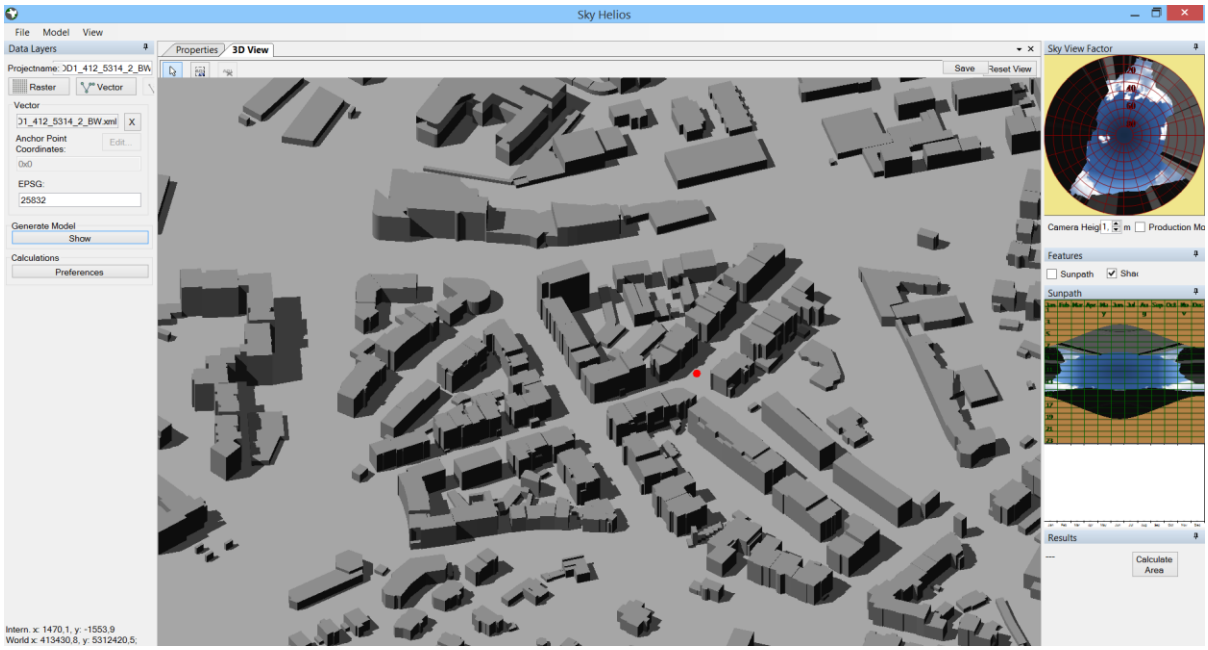

Fig. 1: Shading at 14:34 LST calculated for an excerpt of the City of Freiburg, represented by a CityGML building geometry model using the SkyHelios model. (Source: German Meterological Service).

Conclusion

Both, the RayMan and the SkyHelios model can be valuable tools quantifying the effect of green spaces on thermal perception and thermal stress. Both models are found to be sufficiently fast to calculate thermal conditions for various different settings (e.g. with and without urban green, or with different settings for an urban park) that can be compared afterwards. Additionally, both models are easy to use and support various input options further facilitating the application.

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What about Ourselves? Health as an Argument in climate-related Discussions on City Planning in Baden-Württemberg

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Several cities in Baden-Württemberg, like Stuttgart, Mannheim and Karlsruhe, have a history of discussions on city climate lasting for forty-five years already, including health issues. There are also plans describing how citizens might be protected against heatwaves, for example “HITWIS” in Stuttgart. Planners recognize climate change as stress factor and health risk for humans. Nevertheless, human health is just one factor discussed in practical planning, which is weighted against numerous requirements of daily routine and economic expectations.

In the course of investigations for our project “Urban Green – Fit for Future” (funded by the German Federal Environmental Foundation), we examined health as an argument in 57 land development plans from 13 cities in Baden-Württemberg. Therefore, we focused on regularly debated factors as air pollution and noise, on climate issues, and as a mediating factor, on urban green. Reactions on health issues seem largely restricted to limit further damage and to provide technical means of protection. Measures against air pollution and noise are limited to follow legal requirements. In case of air pollution, even this is difficult, due to a lack of technical measures. Climate as a health issue is, in spite of existing master plans, rarely explicitly discussed in land development plans. It is typically described as “bioclimatic stress”. Polluted air is circumscribed as “air hygiene” issue. Improving local climate is regularly named as a reason for green infrastructure planning. Nevertheless, it is rarely explicitly addressed that this has positive effects on human health.

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Combining ecological and life cycle assessment of urban projects, a way to support biodiversity conservation and climate change reduction

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Introduction

More and more urban planners are preconizing integration of green spaces in urban projects to take advantage of ecosystem services that nature can offer (regulation of heat islands, well-being, etc.). At the same time, many certifications and labels are created to promote and encourage green spaces and biodiversity in cities. Although those initiatives are welcomed, they are not sufficient: attention is generally paid only to in-situ actions based on means approach (versus performance approach). Meanwhile, the environmental performance of buildings are assessed by Life Cycle Assessment (LCA) methods (e.g. the future French building regulation). LCA allows to robustly assess global impacts, such as climate change, through a greenhouse gas (GHG) indicator. Nevertheless, LCA is not the most appropriate method to assess the impacts on biodiversity since the local specificities of the assessed system are poorly or not taken into account. Efforts have to be done in order to assess both in-situ and ex-situ impacts on biodiversity (positive and negative).

Goal and methodology

The aim of this work is to propose methodological developments based on a hybrid method using not only the life cycle thinking approach but also the ecological expertise, GIS and BIM tools (see Fig. 1).

This methodology ensures the approaches' coherence used at different scales of evaluation.

Conclusion

This approach allows us to support decision processes through an integrated modeling and visualization of the results:

- Biodiversity assessment based on LCA and ecological expertise
- Detailed results for technical analysis
- Results in GIS/BIM environment for aid decision

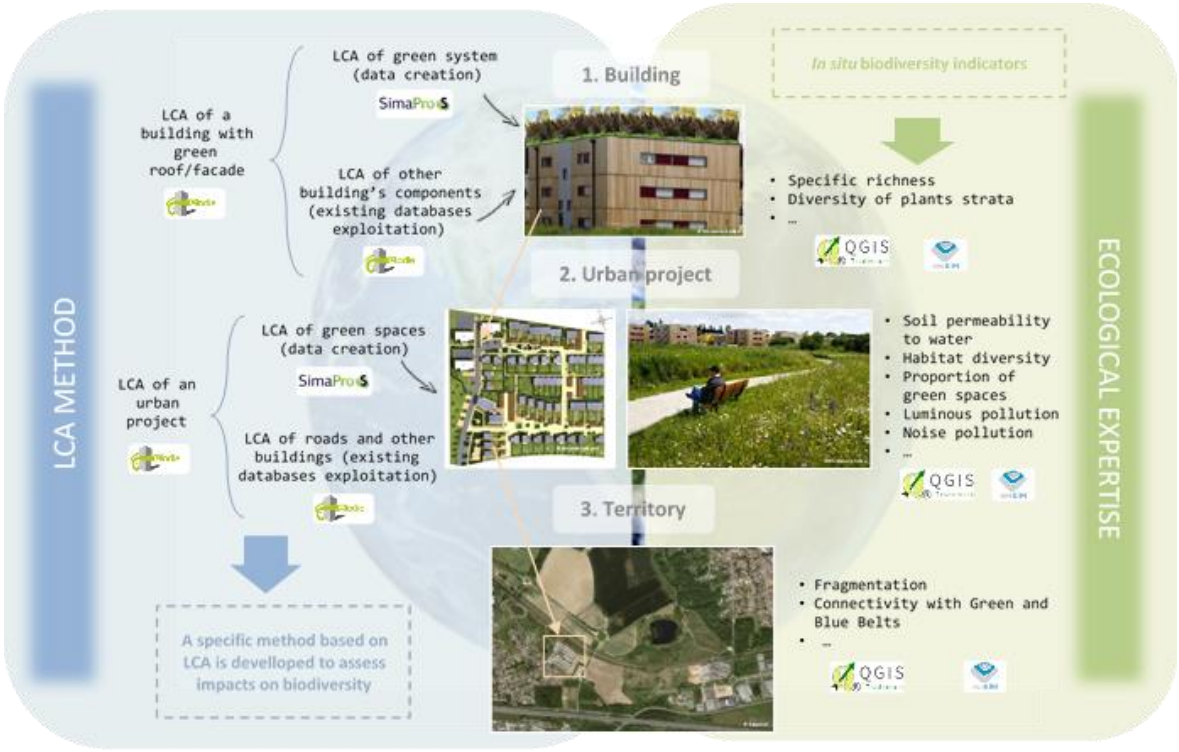

Fig. 1: Hybrid methodology for biodiversity assessment (Source: Aline Brachet)

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Health related effects of urban green spaces and forests in Bavaria

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Forests are of major importance to human society worldwide, contributing to several ecosystem services fundamentally. Recreation as immediate benefit from ecosystems is often analyzed in multiple contexts and at multiple scales. In forestry, approaches to quantify forest ecosystem services (ESS), mostly developed for assessments at the landscape scale, hardly suit to the actual planning unit, which is at the local scale (forest stands). Therefore, we quantified the intensity and motivation of recreational ESS in an urban and a rural forest in southern Germany during a summer and a winter survey. To reach forest visitors, we used the next-to-pass approach in July and December 2016 and in January 2017. We conducted the interviews on weekdays and on weekends and surveyed forest visitors during the entire day to better capture the peaks of forest use of different groups (winter: 233; summer: 245 completed questionnaires).

The results show a concentration of forest visitors in few parts of both forests. For rating of ESS, consistent spatial clustering occurred. Forest visitors rated ESS on average mostly high apart from social cohesion, cooling (seasonally dependent), and dog walking (visitor group specific). We identified a weak influence of forest characteristics on the rating of forest ESS and human benefit. Except from the visitor group, demographic factors hardly affected the ESS rating. Nevertheless, most visitors hardly rated ESS and forest benefits as an important factor for pathway choice. Pathway choice was mostly driven by habit, spontaneity, or vicinity to their neighbourhood. For further planning of forest management for recreation, the major findings mostly agreed between the rural and urban forest. The conducted assessment seems suitable for application in further forest areas to standardize the existing expert-based assessment of recreational use, which is done at the regional scale and thereby designates entire forest areas for recreation.

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“Re-activating landscape in peri urban areas - Quinta do Pisão I Nature Park - A landscape-scale conservation project that links wildlife and people.”

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Cascais Ambiente - Environment Municipal Company of Cascais, Portugal

Introduction

The growth of urban regions in the border of natural protected areas such as a park, can represent a threat for biodiversity and landscape. The pressure from local communities, to gain access to open spaces and wild areas for recreational purposes, promotes disturbance and habitat fragmentation.

Fig. 1: Donkeys in the landscape, (Source: Cascais Ambiente)

Methods

A landscape scale conservation project was implemented in the park, a Natura 2000 site. The aim was to revert the abandon process, to reactivate the farm as a living landscape. Also to respond to local community expectations, for having access to natural areas for recreational purposes. Forest management and farming activities were directed to habitat management, increasing the landscape mosaic and promoting biological diversity.

The park has been opened since 2011, allowing visitors to walk, cycle, ride horses, and to participate in nature workshops and educational programmes. The farm produces and sells organic vegetables, honey and jam, and visitors are invited to pick up crops from the farm themselves. All products are sold in the farm shop promoting the sustainable development.

Results

A survey made in 2014 with 273 inquiries showed that 20,5% of the visitors comes to the park two times a week and 14% on a daily basis. The main purpose of the visitors is to have contact with nature (76,9%), to enjoy the landscape (86.4%), and to relax in their free time (71,1%). Currently the park receives 3500 visitors a month.

Conclusions

The landscape was restored for its value in the collective memory of the communities. The outcome shows that peri urban areas can play an important role as landscape transition areas, to allowing access to the countryside and natural areas. Quinta do Pisão represents an “open door” to the natural park and fills the missing link between the city and the countryside.

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Health Co-benefits from reducing indoor air pollution in Pune, India

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Around 3 billion people cook and heat their homes using solid fuels on open fires or traditional stoves. Such inefficient cooking and heating practices produce high levels of indoor air pollution which includes a range of health damaging Climate Active Pollutants such as black carbon, methane and carbon dioxide. Thus it is needed to prevent indoor air pollution to obtain enormous benefits.

Objectives

1. To compare the PM2.5 and elementary carbon exposure of women using different cook stove design used in the local kitchen
2. To compare lung function through spirometer as an indicator for Chronic Obstructive Pulmonary Disease in women and relate it to the exposure
3. To estimate the effect of introducing clean combustion stoves (e.g. LPG) on both women's health and climate mitigation in the study district

Methodology

This study will be conducted among the women living in rural villages using a household health questionnaire and a Portable Spirometer (measure lung function). Measurement of kitchen air concentrations of black carbon and particulate matter2.5 will be done using quartz filter papers and analyzed further chemically in the laboratory.

Results

As the study is on data collection phase, results are not generated yet.

Policy relevance

Health damaging pollutants such as carbon and particulate matter emitted from the cook stove designs contribute to poor air quality. Use of clean cook-stoves will be proposed as a emission mitigation measure and provide a significant evidence for local and national policy makers to promote such clean fuels to achieve significant health benefits. Limiting emissions of Short-lived climate pollutants will have substantial health and climate co-benefits.

Annex 1 - 2017 ENCA recommendations for taking forward the evidence of the links between biodiversity and health in the face of climate change.

The Interest Group on Climate Change of the Network of Heads of European Nature Conservation Agencies (ENCA), and the BioClim project group funded by the German Federal Agency of Nature Conservation (BfN) developed the following recommendations based on the session outcomes and plenary discussions at the joint BfN/ENCA European Conference on "Biodiversity and Health in the Face of Climate Change".

The conference took place in Bonn, Germany from 27 to 29 June 2017. These recommendations further build on the discussions of an expert workshop at the International Academy for Nature Conservation, Island of Vilm, Germany in October 2016. Both events were organized by the BfN, in cooperation with the ENCA Climate Change Group, and in collaboration with the Helmholtz-Center for Environmental Research – UFZ and the German Centre for integrative Biodiversity Research (iDiv) Halle-Jena-Leipzig. The conference was co-sponsored by World Health Organization (WHO) Regional Office for Europe.

While climate change poses significant challenges to biodiversity and human well-being in Europe, biodiversity in urban as well as in adjacent rural areas can provide health and climate change mitigation and adaptation benefits that can be actively fostered by nature-based solutions. In this context, health is considered in its physical, psychological and social dimension, including socio-environmental equity.

The recommendations were endorsed by the ENCA network at its 21st plenary meeting in Dzūkija National Park, Lithuania, 23rd - 24th October 2017. The recommendations focus on ways forward to promote the evidence of the links between biodiversity and health in the face of climate change in order to foster the wider application of nature-based solutions complementary to already established medical or technical measures. The recommendations highlight five key areas for action:

1. **<u>Increase the evidence base</u> of the contributions of biodiversity for human health and well-being.**

   This can be achieved by:

   - Identifying which aspects of biodiversity can provide benefits for physical, psychological and social health and well-being.
   - Examining how biodiversity benefits health and well-being.
   - Understanding how socio-demographical status modifies biodiversity's effect on health and well-being.
   - Investigating the human health and well-being effects of current biodiversity loss and reduced access to natural environments.
   - Investigating the potential negative effects of biodiversity on human health and well-being, such as vector-borne diseases and allergenic plants. Identify appropriate management measures to reduce these negative health impacts.
   - Investigating the 'dose' of biodiversity required for a positive health effect. How much biodiversity is necessary for human health and well-being?
   - Conducting economic evaluations of biodiversity and human health interventions.

- Developing a standardized monitoring scheme to estimate the health and well-being benefits of the protected area network.

2. **Increase awareness of the human health and well-being effects of natural environments and biodiversity.**

   This can be achieved by:

   - Consolidating the existing research on the health benefits of nature, and the health effects of biodiversity. Highlighting the differences of these effects according to socio-demographical status of the recipients.
   - Emphasizing the contribution of biodiversity in tackling our main health problems; demonstrating the facts and synergies regarding the benefits and risks to health.
   - Tailoring communication of the health benefits of nature and biodiversity to the interests of different stakeholders, practitioners, and policy-makers.
   - Using social media and other platforms to communicate and disseminate simple messages about the health benefits of biodiversity. Working with environmental charities to disseminate these messages to larger audiences.
   - Developing guidance for park managers, and landscape architects, and urban planners and designers describing the key features of biodiversity required for increased health and well-being.
   - Developing guidance for health professionals on how to use natural environments for health promotion as a complement to other already established measures.

3. **Highlight the co-benefits of nature-based solutions for climate change adaptation to policy-makers and regional planning authorities.**

   Nature-based solutions for climate change adaptation provide multiple co-benefits for human health, biodiversity, and climate change. These co-benefits need to be emphasised to policy-makers, politicians, and regional planning authorities. This can be achieved by:

   - Highlighting the interlinkages of climate change, human health and biodiversity by emphasizing that there are direct (e.g. heat stress) as well as indirect (e.g. spread of vector-borne diseases and allergenic plants) negative impacts of climate change on health and biodiversity, but also promoting the potential health effects of nature based solutions to climate change adaptation.
   - Focusing on human health and well-being as a *central benefit* of nature-based solutions for climate change adaption (instead of a co-benefit).
   - Emphasizing the *co-benefits* nature-based solutions for climate change adaptation have for the preservation of ecosystem services and biodiversity conservation.
   - Highlighting the potential of nature-based solutions to climate change adaptation to addressing social health inequalities in terms of reducing climate change susceptibility.
   - Linking Green Infrastructure strategies and/or climate change adaptation strategies to other polices, such as the Healthy City strategy.

4. **<u>Foster application of nature-based solutions for climate change adaptation</u> from society and policy**

   This can be achieved by:

   - Understanding what practitioners and policy-makers require in order to implement the research on biodiversity and health. What are the barriers? What kind of tools, guidance, or processes need to be created?
   - Developing a "common language" to facilitate understanding and cross-sectoral collaboration.
   - Demonstrating successful interventions or projects using case studies to where cross-sector working led to cost-effective and efficient delivery of ecosystem services that provided multiple benefits.
   - Building ownership, cooperation and collaboration on biodiversity, health and climate change issues between the different stakeholders. A co-designed framework plan is likely to be the most successful.
   - Developing integrated tools of analysis and metrics that bring together the different disciplines, sectors and areas of expertise. Existing decision-making process tools may be useful starting points, e.g. Environmental Impact Assessment and Health Impact Assessment.
   - Creating "Sustainable Development Goal-type" indicators to monitor process, success and sustainability, and to provide focus.
   - Implementing robust monitoring and evaluation of the effect of nature-based solutions on climate change adaption, human health and well-being, biodiversity, and ecosystem services.

5. **<u>Effectively design and manage</u> green spaces to ensure people have contact with nature and biodiversity**

   This can be achieved by:

   a. Using both land sparing and land sharing approaches, eg. fostering wildlife both in parks or conservation areas as well as in the urban matrix, to provide opportunities for people to interact with nature and obtain its health benefits.
   b. Managing small urban green spaces to increase the aspects of biodiversity that can be beneficial to human health and well-being. It is important for people to have contact with natural environments in their daily life (e.g. on their ways to school or work, around the home).
   c. Designing larger green spaces and establishing "green corridors" from urban green spaces to rural protected areas to create additional opportunities for recreation and restoration.
   d. Utilising social and physical interventions to facilitate use, and improve the quality of, green spaces. Access to green space does not necessarily result in its use.
   e. Focussing interventions on increasing both the biodiversity of the green space, and the amount of time people spend in that green space. Both have been shown to achieve positive health and well-being benefits.
   f. Marketing protected areas as "health hubs" in order to highlight the value they deliver for human health and well-being.

Annex 2 - Programme of Oral Presentations

	TUESDAY (27.06.2017) **SCIENCE**
8:00 - 18:00	Registration - Foyer
	The Nexus of Biodiversity, Health and Climate Change
9:00	**Introduction and Opening** Beate Jessel *(President, Federal Agency for Nature Conservation - BfN, Germany)*
	Chair: Horst Korn *(Head of Division International Nature Conservation, Federal Agency for Nature Conservation - BfN, Germany)*
9:20	**Welcome and update from ENCA** Ruth Waters *(Natural England / Climate change interest group European Network of Heads of Nature Conservation Agencies - ENCA, UK)*
9:25	**Welcome address from WHO** Elizabet Paunovic *(Head of Office, European Centre for Environment and Health, World Health Organization (WHO) Regional Office for Europe, Germany)*
9:30	**Enhancing Europe's natural capital benefit to human health and climate change** Ronan Uhel *(Head of Programme "Natural Systems and Sustainability", European Environment Agency - EEA, Denmark)*
10:00	**Nature and health – A psychological perspective** Terry Hartig *(Upsala University, Sweden)*
10:30	**Coffee & Tea**
	Chair: Aletta Bonn *(Helmholtz Centre for Environmental Research-UFZ and German Centre of Integrative Biodiversity Research - iDiv, Germany)*
11:00	**Biodiversity and health – Implications for conservation** Kevin Gaston *(University of Exeter, UK)*
11:30	**Linking landscape planning and health – Green space and quality of life** Catharine Ward Thompson *(University of Edinburgh, UK)*
12:00	**Discussion**
12:30	**Lunch / Press Conference / Poster Exhibition, without presenters**
	Physical and psychological effects
14:00	**Mosquito borne diseases and global changes** Ruth Müller *(Chief Manager of the GM mosquitoes confined release facilities PoloGGB, Italy, and Head of the Department Environmental Toxicology and Medical Entomology* *University of Frankfurt, Germany)*
14:20	**Environmental immunology – Allergies and chronic diseases** Stephanie Gilles-Stein *(University clinic, Augsburg, Germany)*
14:40	**Urban nature, health and climate change** Sarah Lindley *(The University of Manchester, Manchester, UK)*

15:00	**Phenotype: Positive health effects on the natural outdoor environment in typical populations of different regions in Europe** Roderick Lawrence *(Director of the Global Environmental Policy Program University Geneva; visiting professor at the United Nations University's International Institute for Global Health)*
15:20	**Discussion**
15:30	**Coffee & Tea**
16:00	**Effects of green spaces on children** Payam Dadvand *(IS Global, Spain)*
16:20	**Happiness in Green Environments** Sjerp de Vries *(Wageningen Environmental Research (Alterra), The Netherlands)*
	Social effects and implications for planning
16:40	**Nature and Health inequalities in the face of climate change** Richard Mitchell *(Institute for Health and Well-being / CRESH, Glasgow University)*
17:00	**Resilience Management for Healthy Cities in a Changing Climate** Thomas Elmqvist *(Stockholm Resilience Centre, Sweden)*
17:20	**Synergies and Trade-offs of Conservation and Health: Implications for sustainable (urban) Health Planning** Thomas Claßen *(NRW Centre for Health (Germany), Section "Health assessments and forecasting")*
17:40	**Discussion**
18:00	**Break**
18:15	**Open Event / Welcome** Thomas Graner *(Deputy of the President of the Federal Agency for Nature Conservation (BfN), Germany)*
	Public evening lecture: Public perceptions and engagement with climate change Wouter Poortinga *(Cardiff University, UK)*
19:00	**Conference buffet, evening reception** hosted by BfN

	WEDNESDAY (28.06.2017) **PRACTICE / IMPLEMENTATION**
8:00 - 8:45	Morning Group Walk *(optional)* Led group walk with Melissa Marselle. Please meet in conference venue foyer at 7.55.
8:00 - 18:00	Registration - Foyer
9:00	**Introduction and review of day 1** **Chair:** Horst Korn *(Head of Division International Nature Conservation, Federal Agency for Nature Conservation - BfN, Germany)*
	Nature-based solutions to improve human health in a changing climate – Practice examples
9:05	**Urban green spaces and health – launching a brief for action** Elizabet Paunovic *(Head of Office, European Centre for Environment and Health, World Health Organization (WHO) Regional Office for Europe)*
9:35	**The healthy cities network Germany** Karsten Mankowski *(Political chair of the German National Healthy Cities Network of healthy cities, Rhein-Kreis Neuss Umwelt- und Gesundheitsamt, Grevenbroich, Germany)*
10:05	**Interactive session plan** Horst Korn *(Head of Division International Nature Conservation, Federal Agency for Nature Conservation - BfN, Germany)*
10:10	**Coffee & Tea**
	Biodiversity, Health and Climate Change – Opportunities, challenges and evidence gaps
10:40	**Interactive Parallel Sessions - SLOT 1** **For details see below** • **Session 1** Biodiversity or Green Space? Evidence for contributions to health in a changing climate **Chair**: Rebecca Lovell *(Defra Research Fellow on the Natural Environment and Human Health, European Centre for Environment and Human Health, University of Exeter Medical School, UK)* • **Session 2** Health and protected areas in a changing climate **Chair**: Veikko Virkkunen *(Metsähallitus, Parks & Wildlife Finland (P&WF))* • **Session 3** Linking Initiatives in biodiversity, health, climate change in policy and practice **Chair**: Hans Keune *(Belgian Biodiversity Platform, The Research Institute for Nature and Forest - INBO, Belgium)* • **Session 4** The benefits of green space for enhancing human health – Lessons learned from urban interventions **Chair**: Matthias Braubach *(World Health Organization Regional Office for Europe)*
12:40	**Lunch / Market place (Poster Session with Presenters)**
14:30	**Interactive Parallel Sessions - SLOT 2** **For details see below** • **Session 5** Psychological effects of nature and biodiversity on human health and well-being **Chair**: Dörte Martens *(Eberswalde University for Sustainable Development, Germany)* • **Session 6** Allergenic plants and vector borne disease – Relevance to human health in a changing climate // **Chair**: Regina Treudler *(University of Leipzig, Germany)*

	• **Session 7** Nature-based solutions for climate change adaptation and their role in fostering health and socio-environmental equity **Chair**: Melissa Marselle *(German Centre of Integrative Biodiversity Research – iDiv)* • **Session 8** Planning and managing urban green spaces for health and biodiversity in a changing climate – Concepts, experiences, practice **Chair**: Stefan Heiland *(Technische Universität Berlin, Germany)*
16:30	**Coffee & Tea**
17:00 - 18:30	**Plenum Summary** Main lecture Hall **Chair:** Horst Korn *(Head of Division International Nature Conservation, Federal Agency for Nature Conservation - BfN, Germany)*
19:00	**Conference dinner**

.	**THURSDAY (29.06.2017)** **POLICY AND BUSINESS**
8:00 - 8:45	Morning Group Walk *(optional)* Led group walk with Melissa Marselle. Please meet in conference venue foyer at 7:55.
8:00 - 12:00	Registration - Foyer
9:00	**Introduction and review of day 2** **Chair**: Horst Korn *(Head of Division International Nature Conservation, Federal Agency for Nature Conservation - BfN, Germany)*
	Biodiversity, Health and Climate Change - current processes and future perspectives
9:10	**Valuing Nature and Benefits to Health – The H2020 health societal challenge** Birgit de Boissezon *(European Commission, DG Research and Innovation, Head of Unit "Sustainable Management of Natural Resources")*
9:30	**Nature's contribution to human health and well-being in a changing climate** Stefan Leiner *(European Commission, DG Environment, Head of Unit "Biodiversity")*
9:50	**Connecting Global Priorities: Biodiversity and Human Health** Cristina Romanelli *(Secretariat of the Convention on Biological Diversity, CBD)*
10:10	**Nature, health and a new urban generation – Unlocking opportunities for nature-based solutions in a changing climate** Luc Bas *(Director of the IUCN European Regional Office)*
10:40	**Coffee & Tea**
11:10	**Back to the Future – Parks as Natural Health Centres** Carol Ritchie *(Executive Director, EUROPARC Federation)*
11:40	**The Health and Social Benefits of Nature Conservation Areas** Patrick ten Brinck *(Head of Green Economy Programme, Director of Brussels Office, Institute for European Environmental Policy, IEEP)*
12:00	**Panel Discussion** Moderator: Horst Korn *(Head of Division International Nature Conservation, Federal Agency for Nature Conservation - BfN, Germany)*
12:50	**The way forward and closing** Beate Jessel *(President, Federal Agency for Nature Conservation - BfN, Germany)*
13:00	**Farewell**
Afternoon	*Meeting of the ENCA interest group on climate change (members only)*

DETAILED PROGRAMME - Interactive Parallel Sessions SLOT 1 WEDNESDAY (28.06.2017) Morning sessions (10:40 - 12:40)	
Session 1 - *Main Lecture Hall "Hörsaal"* **Biodiversity or Green Space? Evidence for contributions to health in a changing climate** **Chair: Rebecca Lovell** *(European Centre for Environment and Human Health, University of Exeter Medical School, UK)*	**Marcus Hedblom,** *Swedish University of Agricultural Sciences*: Urban woodlands and their importance for biodiversity and human well-being **Assaf Shwartz,** *Technion - Israel Institute of Technology*: One size does not fit all – the complex relationship between well-being and biodiversity **Leonie Fischer,** *Technische Universität Berlin*: People across Europe like urban biodiversity **Ruth Waters,** *Natural England*: Getting Outdoors: What motivates people?
Session 2 - *Seminar Room 3.01/ 3.03* **Health and protected areas in a changing climate** **Chair**: **Veikko Virkkunen** *(Metsähallitus, NHS Ostrobothnia Regional Unit / Europark Federation, Finland)*	**Neele Larondelle,** *Europarc Deutschland*: Connecting people with nature: The National Nature Landscapes of Germany **Kerstin Ensinger,** *Schwarzwald Nationalpark / Black Forest National Park, Germany:* The health benefits of experiencing "wilderness" in the Black Forest National Park **Silvestre GarcÍa de Jalón,** *BC3 Research:* Exposure to green areas: Modelling health benefits in a context of study heterogeneity **Albert Bach,** *Institute of Environmental Science and Technology of the Autonomous University of Barcelona*: Forest and human health: A new approach for forest management?
Session 3 - *Seminar Room 3.05/ 3.07* **Linking Initiatives in biodiversity, health, climate change in policy and practice** **Chair**: **Hans Keune** *(Belgian Biodiversity Platform, The Research Institute for Nature and Forest - INBO, Belgium)*	**Dave Stone,** *Natural England*: Climate change, human health and biodiversity: How a socio-ecological conceptualisation of the challenge can provide mutually supportive integrated solutions. **Josipa Habuš,** *Faculty of Veterinary Medicine of the University of Zagreb*: Network for Evaluation of One Health (NEOH): Developing new methodologies for quantitative evaluation of One Health activities **Julie Garnier**, *Odyssey Conservation Trust*: Implementing a One Health approach in transfrontier conservation areas will help build resilience to climate change **Doreen Montag**, *Queen Mary University of London:* Ecosystem services and their impact on peoples' health: A needs-based approach to health assessment ***2-minute 'speed presentations' of posters from:*** • **Kerstin Friesenbichler**, *Der Umweltdachverband / The Environmental Umbrella Organisation, Austria;* • **Lieve Janssens**, *Agency for Sustainable Environment and Nature Policy, Belgium*; • **Snezana Jovanovic**, *WHO Collaborating Centre for Housing and Health*; and • **Hans Keune**, *Belgian Biodiversity Platform, The Research Institute for Nature and Forest (INBO);* • **An Van Nieuwenhuyse**, *Scientific Institute of Public Health, Belgium*
Session 4 - *Media Room "Medienraum"* **The benefits of green space for enhancing human health – Lessons learned from urban interventions** **Chair**: **Matthias Braubach** *(World Health Organization Regional Office for Europe)*	**Matthias Braubach,** *WHO European Centre for Environment and Health*: Benefits of urban green space interventions: lessons from the field **Kate Sheldon,** *Trees for Cities, UK*: Edible Playgrounds by Trees for Cities **Jochem O. Klompmaker,** *National Institute for Public Health and the Environment, The Netherlands* (*RIVM)*: Associations of green space with cardio-metabolic disease. **Jana Verboom,** *Wageningen University and Research, The Netherlands*: Can a neighbourhood greening intervention improve the health and well-being of older residents?

DETAILED PROGRAMME - Interactive Parallel Sessions SLOT 2 WEDNESDAY (28.06.2017) Afternoon sessions (14:30 - 16:30)	
Session 5 - *Main Lecture Hall "Hörsaal"* **Psychological effects of nature and biodiversity on human health and well-being** **Chair**: **Dörte Martens** *(Eberswalde University for Sustainable Development, Germany)*	**Dörte Martens,** *Eberswalde University for Sustainable Development, Germany*: Nature experience areas providing biodiversity and childrens' quality of life – compatible or contradictory aims? **Jens Kolbe,** *Technische Universität Berlin:* The Greener, the Happier? The Effects of Urban Land Use on Residential Well-Being. **Liqing Zhang,** *National University of Singapore*: A Conceptual Framework to Better Understand the Dose-Response Relationships between Urban Green Spaces and Health **Barbara Livoreil,** *Foundation for Research on Biodiversity, France (FRB)*: An assessment from EKLIPSE: What types of nature and characteristics of green and blue spaces significantly impact mental health and well-being?
Session 6 - *Seminar Room 3.01/ 3.03* **Allergenic plants and vector borne diseases – Relevance to human health in a changing climate** **Chair**: **Regina Treudler** *(University of Leipzig, Germany)*	**Vladimir Kendrovski,** *WHO European Centre for Environment and Health*: European WHO operational framework on climate change, health and vector-borne diseases **Astrid Kleber,** *Ministry for the Environment, Energy, Food and Forestry of the Rhineland Palatinate, Germany:* Assessment of health risks from allergenic plants, animals and vector borne diseases in Rhineland-Palatinate under climate change conditions. **Boris Schröder-Esselbach,** *Technische Universität Brauschweig:* Ticks and the city **Stefan Schindler,** *Environment Agency, Austria*: Alien species and human health impacts: Evidence syntheses and the role of climate change
Session 7 - *Seminar Room 3.05/ 3.07* **Nature-based solutions for climate change adaptation and their role in fostering health and socio-environmental equity** **Chair**: **Melissa Marselle** *(German Centre of Integrative Biodiversity Research – iDiv)*	**Conor Kretsch,** *COHAB (Co-operation On Health and Biodiversity) Initiative, Ireland*: Far beyond resilience: Response, relief and recovery in a changing climate **Minka Aduse-Poku,** *University of Cologne:* Potential of Green (Ivy-) Walls With Respect To Temperature-Impact, CO2-Assimilation, Reduction of Fine Dust And Of Nitrous Oxides (NOx) **Chris Skelly,** *Public Health Dorset and University of Southampton*: Urban green space interventions: can the science of microbiomes be used to write a global prevention at scale prescription? **Tatiana Minayeva,** *Wetlands International*: Peatland restoration as a vital means for prevention of peat fires
Session 8 - *Media Room "Medienraum"* **Planning and managing urban green spaces for health and biodiversity in a changing climate – Concepts, experiences, practice** **Chair**: **Stefan Heiland** *(Technische Universität Berlin, Germany)*	**Sandra Boekhold***, National Institute for Public Health and the Environment, The Netherlands* (*RIVM):* City deal on valuing green and water in cities: integration of health and other benefits of nature-based solutions in urban planning **Petra Schneider**, *University of Applied Sciences Magdeburg:* Bioclimatic Risk Assessment as Base for Resilient Urban Climate Adaptation Strategies: Case Study for the City of Chemnitz, Germany **Rebecca Jefferson,** *Royal Society for the Protection of Birds (RSPB):* Biodiversity, human health and climate change at the RSPB **Hannah Roberts,** *University of Leeds:* The influence of park features on park satisfaction in a multi-ethnic, deprived urban area

Annex 3 - Programme of Poster Presentations

SESSION 1 - Biodiversity or green space? Evidence for contribution to health in a changing climate				
No	**Titel**	**Author**	**Presenter**	**Affilation**
1	Unveiling urban green heterogeneity. The Barcelona case study in a Mediterranean setting.	Pablo Knobel Guelar[1] Roser Maneja Zaragoza[1] Payam Dadvand[2] Martí Boada i Juncà[1]	Pablo Knobel Guelar	[1]Institut de Ciència i Tecnologia Ambientals (ICTA). Universitat Autònoma de Barcelona (UAB) [2]Instituto de Salud Global de Barcelona - Campus MAR (ISGlobal)
2	Let's Go – Hiking for Families, Kids und Preschools	Anne-Christine Elsner	Anne-Christine Elsner	Deutscher Wanderverband (DWV)
3	A CICES for Health: Linking ecosystem services and disease classes	Conor E. Kretsch	Conor E. Kretsch	COHAB Initiative Secretariat, Ireland
4	Ecology and biodiversity in cities under climate change – How students can be enabled to understand, evaluate and communicate adaption strategies	Lena Neumann[1] Alexander Siegmund[1, 2]	Lena Neumann	[1]Department of Geography – Research Group for Earth Observation (ʳgeo), Heidelberg University of Education [2]Heidelberg Center for Environment (HCE) & Institute of Geography, Heidelberg University
SESSION 2 - Health and protected areas in a changing climate				
No	**Titel**	**Author**	**Presenter**	**Affilation**
5	Strengthening human-nature nexus in the urban context Lessons from London	Arlinda Sheqiri	Arlinda Sheqiri	Politecnico di Milano
6	"Make me a willow cabin at your gate": How works in protected areas connect people and improve well-being – Model System Estuarine Forest, Hamburg, GER	Heike Markus-Michalczyk	Heike Markus-Michalczyk	Royal Netherlands Institute for Sea Research, Estuarine and Delta Systems, NIOZ, NL
7	Potential health benefits of marine resources in a protected area: the example of Cape Creus (NW Mediterranean)	Josep Lloret	Josep Lloret	University of Girona, Institute of Aquatic Ecology, Campus Montilivi, 17003 Girona, Spain

SESSION 2 - Health and protected areas in a changing climate				
No	**Titel**	**Author**	**Presenter**	**Affilation**
8	Use of an activity tracker to motivate engagement of inactive adults with health walks in a national park: a mixed-methods feasibility study	Katherine N Irvine[1] Alan Melrose[2] Sara L Warber[3]	Katherine N Irvine	[1]James Hutton Institute [2]Active Cairngorms Health Walks Coordinator [3]University of Michigan
9	ESIKOTO project, Finland: Health and well-being of asylum seekers through activation in nature-based activities	Saša Dolinšek Veikko Virkkunen	Veikko Virkkunen	Metsähallitus, Parks & Wildlife
SESSION 3 - Linking initiatives in biodiversity, health, and climate change action in policy and practice				
No	**Titel**	**Author**	**Presenter**	**Affilation**
10	"Biodiversity and health": an ambitious Austrian project brings it together	Kerstin Friesenbichler[1] Arne Arnberger[2] Piero Lercher[3] Hans-Peter Hutter[4]	Kerstin Friesenbichler	[1]Umweltdachverband [2]University of Natural Resources and Life Sciences, Vienna, Austria [3]Austrian Medical Chamber, Vienna; Medical University of Vienna, Austria [4]Medical University of Vienna, Austria; International Society of Doctors for the Environment - Austrian section
11	Implementing a One Health Approach in Transfrontier Conservation Areas Will Help Build Resilience to Climate Change	J. Garnier[1] C. Masterson[2] C. Stockil[2] R.A. KockR.A.[3]	Julie Garnier	[1]Odyssey Conservation Trust [2]C. Wild Programme [3]Royal Veterinary College
12	European One-Health/EcoHealth Community of Practice	Hans Keune[1,2,3] Lucette Flandroy[1,4] Séverine Thys[5] Thierry van den Berg[6] Stefan Roels[6] Nick De Regge[6] Marcella Mori[6] Nicolas Antoine-Moussiaux[7] Maarten Vanhove[8] Javiera Rebolledo[9] Pierre Biot[4] Wim Hiemstra[10] Barbara Haesler[11,12] Aurélie Binot[13]	Hans Keune	[1]Belgian Community of Practice Biodiversity & Health (COPBH) [2]Belgian Biodiversity Platform [3]Research Institute Nature & Forest (INBO) - Belgium [4]Federal Public Service Public Health, DG Environment - Belgium [5]Institute of Tropical Medicine of Antwerp (ITM) - Belgium [6]Veterinary and Agrochemical Research Centre (CODA-CERVA) - Belgium [7]University of Liège, Faculty of Veterinary Medicine (ULg) - Belgium [8]Royal Belgian Institute of Natural Sciences (RBINS) (CEBIOS) - Belgium [9]Scientific Institute of Public Health (WIV-ISP) - Belgium [10]Dutch Farm Experience/Natural Livestock Farming - Netherlands [11]Royal Veterinary College – United Kingdom [12]Network for Evaluation of One Health (NEOH) – EU COST Action network [13]French agricultural research and international cooperation organization (CIRAD) - France

SESSION 3 - Linking initiatives in biodiversity, health, and climate change action in policy and practice				
No	**Titel**	**Author**	**Presenter**	**Affilation**
13	The NAMED project	An Van Nieuwenhuyse	An Van Nieuwenhuyse	Scientific Institute of Public Health
14	Project 'Green light'. Connecting knowledge about nature-health linkages to primary health care practice.	Lieve Janssens Dirk Vandenbussche	Lieve Janssens	Agency for Sustainable Environment and Nature Policy
15	Initiatives of the State Health Office Baden-Württemberg (LGA), Germany	Snezana Jovanovic	Snezana Jovanovic	WHO-CC Housing and Health Landesgesundheitsamt Baden-Württemberg
16	#DokterBos #Doctor-Woods - a SocialMedia campaign to raise awareness on the impact of nature, forest and green on public health and well-being (Flanders, Belgium) *RollUp*	Rik De Vreese	Katriina Kilpi	BOS+
17	Practical and accessible environmental education for all: a National priority in Estonia	Marika Kose[1] Maris Kivistik[2]	Maris Kivistik	[1]Estonian University of Life Sciences, Institute of Agricultural and Environmental Sciences, Department of Botany [2]Estonian Environmental Board
18	Urban Biodiversity in the Context of the UN Sustainable Development Goals (SDGs): The City of Bonn and its peri-urban area as a Case Study	Maximilian Weigend[1] Wolfram Freund1 Jens Mutke[1] Sarah Jeanloz[1] Fabian Droppelmann[1] Wiltrud Terlau[2] Johannes Klement[2]	Wolfram Freund	[1]Nees Institute for Biodiversity of Plants, University of Bonn, Germany [2]International Centre for Sustainable Development, Bonn-Rhein-Sieg University of Applied Sciences, Germany
19	Using 'perspectives on nature' to find a common agenda for biodiversity, climate change and health	AG prins[1] I Bouwma[2] E dammers[1] H Farjon[2] R Pouwels[2] M Vonk[1]	Henk van Zeijts	[1]PBL Netherlands Environmental Assessment Agency [2]Wageningen University & Research
20	Nature Conservation and Health	Beate Job-Hoben Ulrike Hoffmann	Beate Job-Hoben	Federal Agency for Nature Conservation (BfN)

SESSION 4 - The benefits of green space for enhancing human health - lessons learned from urban interventions				
No	**Titel**	**Author**	**Presenter**	**Affilation**
21	Estimating the access to urban green space on household level in German cities	Dennis Kalisch[1] Jens Kolbe[2] Henry Wüstemann[1]	Dennis Kalisch	Technische Universität Berlin, [1]Institute for Landscape Architecture and Environmental Planning, Landscape Economics [2]Institute for Economics and Business Law, Econometrics and Business Statistics
22	Nature-based solutions for health and well-being problems of the ageing urban population?	Jana Verboom[1] Sjerp de Vries[1] Joop van Hezik[2]	Jana Verboom	[1]Wageningen Environmental Research (Alterra) [2]Nature Assisted Health Foundation
SESSION 5 - Psychological effects of nature and biodiversity on human health and well-being				
No	**Titel**	**Author**	**Presenter**	**Affilation**
23	Effects of tree characteristics diversity on psychological restoration	Tina Gerstenberg[1, 2] Mathias Hofmann[1, 3]	Tina Gerstenberg	[1]Centre for Research in Technological Development, Dresden, Germany [2]Forest Research Institute Baden Württemberg, Department Forest and Society [3]Swiss Federal Institute for Forest, Snow and Landscape Research WSL
24	Child Mental Well-being, Child Environmental Attitudes and Biodiversity	Athina Georgiou Shippi	Athina Georgiou Shippi	PhD candidate in Landscape Architecture University of Edinburgh
25	Subjective perception of pollution and noise exposure in relation to urban green space availability	Karolina Koprowska Edyta Laszkiewicz	Karolina Koprowska	Faculty of Economics and Sociology, University of Lodz
26	The impact of wetlands on mental well-being – a case study from Uganda	Sophie-Bo Heinkel Andrea Rechenburg Thomas Kistemann	Sophie-Bo Heinkel	GeoHealth Centre, Institute for Hygiene and Public Health, University of Bonn
27	The benefits of urban medicinal gardens for human health	Vitalija Povilaityte-Petri Pierre Duez	Vitalija Povilaityte-Petri	Department of Therapeutic Chemistry and Pharmacognosy, University of Mons

SESSION 5 - Psychological effects of nature and biodiversity on human health and well-being				
No	**Titel**	**Author**	**Presenter**	**Affilation**
28	Introduced Medicinal (aromatic) Plant Diversity Enhancement and Research Value to Human Lifestyle in Lithuania	Ona Ragažinskienė[1] Lina-Danutė Zutkienė[2]	Ona Ragažinskienė	[1]Vytautas Magnus University Kaunas Botanical Garden [2]Vytautas Magnus University Institute of Foreign Languages
29	Green Learning Environments for Children with Learning Disabilities	Rik De Vreese[1] Katriina Kilpi[2] Ursa Vilhar[3] Paul Nolan[4]	Katriina Kilpi	1BOS+ [2]NatureMinded [3] GOZDIS [4]Mersey Forest
SESSION 6 - Allergenic plants and vector borne diseases – relevance to human health in a changing climate				
No	**Titel**	**Author**	**Presenter**	**Affilation**
30	Leptospirosis and climate change	Josipa Habus[1] Zdenka Persic[2] Silvijo Vince[3] Marko Vucelja[4] Zrinka Stritof[1] Vesna Mojcec[1] Zoran Milas[1] Josip Margaletic[4] Nenad Turk[1]	Josipa Habus	[1]National Reference Laboratory for leptospirosis (NRL), Department of Microbiology and Infectious disease with Clinic, Faculty of Veterinary Medicine, University of Zagreb [2]Croatian National Reference Laboratory for human leptospirosis, Croatian Institute of Public Health [3]Reproduction and obstetric Clinic, Faculty of Veterinary Medicine, University of Zagreb [4]Faculty of Forestry, University of Zagreb, Zagreb, Croatia
31	Long-term dynamics of rodent species relevant to human health: Impact of climate, land-use and biodiversity	C. Imholt[1] K. Jeske[2] A. Geduhn[3] E. Schmolz[3] R.G. Ulrich[2] J. Jacob[1]	Christian Imholt	[1]Julius Kuehn-Institut, Federal Research Institute for Cultivated Plants, Münster, Germany [2]Friedrich-Loeffler-Institut, Federal Research Institute for Animal Health, Greifswald-Insel Riems, Germany [3]German Environment Agency, Berlin, Germany

SESSION 6 - Allergenic plants and vector borne diseases – relevance to human health in a changing climate				
No	**Titel**	**Author**	**Presenter**	**Affilation**
32	Modeling Spatial of Environmental Factors uses Geographically Weighted Regression: The Incidence of Malaria in South Sumatra Indonesia	Hamzah Hasyim[1,2] A. Nursafingi[3] Meghnath Dhimal[2,4] Jan Bauer[2] Doreen Montag[5] David A. Groneberg[2] Ulrich Kuch[2]* Ruth Müller[2]*		[1]Faculty of Public Health, Sriwijaya University, South Sumatra Province, Indonesia [2]Institute of Occupational Medicine, Social Medicine and Environmental Medicine, Goethe University, Frankfurt am Main, Germany [3]Remote Sensing Program, Faculty of Geography, Universitas Gadjah Mada, Yogyakarta, Indonesia [4]Nepal Health Research Council (NHRC), Ramshah Path, Kathmandu, Nepal [5]Barts and the London School of Medicine, Centre for Primary Care and Public Health, Queen Mary University of London, London, UK * These authors act as equivalent co-senior authors
33	Ragweed allergy in Leipzig	R. Treudler[1,2] F. Walther[1] J. Wobser[1] J.C. Simon[1,2]	Regina Treudler	[1]Department of Dermatology, Venerology and Allergology [2]Comprehensive Allergy Centre – LICA, Universitätsmedizin Leipzig, Germany
34	Modelling the risk of autochthonous disease transmissions by Aedes albopictus in Germany using fine-resolution climate data	Stephanie Thomas	Stephanie Thomas	University of Bayreuth

SESSION 7 - Nature-based solutions for climate change adaptation and their role in fostering health and socio-environmental equity				
No	**Titel**	**Author**	**Presenter**	**Affilation**
35	The Heat Health Warning System in Germany - Application and Lessons learned	Andreas Matzarakis	Andreas Matzarakis	Research Center Human Biometeorology, German Meteorological Service
36	INHERIT your future: changing lifestyles and behaviours in the areas of living, moving and consuming, to protect the environment and improve health for all	Ingrid Stegeman Monica Aberg Yngwe Caroline Costongs	Ingrid Stegeman	EuroHealthNet
37	MedMossRoofs: Biocrust moss-dominated green roofs for a changing climate	R. Cruz de Carvalho[1] A.C. Luz[1], J. Vieira[1] P. Pinho[1,2], F. Alves[1] C. Garcia[1] L. Concostrina-Zubiri[1] L. Luis[1], P. Santos[1] P. Palha[3], T. A. Paço[4] S. Milliken[5] C. Branquinho[1] B. Kotzen[5]	Ricardo Cruz de Carvalho	[1]Centro de Ecologia, Evolução e Alterações Ambientais, Faculdade de Ciências, Universidade de Lisboa [2]Centro de Recursos Naturais e Ambiente, Instituto Superior Técnico, Universidade de Lisboa [3]Neoturf – Construção e Manutenção de Espaços Verdes Lda., [4]LEAF, Instituto Superior de Agronomia, Universidade de Lisboa, [5]Faculty of Architecture, Computing & Humanities, University of Greenwich, Old Royal Naval College
38	Boosting our power to detect vulnerability to high temperatures	Agustín Camacho Guerrero	Agustín Camacho Guerrero	Laboratório de Herpetologia, Departamento de Zoologia, Instituto de Biociências, USP
39	THE LIFE PROGRAMME & Adaption to Climate Change	Panos Fetsis	Panos Fetsis	LIFE Programme

SESSION 8 - Planning and managing urban green spaces for health and biodiversity in a changing climate				
No	**Titel**	**Author**	**Presenter**	**Affilation**
40	Impacts of heat waves on health in Moscow and implications for the city green space development	N. E. Terentev b. A. Revich	Nikolai Terentev	Institute of Economic Forecasting, Russian Academy of Sciences, Moscow, Russia
41	ArboCityNet – A cross-sectoral and transdisci-plinary Swiss Urban For-estry Network	Bianca Baerlocher[1] Michael Schulze[2] Eric Amos[3] Christian Betti[3] Roberto Bolgè[4] Clémence Dirac[4] Andrea Finger-Stich[5] Tessa Hegetschweiler[6] Axel Heinrich[7] Jerylee Wilkes[8]	Bianca Baerlocher	[1]HAFL, Bern [2]HRS, Rapperswil [3]Plante et Cité, Genève [4]FOEN, Bern [5]HEPIA, Genève [6]WSL, Birmensdorf [7]ZHAW, Zurich [8]ETH Zurich
42	Quantification of the effect of green spaces on heat stress – Application of micro scale models	Andreas Matzarakis Dominik Fröhlich Marcel Gangwisch	Andreas Matzarakis	Research Center Human Biometeorology, Ger-man Weather Service
43	What about Ourselves? Health as an Argument in climate-related Discus-sions on City Planning in Baden-Württemberg	Anja Kries Rainer Luick Heidi Megerle	Anja Kries	Hochschule für Forst-wirtschaft Rottenburg
44	Combining ecological and life cycle assessment of urban projects, a way to support biodiversity con-servation and climate change reduction	Aline Brachet[1,2] Nicoleta Schiopu[1] Philippe Clergeau[2]	Aline Brachet	[1]Université Paris Est, Centre Scientifique et Technique du Bâtiment, Grenoble [2]Museum National d'Histoire Naturelle, Paris
45	Health related effects of urban green spaces and forests in Bavaria	Joachim Rathmann	Joachim Rathmann	Institut für Geographie und Geologie Julius-Maximilians-Universität Würzburg
46	"Re-activating landscape in peri urban areas - Quinta do Pisão I Nature Park - A landscapescale conservation project that links wildlife and people."	João Cardosode Melo	João Cardosode Melo	Cascais Ambiente
47	Health Co-benefits from reducing indoor air pollu-tion in Pune, India	Rasmila Kawan[1] Sudipto Roy[2] Gufran Beig[3] Rainer Sauerborn[1]	Rasmila Kawan	[1]Institute of Public health, Heidelberg Uni-versity [2]Health Research Cen-ter, Pune, India [3]Indian Institute of Tropical Meteorology, India

Annex 4 - List of Participants

Gender	First Name	Last Name	Institution	Country
Mr	Minka	Aduse-Poku	University of Cologne	Germany
Ms	Fernanda	Amaral	Bonn University	Germany
Ms	Cornelia	Andersohn	German Aerospace Center, Project Management Agency	Germany
Mr	Norbert	Asche	Landesbetrieb Wald und Holz Nordrhein-Westfalen	Germany
Mr	Albert	Bach Pagès	Institute of Environmental Science and Technology	Spain
Ms	Monika	Bachinger	University of Applied Forest Sciences	Germany
Ms	Regine	Baeker	MASGF Brandenburg	Germany
Ms	Cathy	Baldwin	University of Oxford	UK
Mr	Luc	Bas	IUCN European Regional Office	Belgium
Mr	Christoph	Baumeister	Forest Research Institute Baden-Wuerttemberg	Germany
Mr	Keith	Baverstock	University of Eastern Finland	Germany
Ms	Mira	Beinert	UVP-Gesellschaft, Paderborn	Germany
Mr	Lars	Berger	Federal Agency for Nature Conservation (BfN)	Germany
Ms	Martha	Betson	University of Surrey, School of Veterinary Medicine	UK
Ms	Stephanie	Billot Bonef	EDF Service des études médicales	France
Ms	Viorica-Fanica	Bisca	Danube Delta Biosphere Reserve Authority	Romania
Mr	Robbie	Blake	Friends of the Earth Europe	Belgium
Ms	Sandra	Boekhold	RIVM National Institute for Public Health and Environment	The Netherlands
Ms	Katrin	Böhning-Gaese	Senckenberg Biodiversity and Climate Research Centre	Germany
Ms	Aletta	Bonn	UFZ / iDiv	Germany
Ms	Nicole	Botha	GIZ	Germany
Ms	Aline	Brachet	Centre Scientifique et Technique du Bâtiment	France
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