EKLIPSE

Knowledge & Learning Mechanism
on Biodiversity & Ecosystem Services

Methods Protocol

Types and characteristics of urban green & blue spaces having an impact on human mental health and wellbeing

Knowledge assessment and synthesis

This EKLIPSE-protocol is prepared by the EKLIPSE Expert Working Group on Biodiversity and Mental Health to provide recommendations for the conservation, planning, design, and management of urban green and blue infrastructures

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Summary

Based on a request made by the French Ministry in charge of the Environment (MTES), an EKLIPSE Expert Working Group (EKLIPSE EWG) was formed to answer the following question: *"Which types of urban and suburban blue and green spaces and which characteristics (components) of such spaces have a significant impact on human mental health and wellbeing?".* The answer will be provided by examining the scientific literature. Financial support from the World Health Organization (WHO), adding to that initially provided by EKLIPSE, will allow the EWG to conduct two separate systematic reviews (one for blue spaces and one for green spaces).

Previous reviews have been focused on the local amount and availability of, or access to, green (and to a much lesser extent) blue space. The current systematic reviews will be unique in that they focus on the mental health benefits of the type of green (and blue) space and of its distinct characteristics (components).

Each systematic reviews will follow six consecutive stages: 1) eligibility criteria for the articles will be formulated, 2) a systematic search strategy will be employed to yield relevant articles, 3) meta-data will be extracted and coded for each eligible study, 4) each study will be critically appraised, 5) a narrative and descriptive synthesis will be performed, and 6) outcomes of the synthesis will be discussed.

The main deliverable of the project will be two reports (blue and green), but will also include dissemination via oral presentations and each systematic review will be published in a peer-reviewed journal. The outcomes of the systematic reviews will be aimed to inform and provide recommendations to (future) decision makers in several domains, such as health promotion, nature management, spatial policy, urban planning, and design.

1. Introduction

To reduce negative mental health effects of environmental degradation, functional and healthy ecosystems are a necessity, especially in cities (World Health Organization, 2016). At the moment, 74% of the population in Europe already lives in a city[1]. A substantial number of scientific studies have already been conducted on the relationship between exposure to natural environments (green/blue spaces) and human health and wellbeing. At the same time, the heterogeneity of objectives, theoretical frameworks, and research methods make the comparison and the establishment of robust results difficult (Hartig, Mitchell, de Vries, & Frumkin, 2014; Zufferey, 2015; Frumkin, et al., 2017). However, most studies thus far confirm the existence of a significant association between the local presence of green and/or blue spaces and physical as well as mental health (Gascon et al., 2015; Van den Berg, Wendel-Vos, van Poppel, Kemper, van Mechelen, & Maas, 2015).

Such associations are not only observed for self-reported overall mental health but also the prevalence of specific common mental disorders such as depression and anxiety disorders. The converging results were found using different measures, such as diagnostic interviews (De Vries, ten Have, van Dorsselaer, van Wezep, Hermans, & de Graaf, 2016), diagnoses as recorded in general practices (Maas, Verheij, de Vries, Spreeuwenberg, Schellevis, & Groenewegen, 2009), and the use of anti-depressants (Taylor, Wheeler, White, Economou, & Osborne, 2015; Helbich, Klein, Roberts, Hagedoorn, & Groenewegen, 2018).

[1] https://www.un.org/development/desa/en/news/population/2018-revision-of-world-urbanization- prospects.html, accessed on 28 August 2018

Thus far, cross-sectional research on the relationship between urban green and blue space and human health and wellbeing has mainly focused on the presence and availability of, or access to, green and/or blue space, without much regard for the type of green or blue space, its components, characteristics and qualities (Van den Berg et al., 2015). Moreover, those studies rarely allow for causal inferences. In 2007, Velarde, Fry, and Tveit noted that in most experimental studies, only a crude distinction was made between natural and urban landscapes.

Only a few studies have identified more specific characteristics of nature by comparing, for instance, tended versus wild forests (Martens, Gutscher, & Bauer, 2011), or urban parks with urban woodlands (Tyrvaïnen, Ojala, Korpela, Lanki, Tsunetsugu, & Kagawa, 2014).

According to the research agenda recently proposed by Frumkin et al. (2017), the research context has not progressed significantly. They conclude that "standard exposure measures are not grounded in the ecological elements most relevant to human health and wellbeing." For example, the quantity of greenery is often measured using aerial photography or remote sensing techniques. Such data offers little information on the quality of the landscape view from the ground level, and on other attributes, which may be important in terms of generating positive health outcomes.

The only characteristic of green space that has been researched in relation to mental health is its level of biodiversity, with outcomes still being inconclusive (Lovell, Wheeler, Higgins, Irvine, & Depledge, 2014; Korpela, Pasanen, & Ratcliffe, 2018; Marselle, Martens, Dallimer, & Irvine, 2019). More knowledge on the importance of the type, characteristics (components) of urban green or blue space, may help to unlock its potential to contribute to human health (Van den Bosch & Ode Sang, 2017; Zürcher & Andreucci, 2017).

Therefore, we will systematically review the scientific literature that focuses on the influence of type and characteristics of green and blue spaces with regard to mental health and wellbeing benefits in cities and sub-urban areas in an interdisciplinary way. For practical reasons, the EWG has chosen to do so separately for blue and green spaces. The objective is to analyse and synthesize the scientific literature on the effects of different types and characteristics of urban and sub-urban green and blue spaces on mental health and wellbeing. This review aims to inform and provide recommendations to decision makers in several domains, such as health promotion, nature management, spatial policy, and urban planning and design.

1.1 Background

In March 2017, EKLIPSE called for expertise (call for experts No. 2/2017) to assess and share existing knowledge across disciplines following up a request initially put to EKLIPSE by the Expert Working Group Biodiversity & Health, 3rd National Plan on Health and Environment (PNSE3) – Ministry in charge of the Environment (MTES), France. MTES aims to provide recommendations for the "conservation, creation, design and management of natural spaces that would benefit urban citizens, by maintaining or enhancing their mental health and wellbeing," as well as promoting systematic, interdisciplinary, and cross-cultural research.

After a preliminary scoping, it was agreed with the requester to give priority to literature and knowledge comparing the effects of different types of urban and peri-urban open spaces and/or that of variations in characteristics of green/blue components. A range of possible research designs would be eligible for the reviews (before/after, control *versus* treatment, cross-sectional, exposure, and qualitative studies).

For the purpose of this work, the EKLIPSE Expert Working Group on "Mental health and green/blue spaces" (EEWG) defined 'green/blue spaces' as follows:

In accordance with the request, a broad definition of 'urban and peri-urban green spaces' will be adopted in this report, to include a range of urban green and blue landscapes, including urban forests, gardens, parks, allotments and tree-lined walkways. This includes:

- smaller green space features (such as street trees and roadside vegetation)
- green spaces not available for public access or recreational use (such as green roofs and facades, or green space on private grounds)
- larger green spaces that provide various social and recreational functions (such as parks, playgrounds or greenways)" (WHO, 2017)
- Peri-urban green and blue space (such as agricultural land)

The EWG met in person in Paris on 13-14th November 2017 and had additional exchanges afterward. This document outlines the nature of the request, choice of methodologies, details of selected methodologies, and expected outcomes.

1.2 The request

The request is as follows: *"Which types of urban and peri-urban blue and green spaces and which characteristics (components) of such spaces have a significant impact on human mental health and wellbeing?".* The request aims to provide guidelines and recommendations to policy makers, practitioners and researchers regarding the planning, design, construction, and management of natural spaces in urban or sub-urban areas in order to promote the mental health and wellbeing of urbanites. A systematic review (SR) will be conducted in order to answer this question.

A number of systematic reviews have already focused on the amount of green/blue space on mental health (e.g., Annerstedt, & Währborg, 2011; Barton & Pretty, 2010; Britton, Kindermann, Domegan, & Carlin, 2018; Bowler, Buyung-Ali, Knight, & Pullin, 2010; Gascon, Zijlema, Vert, White, & Nieuwenhuisen, 2017). This SR will focus on the influence of the type and design of green and blue spaces and, in principle, will not look at the effect of the amount of green and/or blue space. However, this issue is dependent on the spatial scale of a study. Beyond the level of a single green area, the distribution of green space, while keeping the total amount the same, is considered relevant to planning. For example, how the total amount of green space is divided up and the spatial configuration of the green areas may affect the amount, as well as type, of exposure people will have, which is assumed to be relevant for the mental health and wellbeing effects the green space produces.

Given the consequences of climate change on both health and ecosystems, the results of the SR will be discussed with regard to how types and characteristics of green and blue spaces in cities may affect the provision of ecosystem services related to mental health improvement, as well as by the urban green infrastructure as a whole.

2. Selected Methodological Approach

2.1 Expert Working Group

The expert working group is composed of 11 members from 7 countries. A range of disciplines and backgrounds are covered: urban ecology, biology, landscape architecture, medicine, psychology, and sociology. The work is conducted mainly using emails and internet visual exchanges, and a series of face to face meeting has been organised by EKLIPSE to facilitate key stages of the work. Experts work *in tuitu personae* voluntarily. A post-doc fellow (FB) joined the EWG in April 2019 to help conduct the work, with the financial support of EKLIPSE. A staff of librarians related to two EWG members (JG, HW) is dedicated to literature searches and screening and benefits from the financial support of WHO.

2.2 Systematic Review (SR)

The **knowledge assessment by way of a SR** will focus on collating, assessing, and synthesizing the evidence with regard to mental health effects related to all types of urban and peri-urban green/blue spaces and habitats and related features such as green roofs, living walls, gardens, street trees, allotment gardens, urban orchards, parks, urban forests, water bodies, or agricultural areas.

A SR is well suited for topics on which a substantial volume of studies have been conducted, as is expected to be the case for green space and mental health. A SR will integrate a body of literature by methodically extracting data from a set of qualifying papers, resulting from a systematic, unbiased literature search (Hunt, 1997). Overarching patterns or problems that are not normally discernible among individual studies may emerge. Two separate SRs will be undertaken; one for blue and one for green spaces. Each one will follow six stages that conform to the established protocols for this type of knowledge synthesis (Higgins & Green, 2008):

(A) the population, or 'universe,' of studies about which the review aims to generalise will be defined by strict eligibility criteria;

(B) studies fitting in that universe will be retrieved from the literature through a logical and systematic search strategy;

(C) essential information from each eligible individual study will be extracted and coded;

(D) individual studies will be critically appraised,

(E) outcomes of the different studies will be synthesized and explanations for heterogeneity in outcomes explored, and

(F) the methods, results, and theoretical implications of the analysis will be reported and discussed. If the results of the first three steps indicate this is feasible, and the resources allow it, the SR may include a meta-analysis.

The following steps will be taken for each SR:

1. Define the eligibility criteria for studies and structure the literature search according to PICO/PECO terms (see below), and possible additional criteria.[2] Only peer-reviewed papers will be considered.

2. Develop a checklist for the first step that contains highly eligible studies (i.e., studies that this search should retrieve anyway). This checklist will be based on papers contributed by members of the EWG and on which we agree that they are indeed highly relevant (and satisfy the eligibility criteria, as defined in step 1).

3. Define search terms (including required combinations). Databases to be searched are PubMed, Scopus, and Web of Science.

4. Conduct a preliminary structured search and process a random sample of the hits of this preliminary search (up to making sure that required PICO/PECO elements are present, and other eligibility criteria are satisfied, but not reading full papers) and then adjust and/or refine search terms if necessary, based on whether:

    - the search misses studies that are included in the checklist.
    - there are too many 'false' hits (irrelevant papers) being generated

5. Conduct the final search and proceed to eligibility screening at title, abstract and, subsequently, full-text

6. Extract meta-data from each eligible paper (i.e., descriptive information such as gender composition, but also the unit of observations, outcomes measures, and results)

7. Conduct a critical appraisal for each of the three study types (qualitative, quantitative cross-sectional, and quantitative experimental) based on criteria used to assess biases.

8. Perform a descriptive and narrative synthesis, including looking at possible reasons for heterogeneity of outcomes.

9. Write the EKLIPSE-report and one scientific paper

10. Disseminate the outcomes of our efforts for both SRs.

3. Preliminary details regarding the literature search

The EWG will use the PICO/PECO-approach to define the parameters of the literature search: Population, Intervention or Exposure, Comparators, Outcomes. Many studies in the field of nature and health are cross-sectional and qualitative rather than intervention or experimental studies. All these types of study are deemed relevant.

[2] PICO stands for Population, Intervention, Comparators and Outcomes. PECO is similar, except that the E stands for Exposure. PECO is added because we want to include cross-sectional, epidemiological, and qualitative studies (despite that such studies do not allow firm conclusions regarding the causality of observed associations).

3.1 Population of interest

The request concerns human beings of all ages, gender, nationality, educational background, and income, living in urban areas.

3.2 Interventions & Exposures

When it comes to intervention studies, we will limit ourselves to environmental interventions. That is, interventions that change the physical environment by targeting its components, aspects, or habitat type. Changes in the amount of green or blue space, e.g., the total area of public green space, are not eligible for our SRs. This has been covered in previous work, although quantity may be taken into account as a confounding variable. Within a green area, the amount of vegetation may change (e.g., replacing grass by trees, which is a variation in the respective proportion of various habitat types), and such studies are eligible for the SRs.

At a larger spatial scale than that of an individual green area, the spatial distribution of green spaces, or the configuration of the green infrastructure, is also relevant. For example, relevant questions could be: Is it more beneficial for health outcomes to have several pocket-gardens in a given area, or to have one larger park (while keeping the total green cover the same)? Is it important that the different green areas are connected by green corridors, or does that not matter for mental health? Connectivity is usually considered important from an ecological perspective, but it is unclear if this is also true for mental health and wellbeing effects.

Therapies are interventions on human beings (not on the environment) and assessing their efficacy falls outside the domain that is considered relevant for these SRs. Intervention studies involving therapeutic gardens are considered relevant only when they pertain to the design of the therapeutic garden, and not if they (only) pertain to the therapy conducted in this setting.

Note that the design of an area includes the amenities and facilities present in a green or blue area, as these may influence accessibility, affordances, and attractiveness, and thereby exposure, as well as the type of contact. The management regime for an area, on the other hand, is excluded, as this is not a design aspect.

3.3 Exposure

Any sort of exposure to an outdoor green/blue space in the urban and peri-urban environment, whether planned or accidental, is eligible. Keniger, Gaston, Irvin, and Fuller (2013) propose a typology of indirect, incidental, and intentional interactions with nature. In the category of indirect interactions, they include viewing representations of nature, as well as viewing nature through a window. Viewing representations of nature will be included but will be distinguished from exposure to real green or blue spaces.

3.4 Comparators

The focus of the systematic review is on planning and design options, operationalised in terms of types and /or characteristics of green and blue space. Therefore, the comparison or reference environment is ideally another type of green or blue space (though other comparisons with for instance the built environment will also be included), or the same type with other characteristics, e.g., a comparison between different tree

species. It may also be about the different spatial configuration of green and blue spaces (controlling for the total amount). Studies comparing the amount of blue or green spaces between different areas are not eligible unless they also include a comparison between types or characteristics of those spaces. Studies looking only at a compound measure of blue or green space (e.g., taking fresh and salt water within one category) will not be included. To make sure that the types or characteristics of the green/blue space is truly responsible for observed differences in mental health or wellbeing, other aspects should be/remain the same as much as possible.

3.5 Outcomes

To start with, the literature search will include a wide range of outcome measures with regard to mental health and mental wellbeing. This ranges from the prevalence and/or severity of professionally diagnosed mental disorders (e.g., schizophrenia) and self-reported mental health (e.g., GHQ-12, MHI-5), to life satisfaction and quality of life. Studies looking into momentary assessments of mood will also be included.

For mental disorders, the WHO classification will be adhered to (World Health Organization, 2010). Given that there is a large number of specific mental disorders that may be distinguished, we may need to narrow our focus on the prevalence of (a) the most common mental disorders that (b) have an aetiology that makes an intervening effect of (exposure to) nature plausible. Mental disorders include, for instance, Dementia, Anxiety, Depression, Schizophrenia, Developmental disorders, Hyperactivity, Autism, and Stress as a risk factor to develop these conditions.

4. Additional inclusion criteria (beyond those based on PICO/PECO)

4.1 Methodological criteria

Laboratory experiments will also be eligible when using representations of outdoor nature, rather than employing exposure to actual outdoor nature.

Studies conducted in Europe qualify by definition. Studies conducted in other regions may still be relevant, depending on the region and theme of the study. For example, studies that are very specific for tropical locations/regions are less likely to be relevant for the requester.

4.2 Type and language of publication

We will limit our synthesis to peer-reviewed articles, published in English. There will be no limit on how far back we go in time in the literature search.

4.3 Meta-analysis

If the outcomes of the SR and the resources available allow it, a meta-analysis will be conducted.

4.4 Limitations

Many factors might influence the effectiveness of green/blue urban spaces to promote mental health and wellbeing, besides those relating to the design of the green/blue space, their spatial configuration and their characteristics (components). When available, information on factors deemed relevant will be

listed and critically examined by the EWG (as possible confounders) to better explain the heterogeneity in study results and formulate appropriate recommendations for the requester. Examples of these factors are: cultural and geographical aspects, age, and sex.

5. Expected deliverables

Several deliverables are envisioned as outcomes of the project. The main deliverable will be an EKLIPSE report, but each SR will also be submitted to a peer-reviewed journal to increase the impact and dissemination of the research, and to gain broader acknowledgment by the scientific community. Dissemination of the report will be handled by the EKLIPSE team together with the requester.

Recommendations will be tailored to various practitioners (e.g., landscape architects, urban planners, city managers, etc.). The requester is anticipating recommendations regarding the design and creation of natural spaces in urban and suburban areas to promote the mental health of urbanites, informed by the SR. Ideally, these will be consider by the French 'Code de l'Urbanisme' and 'Code de l'Environment', in accordance with European regulations already in practice or under development. Knowledge gaps and research designs will also be discussed to provide recommendations for future research. Results will also be discussed with regard to the implications of climate change for the provision of this specific type of ecosystem service.

Other envisioned outcomes are oral presentations on the outcomes of the SRs, for a diversity of target groups, ranging from policy-makers to practitioners and students. These activities aim to inform and provide recommendations to (future) decision makers in several domains, such as health promotion, nature management, spatial policy, urban planning, and design.

5.1 List of envisioned activities

Table 1. Envisioned activities

Nr.	Activity
1	Write a preliminary EKLIPSE protocol based on the initial Document of Work
2	Open review of the protocol according to EKLIPSE procedure
3	Prioritize reviews, starting by blue spaces (Blue), then green spaces (Green)
4	Develop checklist for systematic literature search
5	Develop search terms for systematic literature search
6	Develop a procedure for critical appraisal of eligible studies
7	Conduct a systematic literature search (librarians) for Blue
8	Screen search results (eligibility) for Blue
9	Present outcomes thus far at Proof of Concept conference
10	Conduct critical appraisal on Blue
11	Launch search and screening for Green
12	Perform systematic processing of eligible publications for Blue
13	Write narrative synthesis of outcomes for Blue
14	Conduct critical appraisal for Green
15	Write narrative synthesis for Green
16	Examine possible meta-analysis for Green
17	Write EKLIPSE report (Blue and Green together)
18	Open review of EKLIPSE report (Blue and Green)
19	Finalise and publish EKLIPSE report
15	Publish scientific articles (Blue and Green separate)
16	Draft dissemination material based on outcomes and recommendations

Note that activities will not be performed sequentially; in most cases, they will start (have started) before the previous activity has been finished

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